Manual

VIPA System 200V

Order No.: VIPA HB97E

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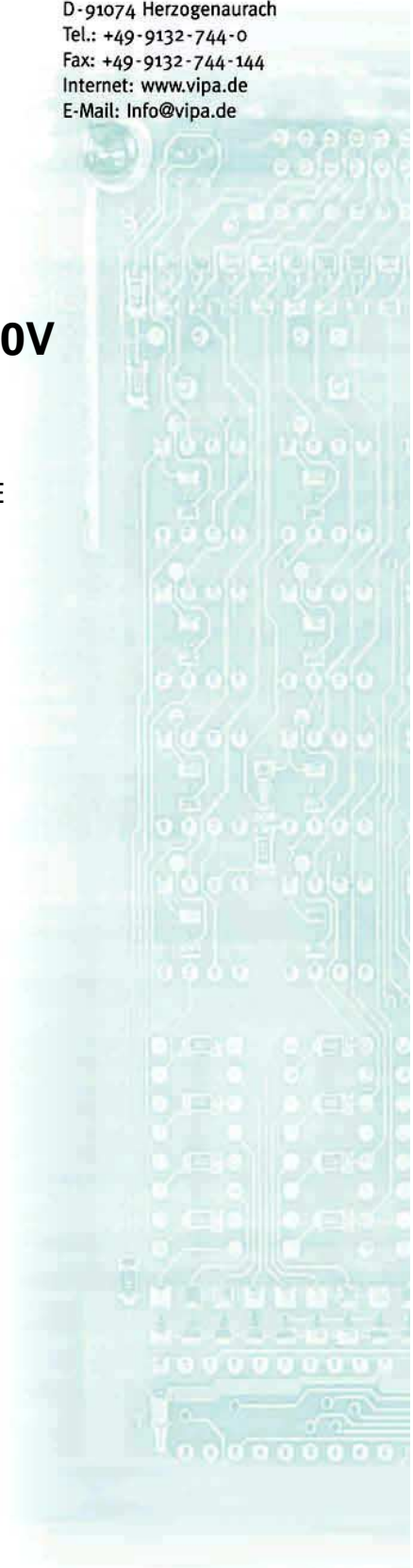
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Suggestions for improvement are always welcome.

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About this manual

This manual describes all System 200V components that are available from VIPA with the exception of the CPUs. In addition to the product summary it contains detailed descriptions of the different modules. You are provided with information on the connection and the utilization of the different System 200V components. Every chapter is concluded with the technical data of the respective module.

A separate set of manuals is available for the CPUs.

Overview   **Chapter 1:**   **Introduction**

This introduction presents the VIPA System 200V as a centralized as well as decentralized automation system.

The chapter also contains general information about the System 200V, i.e. dimensions, installation and operating conditions.

Chapter 2:   **Profibus-DP**

This chapter contains a description of Profibus applications for the System 200V. The text describes the configuration of the VIPA Profibus master and slave modules as well as a number of different communication examples.

Chapter 3:   **Interbus**

This chapter contains all the information that is required to provide a connection between the System 200V peripherals and Interbus. It contains descriptions of the construction, commissioning and the configuration of the Interbus coupler.

Chapter 4:   **CAN bus CANopen**

This chapter deals with the VIPA CANopen slave and related CAN bus applications. The structure of the program and the configuration of CAN slaves is explained by means of examples.

Chapter 5:   **DeviceNet**

This chapter contains a description of the VIPA DeviceNet coupler. A description of the module is followed by an example of the configuration of the DeviceNet coupler and the configuration of the System 200V modules in the DeviceNet manager of Allen - Bradley. The chapter is concluded with an overview of diagnostic messages and Profibus interfacing options.

Chapter 6:   **SERCOS**

Content of this chapter is the description of the SERCOS coupler from VIPA. Another part of this chapter is the project engineering of the SERCOS coupler and the parameterization of the System 200V modules.

### Chapter 7:		Ethernet coupler

Content of this chapter is the description of the Ethernet coupler IM 253NET from VIPA. It contains all information for installation and commissioning of the Ethernet coupler.

### Chapter 8:		PC 288 - CPU

This chapter describes the PC-CPU PC 288 and applications in System 200V. The configuration of a PC-based system is described in detail.

The chapter ends with an overview of the BIOS setup and the registers.

### Chapter 9:		Communication processor CP 240

This chapter contains information on the construction, the interfacing and the communication protocols of the communication processor CP 240. It also contains an explanation of the standard handler blocks for the VIPA CPU 21x and the CPU 24x.

### Chapter 10:		Counter modules

This chapter deals with VIPA counter modules. The chapter also contains information on the SSI module as well as the construction, configuration and the different counter modes along with the respective interfaces.

### Chapter 11:		MotionControl modules FM 253 und FM 254

The chapter describes the VIPA MotionControl stepper and the Motion-Control servo module. It contains information on the assembly, operating modes, data transfer and applications in conjunction with a shaft encoder at FM 253 or FM 254.

### Chapter 12:		Power supplies

This chapter deals with external power supplies for the System 200V. Here you find a comprehensive set of safety related hints and information as well as details on the construction, the installation and commissioning of the module.

### Chapter 13-15:	Digital input/output modules

These chapters describe the digital remote I/O that is available from VIPA. It provides all the information that is required for applications using these modules. Chapter 13 contains information on the input modules, chapter 14 the information on the output modules and chapter 15 provides details on input/output modules.

### Chapter 16-18:	Analog input/output modules

These chapters contain a description of the analog remote I/O. The chapter also provides all the information that is required for applications using each module. Chapter 16 describes the input modules, chapter 17 the output modules and chapter 18 the analog input/output modules that are available from VIPA.

Chapter 19:   System expansion modules

This chapter deals with the system expansion modules that are available for the System 200V. These include amongst others the combination modules SM 238C, the bus expansion modules IM 26x that provide for the expansion of a single bus row to cater for several rows, the mini switch CM 240 and terminal modules required for the expansion of the available number of connections.

Chapter 20:   Installation and installation guidelines

This chapter provides all the information required for the installation and the hook-up of a controller using the components of the System 200V.

Contents

User considerations

Objective and contents   This manual describes the modules that are suitable for use in the System 200V. It contains a description of the construction, project implementation and the technical data.

Target audience   The manual is targeted at users who have a background in automation technology.

Structure of the manual   At present the manual consists of 20 chapters. Every chapter provides a self-contained description of a specific topic.

Guide to the document   The following guides are available in the manual:
- an overall table of contents at the beginning of the manual
- an overview of the topics for every chapter
- an index at the end of the manual.

Availability   The manual is available in:
- printed form, on paper
- in electronic form as PDF-file (Adobe Acrobat Reader)

Icons Headings   Important passages in the text are highlighted by following icons and headings:

Danger!
Immediate or likely danger.
Personal injury is possible.

Attention!
Damages to property is likely if these warnings are not heeded.

Note!
Supplementary information and useful tips.

Safety information

Applications conforming with specifications

The System 200V is constructed and produced for:
- all VIPA System 200V components
- communication and process control
- general control and automation applications
- industrial applications
- operation within the environmental conditions specified in the technical data
- installation into a cubicle

Danger!
This device is not certified for applications in
- in explosive environments (EX-zone)

Documentation

The manual must be available to all personnel in the
- project design department
- installation department
- commissioning
- operation

The following conditions must be met before using or commissioning the components described in this manual:

- Modification to the process control system should only be carried out when the system has been disconnected from power!

- Installation and modifications only by properly trained personnel

- The national rules and regulations of the respective country must be satisfied (installation, safety, EMC ...)

Disposal   **National rules and regulations apply to the disposal of the unit!**

Chapter 1   Introduction

Outline

The focus of this chapter is on the introduction of the VIPA System 200V. Various options of configuring central and decentral systems are presented in a summary.

The chapter also contains the general specifications of the System 200V, i.e. dimensions, installation and environmental conditions.

The chapter ends with a description of the 7 layer model and a table of the communication levels available in automation technology.

Below follows a description of:

- Introduction of the System 200V

- General information, i.e. installation, operational safety and environmental conditions

- 7 layer model and communication layers

Content

Safety information for Users

Handling of electrostatically sensitive modules

VIPA modules make use of highly integrated components in MOS-technology. These components are extremely sensitive to over-voltages that can occur during electrostatic discharges.

The following symbol is attached to modules that can be destroyed by electrostatic discharges:

The symbol is located on the module, the module rack or on packing material and it indicates the presence of electrostatic sensitive equipment.

It is possible that electrostatic sensitive equipment is destroyed by energies and voltages that are far less than the human threshold of perception. These voltages can occur where persons do not discharge themselves before handling electrostatically sensitive modules and they can damage components thereby, causing the module to become inoperable or unusable. Modules that have been damaged by electrostatic discharges may fail after a temperature change, mechanical shock or changes in the electrical load.

Only the consequent implementation of protection devices and meticulous attention to the applicable rules and regulations for handling the respective equipment can prevent failures of electrostatically sensitive modules.

Shipping of electrostatically sensitive modules

Modules have to be shipped in the original packing material.

Measurements and alterations on electrostatically sensitive modules

When you are conducting measurements on electrostatically sensitive modules you should take the following precautions:

- Floating instruments must be discharged before use.
- Instruments must be grounded.

Modifying electrostatically sensitive modules you should only use soldering irons with grounded tips.

Attention!

Personnel and instruments should be grounded when working on electrostatically sensitive modules.

Hints for the deployment of the Green Cable from VIPA

**What is the
Green Cable?**

The Green Cable is a green connection cable, manufactured exclusively for the deployment at VIPA System components.

The Green Cable is a programming and download cable for VIPA CPUs MP^{2}I jack and VIPA fieldbus masters. The Green Cable from VIPA is available under the order no. VIPA 950-0KB00.

The Green Cable allows you to:

- *transfer projects serial*
  Avoiding high hardware needs (MPI transducer, etc.) you may realize a serial point-to-point connection via the Green Cable and the MP^{2}I jack. This allows you to connect components to your VIPA-CPU that are able to communicate serial via a MPI adapter like e.g. a visualization system.

- *execute firmware updates of the CPUs and fieldbus masters*
  Via the Green Cable and an upload application you may update the firmware of all recent VIPA CPUs with MP^{2}I jack and certain fieldbus masters (see Note).

Important notes for the deployment of the Green Cable

Nonobservance of the following notes may cause damages on system components.

For damages caused by nonobservance of the following notes and at improper deployment, VIPA does not take liability!

Note to the application area

The Green Cable may exclusively deployed <u>directly</u> at the concerning jacks of the VIPA components (in between plugs are not permitted). E.g. a MPI cable has to be disconnected if you want to connect a Green Cable.

At this time, the following components support Green Cable:

VIPA CPUs with MP^{2}I jack and fieldbus masters from VIPA.

Note to the lengthening

The lengthening of the Green Cable with another Green Cable res. The combination with further MPI cables is not permitted and causes damages of the connected components!

The Green Cable may only be lengthened with a 1:1 cable (all 9 Pins are connected 1:1).

Overview

The System 200V   The System 200 V is a modular automation system for centralized and decentralized applications requiring low to medium performance specifications. The modules are installed directly on a 35mm DIN rail. Bus connectors inserted into the DIN rail provide the interconnecting bus.

The following figure illustrates the capabilities of the System 200V:

```
                        ┌─────────────────┐
                        │  System 200V    │
                        └─────────────────┘
                ┌────────────────┴────────────────┐
        ┌──────────────┐                  ┌──────────────┐
        │  decentral   │                  │   central    │
        └──────────────┘                  └──────────────┘
              │                         ┌──────────┴──────────┐
          DP 200V                    PC 200V             PLC 200V
```

| Profibus CANopen   SERCOS
Interbus DeviceNet Ethernet | PC-CPU | PLC-CPU
for STEP®5 from Siemens | PLC-CPU
for STEP®7 from Siemens |

| Periphery
Dig. IN / Dig. OUT / Anal. IN / Anal. OUT / FM / CP / CM |
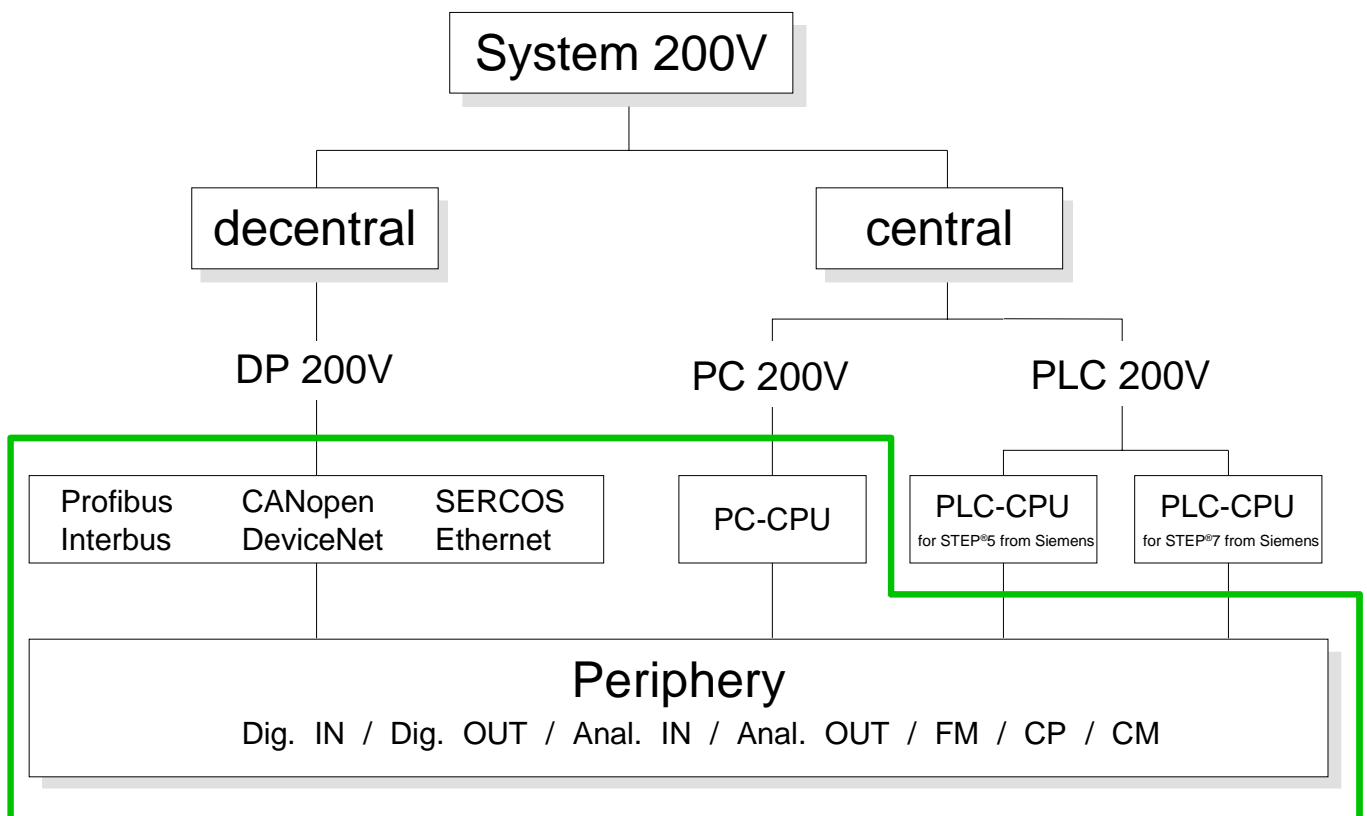
Components

Centralized system	The System 200V series consists of a number of PLC-CPUs. These are programmed in STEP®5 or STEP®7 from Siemens.
	CPUs with integrated Ethernet interfaces or additional serial interfaces simplify the integration of the PLC into an existing network or the connection of additional peripheral equipment.
	The application program is saved in Flash or an additional plug-in memory module.
	The PC based CPU 288 can be used to implement operating/monitoring tasks, control applications or other file processing applications.
	The modules are programmed in C++ or Pascal.
	The PC 288-CPU provides an active interface to the backplane bus and can therefore be employed as central controller for all peripheral and function modules of the VIPA System 200V.
	With the appropriate expansion interface the System 200V can support up to 4 rows.
Decentralized system	In combination with a Profibus DP master and slave the PLC-CPUs or the PC-CPU form the basis for a Profibus-DP network in accordance with DIN 19245-3. The DP network can be configured with WinNCS VIPA configuration tool res. SIMATIC Manager from Siemens.
	Other fieldbus systems may be connected by means of slaves for Interbus, CANopen, DeviceNet, SERCOS and Ethernet described in this manual.
Peripheral modules	A large number of peripheral modules are available from VIPA, for example digital as well as analog inputs/outputs, counter functions, displacement sensors, positioners and serial communication modules.
	These peripheral modules can be used in centralized as well as decentralized mode.

Overview over GSD-files from VIPA

General   The functionality of all VIPA system components are available via different GSD-files.

For the Profibus interface is software standardized, we are able to guatantee the full functionality by including a GSD-file using the STEP®7 manager from Siemens.

For every system family there is an own GSD-file. The assignment to the single systems and the according name is in the hardware catalog (system label) is to find in the following table:

GSD		System			
File name	Symbol label	100V	200V	300V	Comment
DP2V0550.GSD	VIPA_DP200V	✓	✓		Old GSD-file is no longer updated
System 100V					
VIPA04D4.GSD	VIPA_DP100V	✓			For including decentral periphery 15x into DP master system
VIPA_11x.GSD	VIPA_CPU11x	✓			For projekt engineering of the direct I/O periphery in the CPU as virtual Profibus system
VIPA04Dx.GSD	VIPA_CPU11xDP	✓			For including CPU 11x as intelligent slave into DP master system
System 200V					
VIPA0550.GSD	VIPA_DP200V_2		✓		For including IM 253 slave into DP master system
VIPA_21x.GSD	VIPA_CPU21x		✓		For project engineering of the direct I/O periphery in the CPU as virtual Profibus system
VIPA04D5.GSD	VIPA_CPU2xxDP		✓		For including CPU 21x as intelligent slave into DP master system
VIPA2ETH.GSD	VIPA_ETH200V		✓		For project engineering of IM 253NET in WinNCS
System 300V					
VIPA056B.GSD	VIPA_DP300V			✓	For including IM 353 slave into DP master system
VIPA802F.GSD	VIPA_CPU31xDP			✓	For including CPU 31x as intelligent slave into DP master system

General description System 200V

Structure/ dimensions	• Standard 35mm DIN rail
	• Peripheral modules with recessed labelling
	• Dimensions of the basic enclosure:
	1tier width: (HxWxD) in mm: 76x25.4x76 in inches: 3x1x3
	2tier width: (HxWxD) in mm: 76x50.8x76 in inches: 3x2x3

Installation   Please note that you can only install header modules like the CPU, the PC and couplers into plug-in location 1 or 1 and 2 (for double width modules).
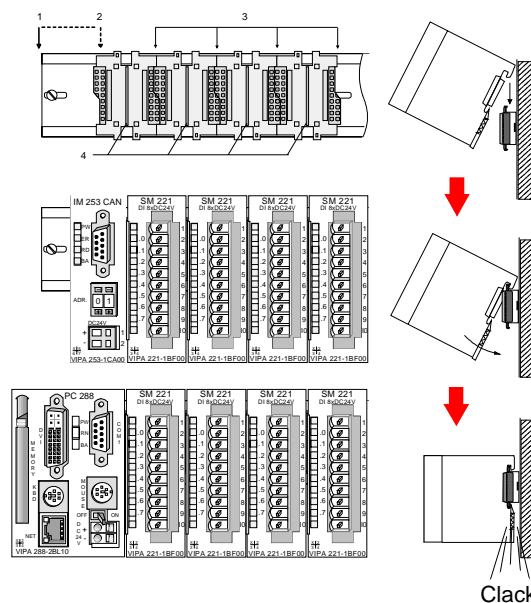
[1]   Header modules like PC, CPU, bus coup-lers (double width)

[2]   Header module (single width)

[3]   Peripheral module

[4]   Guide rails

Note

A maximum of 32 modules can be connected at the back plane bus. Take attention that here the **maximum sum current** of **3,5A** is not exeeded.

Please install modules with a high current consumption directly beside the header module.

The chapter "Assembly and installation guidelines" contains an overview over the current consumptions.

Reliability
• Wiring by means of spring pressure connections (CageClamps) at the front-facing connector, core cross-section 0.08...2.5mm^2 or 1.5 mm^2 (18pole plug)

• Complete isolation of the wiring when modules are exchanged

• Every module is isolated from the backplane bus

• ESD/Burst acc. IEC 61000-4-2 / IEC 61000-4-4 (to level 3)

• Shock resistance acc. IEC 60068-2-6 / IEC 60068-2-27 (1G/12G)

Environmental conditions
• Operating temperature: 0 ... +60°C

• Storage temperature: -25 ... +70°C

• Relative humidity: 5 ... 95% without condensation

• Ventilation by means of a fan is not required

ISO/OSI reference model

Outline   The ISO/OSI reference model is based on a proposal that was developed
by the International Standards Organization (ISO). This represents the first
step towards an international standard for the different protocols. It is
referred to as the ISO-OSI layer model. OSI is the abbreviation for **O**pen
System **I**nterconnection, the communication between open systems. The
ISO/OSI reference model does not represent a network architecture as it
does not define the services and protocols used by the different layers. The
model simply specifies the tasks that the different layers must perform.

All current communication systems are based on the ISO/OSI reference
model which is defined by the ISO 7498 standard. The reference model
structures communication systems into 7 layers that cover different
communication tasks. In this manner the complexity of the communication
between different systems is divided amongst different layers to simplify
the task.

The following layers have been defined:

Layer	Function
Layer 7	Application Layer
Layer 6	Presentation Layer
Layer 5	Session Layer
Layer 4	Transport Layer
Layer 3	Network Layer
Layer 2	Data Link Layer
Layer 1	Physical Layer

Depending on the complexity and the requirements of the communication
mechanisms a communication system may use a subset of these layers.

INTERBUS-S and Profibus for instance only use layers 1 and 2. The
following pages give a short description of the layers.

Layers   **Layer 1**   Bit communication layer (physical layer)

The bit communication layer (physical layer) is concerned with the transfer of data bits via the communication channel. This layer is therefore responsible for the mechanical, electrical and the procedural interfaces and the physical communication medium located below the bit communication layer:

- Which voltage represents a logical 0 or a 1.
- The minimum time that the voltage be present to be recognized as a bit.
- The pin assignment of the respective interface.

Layer 2   Security layer (data link layer)

This layer performs error-checking functions for bit strings transferred between two communicating partners. This includes the recognition and correction or flagging of communication errors and flow control functions.

The security layer (data link layer) converts raw communication data into a sequence of frames. This is where frame limits are inserted on the transmitting side and where the receiving side detects them. These limits consist of special bit patterns that are inserted at the beginning and at the end of every frame. The security layer often also incorporates flow control and error detection functions.

The data security layer is devided into two sub-levels, the LLC and the MAC level.

The MAC (**M**edia **A**ccess **C**ontrol) is the lower level and controls how senders are sharing a single transmit channel.

The LLC (**L**ogical **L**ink **C**ontrol) is the upper level that establishes the connection for transferring the data frames from one device into the other.

Layer 3   Network layer

The network layer is an agency layer.

Business of this layer is to control the exchange of binary data between stations that are not directly connected. It is responsible for the logical connections of layer 2 communication. Layer 3 supports the identification of the single network addresses and the establishing and disconnecting of logical communication channels.

Additionally, layer 3 manages the prior transfer of data and the error processing of data packets.

Layer 4   Transport layer

Layer 4 connects the network structures with the structures of the higher levels by dividing the messages of higher layers into segments and pass them on to the network layer. Hereby, the transport layer converts the transport addresses into network addresses.

Common transport protocols are: TCP, SPX, NWLink and NetBEUI.

Layers
continued...

Layer 5   Session layer

The session layer is also called the communication control layer. It relieves the communication between service deliverer and the requestor by establishing and holding the connection if the transport system has a short time fail out.

At this layer, logical users may communicate via several connections at the same time. If the transport system fails, a new connection is established if needed.

Additionally this layer provides methods for control and synchronization tasks.

Layer 6   Presentation layer

This layer manages the presentation of the messages, when different network systems are using different representations of data.

Layer 6 converts the data into a format that is acceptable for both communication partners.

Here compression/decompression and encrypting/decrypting tasks are processed.

This layer is also called interpreter. A typical use of this layer is the terminal emulation.

Layer 7   Application layer

The application layer is the link between the user application and the network. The tasks of the application layer include the network services like file, print, message, data base and application services as well as the according rules.

This layer is composed from a series of protocols that are permanently expanded following the increasing needs of the user.

Communication layers employed by automation systems

The flow of information in a company presents a vast spectrum of requirements that must be met by the communication systems. Depending on the area of business the bus system or LAN must support a different number of users, different volumes of data must be transferred and the intervals between transfers may vary, etc.

It is for this reason that different bus systems are employed depending on the respective task. These may be subdivided into different classes. The following model depicts the relationship between the different bus systems and the hierarchical structures of a company:

Operational layer	Plant computer PPS CAD	**Factory bus**	
Management layer	Plant-oriented control computer manufacturing, stock, production data PPS CAD	**MAP Broadband**	**TCP/IP**
System layer	Machine and control computer	**Cellular bus** **MAP Carrierband**	**H1**
Process layer	Peripheral systems. machines, CNC, NC, controllers (PLC), measuring systems	**Field bus**	
Sensor / actuator layer	Peripheral components sensor, actuator, regulator, multiplexer, operating consoles	**Sensor / actuator bus**	

It is common that very large volumes of data are transferred on the operational level that are not subject to timing restrictions. However, on the lowest level, i.e. the sensor / actuator level, an efficient transfer of rather small data volumes is essential. In addition, the bus system must often meet real-time requirements on the sensor / actuator level.

Chapter 2   Profibus-DP

Overview

This chapter contains a description of Profibus applications of the System 200V. A short introduction and presentation of the system is followed by the project design and configuration of the Profibus master and slave modules that are available from VIPA. The chapter concludes with a number of communication examples and the technical data.

Below follows a description of:

- System overview of the Profibus modules that are available from VIPA
- The principles of Profibus-DP
- Construction and project engineering of the Profibus masters IM 208DP
- Construction and project engineering of the Profibus slaves IM 253DP
- Sample projects
- Technical data

Content

System overview

**System 200V
Profibus-DP
modules**

Most System 200V Profibus modules from VIPA are available with RS485 as well as a FO connector. The following groups of Profibus modules are available at present:

- Profibus-DP master
- Profibus-DP slave
- Profibus-DP slave combination modules
- CPU 21xDP - CPU 21x for S7 from Siemens with integrated Profibus-DP slave (refer to manual HB103)
- CPU 24xDP - CPU 24x for S5 from Siemens with integrated Profibus-DP slave (refer to manual HB99)

**Profibus-DP
master**

- Profibus-DP master, class 1
- Project design using WinNCS from VIPA or SIMATIC Manager from Siemens
- Project-related data is saved in the internal Flash-ROM or stored on a MMC.
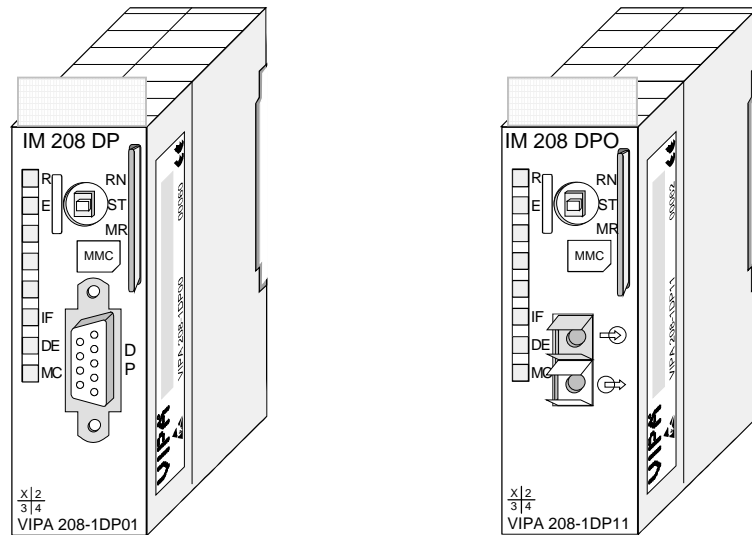
**Order data
DP master**

Type	Order number	Description
IM 208DP	VIPA 208-1DP01	Profibus-DP master with RS485
IM 208DPO	VIPA 208-2DP11	Profibus-DP master with FO connector

Profibus-DP slaves (standard)

- Version with RS485 interface or fiber optic connectors
- Online diagnostic protocol with time stamp
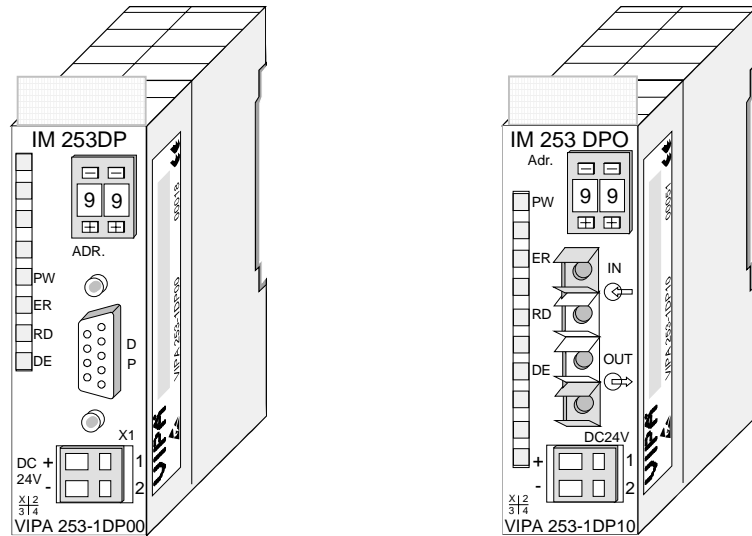
Order data

Type	Order number	Description
IM 253DP	VIPA 253-1DP00	Profibus-DP slave
IM 253DPO	VIPA 253-1DP10	Profibus-DP slave with FO connector

Profibus-DPR slave (redundant)
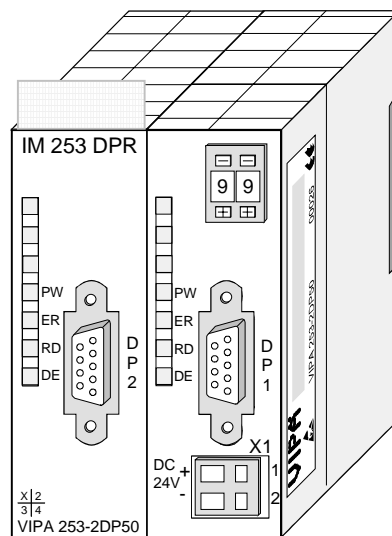
Order data

Type	Order number	Description
IM 253DPR	VIPA 253-2DP50	Profibus-DP slave 2 channel redundant

**Profibus-DP slave
(combi modules)**
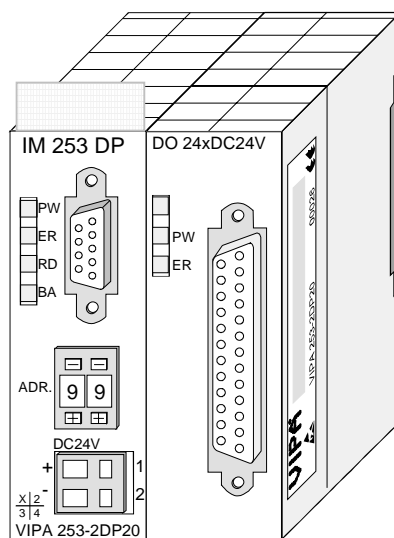
Order data

Type	Order number	Description
IM 253DP DO 24xDC 24V	VIPA 253-2DP20	Profibus-DP slave with 24 DO

Principles

General   Profibus is an international standard applicable to an open fieldbus for building, manufacturing and process automation. Profibus defines the technical and functional characteristics of a serial fieldbus system that can be used to create a low (sensor-/actuator level) or medium (process level) performance network of programmable logic controllers.

Profibus comprises an assortment of compatible versions. The following details refer to Profibus-DP.

Profibus-DP   Profibus-DP is a special protocol intended mainly for automation tasks in a manufacturing environment. DP is very fast, offers Plug'n'Play facilities and provides a cost-effective alternative to parallel cabling between PLC and remote I/O. Profibus-DP was designed for high-speed data communication on the sensor-actuator level.

The data transfer referred to as "Data Exchange" is cyclical. During one bus cycle, the master reads input values from the slaves and writes output information to the slave.

Master and slaves   Profibus distinguishes between active stations (master) and passive stations (slave).

Master devices

Master devices control the data traffic at the bus. It is also possible to operate with multiple masters on a Profibus. This is referred to as multi-master operation. The protocol on the bus establishes a logical token ring between intelligent devices connected to the bus. Only the master that has the token, can communicate with its slaves.

A master (IM 208DP or IM 208DPO) is able to issue unsolicited messages if it is in possession of the access key (token). The Profibus protocol also refers to masters as active participants.

Slave devices

A Profibus slave acquires data from peripheral equipment, sensors, actuators and transducers. The VIPA Profibus couplers (IM 253DP, IM 253DPO and the CPU 24xDP, CPU 21xDP) are modular slave devices that transfer data between the System 200V periphery and the high-level master.

In accordance with the Profibus standards these devices have no bus-access rights. They are only allowed to acknowledge messages or return messages to a master when this has issued a request. Slaves are also referred to as passive participants.

Communication	The bus transfer protocol provides two alternatives for the access to the bus:

Master with master

Master communication is also referred to as token-passing procedure. The token-passing procedure guarantees the accessibility of the bus. The permission to access the bus is transferred between individual devices in the form of a "token". The token is a special message that is transferred via the bus.

When a master is in possession of the token it has the permission to access the bus and it can communicate with any active or passive device. The token retention time is defined when the system is configured. Once the token retention time has expired, the token is passed to the following master which now has permission to access the bus and may therefore communicate with any other device.

Master-slave procedure

Data communication between a master and the slaves assigned to it, is conducted automatically in a predefined and repetitive cycle by the master. You assign a slave to a specific master when you define the project. You can also define which DP slaves are included and which are excluded from the cyclic exchange of data.

Data communication between master and slave can be divided into a parameterization, a configuration and a data transfer phase. Before a DP slave is included in the data transfer phase the master checks whether the defined configuration corresponds with the actual configuration. This check is performed during the definition and configuration phase. The verification includes the device type, format and length information as well as the number of inputs and outputs. In this way a reliable protection from configuration errors is achieved.

The master handles the transfer of application related data independently and automatically. You can, however, also send new configuration settings to a bus coupler.

When the status of the master is DE "Data Exchange" it transmits a new series of output data to the slave and the reply from the slave contains the latest input data.

Data transfer operation

Data is transferred cyclically between the DP master and the DP slave by means of transmit and receive buffers.
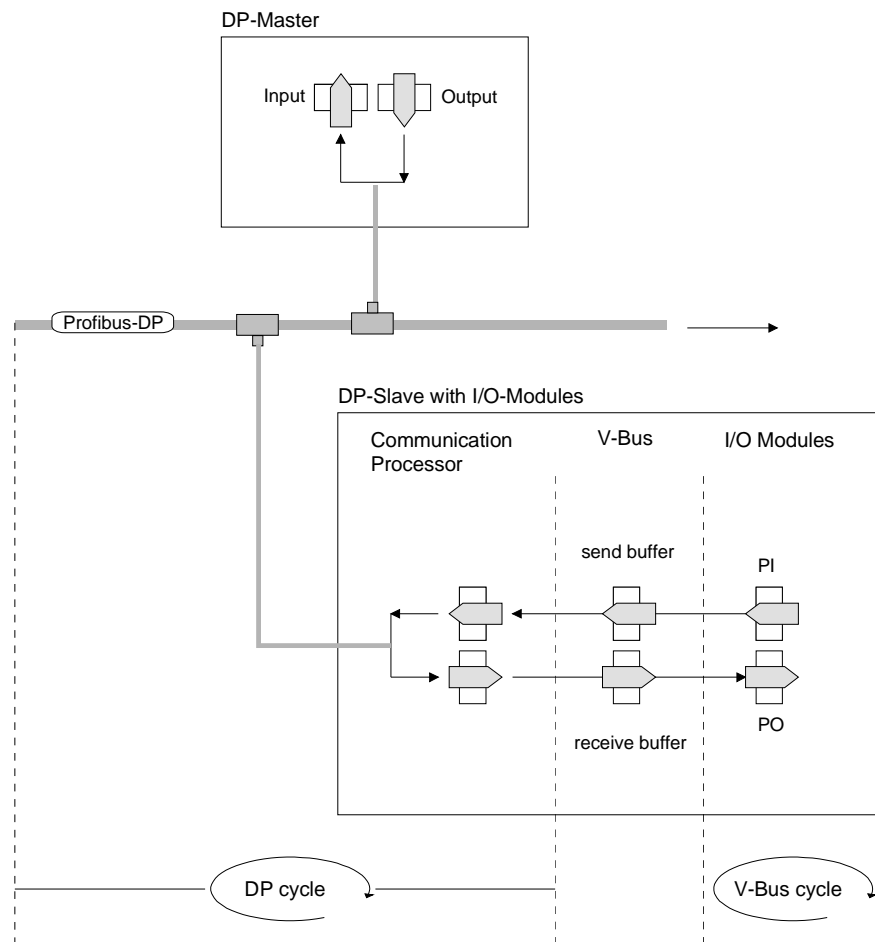
PI: process image of the inputs
PO: process image of the outputs

V-bus cycle

A V-bus cycle (V-Bus=VIPA backplane bus) saves all the input data from the modules in the PI and all the output data from the PO in the output modules. When the data has been saved the PI is transferred into the "send buffer" and the contents of the "receive buffer" is transferred into PO.

DP cycle

During a Profibus cycle the master addresses all its slaves according to the sequence defined in the data exchange. The data exchange reads and writes data from/into the memory areas assigned to the Profibus.

The contents of the Profibus input area is entered into the "receive buffer" and the data in the "send buffer" is transferred into the Profibus output area.

The exchange of data between DP master and DP slave is completed cyclically and it is independent from the V-bus cycle.

V-bus cycle ≤
DP cycle

To ensure that the data transfer is synchronized the V-bus cycle time should always be less than or equal to the DP cycle time.

The parameter **min_slave_interval = 3ms** is located in the GSD-file.

In an average system it is guaranteed that the Profibus data on the V-bus is updated after a max. time of 3ms. You can therefore exchange data with the slave at intervals of 3ms.

Note!

When the V-bus cycle time exceeds the DP cycle time the RUN-LED on the VIPA Profibus slave is extinguished.

This function is supported as of hardware revision level 6.

Data consistency

The VIPA Profibus-DP masters provide "word-consistency"!

Consistent data is the term used for data that belongs together by virtue of its contents. This is the high and the low byte of an analog value (word consistency) as well as the control and status byte along with the respective parameter word for access to the registers.

The data consistency as applicable to the interaction between the periphery and the controller is only guaranteed for 1Byte. This means that input and output of the bits of a byte occurs together. This byte consistency suffices when digital signals are being processed.

Where the data length exceeds a byte, for example in analog values, the data consistency must be extended. Profibus guarantees that the consistency will cater for the required length.

Restrictions

- Max. 125 DP slaves at one DP master - max. 32 slaves/segment
- Max. 16 DPO slaves at one DPO master at 1,5MBaud
- You can only install or remove peripheral modules when you have turned the power off!
- The max. distance for RS485 cables between two stations is 1200m (depending on the baud rate)
- The max. distance for FO cables between two stations is 300m (at HCS-FO) and 50m (at POF-FO)
- The maximum baud rate is 12MBaud
- The Profibus address of operational modules must never be changed.

Diagnostics

Profibus-DP provides an extensive set of diagnostic functions for fast error localization. Diagnostic messages are transferred via the bus and collected by the master.

Data transfer medium

Profibus employs screened twisted pair cable on the basis of the RS485 interfaces or a duplex fiber optic link (FO). The data transfer rate of both systems is limited to a max. of 12MBaud.

For details please refer to the "Installation guidelines".

Electrical system based on RS485

The RS485 interface uses differential voltages. For this reason this kind of interface is less susceptible to interference than a plain voltage or current based interface. The network may be configured as linear or as tree structure. Your VIPA Profibus coupler carries a 9pin socket. This socket is used to connect the Profibus coupler to the Profibus network as a slave.

Due to the bus structure of RS485, any station may be connected or disconnected without interruptions and a system can be commissioned in different stages. Extensions to the system do not affect stations that have already been commissioned. Any failures of stations or new devices are detected automatically.

Optical system using fiber optic data links

The fiber optic system employs pulses of monochromatic light. The optical waveguide is not susceptible to external electrical interference. Fiber optic systems have a linear structure. Each device requires two lines, a transmit and a receive line. It is not necessary to provide a terminator at the last device.

Due to the linear structure of the FO data link, it is not possible to install or remove stations without interruption to data communication.

Addressing

Every device on the Profibus is identified by an address. This address must be unique number in the bus system between 0 and 125. The address of the VIPA Profibus coupler is set by the addressing switch located on the front of the module.

You assign the address to the VIPA Profibus master during the configuration phase.

GSD-file

For configuration purposes you receive a GSD-file containing the performance specifications of VIPA components.

The structure, contents and coding of the GSD-file are defined by the Profibus user organization (PNO) and are available from this organization.

The GSD-file for VIPA Profibus-DP slaves is: VIPA0550.GSD

Install this GSD-file into your configuration tool. You can obtain more detailed information on the installation of GSD-files from the manual supplied with your configuration tool.

IM 208DP - Master - Construction

Properties

- Class 1 Profibus-DP master
- 125 DP slaves (16 at DPO) connectable to one DP master
- Inserts the data areas of the slaves located on the V-bus into the addressing area of the CPU
- Project engineering by means of VIPAs WinNCS or Siemens STEP®7 Manager or ComProfibus
- Diagnostic facilities

Front view IM 208DP
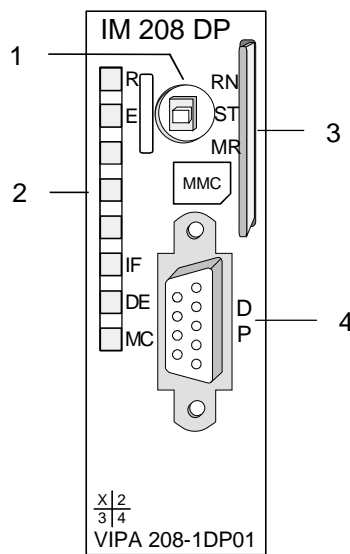
[1]	Operating mode switch RUN/STOP
[2]	LED status indicators
[3]	Slot for memory card
[4]	RS485 interface

Front view IM 208DPO
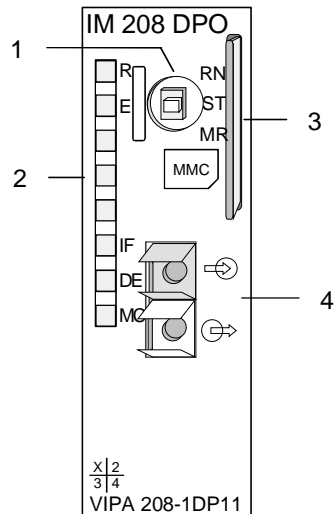
[1]	Operating mode switch RUN/STOP
[2]	LED status indicators
[3]	Slot for memory card
[4]	FO interface

___

Components

LEDs
The module carries a number of LEDs that are available for diagnostic purposes on the bus and for displaying the local status. The following table explains the different colors of the diagnostic LEDs.

Label	Color	Description
R	green	If R is the only LED that is on, then the master status is RUN. The slaves are being accessed and the outputs are 0 ("Clear" state).
		If both R+DE are on the status of the Master is "operate". It is communicating with the slaves.
		Blinks 3 times: Transfer from MMC to Flash-ROM without error.
E	red	On at slave failure (ERROR).
		Blinks 3 times: Transfer from MMC to Flash-ROM without error.
IF	red	Initialization error for bad parameterization
DE	yellow	DE (Data exchange) indicates Profibus communication activity.
MC	yellow	Blinks at reading the parameters from MMC. Is on at wrong parameterization.

RS485 interface (at IM 208DP)
The VIPA Profibus master is connected to your Profibus network via the 9pin socket. The following figure shows the assignment of the individual pins:
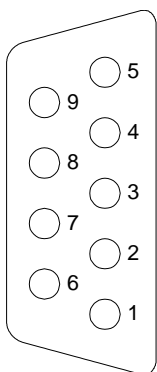
Pin	Assignment
1	shield
2	n.c.
3	RxD/TxD-P
4	CNTR-P
5	GND
6	5V (max. 70mA)
7	n.c.
8	RxD/TxD-N
9	n.c.

FOL interface (at IM 208DPO)
The IM 208DPO is connected to Profibus by a FOL (**f**iber **o**ptic **l**ink) interface. The layout of this interface is shown below:

Connect to receive line (from slave)

Connect to send line (to slave)

___
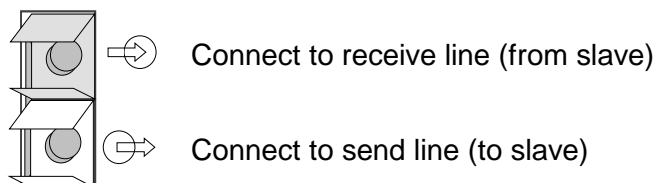
Power supply   The Profibus master receives power via the backplane bus.

Operating mode   The operating mode selector is used to select the operating modes STOP
selector   (ST), RUN (RN) and MEMORY (MR).

                            The master will change to RUN mode if the operating mode selector is set
                            to RN and parameters are acceptable.

                            When the operating mode switch is set to ST, the master will change to
                            STOP mode. In this mode all communication is terminated, the outputs of
                            the allocated slaves will be set to 0 and the master issues an alarm to the
                            controlling system.

                            This chapter contains under "Operating modes" a detailed explanation of
                            the change between RUN and STOP mode.

                            In position MR you may activate:

                            • the data transfer from MMC into Flash-ROM
                            • a serial mode for deploying the VIPA Green Cable
                            • Overall-Reset of the DP master

                            More detailed information about those options is to find further below.

MMC as external   The VIPA MMC (**mem**ory **c**ard) is employed as an external storage
storage medium   medium. The MMC is available from VIPA with the order no.: VIPA 953-
                            0KX00. You can get a external MMC reading device from VIPA (Order no:
                            VIPA 950-0AD00) for your PC. Hereby you can read and write MMC by
                            using your PC.

                            You initiate the transfer of project data from the MMC into the master by
                            setting the operating mode selector into position MR. For details, please
                            refer to the section on "Transferring a project" below.

Operating modes   *Power On*

The DP master is powered on. The master will change automatically to RUN mode when the operating mode lever is in position RUN and the parameters are valid.

STOP

In STOP mode the outputs of the allocated slaves will be set to 0 if the parameters are valid. Although no communication will take place, the master will remain active on the bus using current bus parameters and occupying the allocated bus address. To release the address the Profibus plug must be removed from the DP master.

STOP → RUN

In the RN position the master will re-boot: configuration data and bus parameters are retrieved from the Flash-ROM. **An existing hardware configuration is deleted by the boot procedure of the DP master.**

To transfer a new hardware configuration you have to process Power ON.

At a STOP → RUN crossover the communication link to the slaves is established. At this time only the R-LED will be on. Once communication has been established by means of valid bus parameters the DP master will change to RUN mode. The master interface displays this status by means of the LEDs R and DE.

The DP master will remain in the STOP mode and display a configuration error by means of the IF-LED if the parameters are bad. The DP master will then be active on the bus using the following default bus parameters:

Default bus parameters: Address:1, Communication rate:1.5MBaud.

RUN

In RUN mode the R- and DE-LEDs are on. In this condition data transfer can take place. If an error occurs, e.g. slave failure, the DP master will indicate the event by means of the E-LED and it will issue an alarm to the system on the next higher level.

RUN → STOP

The master is placed in STOP mode. It terminates communication and all outputs are set to 0. An alarm is issued to the system on the next higher level.

IM 208DP - Master - Deployment at CPU 21x

Communication   Via the IM 208 master modules you may connect up to 125 Profibus-DP slaves (up to 16 at DPO) to one System 200V CPU. The master communicates with the slaves and transfers the data areas via the backplane bus into the address area of the CPU. There may occur a maximum of 1024Byte input and 1024Byte output data.

With firmware versions < V3.0.0 there are only 256Byte available for input and output data.

With every boot procedure of the CPU, this fetches the I/O mapping data from all masters.

Alarm processing   The alarm processing is activated, i.e. a IM 208 error message may initialize the following alarms, causing the CPU to call the according OBs:

- Process alarm: OB40
- Diagnostic alarm: OB82
- Slave failure: OB86

As soon as the BASP signal (i.e. "**B**efehls**a**usgabe**sp**erre" = command output lock) comes from the CPU, the IM 208 sets the outputs of the connected periphery to zero.

Note!
After a slave failure, the process image of the inputs is in the same state than before the failure.

Preconditions   At deployment of the IM 208 Profibus-DP master, please make sure that this has a firmware version V3.0.0 or higher; otherwise it is not deployable with a CPU 21x with firmware version V3.0.0 or higher.

The according firmware version is to find on the label at the backside of the module.

Having questions to the firmware update, please call the VIPA support (support@vipa.de).

More detailed descriptions to the inclusion into your CPU are to find in the documentation of your CPU.

Note!
For the deployment with a CPU 24x, the firmware version of the DP master has to be set to level V1.0.7.

IM 208DP - Master - Project engineering

General

You may configure the DP master in different ways:

- Project engineering in the hardware configurator from Siemens and transfer via the system bus as hardware configuration. This allows you only to configure the 1st master (IM 208 res. CPU 21xDPM).

  Please regard that the operating mode lever of the DP master has to be in the position RN for accepting the configuration via system bus.

- Project engineering in the hardware configurator from Siemens and export as wld-file to MMC.

- Project engineering via WinNCS from VIPA res. ComProfibus from Siemens and export as 2bf-file to MMC.

- Transfer Project only at IM 208DP with SIP-Tool and Green Cable
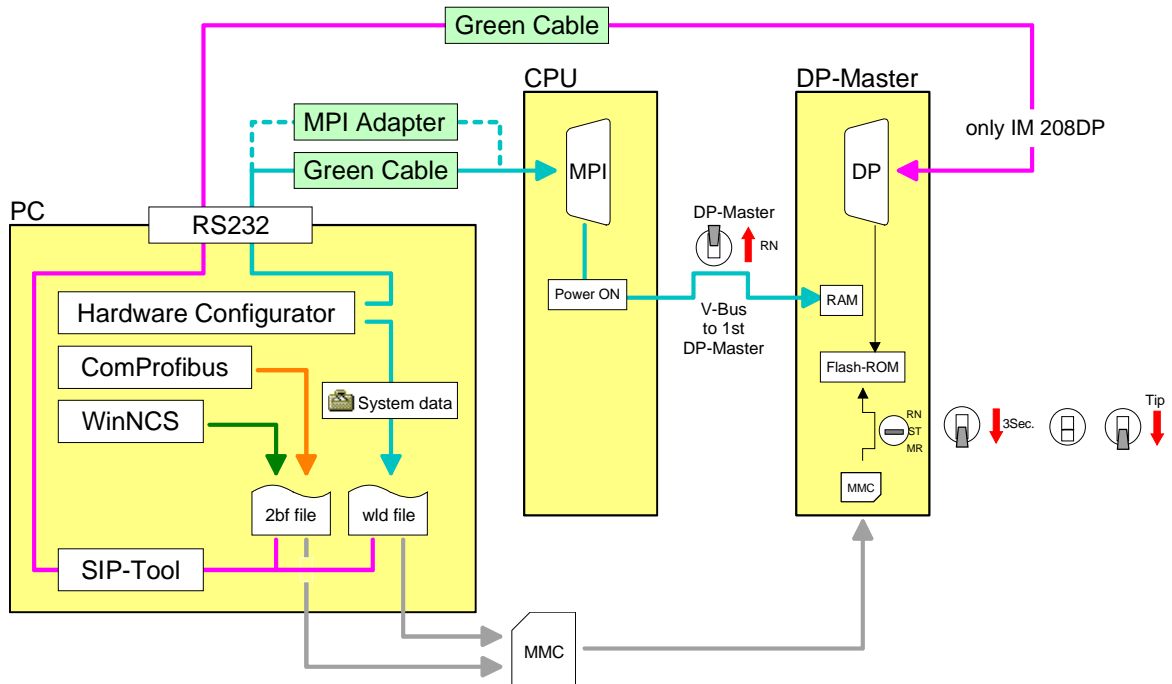
Required firmware versions

DP master and CPU should have a firmware version V.300 or higher, otherwise the DP master may not be deployed at the CPU 21x.

The according firmware version is to find on the label at the backside of each module.

Firmware version

DP master	CPU	Properties
V3.0.0	V3.0.0	1024Byte in- and output data
V3.0.4	V3.0.0	Project engineering via wld-file
V3.0.6	V3.3.0	Project engineering as HW configuration via MPI
V3.0.6	---------	Overall-Reset of the DP master

Project engineering as HW configuration

In the hardware configurator from Siemens you project your PLC system together with the DP master. You transfer this "hardware configuration" via MPI into the CPU. At Power ON, the configuration data is transferred to the DP master if the operating mode lever is in position RN.

Note!

Please make sure, that the operating mode lever of the DP master is in RN position. Otherwise, a STOP-RUN switch causes the master to reboot and the project is deleted.

Please regard also that this allows you only to configure the 1st master in the system! Additional DP master have to be exported as wld-file res. 2bf-file.

Approach with hardware configuration

The steps you have to follow with the hardware configurator from Siemens shall be shortly described here:

1.	Create a new project System 300 and add a profile rail from the hardware catalog.
2.	Insert the CPU 315-2DP. This is to find under: *Simatic300>CPU-300>CPU315-2DP* **(6ES7 315-2AF03-0AB0 V1.2)**
3.	Assign a Profibus address 2 or higher to your master.
4.	Click at DP, select the operating mode "DP master" under *Object properties* and confirm your entry with OK.
5.	With a right-click on "DP", a context menu opens. Choose "Insert master system". Create a new Profibus subnet via NEW. The following picture shows the new master system:

6.	To be compatible to the STEP®7 projecting tool from Siemens, the System 200V CPU has to be included explicitly. For this, you add a System "VIPA_CPU21x" to the subnet. This system is to find in the hardware catalog under: *PROFIBUS DP > Additional field devices > IO > VIPA_System_200V > VIPA_CPU21x.* Assign the Profibus address 1 to this slave. Set the according CPU 21x from VIPA at plug-in location 0 by choosing it in the hardware catalog under *VIPA_CPU21x*. **The plug-in location 0 is mandatory!**
7.	For including the modules connected to the VIPA-Bus, you drag and drop the according System 200V modules from the hardware catalog under *VIPA_CPU21x* to the plug-in locations following the CPU. Start with plug-in location 1. The same is to do for the DP master (place holder).
8.	For projecting DP slaves connected to the DP master select the VIPA_DP200V_2 system. Select the according Profibus system in the hardware catalog and drag it to the DP master subnet. Assign an address > 3 to the slave. Set the according modules at plug-in location 0 by choosing it in the hardware catalog under VIPA_DP200V_2.
9.	Click on (save and translate).

Transfer variants   Depending on the used firmware at CPU and DP master, you have the following transfer possibilities:

1. Transfer via MPI (only for 1st master at the bus)
   Your DP master project is transferred to the CPU together with the PLC program. The CPU transferees the DP master project automatically to the 1st master at the bus system (IM 208DP or CPU 21xDPM) at Power ON.

2. Export of the project as wld-file to MMC
   Export your project as wld-file and transfer it to a MMC. The MMC is to plug in the according DP master.

3. Only IM 208DP: Export of the project as wld-file and data transfer via Green Cable deploying the SIP-Tool from VIPA.

to 1.
Transfer via MPI

10.	Connect your CPU res. your PC via MPI with your CPU.
	For a serial point-to-point transfer from your PC, you may also use the Green Cable from VIPA.
	The Green Cable has the order no. VIPA 950-0KB00 and may only be deployed at compatible modules from VIPA. Please regard the instructions to the Green Cable in the Principles at the beginning of this manual!
	At deployment of the Green Cable from VIPA, the MPI interface has to be configured (PC Adapter MPI, 38400Baud).
11.	Switch your DP master to RUN.
12.	Switch on the power supply of the CPU.
13.	Transfer your project into the CPU with **PLC** > *Load to module* in the hardware configurator from Siemens.
14.	For additional saving of your project on a MMC, you plug a MMC in the CPU slot and transfer the project via **PLC** > *Copy RAM to ROM.* During write operation, the "MC"-LED at the CPU is blinking. Due to the system, the successful write operation is announced too soon. Please wait until the LED extinguishes.

Now the project engineering is completed.

Note!

Please regard also that this allows you only to configure the 1st master in the system! Additional DP masters have to be exported as wld-file and loaded to MMC.

to 2. Export as dpm.wld to MMC	To project additional DP masters, you export your project to a MMC by creating a wld-file. The MMC is then plugged in the according DP master. By using the operating mode lever, you may transfer your project from the MMC into the Flash-ROM of the master.
	After the transfer, you may release the MMC again. This allows you to configure several masters at the same backplane bus with one MMC.

Approach

10.	Create with **File** > *Memory Card File* > *New ...* a new wld-file. This need to have the file name **dpm.wld** to be recognized from the Profibus master. → This file is additionally shown to the configuration window.
11.	Go into your project into the directory *modules* and copy the directory "🗂 System data" into the created dpm.wld-file.
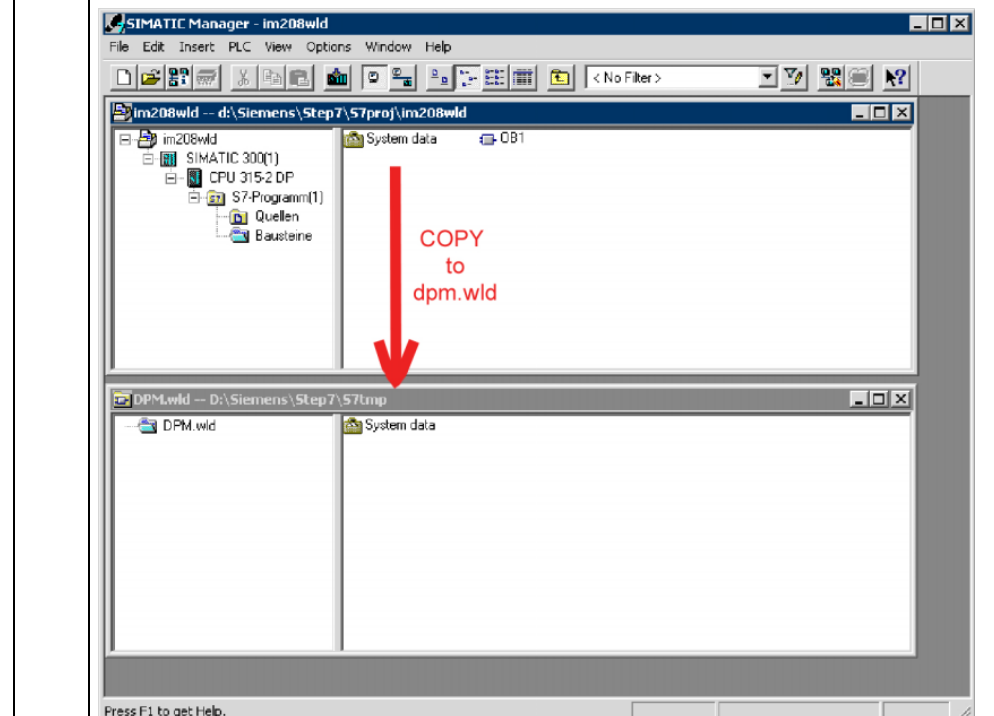
Note!

If an already existing "System data" directory shall be overwritten, you first have to delete that.

to 2. continued
Transfer data from
MMC to internal
Flash-ROM
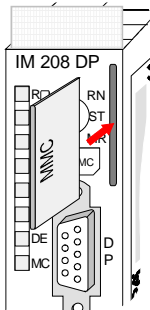
12.	Transfer the wld-file to the MMC by means of a MMC reading device.
13.	Plug-in the MMC memory module into your IM 208DP master
14.	Turn on the power supply for the System 200V.
15.	Hold the operating mode lever of the Profibus master in position MR until the blinking MC-LED switches to permanent on.
16.	Release the operating mode lever and tip it once more to MR. → The data is transferred from the MMC into the internal Flash-ROM. During data transfer all LEDs extinguish. At successful data transfer, the green R-LED blinks 3 times. At error, the red E-LED blinks 3 times.
17.	Now you may release the MMC again.
18.	Switch the master from STOP to RUN. → The IM 208DP master now starts with the new project in the internal Flash-ROM. The RUN-LED (R) and DE are on.

Note!

The project inside the PLC for the 1st Master takes priority over the project downloaded to Flash-ROM of the Master.

If the MMC contains a wld- and a 2bf-file, the wld-file has the priority.

to 3.

Only at IM 208DP
Export as dpm.wld
Transfer via
SIP-Tool from VIPA

The method shown below can only be used at the IM 208DP with RS485-interface. The SIP-Tool is a transfer tool. It is supplied together with WinNCS from VIPA. It allows you to deploy the Green Cable from VIPA to transfer your project as wld- res. 2bf-file into the master serial via the Profibus interface. The transferred project is stored in the internal Flash-ROM of the DP master.

The Green Cable is available at VIPA with the order no.
VIPA 950-0KB00.

Attention!

Please regard the instruction for deploying the Green Cable in the Principles at the beginning of this manual! Profibus DP master from Version 4.0 could only be projected by SIP tool from version 1.06 on!
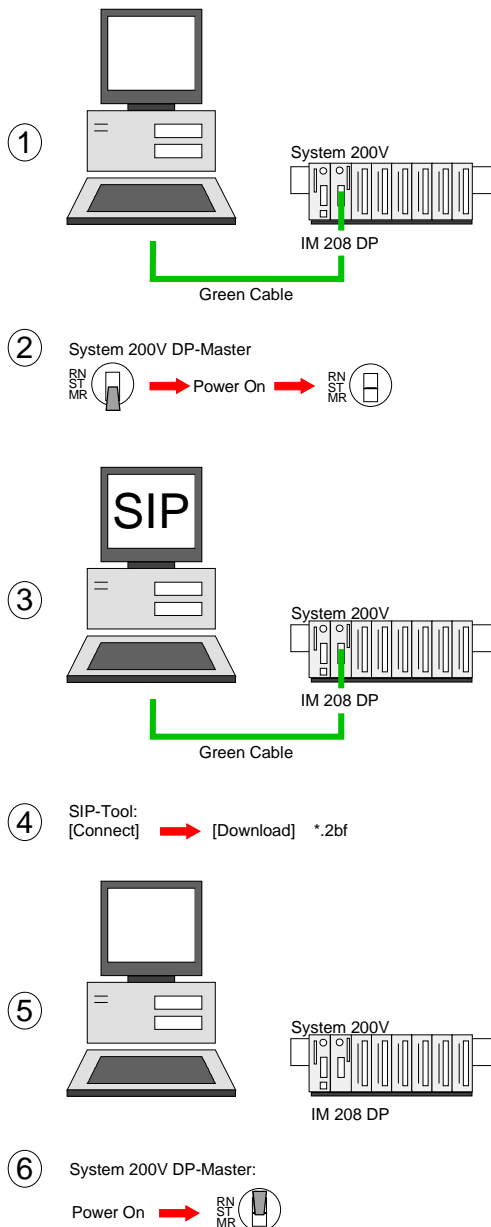
12.	Disconnect the Profibus plug from the DP master.
13.	Connect the "Green Cable" to the serial interface of your PC and to the Profibus interface of the IM 208DP master.
14.	Place and hold the operating mode lever of your master module in position MR and turn on the power supply. Release the lever again. → Now your Profibus master may receive data serial via the Profibus interface.
15.	Turn on your PC and start the SIP tool that is supplied with WinNCS. Select the appropriate COM port and establish a connection by means of [Connect]. When the connection has been established, the SIP tool will display OK in the status line located at the top, otherwise an ERR message will be displayed.
16.	Click [Download], select your dpm.2bf- res. dpm.wld-file and transfer this file into the DP master
17.	Terminate the connection and the SIP tool when the data has been transferred.
18.	Disconnect the "Green Cable" from the master.
19.	Turn off the power supply of your master.
20.	Connect the master to the Profibus network and turn the power supply on again.
21.	Change the operating mode of the master to RUN. → Your IM 208DP Profibus master is now connected to the network with the updated configuration. The configuration data is saved in the internal Flash-ROM.

① System 200V
IM 208 DP
Green Cable

② System 200V DP-Master
RN ST MR → Power On → RN ST MR

③ SIP
System 200V
IM 208 DP
Green Cable

④ SIP-Tool:
[Connect] → [Download]   *.2bf

⑤ System 200V
IM 208 DP

⑥ System 200V DP-Master:
Power On → RN ST MR

Configuration under WinNCS

The Profibus master may be easily configured by means of the VIPA WinNCS configuration tool. You may export your project as 2bf-file on a MMC res. transfer it via SIP-Tool into the DP master (only at IM 208DP possible).

The WinNCS configuration procedure is outlined below. For more detailed information see the manual HB91 for WinNCS.

1.	Start WinNCS and create a new project file for the "Profibus" function by clicking on **File** > *create/open*.
2.	If you have not yet done so, use ![PROFIBUS] to insert a **Profibus function group** into the network window and click [Accept] in the parameter box.
3.	Use ![icon] to insert a **Profibus host/master** into the network window and specify the Profibus address of your master in the parameter window.
4.	Insert a **Profibus slave** into the network window by means of ![icon]. Enter the Profibus address, the family "I/O" and the station type "*VIPA_DP200V_2*" into the parameter window and click [Accept].
5.	Use ![icon] to define the configuration of every peripheral module that is connected to the corresponding slave via the backplane bus. You can select automatic addressing for the periphery by clicking [Auto] and display allocated addresses by means of [MAP]. **Please take care that the automatic address allocation does not cause conflicts with the local periphery!** For intelligent modules like the CP 240 the configurable parameters will be displayed.
6.	When you have configured all the slaves with the respective periphery, the bus parameters for Profibus must be calculated. Select the Profibus function group in the network window. In the parameter window click on the "Bus parameter" tab. Select the required baud rate and click [calculate]. The bus parameters will be calculated - [Accept] these values. The bus parameters must be re-calculated with every change to the set of modules!
7.	Activate the master level in the network window and export your project into the file dpm.2bf.
8.	Transfer the dpm.2bf-file into your IM208 master (see "transferring a project ") .

Note!

For the IM 208 DP master is configured like the IM 308-C from Siemens, you may configure the VIPA module also as IM 308-C under "ComProfibus" from Siemens and export it as 2bf-file.

IM 208DP - Master - Overall-Reset

General

Starting with the firmware version V.3.0.6 of the DP masters, you have the possibility to request an overall-reset at the DP master.

An overall-reset clears all data in the Flash-ROM.

Execute an overall-reset

1.	Turn on the power supply of the System 200V.
2.	Push the operating mode lever of the master module in position MR. Hold it for app. 9s → first, the MC-LED blinks 3 times. For 3s the blinking switches into permanent on. Then, the IF-LED blinks 3 times and switches to permanent on.
3.	Release the lever and tip it within 3s once more in pos. MR. → The content of the Flash-ROM is deleted. The operation has been executed properly when the green R-LED blinks 3 times and the IF-LED is permanent on. As soon as you switch the master to RUN, this boots and starts with its default parameters at the bus. **Default parameter: Address: 1, Transfer rate: 1.5MBaud**

Project engineering via CPU after power-on to first master

If there is a valid profibus project in the CPU, this is automatically transfered via backplane bus into the RAM of the 1st master after power on - independet from position of operating mode lever.

IM 208DP - Master - Firmwareupdate

Overview

Starting with PLC firmware version 3.3.3 a MMC inside your PLC can be used to update the firmware of PLC an DP master. For more details see manual HB103 of your PLC.

For designation the master firmware has the following name convention:

dpmxx**.bin**   xx specifies the slot number the DP master is plugged in (Slot: 00 ... 31)

Attention!

When installing a new firmware you have to be extremely careful. Under certain circumstances you may destroy the DP-Master, for example if the voltage supply is interrupted during transfer or if the firmware file is defective.

In this case, please call the VIPA-Hotline!

**Seek
firmware version**

A label on the rear of the module indicates the firmware version.

**Load firmware and
transfer it to MMC
as *firmware.bin***

- Go to www.vipa.de.
- Click on Service > Download > Firmware Updates.
- Click on "Firmware for Profibus Master System 200V "
- Select the according IM 208 order no. and download the firmware to your PC.
- Rename the file to "**dpm**xx**.bin**" (xx specifies the slot number the DP master is plugged in, starting with 00) and transfer this file onto a MMC.

Note!

The server always stores the latest two firmware versions.

Preconditions for ftp access

For the display of ftp sites in your web browser you may have to execute the following adjustments:

Internet Explorer

ftp access only with version 5.5 or higher

Options > Internet options, Register "Advanced" in the area "Browsing":

   - activate: "Enable folder view for ftp sites"

   - activate: "Use passive ftp ..."

Netscape

ftp- access only with version 6.0 or higher

No further adjustments are required

If you still have problems with the ftp access, please ask your system operator.

Transfer firmware from MMC into DP Master

Get the RUN-STOP lever of your CPU in position STOP.

- Turn off the voltage supply.
- Plug the MMC with the firmware into the CPU. Please take care of the correct plug-in direction of the MMC.
- Turn on the voltage supply.
- After a short boot-up time, the alternate blinking of the LEDs SF and FC shows that the firmware file has been found on the MMC.
- You start the transfer of the firmware as soon as you tip the RUN/STOP lever downwards to MRES within 10s. The CPU shows the transfer via a LED blink line.
- During the update process, the LEDs SF, FC and MMC are alternately blinking. This may last several minutes.
- The update is successful finished when all CPU-LEDs are on. If they are blinking fast, an error occurred.
- After Power OFF - ON the Master starts with new firmware.

IM 253DP - Slave (Standard) - Construction

Properties
- Profibus-DP slave for max. 32 peripheral modules (max. 16 analog modules)
- Max. 152Byte input data and 152Byte output data
- Internal diagnostic protocol with a time stamp
- Integrated DC 24V power supply for the peripheral modules (3.5A max.)
- Supports all Profibus data transfer rates

**Front view
253-1DP00**
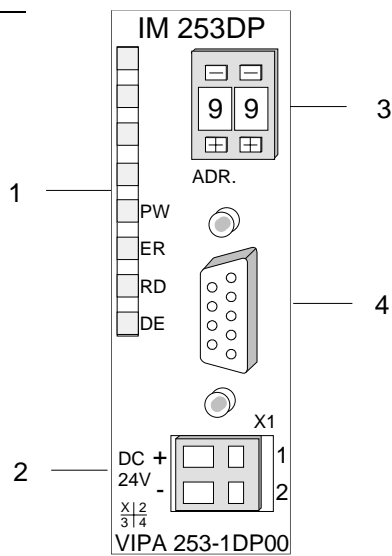
[1]   LED status indicators
[2]   Connector for DC 24V power supply
[3]   Address selector
[4]   RS485 interface

**Front view
253-1DP10**
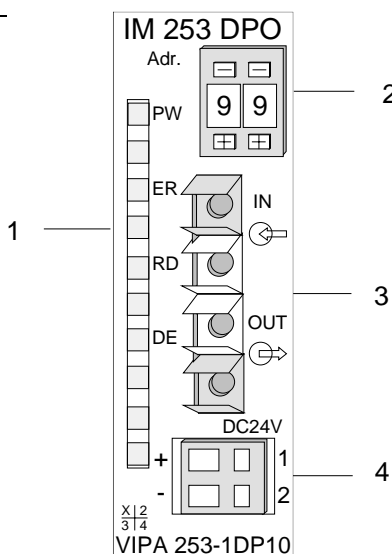
[1]   LED status indicators
[2]   Address selector
[3]   FO interface
[4]   Connector for DC 24V power supply

Components

LEDs   The Profibus slave modules carry a number of LEDs that are available for diagnostic purposes on the bus and for displaying the local status. The following table explains the different colors of the diagnostic LEDs.

Label	Color	Description
PW	yellow	Indicates that the supply voltage is available on the backplane bus. (Power).
ER	red	Turned on and off again when a restart occurs.
		Is turned on when an internal error has occurred.
		Blinks when an initialization error has occurred.
		Alternates with RD when the master configuration is bad (configuration error).
		Blinks in time with RD when the configuration is bad.
RD	green	Is turned on when the status is "Data exchange" and the V-bus cycle is faster than the Profibus cycle.
		Is turned off when the status is "Data exchange" and the V-bus cycle is slower than the Profibus cycle.
		Blinks when self-test is positive (READY) and the initialization has been completed successfully.
		Alternates with ER when the configuration received from the master is bad (configuration error).
		Blinks in time with ER when the configuration is bad
DE	yellow	DE (Data exchange) indicates Profibus communication activity.

RS485 interface   A 9pin socket is provided for the RS485 interface between your Profibus slave and the Profibus.

The following diagram shows the pin assignment for this interface:
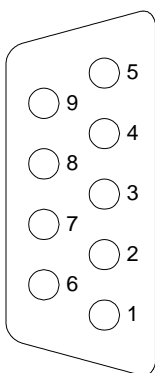
Pin	Assignment
1	shield
2	n.c.
3	RxD/TxD-P
4	CNTR-P
5	GND
6	5V (max. 70mA)
7	n.c.
8	RxD/TxD-N
9	n.c.

FO interface

Send

Receive

IN

Send

Receive

OUT
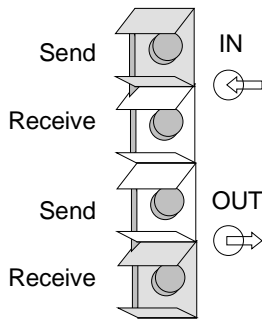
These connectors are provided for the optical waveguide between your Profibus coupler and the Profibus.

The diagram on the left shows the layout of the interface.

Address selector

0 1
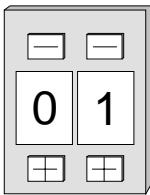
This address selector is used to configure the Profibus address for the DP slave. Addresses may range from 1 to 99. Addresses must be unique on the bus.

The slave address must have been selected before the bus coupler is turned on.

When the address is set to 00 during operation, a once-off image of the diagnostic data is saved to Flash-ROM. Please take care to reset the correct Profibus address, so by the next PowerOn the right Profibus address is used!

Power supply

Every Profibus slave has an internal power supply. This power supply requires DC 24V. In addition to the electronics on the bus coupler, the supply voltage is also used to power any modules connected to the backplane bus. Please note that the maximum current that the integrated power supply can deliver to the backplane bus is 3.5A.

The power supply is protected against reverse polarity.

Profibus and backplane bus are galvanically isolated from each other.

Attention!

Please ensure that the polarity is correct when connecting the power supply!

IM 253DPR - Slave (redundant) - Construction

Redundant system   In principal, the IM 253DPR consists of 2 Profibus-DP slave connections. The two Profibus slaves are controlling the operating modes of each other. Both slaves have the same address at the Profibus and are communicating with a redundant DP master.

Both slaves are reading the peripheral inputs. Only one slave at a time has access to the peripheral outputs. The other slave is passive and in stand-by. As soon as the active slave is failing, the passive slave accesses the peripheral outputs.
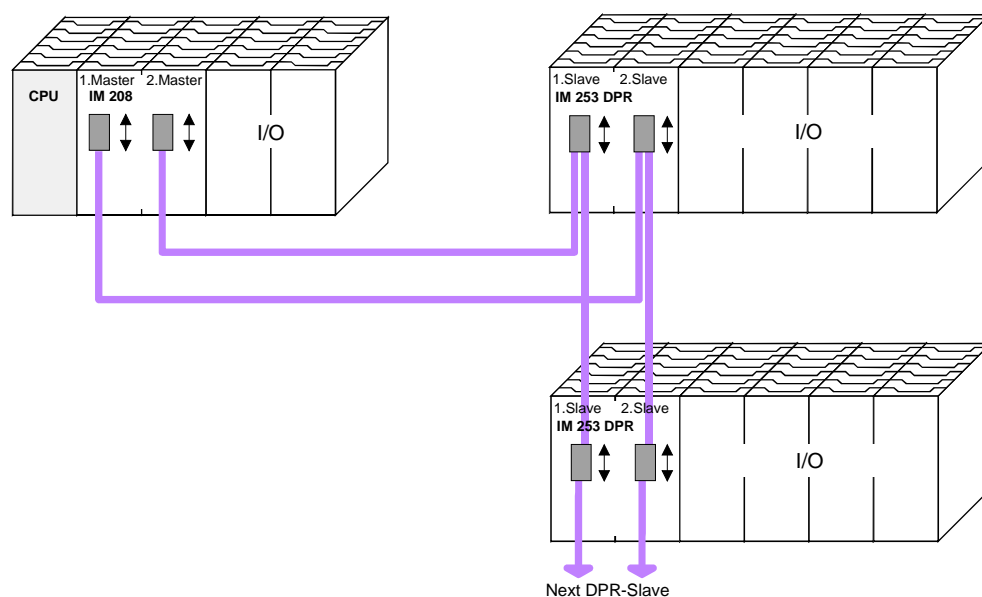
Requirements for the deployment   Please regard to use a redundant DP master for the redundant deployment of the slave module. Every master unit needs the same parameterization and bus configuration.

Properties IM 253DPR

- 2 redundant channels
- DPR slave for max. 32 peripheral modules (max. 16 analog modules)
- Max. 152Byte input data and 152Byte output data
- Internal diagnostic protocol with a time stamp
- Integrated DC 24V power supply for the peripheral modules (max. 3A)
- Supports all Profibus data transfer rates

**Front view
253-2DP50**
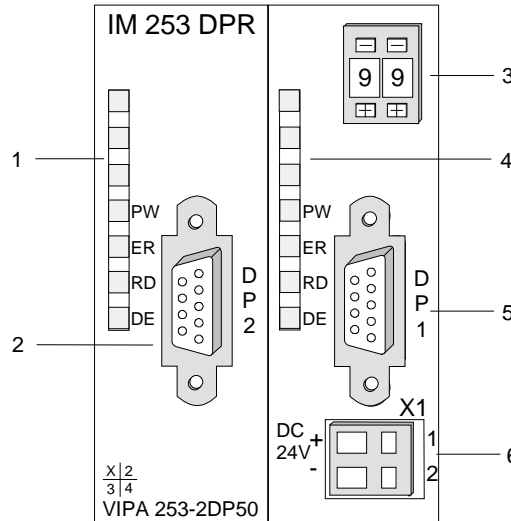
[1]   LED Status DP2
[2]   RS485 interface DP2
[3]   Address selector
[4]   LED Status DP1
[5]   RS485 interface DP1
[6]   Connector for DC 24V power
      supply

Components

LEDs

The redundant slave includes one LED row for every slave unit that are available for diagnostic purposes The following table explains the different colors of the diagnostic LEDs.

Label	Color	Description
PW	yellow	Indicates that the supply voltage is available on the backplane bus. (Power).
ER	red	Turned on and off again when a restart occurs.
		Is turned on when an internal error has occurred.
		Blinks when an initialization error has occurred.
		Alternates with RD when the master configuration is bad (configuration error).
		Blinks in time with RD when the configuration is bad.
RD	green	Blinks at positive self test(READY) and successful initialization.
DE	yellow	DE (Data exchange) indicates Profibus communication activity.

LEDs at redundant operation

During redundant operation the active slave shows its activity via the green RD-LED, at the passive slave the RD-LED is off. At both slaves the PW- and the DE-LED are on.
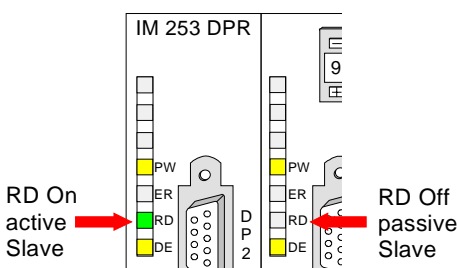
RD	DE	Description
on	on	active slave (write and read)
off	on	passive backup slave (read)

RS485 interface   Via two 9pin RS485 sockets you include the 2 channels into Profibus. Die
The following diagram shows the pin assignment for this interface:
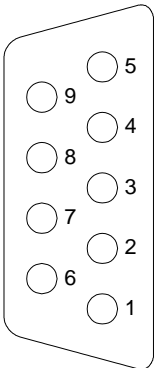
Pin	Assignment
1	shield
2	n.c.
3	RxD/TxD-P
4	CNTR-P
5	GND
6	5V (max. 70mA)
7	n.c.
8	RxD/TxD-N
9	n.c.
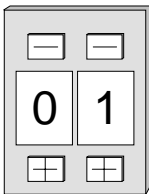
Address selector   This address selector is used to configure the Profibus address for both
DP slaves. Addresses may range from 1 to 99. Addresses must be unique
on the bus.

The slave address must have been selected before the bus coupler is
turned on.

When the address is set to 00 during operation, a once-off image of the
diagnostic data is saved to Flash-ROM. Please take care to reset the
correct Profibus address, so by the next PowerOn the right Profibus
address is used!

Power supply   Every Profibus slave has an internal power supply. This power supply
requires DC 24V. In addition to the electronics on the bus coupler, the
supply voltage is also used to power any modules connected to the
backplane bus. Please note that the maximum current that the integrated
power supply can deliver to the backplane bus is 3.5A.

The power supply is protected against reverse polarity.

Profibus and backplane bus are galvanically isolated from each other.

Attention!

Please ensure that the polarity is correct when connecting the power
supply!

IM 253DP, DO 24xDC 24V - Construction

General

This module consists of a Profibus slave with an integrated 24port output unit. The 24 output channels are controlled directly via the Profibus. The output channels are capable of a maximum load current of 1A each. The total output current must never exceed 4A. The outputs are dc-coupled.

Properties

The following properties distinguish the Profibus output module IM 253DP, DO 24xDC 24V:

- Profibus slave
- 24 digital outputs
- dc-coupled
- Nominal output voltage DC 24V, max. 1A per channel
- Total output current max. 4A
- LED for error indication at overload, over temperature or short circuit
- Suitable for the control of small motors, lamps, magnetic switches and contactors that are controlled via Profibus.

**Front view
IM 253DP,
DO 24xDC 24V**

[1]	LEDs status indicator Profibus
[2]	Profibus socket
[3]	Address selector
[4]	Connector for DC 24V power supply
[5]	LEDs status indicator output unit
[6]	25pin socket for digital output
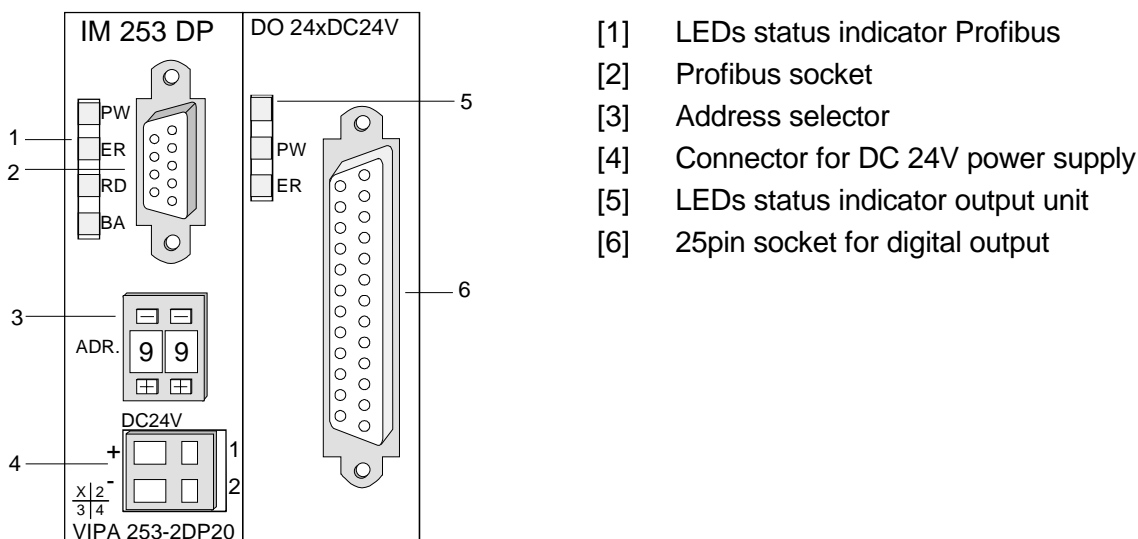
Attention!

In stand-alone operation, the two sections of the module must be joined by means of the 1tier bus connector that is supplied with the modules!

Components   The components of the Profibus section are identical with the components of the Profibus slave modules that were described above.

LEDs Profibus   The Profibus section carries a number of LEDs that can also be used for diagnostic purposes on the bus.

Label	Color	Description
PW	yellow	Indicates that the supply voltage is available (Power).
ER	red	Turned on and off again when a restart occurs.
		Is turned on when an internal error has occurred.
		Blinks when an initialization error has occurred.
		Alternates with RD when the master configuration is bad (configuration error).
		Blinks in time with RD when the configuration is bad.
RD	green	Is turned on when the status is "Data exchange" and the V-bus cycle is faster than the Profibus cycle.
		Is turned off when the status is "Data exchange" and the V-bus cycle is slower than the Profibus cycle.
		Blinks when self-test is positive (READY) and the initialization has been completed successfully.
		Alternates with ER when the configuration received from the master is bad (configuration error).
		Blinks in time with ER when the configuration is bad
DE	yellow	DE (Data exchange) indicates Profibus communication activity.

LEDs digital output section   The digital output section is provided with 2 LEDs with the following function:

Designation	Color	Explanation
PW	yellow	Indicates that power is available from the Profibus section (Power).
ER	red	Is turned on at short circuit, overload or over temperature

Profibus RS485 interface

A 9pin RS485 interface is used to connect your Profibus slave to your Profibus.

The following diagram shows the pin assignment for this interface:
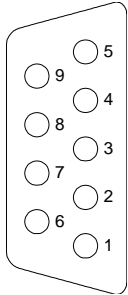
Pin	Assignment
1	shield
2	n.c.
3	RxD/TxD-P
4	CNTR-P
5	GND
6	5V (max. 70mA)
7	n.c.
8	RxD/TxD-N
9	n.c.

Output unit circuit and block diagram

The DC 24V power supply to the output section is provided internally by the power supply of the slave section.
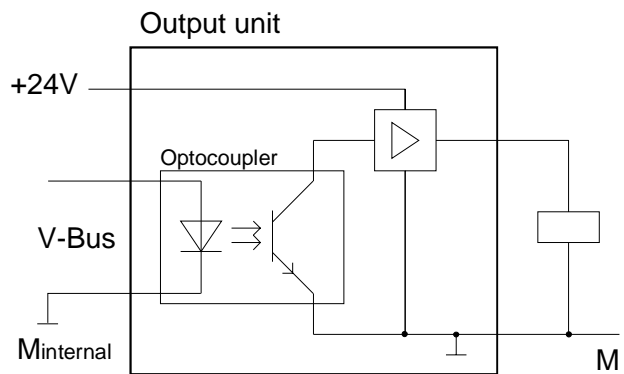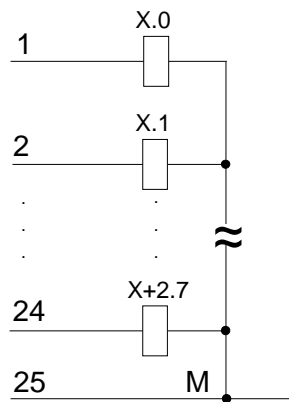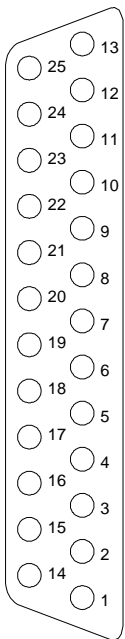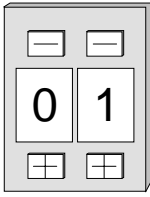
Address selector   This address selector is used to configure the address for the bus coupler.

Addresses may range from 1 to 99. Addresses must be unique on the bus.

The slave address must have been selected before the bus coupler is turned on.

When the address is set to 00 during operation, a once-off image of the diagnostic data is saved to Flash-ROM. Please take care to reset the correct Profibus address, so by the next PowerOn the right Profibus address is used!

Power supply   Every Profibus slave coupler has an internal power supply. This power supply requires DC 24V. In addition to the electronics on the bus coupler, the supply voltage is also used to power any modules connected to the backplane bus. Please note that the maximum current that the integrated power supply can deliver to the backplane bus is 3.5A.

The power supply is protected against reverse polarity and over current.

Profibus and backplane bus are galvanically isolated from each other.

Attention!

If PW is not on when the unit is connected to power, the internal fuse has blown!

Configuration of   Configure the slave like shown below; the project engineering is for all
the outputs   System 200V Profibus slaves identical.

To include the 24 outputs, you should additionally plan the module VIPA 253-2DP20 for the first plug-in location. Seen from the hardware side, the module is directly beside the slave.

IM 253DP - Slave - Block diagram

The following block diagram shows the hardware construction of the bus couplers in principal and the internal communication:

galvanic isolation
(by means of opto couplers and
DC/DC converter)

RS485

Profibus-DP

Data Exchange

Clock

Profibus Controller

Reset

EPROM

Error

Ready

Microcontroller bus

Address selector

Clock

Voltage monitoring

Reset

Microcontroller

System 200V interface

Power

Power supply DC 24V / 5V

24V (terminals)

+5V

System 200V backplane bus
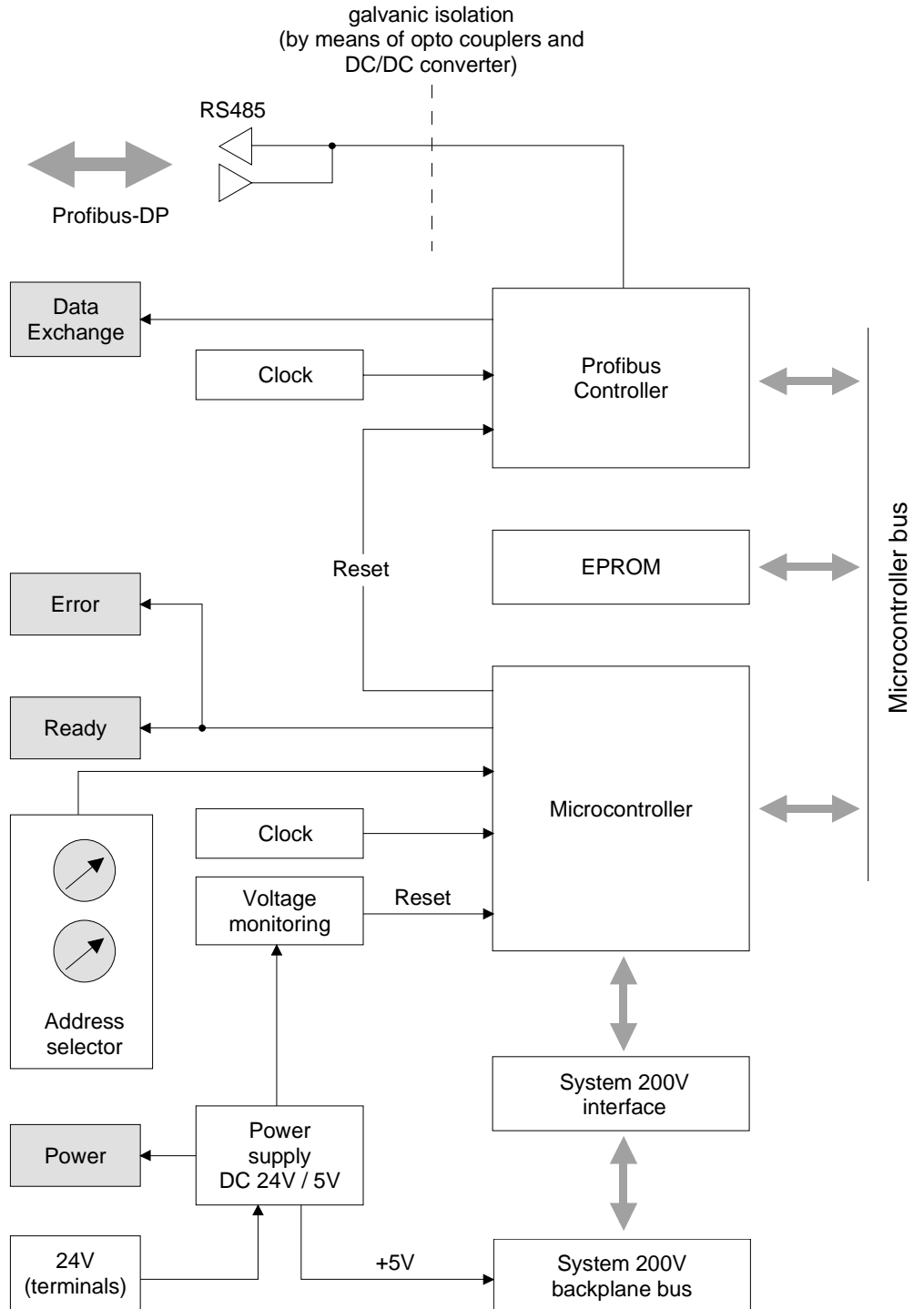
IM 253DP - Slave - Project engineering

General
The module is configured by means of your Profibus master configuration tool. During the configuration you will assign the Profibus slave modules to your master module.

The direct allocation is defined by means of the Profibus address that you have to set at the slave module.

The IM 253 DP-Slaves are projected as "*VIPA_DP200V_2*"-system at the hardware configuration. After the installation of the GSD-file vipa0550.gsd you will find this entry e.g. in the hardware catalog from Siemens under:

Profibus-DP>Additional field devices>I/O>VIPA_System_200V

GSD-file
The IM 253 DP slave is delivered with a disc. The disc contains all GSD- and type files of the Profibus modules from VIPA. The GSD for the IM 253DP is: **vipa0550.gsd**.

Please install the required files from your disc into your configuration tool. Details on the installation of the GSD and/or type files are available from the manual supplied with your configuration tool.

The VIPA WinNCS configuration tool already contains all GSD-files for the VIPA Components!

Deployment IM 253DP, DO 24xDC 24V
At employment of Profibus DP slave combi modules like e.g. the VIPA 253-2DP20, choose "253-2DP20" as module type.

The plug-in location 1 is mandatory, because the module is, seen from the hardware side, directly beside the slave.

Note
Every change in the arrangement of the modules must be followed by a re-calculation of the bus parameters!

Deployment at a IM 208DP master from VIPA
The project engineering of the IM 253DP slave at the DP master from VIPA is to find in the description to the DP master in this chapter.

Applications with the S7-400 from Siemens

The system S7-400 from Siemens uses double-word addressing for the configuration, i.e. a double-word is assigned to every module during configuration. For digital modules the high bytes of the double-words are not used. You can avoid this problem by using the GSD-file for the S7-400 from Siemens. This GSD-file is located in the subdirectory ..\S7-400\ on the accompanying disc.

Using the this GSD-file, you first have to configure all digital inputs followed by all the digital outputs and specify the respective sum in bytes. If there are no input or output modules, you enter 0Byte.

When the digital modules have been configured, you continue with the configuration of the analog modules as before.

Note!

Please note that the S7-400 system from Siemens requires the plug-in location number as module parameters for the analog modules. In this case, the first peripheral module is located at plug-in location 0.

Parameterization in a redundant system

The slave section that achieves firstly the DataExchange state (due to the system, this is always the most left one), is automatically the active slave and has the parameterization access at the peripheral modules.

For assigning new parameters to your remote I/O you should notice that you need an active master-slave-system. Before the transfer of new parameters is possible, both slaves must be in WAITPARAM state.

Start-up behavior IM 253DP slave

After power on, the DP slave executes a self test. It controls its internal functions and the communication via the backplane bus. After the error free start-up, the bus coupler switches into the state "ready". In this state, the DP slave gets its parameters from the DP master and, at valid parameters, switches into the state "DataExchange" DE (DE is permanently on).

At communication errors at the backplane bus, the Profibus slave switches into STOP and boots again after app. 2 seconds. As soon as the test has been completed positive, the RD-LED blinks.

IM 253DP - Slave - Parameters

Outline   At deployment of DP slaves presented in this manual there are 4 parameters for configuration that are individually used for every slave.

Parameters   The following parameters are available:

Plug-in location number
For reasons of compatibility to VIPA slaves with revision level 4 or lower, you may here select the start number of the plug-in location numeration. With DP slaves rev. level 5 and higher, this parameter is ignored.
The following values are possible:
0: plug-in location 0 (default)
1: plug-in location 1

Sync Mode
The SYNC-Mode synchronizes the V-Bus cycle (VIPA backplane bus com-munication) and the DP cycle (Profibus-DP communication).
This guarantees that there is one Profibus transmission per V-Bus cycle.
The following values are possible:
Sync Mode off: DP and V-Bus cycle are asynchronous (default)
Sync Mode on: DP and V-Bus cycle are synchronous

Diagnosis
Via this parameter you influence the diagnosis function of the slaves. The following values are possible:
activated: activates the diagnostic function of the slaves (default)
deactivated: deactivates the diagnostic function of the slaves

Redundancy diagnosis
Via this parameter you may influence the redundant diagnosis function of the slaves and it is only accepted with redundant slaves.
The following values are possible:
activated: activates the red. diagnostic function of the slaves (default)
deactivated: deactivates the redundant diagnostic function of the slaves

IM 253DP - Slave - Diagnostic functions

Overview

Profibus-DP provides an extensive set of diagnostic functions for quick error localization. Diagnostic messages are transferred via the bus and collected by the master.

The most recent 100 diagnostic messages along with a time stamp are stored in RAM res. saved to the Flash of every VIPA Profibus slave. These can be analyzed by means of software. Please call the VIPA hotline for this purpose.

Internal diagnostic system messages

The system also stores diagnostic messages like the status "Ready" or "DataExchange". These are not send to the master.

The contents of the diagnostic RAM is saved by the Profibus slave in a Flash-ROM, every time the status changes between "Ready" and "DataExchange". At restart it deposits the data back to the RAM.

Saving diagnostic data manually

You can manually save the diagnostic data in Flash-ROM by changing the address switch to 00 during "DataExchange" for a short while.

Diagnostic message in case of a power failure

If a power failure or a voltage drop is detected, a time stamp is saved in the EEPROM. If there is still enough voltage left, the diagnostic data is transferred to the master.

At the next startup the time stamp in the EEPROM is used to generate an undervoltage/power-off diagnostic message and saved to the diagnostic RAM.

Direct diagnostics at the Profibus slave module

If you are employing VIPA Profibus slaves you may transfer the latest diagnostic data directly from the module into your PC for analysis by means of the download cable and the concerning "Slave Info Tool" software that are available form VIPA.

Diagnostic addition at IM 253DPR

At deployment of a redundant slave, the diagnostic telegram is extended with an 8Byte sized redundant state. This diagnostic addition is not internally stored. By additionally configuring the state module "State byte IM253-2DP50" as last "module" (most right plug-in location), you are able to include 2Byte of the redundant state into the peripheral area.

This virtual state "module" is available from GSD version 1.30 on.

Structure of the Profibus diagnostic data

The length of the diagnostic messages that are generated by the Profibus slave is 23Byte. This is also referred to as the *device related diagnostic data*.

When the Profibus slave sends a diagnostic message to the master, a 6Byte standard diagnostic block and 1Byte header is prepended to the 23Byte diagnostic data:

Byte 0 ... Byte 5	Standard diagnostic data	precedes message to master
Byte 6	Header device related diagnostics	only for Profibus transfers
Byte 7 ... 29	**Device related diagnostic data**	**Diagnostic data that is saved internally**
Byte x... Byte x+8	Redundancy state of a redundant DP slave	is only added at transfer via Profibus and usage of the redundant slave

Standard diagnostic data

Diagnostic data that is being transferred to the master consist of the standard diagnostic data for slaves and a header byte that are prepended to the device related diagnostic bytes. The Profibus standards contain more detailed information on the structure of standard diagnostic data. These standards are available from the Profibus User Organization. The structure of the standard diagnostic data for slaves is as follows:

Byte	Bit 7 ... Bit 0
0	Bit 0: permanently 0
	Bit 1: slave not ready for data exchange
	Bit 2: configuration data mismatch
	Bit 3: slave has external diagnostic data
	Bit 4: slave does not support the requested function
	Bit 5: permanently 0
	Bit 6: bad configuration
	Bit 7: permanently 0
1	Bit 0: slave requires re-configuration
	Bit 1: statistical diagnostics
	Bit 2: permanently 1
	Bit 3: Watchdog active
	Bit 4: Freeze-command was received
	Bit 5: Sync-command was received
	Bit 6: reserved
	Bit 7: permanently 0
2	Bit 0 ... Bit 6: reserved
	Bit 7: diagnostic data overflow
3	Master address after configuration
	FFh: slave was not configured
4	Ident number high byte
5	Ident number low byte

Header for device related diagnostics

This byte is only prepended to the device related diagnostic data when this is being transferred via Profibus.

Byte	Bit 7 ... Bit 0
6	Bit 0 ... Bit 5: Length device related diagnostic data incl. Byte 6
	Bit 6 ... Bit 7: permanently 0

Device related diagnostics

Byte	Bit 7 ... Bit 0
7 ... 29	Device related diagnostic data that can be stored internally by the slave for analysis

Structure of the device related diagnostic data in the DP slave

As of revision level 6, all diagnostic data that is generated by the Profibus slave is stored in a ring-buffer along with the time stamp. The ring-buffer always contains the most recent 100 diagnostic messages.

You can analyze these messages by means of the "Slave Info Tool".

Since the standard diagnostic data (Byte 0 ... Byte 5) and the header (Byte 6) are not stored, the data in Byte 0 ... Byte 23 corresponds to Byte 7 ... Byte 30 that is transferred via Profibus.

The structure of the device related diagnostic data is as follows:

Byte	Bit 7 ... Bit 0
0	Message
	0Ah: DP parameter error
	14h: DP configuration error length
	15h: DP configuration error entry
	1Eh: undervoltage/power failure
	28h: V-bus parameterization error
	29h: V-bus initialization error
	2Ah: V-bus bus error
	2Bh: V-bus delayed acknowledgment
	32h: diagnostic alarm System 200
	33h: process alarm System 200
	3Ch: new DP address was defined
	3Dh: slave status is ready (only internally)
	3Eh: slave status is DataExchange (only internally)
1	Module no. or plug-in location
	1 ... 32: module no. or plug-in location
	0: module no. or plug-in location not available
2 ... 23	Additional information for message in Byte 0

**Overview of
diagnostic
messages**

The following section contains all the messages that the diagnostic data can consist of. The structure of Byte 2 ... Byte 23 depends on the message (Byte 0). When the diagnostic data is transferred to the master via Profibus, Byte 7 of the master corresponds to Byte 0 of the slave. The specified length represents the "length of the diagnostic data" during the Profibus data transfer.

0Ah   *DP parameter error*   Length: 8

The parameter telegram is too short or too long

Byte	Bit 7 ... Bit 0
0	0Ah: DP parameter error
1	Module no. or plug-in location
	1 ... 32: module no. or plug-in location
	0: module no. or plug-in location not available
2	Length user parameter data
3	Mode
	0: standard mode
	1: 400-mode
4	Number of digital modules (slave)
5	Number of analog modules (slave)
6	Number of analog modules (master)

14h   *DP configuration error - length*   Length: 6

Depending on the mode, the length of the configuration message is compared to the length of the default configuration (modules detected on the V-Bus).

Byte	Bit 7 ... Bit 0
0	14h: DP configuration error - length
1	Module no. or plug-in location
	1 ... 32: module no. or plug-in location
	0: module no. or plug-in location not available
2	Configuration data quantity (master)
4	Configuration data quantity (slave)
3	Mode
	0: Standard mode
	1: 400-mode

15h   *DP configurations error - entry*   Length: 6

Depending on the mode and when the length of the configuration message matches the length of the default configuration the different entries in the configuration message are compared to the default configuration.

Byte	Bit 7 ... Bit 0
0	15h: DP configuration error - entry
1	Module no. or plug-in location
	1 ... 32: module no. or plug-in location
	0: module no. or plug-in location not available
2	Configuration byte master (module identifier)
4	Configuration byte slave (module identifier)
3	Mode
	0: Standard mode
	1: 400-mode

1Eh   *Undervoltage/power failure*   Length: 2

A time stamp is saved immediately to the EEPROM when a power failure or a voltage drop is detected. If there is still enough voltage, the diagnostic data is transferred to the master.

At the next restart, the time stamp in the EEPROM is used to generate an undervoltage/power-off diagnostic message that is saved in the diagnostic RAM.

Byte	Bit 7 ... Bit 0
0	1Eh: Undervoltage/power failure

28h   *V-bus configuration error*   Length: 3

The configuration for the specified plug-in location failed.

Byte	Bit 7 ... Bit 0
0	28h: V-bus configuration error
1	Module no. or plug-in location
	1 ... 32: module no. or plug-in location
	0: module no. or plug-in location not available

29h   *V-bus initialization error*   Length: 2

General backplane bus error

Byte	Bit 7 ... Bit 0
0	29h: V-bus initialization error

2Ah   *V-bus bus error*   Length: 2

Hardware error or module failure

Byte	Bit 7 ... Bit 0
0	2Ah: V-bus error

2Bh   *V-bus delayed acknowledgment*   Length: 2

Reading or writing from/to digital modules failed

Byte	Bit 7 ... Bit 0
0	2Bh: V-bus delayed acknowledgment

32h   *System 200V diagnostic alarm*   Length: 16

Byte	Bit 7 ... Bit 0
0	32h: System 200V diagnostic alarm
1	Module no. or plug-in location
	1 ... 32: module no. or plug-in location
	0: module no. or plug-in location not available
2 ... 14	Data diagnostic alarm

33h   *System 200V process alarm*   Length: 16

Byte	Bit 7 ... Bit 0
0	33h: System 200V process alarm
1	Module no. or plug-in location
	1 ... 32: module no. or plug-in location
	0: module no. or plug-in location not available
2 ... 14	Process alarm data

3Ch   *New DP address assigned*   Length: 2

When the slave has received the service with "Set Slave Address" it sends the respective diagnostic message and re-boots. The slave will then become available on the bus under the new address.

Byte	Bit 7 ... Bit 0
0	3Ch: new DP address has been assigned

3Dh   *Slave status is READY*   Length: none (internal only)

The READY status of the slave is only used internally and is not transmitted via the Profibus.

Byte	Bit 7 ... Bit 0
0	3Dh: slave status is READY

3Eh   *Slave status is DataExchange*   Length: none (only internal)

The DataExchange status of the slave is only used internally and is not transmitted via the Profibus.

Byte	Bit 7 ... Bit 0
0	3Eh: slave status is DataExchange

Redundancy state at deployment of IM 253DPR

At deployment of a redundant slave, the diagnostic message is expanded for 8Byte data with the redundancy state. This diagnostic addition is not stored in the internal diagnostic buffer. The redundancy state has the following structure:

Redundancy state

Byte	Description
X	08h: length of redundancy state permanent at 8
X+1	80h: type of redundancy state
X+2	00h: reserved, permanent 00h
X+3	00h: reserved, permanent 00h
X+4	00h: reserved, permanent 00h
X+5	Red_State slave that communicates with the respective master)
	Bit 0 = slave is backup slave
	Bit 1 = slave is primary slave
	Bit 2 = reserved
	Bit 3 = reserved
	Bit 4 = slave is in DataExchange
	Bit 5 = reserved
	Bit 6 = reserved
	Bit 7 = reserved
X+6	Red_State of second slave
X+7	00h: reserved, permanent 00h

Include the redundancy state into the peripheral area

As from GSD version 1.30 from VIPA, the virtual module "State byte IM253-2DP50" is available in the hardware catalog. When using this module during the project engineering. You may define an address range of 2Byte where the Red_State byte of both slaves shall be stored.

Please regard that you have to configure this module always at the last plug-in location, otherwise the slave will throw a parameterization error.

(De)activate diagnosis

Via the parameterization window of the slaves, you may influence the diagnostic functions by activating res. deactivating diagnosis or the redundancy state.

Installation guidelines

Profibus in general

- The VIPA Profibus-DP network must have a linear structure.
- Profibus-DP consists of minimum one segment with at least one master and one slave.
- A master is always used in conjunction with a CPU.
- Profibus supports a max. of 125 participants.
- A max. of 32 devices are permitted per segment.
- The maximum length of a segment depends on the transfer rate :

9.6 ... 187.5kBaud	$\rightarrow$	1000m
500kBaud	$\rightarrow$	400m
1.5MBaud	$\rightarrow$	200m
3 ... 12MBaud	$\rightarrow$	100m

- The network may have a maximum of 10 segments. Segments are connected by means of repeaters. Every repeater is also seen as participant on the network.
- All devices communicate at the same baud rate, slaves adapt automatically to the baud rate.

Fiber optic system

- Only one fiber optic master may be used on one line.
- Multiple masters may be deployed with a single CPU as long as they are located on the same backplane bus (please take care not to exceed the max. current consumption).
- The maximum length of a FO link between two slaves may not exceed 300m with HCS-FO and 50m with POF-FO, independent from the baud rate.
- The number of bus participants depends on the baud rate:

$\leq$ 1.5MBaud	$\rightarrow$	17 participants incl. master
3MBaud	$\rightarrow$	15 participants incl. master
6MBaud	$\rightarrow$	7 participants incl. master
12MBaud	$\rightarrow$	4 participants incl. master

- The bus does not require termination.

Note!

You should place covers on the unused sockets on any fiber optic device (e.g. the jack for the following participant at the bus end) to prevent being blinded by the light or to stop interference from external light sources. You can use the supplied rubber stoppers for this purpose. Insert the rubber stoppers into the unused openings on the FO interface.

Electrical system

- The bus must be terminated at both ends.
- Masters and slaves may be installed in any combination.

Combined system

- Any FO master may only be installed on an electrical system by means of an **O**ptical **L**ink **P**lug, i.e. slaves must not be located between a master and the OLP.
- Only one converter (OLP) is permitted between any two masters.

Installation and integration with Profibus

- Assemble your Profibus system using the required modules.
- Adjust the address of the bus coupler to an address that is not yet in use on your system.
- Transfer the supplied GSD-file into your system and configure the system as required.
- Transfer the configuration into your master.
- Connect the Profibus cable to the coupler and turn the power supply on.

Note!

The Profibus line must be terminated with ripple resistor. Please ensure that the last participant the line is terminated by means of a terminating resistor.

The FO Profibus system does not require termination!

Profibus using RS485

Profibus employs a screened twisted pair cable based on RS485 interface specifications as the data communication medium.

The following figure shows a Profibus connection using RS485 together with the required terminating resistors:
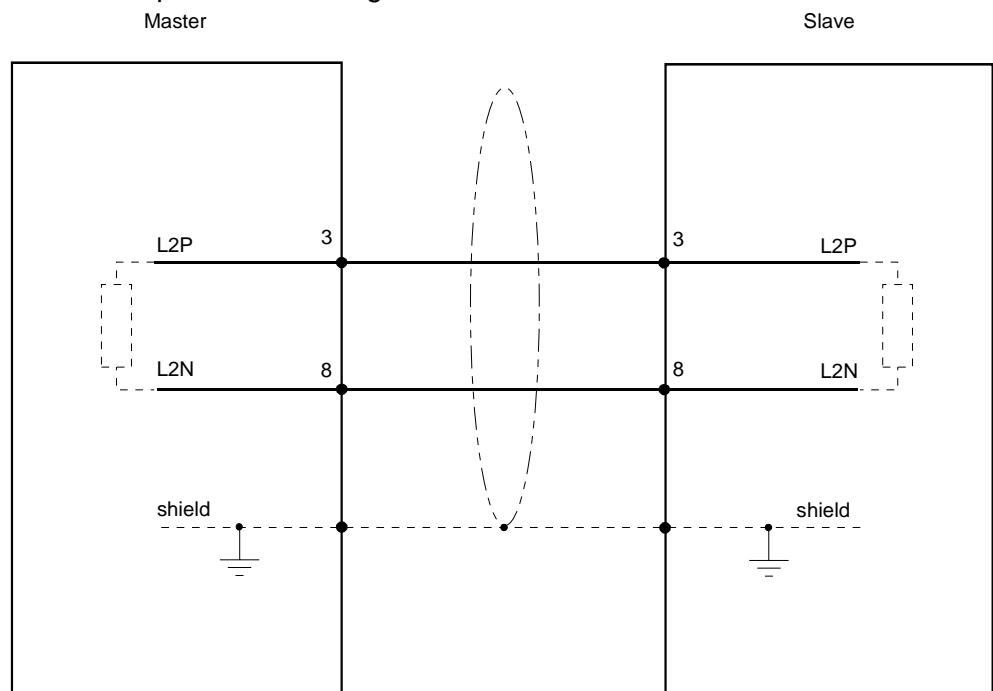
Bus connector

In systems with more than two stations all partners are wired in parallel. For that purpose, the bus cable must be feed-through uninterrupted.

Via the order number VIPA 972-0DP10 you may order the bus connector "EasyConn". This is a bus connector with switchable terminating resistor and integrated bus diagnosis.

all in mm
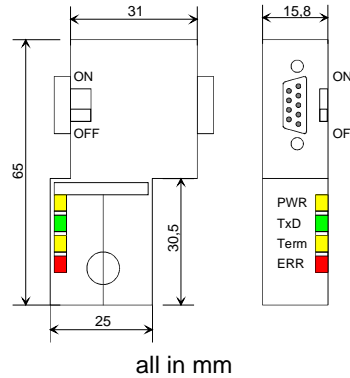
To connect this plug, please use the standard Profibus cable type A with solid wire core according to EN50170.

Under the order no. 905-6AA00 VIPA offers the "EasyStrip" de-isolating tool, that makes the connection of the EasyConn much easier.

all in mm
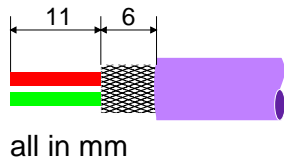
Attention!

The bus cable has always to be terminated at the bus ends with the ripple resistor to avoid reflections and therefore communication problems!

Termination

The bus connector is provided with a switch that is used to activate a terminating resistor.
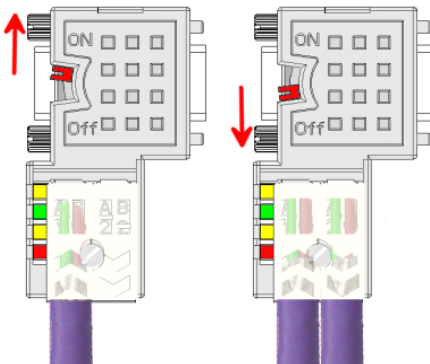
Attention!

The terminating resistor is only effective, if the connector is installed at a slave and the slave is connected to a power supply.

Note!

A complete description of installation and deployment of the terminating resistors is delivered with the connector.

Profibus with FO link

The fiber optic cable/optical waveguide (FO) transfers signals by means of electromagnetic waves at optical frequencies. Total reflection will occur at the point where the coating of the fiber optic cable meets the core since the refractive index of this material is lower than that of the core. This total reflection prevents the ray of light escaping from the fiber optic conductor and it will therefore travel to the end of the fiber optic cable.

The FO cable is provided with a protective coating.

The following diagram shows the construction of a fiber optic cable:

[1]   Fiber coating
[2]   Protective cover
[3]   Fiber core
[4]   Ray of light
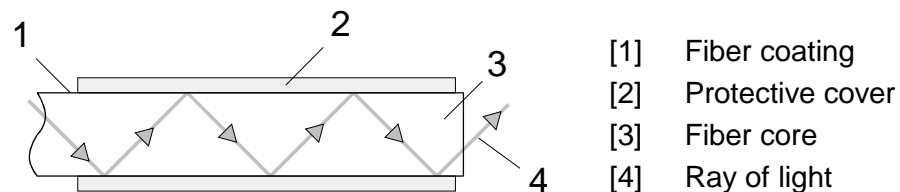
The fiber optic system employs pulses of monochromatic light at a wavelength of 650nm. If the fiber optic cable is installed in accordance with the manufacturers guidelines, it is not susceptible to external electrical interference. Fiber optic systems have a linear structure. Each device requires two lines, a transmit and a receive line (dual core). It is not necessary to provide a terminator at the last device.

The Profibus FO network supports a maximum of 126 devices (including the master). The maximum distance between two devices is limited to 50m.

Advantages of FO over copper cables

- wide bandwidth
- low attenuation
- no cross talk between cores
- immunity to external electrical interference
- no potential difference
- lightning protection
- may be installed in explosive environments
- low weight and higher flexibility
- corrosion resistant
- safety from eavesdropping attempts

Fiber optic cabling under Profibus

The VIPA fiber optic Profibus coupler employs dual core plastic fiber optic cable as the communication medium. Please keep the following points in mind when you connect your Profibus FO coupler: predecessor and successor must always be connected by means of a dual core FO cable.

The VIPA bus coupler carries 4 FO connectors. The communication direction is defined by the color of the connector (dark: receive line, light: send line).

When the bus has been turned on, you recognize the receive line by the light, while the darker line is the send line. VIPA recommends to use the FO connector supplied by Hewlett Packard (HP). These connectors are available in two different versions:

FO connector with crimp-type assembly

FO connector without crimp-type assembly

FO connector with crimp-type assembly

Connection for predecessor

reception

transmission

Connection for successor

transmission

reception

7mm

Pressring

1,5 mm

Cut protruding fiber using a knife to leave app. 1.5 mm. Polish the ends to a flat surface using the HP polishing set

Crimp pressring here with crimping tool

HP order no.:   HFBR-4506 (gray)

HFBR-4506B (black)

Advantages: polarity protection.

You can only install the connector so that the side of the connector shown here faces to the right.

Disadvantages: special tool required

You require a special crimping tool from Hewlett Packard (HP order no.: HFBR-4597) for the installation of the press ring required for strain relief.

Connector installation

You install the connector by first pushing the press-ring onto the dual core FO cable. Separate the two cores for a distance of app. 5cm. Use a stripper to remove the protection cover for app. 7mm.

Insert the two cores into the plug so that the ends of the fiber optic cable protrude at the front. Keep an eye on the polarity of the cores (s.a.).

Push the press-ring onto the plug and crimp the ring by means of the crimp tool. The description of how to trim and polish of the ends of the FO cores is identical to the 2nd connector type shown below.

FO connector without crimp-type assembly

Connection for predecessor

reception →

transmission ←

Connection for successor

transmission ←

reception →

7mm

FO cable

1,5 mm

Cut protruding fiber using a knife to leave app. 1.5 mm. Polish the ends to a flat surface using the HP polishing set .
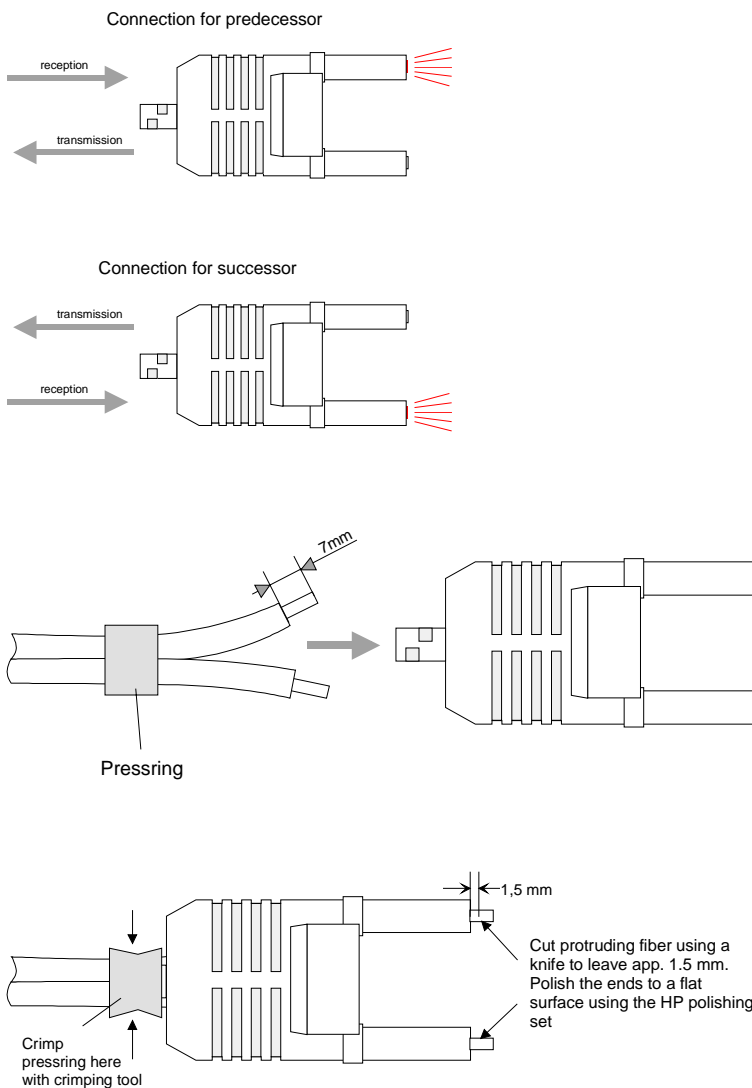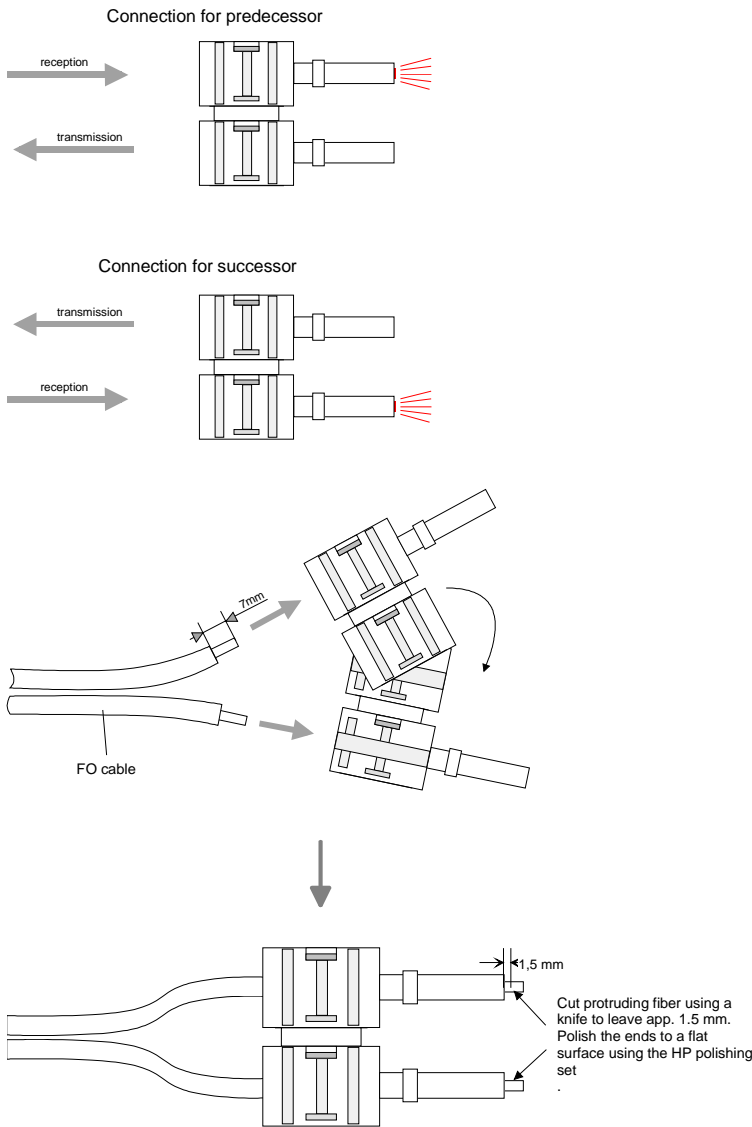
Cutting and polishing the ends of the FO cable

Polishing tool

Abrasive paper
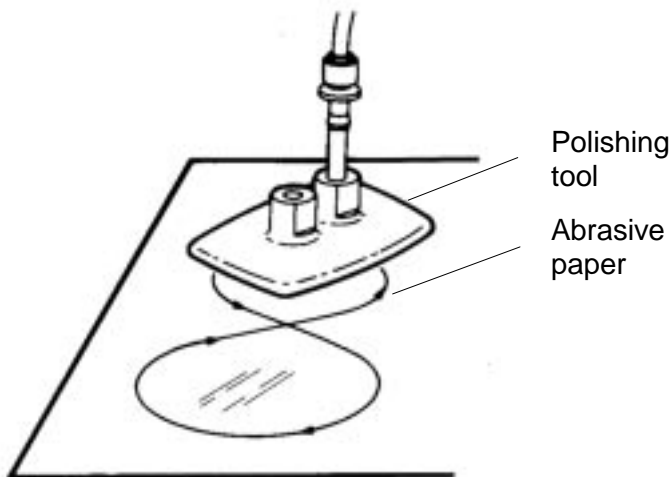
HP order no.:   HFBR-4531

Advantages: no special tool required.

This shell of this type of plug is provided with an integrated strain relief.

The fiber optic cable is clamped securely when you clip the two sections of the shell together.

This system can be used to prepare simplex and duplex plugs. You can assemble a simplex plug by clipping the two sections of a shell together and a duplex plug by clipping two plugs together.

Disadvantages: no protection against polarity reversal.

These plugs can be inserted in two positions. Please check the polarity when you have turned on the power. The light emitting fiber is the fiber for reception.

Assembling a plug:

2 complete plugs are required to assemble a duplex plug. Separate the two cores for a distance of app. 5cm. Use a stripper to remove the protection cover so that app. 7mm of the fiber is visible.

Insert the two cores into the plug so that the ends of the fiber optic cable protrude at the front. Keep an eye on the polarity of the cores (s.a.).

Cut protruding fiber using a knife so that app. 1.5mm are still visible. Polish the ends to a flat surface using the HP polishing set (HP order no.:HFBR-4593).

Insert the plug into the polishing tool and polish the fiber to achieve a plane surface as shown in the figure. The instructions that are included with the set contain a detailed description of the required procedure.

**Example for a
Profibus network**

**One CPU and
multiple master
connections**

The CPU should have a short cycle time to ensure that the data from slave no. 5 (on the right) is always up to date. This type of structure is only suitable when the data from slaves on the slow trunk (on the left) is not critical. You should therefore not connect modules that are able to issue alarms.

CPU with
short cycle time

slow due to the large number of
interfaces, i.e. transferred data is
not always up to date

subject to fast updates.
For short CPU cycle times the data
of IM-interface no. 5 is always up to date.

CPU   IM 208   IM 208

1,2,
3,4   5

IM 253   Input/output periphery

1

IM 253   Input/output periphery

5

IM 253   Input/output periphery

2

IM 253   Input/output periphery

3

IM 253   Input/output periphery

4

Multi master system

Multiple master connections on a single bus in conjunction with a number of slaves:

Expansion options
- master only by means of electrical connections
- slaves by means of electrical or optical connections

Expansion options
- master only by means of electrical connections
- slaves by means of electrical or optical connections

Optical Profibus

CPU   IM 208

1,2,
3,4

IM 253

Input/output periphery

1

IM 253

Input/output periphery

2

IM 253

Input/output periphery

3

IM 253

Input/output periphery

4

Expansion options
- slaves optical
- slaves electric

**Links to other masters via optical
or electrical links (by means of an optical
link plug) are NOT permitted!**

Combination of optical and electrical Profibus

In a combined fiber optical Profibus system only one converter (OLP) may be installed between any two masters!

Ⓐ **Bus connector RS 485**
This bus connector is provided to allow connection of an optical (via OLP) or electrical device to the Profibus line.

Ⓑ **OLP Optical Link Plug**
The OLP provides the interface between the optical and the electrical Profibus network.
The converter is bi-directiona.

Expandable by:
- master - only electrical
- slaves - electrical

This connection must only be used for electrical or optical connections to slaves!

Commissioning

Overview
- Assemble your Profibus system.
- Configure your master system.
- Transfer the configuration into your master.
- Connect the master and slave modules with the Profibus.
- Turn the power supply on.

Installation

Assemble your Profibus system using the wanted modules.

Every Profibus slave coupler has an internal power supply. This power supply requires an external DC 24V power supply. In addition to the circuitry of the bus coupler, the voltage supply is also used to power any modules connected to the backplane bus.

Profibus and backplane bus are galvanically isolated from each other.

Addressing

Adjust the address of every Profibus slave module as required.

Configuration in the master system

Configure your Profibus master in your master system. You can use the WinNCS of VIPA for this purpose.

Transferring your project

A number of different transfer methods are employed due to the fact that a number of different hardware versions of the VIPA Profibus master modules are existing. These transfer methods are described in the master configuration guide for the respective hardware version.

Connecting a system by means of Profibus

In a system with more than one station all stations are wired in parallel. For this reason the bus cable must be feed-through uninterrupted.

You should always keep an eye on the correct polarity!

Note!

To prevent reflections and associated communication problems the bus cable has always to be terminated with its ripple resistor!

Using the diagnostic LEDs

The following example shows the reaction of the LEDs for different types of network interruption.
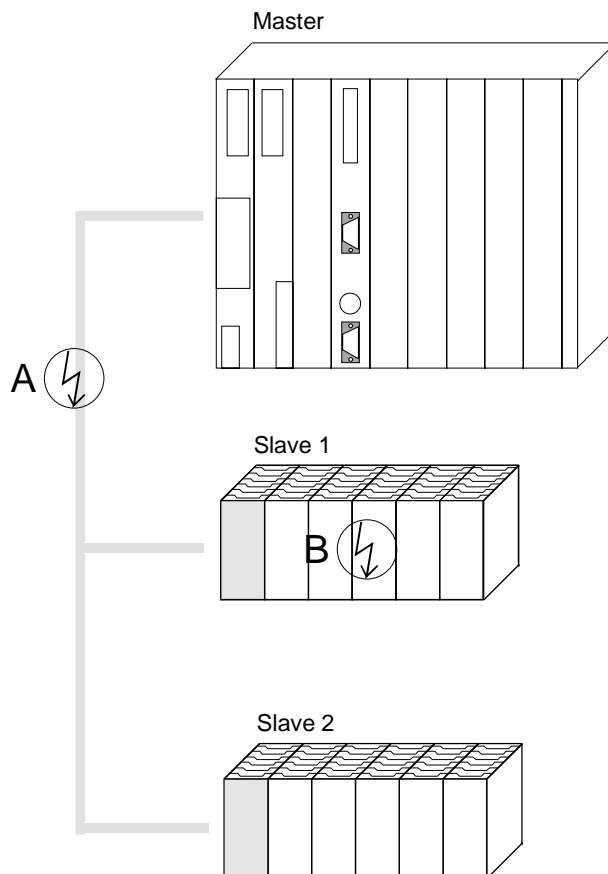
Interruption at position A
The Profibus has been interrupted.

Interruption at position B
Communication via the backplane bus has been interrupted.

LED slave 1	Position of interruption	
LED	A	B
RD	blinks	off
ER	off	on
DE	off	off

LED slave 2	Position of interruption	
LED	A	B
RD	blinks	on
ER	off	off
DE	off	on

Sample projects for Profibus communication

Example 1

Problem

The following example describes a communication between a master and a slave system.

The master system consists of a CPU 21x (here CPU 214-1BA02) and a DP master IM 208DP. This system communicates via Profibus with a IM 253DP and an output module.

Via this system, counter values should be exchanged via Profibus and monitored at the output module. The counter values have to be created in the CPU.

Problem in detail

The CPU has to count from FFh to 00h and transfer the counter value cyclically into the output area of the Profibus master. The master sends this value to the DP slave. The received value shall be monitored at the output module (at address 0).
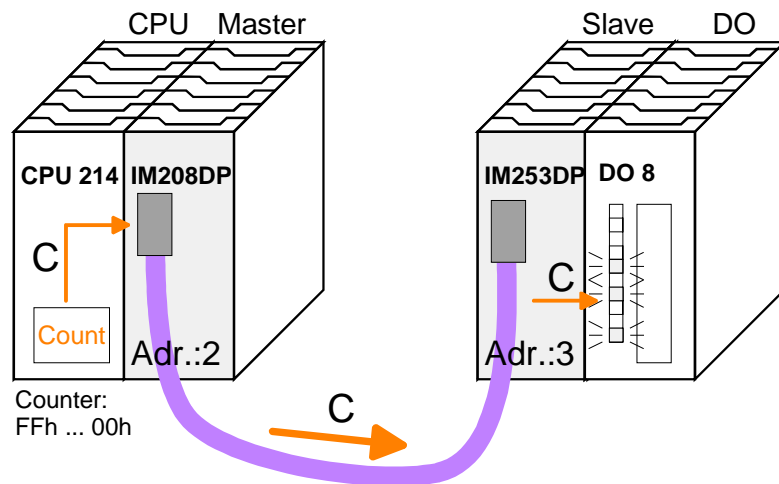
Project data

CPU 214 and IM 208DP (Master)

Counter value: MB 0 (FFh ... 00h)

Profibus address: 2

IM 253DP and DO (Slave)

Profibus address: 3

Output area: Address 0, length: 1 Byte

**Engineering
IM 208DP**

To be compatible with the STEP®7 projecting tool from Siemens, you have to execute the following steps for the System 200V:

- Start the Hardware configurator from Siemens
- Install the GSD-file vipa_21x.gsd
- Project a CPU 315-2DP with DP master (master address 2)
- Add a Profibus slave **"VIPA_CPU21x"** with address 1.
- Include the CPU **214-1BA02** at plug-in location 0.
- Include the DP master 208-1DP01 at plug-in location 1.

To connect your IM 253DP, you have to execute the following steps after including the GSD-file vipa0550.gsd:

- Add the Profibus slave **"VIPA_DP200V_2"** with address 3.
  You will find the DP-Slave in the hardware catalog from Siemens under:
  Profibus-DP>Additional field devices>I/O>VIPA_System_200V
- Include the digital output module 222-1BF00 at plug-in location 0.
- Assign the output address 0.
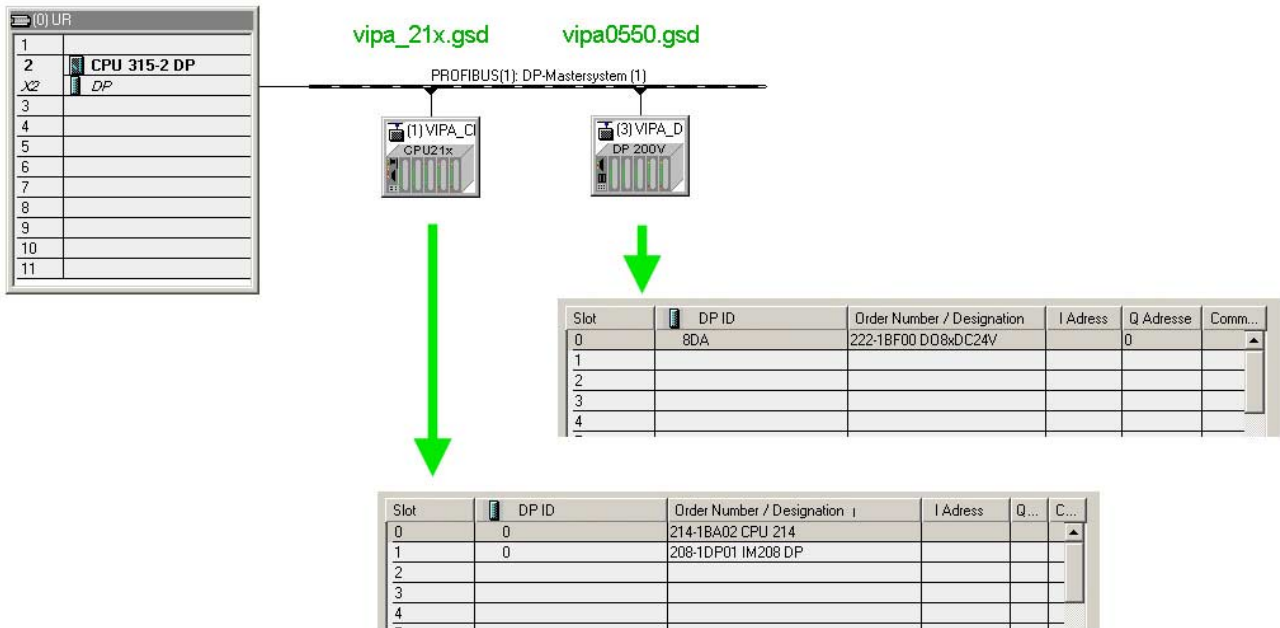
**User application
in the CPU**

For the user application in the CPU, we use the OB35. The OB35 is a time OB, where the call cycle is defined in the CPU properties.

OB 35 (Time-OB)

```
L    MB   0     counter from FFh to 00h
L    1
-I
T    MB   0     remember new counter value
T    AB   0     transfer new counter value to output byte 0
                via Profibus

BE
```

The call cycle of the OB35 may be defined in the properties of your CPU 315-2DP under *prompter alarm*. Type for example 100ms.

**Transfer and
execute project**

Now the programming is complete. Transfer your project into the CPU and execute the program.

- Connect your PU res. PC with your CPU via MPI.

  If your PU doesn't support MPI, you may use the VIPA "Green Cable" to establish a point-to-point connection.

  The "Green Cable" has the order number VIPA 950-0KB00 and may only be used with VIPA CPUs of the Systems 100V, 200V, 300V and 500V. For the employment, the following settings are required:

  - Choose the interface parameterization „PC Adapter (MPI) in your project engineering tool under **Options** > *Configure PU/PC interface.* If needed, you have to add this first.
  - Click on [Properties] and set the wanted COM port and the baud rate 38400 under "Local interface".
- Configure the MPI-interface of your PC.
- Via **PLC** > *Load to module* you transfer your project into the CPU.
- If you want to save your project on MMC additionally, plug-in a MMC and transfer your user application via **PLC** > *Copy RAM to ROM*.

  During the write process the "MC"-LED at the CPU is blinking. Due to the system, the completion of the write operation arrives too soon. It is only completed when the LED has been extinguished.

As soon as CPU and DP master are in RUN, the counter values are transferred via Profibus and monitored at the output module of the DP slave.

Example 2

Problem

This example shows a communication between a CPU 21x (here CPU 214-1BA02) with IM 208 DP master and a CPU 21xDP (CPU 214-2BP02).

Via this system, counter values should be exchanged via Profibus and monitored at the output module of the respective partner.

Problem in detail

The CPU 214 has to count from FFh to 00h and transfer the counter value cyclically into the output area of the Profibus master. The master sends this value to the DP slave of the CPU 214DP.

The received value shall be stored in the input periphery area of the CPU and monitored via the backplane bus at the output module (at address 0).

Vice versa, the CPU 214DP has to count from 00h to FFh, store the value in the output area of the CPU slave and transfer it to the master via Profibus.

This value is monitored at the output module of the CPU 214 (address 0).
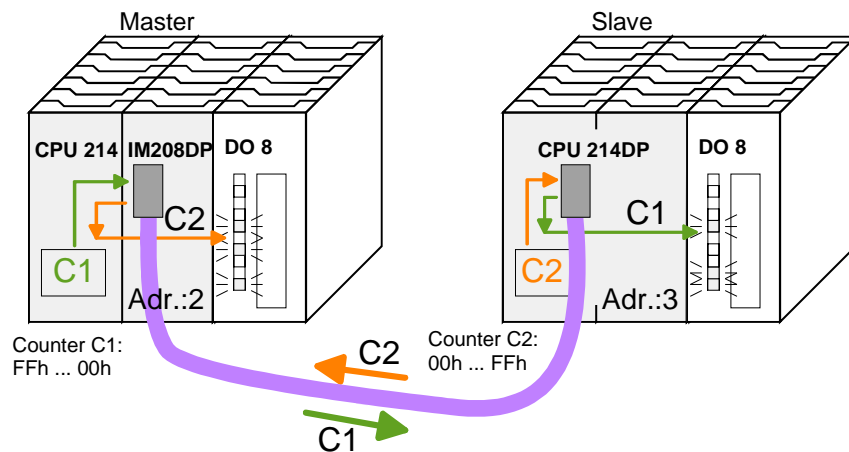
Project data

CPU 214 and DP-Master

Counter value:	MB 0 (FFh ... 00h)	
Profibus address:	2	
Input area:	Address 10	Length: 2 Byte
Output area:	Address 20	Length: 2 Byte

CPU 214DP

Counter value:	MB 0 (00h...FFh)	
Input area:	Address 30	Length: 2 Byte
Output area:	Address 40	Length: 2 Byte
Parameter data:	Address 800	Length: 24 Byte (fix)
Diagnostic data:	Address 900	Length: 6 Byte (fix)
Status data:	Address 1020	Length: 2 Byte (fix)
Profibus address:	3	

Engineering CPU 214 of the DP master

To be compatible with the STEP®7 projecting tool from Siemens, you have to execute the following steps for CPU 214 and DP master:

- Start the Hardware configurator from Siemens
- Install the GSD-file vipa_21x.gsd
- Project a CPU 315-2DP with DP master (master address 2)
- Add a Profibus slave **"VIPA_CPU21x"** with address 1.
- Include a CPU **214-1BA02** at plug-in location 0 of the slave system
- Include the DP master 208-1DP01 (place holder) at plug-in location 1 and include the output module 222-1BF00 at plug-in location 2.
- Give the output module 222-1BF00 at plug-in location 0.

Profibus link-up of the CPU 214DP

To connect your real CPU 214DP, you have to execute the following steps after including the GSD-file vipa04d5.gsd:

- Add the Profibus slave **"VIPA_CPU2xxDP"** (address 3)
- Include the "2 Byte Output" element at plug-in location 0 and choose the output address 20.
- Include the "2 Byte Input" element at plug-in location 1 and choose the input address 10.
- Save your project.
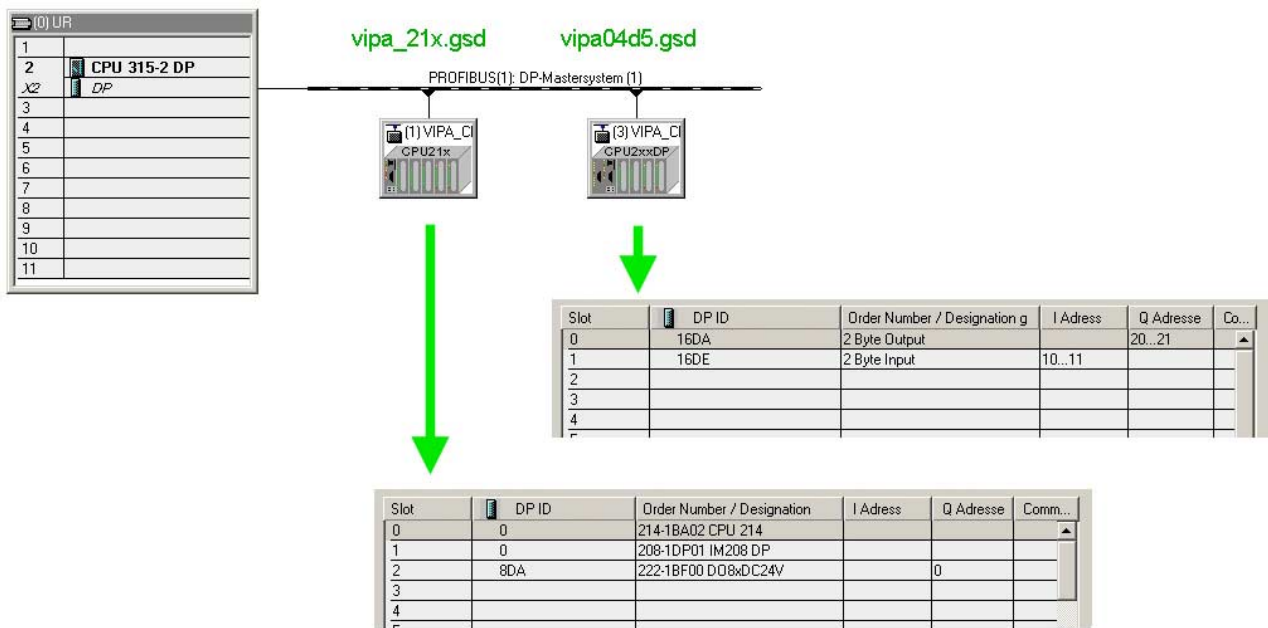
User application in
the CPU 214

The user application in the CPU 21x has 2 tasks to execute, shared
between two OBs:

- Test the communication via control byte.
  Load the input byte from Profibus and monitor the value at the output
  module.

OB 1 (cyclic call)

```
L    B#16#FF
T    QB   20            control byte for slave CPU
L    B#16#FE            load control value 0xFE
L    IB   10            control byte from slave
<>I                     CPU correct?
BEC                     no -> End
                        -----------------------------
                        Data transfer via Profibus
L    IB   11            load input byte 11 (output data
                        of the CPU214DP) and
T    QB   0             transfer to output byte 0
BE
```

- Read counter value from MB 0, decrement it, store in MB 0 and transfer
  it to the CPU 21xDP via Profibus.

OB 35 (Time-OB)

```
L    MB   0             counter from 0xFF to 0x00
L    1
-I
T    MB   0
T    QB   21            Transfer to output byte 21
                        (input data of the CPU214DP)
BE
```

Transfer project and
execute

Transfer your project with the hardware configuration into the CPU and
execute the program. The hardware configuration of CPU 214 and DP
master is now finished.

The following pages describe the project engineering of the CPU 214DP.

Engineering CPU 214DP

To be compatible with the STEP®7 projecting tool from Siemens, you have to execute the following steps for the CPU 214DP:

- Start the Hardware configurator from Siemens
- Install the GSD-file vipa_21x.gsd
- Project a CPU 315-2DP with DP master (master address 2)
- Add a Profibus slave **"VIPA_CPU21x"** with address 1.
- Include the CPU **214-2BP02** at plug-in location 0
- Select the following parameters for the CPU 214DP:
    - Input Add.: 30
    - Input Length: 2
    - Output Add.: 40
    - Output Length: 2
    - Prm. Add.: 800
    - Diag. Add.: 900
    - Stat. Add.: 1020
    - Profibus DP Add.: 3
- Include the output module 222-1BF00 at plug-in location 1 and give them the output address 0.
- Safe your project.
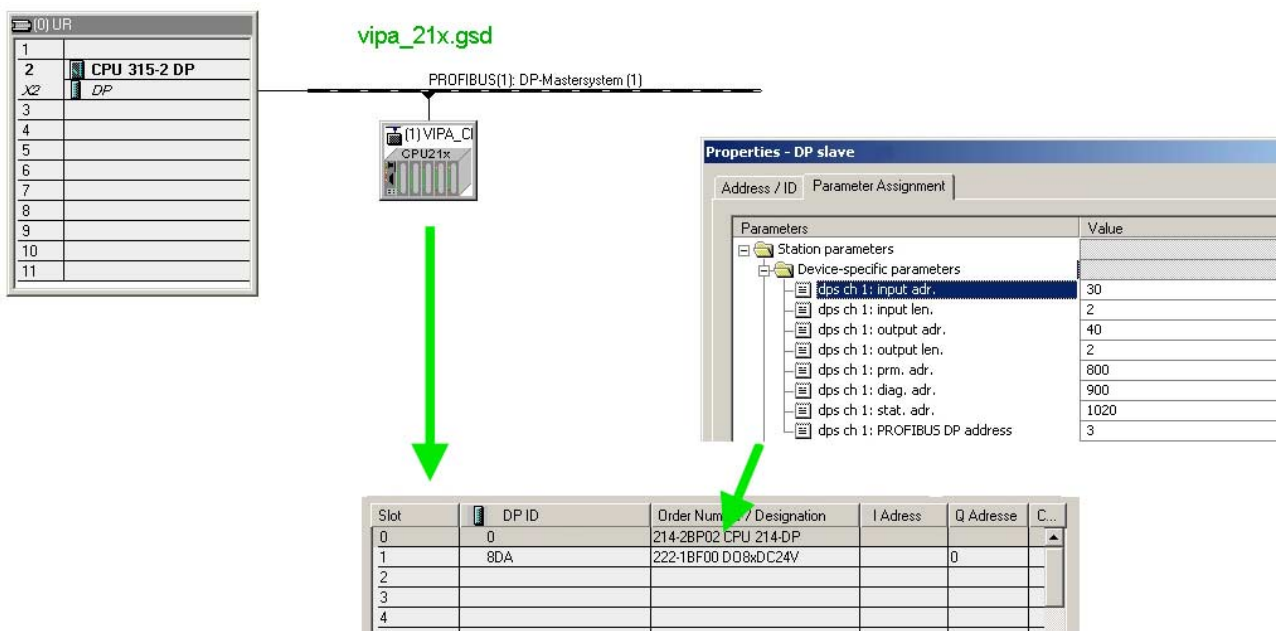
User application
in the CPU 214DP

Like shown above, the user application has 2 tasks, shared between two OBs:

- Load the input byte from the Profibus slave and monitor the value at the output module.

  OB 1 (cyclic call)
  ```
  L    PIW 100              load status data and store it
  T    MW 100               in the bit memory word

  AN   M  100.5             commissioning by DP-Master
  BEC                       successful? no -> End

  A    M  101.4             receive data valid?
  BEC                       no -> End
  L    B#16#FF              load control value and compare with
  L    PIB  30              control byte (1st input byte)
  <>I
  BEC                       receive data not valid


  L    B#16#FE              control byte for Master-CPU
  T    PQB  40
                            ------------------------------
                            Data transfer via Profibus

  L    PIB  31              load periphery byte 31 (input
                            data from Profibus slave) and
  T    IB   0               transfer into output byte 0

  BE
  ```

- Read counter value from MB 0, increment it, store it in MB 0 and transfer it via Profibus to CPU 214.

  OB 35 (Time-OB)
  ```
  L    MB   0               counter from 0x00 to 0xFF
  L    1
  +I
  T    MB   0

  T    PQB  41              Transfer counter value to
                            periphery byte 41 (Output data
                            of the Profibus slave)
  BE
  ```

Transfer project and
execute

Transfer your project with the hardware configuration into the CPU (see Example 1) and execute the program.

As soon as the CPUs and DP master are in RUN, the counter values are transferred via Profibus and monitored at the according output module.

Technical data

**Profibus-DP
master**

IM 208DP

Electrical data	VIPA 208-1DP01
Power supply	via backplane bus
Current consumption	max. 380mA
Isolation	$\geq$ AC 500V
Status indicators	via LEDs on the front
Connections/interfaces	9pin D-type socket Profibus connector
Profibus interface	
Connection	9pin D-type socket
Network topology	Linear bus, active bus terminator at both ends, tap lines are permitted.
Medium	Screened twisted pair cable, under certain conditions unscreened lines are permitted.
Data transfer rate	9.6kBaud to 12MBaud
Total length	100m without repeaters for 12MBaud, 1000m with repeaters
Max. no. of stations	32 stations in any segment without repeaters. Extendible to 126 stations when using repeaters.
Combination with peripheral modules	
max. no of slaves	125
max. no. of input bytes	256 (1024 since V3.0.0)
max. no. of output bytes	256 (1024 since V3.0.0)
Dimensions and weight	
Dimensions (WxHxD) in mm	25.4x76x76
Weight	110g

IM 208DPO

Electrical data	VIPA 208-1DP11
Power supply	via backplane bus
Current consumption	max. 380mA
Isolation	$\geq$ AC 500V
Status indicator	via LEDs on the front
Connections/interfaces	2pin socket for fiber optic cable Profibus interface
Profibus interface	
Connection	2pin socket for fiber optic cable
Network topology	Linear structure with dual FO cable, no bus terminator required
Medium	dual-core fiber optic cable
Data transfer rate	12MBaud
Total length	at POF-FO: max. 50m between stations
	at HCS-FO: max. 300m between stations
Max. no. of stations	17 stations incl. Master (see below)
Combination with peripheral modules	
max. no of slaves	16
max. no. of input bytes	256 (1024 since v3.0.0)
max. no. of output bytes	256 (1024 since v3.0.0)
Dimensions and weight	
Dimensions (WxHxD) in mm	25.4x76x76
Weight	110g

Max. number of stations

The maximum number of DPO participants depends on the baud rate. The table shows the max. number incl. master:

Baud rate	max. no. of participants
$\leq$ 1,5MBaud	17
3MBaud	15
6MBaud	7
12MBaud	4

**Profibus-DP
slave (standard)**

IM 253DP

Electrical data	VIPA 253-1DP00
Power supply	DC 24V (20.4 ... 28.8V), ext. power supply at front
Current consumption	max. 1A
Output current backplane bus	max. 3.5A
Isolation	≥ AC 500V
Status indicator	via LEDs on the front
Connections/interfaces	9pin D-type socket Profibus connector
Profibus interface	
Connection	9pin D-type socket
Network topology	Linear bus, active bus terminator at both ends, tap lines are permitted.
Medium	Screened twisted pair cable, under certain conditions unscreened lines are permitted.
Data transfer rate	9.6kBaud to 12MBaud (automatic adjustment)
Total length	100m without repeater for 12MBaud; 1000m with repeater
Max. no. of stations	32 stations in any segment without repeater. Extendible to 126 stations when using repeaters.
Diagnostic functions	
Standard diagnostics	The last 100 results are stored in Flash-ROM together with a time stamp. This data is accessible by means of a special tool and a cable.
Extended diagnostics	-
Combination with peripheral modules	
max. no of modules	32 (depending on current consumption)
max. digital I/Os	32
max. analog I/Os	16
Dimensions and weight	
Dimensions (WxHxD) in mm	25.4x76x76
Weight	80g

IM 253DPO

Electrical data	VIPA 253-1DP10
Power supply	DC 24V (20.4 ... 28.8V), ext. power supply at front
Current consumption	1A max.
Output current backplane bus	max. 3.5A
Isolation	$\geq$ AC 500V
Status indicator	via LEDs on the front
Connections/interfaces	4pole FO socket Profibus connector
Profibus interface	
Connection	4pole socket for fiber optic cable
Network topology	Linear structure with dual FO cable, no bus termination required
Medium	dual-core fiber optic cable
Data transfer rate	12MBaud
Total length	at POF-FO: max. 50m between stations
	at HCS-FO: max. 300m between stations
Max. no. of stations	17 stations incl. master (see below)
Diagnostic functions	
Standard diagnostics	The last 100 results are stored in Flash-ROM together with a time stamp. This data is accessible by means of a special tool and a cable.
Extended diagnostics	-
Combination with peripheral modules	
max. no of modules	32 (depending on current consumption)
max. digital I/Os	32
max. analog I/Os	16
Dimensions and weight	
Dimensions (WxHxD) in mm	25.4x76x76
Weight	80g

Max. number of stations

The maximum number of DPO participants depends on the baud rate. The table shows the max. number incl. master:

Baud rate	max. no. of participants
$\leq$ 1,5MBaud	17
3MBaud	15
6MBaud	7
12MBaud	4

**Profibus-DP
slave
(redundant)**

IM 253DPR

Electrical data	VIPA 253-2DP50
Power supply	DC 24V (20.4 ... 28.8V), ext. power supply at front
Current consumption	max. 1A
Output current backplane bus	max. 3.5A
Isolation	≥ AC 500V
Status indicator	via LEDs on the front
Connections/interfaces	9pin D-type socket (2x) Profibus connector
2 channels	DP1 / DP2
Profibus interface	
Connection	9pin D-type socket (2x)
Network topology	Linear bus, active bus terminator at both ends, tap lines are permitted.
Medium	Screened twisted pair cable, under certain conditions unscreened lines are permitted.
Data transfer rate	9.6kBaud to 12MBaud (automatic adjustment)
Total length	100m without repeater for 12MBaud; 1000m with repeater
Max. no. of stations	32 stations in any segment without repeater. Extendible to 126 stations when using repeaters.
Diagnostic functions	
Standard diagnostics	The last 100 results are stored in Flash-ROM together with a time stamp. This data is accessible by means of a special tool and a cable.
Extended diagnostics	-
Combination with peripheral modules	
max. no of modules	32 (depending on current consumption)
max. digital I/Os	32
max. analog I/Os	16
Dimensions and weight	
Dimensions (WxHxD) in mm	50.8x76x76
Weight	120g

**Profibus-DP
slave
combination
module**

**IM 253DP
DO 24xDC 24V**

Electrical data	VIPA 253-2DP20
Power supply	DC 24V (20.4 ... 28.8V), ext. power supply at front
Current consumption	max. 5A
Output current backplane bus	max. 3.5A
Isolation	≥ AC 500V
Status indicator	via LEDs on the front
Connections/interfaces	9pin D-type socket Profibus connector
Profibus interface	
Connection	9pin D-type socket
Network topology	Linear bus, active bus terminator at both ends.
Medium	Screened twisted pair cable, under certain conditions unscreened lines are permitted.
Data transfer rate	9.6kBaud to 12MBaud (automatic adjustment)
Total length	100m without repeaters for 12MBaud; 1000m with repeaters
Max. no of stations	32 stations in any segment without repeaters. Extendible to 126 stations when using repeaters.
Status indicator	via LEDs on the front
Combination with peripheral modules	
max. no of modules	31 (depending on current consumption)
max. digital I/Os	31
max. analog I/Os	16
Output unit	
Number of outputs	24
Nominal load voltage	DC 24V (18...35V) supplied internally via Profibus coupler
Output current per channel	1A (sum current max. 4A)
Status indicator	Power (PW) fuse OK, Error (ER) short circuit, overload
Programming data	
Output data	4Byte (3Byte are used)
Dimensions and weight	
Dimensions (WxHxD) in mm	50.8x76x76
Weight	150g

Chapter 3   Interbus

Overview   This chapter contains all the information that you require to connect your System 200V periphery to Interbus.

A description of the Interbus principles is followed by details of the Interbus coupler, its installation and commissioning.

The chapter is concluded by the technical data.

Below follows a description of:

- System overview and Interbus principles
- Hardware structure, deployment and commissioning of the Interbus coupler
- Technical data

System overview

You can use the VIPA Interbus slave to connect up to 16 input and 16 output modules of the System 200V to your Interbus.

At present one Interbus slave module is available from VIPA.
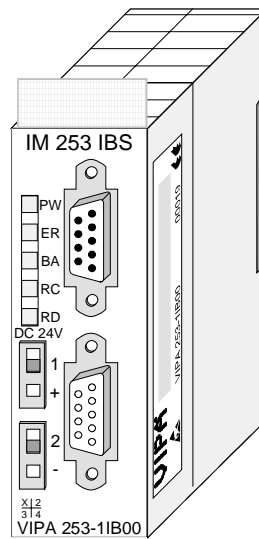
Order data

Order number	Description
VIPA 253-1IB00	Interbus Slave

Principles

General

Interbus is a pure master/slave system that has very few protocol overheads. For this reason it is well suited for applications on the sensor/actuator level. Interbus was developed by PHOENIX CONTACT, Digital Equipment and the Technical University of Lemgo during the 80s. The first system components became available in 1988. To this day the communication protocol has remained virtually unchanged. It is therefore means that it is entirely possible to connect devices of the first generation to the most recent master interfaces (generation 4).

Interbus for sensor and actuator level

The widespread use of Interbus for sensor/actuator level applications may be ascribed to the relatively simple interfacing requirements that are supported by protocol driver chips. These reduce the number of external components required for direct input or output interfacing to a minimum.

Interbus devices are subject to the DIN standard 19258 that defines levels 1 and 2 of the protocol amongst others.

Interbus as shift register

The Interbus system is designed as a ring-type network with a central master-slave access procedure. It has the structure of a distributed shift register. The different registers of the devices connected to the ring are a portion of this shift register. The master shifts the data through this shift register. The ring structure of the network permits simultaneous transmission and reception of data. Data may be sent in both directions on the ring, which uses a single cable.

ID register

Every Interbus module has an ID register (identification register). This register contains information on the type of module, the number of input and output registers as well as status and error flags.

Interbus master

The Interbus coupler can be used to control the peripheral modules of the System 200V via Interbus. In this case the bus coupler replaces the CPU. The Interbus master reads and writes data from/to inputs and outputs respectively. The master is the link to other systems. Every master can control a maximum of 4096 input/output points. These may be located on the local bus or they may be distributed amongst secondary structures connected by means of bus couplers.

It is possible to connect remote ring systems to the main ring to provide a structured system. These remote ring systems are connected by means of bus terminal modules. You can also use these bus terminal modules for long distance communications.

Restrictions on the data capacity

The hardware overhead for Interbus devices increases in proportion with the width of the data. It is for this reason that the maximum data width was limited to 20Byte input data and 20Byte output data.

Secondary Interbus segments (peripheral busses) can be connected or disconnected by means of the respective bus coupler. For this reason the bus can remain operational even if a fault occurs on a peripheral bus connection. The faulty segment can be disconnected from the bus.

Modes of operation

Interbus has two modes of operation:

- ID cycle
  An ID cycle is issued when the Interbus system is being initialized and also upon request. During the ID cycle the bus master reads the ID register of every module connected to the bus to generate the process image.

- Data cycle
  The actual transfer of data occurs during the data cycle. During the data cycle the input data from the registers of all devices is transferred to the master and the output data is transferred from the master to the devices. This is a full duplex data transfer.

Communication medium

Although Interbus appears to have a simple linear structure (a single line linking the master with every module), it has the structure of a ring that includes the outbound line and the return line in a single cable. The last device on the ring closes the loop. On most devices this is an automatic function that occurs when no further line segments are connected.

The physical level of Interbus is based upon the RS422 standard. The signals are connected by means of twisted pair lines. The outbound signal as well as the return signal of Interbus is re-routed via the same cable and every connected station. Communications between 2 devices require a 5core cable due to the ring-based structure and the common logic ground. At a data communications rate of 500kBaud two adjacent stations on the ring may be located at a distance of no more than 400m. The integral repeater function of every device on the bus allows a total distance of up to 13km. The maximum number of devices on the bus is limited to 512.

Process data transfer

Interbus is based upon a ring structure that operates as a cyclic shift register. Every Interbus module inserts a shift register into the ring. The number of I/O points supported by the module determines the length of this shift register. A ring-based shift register is formed due to the fact that all the devices are connected in series and that the output of the last shift register is returned to the bus master. The length and the structure of this shift register depend on the physical construction of the entire Interbus system.

Interbus operates by means of a master-slave access method where the master also provides the link to any high-level control system. The ring-structure includes all connected devices actively in a closed communication loop.

In comparison to client-server protocols where data is only exchanged when a client receives a properly addressed command, Interbus communications is cyclic in nature and data is exchanged at constant inter-vals. Every data cycle addresses all devices on the bus.
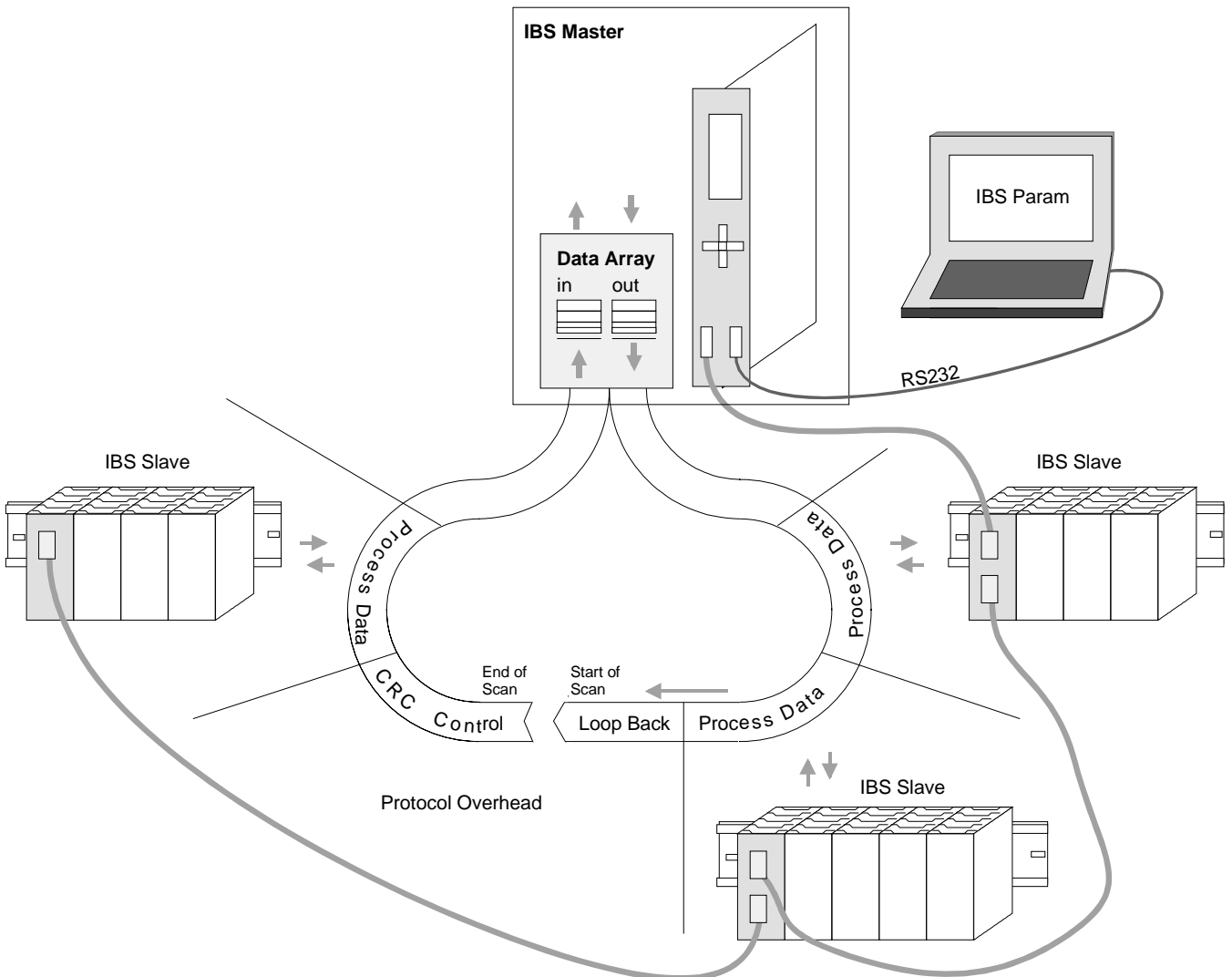
Transfer of control and inspection information

Process data words also contain control and inspection information. This information is only transferred once at the beginning or at the end of the peripheral data of any data cycle. This is why this system is also referred to as a cumulative frame procedure.

Communication principle

The communication principle is independent of the type of data being transferred:

Process data that must be transferred to the periphery is stored in the output buffer of the master in the same sequence as the output stations are connected to the bus. The transfer occurs when the master shifts the "loop-back word" through the ring. Following the loop-back word, all the output data is placed on the bus. This means that the data is shifted through the shift register. The information from the process is returned as input data to the input buffer of the master at the same time as the output data is being sent.

The output data is located at the correct position in the shift registers of the different stations when the entire cumulative frame telegram has been sent and read back again. At this point, the master issues a special control command to the devices on the bus to indicate the end of the data transfer cycle.

When the data check sequence has been processed, output data for the process is transferred from the shift registers. This is stored in the devices connected to the bus and transferred to the respective periphery. At the same time, new information is read from the periphery into the shift registers of the input devices in preparation for the next input cycle. This procedure is repeated on a cyclic basis. This means that the input and output buffers of the master are also updated cyclically. Interbus data communications is therefore full duplex in nature; i.e. both input data and output data are transferred during a single data cycle.

The shift register structure eliminates the need for addresses for every device as is common in other fieldbus systems. The address is defined by the location of the device in the ring.

IM 253IBS - Interbus coupler - Construction

Construction

IM 253 IBS

PW
ER
BA
RC
RD

DC 24V

1
+

2
-

X 2
3 4

VIPA 253-1IB00

1 — [LED status indicators]
2
3
4
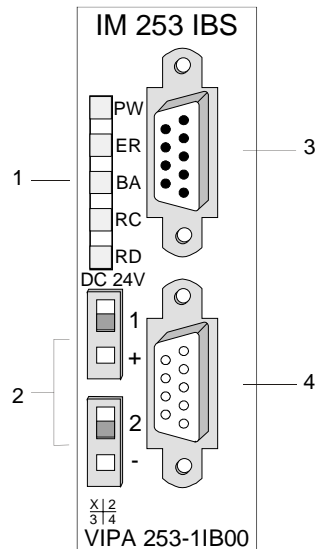
[1]   LED status indicators
[2]   Power supply connector for
      the external 24V supply
[3]   Interbus plug
      inbound interface
[4]   Interbus socket
      outbound interface

Components

LEDs   The module has a number of LEDs are available for diagnostic purposes
                on the bus. The following table explains the purpose and the color of the
                different LEDs.

Label	Color	Description
PW	green	Power LED
		Indicates that the supply voltage is available.
ER	red	Error
		Application error.
BA	green	Bus active
		The BA LED (bus active) indicates an active Interbus data transfer.
RC	green	Remote bus Check
		The RC LED (remote bus Check) indicates that the connection to the previous Interbus device is OK (on) or that it has been interrupted (off).
RD	red	Remote bus disabled
		The RD LED (remote bus Disabled) indicates that the outbound remote bus has been disabled.

Jacks and plugs   The interfaces for the inbound and the outbound bus lines are located on the front of the module. These consist of 9pin D-type connectors.

The following diagram shows the pin assignment for this interface:

Inbound bus line (9pin D-type plug)
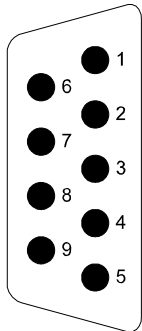
Pin	Assignment
1	DO
2	DI
3	GND1
4	GND $^{*)}$
5	n.c.
6	/DO
7	/DI
8	+5V$^{*)}$ (90 mA)
9	reserved

$^{*)}$ power for the fiber optic converter.
    This voltage is not isolated galvanically!

Outbound bus line (9pin D-type socket)
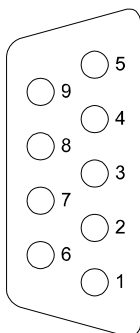
Pin	Assignment
1	DO
2	DI
3	GND
4	reserved
5	+ 5V (90 mA)
6	/DO
7	/DI
8	reserved
9	RBST

Voltage supply   The Interbus coupler has an internal power supply. This power supply requires an external voltage of DC 24V. In addition to the internal circuitry of the bus coupler, the supply voltage is also used to power any devices connected to the backplane bus. Please note that the maximum current that the integrated power supply can deliver to the backplane bus is 3.5A.

The power supply is protected against reverse polarity.

Interbus and the backplane bus are isolated from each other.

Note!
Please pay attention to the polarity of the power supply!

Block diagram   The following block diagram shows the hardware structure of the bus
                           coupler:

galvanic isolation
(by means of optocouplers
and DC/DC converters)

RS422   RS422

Inbound   Outbound
Interbus line   Interbus line

Diagnostic
LEDs

RESET

Interbus
protocol chip

Clock

serial data
communications

EPROM

Expansion registers

RAM

Mikrocontrollerbus

RESET

Microcontroller

Voltage
monitor

System 200V
interface circuitry

Power

Power
supply
24V / 5V

24V
(terminals)   +5V

System 200V
backplane bus
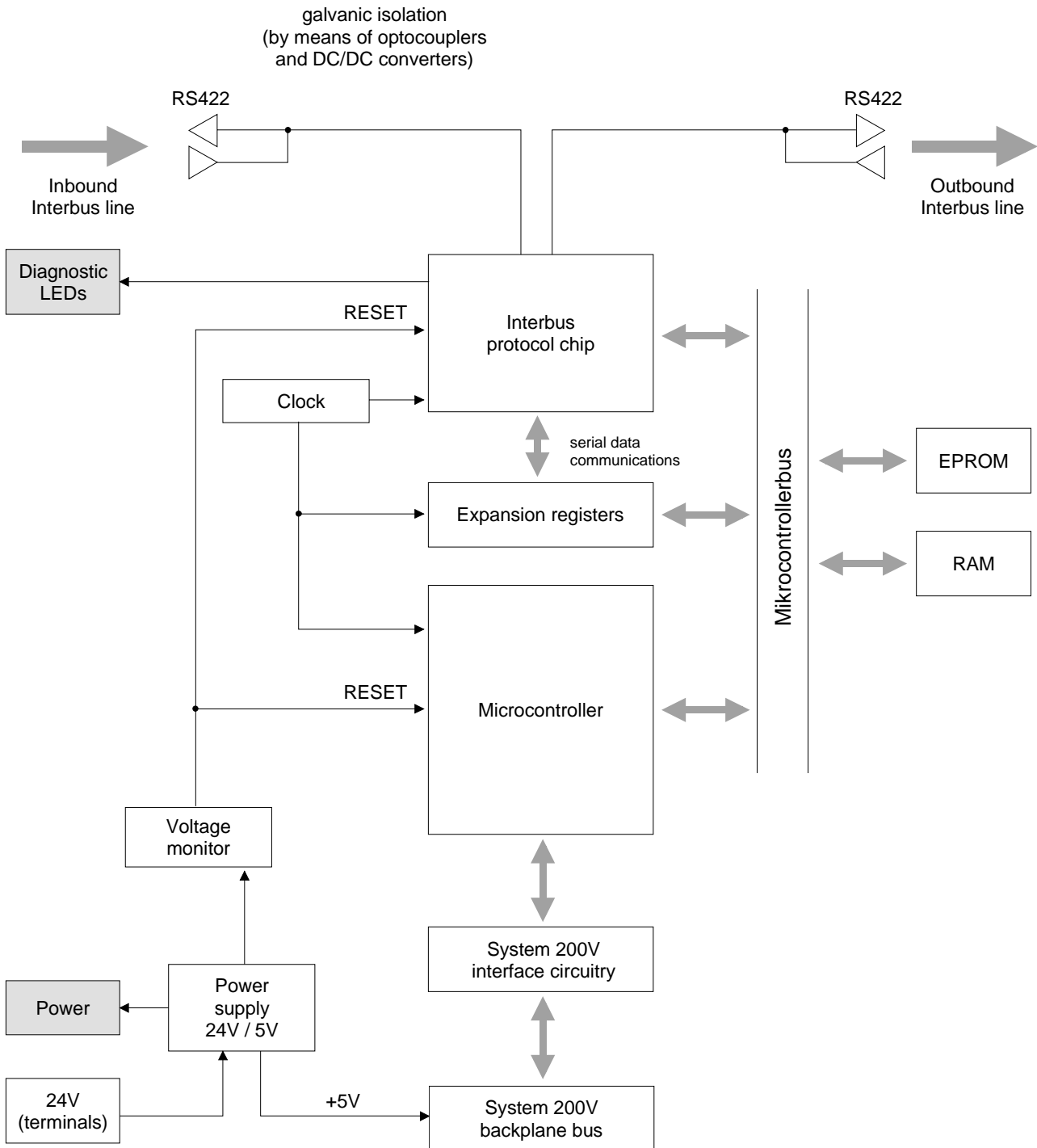
Connection to Interbus

**Interbus wiring
requirements**

Interbus coupler n: Interbus coupler n+1:
Outbound interface   Inbound interface

DO	1	1	DO
/DO	6	6	/DO
COM	3	3	COM
DI	2	2	DI
/DI	7	7	/DI
shield			shield
+5V	5	8	+5V
RBST	9	9	n/c
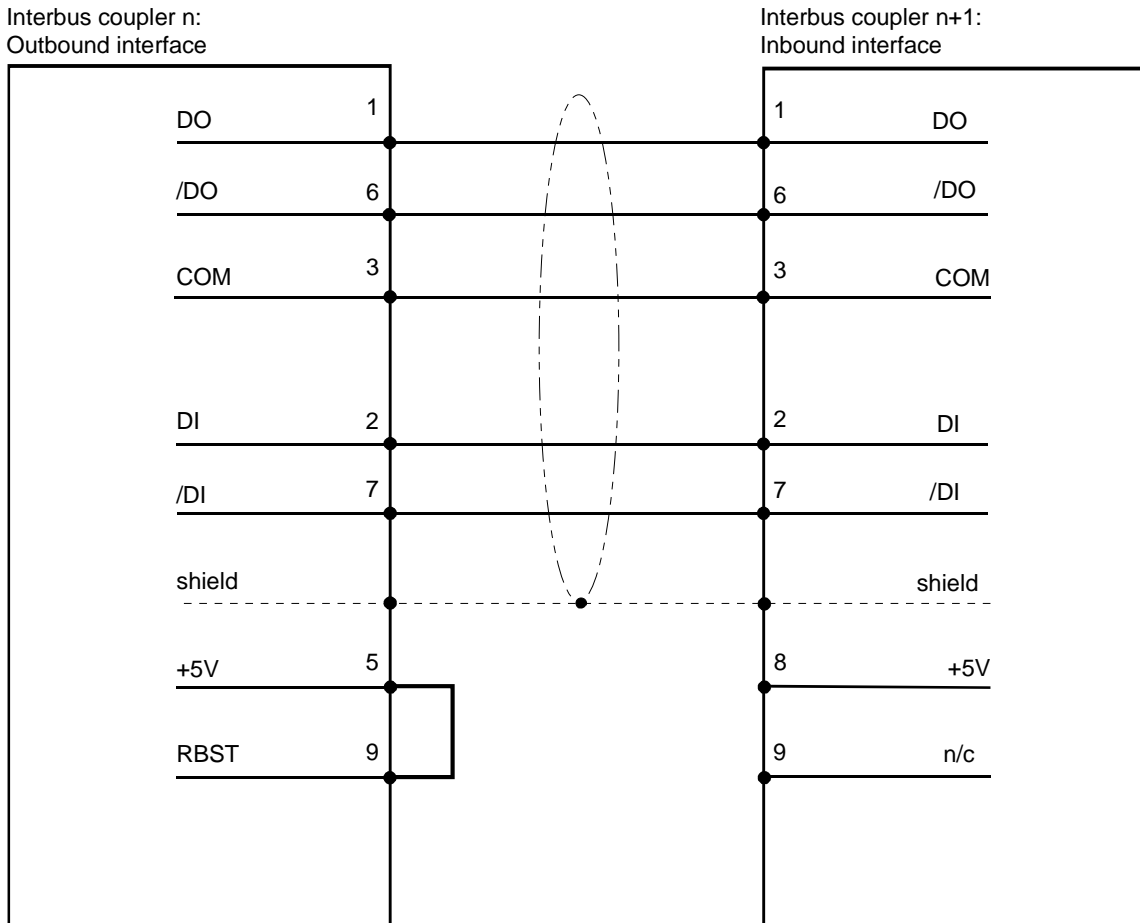
Isolation   Due to the fact that Interbus remote bus segments can be distributed over
                       large areas, it is necessary that individual segments are isolated galvani-
                       cally to prevent problems that could be caused by potential differences.
                       However, according to the recommendations of the Interbus club, it is
                       sufficient to provide galvanic isolation between inbound remote bus
                       interfaces and the remainder of the circuitry. For this reason the outbound
                       remote bus interface is at the same potential as the rest of the circuitry and
                       the backplane bus.

                       Use metallic covers for plugs and apply the screen of the cable to the plug
                       case.

Note!

Please ensure that the link between pins 5 and 9 is installed on the plug for
"subsequent modules" as any subsequent slaves would not be detected if
the link was not present!

Deployment with Interbus

Process data allocation

The bus coupler determines the configuration of the installed modules after power on and enters the respective data into the internal process image. This process image is sent to the master. From the process images the master generates a process data list for all couplers connected to the bus. The following two figures show the process data allocation list.

The bus coupler uses the following set of rules to generate the internal process image:

- Digital signals are bit orientated, i.e. each channel is associated with one bit in the process image.

- Separate areas exist for input and output data.

- In the input and output areas non-digital modules are always placed before digital modules.

- The sequence of these allocations depends on the plug-in location starting from the bus coupler.

- Where the data width differs between inputs and outputs the larger of the two determines the data width used by the Interbus coupler. This is always rounded up to a complete word (max. 20Byte).

The following figures are intended to show the allocation of the process data within the Interbus master.

Purely digital periphery
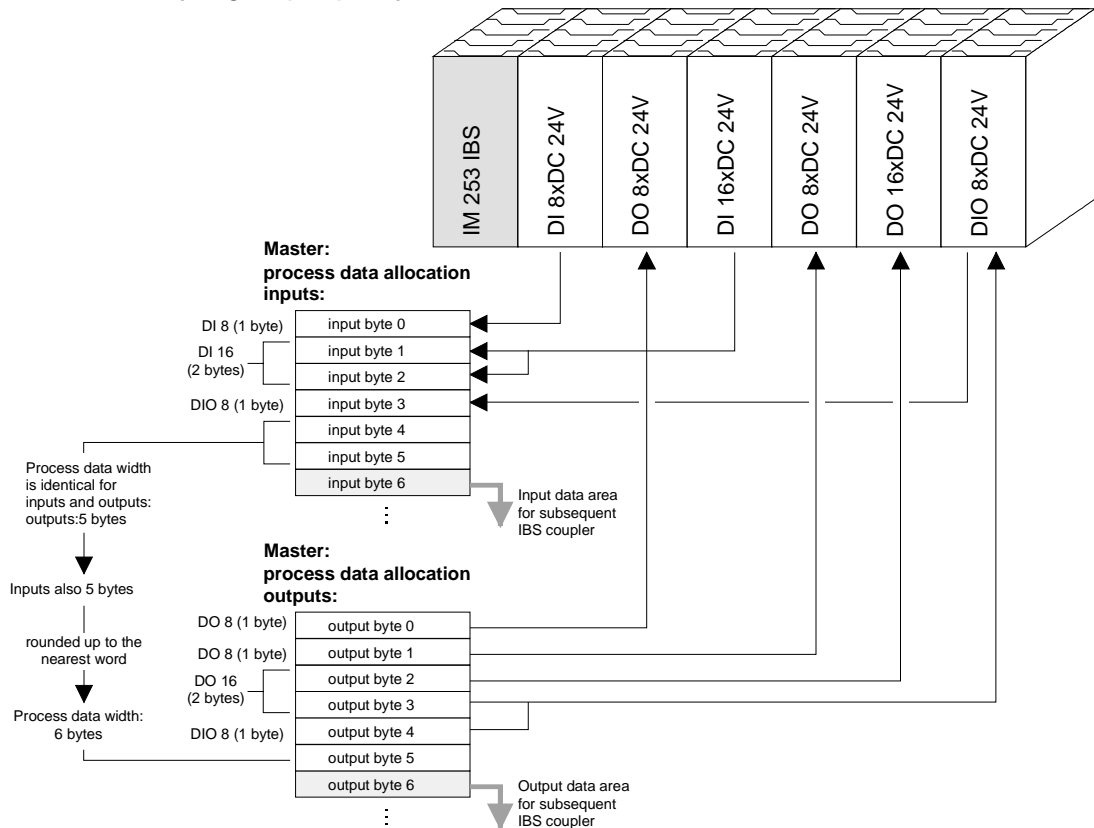
Combination of digital / analog periphery
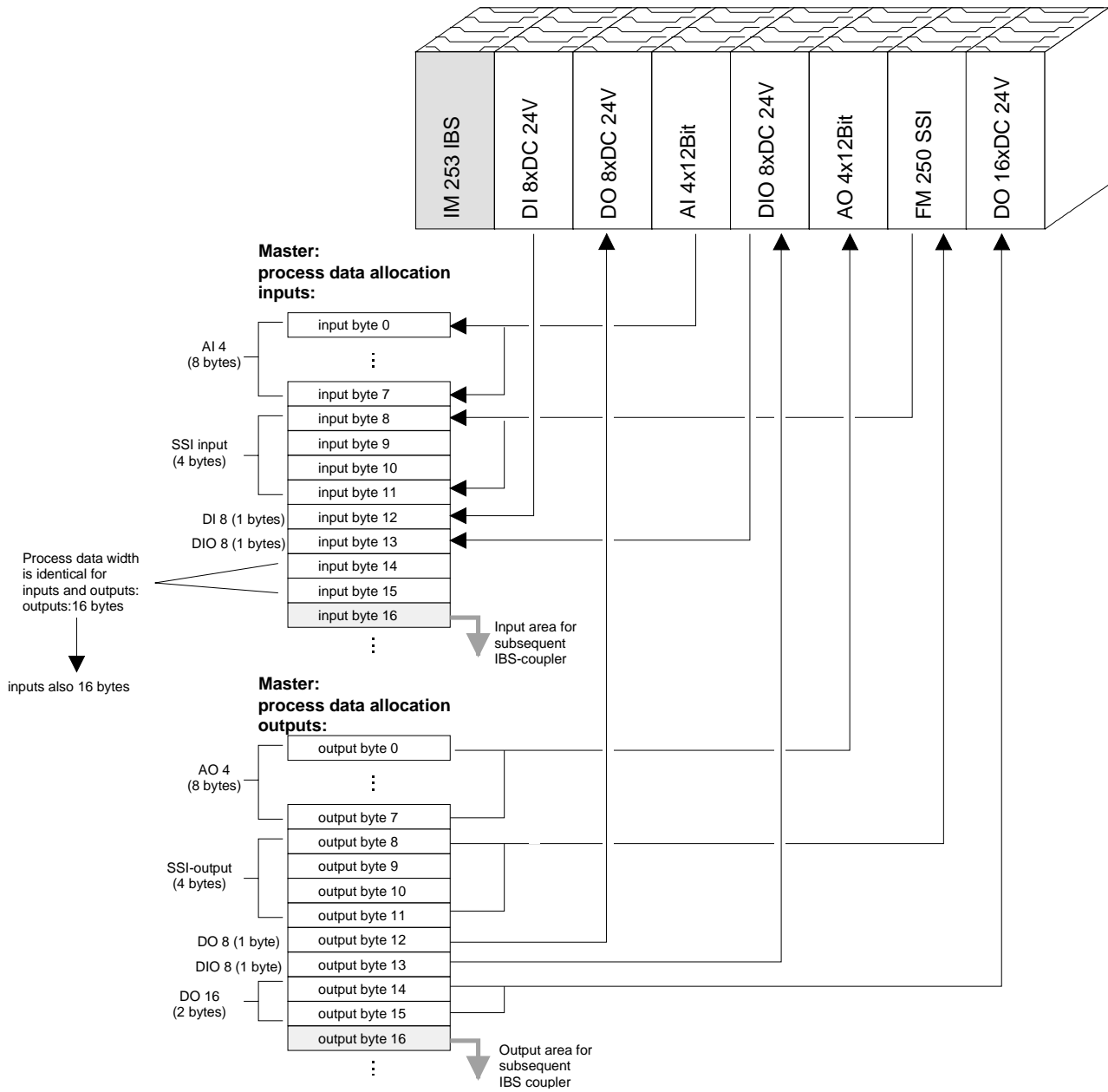
Cyclic process data communications

A process image is employed to exchange input and output data. Communication with digital inputs and outputs is provided by separate data buffers which store the input and output conditions of the modules.

**ID code and
ID length**

During the ID cycle that is executed when the Interbus system is being initialized the different modules connected to the bus identify themselves with their individual functionality and the word length. When the Interbus coupler is turned on, it determines its Interbus length during the initialization phase of the bus modules and generates the respective ID code. Depending on the configuration the Interbus coupler replies with a message identifying it as an analog or a digital remote bus device with variable word length.

**Structure of the
Interbus
ID code**

The Interbus ID code consists of 2Byte. The MSB (Byte 2) describes the length of the data words that will be transferred. Where the width of the input and output data differs, the larger value is used for the Interbus data width. The remaining 3Bit are reserved.

When the module is identified by means of the ID code, the master can only be informed of the data width by means of a word. It is for this reason that the data width is always an even number.

The LSB (Byte 1) describes the type of bus module, i.e. the type of signal and other performance criteria like remote bus, peripheral bus module, PCP, ENCOM or DRIVECOM. Bit 1 and 2 determine the direction of the data.

Byte	Bit 7 ... Bit 0
1	Bit 1 ... Bit 0: Direction of data transfer:
	00: not used
	01: output
	10: input
	11: input/output
	Bit 3 ... Bit 2: terminal type
	Bit 7 ... Bit 4: terminal class
	The type and class are determined by the Interbus-Club
2	Bit 4 ... Bit 0: Data width 0 to 10 words (binary)
	Bit 7 ... Bit 5: reserved

Data consistency   Consistent data is the term used for data that belongs together by virtue of its contents. This is the high and the low byte of an analog value (word consistency) as well as the control and status byte along with the respective parameter word for access to the registers.

The data consistency for a station is guaranteed by the Interbus data communication protocol. Synchronous scanning guarantees the consistency of the entire process image. Inconsistencies can arise due to asynchronous accesses to the data areas of the Interbus master from the control CPU. You can find information on secure access methods to the master interface in the respective manuals.

The basic data consistency is only guaranteed for 1Byte. This means that the bits belonging to a single byte were read or written as a single unit. This byte-related consistency suffices when digital signals are being processed. However, when the data length exceeds a byte, for instance for analog values, then the data consistency must be expanded. You must ensure that you transfer consistent data properly from the Interbus master into your PLC.

For further information please refer to the manual for your Interbus master.

Restrictions   You may combine a maximum of 16 input and 16 output modules with an Interbus coupler. The maximum data width for the input and output data is 10 words.

The configuration of the bus coupler or peripheral modules via the Interbus PCP protocol is not supported.

When the bus coupler is being initialized addresses are assigned to the ET200V peripheral module that are used by the bus coupler to communicate with the module under normal operating conditions. It is not possible to remove or insert any module while the system is active. This is due to the fact that addresses are only assigned after a POWER-ON or a RESET and since the data width of Interbus modules must not change while the system is operational.

In accordance with RS422 standards any remote bus segment (= distance between any two stations) may be at distances up to 400m. The maximum total extent of the system is 12.8km.

Note!
Before the change is implemented, the respective bus coupler must be powered off. Please ensure that you change the initialization in the master in accordance with the changes to the periphery!

Commissioning

Assembly and integration with Interbus

- Assemble your Interbus coupler using the required modules.
- Configure the Interbus coupler by means of the configuration tool that was supplied with the master.
- Connect the Interbus cable to the coupler and turn the power on.

Initialization phase

During the power-on self-test the bus coupler checks the functionality of its components and communications via the backplane bus. The self-test is active while the PW LED is on. When the test has been completed successfully the RC and BA LEDs are on.

Now the peripheral structure is read in. First the number of modules connected to the bus is determined. Then the modules are identified by means of their type identifier. When the peripheral structure has been registered the location identifiers for the modules are generated. This is then transferred to the modules via the backplane bus. This procedure prepares an internal configuration list that is not externally accessible. These location identifiers provide the basis for directly addressed communications. When an error is recognized, the status of the bus coupler is set to STOP. Once the bus coupler has been initialized properly its status is set to READY.

When an error has been removed, the bus coupler can only be returned to normal operation by switching it off and on.

```
                    ( Power
                       ON )
                        |
                        v
                  +-----------+
                  | Self test |
                  +-----------+
                        |
                        v
                  +-----------+
                  | Read data |
                  | about periphery, |
                  | generate list on |
                  | structure |
                  +-----------+
                        |
                        v
                   / Error ? / ----yes----+
                        |                  |
                        no                 |
                        |                  |
                        v                  v
                   ( READY )          ( STOP )
```
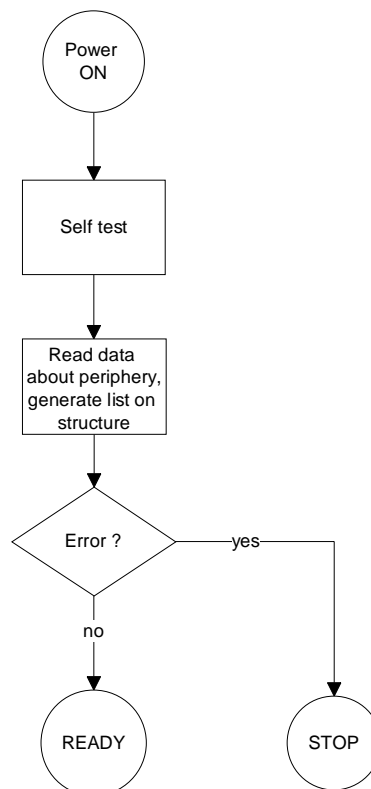
**Diagnostic LEDs
in an example**

The following example shows the reaction of the LEDs to different types of network interruption.
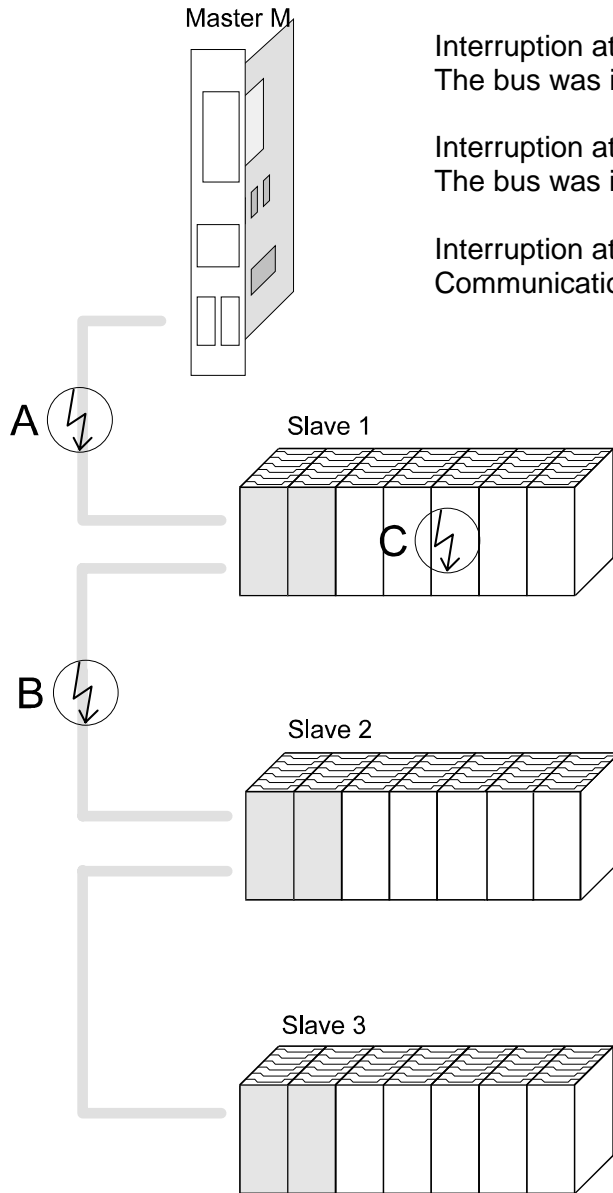
Master M

Interruption at position A
The bus was interrupted between the master and slave1.

Interruption at position B
The bus was interrupted between slave1 and slave2

Interruption at position C
Communications via the backplane bus was interrupted.

A

Slave 1

C

Slave 1	Interruption at position		
LED	A	B	C
ER	off	off	on
BA	off	off	on
RC	off	on	on
RD	on	on	off

B

Slave 2

Slave 2	Interruption at position		
LED	A	B	C
ER	off	off	off
BA	off	off	on
RC	off	off	on
RD	on	on	off

Slave 3

Slave 3	Interruption at position		
LED	A	B	C
ER	off	off	off
BA	off	off	on
RC	off	off	on
RD	on	on	on

Configuration of the master

As mentioned before, Interbus generates a data area containing both input and output bytes. The assignment of the modules connected to the bus coupler and the bits and bytes of the process image is provided by the bus coupler.

The Interbus master exchanges a contiguous input and output data block with every Interbus coupler. The data modules of the PLC or the configuration software allocate the bytes contained in this data block to the addresses of the process image.

Master-Software	Configuration software	Manufacturer
PLC-interfaces version <4	SYS SWT	Phoenix Contact
PLC-interfaces version <4	IBM CMD	Phoenix Contact
PC-interfaces version <3	SYS SWT	Phoenix Contact
general	SYS SWT	Phoenix Contact

Technical data

**Interbus coupler
IM 253IBS**

Electrical data	VIPA 253-1IB00
Power supply	DC 24V (20.4 ... 28.8) via front from ext. power supply
Current consumption	max. 300mA
Output current backplane bus	max. 3.5A
Isolation	$\geq$ AC 500V , according to DIN 19258
Status indicators	via LEDs located on the front
Connections / interfaces	9pin D-type (plug) inbound remote bus 9pin D-type (socket) outbound remote bus
Interbus interface	
Connection	remote bus, 9pin D-type as per DIN 19258
Network topology	Ring with an integrated return line
Medium	Screened twisted pair cable
Data transfer rate	500kBit/s
Total length	12.8km
Distance between two stations	400m
digital inputs/outputs	max.160 input bits and 160 output bits
max. no. of stations	256
Combination with peripheral modules	
max. no. of modules	16
max. digital I/O	16 (process data width 20 I / 20 O)
max. analog I/O	4 (process data width 10 I / 10 O)
	no configuration possible
Dimensions and weight	
Dimensions (WxHxD) in mm	25.4x76x76
Weight	80g

Chapter 4   CANopen

Overview
This chapter contains the description of the VIPA CANopen master/slave. The introduction to the system is followed by the description of the modules.

Another section of this chapter concerns the project engineering for "experts" and an explanation of the telegram structure and the function codes of CANopen.

The description of the Emergency Object and NMT as well as the technical data conclude the chapter.

Below follows a description of:
- CAN-Bus principles
- The VIPA CANopen master/slaves
- The baudrate and module-ID settings
- Deployment of the CANopen slave on the CAN-Bus with a message description
- Description of the CAN specific objects
- Technical data

Content

System overview

**CANopen-
Master
IM 208CAN**

The following CANopen master is available from VIPA:
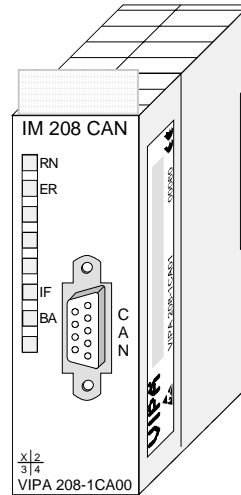
Order data

Order number	Description
VIPA 208-1CA00	CAN-Bus CANopen master 1MBaud, up to125 slaves

**CANopen slave IM
253CAN**

Currently two CANopen bus couplers are available from VIPA:

- CANopen slave IM 253CAN
- CANopen slave IM 253CAN with DO 24xDC 24V
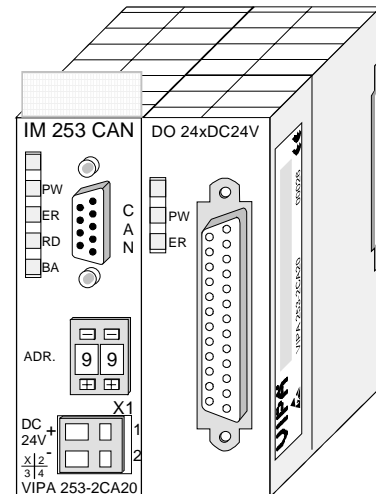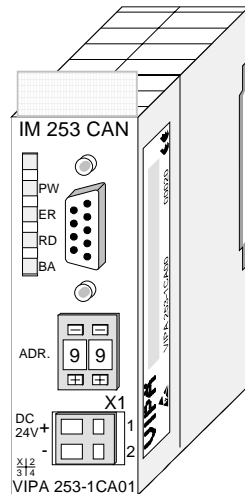
Order data

Order number	Description
VIPA 253-1CA01	CAN-Bus CANopen Slave
VIPA 253-2CA20	CAN-Bus CANopen Slave with DO 24xDC 24V

Principles

General

CANopen (**C**ontrol **A**rea **N**etwork) is an international standard for open fieldbus systems intended for building, manufacturing and process automation applications that was originally designed for automotive applications.

Due to its extensive error detection facilities, the CAN-Bus system is regarded as the most secure bus system. It has a residual error probability of less than 4.7×10^{-11}. Bad messages are flagged and retransmitted automatically.

In contrast to Profibus and Interbus, CAN defines under the CAL-level-7-protocol (CAL=**C**AN **a**pplication **l**ayer) defines various level-7 user profiles for the CAN-Bus. One standard user profile defined by the CIA (**C**AN **i**n **A**utomation) e.V. is CANopen.

CANopen

CANopen is a user profile for industrial real-time systems, which is currently supported by a large number of manufacturers. CANopen was published under the heading of DS-301 by the CAN in Automation association (CIA). The communication specifications DS-301 define standards for CAN devices. These specifications mean that the equipment supplied by different manufacturers is interchangeable. The compatibility of the equipment is further enhanced by the equipment specification DS-401 that defines standards for the technical data and process data of the equipment. DS-401 contains the standards for digital and analog input/output modules.

CANopen comprises a communication profile that defines the objects that must be used for the transfer of certain data as well as the device profiles that specify the type of data that must be transferred by means of other objects.

The CANopen communication profile is based upon an object directory that is similar to the profile used by Profibus. The communication profile DS-301 defines two standard objects as well as a number of special objects:

- Process data objects (PDO)
  PDOs are used for real-time data transfers

- Service data objects (SDO)
  SDOs provide access to the object directory for read and write operations

Communication medium

CAN is based on a linear bus topology. You can use router nodes to construct a network. The number of devices per network is only limited by the performance of the bus driver modules.

The maximum distance covered by the network is determined by the runtimes of the signals. This means that a data rate of 1Mbaud limits the network to 40m and 80kBaud limits the network to 1000m.

The CAN-Bus communication medium employs a screened three-core cable (optionally a five-core).

The CAN-Bus operates by means of differential voltages. For this reason it is less sensitive to external interference than a pure voltage or current based interface. The network must be configured as a serial bus, which is terminated by a 120Ω terminating resistor.

Your VIPA CAN-Bus coupler contains a 9pin socket. You must use this socket to connect the CAN-Bus coupler as a slave directly to your CAN-Bus network.

All devices on the network use the same baudrate.

Due to the bus structure of the network it is possible to connect or disconnect any station without interruption to the system. It is therefore also possible to commission a system in various stages. Extensions to the system do not affect the operational stations. Defective stations or new stations are recognized automatically.

Bus access method

Bus access methods are commonly divided into controlled (deterministic) and uncontrolled (random) bus access systems.

CAN employs a Carrier-Sense Multiple Access (CSMA) method, i.e. all stations have the same right to access the bus as long as the bus is not in use (random bus access).

Data communications is message related and not station related. Every message contains a unique identifier, which also defines the priority of the message. At any instance only one station can occupy the bus for a message.

CAN-Bus access control is performed by means of a collision-free, bit-based arbitration algorithm. Collision-free means that the final winner of the arbitration process does not have to repeat his message. The station with the highest priority is selected automatically when more than one station accesses the bus simultaneously. Any station that is has information to send will delay the transmission if it detects that the bus is occupied.

IM 208CAN - CANopen master - Construction

Properties

- 125 CAN slaves can be connected to one CANopen master
- Project engineering under WinCoCT from VIPA
- Diagnosis ability
- 40 Transmit PDOs
- 40 Receive PDOs
- PDO-Linking
- PDO-Mapping
- 1 SDO as Server, 127 SDO as Client
- Emergency Object
- NMT Object
- Node Guarding, Heartbeat
- In-/output range 0x6xxx each max. 64Bytes
- In-/output range 0xAxxx each max. 320Bytes

**Construction
IM 208CAN**
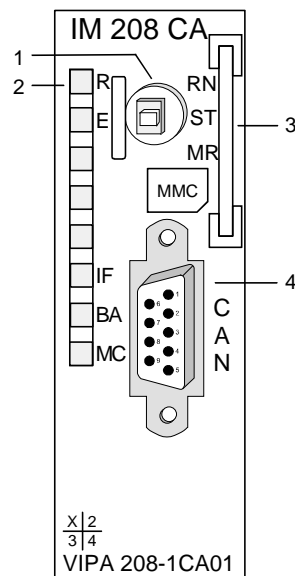
[1]   LED status indicators
[2]   CAN-Bus socket

Components

LEDs

The CANopen master module is equipped with LEDs for diagnostic purposes. The following table shows how the diagnostic LEDs are used along with the respective colors.

Name	Color	Description
RN	green	ON: CPU is in RUN
		OFF: CPU is in STOP
ER	red	ON: During initialization and at slave failure
		OFF: All slaves are in the state "operational"
BA	yellow	ON: BA (**B**us **a**ctive) shows communication via CAN bus.
		Blinks with 1Hz: shows state "pre-operational".
IF	red	ON: „**I**nitialisierungs**f**ehler" (i.e. initialization error) at wrong parameterization.
		OFF: Initialization is OK.

Note!

If all LEDs are blinking with 1Hz, the CAN master awaits valid parameters from the CPU.

CAN-interface

The VIPA CAN-Bus master is connected to the CAN-Bus system by means of a 9pin plug.

The following diagram shows the pin assignment for the interface.:
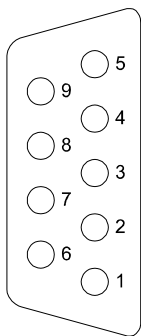
Pin	Assignment
1	reserved
2	CAN low
3	CAN Ground
4	reserved
5	reserved
6	optional Ground
7	CAN high
8	reserved
9	optional +24V
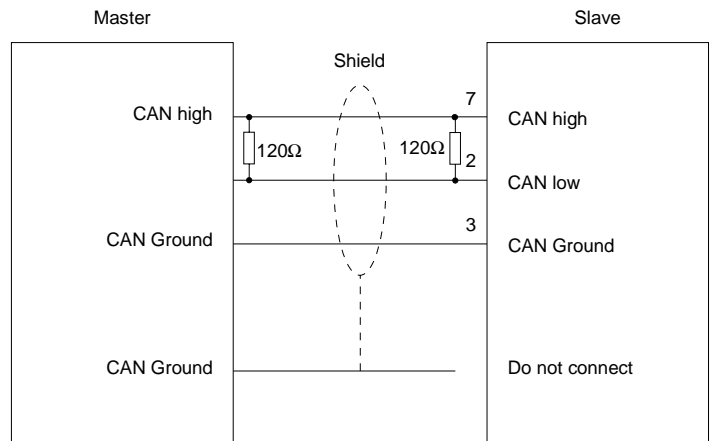
Note!

The end of the bus cable must be terminated with a 120Ω terminating resistor to prevent reflections and the associated communication errors!

Power supply

The CANopen master receives the voltage supply via the backplane bus.

IM 208CAN - CANopen master - Project engineering

The project engineering of the CANopen master happens in WinCoCT (**Win**dows **C**AN**o**pen **C**onfiguration **T**ool) from VIPA. You export your project from WinCoCT as wld-file. This wld-file can then be imported into the hardware configurator from Siemens.

Fast introduction

For the deployment of System 200V modules and the CAN master, you have to include the System 200V modules into the hardware catalog via the GSD-file from VIPA. For the project engineering in the hardware configurator you have to execute the following steps:

- Start WinCoCT and project the CANopen network.
- Create a master group with [ ] and insert a CANopen master via [ ].
- Activate the master function via "Device Access" and "Device is NMT Master".
- Activate in the register "CANopen Manager" Device is NMT Master and confirm your entry.
- Set parameters like diagnosis behavior and CPU address ranges with "Set PLC Parameters".
- Create a slave group with [ ] and add your CANopen slaves via [ ].
- Add modules to your slaves via "Modules" and parameterize them if needed.
- Set your process data connections in the matrix via "Connections" and proof your entries if needed in the process image of the master.
- Save the project and export it as wld-file.
- Switch to the SIMATIC manager from Siemens and copy the data block from the CAN-wld-file into the block directory.
- Project the Profibus-DP master system in the hardware configurator with the following Siemens-CPU: CPU 315-2DP (6ES7 315-2AF03-0AB0)
- The DP master receives an address >1.
- Add the System 200V DP slave system from the hardware catalog to the master system.
- The System 200V DP slave system always requires the address 1.
- Save all and transfer the PLC project together with the wld-file via MPI into the CPU.

In the following you'll find a description of this steps.

Note!

Starting with the firmware version 3.5.0, please use the hardware catalog CPU **6ES7-315-2AF03** V1.2 from Siemens for the project engineering of the VIPA standard CPUs of the Systems 100V, 200V, 300V and 500V!

Precondition for the project engineering	The hardware configurator is a part of the STEP®7 project engineering tool from Siemens. It serves the project engineering. The modules that can be parameterized with are monitored in the hardware catalog. For the deployment of the System 200V modules, the inclusion of the System 200V modules into the hardware catalog is necessary. This happens via a GSD-file from VIPA.

Note!

For the project engineering a thorough knowledge of the STEP®7 manager and the hardware configurator from Siemens is required!

Include GSD-file	• Copy the delivered VIPA GSD-file VIPA_21x.gsd into your GSD-directory... \siemens\step7\s7data\gsd • Start the hardware configurator from Siemens • Close all projects • Choose **Options** > *Install new GSD-file* • Select **VIPA_21x.GSD** Now the modules of the System 200V from VIPA are integrated in the hardware catalog and can be projected.

Note

> **To be compatible to the STEP®7 project engineering tool from Siemens, the System 200V CPUs from VIPA have to be projected as**
>
> **CPU 315-2DP (6ES7 315-2AF03-0AB0)!**
>
> **To be able to directly address the modules, you have to include them in the hardware configurator from Siemens in form of a virtual Profibus system. By including the GSD-file from VIPA, you are able to access the complete function range of the modules.**
>
> **The concrete project engineering happens in the CANopen configuration tool WinCoCT. You may export your project as wld-file and transfer it as DB into your PLC program.**

WinCoCT   WinCoCT (**Win**dows **C**AN**o**pen **C**onfiguration **T**ool) is a configuration tool
developed from VIPA to allow the comfortable project engineering of
CANopen networks.

WinCoCT monitors the CANopen network topology in a graphical user
interface. Here you may place, parameterize and group field devices and
controls and engineer connections.

The selection of the devices happens via a list that can be extended for
your needs with an EDS-file (**E**lectronic **D**ata **S**heet) at any time.

A right click onto a device opens a context menu consisting partly of static
and partly of dynamic components.

For the configuration of the process data exchange, all process data are
monitored in a matrix with the device inputs as rows and the device outputs
as columns. Mark a cross point to create the wanted connection.

The telegram collection and optimization is executed by WinCoCT.
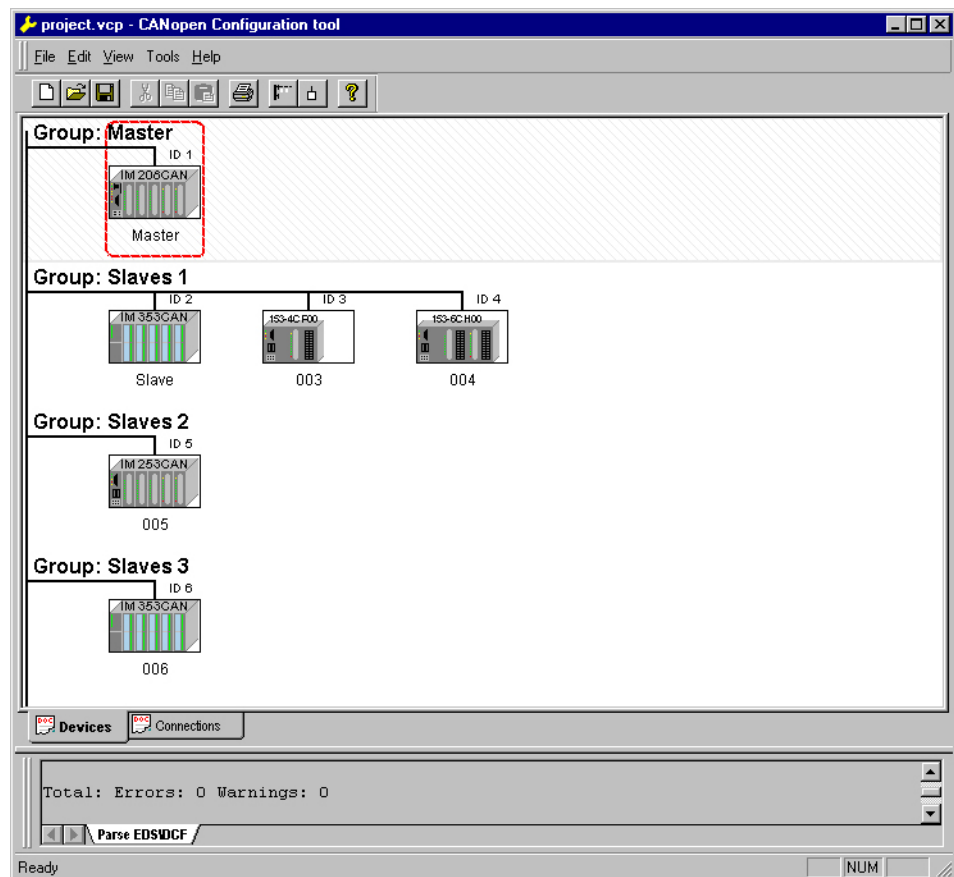
**Set project
parameters**

Via **Tools** > *Project options* you may preset CAN specific parameters like baud rate, selection of the master etc.

More detailed information is to find in the WinCoCT manual.

**Parameter
CAN master**

WinCoCT allows you to preset VIPA specific parameters for the CAN master by doing a right click onto the master and call the following dialog window with Set PLC-Parameters:
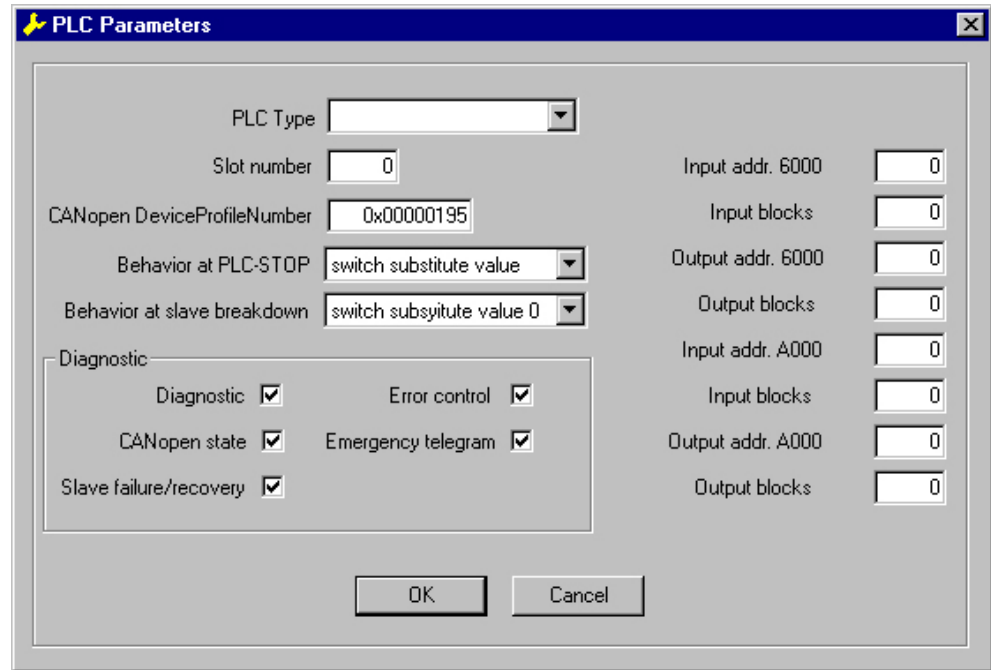
| PLC Type | Reserved for later extensions |

| Slot number | Plug-in location no. at the bus |

0: For the addressing of the CAN master integrated in the CPU

1 ... 32: For the addressing of CAN master at the standard bus

| CANopen
DeviceProfileNumber | Fix at 0x195 |

| Behavior at
PLC-STOP | Here you can define the reaction of the output channels if the CPU switches to STOP. The following values are available: |

Switch substitute value 0: Sets all outputs to 0

Keep last value: Keeps the recent state of the outputs.

Behavior at Slave breakdown	Here you set the reaction for the slave input data in case of a slave failure. *Switch substitute value 0*: The data is set to 0. *Keep the last value*: The recent date remain unchanged.
Diagnostic	This area allows you to define the diagnostic reaction of the CAN master. *Diagnostic:* Activates the diagnostic function *CANopen state:* When activated, the CAN master sends its state "preoperational" or "operational" to the CPU. You may request the state via SFC 13. *Slave failure/recovery:* When activated, the OB 86 is called in the CPU in case of slave failure and reboot. *Error control:* If this option is selected, the NMT master sends all Guarding errors as diagnosis to the CPU, that calls the OB 82. *Emergency Telegram:* At activation, the NMT master sends all Emergency telegrams as diagnosis to the CPU, that calls the OB 82.
Address range in the CPU	The following fields allow you to preset the address ranges in the CPU for the CANopen master in- and output ranges. Each block consists of 4Byte. *Input addr. 6000, Input blocks* PI basic address in the CPU that are occupied from 0x6000 CAN input data. For input blocks max. 16 (64Byte) can be entered. *Output addr. 6000, Output blocks* PO basic address in the CPU that are occupied from 0x6000 CAN output data. For output blocks max. 16 (64Byte) can be entered. *Input addr. A000, Input blocks* PI basic address in the CPU that are occupied from 0xA000 CAN input network variables. For input blocks max. 80 (320Byte) can be entered. *Output addr. A000, Output blocks* PO basic address in the CPU that are occupied from 0xA000 CAN output network variables. For output blocks max. 80 (320Byte) can be entered.
Activate CANopen slave in the CANopen Manager	To enable the master to access a CANopen slave, you have to register it at the according master via WinCoCT. Right click onto your CAN master, choose "Device access" and switch to the register "CANopen Manager". Via [Change] you can register every single slave res. via [Global] all slaves at your master and preset the error behavior. **Please don't forget to apply the settings into your project engineering by clicking on [Apply to slaves].**

Steps of the project engineering

The following text describes the approach of the project engineering with an abstract sample:

The project engineering is divided into three parts:

- CAN master project engineering in WinCoCT and export as wld-file
- Import CAN master project engineering
- Project engineering of the modules

Preconditions

For the project engineering of a CANopen system, the most recent EDS-file has to be transferred into the EDS-directory of WinCoCT.

For the deployment of the System 200V modules, you have to include the System 200V modules with the GSD-file VIPA_21x.gsd from VIPA into the hardware catalog.

CAN master project engineering in WinCoCT

- Copy the required EDS-files into the EDS-directory and start WinCoCT.
- Create a master group via [icon] and insert a CANopen master via [icon] (VIPA_208_1CA00.eds).
- Create a slave group with [icon] and add your CANopen slaves via [icon].
- Right click on the according slave and add the needed modules via „Modules".
- Parameterize the modules with [Parameter] res. via the according object directory.
- Right click on the master and open the dialog "Device Access".
- Activate Device is NMT Master in the register "CANopen Manager" and register the according slaves at the master. Don't forget to apply your settings into your project engineering with [Apply to slaves]!
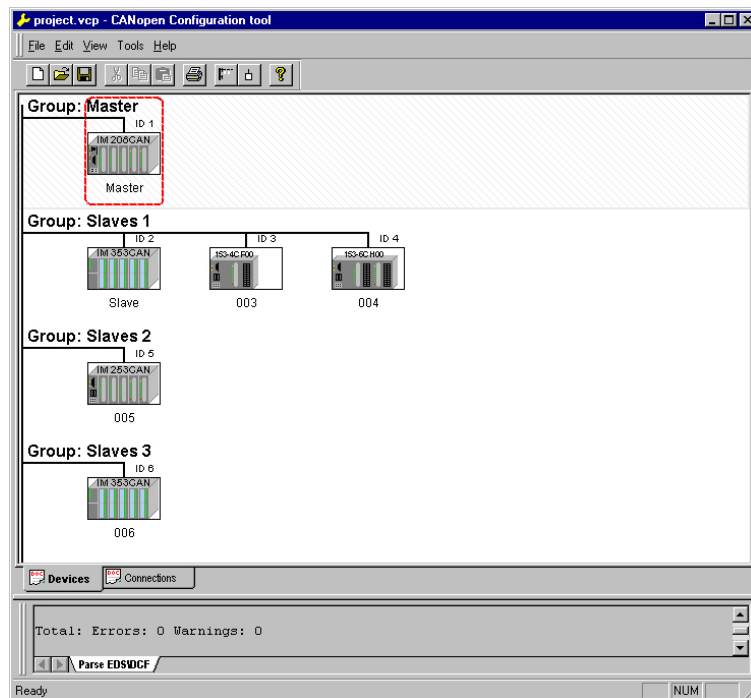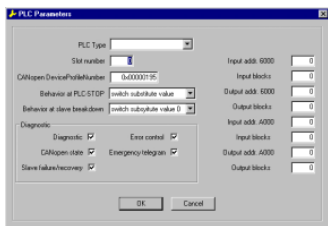
- Right click onto the master and open the VIPA specific dialog "Set PLC Parameters". Here you may adjust the diagnosis behavior and the address ranges that the master occupies in the CPU.
  Under "Slot number" type the slot no., where your CAN master is plugged. At export, WinCoCT creates the according DB no. + 2000.
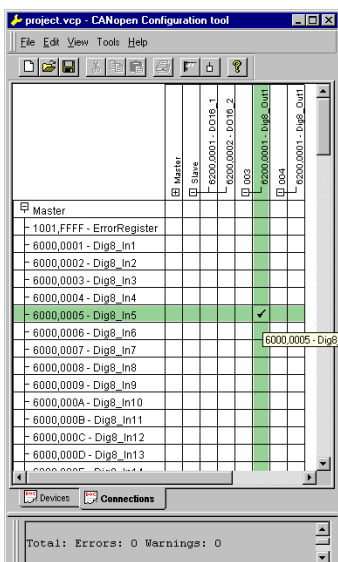
- Change to the register "Connections" in the main window. Here the process data are shown in a matrix as inputs (1st column) and as outputs (1st row).
  To monitor the process data of a device with a "+" click on the according device.

- For helping you, you may only define a connection when the appearing cross has green color. Select the according cell with the mouse pointer in row and column in the matrix and click on it. → The cell is marked with a "✓". You can control the connection by changing into "Devices", click on the master and monitor the process image of the master via "Device Access".

- Save your project.

- Via **File** > *Export* your CANopen project is exported into a wld-file. The name is the combination of project name + node address + ID **Ma**ster/**Sl**ave.

Now your CANopen project engineering under WinCoCT is ready.

Import into PLC program and transfer to CAN master

- Start the SIMATIC manager from Siemens with your PLC project and open the wld-file via **File** > *Memory Card File* > *open*.

- Copy the DB 2xxx into your block directory.

- Start the hardware configurator from Siemens with a new project and insert a profile rail from the hardware catalog.

- Place the following Siemens CPU onto plug-in location 2:
  CPU 315-2DP (6ES7 315-2AF03-0AB0). For the project engineering of the VIPA standard CPUs of the Systems 100V, 200V, 300V and 500V please use starting with the firmware version 3.5.0 the CPU **6ES7-315-2AF03** V1.2 from Siemens from the hardware catalog!

- If for example your CAN master module is directly placed beside the CPU, you project your CAN master on plug-in location 4.

- Starting with plug-in location 5, you include your System 200V modules on the standard bus in the plugged sequence.

- Parameterize your CPU res. the modules when needed. The parameter window is opened when you double click on the according module.

- Save your project and transfer it to your CPU.

After the transfer the CPU recognizes the DB for the CAN master and passes the contents of the DB on to the according CAN master at STOP-RUN change.

IM 208CAN - CANopen master - Mode

Power On

DB2xxx von SPS?

time_out > 10s?

IF-LED on

DB2xxx OK?

IF-LED on
ERR-LED on

Typ = Master?

configuriere Slave

ERR-LED off
IF-LED aus

BA-LED blinks (1Hz)
Slave:
pre-operational

wait to Master-
kommunication

configuriere Master
IF-LED off
configuriere Slaves

LED BA on
Master-Zustand:
operational

Slaves: operational

all Slaves
operational?

ERR-LED on
configuriere Slave

ERR-LED off

Configuration
ok?

Data exchange

Slave: operational

STOP → RUN (automatically)

After POWER ON and at valid project data in the CPU, the master switches automatically into RUN. The master has no operating mode lever.

After POWER ON, the project data is automatically send from the CPU to the CAN master. This establishes a communication to the CAN slaves.

At active communication and valid bus parameters, the CAN master switches into the state "operational". The LEDs RUN and BA are on.

At invalid parameters, the CAN master remains in STOP and shows the parameterization error via the IF-LED.

RUN

In RUN, the RUN- and BA-LEDs are on. Now data can be exchanged.

In case of an error, like e.g. slave failure, the ERR-LED at the CAN master is on and an alarm is send to the CPU.

IM 208CAN - CANopen master - Process image

The process image is build of the following parts:

- Process image for input data (PI) for RPDOs
- Process image for output data (PO) for TPDOs

Every part consists of 64Byte "Digital-Data"- and 320Byte "Network Variables".

Input data   For input data, the following objects are available:

- 8 Bit digital input (Object 0x6000)
- 16 Bit digital input (Object 0x6100)
- 32 Bit digital input (Object 0x6120)
- 8 Bit input network variables (Object 0xA040)
- 16 Bit input network variables (Object 0xA100)
- 32 Bit input network variables (Object 0xA200)
- 64 Bit input network variables (Object 0xA440)

Like to see in the following illustration, the objects of the digital input data use the same memory area of the CPU.

For example, an access to Index 0x6000 with Subindex 2 corresponds an access to Index 0x6100 with Subindex 1. Both objects occupy the same memory cell in the CPU.

Please regard that the input network variables also use the same memory area.

*) CMS = **C**ANopen **M**aster/**S**lave
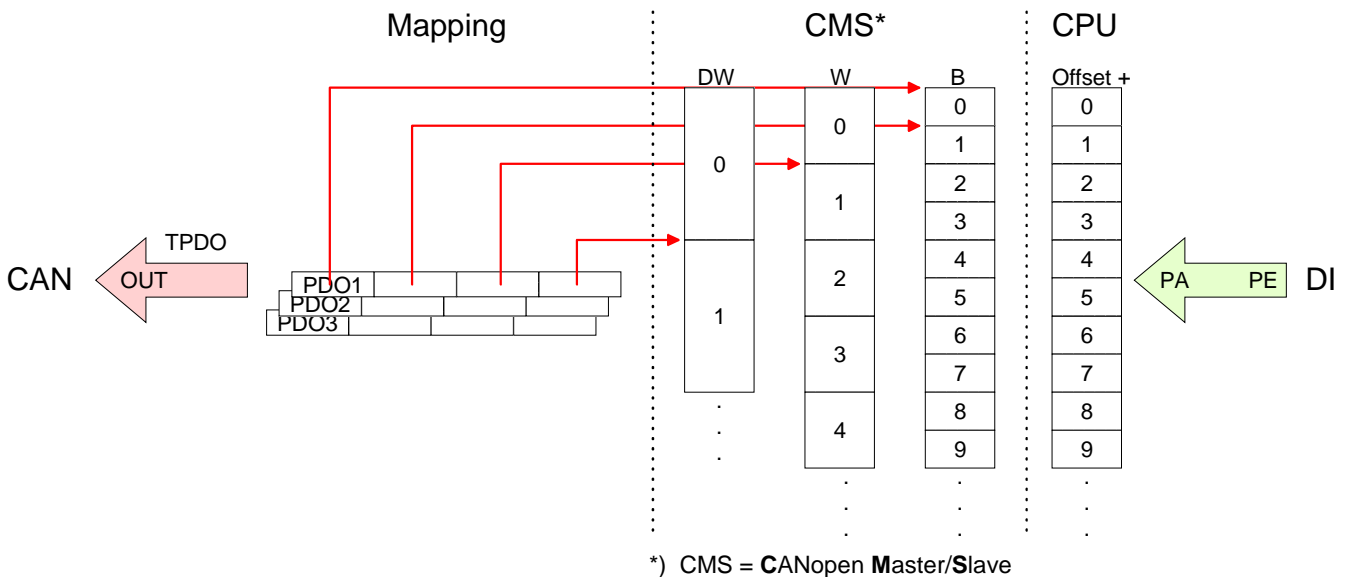
Output-data   For the digital output data, the assignment is similar.

For output data, the following objects are available:

- 8 Bit digital output (Object 0x6200)
- 16 Bit digital output (Object 0x6300)
- 32 Bit digital output (Object 0x6320)
- 8 Bit output network variables (Object 0xA400)
- 16 Bit output network variables (Object 0xA580)
- 32 Bit output network variables (Object 0xA680)
- 64 Bit output network variables (Object 0xA8C0)

Like to see in the following illustration, the objects of the digital output data use the same memory area of the CPU.

For example, an access to Index 0x6200 with Subindex 2 corresponds an access to Index 0x6300 with Subindex 1. Both objects occupy the same memory cell in the CPU.

Please regard that the output network variables also use the same memory area.

*) CMS = **C**ANopen **M**aster/**S**lave
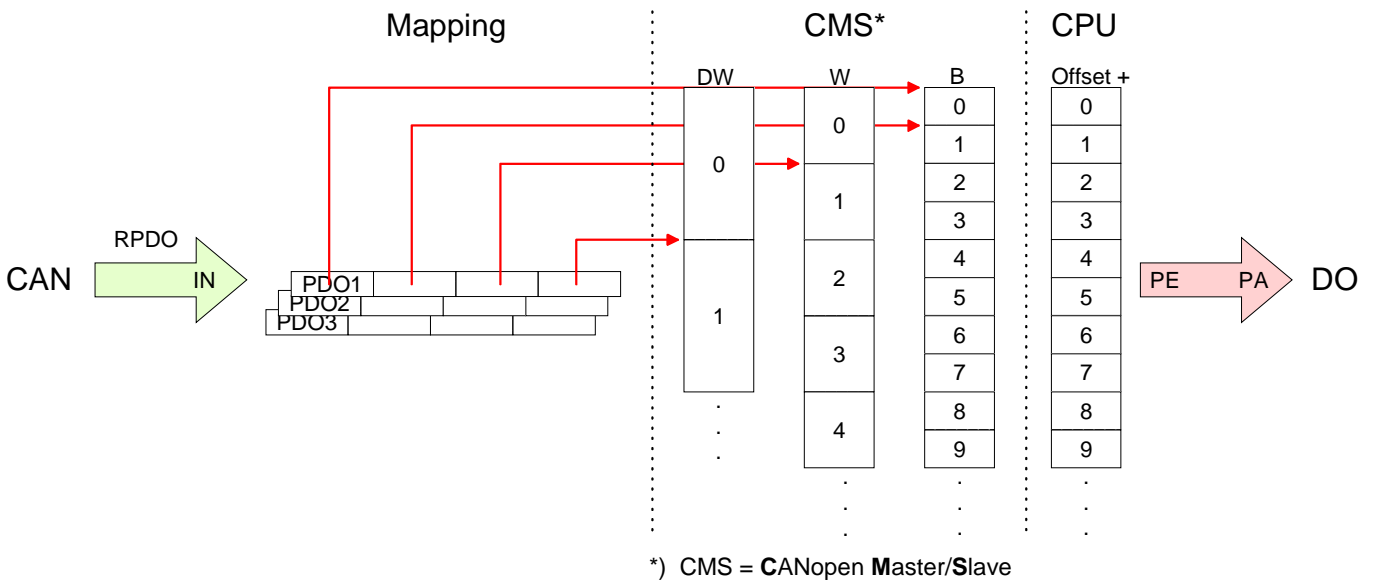
IM 208CAN - CANopen master - Messages

Identifier

All CANopen messages have the following structure according to CIA DS-301:

Identifier

Byte	Bit 7 ... Bit 0
1	Bit 3 ... Bit 0: most significant 4 bits of the module-ID
	Bit 7 ... Bit 4: CANopen function code
2	Bit 3 ... Bit 0: data length code (DLC)
	Bit 4: RTR-Bit: 0: no data (request code)
	1: data available
	Bit 7 ... Bit 5: Least significant 3 bits of the module-ID

Data

Data

Byte	Bit 7 ... Bit 0
3 ... 10	Data

An additional division of the 2Byte identifier into function portion and a module-ID gives the difference between this and a level 2 message. The function determines the type of message (object) and the module-ID addresses the receiver.

CANopen devices exchange data in the form of objects. The CANopen communication profile defines two different object types as well as a number of special objects.

The VIPA CAN master supports the following objects:

- 40 Transmit PDOs (PDO Linking, PDO Mapping)
- 40 Receive PDOs (PDO Linking, PDO Mapping)
- 2 Standard SDOs (1 Server, 127 Clients)
- 1 Emergency Object
- 1 Network management Object NMT
- Node Guarding
- Heartbeat

Note!

The exact structure and data content of all objects is described in the CIA-Profiles DS-301, DS-302, DS-401 and DS-405.

Structure of the device model
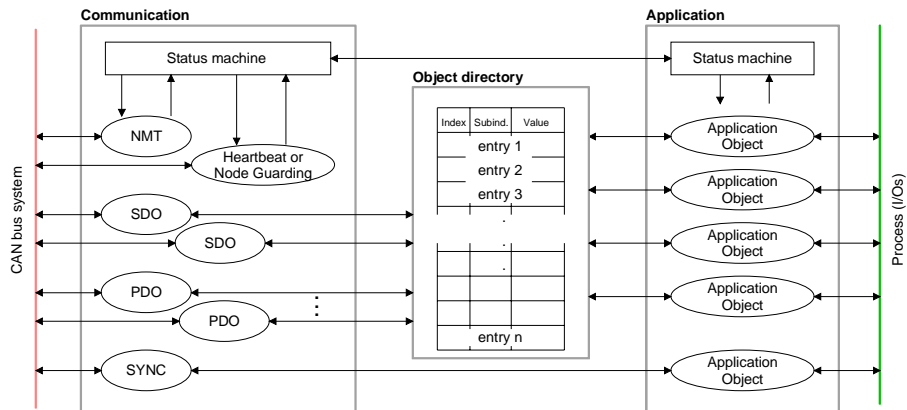
A CANopen device can be structured as follows:

Communication

Serves the communication data objects and the concerning functionality for data transfer via the CANopen network.

Application

The application data objects contain e.g. in- and output data. In case of an error, an application status machine switches the outputs in a secure state.

The object directory is organized as 2 dimension table. The data is addressed via index and sub-index.

Object directory

This object directory contains all data objects (application data + parameters) that are accessible and that influence the behavior of communication, application and status machines.

PDO

In many fieldbus systems the whole process image is transferred - mostly more or less cyclically. CANopen is not limited to this communication principle, for CAN supports more possibilities through multi master bus access coordination.

CANopen divides the process data into segments of max. 8Byte. These segments are called **p**rocess **d**ata **o**bjects (PDOs). Every PDO represents one CAN telegram and is identified and prioritized via its specific CAN identifier.

For the exchange of process data, the VIPA CAN-Master supports 80 PDOs. Every PDO consists of a maximum of 8 data bytes. The transfer of PDOs is not verified by means of acknowledgments since the CAN protocol guarantees the transfer.

There are 40 Tx transmit PDOs for input data and 40 Rx receive PDOs for output data. The PDOs are named seen from the CAN-Master:

Receive PDOs (RxPDOs) are received by the CAN-Master and contain input data.

Transmit PDOs (TxPDOs) are send by the CAN-Master and contain output data.

The assignment of the PDOs to input or output data occurs via WinCoCT automatically

SDO

For access to the object directory, the **S**ervice-**D**ata-**O**bject (SDO) is used. The SDO allows you a read or write access to the object directory. In the CAL-Layer-7-Protocol you find the specification of the Multiplexed-Domain-Transfer-Protocol that is used by the SDOs. This protocol allows you to transfer data with any length. At need, the messages are divided into several CAN messages with identical identifier (segmentation). A SDO is transferred acknowledged, i.e. every reception of a message is acknowledged.

Note!

A more detailed description of the SDO telegrams is to find in the CiA norm DS-301.

In the following only the error messages are described that may occur at a wrong parameter communication.

SFC 219 CAN_TLGR SDO request to CAN master

Every CPU has the SFC 219 integrated. This allows you to start a SDO read or write access from your PLC program to the CAN master.

You address your master via the plug-in location and the destination slave via its CAN address. The process data is defined by index and subindex. Via SDO every access transfers max. one data word process data. The SFC 219 contains the following parameters:

Adresse	Deklaration	Name	Typ	Anfangswe	Kommentar
0.0	in	Request	BOOL		
1.0	in	Slot_Master	BYTE		
2.0	in	NodeID	BYTE		
3.0	in	Transfertyp	BYTE		
4.0	in	Index	DWORD		
8.0	in	Subindex	DWORD		
12.0	out	CanOpenError	DWORD		
16.0	out	RetVal	WORD		
18.0	out	Busy	BOOL		
20.0	in_out	DataBuffer	ANY		

Request

Control parameter: 1: Start the order

Slot_Master

0: VIPA 21x-2CM01

1...32: VIPA 208-1CA00, depending on plug-in location no.

NodeID

Address of the CANopen node (1...127)

Transfer type

40h, 60h: Read SDO

61h: Write SDO (undefined length)
23h: Write SDO (1 DWORD)
2Bh: Write SDO (1 WORD)
2Fh: Write SDO (1 BYTE)

Index

CANopen Index

Subindex

CANopen Subindex

CanOpenError   If no error occurs CANopenError returns value 0.

In case of error the CANopenError contains one of the following error messages which are generated in the CAN master:

Code	Description
0x05030000	Toggle bit not alternated
0x05040000	SDO protocol timed out
0x05040001	Client/server command specifier not valid or unknown
0x05040002	Invalid block size (block mode only)
0x05040003	Invalid sequence number (block mode only)
0x05040004	CRC error (block mode only)
0x05040005	Out of memory
0x06010000	Unsupported access to an object
0x06010001	Attempt to read a write only object
0x06010002	Attempt to write a read only object
0x06020000	Object does not exist in the object dictionary
0x06040041	Object cannot be mapped to the PDO
0x06040042	The number and length of the objects to be mapped would exceed PDO length
0x06040043	General parameter incompatibility reason
0x06040047	General internal incompatibility in the device
0x06060000	Access failed due to an hardware error
0x06070010	Data type does not match, length of service parameter does not match
0x06070012	Data type does not match, length of service parameter too high
0x06070013	Data type does not match, length of service parameter too low
0x06090011	Sub-index does not exist
0x06090030	Value range of parameter exceeded (only for write access)
0x06090031	Value of parameter written too high
0x06090032	Value of parameter written too low
0x06090036	Maximum value is less than minimum value
0x08000000	general error
0x08000020	Data cannot be transferred or stored to the application
0x08000021	Data cannot be transferred or stored to the application because of local control
0x08000022	Data cannot be transferred or stored to the application because of the present device state
0x08000023	Object dictionary dynamic generation fails or no object dictionary is present (e.g. object dictionary is generated from file and generation fails because of an file error)

RetVal   When the function has been executed successfully, the return value contains the valid length of the respond data: 1: BYTE, 2: WORD, 4: DWORD.

Unless a SDO demand was processed error free, RetVal contains the length of the valid response data: 1: BYTE, 2: WORD or 4: BYTE.

If an error occurs during function processing, the return value contains an error code.

Value	Description
F021h	Invalid slave address (Call parameter equal 0 or above 127)
F022h	Invalid Transfer type (Value unequal 60h, 61h)
F023h	Invalid data length (data buffer to small, at SDO read access it should be at least 4Byte, at SDO write access 1Byte, 2Byte or 4Byte).
F024h	The SFC is not supported
F025h	Write buffer in the CANopen master full, service can not be processed at this time.
F026h	Read buffer in the CANopen master full, service can not be processed at this time.
F027h	The SDO read or write access returned wrong answer, see CANopen Error Codes.
F028h	SDO-Timeout (no CANopen participant with this Node-Id has been found).

Busy   Busy = 1: The read/write job is not yet completed.

DataBuffer   SFC data communication area.

Read SDO: Destination area for the SDO data that were read.

Write SDO: Source area for the SDO data that were write.

Note

Unless a SDO demand was processed error free, RetVal contains the length of the valid response data in 1, 2 or 4 byte and the CanOpenError the value 0.

IM 208CAN - CANopen master - Object directory

Structure

The CANopen object directory contains all relevant CANopen objects for the bus coupler. Every entry in the object directory is marked by a 16Bit index.

If an object exists of several components (e.g. object type Array or Record), the components are marked via an 8Bit sub-index.

The object name describes its function. The data type attribute specifies the data type of the entry.

The access attribute defines, if the entry may only be read, only be written or read and written.

The object directory is divided into the following 3 parts:

Communication specific profile area (0x1000 – 0x1FFF)

This area contains the description of all relevant parameters for the communication.

0x1000 – 0x1011	General communication specific parameters (e.g. device name)
0x1400 – 0x1427	Communication parameters (e.g. identifier) of the receive PDOs
0x1600 – 0x1627	Mapping parameters of the receive PDOs
	The mapping parameters contain the cross-references to the application objects that are mapped into the PDOs and the data width of the depending object.
0x1800 – 0x1827	Communication and mapping parameters of the
0x1A00 – 0x1A27	transmit PDOs

Manufacturer specific profile area (0x2000 – 0x5FFF)

Here you find the manufacturer specific entries. The CAN master from VIPA has no manufacturer specific entries.

Standardized device profile area (0x6000 – 0x9FFF)

This area contains the objects for the device profile acc. DS-401.

Note!

For the CiA norms are exclusively available in English, we adapted the object tables. Some entries are described below the according tables..

Object directory overview

Index	Content of Object
1000h	Device type
1001h	Error register
1005h	COB-ID SYNC
1006h	Communication Cycle Period
1007h	Synchronous Window Length
1008h	Manufacturer Hardware Version
1009h	Hardware Version
100Ah	Software Version
100Ch	Guard Time
100Dh	Life Time Factor
1016h	Consumer Heartbeat Time
1017h	Producer Heartbeat Time
1018h	Identity Object
1400h to 1427h	Receive PDO Communication Parameter
1600h to 1627h	Receive PDO Mapping Parameter
1800h to 1827h	Transmit PDO Communication Parameter
1A00h to 1A27h	Transmit PDO Mapping Parameter
1F22h	Concise DCF
1F25h	Post Configuration
1F80h	NMT StartUp
1F81h	Slave Assignment
1F82h	Request NMT
1F83h	Request Guarding
6000h	Digital-Input-8-Bit Array (see DS 401)
6100h	Digital-Input-16-Bit Array (see DS 401)
6120h	Digital-Input-32Bit Array (see DS 401)
6200h	Digital-Output-8-Bit Array (see DS 401)
6300h	Digital-Output-16-Bit Array (see DS 401)
6320h	Digital-Output-32-Bit Array (see DS 401)
A040h	Dynamic Unsigned8 Input
A100h	Dynamic Unsigned16 Input
A200h	Dynamic Unsigned32 Input
A4400h	Dynamic Unsigned64 Input
A4C0h	Dynamic Unsigned8 Output
A580h	Dynamic Unsigned16 Output
A680h	Dynamic Unsigned32 Output
A8C0h	Dynamic Unsigned64 Output

Device Type

Index	Sub-index	Name	Type	Attr.	Map.	Default value	Meaning
0x1000	0	Device Type	Unsigned32	ro	N	0x00050191	Statement of device type

The 32Bit value is divided into two 16Bit fields:

MSB	LSB
Additional information Device	**profile number**
0000 0000 0000 wxyz (bit)	405dec=0x0195

The "additional information" contains data related to the signal types of the I/O device:

z=1 → digital inputs

y=1 → digital outputs

x=1 → analog inputs

w=1 → analog outputs

Error register

Index	Sub-Index	Name	Type	Attr.	Map.	Default value	Meaning
0x1001	0	Error Register	Unsigned8	ro	Y	0x00	Error register

Bit 7							Bit 0
ManSpec	reserved	reserved	Comm.	reserved	reserved	reserved	Generic

ManSpec.: Manufacturer specific error, specified in object 0x1003.

Comm.:   Communication error (overrun CAN)

Generic: A not more precisely specified error occurred (flag is set at every error message)

SYNC identifier

Index	Sub-Index	Name	Type	Attr.	Map.	Default value	Meaning
0x1005	0	COB-Id sync message	Unsigned32	ro	N	0x80000080	Identifier of the SYNC message

The lower 11Bit of the 32Bit value contain the identifier (0x80=128dez), while the MSBit indicates whether the device receives the SYNC telegram (1) or not (0).

Attention: In contrast to the PDO identifiers, the MSB being set indicates that this identifier is relevant for the node.

SYNC interval

Index	Sub-index	Name	Type	Attr.	Map.	Default value	Meaning
0x1006	0	Communi-cation cycle period	Unsigned32	rw	N	0x00000000	Maximum length of the SYNC interval in µs.

If a value other than zero is entered here, the master goes into error state if no SYNC telegram is received within the set time during synchronous PDO operation.

Synchronous Window Length

Index	Sub-index	Name	Type	Attr.	Map.	Default value	Meaning
0x1007	0	Synchronous window length	Unsigned32	rw	N	0x00000000	Contains the length of time window for synchronous PDOs in µs.

Device name

Index	Sub-index	Name	Type	Attr.	Map.	Default value	Meaning
0x1008	0	Manufacturer device name	Visible string	ro	N		Device name of the bus coupler

VIPA Master / Slave 208-1CA00

Since the returned value is longer than 4Byte, the segmented SDO protocol is used for transmission.

Hardware version

Index	Sub-index	Name	Type	Attr.	Map.	Default value	Meaning
0x1009	0	Manufacturer Hardware version	Visible string	ro	N	1.00	Hardware version number of bus coupler

Since the returned value is longer than 4Byte, the segmented SDO protocol is used for transmission.

Software version

Index	Sub-index	Name	Type	Attr.	Map.	Default value	Meaning
0x100A	0	Manufacturer Software version	Visible string	ro	N	1.xx	Software version number CANopen software

Since the returned value is longer than 4Byte, the segmented SDO protocol is used for transmission.

Guard time

Index	Sub-index	Name	Type	Attr.	Map.	Default value	Meaning
0x100C	0	Guard time [ms]	Unsigned16	rw	N	0x0000	Interval between two guard telegrams. Is set by the NMT master or configuration tool.

Life time factor

Index	Sub-index	Name	Type	Attr.	Map.	Default value	Meaning
0x100D	0	Life time factor	Unsigned8	rw	N	0x00	Life time factor x guard time = life time (watchdog for life guarding)

If a guarding telegram is not received within the life time, the node enters the error state. If the life time factor and/or guard time =0, the node does not carry out any life guarding, but can itself be monitored by the master (node guarding).

Consumer Heartbeat Time

Index	Sub-index	Name	Type	Attr.	Map.	Default value	Meaning
0x1016	0	Consumer heartbeat time	Unsigned8	ro	N	0x05	Number of entries
	1...127		Unsigned32	rw	N	0x00000000	Consumer heartbeat time

Structure of the "Consumer Heartbeat Time" entry::

Bits	31-24	23-16	15-0
Value	Reserved	Node-ID	Heartbeat time
Encoded as	Unsigned8	Unsigned8	Unsigned16

As soon as you try to configure a consumer heartbeat time unequal zero for the same node-ID, the node interrupts the SDO download and throws the error code 0604 0043hex.

**Producer
Heartbeat Time**

Index	Sub-index	Name	Type	Attr.	Map.	Default value	Meaning
0x1017	0	Producer heartbeat time	Unsigned16	rw	N	0x0000	Defines the cycle time of heartbeat in ms

Identity Object

Index	Sub-index	Name	Type	Attr.	Map.	Default value	Meaning
0x1018	0	Identity Object	Unsigned8	ro	N	0x04	Contains general Information about the device (number of entries)
	1	Vendor ID	Unsigned32	ro	N	0xAFFEAFFE	Vendor ID
	2	Product Code	Unsigned32	ro	N	0x2081CA00	Product Code
	3	Revision Number	Unsigned32	ro	N		Revision Number
	4	Serial Number	Unsigned32	ro	N		Serial Number

**Communication
parameter RxPDO**

Index	Sub-index	Name	Type	Attr.	Map.	Default value	Meaning
0x1400 ... 0x1427	0	Number of Elements	Unsigned8	ro	N	0x02	Communication parameter for the first receive PDOs, Subindex 0: number of following parameters
	1	COB-ID	Unsigned32	rw	N	0xC0000200 + NODE_ID	COB-ID RxPDO1
	2	Transmis-sion type	Unsigned8	rw	N	0xFF	Transmission type of the PDO

Sub-index 1 (COB-ID): The lower 11Bit of the 32Bit value (Bits 0-10) contain the CAN identifier, the MSBit (Bit 31) shows if the PDO is active (1) or not(0), Bit 30 shows if a RTR access to this PDO is permitted (0) or not (1).

The sub-index 2 contains the transmission type.

Mapping RxPDO

Index	Sub-index	Name	Type	Attr.	Map.	Default value	Meaning
0x1600 ... 0x1627	0	Number of Elements	Unsigned8	rw	N	0x01	Mapping parameter of the first receive PDO; subindex 0: number of mapped objects
	1	1st mapped object	Unsigned32	rw	N	0x62000108	(2 byte index, 1 byte subindex, 1 byte bit-width)
	2	2nd mapped object	Unsigned32	rw	N	0x62000208	(2 byte index, 1 byte subindex, 1 byte bit-width)
	...	...	...	...	...	...	...
	8	8th mapped	Unsigned32	rw	N	0x62000808	(2 byte index, 1 byte subindex, 1 byte bit-width)

The reception PDOs get a default mapping automatically from the master depending on the connected modules.

Communication parameter TxPDO1

Index	Sub-index	Name	Type	Attr.	Map.	Default value	Meaning
0x1800 ... 0x1827	0	Number of Elements	Unsigned8	ro	N	0x05	Communication parameter of the first transmit PDO, subindex 0: number of following parameters
	1	COB-ID	Unsigned32	rw	N	0x80000180 + NODE_ID	COB-ID TxPDO1
	2	Transmission type	Unsigned8	rw	N	0xFF	Transmission type of the PDO
	3	Inhibit time	Unsigned16	rw	N	0x0000	Repetition delay [value x 100 µs]
	5	Event time	Unsigned16	rw	N	0x0000	Event timer [value x 1 ms]

Sub-index 1 (COB-ID): The lower 11Bit of the 32Bit value (Bits 0-10) contain the CAN identifier, the MSBit (Bit 31) shows if the PDO is active (1) or not (0), Bit 30 shows if a RTR access to this PDO is permitted (0) or not (1). The sub-index 2 contains the transmission type, sub-index 3 the repetition delay time between two equal PDOs. If an event timer exists with a value unequal 0, the PDO is transmitted when the timer exceeds.

If a inhibit timer exists, the event is delayed for this time.

Mapping TxPDO1

Index	Sub-index	Name	Type	Attr.	Map.	Default value	Meaning
0x1A00 ... 0x1A27	0	Number of Elements	Unsigned8	rw	N	depending on the components fitted	Mapping parameter of the first transmit PDO; subindex 0: number of mapped objects
	1	1st mapped object	Unsigned32	rw	N	0x60000108	(2 byte index, 1 byte subindex, 1 byte bit-width)
	2	2nd mapped object	Unsigned32	rw	N	0x60000208	(2 byte index, 1 byte subindex, 1 byte bit-width)
	...	...	...	...	...	...	...
	8	8th mapped object	Unsigned32	rw	N	0x60000808	(2 byte index, 1 byte subindex, 1 byte bit-width)

The send PDOs get a default mapping automatically from the coupler depending on the connected modules.

Concise DCF

Index	Sub-index	Name	Type	Attr.	Map.	Default value	Meaning
0x1F22	Array	Concise DCF	Domain	rw	N		

This object is required for the Configuration Manager. The Concise-DCF is the short form of the DCF (**D**evice **C**onfiguration **F**ile).

Post Configuration

Index	Sub-index	Name	Type	Attr.	Map.	Default value	Meaning
0x1F25	Array	ConfigureSlave	Unsigned32	rw	N	0x00000000	

Via this entry, the Configuration Manager can be forced to transfer a stored configuration into the net.

The configuration can be initiated for a defined node at any time via the index 0x1F25.

Subindex 0 has the value 128.

Subindex x (with x = 1..127): Starts the reconfiguration for nodes with the node ID x.

Subindex 128: reconfiguration of all nodes.

For example: If you want to initiate the configuration for node 2 and there are configuration data for this node available, you have to write the value 0x666E6F63 (ASCII = "conf") to the object 1F25h Subindex 2.

NMT Start-up

Index	Sub-index	Name	Type	Attr.	Map.	Default value	Meaning
0x1F80	0x00	NMTStartup	Unsigned32	rw	N	0x00000000	

Define the device as NMT master.

Bit	Meaning
Bit 0	0 : Device is NOT the NMT Master. All other bits have to be ignored. The objects of the Network List have to be ignored.
	1 : Device is the NMT Master.
Bit 1	0 : Start only explicitly assigned slaves.
	1 : After boot-up perform the service NMT Start Remote Node All Nodes
Bit 2..31	Reserved by CiA, always 0

Slave Assignment

Index	Sub-index	Name	Type	Attr.	Map.	Default value	Meaning
0x1F81	0x00	SlaveAssignment	Unsigned32	rw	N	0x00000000	

Enter the nodes that are controlled by the master. For every assigned node you need one entry.

Subindex 0 has the value 127. Every other Subindex corresponds with the Node-ID of the node.

Byte	Bit	Description
Byte 0	Bit 0	0: Node with this ID is not a slave
		1: Node with this ID is a slave. After configuration (with Configuration Manager) the Node will be set to state Operational.
	Bit 1	0: On Error Control Event or other detection of a booting slave inform the application.
		1: On Error Control Event or other detection of a booting slave inform the application and automatically start Error Control service.
	Bit 2	0: On Error Control Event or other detection of a booting slave do NOT automatically configure and start the slave.
		1: On Error Control Event or other detection of a booting slave do start the process Start Boot Slave.
	Bit 3..7	Reserved by CiA, always 0
Byte 1		8 Bit Value for the RetryFactor
Byte 2,3		16 Bit Value for the GuardTime

Request NMT

Index	Sub-Index	Name	Type	Attr.	Map.	Default value	Meaning
0x1F82	0x00	RequestNMT	Unsigned32	rw	N	0x00000000	

If a totally automatic start of the stack is not wanted, the functionalities:

- Status change
- Start of the guarding
- Configuration via CMT

can be also executed at request for every node. The request always happens via objects in the object directory.

The switch of the communication state of all nodes in the network (including the local slaves) happens via the entry 1F82h in the local object directory:

Subindex 0 has the value 128.

Subindex x (with x=1..127): Initiates the NMT service for nodes with Node ID x.

Subindex 128: Initiates NMT service for all nodes.

At write access, the wanted state is given as value.

State	Value
Prepared	4
Operational	5
ResetNode	6
ResetCommunication	7
PreOperational	127

Request Guarding

Index	Sub-index	Name	Type	Attr.	Map.	Default value	Meaning
0x1F83	0x00	RequestGuarding	Unsigned32	rw	N	0x00000000	

Subindex 0 has the value 128.

Subindex x (with x=1..127): Initiates guarding for the slave with Node ID x.

Value	Write Access	Read Access
1	Start Guarding	Slave actually is guarded
0	Stop Guarding	Slave actually is not guarded

Subindex 128: Request Start/Stop Guarding for all nodes.

8bit Digital inputs

Index	Sub-index	Name	Type	Attr.	Map.	Default value	Meaning
0x6000	0x00	8bit digital input block	Unsigned8	ro	N	0x01	Number of available digital 8bit input blocks
	0x01	1st input block	Unsigned8	ro	Y		1st digital input block
	...	...	...	...	...	...	...
	0x40	64th input block	Unsigned8	ro	Y		64th digital input block

16bit Digital inputs

Index	Sub-Index	Name	Type	Attr.	Map.	Default value	Meaning
0x6100	0x00	16bit digital input block	Unsigned8	ro	N	depending on the fitted components	Number of available digital 16bit input blocks
	0x01	1st input block	Unsigned16	ro	N		1st digital input block
	...	...	...	...	...	...	...
	0x20	32nd input block	Unsigned16	ro	N		32nd digital input block

32bit Digital inputs

Index	Sub-index	Name	Type	Attr.	Map.	Default value	Meaning
0x6120	0x00	32bit digital input block	Unsigned8	ro	N	depending on the compo-nents fitted	Number of available digital 32bit input blocks
	0x01	1st input block	Unsigned32	ro	N		1st digital input block
	...	...	...	...	...	...	...
	0x10	16th input block	Unsigned32	ro	N		16th digital input block

**8bit Digital
outputs**

Index	Sub-index	Name	Type	Attr.	Map.	Default value	Meaning
0x6200	0x00	8bit digital output block	Unsigned8	ro	N	0x01	Number of available digital 8bit output blocks
	0x01	1st output block	Unsigned8	rw	Y		1st digital output block
	...	...	...	...	...	...	...
	0x40	64th output block	Unsigned8	rw	Y		64th digital output block

**16bit Digital
outputs**

Index	Sub-index	Name	Type	Attr.	Map.	Default value	Meaning
0x6300	0x00	16bit digital input block	Unsigned8	ro	N	Depending on the components fitted	Number of available digital 16bit output blocks
	0x01	1st output block	Unsigned16	rw	N		1st digital output block
	...	...	...	...	...	...	...
	0x20	32nd output block	Unsigned16	rw	N		32nd digital output block

**32bit Digital
outputs**

Index	Sub-index	Name	Type	Attr.	Map.	Default value	Meaning
0x6320	0x00	32bit digital input block	Unsigned8	ro	N	Depending on the components fitted	Number of available digital 32bit output blocks
	0x01	1st output block	Unsigned32	rw	N		1st digital output block
	...	...	...	...	...	...	...
	0x10	16th output block	Unsigned32	rw	N		16th digital output block

8bit Network input variables

Index	Sub-index	Name	Type	Attr.	Map.	Default value	Meaning
0xA040	0x00	8bit digital input block	Unsigned8	ro	N	0x01	Number of available digital 8bit input blocks
	0x01	1st input block	Unsigned8	ro	Y		1st digital input block
	...	...	...	...	...	...	...
	0x140	320th input block	Unsigned8	ro	Y		320th digital input block

16bit Network input variables

Index	Sub-index	Name	Type	Attr.	Map.	Default value	Meaning
0xA100	0x00	16bit digital input block	Unsigned8	ro	N	depending on the fitted components	Number of available digital 16bit input blocks
	0x01	1st input block	Unsigned16	ro	N		1st digital input block
	...	...	...	...	...	...	...
	0xA0	160th input block	Unsigned16	ro	N		160th digital input block

32bit Network input variables

Index	Sub-index	Name	Type	Attr.	Map.	Default value	Meaning
0xA200	0x00	32bit digital input block	Unsigned8	ro	N	depending on the components fitted	Number of available digital 32bit input blocks
	0x01	1st input block	Unsigned32	ro	N		1st digital input block
	...	...	...	...	...	...	...
	0x50	80th input block	Unsigned32	ro	N		80th digital input block

64bit Network input variables

Index	Sub-index	Name	Type	Attr.	Map.	Default value	Meaning
0xA440	0x00	64bit digital input block	Unsigned8	ro	N	depending on the components fitted	Number of available digital 64bit input blocks
	0x01	1st input block	Unsigned32	ro	N		1st digital input block
	...	...	...	...	...	...	...
	0x28	40th input block	Unsigned32	ro	N		40th digital input block

8bit Network output variables

Index	Sub-index	Name	Type	Attr.	Map.	Default value	Meaning
0xA400	0x00	8bit digital output block	Unsigned8	ro	N	0x01	Number of available digital 8bit output blocks
	0x01	1st output block	Unsigned8	rw	Y		1st digital output block
	...	...	...	...	...	...	...
	0x140	320th output block	Unsigned8	rw	Y		320th digital output block

16bit Network output variables

Index	Sub-index	Name	Type	Attr.	Map.	Default value	Meaning
0xA580	0x00	16bit digital input block	Unsigned8	ro	N	Depending on the compo-nents fitted	Number of available digital 16bit output blocks
	0x01	1st output block	Unsigned16	rw	N		1st digital output block
	...	...	...	...	...	...	...
	0xA0	160th output block	Unsigned16	rw	N		160th digital output block

32bit Network output variables

Index	Sub-index	Name	Type	Attr.	Map.	Default value	Meaning
0xA680	0x00	32bit digital input block	Unsigned8	ro	N	Depending on the compo-nents fitted	Number of available digital 32bit output blocks
	0x01	1st output block	Unsigned32	rw	N		1st digital output block
	...	...	...	...	...	...	...
	0x50	80th output block	Unsigned32	rw	N		80th digital output block

64bit Network output variables

Index	Sub-index	Name	Type	Attr.	Map.	Default value	Meaning
0xA8C0	0x00	64bit digital input block	Unsigned8	ro	N	Depending on the compo-nents fitted	Number of available digital 64bit output blocks
	0x01	1st output block	Unsigned32	rw	N		1st digital output block
	...	...	...	...	...	...	...
	0x50	40th output block	Unsigned32	rw	N		40th digital output block

IM 253CAN - CANopen slave - Construction

Properties
- 10 Rx and 10 TxPDOs
- 2 SDOs
- Support of all baudrates
- PDO linking
- PDO mapping

Construction
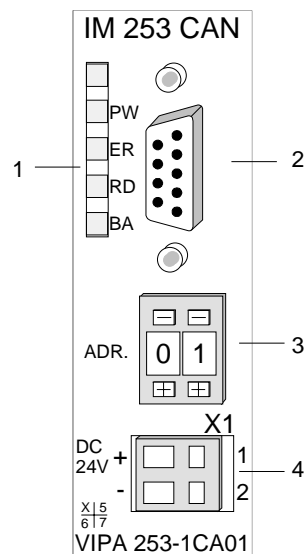
[1] LED status indicators
[2] CAN-Bus socket
[3] Address or baudrate selector
[4] Connector for an external 24V supply

Components

LEDs   The module is equipped with four LEDs for diagnostic purposes. The following table shows how the diagnostic LEDs are used along with the respective colors.

Name	Color	Description
PW	yellow	Indicates that the supply voltage is available.
ER	red	On when an error was detected in the backplane bus communications.
RD	green	Blinks at 1Hz when the self-test was positive and initialization was OK.
		Is turned on when data is being communicated via the V-Bus.
BA	yellow	Off the self-test was positive and the initialization was OK.
		Blinks at 1Hz when the status is "Pre-operational".
		Is turned on when the status is "Operational".
		Blinks at 10Hz when the status is "Prepared".

Status indicator as a combination of LEDs

Various combinations of the LEDs indicate the different operating states:

🟨	PW on	Error during RAM or EEPROM initialization
🟥	ER on	
🟩	RD on	
🟨	BA on	

🟨	PW on	Baudrate setting activated
⊠	ER blinks 1Hz	
⊠	RD blinks 1Hz	
⊠	BA blinks 1Hz	

🟨	PW on	Error in the CAN baudrate setting
⊠	ER blinks 10Hz	
⊠	RD blinks 10Hz	
⊠	BA blinks 10Hz	

🟨	PW on	Module-ID setting activated
☐	ER off	
⊠	RD blinks 1Hz	
☐	BA off	

9pin D-type socket

The VIPA CAN-Bus coupler is connected to the CAN-Bus system by means of a 9pin socket.

The following diagram shows the pin assignment for the interface.

Pin	Assignment
1	n.c.
2	CAN low
3	CAN ground
4	n.c.
5	n.c.
6	optional ground
7	CAN high
8	n.c.
9	optional pos. supply

**Address selector
for Baudrate and
module-ID**

The address selector is used to specify the module-ID as well as the CAN baudrate.

For details please refer to the section under the heading "IM 253CAN - CANopen slave - Baudrate and module-" in this chapter.

Power supply

The CAN-bus coupler is equipped with an internal power supply. This power supply requires an external supply of DC 24V. In addition to the internal circuitry of the bus coupler the supply voltage is also used to power any devices connected to the backplane bus. Please note that the maximum current available for the backplane bus from the internal power supply is limited to 3.5A.

The power supply is protected against reverse polarity.

CAN-Bus and backplane bus are isolated from each other.

CAN-Bus wiring

The CAN-Bus communication medium bus is a screened three-core cable.

Line termination

All stations on systems having more than two stations are wired in parallel. This means that the bus cable must be looped from station to station without interruptions.

Note!

The end of the bus cable must be terminated with a 120Ω terminating resistor to prevent reflections and the associated communication errors!

Block diagram   The following block diagram shows the hardware structure of the bus coupler and the internal communication:

galvanic isolation
(by means of optocouplers and
DC/DC converter)

CAN Transceiver

CANopen-Bus

| Data Exchange |

| Clock | → | CAN-Bus Controller |

Reset

| EPROM |

| Error |

| BA |

| Clock | → | Microcontroller |

| Voltage monitoring | Reset →

Address selector

| Power | ← | Power supply 24V / 5V |

| 24V (terminals) | +5V

| System 200V interface circuitry |

| System 200V backplane bus |

Microcontrollerbus

IM 253CAN, DO 24xDC 24V - Construction

Properties
- CANopen slave with 24 digital outputs on-board
- Project engineering via standard tools (e.g. SyCon from Hilscher)
- 1 Rx PDO
- 2 SDOs
- Support of all baudrates
- PDO linking
- PDO mapping: fix

Construction

Components
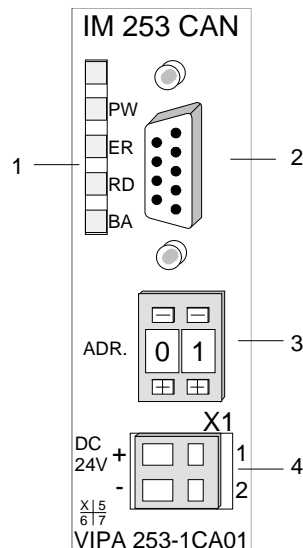
IM 253 CAN

PW
ER
RD
BA

1

2

ADR. 0 1

3

X1
DC
24V +
-
X 5
6 7
VIPA 253-1CA01

1
2

4

[1] LED status indicators
[2] CAN-Bus socket
[3] Address or baudrate selector
[4] Connector for an external 24V supply
[5] LEDs status indicator output unit
[6] 25pin jack for digital output

LEDs   The module is equipped with four LEDs for diagnostic purposes. The following table shows how the diagnostic LEDs are used along with the respective colors.

Name	Color	Description
PW	yellow	Indicates that the supply voltage is available.
ER	red	On when an error was detected in the backplane bus communications.
RD	green	Blinks at 1Hz when the self-test was positive and initialization was OK.
		Is turned on when data is being communicated via the V-Bus.
BA	yellow	Off the self-test was positive and the initialization was OK.
		Blinks at 1Hz when the status is "Pre-operational".
		Is turned on when the status is "Operational".
		Blinks at 10Hz when the status is "Prepared".

Status indicator as a combination of LEDs

Various combinations of the LEDs indicate the different operating states:

🟨	PW on	Error during RAM or EEPROM initialization
🟥	ER on	
🟩	RD on	
🟨	BA on	

🟨	PW on	Baudrate setting activated
❎	ER blinks 1Hz	
❎	RD blinks 1Hz	
❎	BA blinks 1Hz	

🟨	PW on	Error in the CAN baudrate setting
❎	ER blinks 10Hz	
❎	RD blinks 10Hz	
❎	BA blinks 10Hz	

🟨	PW on	Module-ID setting activated
⬜	ER off	
❎	RD blinks 1Hz	
⬜	BA off	

LEDs digital output unit

The digital output unit provides 2 LEDs with the following function:

Label	Color	Description
PW	yellow	Signalizes applying voltage via Profibus unit (Power).
ER	red	On at short circuit, overload and overheat

9pin D-type socket   The VIPA CAN-Bus coupler is connected to the CAN-Bus system by means of a 9pin socket.

The following diagram shows the pin assignment for the interface.
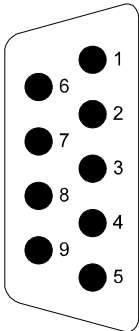
Pin	Assignment
1	n.c.
2	CAN low
3	CAN ground
4	n.c.
5	n.c.
6	optional ground
7	CAN high
8	n.c.
9	optional pos. supply

Output unit: The DC 24V voltage supply of the output section happens via the power
Connection and   supply of the slave unit.
schematic
diagram

Address selector for baudrate and module-ID
The address selector is used to specify the module-ID as well as the CAN baudrate.

For details please refer to the section under the heading "IM 253CAN - CANopen slave - Baudrate and module-" in this chapter.

Power supply
The CAN-bus coupler is equipped with an internal power supply. This power supply requires an external supply of DC 24V. In addition to the internal circuitry of the bus coupler the supply voltage is also used to power any devices connected to the backplane bus. Please note that the maximum current available for the backplane bus from the internal power supply is limited to 3.5A.

The power supply is protected against reverse polarity.

CAN-Bus and backplane bus are isolated from each other.

CAN-Bus wiring
The CAN-Bus communication medium bus is a screened three-core cable.
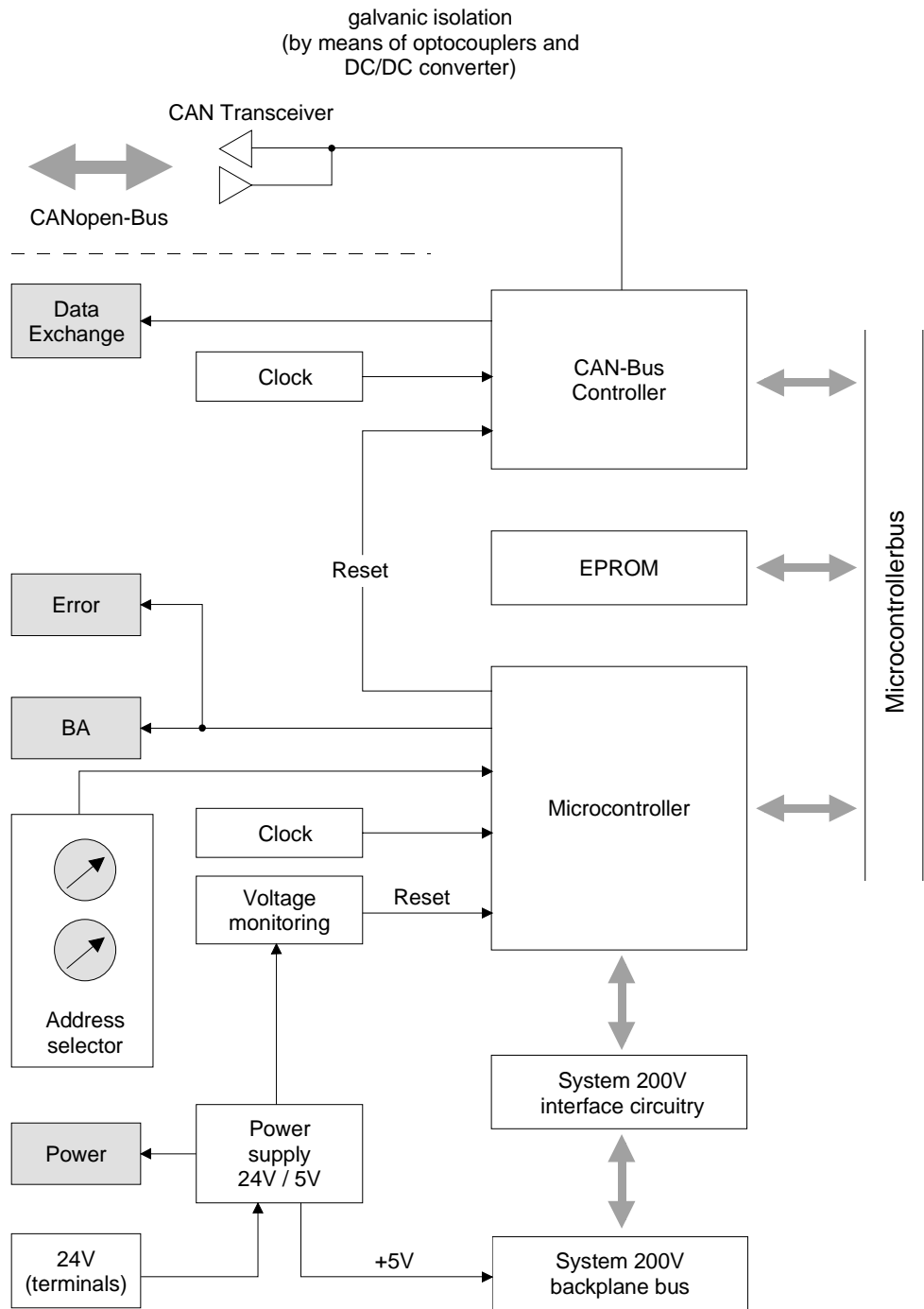

Line termination

All stations on systems having more than two stations are wired in parallel. This means that the bus cable must be looped from station to station without interruptions.

Note!

The end of the bus cable must be terminated with a 120Ω terminating resistor to prevent reflections and the associated communication errors!

IM 253CAN - CANopen slave - Fast introduction

Outline

This section is for experienced CANopen user that are already common with CAN. It will be shortly outlined, which messages are necessary for the deployment of the System 200V under CAN in the start configuration.

Note!

Please regard that this manual prints the hexadecimal numbers in the type for developers "0x".

e.g.: **0x**15AE = 15AE**h**

Adjusting baudrate and module-ID

Via the address selector you have to adjust a common baudrate at the bus couplers as well as different node-IDs.

After starting your power supply, you program the baudrate and the module-ID via 00 at the address selector within 10s.

For details please refer to the section under the heading "IM 253CAN - CANopen slave - Baudrate and module-" in this chapter.

CAN identifier

The CAN identifier for the in-/output data of the System 200V are generated from the node addresses (1...99):

Kind of data	Default CAN identifier	Kind of data	Default CAN identifier
digital inputs 1 ... 64Bit	0x180 + Node address	digital outputs 1 ... 64Bit	0x200 + Node address
analog inputs 1 ... 4 words	0x280 + Node address	analog outputs 1 ... 4 Words/Channels	0x300 + Node address
other digital or analog inputs	0x380 + Node address	other digital or analog outputs	0x400 + Node address
	0x480 + Node address		0x500 + Node address
	0x680 + Node address		0x780 + Node address
	0x1C0 + Node address		0x240 + Node address
	0x2C0 + Node address		0x340 + Node address
	0x3C0 + Node address		0x440 + Node address
	0x4C0 + Node address		0x540 + Node address
	0x6C0 + Node address		0x7C0 + Node address

Digital in-/outputs   The CAN messages with digital input data are represented as follows:

Identifier 0x180+Node address + up to 8Byte user data

Identifier 11Bit	**DI 0** 8Bit	**DI 1** 8Bit	**DI 2** 8Bit	**...**	**DI 7** 8Bit

The CAN messages with digital output data are represented as follows:

Identifier 0x200+Node address + up to 8Byte user data

Identifier 11Bit	**DO 0** 8Bit	**DO 1** 8Bit	**DO 3** 8Bit	**...**	**DO 7** Bit

Analog in-/outputs   The CAN messages with analog input data are represented as follows::

Identifier 0x280+Node address + up to 4Words user data

Identifier 11Bit	**AI 0** 1Word	**AI 1** 1Word	**AI 2** 1Word	**AI 3** 1Word

The CAN messages with analog output data are represented as follows:

Identifier 0x300+Node address + up to 4Words user data

Identifier 11Bit	**AI 0** 1Word	**AI 1** 1Word	**AI 2** 1Word	**AI 3** 1Word

Node Guarding   For the System 200V works per default in event-controlled mode (no cyclic DataExchange), a node failure is not always immediately detected. Remedy is the control of the nodes per cyclic state request (Node Guarding).

You request cyclically a state telegram via Remote-Transmit-Request (RTR): the telegram only consists of a 11Bit identifier:

Identifier 0x700+Node address

Identifier 11Bit

The System 200V node answers with a telegram that contains one state byte:

Identifier 0x700+Node address + State byte

Identifier 11Bit	**Status** 8Bit

Bit 0 ... 6:   Node state
            0x7F: Pre-Operational
            0x05: Operational
            0x04: Stopped res. Prepared
Bit 7:   Toggle-Bit, toggles after every send

To enable the bus coupler to recognize a network master failure (watchdog function), you still have to set the Guard-Time (Object 0x100C) and the Life-Time-Factor (Object 0x100D) to values≠0.

(reaction time at failure: Guard-Time x Life Time Factor).

Heartbeat   Besides the Node Guarding, the System 200V CANopen coupler also
                       supports the Heartbeat Mode.

                       If there is a value set in the index 0x1017 (Heartbeat Producer Time), the
                       device state (Operational, Pre-Operational, ...) is transferred when the
                       Heartbeat-Timer run out by using the COB identifier (0x700+Module-Id):

                       Identifier 0x700+Node address + State byte

Identifier 11Bit	**Status** 8Bit

                       The Heartbeat Mode starts automatically as soon as there is a value in
                       index 0x1017 higher 0.

Emergency Object   To send internal device failures to other participants at the CAN-Bus with a
                       high priority, the VIPA CAN-Bus coupler supports the Emergency Object.

                       To activate the emergency telegram, you need the **COB-Identifier** that is
                       fixed after boot-up in the object directory of the variable 0x1014in
                       hexadecimal view: **0x80 + Module-ID.**

                       The emergency telegram has always a length of 8Byte. It consists of:

                       Identifier 0x80 + Node address + 8Byte user data

Identifier 11Bit	**EC0**	**EC1**	**Ereg**	**Inf0**	**Inf1**	**Inf2**	**Inf3**	**Inf4**

Error Code	Meaning	Info 0	Info 1	Info 2	Info 3	Info4
0x0000	Reset Emergency	0x00	0x00	0x00	0x00	0x00
0x1000	Module Configuration has changed and Index 0x1010 is equal to 'save'	0x06	0x00	0x00	0x00	0x00
0x1000	Module Configuration has changed	0x05	0x00	0x00	0x00	0x00
0x1000	Error during initialization of backplane modules	0x01	0x00	0x00	0x00	0x00
0x1000	Error during module configuration check	0x02	Module Number	0x00	0x00	0x00
0x1000	Error during read/write module	0x03	Module Number	0x00	0x00	0x00
0x1000	Module parameterization error	0x30	Module Number	0x00	0x00	0x00
0x1000	Diagnostic alarm from an analog module	0x40 + Module Number	diagnostic byte 1	diagnostic byte 2	diagnostic byte 3	diagnostic byte 4
0x1000	Process alarm from an analog module	0x80 + Module Number	diagnostic byte 1	diagnostic byte 2	diagnostic byte 3	diagnostic byte 4
0x1000	PDO Control	0xFF	0x10	PDO Number	LowByte Timer Value	HighByte Timer Value
0x5000	Module					
0x6300	SDO PDO-Mapping	LowByte MapIndex	HighByte MapIndex	No. Of Map Entries	0x00	0x00
0x8100	Heartbeat Consumer	Node ID	LowByte Timer Value	HighByte Timer Value	0x00	0x00
0x8100	SDO Block Transfer	0xF1	LowByte Index	HighByte Index	SubIndex	0x00
0x8130	Node Guarding Error	LowByte GuardTime	HighByte GuardTime	LifeTime	0x00	0x00
0x8210	PDO not processed due to length error	PDO Number	Wrong length	PDO length	0x00	0x00
0x8220	PDO length exceeded	PDO Number	Wrong length	PDO length	0x00	0x00

Note!

The now described telegrams enable you to start and stop the System 200V, read inputs, write outputs and control the modules.

In the following, the functions are described in detail.

IM 253CAN - CANopen slave - Baudrate and module-ID

Outline

You have the option to specify the baudrate and the module-ID by setting the address selector to 00 within a period of 10s after you have turned the power on.

The selected settings are saved permanently in an EEPROM and can be changed at any time by means of the procedure shown above.

Specifying the baudrate by means of the address selector

- Set the address selector to 00.
- Turn on the power to the CAN-Bus coupler.

  The LEDs ER, RD, and BA will blink at a frequency of 1Hz. For a period of 5s you can now enter the CAN baudrate by means of the address selector:
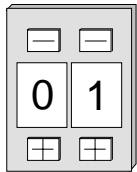
Address selector	CAN baudrate	max. guar. bus distance
"00"	1Mbaud	25m
"01"	500kBaud	100m
"02"	250kBaud	250m
"03"	125kBaud	500m
"04"	100kBaud	600m
"05"	50kBaud	1000m
"06"	20kBaud	2500m
"07"	10kBaud	5000m
"08"	800kBaud	50m

After 5 seconds the selected CAN baudrate is saved in the EEPROM.

Module-ID selection

LEDs ER and BA are turned off and the red RD-LED continues to blink.

At this point you have 5s to enter the required module-ID.

- Define the module-ID in a range between 01...99 by means of the address selection switch. Every module-ID may only exist once on the bus. The module-ID must be defined before the bus coupler is turned on.

  The entered module-IDs are accepted when a period of 5s has expired after which the bus coupler returns to the normal operating mode (status: "Pre-Operational").

Baudrate selection by an SDO-write operation

You can also modify the CAN baudrate by means of an SDO-Write operation to the object "2001h". The entered value is used as the CAN baudrate when the bus coupler has been RESET. This method is a most convenient when you must change the CAN baudrate of all the bus couplers of a system from a central CAN terminal. The bus couplers use the programmed Baudrate when the system has been RESET.

IM 253CAN - CANopen slave - Message structure

Identifier   All CANopen messages have the following structure according to CiA DS-301:

Identifier

Byte	Bit 7 ... Bit 0
1	Bit 3 ... Bit 0: most significant 4 bits of the module-ID
	Bit 7 ... Bit 4: CANopen function code
2	Bit 3 ... Bit 0: data length code (DLC)
	Bit 4: RTR-Bit: 0: no data (request code)
	1: data available
	Bit 7 ... Bit 5: Least significant 3 bits of the module-ID

Data   *Data*

Byte	Bit 7 ... Bit 0
3 ... 10	Data

An additional division of the 2Byte identifier into function portion and a module-ID gives the difference between this and a level 2 message. The function determines the type of message (object) and the module-ID addresses the receiver.

CANopen devices exchange data in the form of objects. The CANopen communication profile defines two different object types as well as a number of special objects.

The VIPA CAN-Bus coupler IM 253 CAN supports the following objects:

- 10 transmit PDOs (PDO Linking, PDO Mapping)
- 10 receive PDOs (PDO Linking, PDO Mapping)
- 2 standard SDOs
- 1 emergency object
- 1 network management object NMT
- Node Guarding
- Heartbeat

The VIPA CAN-Bus coupler IM 253 CAN with DO 24xDC 24V supports the following objects:

- 1 receive PDO (PDO Linking, PDO Mapping: fix)
- 2 standard SDOs
- 1 emergency object
- 1 network management object NMT
- Node Guarding
- Heartbeat

CANopen function codes

Every object is associated with a function code. You can obtain the required function code from the following table:

Object	Function code (4 bits)	Receiver	Definition	Function
NMT	0000	Broadcast	CiA DS-301	Network managem.
EMERGENCY	0001	Master	CiA DS-301	Error message
PDO1S2M	0011	Master, Slave (RTR)	CiA DS-301	Digital input data 1
PDO1M2S	0100	Slave	CiA DS-301	Digital output data 1
SDO1S2M	1011	Master	CiA DS-301	Configuration data
SDO1M2S	1100	Slave	CiA DS-301	Configuration data
Node Guarding	1110	Master, Slave (RTR)	CiA DS-301	Module monitoring
Heartbeat	1110	Master, Slave	Application spec.	Module monitoring

Note!

A detailed description of the structure and the contents of these objects is available in "CiA Communication Profile DS-301 Version 3.0" and "CiA Device Profile for I/O-Modules DS-401 Version 1.4".

Structure of the device model

A CANopen device can be structured as follows:

Communication

Serves the communication data objects and the concerning functionality for data transfer via the CANopen network.

Application

The application data objects contain e.g. in- and output data. In case of an error, an application status machine switches the outputs in a secure state.

The object directory is organized as 2 dimension table. The data is addressed via index and sub-index.

Object directory

This object directory contains all data objects (application data + parameters) that are accessible and that influence the behavior of communication, application and status machines.

IM 253CAN - CANopen slave - PDO

PDO

In many fieldbus systems the whole process image is transferred - mostly more or less cyclically. CANopen is not limited to this communication principle, for CAN supports more possibilities through multi master bus access coordination.

CANopen divides the process data into segments of max. 8Byte. These segments are called **p**rocess **d**ata **o**bjects (PDOs). Every PDO represents one CAN telegram and is identified and prioritized via its specific CAN identifier.

For the exchange of process data, the VIPA CAN-Bus coupler IM 253CAN supports 20 PDOs. Every PDO consists of a maximum of 8 data bytes. The transfer of PDOs is not verified by means of acknowledgments since the CAN protocol guarantees the transfer.

There are 10 Tx transmit PDOs for input data and 10 Rx receive PDOs for output data. The PDOs are named seen from the bus coupler:

Receive PDOs (RxPDOs) are received by the bus coupler and contain output data.

Transmit PDOs (TxPDOs) are send by the bus coupler and contain input data.

The assignment of the PDOs to input or output data occurs automatically.

Variable PDO mapping

CANopen predefines the first two PDOs in the device profile. The assignment of the PDOs is fixed in the mapping tables in the object directory. The mapping tables are the cross-reference between the application data in the object directory and the sequence in the PDOs.

The assignment of the PDOs, automatically created by the coupler, are commonly adequate. For special applications, the assignment may be changed. Herefore you have to configure the mapping tables accordingly.

First, you write a 0 to sub-index 0 (deactivates the current mapping configuration). Then you insert the wanted application objects into sub-index 1...8. Finally you parameterize the number of now valid entries in sub-index 0 and the coupler checks the entries for their consistency.

Note!

The IM 253CAN with DO 24xDC 24V provides only 1 receive PDO, the PDO mapping is fix.

**PDO identifier
COB-ID**

The most important communication parameter of a PDOs is the CAN identifier (also called "Communication Object Identifier", COB-ID). It serves the identification of the data and sets the priority of bus access.

For every CAN data telegram only one sending node may exist (producer). Due to the ability of CAN to send all messages per broadcast procedure, however, a telegram may be received by several bus participants at the same time (consumer). Therefore, one node may deliver its input information to different bus stations similarly - without needing the pass through a logical bus master.

The System 200V provides receive and transmit PDOs default identifier in dependence of the node address.

Below follows a list of the **COB identifiers** for the receive and the transmit PDO transfer that are pre-set after boot-up.

The transmission type in the object directory (indices 0x1400-0x1409 and 0x1800-0x1809, sub-index 0x02) is preset to asynchronous, event controlled (= 0xFF). The EVENT-timer (value * 1ms) can be used to transmit the PDOs cyclically.

Send: 0x180 + module-ID: PDO1S2M digital   (acc. DS-301)
               0x280 + module-ID: PDO2S2M analog
               0x380 + module-ID: PDO3S2M digital or analog
               0x480 + module-ID: PDO4S2M
               0x680 + module-ID: PDO5S2M
               0x1C0 + module-ID: PDO6S2M
               0x2C0 + module-ID: PDO7S2M
               0x3C0 + module-ID: PDO8S2M
               0x4C0 + module-ID: PDO9S2M
               0x6C0 + module-ID: PDO10S2M

Receive: 0x200 + module-ID: PDO1M2S digital   (acc. DS-301)
               0x300 + module-ID: PDO2M2S analog
               0x400 + module-ID: PDO3M2S digital or analog
               0x500 + module-ID: PDO4M2S
               0x780 + module-ID: PDO5M2S
               0x240 + module-ID: PDO6M2S
               0x340 + module-ID: PDO7M2S
               0x440 + module-ID: PDO8M2S
               0x540 + module-ID: PDO9M2S
               0x7C0 + module-ID: PDO10M2S

PDO linking   If the Consumer-Producer model of the CANopen PDOs shall be used for direct data transfer between nodes (without master), you have to adjust the identifier distribution accordingly, so that the TxPDO identifier of the producer is identical with the RxPDO identifier of the consumer:

This procedure is called PDO linking. this enables for example the simple installation of electronic gearing where several slave axis are listening to the actual value in TxPDO of the master axis.

PDO Communica-tion types   CANopen supports the following possibilities for the process data transfer:

- Event triggered
- Polled
- Synchronized

Event triggered   The "event" is the alteration of an input value, the data is send immediately after value change. The event control makes the best use of the bus width for not the whole process image is send but only the changed values. At the same time, a short reaction time is achieved, because there is no need to wait for a master request.

Polled   PDOs may also be polled via data request telegrams (remote frames) to give you the opportunity to e.g. send the input process image of event triggered inputs to the bus without input change for example a monitoring or diagnosis device included during runtime.

The VIPA CANopen bus couplers support the query of PDOs via remote frames - for this can, due to the hardware, not be granted for all CANopen devices, this communication type is only partially recommended.

Synchronized   It is not only convenient for drive applications to synchronize the input information request and the output setting. For this purpose, CANopen provides the SYNC object, a CAN telegram with high priority and no user data which receipt is used by the synchronized nodes as trigger for reading of the inputs res. writing of the outputs.

PDO transmission type

The parameter "PDO transmission type" fixes how the sending of the PDOs is initialized and what to do with received ones:

Transmission Type	Cyclical	Acyclical	Synchronous	Asynchronous
0		x	x	
1-240	x		x	
254,255				x

Synchronous

The transmission type 0 is only wise for RxPDOs: the PDO is analyzed at receipt of the next SYNC telegram.

At transmission type 1-240, the PDO is send res. expected cyclically: after every "n^{th}" SYNC (n=1...240). For the transmission type may not only be combined within the network but also with a bus, you may thus e.g. adjust a fast cycle for digital inputs (n=1), while data of the analog inputs is transferred in a slower cycle (e.g. n=10). The cycle time (SYNC rate) may be monitored (Object 0x1006), at SYNC failure, the coupler sets its outputs in error state.

Asynchronous

The transmission types 254 + 255 are asynchronous or also event triggered. The transmission type 254 provides an event defined by the manufacturer, at 255 it is fixed by the device profile.

When choosing the event triggered PDO communication you should keep in mind that in certain circumstances there may occur a lot of events similarly. This may cause according delay times for sending PDOs with lower priority values.

You should also avoid to block the bus by assigning a high PDO priority to an often alternating input ("babbling idiot").

Inhibit time

Via the parameter "inhibit time" a "send filter" may be activated that does not lengthen the reaction time of the relatively first input alteration but that is active for the following changes.

The inhibit time (send delay time) describes the min. time span that has to pass between the sending of two identical telegrams.

When you use the inhibit time, you may ascertain the max. bus load and for this the latent time in the "worst case".

IM 253CAN - CANopen slave - SDO

SDO
The **S**ervice **D**ata **O**bject (SDO) serves the read or write access to the object directory. The CAL layer 7 protocol gives you the specification of the Multiplexed-Domain-Transfer-Protocol that is used by the SDOs. This protocol allows you to transfer data of any length because where appropriate, messages are distributed to several CAN messages with the same identifier (segment building).

The first CAN message of the SDO contain process information in 4 of the 8 bytes. For access to object directory entries with up to 4Byte length, one single CAN message is sufficient. The following segments of the SDO contain up to 7Byte user data. The last Byte contains an end sign. A SDO is delivered with acknowledgement, i.e. every reception of a message is receipted.

The COB identifiers for read and write access are:
- Receive-SDO1: 0x600 + Module-ID
- Transmit-SDO1: 0x580 + Module-ID

Note!

A detailed description of the SDO telegrams is to find in the DS-301 norm from CiA.

In the following only the error messages are described that are generated at wrong parameterization.

SDO error codes

Code	Error
0x05030000	Toggle bit not alternated
0x05040000	SDO protocol timed out
0x05040001	Client/server command specifier not valid or unknown
0x05040002	Invalid block size (block mode only)
0x05040003	Invalid sequence number (block mode only)
0x05040004	CRC error (block mode only)
0x05040005	Out of memory
0x06010000	Unsupported access to an object
0x06010001	Attempt to read a write only object
0x06010002	Attempt to write a read only object
0x06020000	Object does not exist in the object dictionary
0x06040041	Object cannot be mapped to the PDO
0x06040042	The number and length of the objects to be mapped would exceed PDO length
0x06040043	General parameter incompatibility reason
0x06040047	General internal incompatibility in the device
0x06060000	Access failed due to an hardware error
0x06070010	Data type does not match, length of service parameter does not match
0x06070012	Data type does not match, length of service parameter too high
0x06070013	Data type does not match, length of service parameter too low
0x06090011	Sub-index does not exist
0x06090030	Value range of parameter exceeded (only for write access)
0x06090031	Value of parameter written too high
0x06090032	Value of parameter written too low
0x06090036	Maximum value is less than minimum value
0x08000000	general error
0x08000020	Data cannot be transferred or stored to the application
0x08000021	Data cannot be transferred or stored to the application because of local control
0x08000022	Data cannot be transferred or stored to the application because of the present device state
0x08000023	Object directory dynamic generation fails or no object directory is present (e.g. object directory is generated from file and generation fails because of an file error)

IM 253CAN - CANopen slave - Object directory

Structure

The CANopen object directory contains all relevant CANopen objects for the bus coupler. Every entry in the object directory is marked by a 16Bit index.

If an object exists of several components (e.g. object type Array or Record), the components are marked via an 8Bit sub-index.

The object name describes its function. The data type attribute specifies the data type of the entry.

The access attribute defines, if the entry may only be read, only be written or read and written.

The object directory is divided into the following 3 parts:

Communication specific profile area (0x1000 – 0x1FFF)

This area contains the description of all relevant parameters for the communication.

0x1000 – 0x1011	General communication specific parameters (e.g. device name)
0x1400 – 0x140F	Communication parameters (e.g. identifier) of the receive PDOs
0x1600 – 0x160F	Mapping parameters of the receive PDOs
	The mapping parameters contain the cross-references to the application objects that are mapped into the PDOs and the data width of the depending object.
0x1800 – 0x180F 0x1A00 – 0x1A0F	Communication and mapping parameters of the transmit PDOs

Manufacturer specific profile area (0x2000 – 0x5FFF)

Here you may find the manufacturer specific entries like e.g. PDO Control, CAN baudrate (baudrate after RESET) etc.

Standardized device profile area (0x6000 – 0x9FFF)

This area contains the objects for the device profile acc. DS-401.

Note!

For the CiA norms are exclusively available in English, we adapted the object tables. Some entries are described below the according tables.

Object directory overview

Index		Content of Object
0x1000		Device type
0x1001		Error register
0x1003		Error store
0x1004		Number of PDOs
0x1005		SYNC identifier
0x1006		SYNC interval
0x1008		Device name
0x1009		Hardware version
0x100A		Software version
0x100B		Node number
0x100C		Guard time
0x100D		Life time factor
0x100E		Node Guarding Identifier
0x1010	X	Save parameter
0x1011	X	Load parameter
0x1014		Emergency COB-ID
0x1016	X	Heartbeat consumer time
0x1017	X	Heartbeat producer time
0x1018		Device identification
0x1027		Module list
0x1029		Error behavior
0x1400 - 0x1409	X	Communication parameter for receive PDOs (RxPDO, Master to Slave)
0x1600 - 0x1609	X	Mapping parameter for receive PDOs (RxPDO)
0x1800 - 0x1809	X	Communication parameter for transmit PDOs (TxPDO, Slave to Master)
0x1A00 - 0x1A09	X	Mapping parameter for transmit PDOs (TxPDO)
0x2001		CAN-Baudrate
0x2100		Kill EEPROM
0x2101		SJA1000
0x2400	X	PDO Control
0x3001 - 0x3010	X	Module Parameterization
0x3401	X	Module Parameterization
0x6000		Digital-Input-8-Bit Array (see DS 401)
0x6002	X	Polarity Digital-Input-8-Bit Array (see DS 401)
0x6100		Digital-Input-16-Bit Array (see DS 401)
0x6102		Polarity Digital-Input-16-Bit Array (v DS 401)
0x6120		Digital-Input-32Bit Array (see DS 401)
0x6122		Polarity Digital-Input-32-Bit Array (see DS 401)
0x6200		Digital-Output-8-Bit Array (see DS 401)
0x6202	X	Polarity Digital-Output-8-Bit Array (see DS 401)
0x6206	X	Fault Mode Digital-Output-8-Bit Array (see DS 401)
0x6207	X	Fault State Digital-Output-8-Bit Array (see DS 401)
0x6300		Digital-Output-16-Bit Array (see DS 401)

**... continued
object directory
overview**

Index		Content of Object
0x6302		Polarity Digital-Output-16-Bit Array (see DS 401)
0x6306		Fault Mode Digital-Output-16-Bit Array (see DS 401)
0x6307		Fault State Digital-Output-16-Bit Array (see DS 401)
0x6320		Digital-Output-32-Bit Array (see DS 401)
0x6322		Polarity Digital-Output-32-Bit Array (see DS 401)
0x6326		Fault Mode Digital-Output-32-Bit Array (see DS 401)
0x6327		Fault State Digital-Output-32-Bit Array (see DS 401)
0x6401		Analog-Input Array (see DS 401)
0x6411		Analog-Output Array (see DS 401)
0x6421	X	Analog-Input Interrupt Trigger Array (see DS 401)
0x6422		Analog-Input Interrupt Source Array (see DS 401)
0x6423	X	Analog-Input Interrupt Enable (see DS 401)
0x6424	X	Analog-Input Interrupt Upper Limit Array (see DS 401)
0x6425	X	Analog-Input Interrupt Lower Limit Array (see DS 401)
0x6426	X	Analog-Input Interrupt Delta Limit Array (see DS 401)
0x6443	X	Fault Mode Analog-Output Array (see DS 401)
0x6444	X	Fault State Analog-Output Array (see DS 401)

X = save into EEPROM

Device Type

Index	Sub-index	Name	Type	Attr.	Map.	Default value	Meaning
0x1000	0	Device Type	Unsigned32	ro	N	0x00050191	Statement of device type

The 32Bit value is divided into two 16Bit fields:

MSB	LSB
Additional information device	**Profile number**
0000 0000 0000 wxyz (bit)	401dec=0x0191

The "additional information" contains data related to the signal types of the I/O device:

z=1 → digital inputs

y=1 → digital outputs

x=1 → analog inputs

w=1 → analog outputs

Error register

Index	Sub-index	Name	Type	Attr.	Map.	Default value	Meaning
0x1001	0	Error Register	Unsigned8	ro	Y	0x00	Error register

Bit7							**Bit0**
ManSpec	reserved	reserved	Comm.	reserved	reserved	reserved	Generic

ManSpec.: Manufacturer specific error, specified in object 0x1003.

Comm.:   Communication error (overrun CAN)

Generic: A not more precisely specified error occurred (flag is set at every error message)

Error store

Index	Sub-index	Name	Type	Attr.	Map.	Default value	Meaning
0x1003	0	Predefined error field (error store)	Unsigned8	ro	N	0x00	Object 0x1003 contains a description of the error that has occurred in the device - sub-index 0 has the number of error states stored
	1	Actual error	Unsigned32	ro	N		Last error state to have occurred
	...	...	...	...	...	...	...
	254		Unsigned32	ro	N		A maximum of 254 error states

The "predefined error field" is divided into two 16Bit fields:

MSB	LSB
Additional information	**Error code**

The additional code contains the error trigger (see emergency object) and thereby a detailed error description.

New errors are always saved at sub-index 1, all the other sub-indices being appropriately incremented.

By writing a "0" to sub-index 0, the whole error memory is cleared. If there has not been an error since PowerOn, then object 0x1003 exists only of sub-index 0 with entry "0".

Via reset or PowerCycle, the error memory is cleared.

Number of PDOs

Index	Sub index	Name	Type	Attr.	Map.	Default value	Meaning
0x1004	0	Number of PDOs supported	Unsigned32	ro	N	0x000A000A	Number of PDOs supported
	1	Number of synchronous PDOs supported	Unsigned32	ro	N	0x000A000A	Number of synchronous PDOs supported
	2	Number of asynchronous PDOs supported	Unsigned32	ro	N	0x000A000A	Number of asynchronous PDOs supported

The 32Bit value is divided into two 16Bit fields:

MSB	LSB
Number of receive (Rx)PDOs supported	**Number of send (Tx)PDOs supported**

SYNC identifier

Index	Sub index	Name	Type	Attr.	Map.	Default value	Meaning
0x1005	0	COB-Id sync message	Unsigned32	ro	N	0x80000080	Identifier of the SYNC message

The lower 11Bit of the 32Bit value contain the identifier (0x80=128dez), while the MSBit indicates whether the device receives the SYNC telegram (1) or not (0).

Attention: In contrast to the PDO identifiers, the MSB being set indicates that this identifier is relevant for the node.

SYNC interval

Index	Sub index	Name	Type	Attr.	Map.	Default value	Meaning
0x1006	0	Communication cycle period	Unsigned32	rw	N	0x00000000	Maximum length of the SYNC interval in µs.

If a value other than zero is entered here, the coupler goes into error state if no SYNC telegram is received within the set time during synchronous PDO operation.

Synchronous Window Length

Index	Sub index	Name	Type	Attr.	Map.	Default value	Meaning
0x1007	0	Synchronous window length	Unsigned32	rw	N	0x00000000	Contains the length of time window for synchronous PDOs in µs.

Device name

Index	Sub-index	Name	Type	Attr.	Map.	Default value	Meaning
0x1008	0	Manufacturer device name	Visible string	ro	N		Device name of the bus coupler

VIPA IM 253 1CA01 = VIPA CANopen slave IM253-1CA01

Since the returned value is longer than 4Byte, the segmented SDO protocol is used for transmission.

Hardware version

Index	Sub-index	Name	Type	Attr.	Map.	Default value	Meaning
0x1009	0	Manufacturer Hardware version	Visible string	ro	N		Hardware version number of bus coupler

VIPA IM 253 1CA01 = 1.00

Since the returned value is longer than 4Byte, the segmented SDO protocol is used for transmission.

Software version

Index	Sub-index	Name	Type	Attr.	Map.	Default value	Meaning
0x100A	0	Manufacturer Software version	Visible string	ro	N		Software version number CANopen software

VIPA IM 253 1CA01 = 3.xx

Since the returned value is longer than 4Byte, the segmented SDO protocol is used for transmission.

Node number

Index	Sub-index	Name	Type	Attr.	Map.	Default value	Meaning
0x100B	0	Node ID	Unsigned32	ro	N	0x00000000	Node number

The node number is supported for reasons of compatibility.

Guard time

Index	Sub-index	Name	Type	Attr.	Map.	Default value	Meaning
0x100C	0	Guard time [ms]	Unsigned16	rw	N	0x0000	Interval between two guard telegrams. Is set by the NMT master or configuration tool.

Life time factor

Index	Sub-index	Name	Type	Attr.	Map.	Default value	Meaning
0x100D	0	Life time factor	Unsigned8	rw	N	0x00	Life time factor x guard time = life time (watchdog for life guarding)

If a guarding telegram is not received within the life time, the node enters the error state. If the life time factor and/or guard time =0, the node does not carry out any life guarding, but can itself be monitored by the master (node guarding).

Guarding identifier

Index	Sub-index	Name	Type	Attr.	Map.	Default value	Meaning
0x100E	0	COB-ID Guarding Protocol	Unsigned32	ro	N	0x000007xy, xy = node ID	Identifier of the guarding protocol

Save parameters

Index	Sub-index	Name	Type	Attr.	Map.	Default value	Meaning
0x1010	0	Store Parameter	Unsigned8	ro	N	0x01	Number of store Options
	1	Store all parameters	Unsigned32	ro	rw	0x01	Stores all (storable) Parameters

By writing the string "save" in ASCII code (hex code: 0x65766173) into sub-index 1, the current parameters are placed into non-volatile storage (byte sequence at the bus incl. SDO protocol: 0x23 0x10 0x10 0x01 0x73 0x61 0x76 0x65).

If successful, the storage process is confirmed by the corresponding TxSDO (0x60 in the first byte).

Note!

For the bus coupler is not able to send or receive CAN telegrams during the storage procedure, storage is only possible when the node is in pre-operational state.

It is recommended to set the complete net to the pre-operational state before storing data to avoid a buffer overrun.

**Load default
values**

Index	Sub-index	Name	Type	Attr.	Map.	Default value	Meaning
0x1011	0	Restore parameters	Unsigned8	ro	N	0x01	Number of reset options
	1	Restore all parameters	Unsigned32	rw	N	0x01	Resets all parameters to their default values

By writing the string "load" in ASCII code (hex code: 0x64616F6C) into sub-index 1, all parameters are set back to default values (delivery state) **at next start-up (reset)** (byte sequence at the bus incl. SDO protocol: 0x23 0x11 0x10 0x01 0x6C 0x6F 0x61 0x64).

This activates the default identifiers for the PDOs.

**Emergency
COB-ID**

Index	Sub-index	Name	Type	Attr.	Map.	Default value	Meaning
0x1014	0	COB-ID Emergency	Unsigned32	ro	N	0x00000080 + Node_ID	Identifier of the emergency telegram

**Consumer
heartbeat time**

Index	Sub-index	Name	Type	Attr.	Map.	Default value	Meaning
0x1016	0	Consumer heartbeat time	Unsigned8	ro	N	0x05	Number of entries
	1		Unsigned32	rw	N	0x00000000	Consumer heartbeat time

Structure of the "Consumer Heartbeat Time" entry:

Bits	31-24	23-16	15-0
Value	Reserved	Node-ID	Heartbeat time
Encoded as	Unsigned8	Unsigned8	Unsigned16

As soon as you try to configure a consumer heartbeat time unequal zero for the same node-ID, the node interrupts the SDO download and throws the error code 0604 0043hex.

**Producer
heartbeat time**

Index	Sub-index	Name	Type	Attr.	Map.	Default value	Meaning
0x1017	0	Producer heartbeat time	Unsigned16	rw	N	0x0000	Defines the cycle time of heartbeat in ms

Identity Object

Index	Sub-index	Name	Type	Attr.	Map.	Default value	Meaning
0x1018	0	Identity Object	Unsigned8	ro	N	0x04	Contains general information about the device (number of entries)
	1	Vendor ID	Unsigned32	ro	N	0xAFFEAFFE	Vendor ID
	2	Product Code	Unsigned32	ro	N	0x2531CA01	Product Code
	3	Revision Number	Unsigned32	ro	N		Revision Number
	4	Serial Number	Unsigned32	ro	N		Serial Number

Modular Devices

Index	Sub-index	Name	Type	Attr.	Map.	Default value	Meaning
0x1027	0	Number of connected modules	Unsigned8	ro	N		Contains general information about the device (number of entries)
	1	Module 1	Unsigned16	ro	N		Identification number of Module 1
	...	...	...	...	...	...	...
	N	Module N	Unsigned16	ro	N		Identification number of Module N

Module types

I/O-Module type	Identification (hex)	No. of Digital-Input-Bytes	No. of Analog-Input-Bytes	No. of Digital-Output-Bytes	No. of Analog-Output-Bytes
DI 8xDC24V	0x9FC1	1	-	-	-
DI 16xDC24V	0x9FC2	2	-	-	-
DI 14xDC24V/2C	0x08C0	2	4	-	6
DI 32xDC24V	0x9FC4	4	-	-	-
DO 8xDC24V	0xAFC8	-	-	1	-
DO 16xDC24V	0xAFD0	-	-	2	-
DO 32xDC24V	0xAFD8	-	-	4	-
DIO 8xDC24V	0xBFC9	1	-	1	-
DIO 16xDC24V	0xBFD2	2	-	2	-
AI2x12Bit	0x15C3	-	4	-	-
AI4x12Bit	0x15C4	-	8	-	-
AI8x12Bit	0x15C5	-	16	-	-
AO4x12Bit	0xA5E0	-	-	-	8
AI2/AO2x12Bit	0x45DB	-	4	-	4
CP 240	0x1CC1	16	-	16	-
FM 250	0xB5F4	-	10	-	10
FM 250-SSI	0xB5DB	-	4	-	4
FM 253,FM 254	0x18CB	-	12	-	12

Error Behavior

Index	Sub-index	Name	Type	Attr.	Map.	Default value	Meaning
0x1029	0	Error behavior	Unsigned8	ro	N	0x02	Number of Error Classes
	1	Communication Error	Unsigned8	ro	N	0x00	Communication Error
	2	Manufacturer specific error	Unsigned8	ro	N	0x00	Manufacturer specific error

As soon as a device failure is detected in "operational" state, the module should automatically change into the "pre-operational" state.

If e.g. an "Error behavior" is implemented, the module may be configured that its going into STOP at errors.

The following error classes may be monitored:

0 = pre-operational

1 = no state change

2 = stopped

3 = reset after 2 seconds

**Communication
parameter RxPDO1**

Index	Sub-index	Name	Type	Attr.	Map.	Default value	Meaning
0x1400	0	Number of Elements	Unsigned8	ro	N	0x02	Communication parameter for the first receive PDOs, sub-index 0: number of following parameters
	1	COB-ID	Unsigned32	rw	N	0xC0000200 + NODE_ID	COB-ID RxPDO1
	2	Transmission type	Unsigned8	rw	N	0xFF	Transmission type of the PDO

Sub-index 1 (COB-ID): The lower 11Bit of the 32Bit value (Bits 0-10) contain the CAN identifier, the MSBit (Bit 31) shows if the PDO is active (1) or not(0), Bit 30 shows if a RTR access to this PDO is permitted (0) or not (1).

The sub-index 2 contains the transmission type.

**Communication
parameter RxPDO2**

Index	Sub-index	Name	Type	Attr.	Map.	Default value	Meaning
0x1401	0	Number of Elements	Unsigned8	ro	N	0x02	Communication parameter for the first receive PDOs, sub-index 0: number of following parameters
	1	COB-ID	Unsigned32	rw	N	0xC0000300 + NODE_ID	COB-ID RxPDO2
	2	Transmission type	Unsigned8	rw	N	0xFF	Transmission type of the PDO

**Communication
parameter RxPDO3**

Index	Sub-index	Name	Type	Attr.	Map.	Default value	Meaning
0x1402	0	Number of Elements	Unsigned8	ro	N	0x02	Communication parameter for the first receive PDOs, sub-index 0: number of following parameters
	1	COB-ID	Unsigned32	rw	N	0xC0000400 + NODE_ID	COB-ID RxPDO3
	2	Transmission type	Unsigned8	rw	N	0xFF	Transmission type of the PDO

**Communication
parameter RxPDO4**

Index	Sub-index	Name	Type	Attr.	Map.	Default value	Meaning
0x1403	0	Number of Elements	Unsigned8	ro	N	0x02	Communication parameter for the first receive PDOs, sub-index 0: number of following parameters
	1	COB-ID	Unsigned32	rw	N	0xC0000500 + NODE_ID	COB-ID RxPDO4
	2	Transmission type	Unsigned8	rw	N	0xFF	Transmission type of the PDO

**Communication
parameter RxPDO5**

Index	Sub-index	Name	Type	Attr.	Map.	Default value	Meaning
0x1404	0	Number of Elements	Unsigned8	ro	N	0x02	Communication parameter for the first receive PDOs, sub-index 0: number of following parameters
	1	COB-ID	Unsigned32	rw	N	0xC0000780 + NODE_ID	COB-ID RxPDO5
	2	Transmission type	Unsigned8	rw	N	0xFF	Transmission type of the PDO

**Communication
parameter RxPDO6**

Index	Sub-index	Name	Type	Attr.	Map.	Default value	Meaning
0x1405	0	Number of Elements	Unsigned8	ro	N	0x02	Communication parameter for the first receive PDOs, sub-index 0: number of following parameters
	1	COB-ID	Unsigned32	rw	N	0xC0000240 + NODE_ID	COB-ID RxPDO6
	2	Transmission type	Unsigned8	rw	N	0xFF	Transmission type of the PDO

**Communication
parameter RxPDO7**

Index	Sub-index	Name	Type	Attr.	Map.	Default value	Meaning
0x1406	0	Number of Elements	Unsigned8	ro	N	0x02	Communication parameter for the first receive PDOs, sub-index 0: number of following parameters
	1	COB-ID	Unsigned32	rw	N	0xC0000340 + NODE_ID	COB-ID RxPDO7
	2	Transmission type	Unsigned8	rw	N	0xFF	Transmission type of the PDO

**Communication
parameter RxPDO8**

Index	Sub-index	Name	Type	Attr.	Map.	Default value	Meaning
0x1407	0	Number of Elements	Unsigned8	ro	N	0x02	Communication parameter for the first receive PDOs, sub-index 0: number of following parameters
	1	COB-ID	Unsigned32	rw	N	0xC0000440 + NODE_ID	COB-ID RxPDO8
	2	Transmission type	Unsigned8	rw	N	0xFF	Transmission type of the PDO

**Communication
parameter RxPDO9**

Index	Sub-index	Name	Type	Attr.	Map.	Default value	Meaning
0x1408	0	Number of Elements	Unsigned8	ro	N	0x02	Communication parameter for the first receive PDOs, sub-index 0: number of following parameters
	1	COB-ID	Unsigned32	rw	N	0xC0000540 + NODE_ID	COB-ID RxPDO9
	2	Transmission type	Unsigned8	rw	N	0xFF	Transmission type of the PDO

**Communication
parameter RxPDO10**

Index	Sub-index	Name	Type	Attr.	Map.	Default value	Meaning
0x1409	0	Number of Elements	Unsigned8	ro	N	0x02	Communication parameter for the first receive PDOs, sub-index 0: number of following parameters
	1	COB-ID	Unsigned32	rw	N	0xC00007C0 + NODE_ID	COB-ID RxPD10
	2	transm. type	Unsigned8	rw	N	0xFF	Transmission type of the PDO

Mapping RxPDO1

Index	Sub-index	Name	Type	Attr.	Map.	Default value	Meaning
0x1600	0	Number of Elements	Unsigned8	rw	N	0x01	Mapping parameter of the first receive PDO; sub-index 0: number of mapped objects
	1	1st mapped object	Unsigned32	rw	N	0x62000108	(2 byte index, 1 byte sub-index, 1 byte bit-width)
	2	2nd mapped object	Unsigned32	rw	N	0x62000208	(2 byte index, 1 byte sub-index, 1 byte bit-width)
	...	...	...	...	...	...	...
	8	8th mapped	Unsigned32	rw	N	0x62000808	(2 byte index, 1 byte sub-index, 1 byte bit-width)

The first receive PDO (RxPDO1) is per default for the digital outputs. Depending on the number of the inserted outputs, the needed length of the PDO is calculated and mapped into the according objects.

For the digital outputs are organized in bytes, the length of the PDO can be directly seen in sub-index 0.

If the mapping is changed, the entry in sub-index 0 has to be adjusted accordingly.

Mapping RxPDO2

Index	Sub-index	Name	Type	Attr.	Map.	Default value	Meaning
0x1601	0	Number of Elements	Unsigned8	rw	N	0x01	Mapping parameter of the second receive PDO; sub-index 0: number of mapped objects
	1	1st mapped object	Unsigned32	rw	N	0x64110110	(2 byte index, 1 byte sub-index, 1 byte bit-width)
	2	2nd mapped object	Unsigned32	rw	N	0x64110210	(2 byte index, 1 byte sub-index, 1 byte bit-width)
	...	...	...	...	...	...	...
	8	8th mapped	Unsigned32	rw	N	0x00000000	(2 byte index, 1 byte sub-index, 1 byte bit-width)

The 2nd receive PDO (RxPDO2) is per default for the analog outputs. Depending on the number of the inserted outputs, the needed length of the PDO is calculated and the according objects are mapped.

For the digital outputs are organized in words, the length of the PDO can be directly seen in sub-index 0.

If the mapping is changed, the entry in sub-index 0 has to be adjusted accordingly.

Mapping RxPDO3-RxPDO10

Index	Sub-index	Name	Type	Attr.	Map.	Default value	Meaning
0x1602 - 0x1609	0	Number of Elements	Unsigned8	rw	N	0x01	Mapping parameter of the 3rd to 10th receive PDO; sub-index 0: number of mapped objects
	1	1st mapped object	Unsigned32	rw	N	0x00000000	(2 byte index, 1 byte sub-index, 1 byte bit-width)
	2	2 nd mapped object	Unsigned32	rw	N	0x00000000	(2 byte index, 1 byte sub-index, 1 byte bit-width)
	...	...	...	...	...	...	...
	8	8th mapped	Unsigned32	rw	N	0x00000000	(2 byte index, 1 byte sub-index, 1 byte bit-width)

The receive PDOs 3 to 10 (RxPDO3) get an automatic default mapping via the coupler depending from the connected terminals. The procedure is described under "PDO mapping".

**Communication
parameter TxPDO1**

Index	Sub-index	Name	Type	Attr.	Map.	Default value	Meaning
0x1800	0	Number of Elements	Unsigned8	ro	N	0x05	Communication parameter of the first transmit PDO, sub-index 0: number of following parameters
	1	COB-ID	Unsigned32	rw	N	0x80000180 + NODE_ID	COB-ID TxPDO1
	2	Transmission type	Unsigned8	rw	N	0xFF	Transmission type of the PDO
	3	Inhibit time	Unsigned16	rw	N	0x0000	Repetition delay [value x 100 µs]
	5	Event time	Unsigned16	rw	N	0x0000	Event timer [value x 1 ms]

Sub-index 1 (COB-ID): The lower 11Bit of the 32Bit value (Bits 0-10) contain the CAN identifier, the MSBit (Bit 31) shows if the PDO is active (1) or not (0), Bit 30 shows if a RTR access to this PDO is permitted (0) or not (1). The sub-index 2 contains the transmission type, sub-index 3 the repetition delay time between two equal PDOs. If an event timer exists with a value unequal 0, the PDO is transmitted when the timer exceeds.

If a inhibit timer exists, the event is delayed for this time.

**Communication
parameter TxPDO2**

Index	Sub-index	Name	Type	Attr.	Map.	Default value	Meaning
0x1801	0	Number of Elements	Unsigned8	ro	N	0x05	Communication parameter of the second transmit PDO, sub-index 0: number of following parameters
	1	COB-ID	Unsigned32	rw	N	0x80000280 + NODE_ID	COB-ID TxPDO2
	2	Transmission type	Unsigned8	rw	N	0xFF	Transmission type of the PDO
	3	Inhibit time	Unsigned16	rw	N	0x0000	Repetition delay [value x 100 µs]
	5	Event time	Unsigned16	rw	N	0x0000	Event timer [value x 1 ms]

**Communication
parameter TxPDO3**

Index	Sub-index	Name	Type	Attr.	Map.	Default value	Meaning
0x1802	0	Number of Elements	Unsigned8	ro	N	0x05	Communication parameter for the 3rd transmit PDO.
	1	COB-ID	Unsigned32	rw	N	0x80000380 + NODE_ID	COB-ID TxPDO3
	2	Transmission type	Unsigned8	rw	N	0xFF	Transmission type of the PDO
	3	Inhibit time	Unsigned16	rw	N	0x0000	Repetition delay [value x 100 µs]
	5	Event time	Unsigned16	rw	N	0x0000	Event timer [value x 1 ms]

**Communication
parameter TxPDO4**

Index	Sub-index	Name	Type	Attr.	Map.	Default value	Meaning
0x1803	0	Number of Elements	Unsigned8	ro	N	0x05	Communication parameter for the 4th transmit PDO.
	1	COB-ID	Unsigned32	rw	N	0x80000480 + NODE_ID	COB-ID TxPDO4
	2	Transmission type	Unsigned8	rw	N	0xFF	Transmission type of the PDO
	3	Inhibit time	Unsigned16	rw	N	0x0000	Repetition delay [value x 100 µs]
	5	Event time	Unsigned16	rw	N	0x0000	Event timer [value x 1 ms]

**Communication
parameter TxPDO5**

Index	Sub-index	Name	Type	Attr.	Map.	Default value	Meaning
0x1804	0	Number of Elements	Unsigned8	ro	N	0x05	Communication parameter for the 5th transmit PDO.
	1	COB-ID	Unsigned32	rw	N	0x80000680 + NODE_ID	COB-ID TxPDO5
	2	Transmission type	Unsigned8	rw	N	0xFF	Transmission type of the PDO
	3	Inhibit time	Unsigned16	rw	N	0x0000	Repetition delay [value x 100 µs]
	5	Event time	Unsigned16	rw	N	0x0000	Event timer [value x 1 ms]

**Communication
parameter TxPDO6**

Index	Sub-index	Name	Type	Attr.	Map.	Default value	Meaning
0x1805	0	Number of Elements	Unsigned8	ro	N	0x05	Communication parameter for the 6th transmit PDO.
	1	COB-ID	Unsigned32	rw	N	0x800001C0 + NODE_ID	COB-ID TxPDO6
	2	Transmission type	Unsigned8	rw	N	0xFF	Transmission type of the PDO
	3	Inhibit time	Unsigned16	rw	N	0x0000	Repetition delay [value x 100 µs]
	5	Event time	Unsigned16	rw	N	0x0000	Event timer [value x 1 ms]

**Communication
parameter TxPDO7**

Index	Sub-index	Name	Type	Attr.	Map.	Default value	Meaning
0x1806	0	Number of Elements	Unsigned8	ro	N	0x05	Communication parameter for the 7th transmit PDO.
	1	COB-ID	Unsigned32	rw	N	0x800002C0 + NODE_ID	COB-ID TxPDO7
	2	Transmission type	Unsigned8	rw	N	0xFF	Transmission type of the PDO
	3	Inhibit time	Unsigned16	rw	N	0x0000	Repetition delay [value x 100 µs]
	5	Event time	Unsigned16	rw	N	0x0000	Event timer [value x 1 ms]

**Communication
parameter TxPDO8**

Index	Sub-index	Name	Type	Attr.	Map.	Default value	Meaning
0x1807	0	Number of Elements	Unsigned8	ro	N	0x05	Communication parameter for the 8th transmit PDO.
	1	COB-ID	Unsigned32	rw	N	0x800003C0 + NODE_ID	COB-ID TxPDO8
	2	Transmission type	Unsigned8	rw	N	0xFF	Transmission type of the PDO
	3	Inhibit time	Unsigned16	rw	N	0x0000	Repetition delay [value x 100 µs]
	5	Event time	Unsigned16	rw	N	0x0000	Event timer [value x 1 ms]

**Communication
parameter TxPDO9**

Index	Sub-index	Name	Type	Attr.	Map.	Default value	Meaning
0x1808	0	Number of Elements	Unsigned8	ro	N	0x05	Communication parameter for the 9th transmit PDO.
	1	COB-ID	Unsigned32	rw	N	0x800004C0 + NODE_ID	COB-ID TxPDO9
	2	Transmission type	Unsigned8	rw	N	0xFF	Transmission type of the PDO
	3	Inhibit time	Unsigned16	rw	N	0x0000	Repetition delay [value x 100 µs]
	5	Event time	Unsigned16	rw	N	0x0000	Event timer [value x 1 ms]

**Communication
parameter
TxPDO10**

Index	Sub-index	Name	Type	Attr.	Map.	Default value	Meaning
0x1809	0	Number of Elements	Unsigned8	ro	N	0x05	Communication parameter for the 10th transmit PDO.
	1	COB-ID	Unsigned32	rw	N	0x800006C0 + NODE_ID	COB-ID TxPDO10
	2	Transmission type	Unsigned8	rw	N	0xFF	Transmission type of the PDO
	3	Inhibit time	Unsigned16	rw	N	0x0000	Repetition delay [value x 100 µs]
	5	Event time	Unsigned16	rw	N	0x0000	Event timer [value x 1 ms]

Mapping TxPDO1

Index	Sub-index	Name	Type	Attr.	Map.	Default value	Meaning
0x1A00	0	Number of Elements	Unsigned8	rw	N	depending on the components fitted	Mapping parameter of the first transmit PDO; sub-index 0: number of mapped objects
	1	1st mapped object	Unsigned32	rw	N	0x60000108	(2 byte index, 1 byte sub-index, 1 byte bit-width)
	2	2nd mapped object	Unsigned32	rw	N	0x60000208	(2 byte index, 1 byte sub-index, 1 byte bit-width)
	...	...	...	...	...	...	...
	8	8th mapped object	Unsigned32	rw	N	0x60000808	(2 byte index, 1 byte sub-index, 1 byte bit-width)

| **... continue**
Mapping TxPD01 | The first send PDO (TxPDO1) is per default for digital inputs. Depending on the number of the inserted inputs, the needed length of the PDO is calculated and the according objects are mapped. |

For the digital inputs are organized in bytes, the length of the PDO can be directly seen in sub-index 0.

If the mapping is changed, the entry in sub-index 0 has to be adjusted accordingly.

Mapping TxPDO2

Index	Sub-index	Name	Type	Attr.	Map.	Default value	Meaning
0x1A01	0	Number of Elements	Unsigned8	rw	N	depending on the components fitted	Mapping parameter of the second transmit PDO; sub-index 0: number of mapped objects
	1	1st mapped object	Unsigned32	rw	N	0x64010110	(2 byte index, 1 byte sub-index, 1 byte bit-width)
	2	2nd mapped object	Unsigned32	rw	N	0x64010210	(2 byte index, 1 byte sub-index, 1 byte bit-width)
	...	...	...	...	...	...	...
	8	8th mapped object	Unsigned32	rw	N	0x00000000	(2 byte index, 1 byte sub-index, 1 byte bit-width)

The 2nd send PDO (RxPDO2) is per default for the analog inputs. Depending on the number of the inserted outputs, the needed length of the PDO is calculated and the according objects are mapped.

For the digital outputs are organized in words, the length of the PDO can be directly seen in sub-index 0.

If the mapping is changed, the entry in sub-index 0 has to be adjusted accordingly.

**Mapping TxPDO3-
TxPDO10**

Index	Sub-index	Name	Type	Attr.	Map.	Default value	Meaning
0x1A02 - 0x1A09	0	Number of Elements	Unsigned8	rw	N	depending on the components fitted	Mapping parameter of the 3rd to 10 th transmit PDO; sub-index 0: number of mapped objects
	1	1st mapped object	Unsigned32	rw	N	0x00000000	(2 byte index, 1 byte sub-index, 1 byte bit-width)
	2	2nd mapped object	Unsigned32	rw	N	0x00000000	(2 byte index, 1 byte sub-index, 1 byte bit-width)
	...	...	...	...	...	...	...
	8	8th mapped object	Unsigned32	rw	N	0x000000000	(2 byte index, 1 byte sub-index, 1 byte bit-width)

The send PDOs 3 to 10 (RxPDO3) get an automatic default mapping via the coupler depending from the connected terminals. The procedure is described under "PDO mapping".

CAN baudrate

Index	Sub-index	Name	Type	Attr.	Map.	Default value	Meaning
0x2001	0	CAN-Baudrate	Unsigned8	rw	N	0x01	Setting CAN-Baudrate

This index entry writes a new baudrate into the EEPROM.
At the next start-up (reset) the CAN coupler starts with the new baudrate.

Value	CAN baudrate
"00"	1MBaud
"01"	500kBaud
"02"	250kBaud
"03"	125kBaud
"04"	100kBaud
"05"	50kBaud
"06"	20kBaud
"07"	10kBaud
"08"	800kBaud

KILL EEPROM

Index	Sub-index	Name	Type	Attr.	Map.	Default value	Meaning
0x2100	0	KILL EEPROM	Boolean	wo	N		KILL EEPROM

The KILL EEPROM is supported for reasons of compatibility.

Writing to index 0x2100 deletes all stored identifiers from the EEPROM.

The CANopen coupler start **at the next start-up (reset**) with the default configuration.

SJA1000
Message Filter

Index	Sub-index	Name	Type	Attr.	Map.	Default value	Meaning
0x2101	0	Number of Elements	Unsigned8	ro	N	0x02	SJA1000 Message Filter
	1	Acceptance mask	Unsigned8	ro	N		Acceptance mask
	2	Acceptance code	Unsigned8	ro	N		Acceptance code

With the help of the acceptance filter, the CAN controller is able to allow passing of received messages to the RXFIFO only when the identifier bits of the received message are equal to the predefined ones within the acceptance filter. The acceptance filter is defined via the acceptance code register and the acceptance mask register.

These filters are updated after start-up and communication reset.

Acceptance mask: The acceptance mask register qualifies which of the corresponding bits of the acceptance code are relevant (AM.X = 0) and which ones are 'don't care' (AM.X = 1) for acceptance filtering.

Acceptance code: The acceptance code bits (AC.7 to AC.0) and the eight most significant bits of the message identifier (ID.10 to ID.3) have to be in the same bit positions which are marked as relevant by the acceptance mask bits (AM.7 to AM.0). If the following condition is fulfilled, the messages are accepted:

$0(ID.10$ to $ID.3) \equiv (AC.7$ to $AC.0)] \vee (AM.7$ to $AM.0) \equiv 11111111$

PDO control

Index	Sub-index	Name	Type	Attr.	Map.	Default value	Meaning
0x2400	0	Number of Elements	Unsigned8	ro	N	0x0A	Time control for RxPDOs
	1	RxPDO1	Unsigned16	rw	N	0x0000	Timer value [ms]
	2	RxPDO2	Unsigned16	rw	N	0x0000	Timer value [ms]
	...	...	...	...	...	...	...
	10	RxPDO10	Unsigned16	rw	N	0x0000	Timer value [ms]

The control starts as soon as the timer is unequal 0. Every received RxPDO resets the timer. When the timer has been expired, the CAN coupler switches into the state "pre-operational" and sends an emergency telegram.

Module Parameterization

Index	Sub-index	Name	Type	Attr.	Map.	Default value	Meaning
0x3001 - 0x3010	0	Number of Elements	Unsigned8	ro	N	0x04 or 0x00	Number of entries 0x04 : module available 0x00 : no module available
	1	Prm 1 to 4	Unsigned32	rw	N	depending on the compo-nents fitted	Parameter bytes 1 to 4
	2	Prm 5 to 8	Unsigned32	rw	N	depending on the compo-nents fitted	Parameter bytes 5 to 8
	3	Prm 9 to 12	Unsigned32	rw	N	depending on the compo-nents fitted	Parameter bytes 9 to 12
	4	Prm 13 to 16	Unsigned32	rw	N	depending on the compo-nents fitted	Parameter bytes 13 to 16

Via the indices 0x3001 to 0x3010 you may parameterize the analog modules, counter and communication modules.

**Default
configuration**

AI4	0x00, 0x00, 0x28, 0x28, 0x28, 0x28, 0x00, 0x00, 0x00, 0x00, 0x00, 0x00, 0x00, 0x00, 0x00, 0x00
AI8	0x00, 0x00, 0x26, 0x26, 0x26, 0x26, 0x00, 0x00, 0x00, 0x00, 0x00, 0x00, 0x00, 0x00, 0x00, 0x00
AO4	0x00, 0x00, 0x09, 0x09, 0x09, 0x09, 0x00, 0x00, 0x00, 0x00, 0x00, 0x00, 0x00, 0x00, 0x00, 0x00
AI/AO	0x00, 0x00, 0x09, 0x09, 0x09, 0x09, 0x00, 0x00, 0x00, 0x00, 0x00, 0x00, 0x00, 0x00, 0x00, 0x00
CP 240	0x00, 0x00, 0x00, 0x00, 0x00, 0x13, 0x06, 0x00, 0x00, 0x00, 0x00, 0x00, 0x00, 0x00, 0x00, 0x00
FM 250	0x00, 0x00, 0x00, 0x00, 0x00, 0x00, 0x00, 0x00, 0x00, 0x00, 0x00, 0x00, 0x00, 0x00, 0x00, 0x00
FM 254	0x00, 0x00, 0x00, 0x00, 0x00, 0x00, 0x00, 0x00, 0x00, 0x00, 0x00, 0x00, 0x00, 0x00, 0x00, 0x00

Example 1   **Set AI4 to mode 0x2C**

**Read default
configuration**
Read SubIndex 0 M2S: 0x40 0x01 0x30 0x00 0x00 0x00 0x00 0x00
                 S2M: 0x4F 0x01 0x30 0x00 0x04 0x00 0x00 0x00
Read SubIndex 1 M2S: 0x40 0x01 0x30 0x01 0x00 0x00 0x00 0x00
                 S2M: 0x43 0x01 0x30 0x01 0x00 0x00 0x28 0x28
Read SubIndex 2 M2S: 0x40 0x01 0x30 0x02 0x00 0x00 0x00 0x00
                 S2M: 0x43 0x01 0x30 0x02 0x28 0x28 0x00 0x00
Read SubIndex 3 M2S: 0x40 0x01 0x30 0x03 0x00 0x00 0x00 0x00
                 S2M: 0x43 0x01 0x30 0x03 0x00 0x00 0x00 0x00
Read SubIndex 4 M2S: 0x40 0x01 0x30 0x04 0x00 0x00 0x00 0x00
                 S2M: 0x43 0x01 0x30 0x04 0x00 0x00 0x00 0x00

**Write new
configuration**
Write SubIndex 1 M2S: 0x23 0x01 0x30 0x01 0x00 0x00 0x2C 0x2C
                  S2M: 0x60 0x01 0x30 0x01 0x00 0x00 0x00 0x00
Write SubIndex 2 M2S: 0x23 0x01 0x30 0x02 0x2C 0x2C 0x00 0x00
                  S2M: 0x60 0x01 0x30 0x02 0x00 0x00 0x00 0x00

**Read new
configuration**
Read SubIndex 0 M2S: 0x40 0x01 0x30 0x00 0x00 0x00 0x00 0x00
                 S2M: 0x4F 0x01 0x30 0x00 0x04 0x00 0x00 0x00
Read SubIndex 1 M2S: 0x40 0x01 0x30 0x01 0x00 0x00 0x00 0x00
                 S2M: 0x43 0x01 0x30 0x01 0x00 0x00 0x2C 0x2C
Read SubIndex 2 M2S: 0x40 0x01 0x30 0x02 0x00 0x00 0x00 0x00
                 S2M: 0x43 0x01 0x30 0x02 0x2C 0x2C 0x00 0x00
Read SubIndex 3 M2S: 0x40 0x01 0x30 0x03 0x00 0x00 0x00 0x00
                 S2M: 0x43 0x01 0x30 0x03 0x00 0x00 0x00 0x00
Read SubIndex 4 M2S: 0x40 0x01 0x30 0x04 0x00 0x00 0x00 0x00
                 S2M: 0x43 0x01 0x30 0x04 0x00 0x00 0x00 0x00

Example 2   **Set FM250 to Counter Mode 0x08 and 0x0B**

Read default   Read SubIndex 0   M2S: 0x40 0x02 0x30 0x00 0x00 0x00 0x00 0x00
configuration   S2M: 0x4F 0x02 0x30 0x00 0x04 0x00 0x00 0x00
                       Read SubIndex 1   M2S: 0x40 0x02 0x30 0x01 0x00 0x00 0x00 0x00
                                         S2M: 0x43 0x02 0x30 0x01 0x00 0x00 0x00 0x00

Write new   Write SubIndex 1 M2S: 0x23 0x02 0x30 0x01 0x08 0x0B 0x00 0x00
configuration   S2M: 0x60 0x02 0x30 0x01 0x00 0x00 0x00 0x00

Read new   Read SubIndex 0   M2S: 0x40 0x02 0x30 0x00 0x00 0x00 0x00 0x00
configuration   S2M: 0x4F 0x02 0x30 0x00 0x04 0x00 0x00 0x00
                       Read SubIndex 1   M2S: 0x40 0x02 0x30 0x01 0x00 0x00 0x00 0x00
                                         S2M: 0x43 0x02 0x30 0x01 0x08 0x0B 0x00 0x00

**Module
parameterization**

Index	Sub-index	Name	Type	Attr.	Map.	Default value	Meaning
0x3401	0x00	Number of Elements	Unsigned8	ro	N	depending on the components fitted	Number of entries
	0x01	1st mapped object	Unsigned32	rw	N		
	...	...	...	...	...	...	
	0x40	8th mapped object	Unsigned32	rw	N		

The index 0x3401 is supported for reasons of compatibility.

Use index 3001 to 3010 for new projects. Alternative options to write/read analog parameters:

Sub-index 0…0x40 (256 bytes):

Sub-index 0: number of sub-indices

Sub-index 1: parameter byte 0 ... 3

...

Sub-index 0x20: parameter byte 124 ... 127

Every sub-index consists of 2 data words. Enter your parameter bytes here. Every analog input or output module has 16Byte parameter data, i.e. they occupy 4 sub-indices, e.g.:

1. analog module sub-indices 1 to 4,

2. analog module sub-indices 5 to 8,

3. analog module sub-indices 9 to 12.

8bit digital inputs

Index	Sub-Index	Name	Type	Attr.	Map.	Default value	Meaning
0x6000	0x00	8bit digital input block	Unsigned8	ro	N	0x01	Number of available digital 8bit input blocks
	0x01	1st input block	Unsigned8	ro	Y		1st digital input block
	...	...	...	...	...	...	...
	0x48	72nd input block	Unsigned8	ro	Y		72nd digital input block

**8bit polarity digital
inputs**

Index	Sub-Index	Name	Type	Attr.	Map.	Default value	Meaning
0x6002	0x00	8bit digital input block	Unsigned8	ro	N	0x01	Number of available digital 8bit input blocks
	0x01	1st input block	Unsigned8	rw	N	0x00	1st polarity digital input block
	...	...	...	...	...	...	...
	0x48	72nd input block	Unsigned8	rw	N	0x00	72nd polarity digital input block

Individual inverting of input polarity:

1 = input inverted

0 = input not inverted

16bit digital inputs

Index	Sub-Index	Name	Type	Attr.	Map.	Default value	Meaning
0x6100	0x00	16bit digital input block	Unsigned8	ro	N	depending on the fitted components	Number of available digital 16bit input blocks
	0x01	1st input block	Unsigned16	ro	N		1st digital input block
	...	...	...	...	...	...	...
	0x24	36nd input block	Unsigned16	ro	N		36nd digital input block

**16bit polarity
digital inputs**

Index	Sub-Index	Name	Type	Attr.	Map.	Default value	Meaning
0x6102	0x00	16bit digital input block	Unsigned8	ro	N	depending on the compo-nents fitted	Number of available digital 16bit input blocks
	0x01	1st input block	Unsigned16	rw	N	0x0000	1st polarity digital input block
	...	...	...	...	...	...	...
	0x24	36th input block	Unsigned16	rw	N	0x0000	36th polarity digital input block

Individual inverting of input polarity:

1 = input inverted
0 = input not inverted

32bit digital inputs

Index	Sub-Index	Name	Type	Attr.	Map.	Default value	Meaning
0x6120	0x00	32bit digital input block	Unsigned8	ro	N	depending on the compo-nents fitted	Number of available digital 32bit input blocks
	0x01	1st input block	Unsigned32	ro	N		1st digital input block
	...	...	...	...	...	...	...
	0x12	18zh input block	Unsigned32	ro	N		18zh digital input block

**32bit polarity
digital inputs**

Index	Sub-Index	Name	Type	Attr.	Map.	Default value	Meaning
0x6122	0x00	8bit digital input block	Unsigned8	ro	N	depending on the components fitted	Number of available digital 32bit input blocks
	0x01	1st input block	Unsigned32	rw	N	0x00000000	1st polarity digital input block
	...	...	...	...	...	...	...
	0x12	18th input block	Unsigned32	rw	N	0x00000000	18th polarity digital input block

Individual inverting of input polarity:

1 = input inverted
0 = input not inverted

8bit digital outputs

Index	Sub-Index	Name	Type	Attr.	Map.	Default value	Meaning
0x6200	0x00	8bit digital output block	Unsigned8	ro	N	0x01	Number of available digital 8bit output blocks
	0x01	1st output block	Unsigned8	rw	Y		1st digital output block
	...	...	...	...	...	...	...
	0x48	72nd output block	Unsigned8	rw	Y		72nd digital output block

**8bit change polarity
digital outputs**

Index	Sub-Index	Name	Type	Attr.	Map.	Default value	Meaning
0x6202	0x00	8bit digital output block	Unsigned8	ro	N	0x01	Number of available digital 8bit output blocks
	0x01	1st output block	Unsigned8	rw	N	0x00	1st polarity digital output block
	...	...	...	...	...	...	...
	0x48	72nd output block	Unsigned8	rw	N	0x00	72nd polarity digital output block

Individual inverting of input channels:

1 = input inverted
0 = input not inverted

**8bit error mode
digital outputs**

Index	Sub-Index	Name	Type	Attr.	Map.	Default value	Meaning
0x6206	0x00	8bit digital output block	Unsigned8	ro	N	0x01	Number of available digital 8bit output blocks
	0x01	1st output block	Unsigned8	rw	N	0xFF	1st error mode digital output block
	...	...	...	...	...	...	...
	0x48	72nd output block	Unsigned8	rw	N	0xFF	72nd error mode digital output block

This object indicates whether an output is set to a pre-defined error value (set in object 0x6207) in case of an internal device failure.

1 = overtake the value from object 0x6207
0 = keep output value in case of error

**8bit error value
digital outputs**

Index	Sub-Index	Name	Type	Attr.	Map.	Default value	Meaning
0x6207	0x00	8bit digital output block	Unsigned8	ro	N	0x01	Number of available digital 8bit output blocks
	0x01	1st output block	Unsigned8	rw	N	0x00	1st error value digital output block
	...	...	...	...	...	...	...
	0x48	72nd output block	Unsigned8	rw	N	0x00	72nd error value digital output block

Presupposed that the error mode is active, device failures set the output to the value configured by this object.

1 = Set output value to 0 if object 0x6206 is enabled.

0 = Set output value to 1 if object 0x6206 is enabled.

**16bit digital
outputs**

Index	Sub-Index	Name	Type	Attr.	Map.	Default value	Meaning
0x6300	0x00	16bit digital input block	Unsigned8	ro	N	Depending on the components fitted	Number of available digital 16bit output blocks
	0x01	1st output block	Unsigned16	rw	N		1st digital output block
	...	...	...	...	...	...	...
	0x24	36th output block	Unsigned16	rw	N		36th digital output block

**16bit change
polarity digital
outputs**

Index	Sub-Index	Name	Type	Attr.	Map.	Default value	Meaning
0x6302	0x00	16bit digital input block	Unsigned8	ro	N	Depending on the compo-nents fitted	Number of available digital 16bit output blocks
	0x01	1st output block	Unsigned16	rw	N	0x0000	1st polarity digital output block
	...	...	...	...	...	...	...
	0x24	36th output block	Unsigned16	rw	N	0x0000	36th polarity output block

Individual inverting of output polarity:

1 = output inverted

0 = output not inverted

**16bit error mode
digital outputs**

Index	Sub-Index	Name	Type	Attr.	Map.	Default value	Meaning
0x6306	0x00	16bit digital input block	Unsigned8	ro	N	Depending on the compo-nents fitted	Number of available digital 16bit output blocks
	0x01	1st output block	Unsigned16	rw	N	0xFFFF	1st error mode digital output block
	...	...	...	...	...	...	...
	0x24	36th output block	Unsigned16	rw	N	0xFFFF	36th error mode digital output block

This object indicates whether an output is set to a pre-defined error value (set in object 0x6207) in case of an internal device failure.

1 = overtake the value from object 0x6207

0 = keep output value in case of error

**16bit error value
digital outputs**

Index	Sub-Index	Name	Type	Attr.	Map.	Default value	Meaning
0x6307	0x00	16bit digital input block	Unsigned8	ro	N	Depending on the compo-nents fitted	Number of available digital 16bit output blocks
	0x01	1st output block	Unsigned16	rw	N	0x0000	1st error value digital output block
	...	...	...	...	...	...	...
	0x24	36th output block	Unsigned16	rw	N	0x0000	36th error value digital output block

Presupposed that the error mode is active, device failures set the output to the value configured by this object.

1 = Set output value to 0 if object 0x6206 is enabled.
0 = Set output value to 1 if object 0x6206 is enabled.

**32bit digital
outputs**

Index	Sub-Index	Name	Type	Attr.	Map.	Default value	Meaning
0x6320	0x00	32bit digital input block	Unsigned8	ro	N	Depending on the compo-nents fitted	Number of available digital 32bit output blocks
	0x01	1st output block	Unsigned32	rw	N		1st digital output block
	...	...	...	...	...	...	...
	0x12	18th output block	Unsigned32	rw	N		18th digital output block

**32bit change
polarity digital
outputs**

Index	Sub-Index	Name	Type	Attr.	Map.	Default value	Meaning
0x6322	0x00	32bit digital input block	Unsigned8	ro	N	Depending on the compo-nents fitted	Number of available digital 32bit output blocks
	0x01	1st output block	Unsigned32	rw	N	0x00000000	1st polarity digital output block
	...	...	...	...	...	...	...
	0x12	18th output block	Unsigned32	rw	N	0x00000000	18th polarity output block

Individual inverting of output polarity:

1 = output inverted

0 = output not inverted

**32bit error mode
digital outputs**

Index	Sub-Index	Name	Type	Attr.	Map.	Default value	Meaning
0x6326	0x00	32bit digital input block	Unsigned8	ro	N	Depending on the compo-nents fitted	Number of available digital 32bit output blocks
	0x01	1st output block	Unsigned32	rw	N	0xFFFFFFFF	1st error mode digital output block
	...	...	...	...	...	...	...
	0x48	18th output block	Unsigned32	rw	N	0xFFFFFFFF	18th error mode digital output block

This object indicates whether an output is set to a pre-defined error value (set in object 0x6207) in case of an internal device failure.

1 = overtake the value from object 0x6207

0 = keep output value in case of error

**32bit error value
digital outputs**

Index	Sub-Index	Name	Type	Attr.	Map.	Default value	Meaning
0x6237	0x00	32bit digital input block	Unsigned8	ro	N	depending on the compo-nents fitted	Number of available digital 32bit output blocks
	0x01	1st output block	Unsigned32	rw	N		1st error value digital output block
	...	...	...	...	...	...	...
	0x12	18th output block	Unsigned32	rw	N		18th error value digital output block

Presupposed that the error mode is active, device failures set the output to the value configured by this object.

1 = Set output value to 0 if object 0x6206 is enabled.

0 = Set output value to 1 if object 0x6206 is enabled.

Analog inputs

Index	Sub-Index	Name	Type	Attr.	Map.	Default value	Meaning
0x6401	0x00	2byte input block	Unsigned8	ro	N	depending on the compo-nents fitted	Number of available analog inputs
	0x01	1st input channel	Unsigned16	ro	Y		1st analog input channel
	...	...	...	...	...	...	...
	0x24	24th input channel	Unsigned16	ro	Y		24th analog input channel

Analog outputs

Index	Sub-Index	Name	Type	Attr.	Map.	Default value	Meaning
0x6411	0x00	2byte output block	Unsigned8	ro	N	depending on the compo-nents fitted	Number of available analog outputs
	0x01	1st output channel	Unsigned16	ro	Y		1st analog output channel
	...	...	...	...	...	...	...
	0x24	24th output channel	Unsigned16	ro	Y		24th analog output channel

**Analog input
interrupt trigger
selection**

Index	Sub-Index	Name	Type	Attr.	Map.	Default value	Meaning
0x6421	0x00	Number of Inputs	Unsigned8	ro	N	depending on the components fitted	Number of available analog inputs
	0x01	Trigger 1st input channel	Unsigned8	rw	N	0x07	Input interrupt trigger for 1st analog input channel
	...	...	...	...	...	...	...
	0x24	Trigger 24th input channel	Unsigned8	rw	N	0x07	Input interrupt trigger for 24th analog input channel

This object determines which events shall cause an interrupt for a specific channel. Bits set in the list below refer to the interrupt trigger.

Bit no.	Interrupt trigger
0	Upper limit exceeded 6424
1	Input below lower limit 6425
2	Input changed by more than negative delta 6426
3 to 7	Reserved

**Analog input
interrupt source**

Index	Sub-Index	Name	Type	Attr.	Map.	Default value	Meaning
0x6422	0x00	Number of Interrupt	Unsigned8	ro	N	0x01	Number of interrupt source bank
	0x01	Interrupt source bank	Unsigned32	ro	N	0x00000000	Interrupt source bank 1

This object defines the channel that is responsible for the interruption. Bits set refer to the number of the channel that caused the interruption. The bits are automatically reset, after they have been read by a SDO or send by a PDO.

1 = interruption produced

0 = interruption not produced

**Event driven
analog inputs**

Index	Sub-index	Name	Type	Attr.	Map.	Default value	Meaning
0x6423	0x00	Global interrupt enable	Boolean	rw	N	FALSE ("0")	Activates the event-driven transmission of PDOs with analog inputs

Although the analog inputs are -acc. to CANopen - per default set to the transmission type 255 (event triggered) in the TxPDO2, the "event" (the alteration of an input value) is suppressed by the event control in object 0x6423 in order to prevent the bus from being swamped with analog signals.

Before activation, it is convenient to parameterize the transmission behavior of the analog PDOs by setting an inhibit time (object 0x1800ff, sub-index 3) and/or limit value monitoring (objects 0x6424 + 0x6425) and/or a delta function (object 0x6426).

**Upper limit value
analog inputs**

Index	Sub-Index	Name	Type	Attr.	Map.	Default value	Meaning
0x6424	0x00	Number of Inputs	Unsigned8	ro	N	depending on the components fitted	Number of available analog inputs
	0x01	Upper limit 1st input channel	Unsigned32	rw	N	0x00000000	Upper limit value for 1st analog input channel
	...	...	...	...	...	...	...
	0x24	Upper limit 24th input channel	Unsigned32	rw	N	0x00000000	Upper limit value for 24th analog input channel

Values unequal to zero are activating the upper limit value for this channel. A PDO is then transmitted when the upper limit value is exceeded. In addition, the event trigger has to be active (object 0x6423). The data format corresponds to that of the analog inputs.

**Lower limit value
analog inputs**

Index	Sub-Index	Name	Type	Attr.	Map.	Default value	Meaning
0x6425	0x00	Number of Inputs	Unsigned8	ro	N	depending on the components fitted	Number of available analog inputs
	0x01	Lower limit 1st input channel	Unsigned32	rw	N	0x00000000	Lower limit value for 1st analog input channel
	...	...	...	...	...	...	...
	0x24	Lower limit 24th input channel	Unsigned32	rw	N	0x00000000	Lower limit value for 24th analog input channel

Values unequal to zero are activating the lower limit value for this channel. A PDO is then transmitted when the lower limit value is underrun. In addition, the event trigger has to be active (object 0x6423). The data format corresponds to that of the analog inputs.

Delta function

Index	Sub-Index	Name	Type	Attr.	Map.	Default value	Meaning
0x6426	0x00	Number of Inputs	Unsigned8	ro	N	depending on the components fitted	Number of available analog inputs
	0x01	Delta value 1st input channel	Unsigned32	rw	N	0x00000002	Delta value for 1st analog input channel
	...	...	...	...	...	...	...
	0x24	Delta value 24th input channel	Unsigned32	rw	N	0x00000002	Delta value for 24th analog input channel

Values unequal to zero are activating the delta function for this channel. A PDO is then transmitted when the value has been changed for more than the delta value since the last transmission. In addition, the event trigger has to be active (object 0x6423). The data format corresponds to that of the analog inputs (The delta function accepts only positive values).

**Analog output
error mode**

Index	Sub-Index	Name	Type	Attr.	Map.	Default value	Meaning
0x6443	0x00	Analog output block	Unsigned8	ro	N	Depending on the components fitted	Number of available analog outputs
	0x01	1st analog output block	Unsigned8	rw	N	0xFF	1st error mode analog output block
	...	...	...	...	...	...	...
	0x24	36th analog output block	Unsigned8	rw	N	0xFF	36th error mode analog output block

This object indicates whether an output is set to a pre-defined error value (set in object 0x6444) in case of an internal device failure.

0 = current value

1 = reverts to error value 0x6444

**Analog output
error value**

Index	Sub-Index	Name	Type	Attr.	Map.	Default value	Meaning
0x6444	0x00	16bit digital input block	Unsigned8	ro	N	Depending on the components fitted	Number of available analog output blocks
	0x01	1st analog block	Unsigned16	rw	N	0x0000	1st analog output block
	...	...	...	...	...	...	...
	0x24	36th analog block	Unsigned16	rw	N	0x0000	36th analog output block

Presupposed that the corresponding error (0x6443) is active, device failures set the output to the value configured by this object.

SDO Abort Codes

0x05030000	//Toggle bit not alternated
0x05040000	//SDO protocol timed out
0x05040001	//Client/server command specifier not valid or unknown
0x05040002	//Invalid block size (block mode only)
0x05040003	//Invalid sequence number (block mode only)
0x05040004	//CRC error (block mode only)
0x05040005	//Out of memory
0x06010000	//Unsupported access to an object
0x06010001	//Attempt to read a write only object
0x06010002	//Attempt to write a read only object
0x06020000	//Object does not exist in the object dictionary
0x06040041	//Object cannot be mapped to the PDO
0x06040042	//The number and length of the objects to be mapped would exceed PDO length
0x06040043	//General parameter incompatibility reason
0x06040047	//General internal incompatibility in the device
0x06060000	//Access failed due to an hardware error
0x06070010	//Data type does not match, length of service parameter does not match
0x06070012	//Data type does not match, length of service parameter too high
0x06070013	//Data type does not match, length of service parameter too low
0x06090011	//Sub-index does not exist
0x06090030	//Value range of parameter exceeded (only for write access)
0x06090031	//Value of parameter written too high
0x06090032	//Value of parameter written too low
0x06090036	//Maximum value is less than minimum value
0x08000000	//general error
0x08000020	//Data cannot be transferred or stored to the application
0x08000021	//Data cannot be transferred or stored to the application because of local control
0x08000022	//Data cannot be transferred or stored to the application because of the present device state
0x08000023	//Object dictionary dynamic generation fails or no object dictionary is present (e.g. object dictionary is generated from file and generation fails because of an file error)

IM 253CAN - CANopen slave - Emergency Object

Outline   The VIPA CAN-Bus coupler is provided with the emergency object to notify other devices connected to the CANopen bus about internal error events or CAN-Bus errors. It has a high priority and gives you important information about the states of device and network.

Note!

We strongly recommend to analyze the emergence object - it is an important information pool!

Telegram structure   The emergency telegram has always a length of 8Byte. It starts with 2Byte error code followed by the 1Byte error register and closes with 5Byte additional code.

Error code low byte	Error code high byte	ErrorRegister Index 0x1001	Info 0	Info 1	Info 2	Info 3	Info 4

Error messages

Error Code	Meaning	Info 0	Info 1	Info 2	Info 3	Info4
0x0000	Reset Emergency					
0x1000	PDO Control	0xFF	0x10	PDO Number	LowByte Timer Value	HighByte Timer Value
0x8100	Heartbeat Consumer	Node ID	LowByte Timer Value	HighByte Timer Value	0x00	0x00
0x8100	SDO Block Transfer	0xF1	LowByte Index	HighByte Index	SubIndex	0x00
0x8130	Node Guarding Error	LowByte GuardTime	HighByte GuardTime	LifeTime	0x00	0x00
0x8210	PDO not processed due to length error	PDO Number	Wrong length	PDO length	0x00	0x00
0x8220	PDO length exceeded	PDO Number	Wrong length	PDO length	0x00	0x00

IM 253CAN - CANopen slave - NMT - network management

Network management (NMT) provides the global services specifications for network supervision and management. This includes the login and logout of the different network devices, the supervision of these devices as well as the processing of exceptions.

NMT service messages have the COB identifier 0000h. An additional module-ID is not required. The length is always 2 data bytes.

The 1st data byte contains the NMT command specifier: **CS**.

The 2nd data byte contains the module-ID (0x00 for broadcast command).

The following picture shows an overview over all CANopen status changes and the corresponding NMT command specifiers:
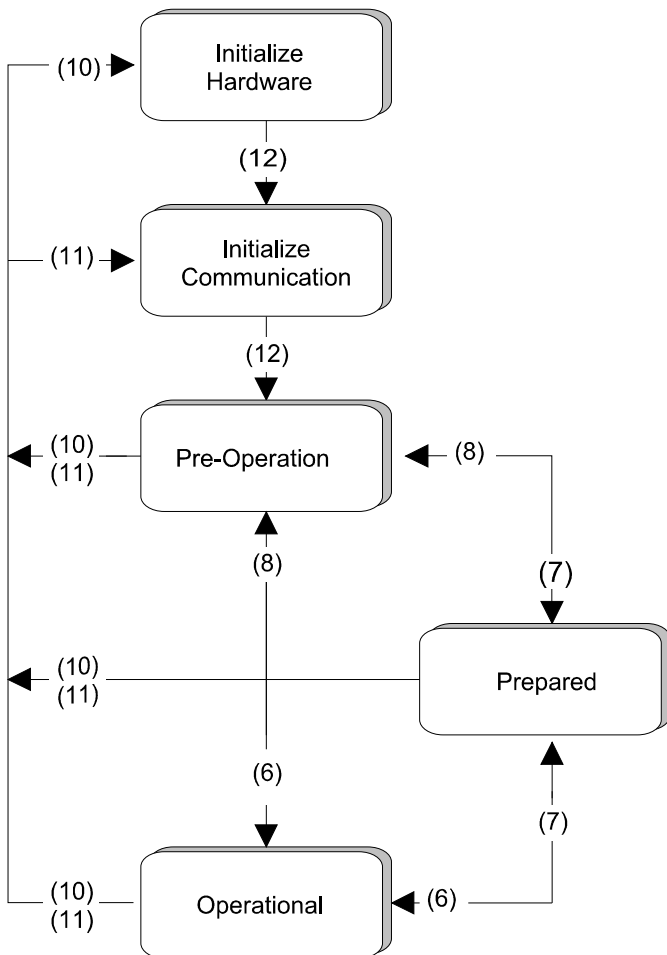
(1): The initialization state is reached automatically after start-up.

(6): "Start_Remote_Node" (CS: 0x01)

Starts the module, releases outputs and starts the PDO transmission.

(7): "Stop_Remote_Node" (CS: 0x02)

Outputs are switching into error state, SDO and PDO are switched off.

(8): "Enter_Pre-operational_State" (CS:0x80)

Stops PDO transmission, SDO still active.

(10): "Reset_Node" (CS:0x81)

Executes reset. All objects are set back to PowerOn defaults.

(11): "Reset_Communication" (CS:0x82)

Executes reset of the communication functions. Objects 0x1000 - 0x1FFF are set back to PowerOn defaults.

(12): After initialization the state "pre-operational is automatically reached - here the boot-up message is send.

Node Guarding

The bus coupler also supports the Node Guarding object as defined by CANopen to ensure that other devices on the bus are supervised properly.

Node Guarding operation is started when the first guard requests (RTR) is received from the master. The respective COB identifier is permanently set to 0x700 + module-ID at variable 0x100E in the object directory. If the coupler does not receive a guard request message from the master within the "guard time" (object 0x100C) when the node guarding mode is active the module assumes that the master is not operating properly. When the time determined by the product of "guard time" (0x100C) and "life-time factor" (0x100D) has expired, the module will automatically assume the status "pre-operational".

When either the "guard time" (object 0x100C) or the "life-time factor" (0x100D) has been set to zero by an SDO download from the master, the expiry of the guard time is not monitored and the module remains in its current operating mode.

Heartbeat

The VIPA CAN coupler also supports the Heartbeat Mode in addition to Node Guarding.

When a value is entered into index 0x1017 (Heartbeat Producer Time) then the device status (Operational, Pre-Operational,...) of the bus coupler is transferred by means of the COB identifier (0x700+module-ID) when the heartbeat timer expires.

The Heartbeat Mode starts automatically as soon as the index 1017h contains a value that is larger than 0.

Technical data

CANopen master
IM 208 CAN

Electrical data	VIPA 208-1CA00
Power supply	via backplane bus
Current consumption	max. 380mA
Isolation	≥ AC 500V
Status indicator	by means of LEDs located on the front
Connectors/interfaces	9pin D-type (socket) CAN-Bus connection
CAN-Bus interface	
Connection	9pin D-type plug
Network topology	Linear bus, active bus termination at one end, tap lines permitted.
Medium	Screened three-core cable, unscreened cable permitted - depending on environment.
Data transfer rate	10kBaud to 1MBaud
Max. overall length	1000m at 50kBaud without repeaters
Max. no. of stations	127 stations (depending on the master interface)
Combination with peripheral modules	
Max. number of slaves	125
Max. number of TxPDOs	40
Max. number of RxPDOs	40
Max. number of input bytes	384
Max. number of output bytes	384
Dimensions and weight	
Dimensions (WxHxD) in mm	25.4x76x76
Weight	80g

CANopen slave
IM 253CAN

Electrical data	VIPA 253-1CA01
Power supply	DC 24V (20.4 ... 28.8) via front from ext. power supply
Current consumption	max. 700mA
Output current backplane bus	max. 3.5A
Isolation	$\geq$ AC 500V
Status indicator	by means of LEDs located on the front
Connectors/interfaces	9pin D-type (socket) CAN-Bus connection
CAN-Bus interface	
Connection	9pin D-type plug
Network topology	Linear bus, active bus termination at one end, tap lines permitted.
Medium	Screened three-core cable, unscreened cable permitted - depending on environment.
Data transfer rate	10kBaud to 1MBaud
Max. overall length	1000m at 50kBaud without repeaters
Digital inputs/outputs	Any combination of max. of 32 I/O modules per coupler.
Max. no. of stations	127 stations (depending on the master interface)
Combination with peripheral modules	
max. no. of modules	32 (depending on current consumption)
max. inputs/outputs	80Byte each (80Byte = 10 PDOs à 8Byte)
Dimensions and weight	
Dimensions (WxHxD) in mm	25.4x76x76
Weight	80g

CANopen slave
IM 253CAN,
DO 24xDC 24V

Electrical data	VIPA 253-2CA20
Power supply	DC 24V (20.4 ... 28.8) via front from ext. power supply
Current consumption at L+	max. 800mA
Output current backplane bus	3.5A
Isolation	$\geq$ AC 500V
Status indicator	by means of LEDs located on the front
Connectors/interfaces	9pin D-type (socket) CAN-Bus connection
CAN-Bus interface	
Connection	9pin D-type plug
Network topology	Linear bus, active bus termination at one end, tap lines permitted.
Medium	Screened three-core cable, unscreened cable permitted - depending on environment.
Data transfer rate	10kBaud to 1MBaud
Max. overall length	1000m at 50kBaud without repeaters
Max. no. of stations	127 stations (depending on the master interface)
Output unit	
Number of outputs	24
Nominal load voltage	DC 24V (18...35V) internal via CAN coupler
Output current per channel	0.5A (Total current max. 4A)
Status monitor	Power (PW) fuse ok, Error (ER) short circuit, overload
Programming data	
Output data	3Byte
Dimensions and weight	
Dimensions (WxHxD) in mm	50.8x76x76
Weight	150g

Chapter 5   DeviceNet

Overview   This chapter contains the description of the VIPA DeviceNet slave. The in-
troduction to the system is followed by the description of the module.
Another section of this chapter concerns the configuration by means of the
DeviceNet-Manager of Allen - Bradley This section describes the configu-
ration of the DeviceNet coupler and the System 200V modules.

Below follows a description of:

* DeviceNet principles
* Hardware description of the VIPA DeviceNet coupler IM 253DN
* Configuration by means of the *DeviceNet-Manager* inc. examples
* Diagnostics
* Technical data

Content

System overview

You can use the VIPA DeviceNet coupler to link-up up to 32 modules (of 40Byte each) of your System 200V periphery by means of DeviceNet.

The following DeviceNet components are currently available from VIPA.
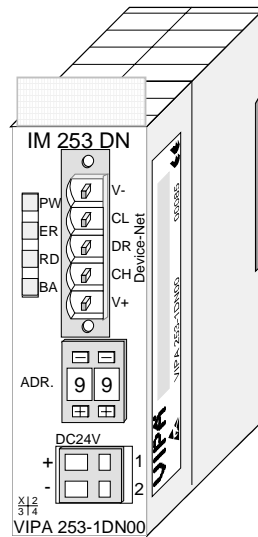
Order data
DeviceNet

Type	Order number	Description
IM 253DN	VIPA 253-1DN00	DeviceNet coupler

Principles

General   DeviceNet is an open low-end network that is based upon the physical properties of CAN-Bus. The bus is also used to supply the devices with the required DC 24V power.

You can use DeviceNet to install direct connections between your control system and simple industrial devices like sensors and switches as well as technologically advanced devices like frequency converters and barcode readers.

Direct interfacing improves communications between the different devices and provides important diagnostic facilities at the device level.

DeviceNet   DeviceNet is an open device net standard that satisfies the user profile for industrial real-time system applications.

The DeviceNet protocol has an open specification that is the property of and administered by the independent vendor organization "Open DeviceNet Vendor Association" ODVA.

This is where standardized device profiles are created to provide compatibility and exchangeability on logical level for simple devices of the same type.

In contrast to the classical source–destination model, DeviceNet uses a modern producer/consumer model that requires data packets with identifier fields for the identification of the data.

This approach caters for multiple priority levels, more efficient transfers of I/O data and multiple consumers for the data.

A device that has data to send *produces* the data on the network together with an identifier. All devices requiring data listen for messages. When a device recognizes a suitable identifier, they act and *consume* the respective data.

DeviceNet carries two types of messages:

- *I/O messages*
  Messages that are subject to critical timing constraints and that are contain data for control purposes that can be exchanged by means of a single or multiple connections and that employ identifiers with a high priority.

- *explicit messages*
  These are used to establish multi-purpose point-to-point communication paths between two devices which are used for the configuration of network couplers and for diagnostic purposes. These functions usually employ identifiers of a low priority.

Messages that are longer than 8Byte are subject to the fragmentation service. A set of rules for master/slave, peer-to-peer- and multi-master connections is also available.

Communication medium

DeviceNet employs a master line/tap line topology with up to 64 network nodes. The maximum distance is either 500m at a rate of 125kBaud, 250m at a rate of 250kBaud or 100m at a rate of 500kBaud.

The length of the tap lines can be up to 6m while the total length of all spur lines depends on the baudrate.

Network nodes can be removed from or inserted into the network without interruption of the network operation. New stations and failed stations are detected automatically.

DeviceNet employs a screened five-core cable as data communication medium.

DeviceNet uses voltage differences and for this reason it exhibits less sensitivity to interference than a voltage or current based interface.

Signals and power supply conductors are included in the same network cable. It is therefore possible to connect devices that obtain the operating voltage via the network as well as devices with an integrated power supply. Furthermore it is possible to connect redundant power supplies to the network that guarantees the power supply when required.

Bus access method

DeviceNet operates according to the Carrier-Sense Multiple Access (CSMA) principle, i.e. every station on the network may access the bus when it is not occupied (random access).

The exchange of messages is message orientated and not station orientated. Each message is provided with a unique and priorizing identifier. At any time only one station is able to occupy the bus with its messages.

The DeviceNet bus access control is subject to non-destructive, bit-wise arbitration. In this case non-destructive means that the successful station participating in the arbitration doesn't need to re-send its message. The most important station is selected automatically when multiple stations access the bus simultaneously. If a station that is ready to send recognizes that the bus is occupied, its send request is delayed until the current transfer has been completed.

Addressing

All stations on the bus must be uniquely identified by means of an ID address. Every DeviceNet device has addressing facilities.

EDS file

The properties of the DeviceNet units are supplied in the form of an EDS file (**E**lectronic **D**ata **S**heet) to configure a slave interface by means of your configuration tool.

IM 253DN - DeviceNet coupler - Construction

The DeviceNet coupler IM 253DN provides a simple method of interfacing any decentral peripheral modules by means of the DeviceNet protocol.

Properties

- Group 2 only Device
  - employs the predefined connection set
- Poll only Device
  - no BIT STROBE mode support
  - no CHANGE OF STATE support
- supports all baudrates: 125, 250 and 500kBaud
- address selection by means of switches
- definition of the data rate by means of a special POWER ON procedure (start from address 90...92)
- LED status indicators
- a max. of 32 peripheral modules can be installed
- of these a max. of 8 may be configurable modules
- module configuration by means of the *DeviceNet-Manager*

**Front view
253-1DN00**
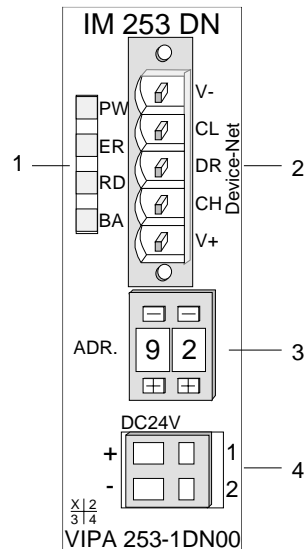
[1]   LED status indicator
[2]   DeviceNet connector
[3]   Address selector
[4]   DC 24V power supply
       connector

Components

LEDs

4 LEDs on the front show the current status of the module for the quick troubleshooting. A detailed description of the troubleshooting procedure by means of the LEDs and the backplane is available in a section of the chapter "diagnostics".

Label	Color	Description
PW	yellow	Power-LED: supply voltage available
ER	red	DeviceNet or backplane bus bus error
RD	green	Backplane bus status
BA	yellow	DeviceNet status

DeviceNet interfacing

The DeviceNet connection is provided by a 5pin Open Style connector. The pin assignment is imprinted on the front of the module.

[V-]   GND operating voltage
[CL]   CAN low
[DR]   DRAIN
[CH]   CAN HIGH
[V+]   DC 24V operating voltage
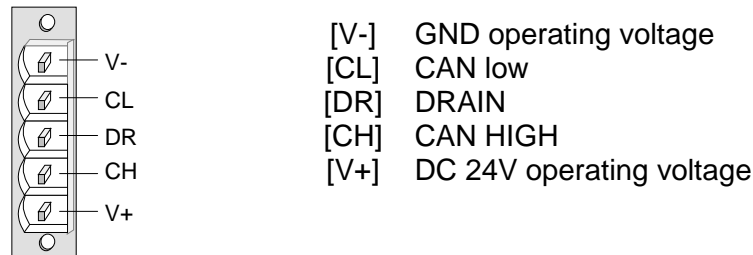
Address selector

The address selector is used for:

- the definition of the unique DeviceNet address
- programming of the baudrate
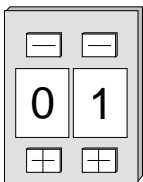
Addresses:

0...63: DeviceNet address

90, 91, 92: set communication rate to 125, 250, 500kBaud

Power supply

Every DeviceNet slave has an internal power supply. This power supply requires DC 24V. In addition to the electronics on the bus coupler, the supply voltage is also used to power any modules connected to the backplane bus. Please note that the maximum current that the integrated power supply can deliver to the backplane bus is 3.5A.

The power supply is protected against reverse polarity.

DeviceNet and backplane bus are galvanically isolated from each other.

Note!

The DeviceNet coupler does not require any current from the power that is available via the DeviceNet.

Block diagram   The following block diagram shows the hardware structure of the bus
                           coupler in principle as well as the internal communication:
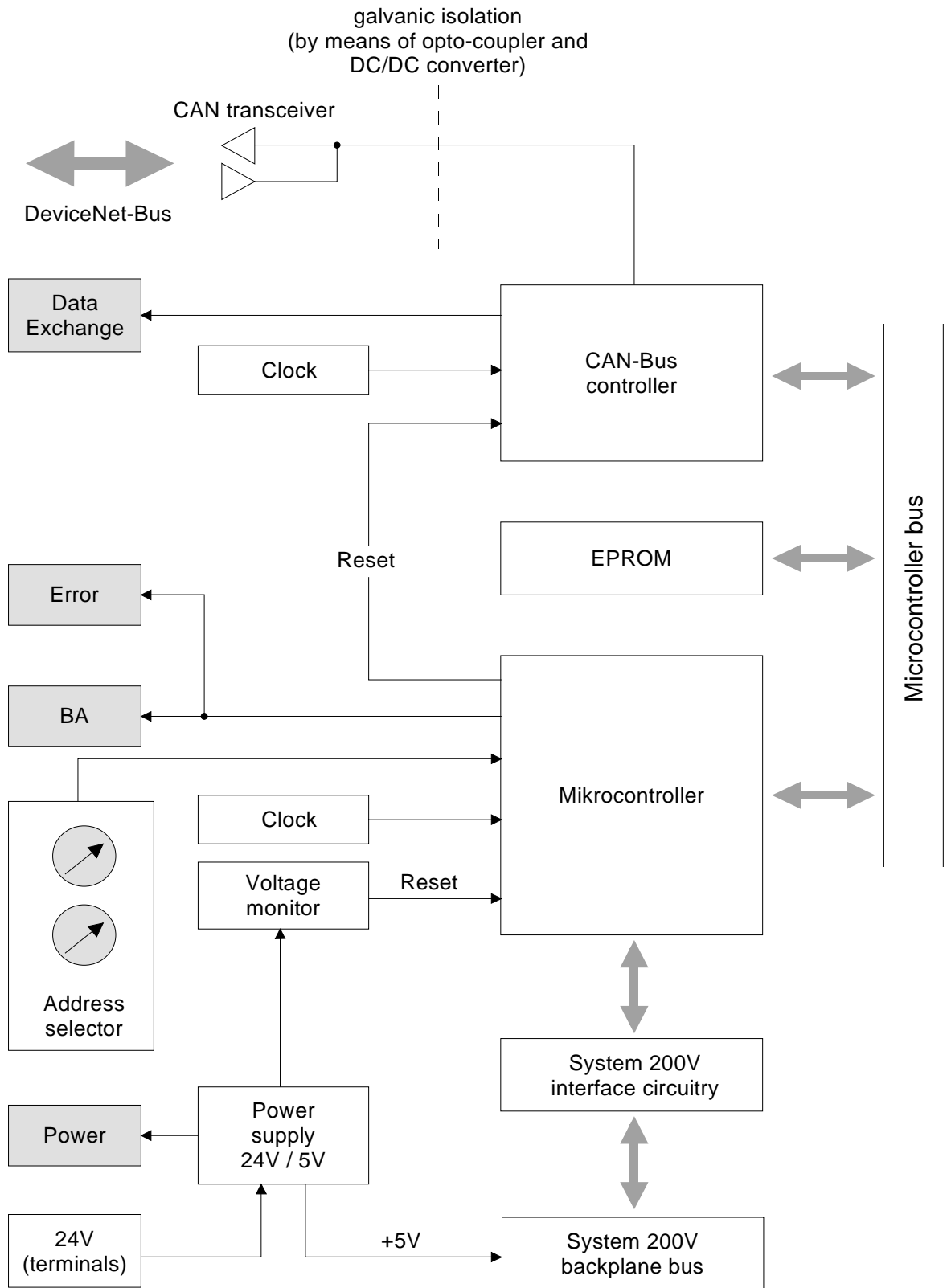
Configuration by means of the DeviceNet-Manager

Overview

The DeviceNet is configured by means of the *DeviceNet-Manager* software from Allen - Bradley.

The following steps are necessary for the configuration:

- Configuration of the *DeviceNet-Manager*
- Set baudrate and DeviceNet address of the module
- Test the DeviceNet
- Module configuration
- I/O addressing of the DeviceNet scanner (master)

Configuration of the DeviceNet-Manager

During the configuration the module specific data of the VIPA DeviceNet coupler are defined and supplied to the *DeviceNet-Manager*.

The following steps are required:

- Insert the supplied disc into your PC.
- Copy the file **IM253DN.BMP** to your PC into the directory **/DNETMGR/RES** of the *DeviceNet-Manager*
- The EDS file is located in a sub-directory of 501.VND on the disc. Copy the file **1.EDS** into the directory **/DNETMGR/EDS/501.VND/0.TYP/-1.COD**

You can also copy the entire tree

```
501.vnd
    |-- 0.typ
        |--1.cod
            |-- 1.eds
            |-- device.bmp
```

into the directory DNETMGR/EDS.

Specifying baudrate and DeviceNet address

You may set the baudrate as well as the DeviceNet address when the power has been turned off. These will be transferred into the module when you turn the respective power supply on.

Setting the baudrate

All stations connected to the bus communicate at the same baudrate. You may define the required rate by means of the address selector.

- Turn off the power supply
- Set the address selector to the wanted baudrate

Setting	baudrate in kBaud
90	125
91	250
92	500

- Turn on the power supply

  The selected transmission rate is saved to the EEPROM.

  At this point your DeviceNet coupler is set to the correct baudrate.

LED-indicator RD-LED ER-LED

When the baudrate has been saved successfully, the RD-LED (green) will be turned on.

When the baudrate was selected incorrectly, the ER-LED will be turned on.

Setting the DeviceNet address

All stations connected to the bus must have a unique DeviceNet address. The address can be defined by means of the address selector when the supply has been turned off.

- Turn off the power supply
- Set the address selector to the required address.
  Please ensure that the address is unique in the system and that it is located between 0 and 63.
- Turn on the power supply

  The selected addressis saved to the RAM.

Note!

Any changes to the addressing will only become effective after a POWER ON or an automatic reset. Changes to settings are not recognized during normal operations.

LED indicator ER-LED

When the address is not valid or if it already exists the ER-LED (red) will be turned on after power on.

Test in conjunction with the DeviceNet

Approach
- Connect the PC containing the *DeviceNet-Manager* and the VIPA DeviceNet coupler to the DeviceNet.
- Define the baudrate and the node address at the coupler
- Turn on the power supply of the bus coupler
- Start the *DeviceNet-Manager*.
- Enter the same data rate into the manager that was selected at the bus coupler
- Start the function NETWORK WHO in the manager

  The following network windows is displayed:
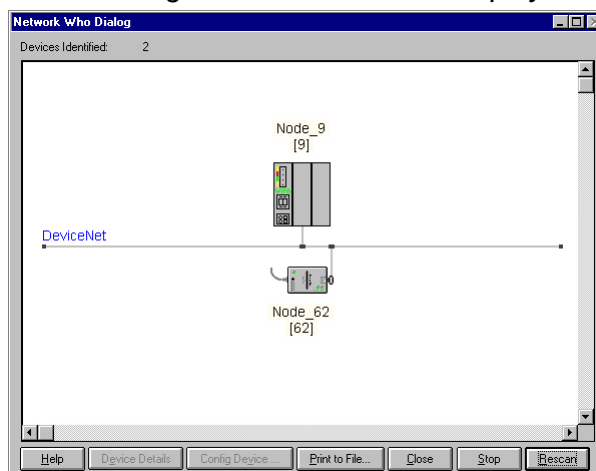
Device Details
- Right-click the bus coupler.
- Select the function DEVICE DETAILS in the context menu.

  The DEVICE DETAILS box is displayed on screen
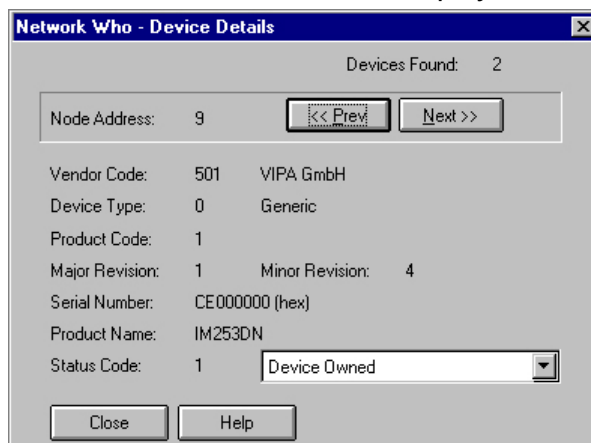
Here you may display DeviceNet address (node address), the Vendor Code (in this case this is 501 for VIPA GmbH) and other internal information about every module on the bus.

Module configuration in the DeviceNet-Manager

The System 200V includes configurable modules like analog modules. When you are using these modules in conjunction with a DeviceNet coupler the respective parameters have to be saved in the DeviceNet coupler.

Configuration in groups

The following conditions apply to the configuration:

- DeviceNet manages the parameter data in groups.
- Every DeviceNet coupler is able to process and store a maximum of 144Byte of parameter data.
- These 144Byte are divided into 8 groups of 18Byte each.
- Every group can contain the parameter data of 1 module.
- Groups are identified by a prefix-No. (1...8) in the parameter name.
- The number of parameter bytes is defined in the parameter "Len" (1st parameter) of a group. The number of parameter bytes is available from the technical data contained in the documentation on the peripheral modules.
- The group allocation for a module does not depend on the location or the installation sequence.
- The allocation of the plug-in location is defined by means of the "Slot"-parameter of a group (2nd parameter)
- The values may be entered as bit patterns by double-clicking a parameter
- Unused groups are identified by a "Value" 0000 0000.

Approach

Precondition: The IM 253DN coupler is active on the bus.

Below follows a description of how the parameter settings are defined in the *DeviceNet-Manager*.

- Execute the function WHO in the *DeviceNet-Manager*.

    This will open a network window that includes your coupler.

- Double-click the icon of the bus coupler where you want to modify the parameter data.

    The parameters are read from the coupler and displayed in the following window:
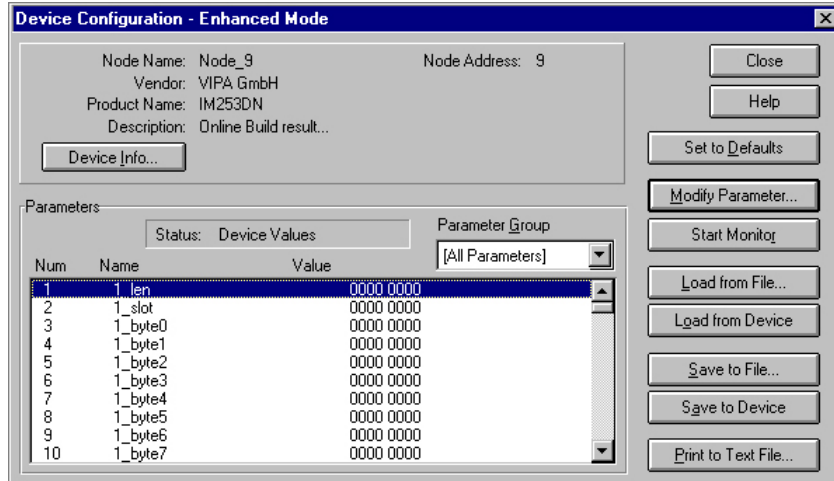
- Locate an unused group in the list of parameters (Value=0000 0000)

  You may display all 8 groups in the parameter list by choosing "All Parameters" in the selection field *Parameter Group.*

- Double click the "Len"-parameter

  The following dialog box is displayed:
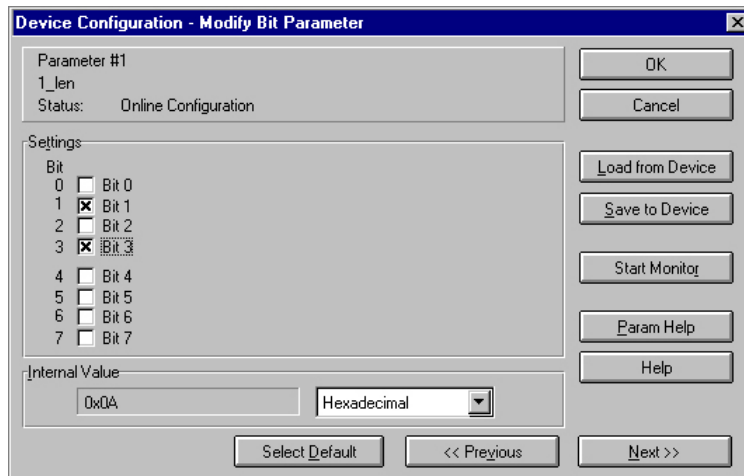
- Enter the number of parameter bytes (bit coded) of the module that you are configuring. You can obtain the number from the documentation for the peripheral module. Set or reset the respective bits by clicking the checkbox.

- Click [OK] to close the mask. The next parameter (slot) of the same group is displayed when you click the button [Next>>].

- Now you have to enter the plug-in location number of the module you are configuring as a bit-code in the same manner.

  You can retrieve the input range by means of the button [Param Help].

- At this point you can enter the parameter bytes for your module one after the other by clicking [Next >>].

- If you wish to configure other modules you have to select another unused group and proceed in the same manner.

- When you have entered all parameters into the different groups you transfer and save the parameters in the DeviceNet coupler by clicking the [Save to Device] button.

  The following selection window is opened:
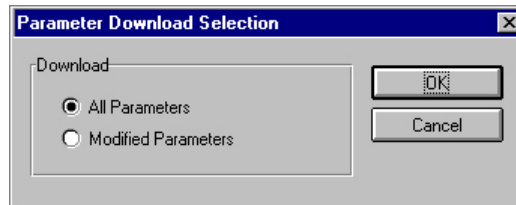
Here you may decide whether you want to transfer all the parameters or only the parameters that were modified.

- During the transfer the status text "Status: downloading" is displayed. When the transfer has completed, the status text changes to "Status: Device Values"

- If you were to request the "Device Details", you may see that the bit CONFIGURED is now also included in the status.
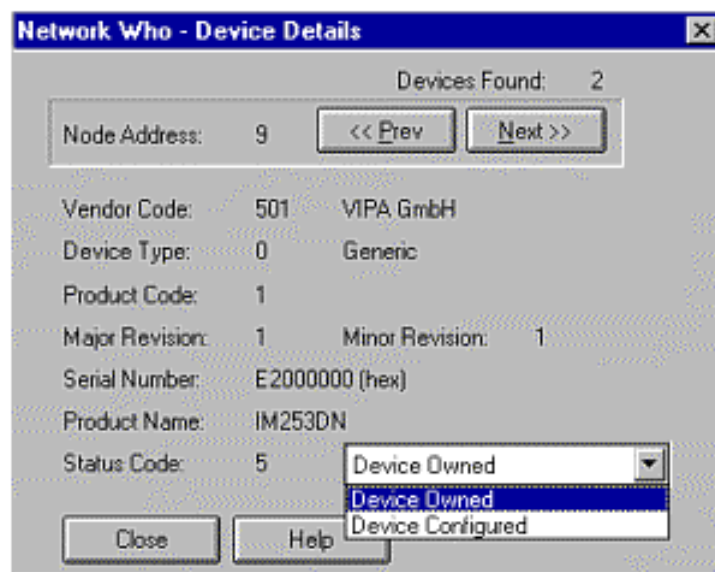
When you have entered the parameter values and downloaded them into the DeviceNet coupler, the peripheral modules connected via the backplane bus have been configured accordingly.

Example   The following example is intended to show the configuration of the System 200V. Let us assume that the system has the following structure:

DN-Slave	DI 8	DI 8	DI 8	DO 8	DO 8	DO 8	DO 8	DO 8	DO 8	AI 8 Param. 10 Byte
IM253DN	SM221	SM221	SM221	SM221	SM221	SM221	SM221	SM221	SM231	SM231
Slot 0	Slot 1	Slot 2	Slot 3	Slot 4	Slot 5	Slot 6	Slot 7	Slot 8	Slot 9	Slot 10
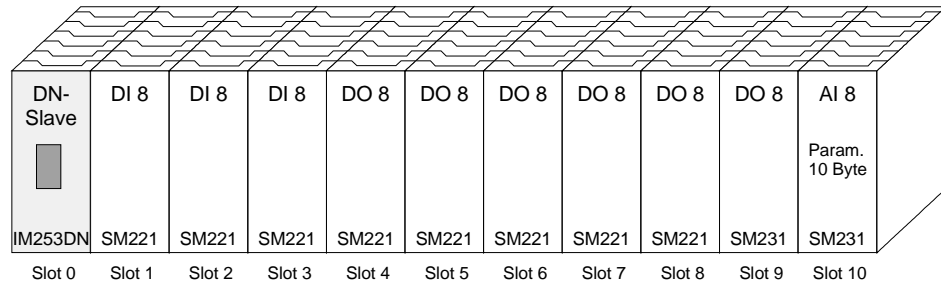
The example shows a DeviceNet coupler with 10 modules; however, the modules installed in plug-in locations 1 to 9 can not be configured.

Below follows the description of the configuration of the analog-module in location 10:

Precondition: - the hardware was assembled and is active on the bus.

                   - the Allen - Bradley *DeviceNet-Manager* was installed.

- Execute the function WHO in the *DeviceNet-Manager* and open the parameter window by double-clicking the DeviceNet coupler.
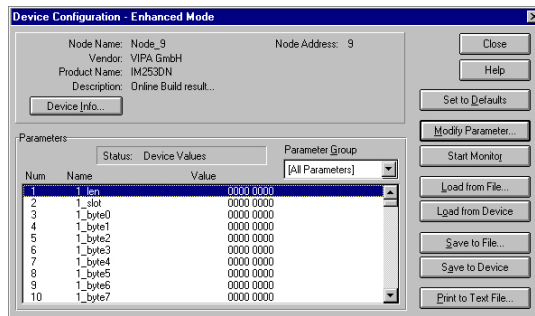
- Locate an unused group in the parameter list (Value=0000 0000)
- Double-click the "Len"-parameter.
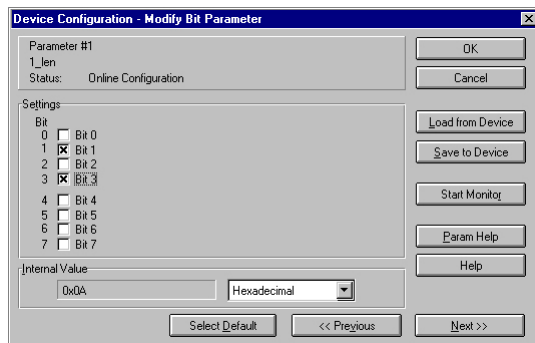
The analog module has 10Byte of parameter data. Enter this value as a bit-coded value.

- Click [Next>>] and enter the location 10 as the "slot".
- You may now enter the parameter bytes of your module by clicking [Next >>] repeatedly.

The analog input module has the following parameters:

Byte	Bit 7 ... Bit 0	Default
0	Diagnostic alarm byte: Bit 0 ... 5: reserved Bit 6: 0: Diagnostic alarm inhibited 1: Diagnostic alarm enabled Bit 7: reserved	00h
1	reserved	00h
2	Function no. channel 0 (see module description)	2Dh
3	Function no. channel 1 (see module description)	2Dh
4	Function no. channel 2 (see module description)	2Dh
5	Function no. channel 3 (see module description)	2Dh
6	Option byte channel 0	00h
7	Option byte channel 1	00h
8	Option byte channel 2	00h
9	Option-byte channel 3	00h

- When all parameters have been entered into the group you transfer and save the parameters in the DeviceNet coupler by means of [Save to Device].

- During the transfer the status text is displayed as "Status: downloading". When the transfer has been completed the status text changes to "Status: Device Values"

Note!

Parameters may be changed at any time. For this purpose you have to click [Load from Device], then enter the required changes and save them by means of [Save to Device].

I/O addressing of the DeviceNet scanner

The DeviceNet coupler determines the modules installed on the backplane bus automatically and uses the result to generate the number of input and output bytes.

You have to determine these two values when you configure the input/output modules and enter them in the DeviceNet scanner (master):

- produced connection size (number of input bytes)
- consumed connection size (number of output bytes)

The addressing results from the sequence of the modules (plug-in location 1 to 32) and the base address that was defined in the DeviceNet scanner for the bus coupler.

DeviceNet scanner configuration

- Set the DeviceNet scanner to connection type POLL IO.
- Define the parameters:
  "Receive data size" = number of input bytes
  "Transmit data size" = number of output bytes
- Define the base address (mapping) of receive data and transmit data as required.
- Activate the DeviceNet coupler IM 253DN in the scan list.
- Start the DeviceNet scanner.

When the DeviceNet scanners have been configured, the input and output modules are accessible via the defined addresses.

Example

The following 6 modules have been installed into the backplane bus:

Plug-in location	Installed module	Input data	Output data
Slot 0	DeviceNet coupler	-	-
Slot 1	Digital Out SM 222		1Byte
Slot 2	Digital Out SM 222		1Byte
Slot 3	Digital In SM 221	1Byte	
Slot 4	Analog In SM 231	4Words	
Slot 5	Analog Out SM 232		4Words
Total:		1+4*2=9Byte	1+1+4*2=10Byte

The result is:

- produced connection size: 9Byte (sum of input bytes)
- consumed connection size: 10Byte (sum of output bytes)

Diagnostics

Overview   The LEDs installed to display the status allow extensive diagnostics during the POWER ON - procedure as well as during operation. The result of the diagnosis is determined by the combination of the different LEDs and the current operating mode.

Explanation:

LED	Description
☐ off	LED turned off
🟨 on	LED is permanently on
⊠ blinks	LED blinks

The following operating modes are available depending on the position of the address selector:

- DeviceNet mode (address selector in position 0...63)
- Configuration mode (address selector in position 90...92)

DeviceNet mode

POWER ON
without DeviceNet

LED	Description
🟨 PW on ☐ ER off ⊠ RD blinks ☐ BA off	After POWER ON the PW-LED is turned on and indicates a properly operating power supply. The RD-LED blinks since the configuration data, stored in the EEPROM, was transferred successfully into the peripheral modules
🟨 PW on 🟥 ER on ☐ RD off ☐ BA off	After POWER ON the PW-LED is turned on. The ER-LED is on due to errors on the backplane bus or when the configuration data could not be transferred into the peripheral modules.

POWER ON with DeviceNet without master

LED	Description
🟨 PW on ☐ ER off ⊠ RD blinks ⊠ BA blinks	After POWER ON the PW-LED is turned on. The RD-LED blinks because: • the backplane bus is operating properly • the configuration data was transferred successfully from the EEPROM into the configurable peripheral modules. The BA-LED blinks because: • at least one additional device is active on the DeviceNet, • and the address set up on the coupler is unique.
🟨 PW on 🟥 ER on ☐ RD off ☐ BA off	After POWER ON the PW-LED is turned on. The ER- LED is on due to one of the following conditions on the DeviceNet coupler: • bad address or address occupied by another device • data transfer rate is bad.
🟨 PW on 🟥 ER on ⊠ RD blinks ⊠ BA blinks	After POWER ON the PW-LED is on. The ER-LED is turned on when the configuration data could not be transferred into the configurable peripheral module. The RD-LED blinks because • the backplane bus is operating properly • the configuration data was not transferred into the configurable peripheral modules. The BA-LED blinks because • at least one other device is active on the DeviceNet, • the address set up on the coupler is unique.

POWER ON with DeviceNet and master

LED	Description
☐ PW on	After POWER ON the PW-LED is on.
◼ ER on	The ER-LED is turned on since the configuration data was not transferred into the configurable peripheral modules.
☒ RD blinks	
☐ BA on	The RD-LED blinks because
	• the backplane bus operates properly
	• the configuration data was not transferred into the configurable peripheral modules.
	The BA-LED is turned on
	• because the coupler IM 253DN has established a DeviceNet-connection to a master.
	Note!
	The IM 253DN coupler executes a reset after 30s.
	An error that occurs during POWER ON with DeviceNet and master displays the same combination of LEDs as a hardware error.
	It is possible to distinguish between these cases:
	• by interruption of the DeviceNet connection → ER-LED and RD are blinking!
	• with a network WHO in the *DeviceNet-Manager* → in case of a hardware error the IM253DN will not appear on the network
	Please call the VIPA hotline if a hardware error occurs!

Proper operation with DeviceNet and master

LED	Description
☐ PW on	After POWER ON the PW-LED is on. The RD-LED is turned on because the connection to the peripheral modules could be established via the backplane bus.
☐ ER off	
◼ RD on	
☐ BA on	The BA-LED is turned on because the coupler IM 253DN established a DeviceNet connection with a master.

Errors during the operation with DeviceNet and master

LED	Description
🟨 PW on 🟥 ER on ⬜ RD off 🟨 BA on	After POWER ON the PW-LED is on. The ER-LED is turned on because an error was detected on the backplane bus. The BA-LED is turned on because the IM 253DN coupler established a DeviceNet connection with a master. Note! The IM 253DN coupler will execute a reset after 30s.

Change of state from operational to module error status

LED	Description
🟨 PW on 🟥 ER on ⬜ RD off ⬜ BA off	The ER-LED is turned on for 1 second because a module error was detected. Subsequently the coupler IM 253DN will execute a reset. After the reset the coupler is re-started and it indicates the error by means of the respective LED combination.

Indicators after a re-start and a reset

LED	Description
🟨 PW on 🟥 ER on 🟩 RD blinks 🟨 BA on	The ER-LED is turned on permanently and the RD-LED blinks because the quantity of I/O data was changed by the failure of the module. The configuration data could not be transferred. All Allen - Bradley scanners will display message #77.
🟨 PW on ⬜ ER off 🟩 RD on 🟨 BA on	The ER-LED is not turned on and the RD-LED is permanently on because the quantity of I/O data was modified by the failure of the module. The connection with the I/O modules was established. All Allen - Bradley scanners will display message #77.

Change of state from operational to connection error status

LED	Description
🟨 PW on	The ER-LED blinks because the timer of the
❎ ER blinks	I/O connection detected an error. The RD-LED blinks
❎ RD blinks	because the I/O-connection does not exist any
🟨 BA on	longer. All inputs and outputs are set to zero.
	The BA-LED is turned on because the connection with
	the master is still established.

Configuration mode

POWER ON in configuration mode

LED	Description
🟨 PW on	After POWER ON the PW-LED is turned on and
☐ ER off	indicates that the power supply operates properly.
🟩 RD on	The RD-LED is turned on after a short delay since the
☐ BA off	baudrate was transferred into the EEPROM.

Device error

LED	Description
🟨 PW on	The address that was set up on the coupler is not valid.
🟥 ER on	Change the address to a valid setting:
☐ RD off	• 0...63 as DeviceNet address
☐ BA off	• 90...92 for the definition of the baudrate
🟨 PW on	When the coupler is not connected to the DeviceNet,
🟥 ER on	an error was detected in the internal EEPROM or in
🟩 RD on	RAM. When a DeviceNet connection exists, it is also
🟨 BA on	possible that an error has occurred during the transfer
	of the configuration data into the peripheral modules.
	Note!
	Errors that occur during POWER ON with DeviceNet
	and master display the same combination of LEDs as
	a hardware error.
	It is possible to distinguish between these cases:
	• by interruption of the DeviceNet connection
	$\rightarrow$ ER-LED and RD are blinking!
	• with a network WHO in the *DeviceNet-Manager*
	$\rightarrow$ in case of a hardware error the IM 253DN
	will not appear on the network
	Please call the VIPA hotline if a hardware error occurs!

Technical data

DeviceNet coupler
IM 253DN

Electrical data	VIPA 253-1DN00
Power supply	DC 24V (20.4 ... 28.8) via front from ext. power supply
Current consumption	Bus coupler: 50mA
	incl. supply to the peripheral modules: 800mA max.
Output current backplane bus	3.5A
Isolation	500V rms
between DeviceNet and backplane bus	
Function specific data	
Status indicator	by means of LEDs on the front
Physical connection to DeviceNet	5pin Open Style connector
Network topology	Linear bus, tap lines up to 6m length
Communication medium	Screened 5core cable
Communication rate	125, 250, 500kBaud
Overall length of the bus	up to 500m
Number of stations	max. 64
Combination with peripheral modules	
Number of modules	max. 32
Inputs	max. 256Byte
Outputs	max. 256Byte
Dimensions and Weight	
Dimensions (BxHxT)	25.4x76x76mm
Weight	80g

Chapter 6   SERCOS

Outline   Content of this chapter is the description of the SERCOS coupler from VIPA. A system overview is followed by a description of the module. Another part of this chapter is the project engineering. With the help of examples we will explain the project engineering of the SERCOS coupler and the parameterization of the System 200V modules.

The description closes with an overview of diagnostic messages and the technical data.

The following text describes:

- SERCOS principles
- Hardware description of the SERCOS coupler IM 253SC from VIPA
- Description of the identifiers with assignment sample
- Example for the parameterization
- Technical data

Content

Note!

For the deployment of the SERCOS coupler in this chapter, a thorough knowledge of SERCOS is required.

This manual describes exclusively the VIPA specific properties.

The description of the properties included in the SERCOS standard, like e.g. the identifiers S-0 and S-1 are to find, for example, in the SERCOS specification of the SERCOS Interface Committee.

System overview

With the SERCOS coupler from VIPA you may connect up to 32 modules of your 200V periphery to SERCOS.

The following SERCOS components are available from VIPA at this time.
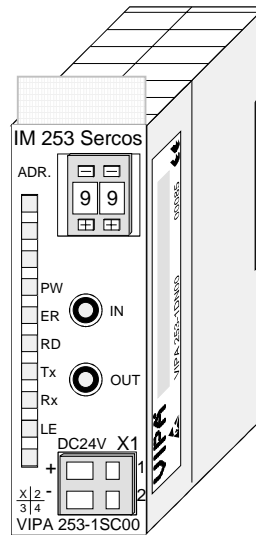
Order data
SERCOS

Type	Order number	Description
IM 253SC	VIPA 253-1SC00	SERCOS coupler

Principles

SERCOS   SERCOS means **Se**rial **R**eal Time **C**ommunication **S**ystem and has been established for numeric controls all over the world. Beyond the classic CNC machines this technique has proofed its worth as fast and precise motion control in the whole automation branch.

SERCOS, also called "SERCOS Interface", is a standardized digital drive interface based on fiber optic transmitter technology.

The high real-time demands and the interference secure fiber optic techno-logy are distinguishing features of this bus system.

With the SERCOS coupler IM 253SC from VIPA, the SERCOS connection to the sensor/actuator level is now possible.

The SERCOS coupler is anticipated for the fast data exchange at the sensor/actuator level. Here, central controls, like e.g. a PLC, communicate with decentral in- and output modules via a fast serial connection. The data exchange with this decentral devices is executed cyclically.

The master reads the input information from the slaves (drive telegram) and sends the output information to the slaves (master data telegram).

A maximum of 254 slaves may be connected to one bus.

Communication   SERCOS knows three kinds of telegrams for the communication:

- *Master-Sync telegram*
  The Master-Sync telegram is received simultaneously by all drives and serves the synchronization of all time related commands of the numeric control (NC) and drives.

- *Master-Data telegram*
  The Master-Data telegram is also received by all drives simultaneously. It contains the cyclical data and service data for all drives.

- *Configurable data field*
  The real-time data is completely transferred in every communication cycle in the so called configurable data field. The drives are sending their telegrams in sequence during assigned time windows. With the help of an ident no. system, the real-time data to send may be fixed during initialization. You may transfer numeric data like set point and effective values as well as bit lists with in-/output commands.

The exchange of service data needs a request from the master. Service data is transferred with a handshake procedure in 2, 4, 6 or 8Byte portions in the service data field "Info" and assembled again at the recipient.

FO as transfer medium

SERCOS uses a closed fiber optic ring (FO) as transfer medium. FO has a high immunity against electromagnetic interference. The ring structure needs the less number of FO and doesn't require T-connectors.

Using plastic FO, the length of each transfer section may be up to 50m, with glass fiber FO up to 250m. The maximum number of participants per ring is 254.

The exact number depends on the following factors:

- Required communication cycle time
- Operating data amount
- Data rate

Bus access procedure

The communication happens cyclically during the operation as a master slave communication. The cyclic time is defined during initialization and may range between 62µs and 65ms.

This cycle times are specified in a way that the required synchronization with fixed working cycle times in control and drives is met.

The communication master in a SERCOS ring is always the NC control.

Addressing

All participants at the bus must be identified by an unique address. Every SERCOS device has the option to fix the address.

ID number for data exchange

The addressing of the data at the demand control data exchange and the definition of the real-time data happens with SERCOS via ident numbers. For the ID numbers, are value range of 2^{16} is fixed, divided into two areas:

1 ... 32767: for data (S-0 ... S-7)

32768 ... 65535: for parameters (P-0 ... P-7)

An identifier consists of 2Byte and has the following structure:

0: S   0 ... 7   0 ... 4095
1: P
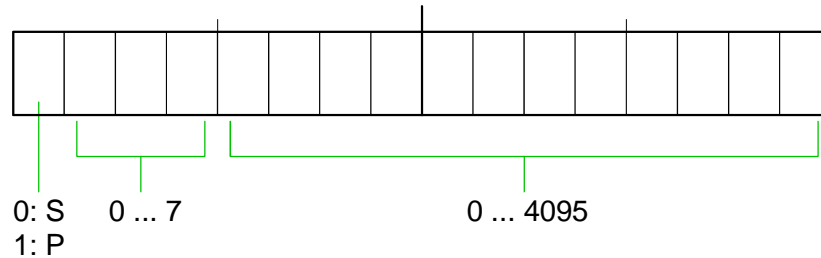
Example: Coding of S-2-1200

0	0	1	0	0	1	0	0	1	0	1	1	0	0	0	0
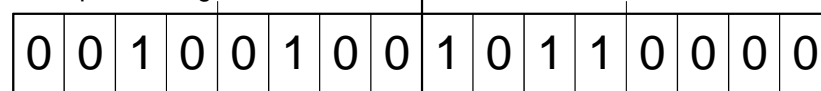
IM 253Sercos - SERCOS coupler - Construction

Properties   The SERCOS coupler IM 253SC supports the easy connection of decentral peripheral modules of the System 200V to SERCOS.

The SERCOS coupler is distinguished by the following properties:

- Fiber Optic (FO) Transmitters for use with 1mm Plastic Optical Fiber and 200µm Hard Clad Silica HCS®
- Support of all SERCOS baudrates (2, 4, 8, 16MBaud)
- Support of all System 200V modules from VIPA
- max. 32 peripheral modules, the number of analog modules is limited to 16 modules (please regard the assembly guidelines)
- max. 256Byte input and 256Byte output data
- Minimal SERCOS cycle: 1ms
- Address adjuster addresses (1 ... 89) and parameterization (90 ... 99)
- Integrated DC 24V power supply for voltage supply from coupler peripheral modules.
- LED status indicator

**Front view
253-1SC00**
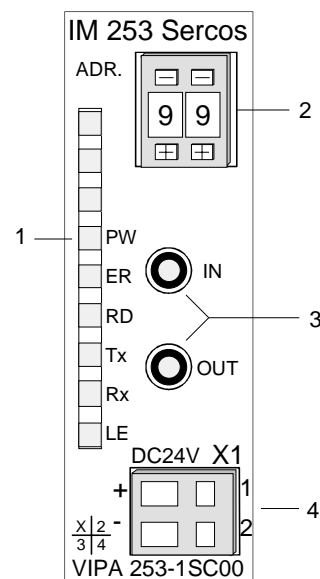
[1]	LED status indicator
[2]	Address adjuster
[3]	FO connection to SERCOS
[4]	DC 24V connection supply voltage

Components

LEDs   For the fast diagnosis of the recent module status there are 6 LEDs at the
                            frontside.

Label	Color	Description
PW	yellow	Power LED: operating voltage on
ER	red	Error and the backplane bus or SERCOS
RD	green	Blinks at System OK and boot-up is in Phase 4.
		Is on when Phase 4 has been reached.
Tx	yellow	Is on at send activity via SERCOS
Rx	yellow	Is on at receive activity via SERCOS
LE	red	Error in the FO communication (line interruption res. hardware defect)
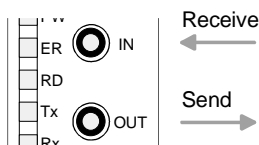
FO connection   Via this jack you include the SERCOS coupler via FO transmitters into your
SERCOS   SERCOS.

The connection to SERCOS takes place via 2 jacks. The direction of the 2
jacks is shown at the left side.

The jacks are for use with 1mm Plastic Optical Fiber and 200μm Hard Clad
Silica HCS®.
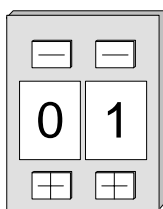
Address selector   The address adjuster selector:

- the fixing of an unique SERCOS address (1 ... 89)
- the programming of the baudrate (90 ... 93)
- the adjustment of the light intensity (94 ... 97)
- the predefining of the time window calculation mode (98, 99)

Power supply   The SERCOS coupler has an integrated power supply, protected against
                            inverse polarity and overcurrent.

This power supply also provides the connected peripheral modules with
max. 3,5A via the back plane bus.

The connection of the supply voltage is at the frontside. The power supply
has to be provided with DC 24V (20.4 ... 28.8V).

Block diagram   The following block diagram shows the principle of the hardware structure
                      of the SERCOS coupler and the internal communication:
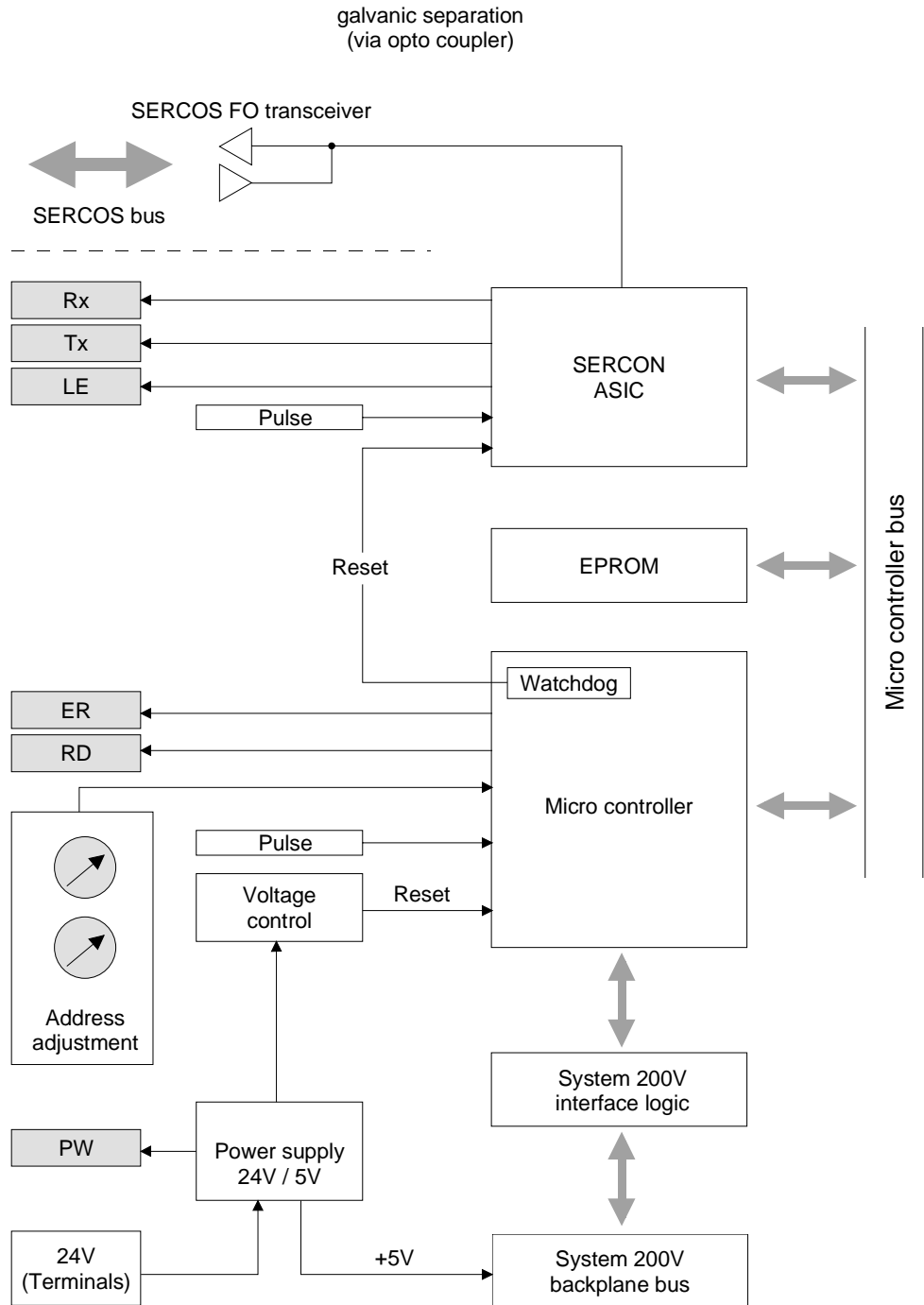
Basic parameterization via address adjuster

Overview
Via the address adjuster you may alter basic settings of the SERCOS coupler. Choose the according address code at the shut-down SERCOS coupler. At power on, this code is stored permanently in the SERCOS module.

The following basic settings may be altered in this way:

- Baudrate
- Light intensity
- Time window calculation

Note!
Please regard, that you may use the address adjuster only in off state. Otherwise malfunctions of the SERCOS couplers may occur!

Approach
Turn off the supply voltage of the SERCOS coupler.

Choose the according address code at the address adjuster.

Turn on the voltage supply.

$\rightarrow$ The assigned parameter is permanently stored in the SERCOS coupler and this is shown via the green RD-LED.

Value range
00:      reserved (may not be used)

01 ... 89: possible SERCOS station addresses

90 ... 99: VIPA additional functions for basic parameterization

Fix baudrate
All participants connected together at the bus are communicating at the same baudrate. You may fix the wanted baudrate via the address adjuster.

- Turn off the voltage supply.
- Choose the wanted baudrate at the address adjuster. Here means:

         90: 2Mbaud
         91: 4Mbaud
         92: 8Mbaud
         93: 16Mbaud

- Turn on the voltage supply.
- $\rightarrow$ The assigned baudrate is permanently stored in the SERCOS coupler and this is shown via the green RD-LED.

Fix light intensity   You may predefine the light intensity of the FO diode in 4 steps.

• Turn off the voltage supply.

• Choose the wanted light intensity at the address adjuster. You have following possibilities:

                94: light intensity 0 (Minimum)
                95: light intensity 1
                96: light intensity 2
                97: light intensity 3 (Maximum)

• Turn on the voltage supply.

→ The assigned light intensity is permanently stored in the SERCOS coupler and this is shown via the green RD-LED.

Time window calculation   Set here the operating mode for the time window calculation. The following 2 modes are possible:

98: Mode_All_Cyclic

The complete periphery is available in the cyclic SERCOS operation. Additionally you may also use the service channel. Depending on the number of modules you need SERCOS cycles of 2ms or more. The more periphery is connected, the higher you have to choose the SERCOS cycle time.

99: Mode_All_Service_Channel

In this mode, no periphery is available in the cyclic operation. For this you may operate the SERCOS ring with a cycle time of 1ms. Here you may address the peripheral modules exclusively via the service channel.

SERCOS Identifier

Overview

The read and write access to the System 200V under SERCOS takes place via ident numbers (short: IDN).

For the SERCOS coupler IM 253SC there are the following 3 ranges:

S-0-xxxx, S-1-xxxx: Standard IDNs, fixed by the SERCOS Interface Committee

S-2-xxxx, S-3-xxxx: IDNs from VIPA for transferring in- and output data.

P-0-xxxx: IDNs from VIPA for transferring parameter data

Standard IDNs S-0-xxxx, S-1-xxxx

The SERCOS coupler IM 253SC supports all Standard IDNs. More detailed information is to find in the SERCOS specification of the SERCOS Committee.

Depending on the operating mode the two Standard-ID lists are filled:

- Mode_All_Cyclic

  S-0-0187:   points to all input identifier S-2-xxxx
  S-0-0188:   points to all output identifier S-3-xxxx

- Mode_All_Service_Channel

  S-0-0187:   List is empty
  S-0-0188:   List is empty

VIPA specific IDNs S-2-xxxx, S-3-xxxx, P-0-xxxx

For the System 200V is are modular system, you may connect up to 32 modules in any sequence and assortment to the SERCOS coupler IM 253SC.

This builds dynamically very different configurations of in- and output channels. A module may occupy one or more of this channels. The maximum number of in-/output channels (I/O channels) is restricted to 256. The mapping of the modules and the I/O channels into the S-2- res. S-3-area and (at parameterizable modules additionally) into the P area happens automatically.

VIPA specific assignment of the IDN S-2-xxxx, S-3-xxxx and P-0-xxxx

The modules are scanned from the left to the right (Plug-in location 1 to 32) and separated after input and output the identifiers are created:

- Input channels are created in steps of 10s as S-2-ccc0 identifier.
  Here is ccc = 000 ... 255.
  Range: S-2-0000, S-2-0010, S-2-0020, ... S-2-2550

- Output channels are created in steps of 10s as S-3-ccc0 identifier.
  Here is ccc = 000 ... 255
  Range: S-3-0000, S-3-0010, S-3-0020, ... S-3-2550

- If you plug-in parameterizable modules, a P-0-ssxx identifier block is created for each module. Here is:
  Plug-in location: ss = 01 ... 32, Parameter: xx = 00 ... 17
  Example: P-0-0100 (module in plug-in location 1), P-0-0200 (module in plug-in location 2), ... P-0-3200 (module in plug-in location 32)

VIPA specific S-Identifier

For the S-Identifier there are the following information:

Name (consists of max. 32 characters)

Format: S.I.T_W.D

with

S = plug-in location (1..32)
I = module internal Byte offset at multi channel modules (0..15)
T = Type: (DIGITAL, ANALOG)
W = Data width: (BYTE, WORD, DOUBLE =1,2,4Byte)
D = Direction: (IN,OUT)

Example: Name: "1.0.DIGITAL_BYTE.IN" means:

The module in plug-in location 1 provides one Byte digital input data starting at the internal address 0 .

Attribute

in accordance to the SERCOS specification, the attribute fixes if the operating date is readable res. writeable. More detailed information is to find in the SERCOS specification of the SERCOS Committee.

Operating date

Here the in- res. output date with the according data width.

VIPA specific P-Identifier (always)

The SERCOS coupler always contains the two identifiers P-0-0000 and P-0-0001.

P-0-0000

Name: WRITE_PARAMETER

Attribute: Read/Write in Phase 0..3, Read Only in Phase 4

Operating date: 1 = Init adopt all parameter into EEPROM.
2 = Init delete all parameter in EEPROM.
0 = Return value OK
65535 (FFFFhex) = Return value ERROR

P-0-0001

Name: Estimated SERCOS cycle time

Attribute: Read Only

Unit: Micro seconds

Operating date: The chosen SERCOS cycle time must be higher than this value! (e.g. 1460 means that the estimated cycle time for the present module structure is 1.46ms and therefore you have to choose a SERCOS cycle of at least 2ms.)

18 VIPA specific P-Identifier (at parameterizable modules)

If you deploy parameterizable modules, for each parameterizable module a 18 P-0-ssxx identifier block is created dynamically. Here ss means plug-in location (1 ... 32) and xx for the parameter no. (0 ... 17).

In principle these additional P-0 identifiers have the following structure:

P-0-ss00

Name: ss.SLOT

Attribute: Read Only

Operating date: Indicates that there is a parameterizable module at the plug-in location

P-0-ss01

Name: ss.LENGTH

Attribute: Read/Write in Phase 0 ... 3, Read Only in Phase 4

Operating date: number of the now following parameter bytes for this module (value: 0 ... 15).

P-0-ss02

Name: ss.PARAMETER.0

Attribute: Read/Write in Phase 0..3, Read Only in Phase 4

Operating date: Parameter byte 0 (value: 0..255)

The length value and a description of the parameters to transfer are to find in the according chapters of the modules in this manual.

...

P-0-ss17

Name: ss.PARAMETER.15

Attribute: Read/Write in Phase 0..3, Read Only in Phase 4

Operating date: Parameter byte 15 (value: 0..255)

Example for the automatic ID assignment

Structure   The following example describes how the automatic identifier assignment happens in the SERCOS coupler.

It has the following structure:

Logical Position: 1   2   3   4   5   6   7   8   9
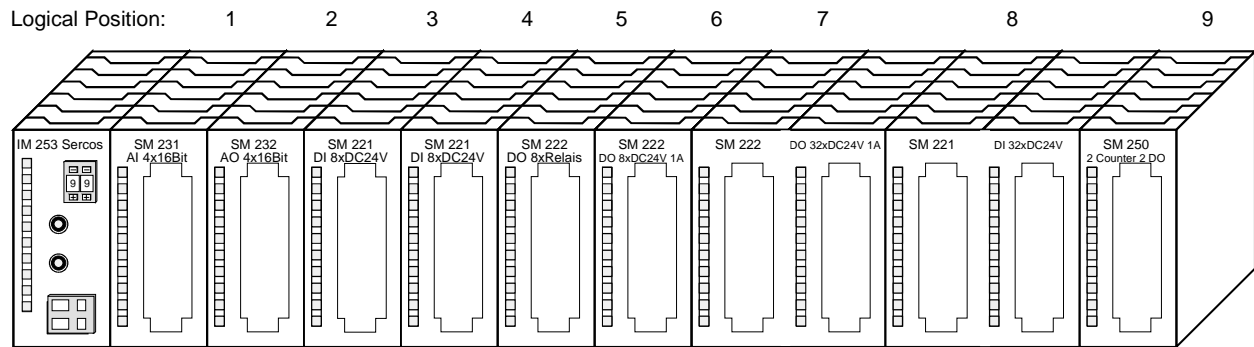
Logical position	Module	Input	Output	Parameter
1	VIPA 231-1BD52 (4 channel multi Analog Input)	ANALOG_WORD ANALOG_WORD ANALOG_WORD ANALOG_WORD		10 Byte
2	VIPA 232-1BD51 (4 channel multi Analog Output)		ANALOG_WORD ANALOG_WORD ANALOG_WORD ANALOG_WORD	6 Byte
3	VIPA 221-1BF00 (8bit digital Input)	DIGITAL_BYTE		-
4	VIPA 221-1BF00 (8bit digital Input)	DIGITAL_BYTE		-
5	VIPA 222-1HF00 (8bit digital Output, Relay)		DIGITAL_BYTE	-
6	VIPA 222-1BF00 (8bit digital Output, Transistor)		DIGITAL_BYTE	-
7	VIPA 222-2BL10 (32bit digital Output, Transistor)		DIGITAL_DOUBLE	-
8	VIPA 221-2BL10 (32bit digital Input)	DIGITAL_DOUBLE		-
9	VIPA 250-1BA00 (Counter Module with 2x32Bit Counter and control register)	DIGITAL_DOUBLE DIGITAL_DOUBLE DIGITAL_BYTE DIGITAL_BYTE	DIGITAL_DOUBLE DIGITAL_DOUBLE DIGITAL_BYTE DIGITAL_BYTE	2 Byte

Automatically created identifiers   For this structure, the following identifiers are created automatically:

S-2-Identifier (Input)

Identifier	Name	Comment
S-2-0000	1.0.ANALOG_WORD.IN	Module in position 1 Inside the module at Byte offset 0 An analog word Input
S-2-0010	1.2.ANALOG_WORD.IN	Module in position 1 Inside the module at Byte offset 2 An analog word Input
S-2-0020	1.4.ANALOG_WORD.IN	Module in position 1 Inside the module at Byte offset 4 An analog word Input
S-2-0030	1.6.ANALOG_WORD.IN	Module in position 1 Inside the module at Byte offset 6 An analog word Input
S-2-0040	3.0.DIGITAL_BYTE.IN	Module in position 3 Inside the module at Byte offset 0 An digital Byte Input
S-2-0050	4.0.DIGITAL_BYTE.IN	Module in position 4 Inside the module at Byte offset 0 An digital Byte Input
S-2-0060	8.0.DIGITAL_DOUBLE.IN	Module in position 8 Inside the module at Byte offset 0 An digital double word Input

... continue

S-2-0070	9.0.DIGITAL_DOUBLE.IN	Module in position 9 Inside the module at Byte offset 0 An digital double word Input
S-2-0080	9.4.DIGITAL_DOUBLE.IN	Module in position 9 Inside the module at Byte offset 4 An digital double word Input
S-2-0090	9.8.DIGITAL_BYTE.IN	Module in position 9 Inside the module at Byte offset 8 An digital Byte Input
S-2-0100	9.9.DIGITAL_BYTE.IN	Module in position 9 Inside the module at Byte offset 9 An digital Byte Input

S-3-Identifier (Output)

S-3-0000	2.0.ANALOG_WORD.OUT	Module in position 2 Inside the module at Byte offset 0 An analog word Output
S-3-0010	2.2.ANALOG_WORD.OUT	Module in position 2 Inside the module at Byte offset 2 An analog word Output
S-3-0020	2.4.ANALOG_WORD.OUT	Module in position 2 Inside the module at Byte offset 4 An analog word Output
S-3-0030	2.6.ANALOG_WORD.OUT	Module in position 2 Inside the module at Byte offset 6 An analog word Output
S-3-0040	5.0.DIGITAL_BYTE.OUT	Module in position 5 Inside the module at Byte offset 0 A digital Byte Output

... continue

S-3-0050	6.0.DIGITAL_BYTE.OUT	Module in position 6
		Inside the module at Byte offset 0
		A digital Byte
		Output
S-3-0060	7.0.DIGITAL_DOUBLE.OUT	Module in position 7
		Inside the module at Byte offset 0
		A digital double word
		Output
S-3-0070	9.0.DIGITAL_DOUBLE.OUT	Module in position 9
		Inside the module at Byte offset 0
		A digital double word
		Output
S-3-0080	9.4.DIGITAL_DOUBLE.OUT	Module in position 9
		Inside the module at Byte offset 4
		A digital double word
		Output
S-3-0090	9.8.DIGITAL_BYTE.OUT	Module in position 9
		Inside the module at Byte offset 8
		A digital Byte
		Output
S-3-0100	9.9.DIGITAL_BYTE.OUT	Module in position 9
		Inside the module at Byte offset 9
		A digital Byte
		Output

P-0-Identifier (Parameter) always present

P-0-0000	WRITE_PARAMETER	Set here the init for read/write all parameters:
		1=Write, 2=Clear
P-0-0001	Estimated SERCOS cycle time	Value here: 1460 Micro seconds
		i.e. you may run this assembly with 2ms SERCOS cycle.

P-0-Identifier (Parameter) at parameterizable modules

P-0-0100	1.SLOT	At position 1 is a parameterizable module
P-0-0101	1.LENGTH	(operating date) Bytes shall be transferred to the module at position 1.
P-0-0102	1.PARAMETER.0	Parameter byte 0 for module at position 1
P-0-0103	1.PARAMETER.1	Parameter byte 1 for module at position 1
P-0-0104	1.PARAMETER.2	Parameter byte 2 for module at position 1
P-0-0105	1.PARAMETER.3	Parameter byte 3 for module at position 1
P-0-0106	1.PARAMETER.4	Parameter byte 4 for module at position 1
P-0-0107	1.PARAMETER.5	Parameter byte 5 for module at position 1
P-0-0108	1.PARAMETER.6	Parameter byte 6 for module at position 1
P-0-0109	1.PARAMETER.7	Parameter byte 7 for module at position 1
P-0-0110	1.PARAMETER.8	Parameter byte 8 for module at position 1
P-0-0111	1.PARAMETER.9	Parameter byte 9 for module at position 1
P-0-0112	1.PARAMETER.10	Parameter byte 10 for module at position 1
P-0-0113	1.PARAMETER.11	Parameter byte 11 for module at position 1
P-0-0114	1.PARAMETER.12	Parameter byte 12 for module at position 1
P-0-0115	1.PARAMETER.13	Parameter byte 13 for module at position 1
P-0-0116	1.PARAMETER.14	Parameter byte 14 for module at position 1
P-0-0117	1.PARAMETER.15	Parameter byte 15 for module at position 1
P-0-0200	2.SLOT	At position 2 is a parameterizable module
P-0-0201	2.LENGTH	(operating date) Bytes shall be transferred to the module at position 2.
P-0-0202	2.PARAMETER.0	Parameter byte 0 for module at position 2
P-0-0203	2.PARAMETER.1	Parameter byte 1 for module at position 2
P-0-0204	2.PARAMETER.2	Parameter byte 2 for module at position 2
P-0-0205	2.PARAMETER.3	Parameter byte 3 for module at position 2
P-0-0206	2.PARAMETER.4	Parameter byte 4 for module at position 2
P-0-0207	2.PARAMETER.5	Parameter byte 5 for module at position 2
P-0-0208	2.PARAMETER.6	Parameter byte 6 for module at position 2
P-0-0209	2.PARAMETER.7	Parameter byte 7 for module at position 2
P-0-0210	2.PARAMETER.8	Parameter byte 8 for module at position 2
P-0-0211	2.PARAMETER.9	Parameter byte 9 for module at position 2
P-0-0212	2.PARAMETER.10	Parameter byte 10 for module at position 2
P-0-0213	2.PARAMETER.11	Parameter byte 11 for module at position 2
P-0-0214	2.PARAMETER.12	Parameter byte 12 for module at position 2
P-0-0215	2.PARAMETER.13	Parameter byte 13 for module at position 2
P-0-0216	2.PARAMETER.14	Parameter byte 14 for module at position 2
P-0-0217	2.PARAMETER.15	Parameter byte 15 for module at position 2

... continue

P-0-0900	9.SLOT	At position 9 is a parameterizable module
P-0-0901	9.LENGTH	(operating date) Bytes shall be transferred to the module at position 9.
P-0-0902	9.PARAMETER.0	Parameter byte 0 for module at position 9
P-0-0903	9.PARAMETER.1	Parameter byte 1 for module at position 9
P-0-0904	9.PARAMETER.2	Parameter byte 2 for module at position 9
P-0-0905	9.PARAMETER.3	Parameter byte 3 for module at position 9
P-0-0906	9.PARAMETER.4	Parameter byte 4 for module at position 9
P-0-0907	9.PARAMETER.5	Parameter byte 5 for module at position 9
P-0-0908	9.PARAMETER.6	Parameter byte 6 for module at position 9
P-0-0909	9.PARAMETER.7	Parameter byte 7 for module at position 9
P-0-0910	9.PARAMETER.8	Parameter byte 8 for module at position 9
P-0-0911	9.PARAMETER.9	Parameter byte 9 for module at position 9
P-0-0912	9.PARAMETER.10	Parameter byte 10 for module at position 9
P-0-0913	9.PARAMETER.11	Parameter byte 11 for module at position 9
P-0-0914	9.PARAMETER.12	Parameter byte 12 for module at position 9
P-0-0915	9.PARAMETER.13	Parameter byte 13 for module at position 9
P-0-0916	9.PARAMETER.14	Parameter byte 14 for module at position 9
P-0-0917	9.PARAMETER.15	Parameter byte 15 for module at position 9

Example
parameterization

For example, the following values shall be set:

AI 4x16Bit (231-1BD52) at position 1

Length: 10 Byte

Parameter:

Byte	Description	Set property	Handling value
0	Diagnostic alarm Byte:	deactivated	00h = 0dez
1	reserved	00h	00h = 0dez
2	Function no. channel 0	Voltage ±10V in the S7 format from Siemens	28h = 40dez
3	Function no. channel 1	Voltage ±10V in the S7 format from Siemens	28h = 40dez
4	Function no. channel 2	Current 4...20mA in S7 format from Siemens	2Dh = 45dez
5	Function no. channel 3	Current 4...20mA in S7 format from Siemens	2Dh =45dez
6	Option Byte channel 0	default	00h = 0dez
7	Option Byte channel 1	default	00h = 0dez
8	Option Byte channel 2	default	00h = 0dez
9	Option Byte channel 3	default	00h = 0dez

Herefore the table has the following entries:

P-0-0100	1.SLOT	At position 1 is a parameterizable module
P-0-0101	1.LENGTH	10dez
P-0-0102	1.PARAMETER.0	0dez
P-0-0103	1.PARAMETER.1	0dez
P-0-0104	1.PARAMETER.2	40dez
P-0-0105	1.PARAMETER.3	40dez
P-0-0106	1.PARAMETER.4	45dez
P-0-0107	1.PARAMETER.5	45dez
P-0-0108	1.PARAMETER.6	0dez
P-0-0109	1.PARAMETER.7	0dez
P-0-0110	1.PARAMETER.8	0dez
P-0-0111	1.PARAMETER.9	0dez
P-0-0112	1.PARAMETER.10	
...	...	are created but not used
P-0-0117	1.PARAMETER.15	

Set the value in **P-0-0000** to 1 and the parameters are stored in the EEPROM of the SERCOS coupler.

At successful transfer, you get the return value 0 and at the analog input module the LEDs F2 and F3 for wirebreak recognition are illuminated due to the current measuring range.

AO 4x16Bit (232-1BD51) at position 2

Length: 6Byte

Parameter:

Byte	Description	Set property	Handling value
0	Diagnostic alarm Byte:	deactivated	00h = 0dez
1	reserved	00h	00h = 0dez
2	Function no. channel 0	Voltage ±10V in the S7 format from Siemens	09h = 9dez
3	Function no. channel 1	Voltage ±10V in the S7 format from Siemens	09h = 9dez
4	Function no. channel 2	Current 4...20mA in S7 format from Siemens	0Ch = 12dez
5	Function no. channel 3	Current 4...20mA in S7 format from Siemens	0Ch =12dez

Herefore the table has the following entries:

P-0-0200	2.SLOT	At position 2 is a parameterizable module
P-0-0201	2.LENGTH	6dez
P-0-0202	2.PARAMETER.0	0dez
P-0-0203	2.PARAMETER.1	0dez
P-0-0204	2.PARAMETER.2	9dez
P-0-0205	2.PARAMETER.3	9dez
P-0-0206	2.PARAMETER.4	12dez
P-0-0207	2.PARAMETER.5	12dez
P-0-0208 ... P-0-0217	2.PARAMETER.6 ... 2.PARAMETER.15	are created but not used

Set the value in **P-0-0000** to 1 and the parameters are stored in the EEPROM of the SERCOS coupler.

At successful transfer, you get the return value 0 and at the analog output module the LED for wirebreak recognition are illuminated due to the current measuring range.

SM 250 2 Counter 2 DO (250-1BA00) at position 2

Length: 2Byte

Parameter:

Byte	Description	Set property	Handling value
0	Mode Counter 0	Frequency	16dez
1	Mode Counter 1	measurement	16dez

Herefore the table has the following entries::

P-0-0900	9.SLOT	At position 9 is a parameterizable module
P-0-0901	9.LENGTH	2dez
P-0-0902	9.PARAMETER.0	16dez
P-0-0903	9.PARAMETER.1	16dez
P-0-0904 ... P-0-0917	9.PARAMETER.2 ... 9.PARAMETER.15	are created but not used

Set the value in **P-0-0000** to 1 and the parameters are stored in the EEPROM of the SERCOS coupler.

At successful transfer, you get the return value 0.

Technical Data

SERCOS coupler
IM 253SC

Electrical Data	VIPA 253-1SC00
Voltage supply	DC 24V (20.4 ... 28.8V) via front by ext. pow. supply
Current consumption	Bus coupler: 50mA
	incl. supply of the peripheral modules: max. 3.5A (5V)
Output current backplane bus	max. 3.5A
Potential separ. to the backplane bus	500V eff.
Function specific data	
Status indicator	via LED at the frontside
Physical connection SERCOS	FO jacks
Network topology	Ring
Transfer medium	Fiber optic transmitter, for use with 1mm Plastic
	Optical Fiber and 200µm Hard Clad Silica HCS®
Transfer rate	2, 4, 8, 16MBaud
Number of participants	max. 89
Combination with peripheral modules	
Module number	max. 32
Inputs	max. 256Byte
Outputs	max. 256Byte
Dimensions and Weight	
Dimensions (WxHxD)	25.4x76x76mm
Weight	75g

Chapter 7   Ethernet coupler

Outline   Content of this chapter is the description of the Ethernet coupler IM 253NET from VIPA. It contains all information for installation and commissioning of the Ethernet coupler.

The chapter starts with the principles. Here the basic expressions of the Ethernet communication are explained together with the guidelines for building up a network.

Another part describes the hardware components and the access to the Ethernet coupler.

The chapter ends with the used protocols, a sample for socket programming and the technical data.

The following text contains:

* System overview
* Principles of the Ethernet communication
* Construction of the Ethernet coupler
* Principles of the automatic address allocation
* (Online-)access to the Ethernet coupler
* Programming sample
* Technical data

System overview

Typical fieldbus systems are divided into master and slave systems.

Master system are CPs, coupled to a CPU, allowing remote programming res. visualization of the according CPU as well as the data transfer between several TCP/IP participants.

Slave systems on the other hand are "data collectors" that deliver the I/O data of the connected modules to the requesting master.

The Ethernet coupler described in this chapter is a slave system.

For the communication happens via TCP/IP, the slave system is referred to as server and a master as client.

The Ethernet coupler from VIPA allows you to connect up to 32 modules of your System 200V periphery via Ethernet. With each protocol up to 8 clients may communicate simultaneously with the Ethernet coupler.

At this time, VIPA offers the following Ethernet coupler:
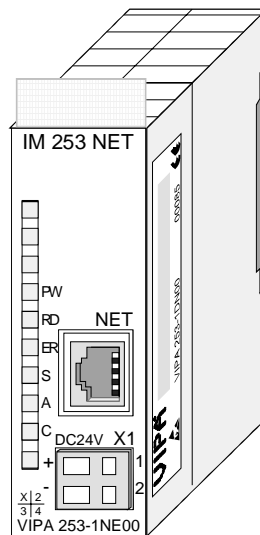
	Type	Order number	Description
Ordering data **Ethernet coupler**	IM 253NET	VIPA 253-1NE00	Ethernet coupler

Principles of Ethernet

Ethernet

Originally, Ethernet has been developed from DEC, Intel and Xerox (as DIX standard) for the data transfer between office devices. Nowadays it normally means the specification *IEEE 802.3 CSMA/CD*, first published in 1985. Due to the worldwide deployment and the high lot sizes, this technology is commonly available and reasonably priced. This allows the easy link-up to existing networks.

Ethernet transports Ethernet packages from one sender to one ore more receivers. This transfer happens without acknowledgement and without repetition of lost packages. For a secure data transfer, protocols like TCP/IP are used that are accompanying Ethernet.

Twisted Pair

In the early days of networking the Triaxial- (yellow cable) or thin Ethernet cable (Cheapernet) was used as communication medium. This has been superseded by the twisted pair network cable due to its immunity to interference. The IM 253NET Ethernet coupler has a twisted-pair connector.

Where the coaxial Ethernet networks are based on a bus topology the twisted pair network is based on a point-to-point scheme.

The network that may be established by means of this cable has a star topology. Every station is connected to the hub/switch by means of a separate cable. The hub/switch provides the interface to the Ethernet.

Hub

The hub is the central element that is required to implement a twisted pair Ethernet network. It is the job of the hub to regenerate and to amplify the signals in both directions. At the same time it must have the facility to detect and process segment wide collisions and to relay this information. The hub is not accessible by means of a separate network address since it is not visible to the stations on the network. A hub has provisions to interface with Ethernet or another hub.

Switch

A switch also is a central element for implementing a twisted pair Ethernet network. Several station res. hubs are connected together via a switch. These then may communicate with each other via the switch without causing network load. An intelligent hardware analyses the incoming telegrams for every port of the switch and passes them collision free on to the destination stations at the switch. A switch optimizes the band width of every connected segment of a network. Switches allow changing exclusive connections between the connected segment of a network.

Access control   Ethernet supports the principle of random bus access: every station on the network accesses the bus independently as and when required. These accesses are coordinated by a CSMA/CD (Carrier Sense Multiple Access/Collision Detection) scheme: every station "listens" on the bus cable and receives communication messages that are addressed to it.

Stations only initiate a transmission when the line is unoccupied. In the event that two participants should start transmitting simultaneously, they will detect this and stop transmitting to restart after a random delay time has expired.

Communication   The Ethernet coupler is connected with the modules via the backplane bus. It collects their data and places this as "server" (slave) at the disposal of the superordinated "client" (master system).

The communication happens via TCP/IP with leading ModbusTCP or Siemens S5 header protocol.

Vice versa, the Ethernet coupler receives the data, addressed to it by IP address and port, and transfers it to its output periphery. For project engineering, VIPA offers the configuration tool WinNCS that allows you to configure the Ethernet coupler online.

For test and diagnostic purposes the Ethernet slave provides a web server that allows the read and write access to the I/O periphery as well as the parameterization of the modules.

Overview Protocols   Protocols define rules or standards that enables different computers to establish communication connections and exchange data as error free as possible.

The so called ISO/OSI layer model is generally accepted for the standardization of computer communication. The layer model is based upon seven layers with guidelines for the deployment of hard- and software.

Layer	Function	Protocol
Layer 7	Application Layer (Application)	Siemens S5 Header, ModbusTCP
Layer 6	Presentation Layer (Presentation)	
Layer 5	Session Layer (Session)	
Layer 4	Transport Layer (Transport)	TCP
Layer 3	Network Layer (Network)	IP
Layer 2	Data Link Layer (Security)	
Layer 1	Physical Layer (Bit transfer)	

	Layer 2	Layer 3	Layer 4	Layer 7	
Telegram structure	MAC/DLL	IP	TCP	API	...
	14 Byte	20 Byte	20 Byte	Length depends on protocol	
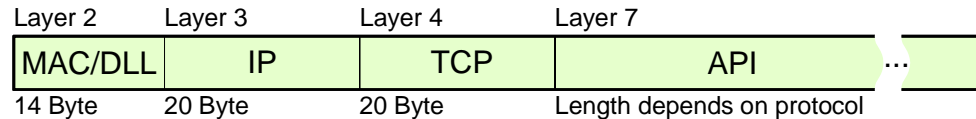
MAC/DLL   While the Ethernet physics covers with its normed signal levels Layer 1, MAC/DLL covers the conditions of the security layer (Layer 2). With MAC (**M**edium **A**ccess **C**ontrol) / DLL (**D**ata **L**ink **L**ayer) the communication happens at the lowest Ethernet level using MAC addresses. Every Ethernet communication participant has a MAC address that must be unique at the network.

The deployment of MAC addresses specifies source and destination unambiguously.

IP   The Internet Protocol covers the network layer (layer 3) of the ISO/OSI layer model.

The main purpose of IP is to send data packages from one station to another, passing several other stations. This data packages are referred to as datagrams. The IP does neither serve the according sequence nor the deliverance at the receiver.

For the unambiguous distinction between sender and receiver, 32Bit addresses are used (IP addresses) that are normally written in four octets of each 8Bit, e.g. 172.16.192.11. One octet may represent numbers between 0 and 255.

A part of the address specifies the network, the rest identifies the single stations in the network. The proportions of network part and station part is floating and depends on the network size.

TCP   The TCP (**T**ransmission **C**ontrol **P**rotocol) puts directly upon the IP and covers therefore the transport layer (layer 4) of the ISO/OSI layer model. TCP is a connection orientated end-to-end protocol and serves the logical connection between two partners.

TCP ensures the sequential correct and reliable data transfer.

Every datagram is preceded by a header of at least 20 octets that contains, among others, the serial number for the according sequence. This causes that within a network, the single datagrams may reach their destination on different ways.

API   API means **A**pplication **P**rogramming **I**nterface. API covers the conditions of the Application Layer (Layer 7).

Here, the header and user data of the according protocols are stored.

The Ethernet coupler IM 253NET from VIPA uses the following protocols, described further below:

- ModbusTCP
- Siemens S5 Header

API structure

Layer 2	Layer 3	Layer 4	Layer 7	
MAC/DLL	IP	TCP	API	...
14 Byte	20 Byte	20 Byte	Length depends on protocol	

ModbusTCP

Port 502	ModbusTCP-Header	Modbus	User data	...	CRC
	6 Byte	2 Byte	max.254 Byte		

Siemens S5

Port 7779/7780	Siemens S5 Header	User data	...
	16 Byte	max.64kByte	
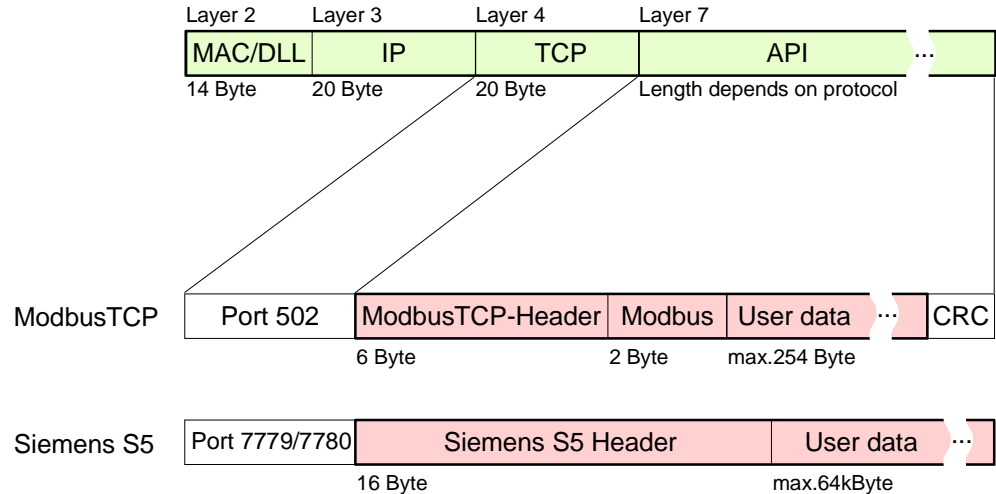
ModbusTCP

ModbusTCP is a Modbus-RTU protocol, put upon TCP/IP.

The Modbus protocol is a communication protocol supporting a hierarchic structure with one master and several slaves. ModbusTCP extends Modbus to a client server communication where several client may access a server.

For the addressing happens by means of the IP addresses, the address integrated in the Modbus telegram irrelevant. Furthermore, the check sum is not required because the sequence insurance happens via TCP/IP.

After the request of a client, this awaits the answer of the server for a configurable time.

ModbusTCP exclusively uses the RTU format.

Every Byte is transferred as one sign. This enables a higher data pass-through than the Modbus-ASCII format. The RTU time supervision is omitted for the header contains the size of the telegram length to be received.

Data that are transferred via ModbusTCP may contain bit and word information. At bit chains, the highest bit is send first, i.e. in a word it is at the most left position. At words, the highest Byte is send first.

The access to a Modbus slave happens via function codes that are described in detail in this chapter further below.

Siemens S5 Header

The Siemens S5 Header protocol serves the data transfer between PLC systems. Deploying the organization format (short ORG) integrated in the Siemens S5 Header protocol, a short description of a data source res. data destination in PLC environment is possible.

The possible ORG formats are corresponding to Siemens.

Planning a network

General   The main characteristic of a bus structure is the existence of a single
physical transfer line. As physical transfer mediums are used:

• one or more electrical cables (drilled cable)

• coaxial cable (Triaxial cable)

• fiber optic transmitter.

To enable the communication between the single stations, rules and
instructions have to be arranged and kept.

The appointments cover the form of the data protocol, the access
procedure to the bus and more basics for communication. The Ethernet
coupler IM 253NET from VIPA has been developed upon the ISO
standards and norms.

Standards and   The following standards and norms about network technologies have been
norms   fixed by international and national committees:

ANSI   American National Standards Institute
The ANSI X3T9.5 standard currently defines the provisions for high speed
LAN's (100 MB/s) based on fiber optic technology.
(FDDI) Fiber Distributed Data Interface.

CCITT   Committee Consultative Internationale de Telephone et Telegraph.
Amongst others, this advisory committee has produced the provisions for
the connection of industrial networks (MAP) to office networks (TOP) on
Wide Area networks (WAN).

ECMA   European Computer Manufacturers Association.
Has produced various MAP and TOP standards.

EIA   Electrical Industries Association (USA)
This committee has issued standard definitions like RS-232 (V.24) and
RS-511.

IEC   International Electrotechnical Commission.
Defines certain special standards, e.g. for the Field bus.

ISO   International Organization for Standardization.
This association of national standards organizations developed the OSI-
model (ISO/TC97/SC16). It provides the framework for the standardization
of data communications. ISO standards are included in different national
standards like for example UL and DIN.

IEEE   Institute of Electrical and Electronic Engineers (USA).
The project-group 802 determines LAN-standards for transfer rates of 1 to
20 MB/s. IEEE standards often form the basis for ISO-standards, e.g.
IEEE 802.3 = ISO 8802.3.

Overview components

A twisted pair network can only be constructed with a star topology.
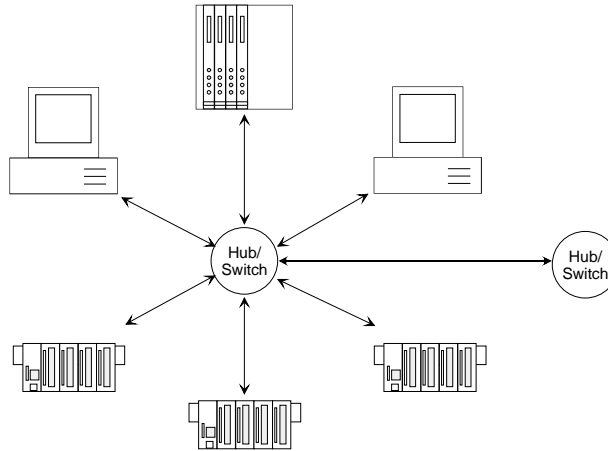
Mini-Switch CM 240
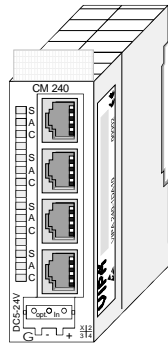
Twisted Pair Cable

A Twisted Pair cable is a cable with four cores drilled in pairs.

The single cores have a diameter of 0.4 to 0.6mm.

Restrictions

This is a summary of the restrictions and rules referring to Twisted Pair:

• Maximum number of coupler elements per segment   2
• Maximum length of a segment   100m

Analyzing the requirements

• What is the size of the area that must be served by the network?
• How many network segments provide the best solution for the physical (space, interference related) conditions encountered on site?
• How many network stations (SPS, IPC, PC, transceiver, bridges if required) must be connected to the cable?
• What is the distance between the different stations on the network?
• What is the expected "growth rate" and the expected number of connections that must be catered for by the system?
• What is the expected data amount (Band width, accesses/sec.)?

Drawing a network diagram

Draw a diagram of the network. Identify every hardware item (i.e. station cable, Hub, switch). Observe the applicable rules and restrictions.

• Measure the distance between all components to ensure that the maximum length is not exceeded.

IM 253NET - Ethernet coupler - Construction

Properties

- Ethernet coupler with ModbusTCP and Siemens S5 Header protocol
- max. 32 modules connectable with max. 256Byte input and 256Byte output data
- I/O access with both protocols via PC software like e.g. the OPC server from VIPA
- Online project engineering under WinNCS from VIPA with automatic coupler search and parameterization of modules in plain text. Here you may also fix IP address, subnet mask and coupler name and execute a firmware update.
- Integrated web server for test and diagnosis
- RJ45 jack 100BaseTX, 10BaseT
- Automatic polarity and baud rate recognition (auto negotiation)
- Automatic recognition of parallel or crossed cable (auto crossover)
- Network LEDs for link/activity, speed and collision
- Status-LEDs for Ready and Error

Delivery default

IP address: 10.0.0.1

Password for alteration access via WinNCS: 00000000

⚠️ **Attention!**

For every Ethernet coupler is delivered with the IP address 10.0.0.1, you must not connect more than one new Ethernet coupler at one time.

First commissioning: Connect the new coupler with the network, assign a TCP/IP address. Now you may connect the next new coupler...

**Front view
IM 208DP**

```
IM 253 NET
    PW
    RD    NET
1   ER
    S          2
    A
    C  DC24V  X1
    +         1
    -         2   3
   X|2
   3|4
VIPA 253-1NE00
```
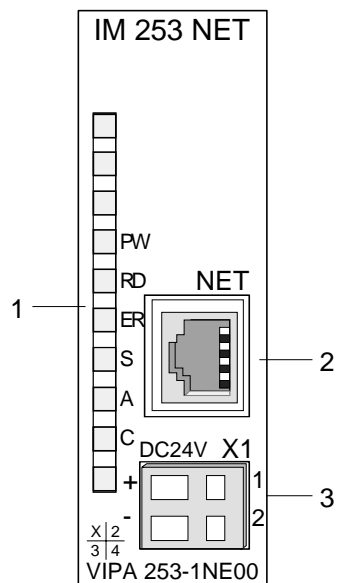
[1]   LED Status monitor
[2]   RJ45 jack for Twisted Pair
[3]   DC 24V voltage supply

Components

LEDs

The Ethernet coupler has different LEDs for diagnosis and monitoring the operational state. The usage and meaning of the colors are described in the following table.

Label	Color	Description
PW	Yellow	Power: DC 24V voltage supply is present
RD	Green	Ready: The Ethernet coupler has booted. I/O periphery, connected to the backplane bus can be accessed.
ER	Red	Error: Shows an error like e.g. module failure or parameterization error (Details: see coupler web site)
S	Green	Speed: on: 100MBit, off: 10Mbit
A	Green	Activity: on: physically connected off: no physical connection blinking: shows bus activity
C	Green	Collision: on: full duplex operation active off: half duplex operation active blinking: collision detected

RJ45 Ethernet connection

The RJ45 jack is the Twisted-Pair connection to Ethernet. The jack has the following pin assignment:

8pin RJ45 jack:
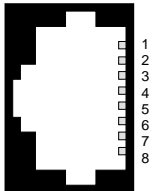
Pin	Signal
1	Transmit +
2	Transmit -
3	Receive +
4	-
5	-
6	Receive -
7	-
8	-

Power supply

The Ethernet coupler comes with an integrated power supply. The power supply has to be supplied with DC 24V (20.4 ... 28.8V) via the front. By means of the supply voltage, the bus coupler electronic is supplied as well as the connected modules via backplane bus. Please regard that the integrated power supply may supply the backplane bus with max. 3.5A. The power supply is protected against inverse polarity and overcurrent, Ethernet and backplane bus are galvanically isolated.

Access to the Ethernet coupler

Overview   The following illustration shows the Ethernet coupler IM 253NET access possibilities.
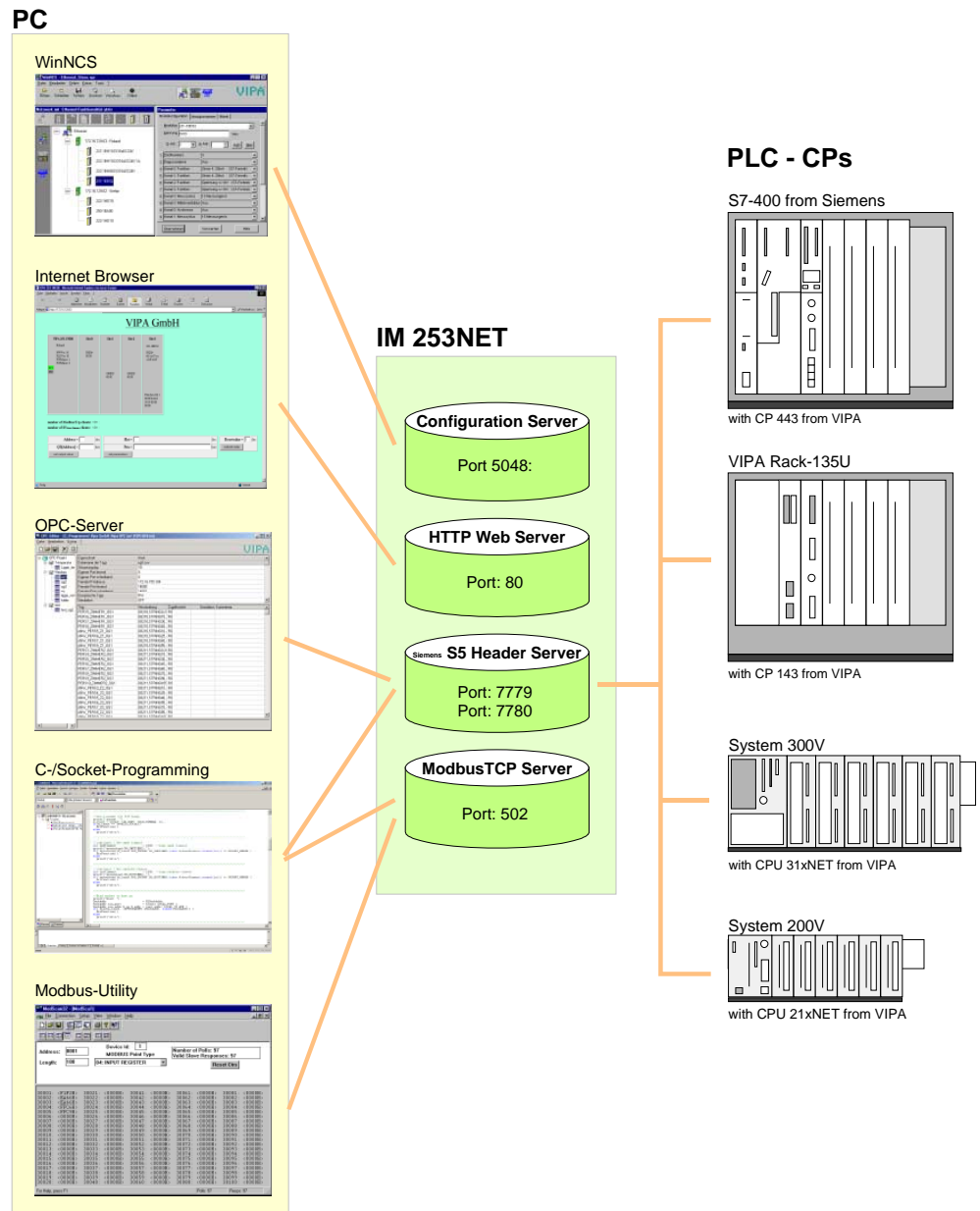
Access from PC

WinNCS for project engineering

The access happens via Port 5048 on the configuration server.

The configuration server calculates the number of plugged modules, their address and parameter ranges and puts the information under its IP address at the disposal of WinNCS.

WinNCS searches all couplers of the network via broadcast (slaves). The network to search is here until the gateway.

The collected data is used by WinNCS to model a symbolic network and is monitored in the network window.

Now you may assign real module types to the symbolic network and parameterize them.

Now you can assign an IP address to the Ethernet coupler online and update the firmware.

In WinNCS you also define the http web server properties of the Ethernet coupler.

All changing accesses are password protected. The password is requested once per session and slave.

In delivery state the password is `00000000`

Note!
Before you may access the Ethernet slave via internet browser, you have to assign an IP address according to your network. This may happen online via WinNCS.

Internet Browser for diagnosis and test

The access is via Port 80 at the HTTP web server.

The http server transfers a dynamically built web site that shows the recent configuration of the Ethernet coupler.

Besides of the firmware version and RDY/ERR-LED state, the I/O states and the parameters of the modules are shown.

The website also gives you the opportunity to send your alterations online, like accessing module outputs, change the parameters and initialize a re-boot of the Ethernet coupler.

OPC server for data transfer between coupler and PC

The access happens via the ports 7779 and 7780 on the Siemens S5 Header Server. Via these ports, fetch and write accesses via the VIPA OPC server are enabled.

The VIPA OPC server is a comfortable tool for visualization and data transfer.

C-/Socket programming for data transfer between coupler and PC

At ModbusTCP, the access is via port 502 at the ModbusTCP server and at Siemens S5 header via the ports 7779 and 7780 on the Siemens S5 Header Server.

This possibility of data transfer is for C program developers who want to create an open interface by means of socket programming.

Via simple C programs it is possible to transfer data between PC and Ethernet coupler. Depending on the program, the data is transferred via ModbusTCP or via Siemens S5 Header.

More detailed information about programming with sample sources is to find further below in this chapter.

Modbus utility

The access is via port 502 at the ModbusTCP Server. Modbus utility means all tools and programs that have a ModbusTCP interface.

For example, you may find the demo tool "ModbusScan32" from WinTech for download under www.win-tech.com.

Access from SPS res. CP

Data transfer between coupler and CP via Siemens S5 Header

The access happens via the ports 7779 and 7780 on the Siemens S5 Header Server. Via this ports, the VIPA CP, OPC server or other devices have fetch and write access.

For the communication, you need a PLC program in the CPU that serves the in-/output areas of the CP. Herefore, you have to configure fetch/write connections at the CP.

Principle of the automatic address allocation

Automatic addressing

To individually call the connected peripheral modules, certain addresses in the Ethernet coupler have to be assigned to them. For input and output area, the Ethernet coupler has an address range of each 256Byte.

The address allocation (also called Mapping) happens automatically and may not be influenced. The mapping may be seen via the website of the coupler.

Rules

At boot-up, the Ethernet coupler assigns automatically addresses for its in-/output periphery following this rules:

- All modules are mapped from left (Ethernet coupler) to right in ascending sequence starting with address 0.

- It is separated between in- and output area (if a module has in- and output data, these are stored at different addresses).

- There is no separation between digital and analog data. The Ethernet coupler creates cohere areas for in- and output data.

Note!

A description of the in- and output areas that are occupied by a module is to find in the concerning module description.

Please regard that modules that are occupying more than 1Byte like e.g. analog modules, are stored starting with an even address. Otherwise ModbusTCP has problems with word accesses.

Sample for the automatic address allocation

The following picture illustrates the automatic address allocation:
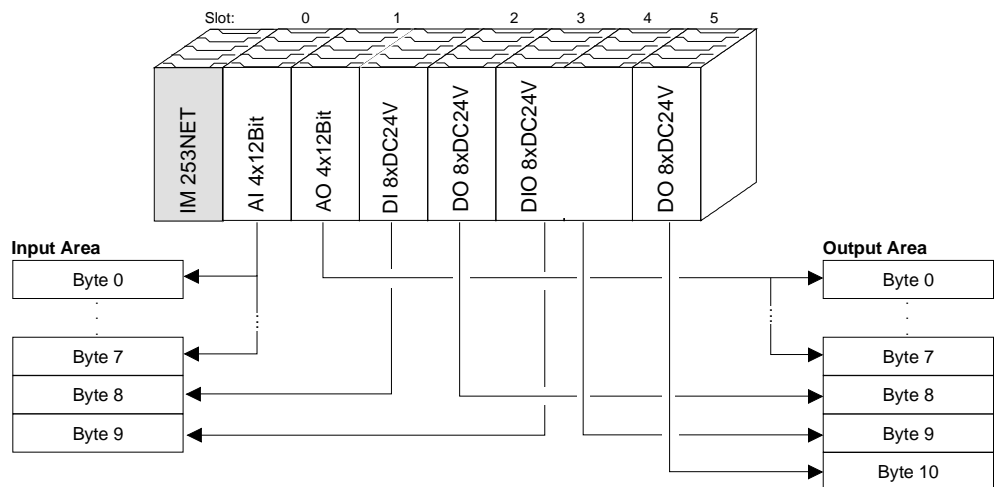
Project engineering under WinNCS

Preconditions
The project engineering happens via WinNCS starting with V3.09. For project engineering , the following preconditions should be met:

- Recent VIPA2ETH.GSD is stored in WinNCS/GSD/Englisch.

  For project engineering of the System 200V modules in WinNCS you receive the features of the VIPA components with a GSD-file.

  The GSD-file for the IM 253NET Ethernet coupler from VIPA is: VIPA2ETH.GSD

  Copy this GSD-file into WinNCS/GSD/Englisch.

  The latest version is to find under ftp.vipa.de/support.

- For online project engineering, the IM 253NET should be assembled with the according modules, connected to the Ethernet and supplied with voltage.

Attention!
For every Ethernet slave is delivered with the IP address 10.0.0.1, you must not install more than one new Ethernet slave at a time!

Approach online project engineering

- Start WinNCS and create a new "Ethernet" project via **File** > *Create/Open project*.
  → A parameter windows for online search of "Slaves" and "Stations" opens. [Slaves] lists all Ethernet coupler and [Stations] all CPs.

- Click at [Slaves]
  → All Ethernet coupler are searched and listed with IP address and where applicable with label.

- Via double-click at a listed slave, this is overtaken into the network window and listed with the concerning I/O periphery.
  → If there is no parameterization yet, the modules are listed as symbol (without label).

- Now you assign the according module type to the listed module symbol in the parameter window and adjust the parameters when needed. The address range that is occupied by the module in the TCP data stream is automatically preset by the Ethernet coupler.

- As soon as you click at [apply], you have to type the password. The password request happens once per session and coupler. In delivery state, the password is `00000000`. With correct password, the data is transferred online to the Ethernet coupler. Repeat this for all listed modules.

- Save your project.

Diagnosis and test via Internet Browser

Addressing

Type the configured IP address of your Ethernet coupler into your Internet Browser. Now you have access to a dynamically built-up website of the HTTP server.

Please regard that the website always contains the information of the last update.

For an update, click at <u>home</u> in the lower left corner of the website.

Structure of Website

The website is dynamically built-up and depends on the number of the modules connected to the Ethernet coupler. The access rights to this website are in WinNCS freely configurable.

The following elements are to find on the website:

- Diagnosis Ethernet coupler
- Diagnosis in-/output periphery
- Information about connected clients
- Elements for active access to the Ethernet coupler

Diagnosis
Ethernet coupler

Diagnosis
In-/Output periphery

VIPA 253-1NE00	**Slot 0**	**Slot 1**	**Slot 2**	**Slot 3**	**Slot 4**
Station A	221-1BH10	222-1BH10	221-1BH10	223-2BL10	231-1BD52
HWVer: 10 PLDVer: 10	IB[0]= 00 00		IB[2]= 00 00	IB[4]= 00 00	IB[6]= 00 00 00 00 00 00 00 00
FWMajor: 1 FWMinor: 3		QB[0]= 00 00		QB[2]= 00 00	
RDY ERR					Prm(len10)= 00 00 2d 2d 28 28 00 00 00 00

Information about connected clients

Number of Modbus/TCP clients:<2>: [172.16.131.31] [172.16.131.55]

Number of S5 from Siemens **clients:** <1>: [172.16.131.10]

Elements for the active access to the Ethernet coupler

Password = [ ]	Password = [ ]	Password = [ ]	Password = [ ]
Address = [ ] dec	Slot = [ ] dec	Resetvalue = [1] dec	Timeout = [0] msec
QB[Address] = [ ] hex	Prm = [ ] hex	Reboot node	Set timeout
Set output value	Set parameters		

<u>home</u>

Diagnosis Ethernet coupler

```
┌─────────────────┐
│  VIPA 253-1NE00 │
│                 │
│    Station A    │
│                 │
│                 │
│    HWVer: 10    │
│    PLDVer: 10   │
│                 │
│                 │
│    FWMajor: 1   │
│    FWMinor: 3   │
│   ┌─────┐       │
│   │ RDY │       │
│   │ ERR │       │
│   └─────┘       │
│                 │
│                 │
└─────────────────┘
```

This area shows all information about the Ethernet coupler like symbolic name, version and status monitors of the LEDs.

Symbolic name: Via WinNCS you may assign a symbolic name to the Ethernet coupler besides the IP address.

HWVer: This is the hardware version (electronics). The HW release (only number before comma) is also at the front side of the module.

PLDVer: The PLD (**P**rogrammable **L**ogic **D**evice) is a programmable logic block for control of the communication between backplane bus and processor.

FWMajor, FWMinor: The firmware version is divided into *FWMajor* (main version) and *FWMinor* (lower version). A lower version contains small alterations. When basic alterations are made, the main version number is increased.

Status monitor

```
┌─────────────────┐
│  VIPA 253-1NE00 │
│                 │
│    Station A    │
│                 │
│                 │
│    HWVer: 10    │
│    PLDVer: 10   │
│                 │
│                 │
│    FWMajor: 1   │
│    FWMinor: 3   │
│   ┌─────┐       │
│   │ RDY │       │
│   │ ERR │       │
│   └─────┘       │
│ QVZ=0, Ready=1, Run=0, │
│ Bus_Err=1, Init_Err=0, │
│ Prm_Err=0, Alarm=0,    │
│ old_number_modules=4   │
│ new_number_modules=3   │
└─────────────────┘
```

RDY, ERR: Status monitor of the LEDs RD and ER

As long as the Ethernet coupler communicates error free, the status monitor remains like shown above. In case of an error, e.g. the following message is displayed below ERR:
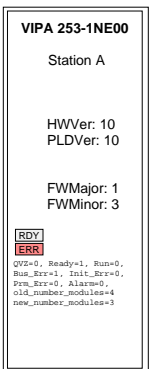
```
QVZ=0 Ready=1, Run=0, Bus_Err=1, Init_Err=0, Prm_Err=0, Alarm=0
old_number_modules=4, new_number_modules=3
```

This message shows that one module is defect.

Module area Slot 0 ... 31

```
┌─────────────────┐
│     Slot 4      │
│                 │
│   231-1BD52     │
│                 │
│                 │
│   IB[6]=        │
│   00 27 af 00   │
│   00 00 2d 04   │
│                 │
│                 │
│                 │
│                 │
│   Prm(len10)=   │
│   00 00 2d 2d   │
│   28 28 00 00   │
│   00 00         │
│                 │
└─────────────────┘
```
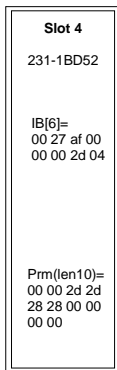
This area shows all information about the in-/output periphery like module name, in-/output assignment and parameter bytes.

Module name: The order number of the module serves as module name. This allows an unambiguous identification of the module.

In-/output assignment: Here you find four informations:

- Type: input area (IB), output area (QB)
- The start address of the area is in brackets
- You see the number of bytes occupied by the module
- The content of the bytes corresponds to that of the Ethernet coupler at the last website update

Example: `Slot 4`   This means: The module at slot 4 occupies 8Byte of the input area, starting with Byte 6 and has a hexadecimal content.

`IB[6]=`
`00 00 00 00`   The image is put out in little endian (Intel)
`00 00 00 00`   format (Low-Byte, High-Byte).

The `Prm()=` Parameter bytes contain the following information:

- The length of the parameter block is in brackets with a preceding `len`.
- The content of the bytes are the parameter bytes of the according module.

Information about connected clients

This area gives you information about number and IP address of the clients that are communicating with the Ethernet coupler at the time via ModbusTCP res. Siemens S5 Header protocol. With every protocol, a max. of 8 clients may communicate simultaneously with the Ethernet slave.

The number is in <> followed by the IP addresses in [].

Example:

Number of ModbusTCP clients: <2>: [172.16.131.20] [172.16.140.63]

(At this time, 2 clients are communicating via ModbusTCP with the IP addresses 172.16.131.20 and 172.16.140.63.)

Elements for the active access...

Whereas the elements above are displaying information, the active access elements here allow to access the Ethernet coupler and its modules online.

Every control element is password protected. Use the password configured for your coupler (default = "0000 0000").

The following 4 control elements are available:

• Control outputs
• Parameterize module
• Reset the Ethernet coupler
• Configure Timeout

Control outputs

This control element allows you to set values into a wanted address area and transfer them via [Set output value] to the Ethernet coupler.

Please regard that the address has to be a decimal number and the value a Hex number. You may transfer a max. of 4Byte to the address given in `Adress`.

Please regard that the Bytes always have to be transferred with a leading zero. Space signs are serving as Byte separator.

Example:	Address=0	
	QB[Address]= 12 →	QB[0]= 12 00
	QB[Address]= 1 2 →	QB[0]= 01 02
	QB[Address]= 1234→	QB[0]= 12 34
	QB[Address]= 123 →	QB[0]= 01 23

Parameterize module

This control element allows you to provide the module online with parameters by typing the parameter bytes into `Prm` and setting a plug-in location via `Slot`.

With [Set parameters], the according parameters are transferred to the according module.

Please regard that the slot number has to be a decimal number and the parameter a Hex number.

Bytes are always transferred with a leading zero. A zero <u>must</u> be inserted as separator.

Note!

Always transfer the complete number of parameter bytes to a module, otherwise errors at the module may occur.

The number of parameters and their assignment is to find in the description of the concerning module.

Password =	
Resetvalue =	1	dec
Reboot node		

Reset of the Ethernet coupler

Via [Reboot node] a reset of the Ethernet coupler is initialized. After a re-boot, you have to update the website via *home*.

By presetting a r*eset value*, you may additionally to the re-boot of the Ethernet coupler delete the configuration or module parameters.

Permissible r*eset value* values are 1, 2 or 3. Other values are ignored!

Reset value= 1   Re-boot of the coupler (default setting)

Reset value= 2   Delete the module configuration (module name)
                  and re-boot the coupler

Reset value= 3   Delete the module parameters and re-boot the coupler

---

Password =	
Timeout =	0	msec
Set timeout		

Configure Timeout

The coupler offers a connection timeout.

If the value 0 is transferred, this function is deactivated. (In the picture of the Ethernet coupler "Timout: off" is shown).

Note!

Choose "Timout: off" if you want to control outputs via internet browser otherwise all outputs are set to the secure state 0 after timeout.

With timeout values > 0msec, an I/O connection must read/write faster than the time value. If not, the connections are terminated and the outputs are set to the secure state 0.

The RD LED blinks and the website shows "ready" in small letters.

ModbusTCP

General

ModbusTCP is a Modbus protocol put upon TCP/IP, where the IP address serves the addressing. The ModbusTCP allows a client-server-communication, several clients may be provided from one server.

Telegram structure incl. TCP/IP

The request telegrams sent by a master and the respond telegrams of the slave have the same structure:

ModbusTCP	Slave address	Function code	Data
6Byte-Header with number of following Bytes	1Byte data	1Byte data	max 254Byte

ModbusTCP-Header (6Byte)

For send and receive telegrams, ModbusTCP uses a header of 6Byte with the following structure:

ModbusTCP header

Byte	Name	Description
0	Transaction identifier (High-Byte)	Is sent back by the server (user-defined)
1	Transaction identifier (Low-Byte)	Is sent back by the server (user-defined)
2	Protocol identifier (High-Byte)	Always 0
3	Protocol identifier (Low-Byte)	Always 0
4	Length field (High-Byte)	Always 0 because messages < 256Byte
5	Length field (Low-Byte)	Number of following bytes

Normally, Byte 0 ... 4 have the value 0. You may also increase Byte 0 and 1 in the slave and thus establish an additional control.

Modbus function codes

Naming convention   Modbus has some naming conventions:

Bit = Coil
IN: "Input Status"
OUT: "Coil Status"

Word = Register
IN: "Input Register"
OUT: "Holding Register"
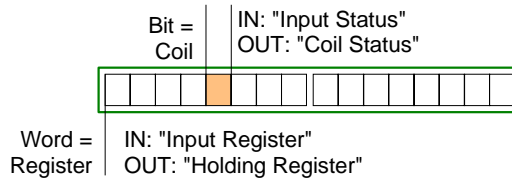
- Modbus differentiates between bit and word access;
  Bits = "Coils" and Words = "Register".
- Bit inputs are referred to as "Input-Status" and Bit outputs as "Coil-Status".
- Word inputs are referred to as "Input-Register" and Word outputs as "Holding-Register".

Range definitions   Normally the access under Modbus happens by means of the ranges 0x, 1x, 3x and 4x.

0x and 1x gives you access to *digital* Bit areas and 3x and 4x to *analog* word areas.

For the Ethernet coupler from VIPA is not differentiating digital and analog data, the following assignment is valid:

0x: Bit area for output
     Access via function code 01h, 05h, 0Fh

1x: Bit area for input
     Access via function code 02h

3x: Word area for input
     Access via function code 04h, 17h

4x: Word area for output
     Access via function code 03h, 06h, 10h, 17h

1x0001
1x0002
1x0003
1x0022

IN

3x0001   3x0002   3x0003

0x0001
0x0002
0x0003
0x0022

OUT

4x0001   4x0002   4x0003
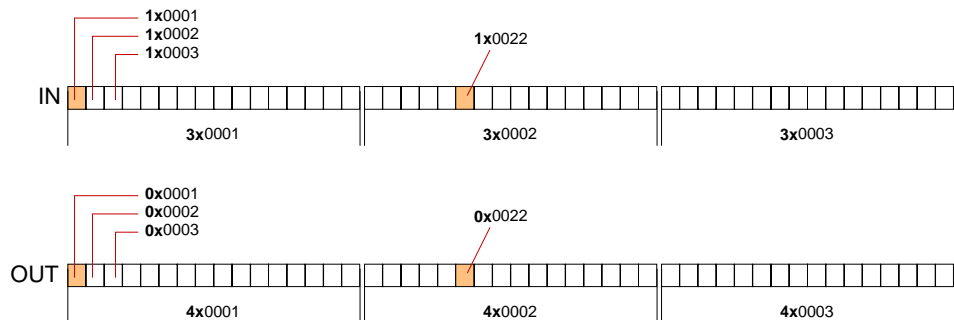
A description of the function codes follows below.

Overview   The following Modbus function codes are implemented:

Code	Command	Description
01h	Read n Bits	Read n Bits of output area 0x
02h	Read n Bits	Read n Bits of input area 1x
03h	Read n Words	Read n Words of output area 4x
04h	Read n Words	Read n Words input area 3x
05h	Write one Bit	Write 1 Bit to output area 0x
06h	Write one Word	Write 1 Word to output area 4x
0Fh	Write n Bits	Write n Bits to area 0x
10h	Write n Words	Write n Words to area 4x
17h	Write n Words and Read m Words	Write n words into output area 4x and the respond contains m read words of the input area 3x

The Ethernet coupler from VIPA does not differentiate between digital and analog data!

Note!

The Byte sequence in a Word always is:

1 Word	
High Byte	Low Byte

Respond of the   If the slave announces an error, the function code is send back with a "OR"
coupler   and 80h. Without an error, the function code is sent back.

Coupler answer: Function code OR 80h   → Error
                   Function code   → OK

Read n Bits   This function enables the reading from a slave bit by bit.
01h, 02h

Command telegram

ModbusTCP-Header	Slave address	Function code	Address 1st Bit	Number of Bits
x x 0 0 0 6				
6Byte	1Byte	1Byte	1Wordt	1Word

Respond telegram

ModbusTCP-Header	Slave address	Function code	Number of read Bytes	Data 1st Byte	Data 2nd Byte	...
x x 0 0 0 ،						
6Byte	1Byte	1Byte	1Byte	1Byte	1Byte max. 252Byte	

max. 255Byte

Read n Words 03h, 04h   This function enables the reading from a coupler word by word.

Command telegram

ModbusTCP-Header	Slave address	Function code	Address Word	Number of Words
x x 0 0 0 6				
6Byte	1Byte	1Byte	1Word	1Word

Respond telegram

ModbusTCP-Header	Slave address	Function code	Number of read Bytes	Data 1st Word	Data 2nd Word	...
x x 0 0 0						
6Byte	1Byte	1Byte	1Byte	1Word	1Word max. 126Words	

max. 255Byte

Write a Bit 05h   This function allows to alter a Bit in your coupler. A status change happens via "Status Bit" with the following values:

"Status Bit" = 0000h $\rightarrow$ Bit = 0, " Status Bit" = FF00h $\rightarrow$ Bit = 1

Command telegram

ModbusTCP-Header	Slave address	Function code	Address Bit	Status Bit
x x 0 0 0 6				
6Byte	1Byte	1Byte	1Word	1Word

Respond telegram

ModbusTCP-Header	Slave address	Function code	Address Bit	Status Bit
x x 0 0 0 6				
6Byte	1Byte	1Byte	1Word	1Word

**Write a word
06h**

This function sends a word to the coupler. This allows to overwrite a register in the coupler.

Command telegram

ModbusTCP-Header	Slave address	Function code	Address Word	Value Word
x x 0 0 0 6				
6Byte	1Byte	1Byte	1Word	1Word

Respond telegram

ModbusTCP-Header	Slave address	Function code	Address Word	Value Word
x x 0 0 0 6				
6Byte	1Byte	1Byte	1Word	1Word

**Write n Bits
0Fh**

This function writes n Bits to the slave. Please regard that the number of Bits has additionally given in Byte.

Command telegram

ModbusTCP-Header	Slave address	Function code	Address 1st Bit	Number of Bits	Number of Bytes	Data 1st Byte	Data 2nd Byte	...
x x 0 0 0 \								
	1Byte	1Byte	1Word	1Word	1Byte	1Byte	1Byte	1Byte

max. 255Byte

max. 248Byte

Respond telegram

ModbusTCP-Header	Slave address	Function code	Address 1st Bit	Number of Bits
x x 0 0 0 6				
	1Byte	1Byte	1Wort	1Wort

Write n Words 10h   Via this function you may write n Words to the slave.

Command telegram

ModbusTCP-Header	Slave address	Function code	Address 1st Word	Number of Words	Number of Bytes	Data 1st word	Data 2nd word	...
x x 0 0								
	1Byte	1Byte	1Word	1Word	1Byte	1Word	1Word	1Word

max. 255Byte

max. 124Words

Respond telegram

ModbusTCP-Header	Slave address	Function code	Address 1st Word	Number of Words
x x 0 0 0 6				
	1Byte	1Byte	1Wort	1Wort

Write n Words and Read m Words 17h   This function allows to write n words and read m words with a request.

Command telegram

ModbusTCP-Header	Slave address	Functions code	Read address	Read number of words	Write address	Write No. of words	Write No. of Bytes	Write Data 1st word	Write Data 2nd word	...
x x 0 0										
	1Byte	1Byte	1Word	1Word	1Word	1Word	1Byte	1Word	1Word	

max. 255Byte

max. 117Words

Respond telegram

ModbusTCP-Header	Slave address	Functions code	Read number of Bytes	Read Data 1st word	Read Data 2nd word	...
x x 0 0						
6Byte	1Byte	1Byte	1Byte	1Word	1Word	

max. 255Byte

max. 126Words

Siemens S5 Header Protocol

General   The Siemens S5 Header protocol serves the data exchange between PLC systems. Deploying the organization format (short ORG) that is included in the Siemens S5 Header protocol, a short description of a data source res. destination in PLC environment is possible.

ORG formats   The used ORG formats are corresponding to the Siemens specifications and are listed in the following table.

The ORG block is optional at READ and WRITE.

The ERW specification is irrelevant for the Ethernet coupler.

The start address and the number are addressing the memory area and are stored in HIGH-/LOW format (Motorola – Address format)

Description	Type	Area
ORG specification	BYTE	1..x
ERW specification	BYTE	irrelevant
Start address	HILOWORD	0..y
Number	HILOWORD	1..z

The following table lists the useable ORG formats. The "length" may not be specified as -1 (FFFFh).

ORG specification *02h-05h*

CPU area	MB	EB	AB	PB
ORG specification	02h	03h	04h	05h
Description	Only permitted: Read MB0 with length 4. The total length of the in- and output areas is calculated and stored in	Source/destination data out/in Process image inputs (PAE).	Source/destination data out/in Process image outputs (PAA).	Source/destination data out/in peripheral module At source data input modules, at destination data output modules.
DBNR	MB0 ... MB3 in this format:	irrelevant	irrelevant	irrelevant
Start address Meaning Permitted range:	MB0: Length In area MB1: 00 MB2: Length Out area MB3: 00	EB-No. from where on the data is fetched res. written. 0...255	AB-No. from where on the data is fetched res. written. 0...255	PB-No. from where on the data is fetched res. written. 0... 255
Number Meaning Permitted range:		Length of the source/destination data block in Bytes. 1...256	Length of the source/destination data block in Bytes. 1...256	Length of the source/destination data block in Bytes. 1...256

**Structure
PLC header**

READ and WRITE are created by the Ethernet coupler header for request res. acknowledgement telegrams. The headers have normally a length of 16Byte and have the following structure:

	Client (PLC, PC)		**Server (Ethernet slave)**

at WRITE

Request telegram

System spec.	="S"
	="5"
Length.Header	=16d
Spec.OP-Code	=01
Length OP-Code	=03
OP-Code	**=03**
ORG-Block	=03
Length ORG-Block	=08
ORG specification	
DBNR	
Start address	H
	L
Length	H
	L
Empty block	=FFh
Length	=02
Data up to 64K but only if error no. =0	

Acknowledgement telegram

System spec.	="S"
	="5"
Length.Header	=16d
Spec.OP-Code	=01
Length OP-Code	=03
OP-Code	**=04**
Ackn. block	=0Fh
Length ackn. Block	=03
Error No.	=Nr.
Empty block	=FFh
Length empty block	=07
free	

at READ

Request telegram

System spec.	="S"
	="5"
Length.Header	=16d
Spec.OP-Code	=01
Length OP-Code	=03
OP-Code	**=05**
ORG-Block	=03
Length ORG-Block	=08
ORG specification	
DBNR	
Start address	H
	L
Length	H
	L
Empty block	=FFh
Length	=02

Acknowledgement telegram

System spec.	="S"
	="5"
Length.Header	=16d
Spec.OP-Code	=01
Length OP-Code	=03
OP-Code	**=06**
Ackn. block	=0Fh
Length ackn. Block	=03
Error No.	=Nr.
Empty block	=FFh
Length empty block	=07
free	
Data up to 64K but only if error no. =0	

**Possible error
numbers**
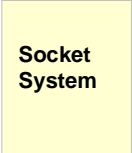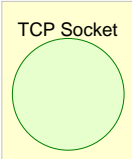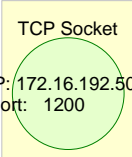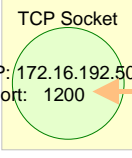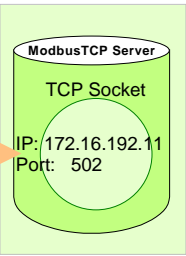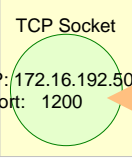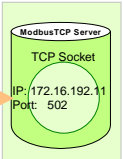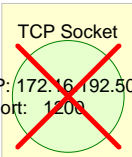
The following error numbers may be included in the acknowledgement telegram:

0: no error

3: Address outside the defines area

6: No valid ORG format (Specification data source/destination is wrong).
  Permitted: EB, AB, PB and MB

Programming sample

Steps of Programming

For the deployment of the Ethernet couplers at a PC you should have a thorough knowledge in C programming, especially in socket programming. This section gives you a short overview about the programming.

PC
IP: 172.16.192.50

Slave
IP: 172.16.192.11

1.

Socket System

to 1.   Start Microsoft Socket System

```
WSAStartup (wVersionRequested, &wsaData);
```

2.

TCP Socket

to 2.   Reserve Socket resources for TCP

```
m_lsock = socket (AF_INET, SOCK_STREAM, 0):
```

3.

TCP Socket

IP: 172.16.192.50
Port: 1200

to 3.   Link-up the socket to the local PC

```
SockAddr.sin_port = htons( 0 );
SockAddr.sin_addr.S_un.S_addr = inet_addr( "0.0.0.0" );
bind(m_lsock, (LPSOCKADDR) &SockAddr, sizeof(SockAddr));
```

By calling `bind` with the value 0 for port and IP address, the socket gets the PC-IP address and the next free Port.
(here: IP: 172.16.192.50, Port: 1200)

4.

TCP Socket

IP: 172.16.192.50
Port: 1200

ModbusTCP Server
TCP Socket
IP: 172.16.192.11
Port: 502

to 4.   Establish connection to external device

```
SockAddr.sin_port = htons (m_wPort);
SockAddr.sin_addr.S_un.S_addr = inet_addr(m_szIpAddress);
connect(m_lsock, (LPSOCKADDR) &SockAddr, sizeof(SockAddr));
```

5.

TCP Socket

IP: 172.16.192.50
Port: 1200   Data

ModbusTCP Server
TCP Socket
IP: 172.16.192.11
Port: 502

to 5.   For write res. read access you have to build up telegrams according to the protocol and store them in sndBuf.

sndBufLen contains the number of Bytes to be sent.

Read access

Send sndBuf (Request)

```
send(m_lsock, (char *)sndBuf, sndBufLen, 0);
```

Receive telegram in rcvBuf (Response+data)

```
recv(m_lsock, (char *)rcvBuf, sizeof(rcvBuf), 0);
```

Write access

Send sndBuf (Request+data)

```
send(m_lsock, (char *)sndBuf, sndBufLen, 0);
```

Receive telegram in rcvBuf (Response)

```
recv(m_lsock, (char *)rcvBuf, sizeof(rcvBuf), 0);
```

to 6.   Close socket again

```
closesocket(m_lsock);
```

6.

TCP Socket

IP: 172.16.192.50
Port: 1200

An easy programming sample can be downloaded under ftp.vipa.de/support Demo Client: Cx000059.

Technical data

IM 253NET

Electrical data	VIPA 253-1NE00
Voltage supply	DC 24V (20.4 ... 28.8V) via front from ext. power supply
Current consumption	120mA
Output current backplane bus	3.5A
Potential separation	$\geq$ AC 500V
Status monitor	Via LEDs at the front side
Interfaces	RJ45 for Twisted-Pair-Ethernet
Ethernet Interface	
Connection	RJ45
Network topology	Star topology
Medium	Twisted Pair
Transfer rate	10/100MBit
Total length	max. 100m per segment
Online access	
Test/Diagnosis	http server integrated that graphically displays the configuration via website and supports parameterization and project engineering options for test purposes.
Project engineering	Via WinNCS with online coupler search and engineering
Combination with peripheral modules	
max. number of clients	8 per ModbusTCP res. Siemens S5 protocol
max. number of input byte	256
max. number of output byte	256
Dimensions and Weight	
Dimensions (WxHxD) in mm	25.4x76x76
Weight	70g

Chapter 8   PC 288 - CPU

Overview   This chapter contains a description of operation of the PC 288 in the System 200V. After a summary and an overview of the system we will introduce you to the configuration of a PC-based system.

The chapter concludes with the technical data.

The following description includes:

- System overview
- Principles
- Construction
- Configuration
- Technical data

System overview

PC 288

The PC 288 is a complete 486DX based PC. It is suitable for central and decentral control applications.

The external storage media is provided by CompactFlash cards or hard disks (IBM Microdrive) with a capacity of up to 1GByte.

Order data PC 288

Type	Order number	Description
PC 288 - CPU	VIPA 288-2BL10	486 PC-LAN; 66MHz
CompactFlash	VIPA 950-1KS00	CompactFlash Type II
HDD	VIPA 950-1KH00	HDD 340MByte, 540MByte or 1GByte IBM Microdrive

Principles

General

The PC 288 provides you with a complete PC-AT in a compact package with the performance of a 486DX processor. MS-DOS 6.22 is pre-installed on the internal 8MB Flash-ROM.

The PC 288 has connectors for a mouse, a keyboard, a display monitor or a TFT-display as well as an RJ45 socket for network connection.

External memory is provided by a CompactFlash card (type II), which is inserted directly into the front of the unit. You may install CompactFlash cards resp. hard disks IBM Microdrive with a memory capacity up to 1GB.

Applications

This PC conforms to System 200V requirements and it can be employed as master in conjunction with System 200V peripherals. You may use this combination to implement the structures that represent machines and plants in stand-alone operation or a Profibus network.

Configuration

Control applications and simple graphic representations may be programmed in C and C++.

Since the source code for the vbus_api application program has been placed in the public domain, it is a simple matter to create control applications.

You can also use it to program the drivers for many different operating systems.

Properties

- PC-AT compatible
- STPC INDUSTRIAL 66MHz
- 32MB RAM
- 8MB DiskOnChip®, bootable
- TYPE II slot for CompactFlash™ memory card
- Serial interface COM1
- Connector for an AT-type keyboard and compatible keyboards (foil keyboard, etc.) via a mini-DIN socket
- Mini-DIN socket for a mouse
- Powered by the 24V supply
- Integrated V-Bus controller for the control of System 200V modules
- Integrated Watchdog timer
- DV interface (Digital Visual Interface)
  Connector for a TFT - LCD via PANEL LINK®

PC 288 - CPU - Construction

**Front view
PC 288**

[1]	Eject button for CompactFlash®
[2]	CompactFlash socket
[3]	DV interface for TFT screen
[4]	PS2 socket for keyboard
[5]	Ethernet activity indicator LED
[6]	RJ45 socket for Ethernet LAN
[7]	100Mbit LAN-LED
[8]	Status indicator LEDs
[9]	9pin serial interface
[10]	PS2 socket for mouse
[11]	ON/OFF power supply lever
[12]	Connector for DC 24V power supply
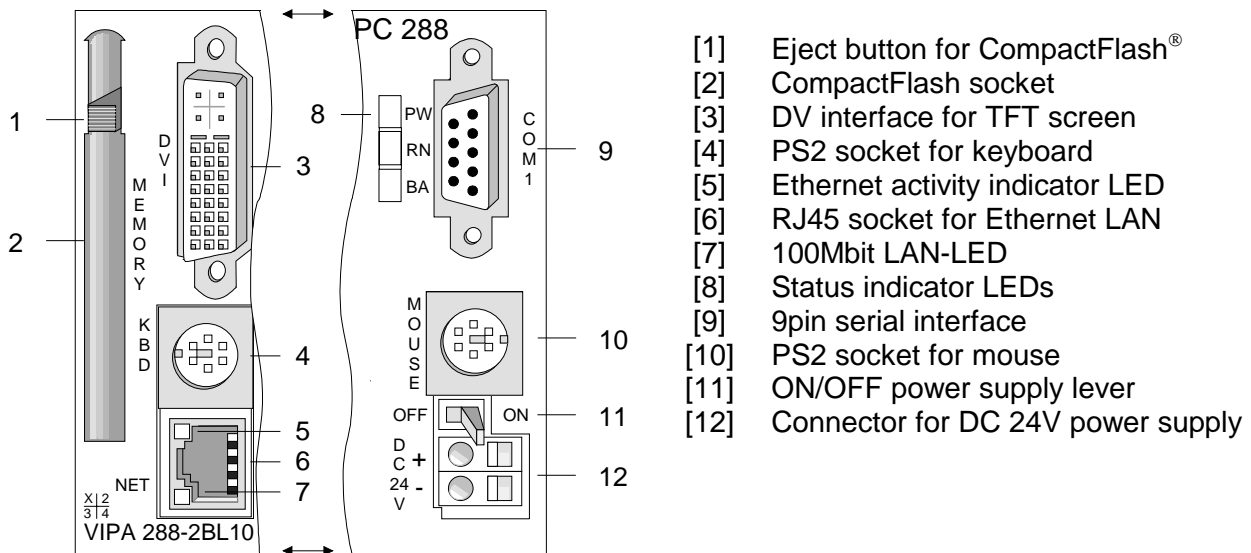
Components

LEDs

The PC 288 is equipped with 3 LEDs that are used as status indicators. These 3 LEDs are on when the power supply is turned on.

The following table shows the purpose and the respective color of these LEDs.

Name	Color	Description
PW	Yellow	Indicates that the PC has been turned on. The PC and the backplane bus (V-Bus) are receiving power.
RN	Green	Is on when the PC status is software RUN and V-Bus communication is active.
		This LED is not turned on when a V-Bus error occurs.
BA	Red	Is turned on when the output commands have been locked (BASP), i.e. the output modules are not enabled.

ON/OFF lever

The ON/OFF switch controls the power supplied to the circuitry of the PC and to the backplane bus.

Power supply

The PC is provided with an internal power unit. Power is connected by means of two terminals located on the front of the unit. The ON/OFF switch controls the power unit. In position OFF, power is removed from the backplane bus and the circuitry of the PC.

The power supply requires DC 24V (20...30V). The supply voltage is used to power the circuitry of the PC as well as the various modules that are connected to the PC via the backplane bus with max. 3.5A.

Note!

Verify that the polarity of the power connection is correct!

Socket for CompactFlash

This socket can accommodate a type II CompactFlash® memory card. The PC includes this card into the system as an additional drive.

The CompactFlash® adapter provides compatibility with the "large" PCMCIA type II format to the memory. This means that you may exchange data with any PC via the PCMCIA slot.

Note!

Never eject or insert the memory card when the PC is turned on!

**Sockets and
plugs**

**Serial interface
COM 1**

The connector of the serial interface is accessible as COM 1 and it has been designed to cater for a maximum distance of 15m at a communication rate of 38.4kBaud. Data is communicated by means of data, handshaking and control lines.
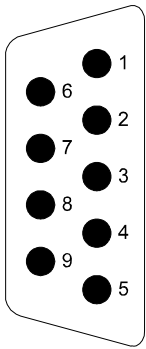
Pin	RS232C	RS422/485
1	DCD-	CTS-
2	RXD	RXD-
3	TXD	TXD+
4	DTR-	TXD-
5	GND	GND
6	DSR-	RXD+
7	RTS-	RTS+
8	CTS-	RTS-
9	RI-	CTS+

**PS2 socket
KBD/MOUSE**

The pin assignment of the two PS2 sockets is identical. Connect your keyboard to the "KBD" socket and your mouse to the "MOUSE" socket.
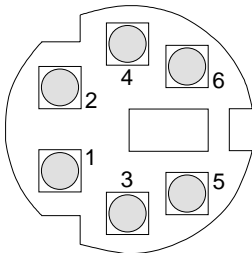
Pin	Assignment
1	+ KBD-Data (I/O)
2	reserved
3	GND
4	+5V
5	+ KBD-Clock (I/O)
6	reserved

RJ45 socket

The RJ45 socket provides a twisted-pair connection to your Ethernet LAN. The pin assignment and the purpose of the LEDs is as follows:
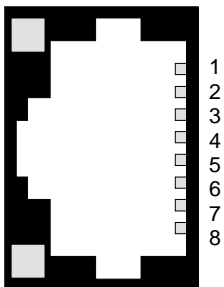
Pin	Signal
1	Transmit +
2	Transmit -
3	Receive +
4	-
5	-
6	Receive -
7	-
8	-

LED	
Ethernet activity (yellow)	On when a active Ethernet connection exists, blinks during data transfers
Rate (green)	Is turned on when 100MBit data transfer is active, else it is off.

DVI socket   The DVI socket is the interface for analog and digital displays and monitors with a maximum resolution of 1280x1024 pixel.

The pin assignment of the socket is as follows:
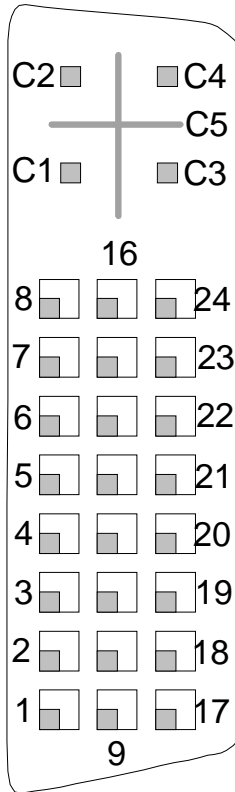
Pin	Signal
C1	Analog Red
C2	Analog Green
C3	Analog Blue
C4	Analog Horizontal Sync
C5	Analog RGB Return
1	T.M.D.S Data2-
2	T.M.D.S Data2+
3	T.M.D.S Data2/4 Shield
4	T.M.D.S Data4-
5	T.M.D.S Data4-
6	DDC Clock
7	DDC Data
8	Analog Vertical Sync
9	T.M.D.S Data1-
10	T.M.D.S Data1+
11	T.M.D.S Data1/3 Shield
12	T.M.D.S Data3-
13	T.M.D.S Data3+
14	+5V Power
15	Ground (return for +5V, HSync and VSync)
16	Hot Plug Detect
17	T.M.D.S Data0-
18	T.M.D.S Data0+
19	T.M.D.S Data0/5 Shield
20	T.M.D.S Data5-
21	T.M.D.S Data5+
22	T.M.D.S Clock Shield
23	T.M.D.S Clock+
24	T.M.D.S Clock-

Block diagram   The following block diagram shows the logical structure of the PC:
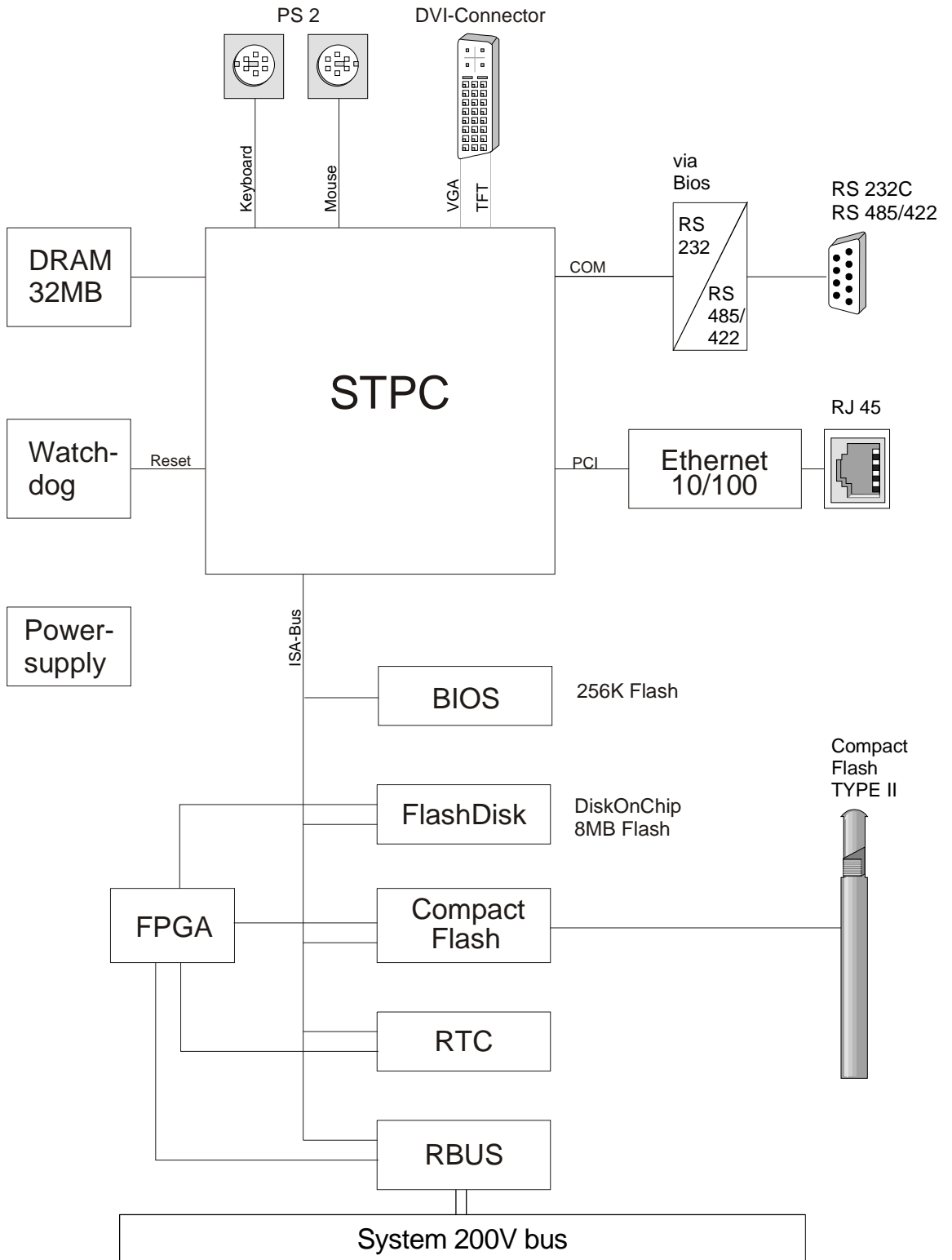
Storage media applications

Overview

The PC 288 has a Flash-ROM based internal drive providing 8MB of space and a type II CompactFlash® slot.

A CompactFlash® adapter provides the compatibility between the CompactFlash® card and the "large" PCMCIA type II format. This can be used to establish a communication link to PCs with a PCMCIA slot.

The physical drives are assigned via the BIOS-SETUP program.

Different settings determine the boot behavior of the PC 288.

Inserting/ejecting a CompactFlash®

Every CompactFlash® memory module has an extraction lip [1]. Make sure that this extraction lip faces to the right.

Insert the memory module into the PC 288 without force until it locks and the eject lever [2] becomes visible.

If you wish to eject the CompactFlash® adapter you press this eject lever.
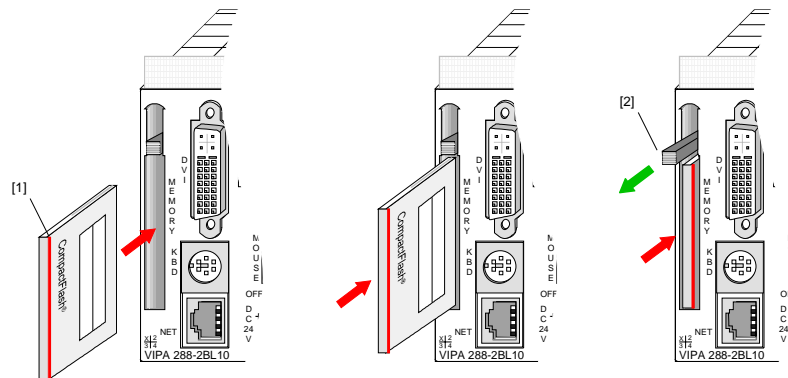
Note!

Never eject or insert the CompactFlash® memory card when the PC is turned on!

The memory card has to be introduced in the setup!

Protection against inadvertent ejection
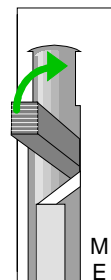
You may fold the eject lever upwards into the enclosure to protect the unit against inadvertent ejection of the CompactFlash® card.

To eject the memory card you fold the eject lever out of the back to the original position or you can press the lever in the fold-away position using a pointed object, e.g. by means of a screwdriver.

Deployment in the System 200V

Overview

Applications using the PC 288 require C-language programming knowledge. VIPA supplies the PC together with the open source code of the software interface.

Since this code contains a description of all the functions together with examples of the application of the different functions, we do not include further details of these and the V-Bus organization in this manual.

The **vbus_api.c** contains all the functions.

The file **vbus_api.h** contains the respective descriptions.

The file **softsps.c** contains an application example for these functions.

Automatic address allocation

Certain addresses in the PC must be associated with specific peripheral modules so that the installed modules can be accessed.

The PC 288 has a peripheral area (address 0...255)and a process image of the inputs and outputs (0...127 per address) that is similar to the memory organization of a CPU.

During the start-up phase the PC automatically assigns peripheral addresses to the digital input/output modules starting from 0.

The automatic addressing for analog modules assigns even addresses starting from 128.

Signal status in the process image

The statuses of the signals at the lower addresses (0...127) are also transferred into a special memory area, the *process image*.

The process image is divided into two parts:

- Process image of inputs (PAE)
- Process image of outputs (PAA)
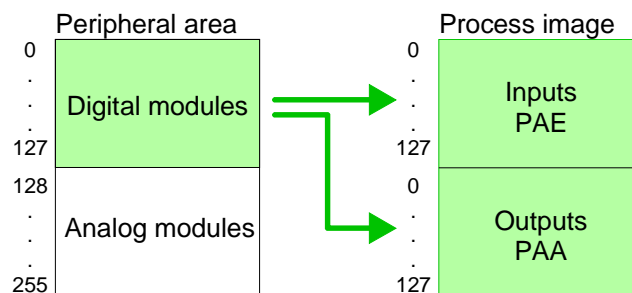
In contrast to the CPU the process image of the PC 288 is not updated automatically. This facility is provided by the functions *vbus_read_pa* and *vbus_write_pa*.

Read and write access

The modules are accessible by means of read or write accesses to the peripheral bytes or the process image.

Note!

Please note that the read and write access to one address can be directed to <u>different</u> modules,

e.g.   *vbus_read_pword (128,&w)* reads from the AI at plug-in location 3

vbus_write_pword (128,w) writes to the AO at plug-in location 6

Separate address ranges are assigned to digital and to analog modules during automatic address allocation.

Digital modules: 0...127

Analog modules: 128...255

The following figure explains the process of the automatic address allocation:
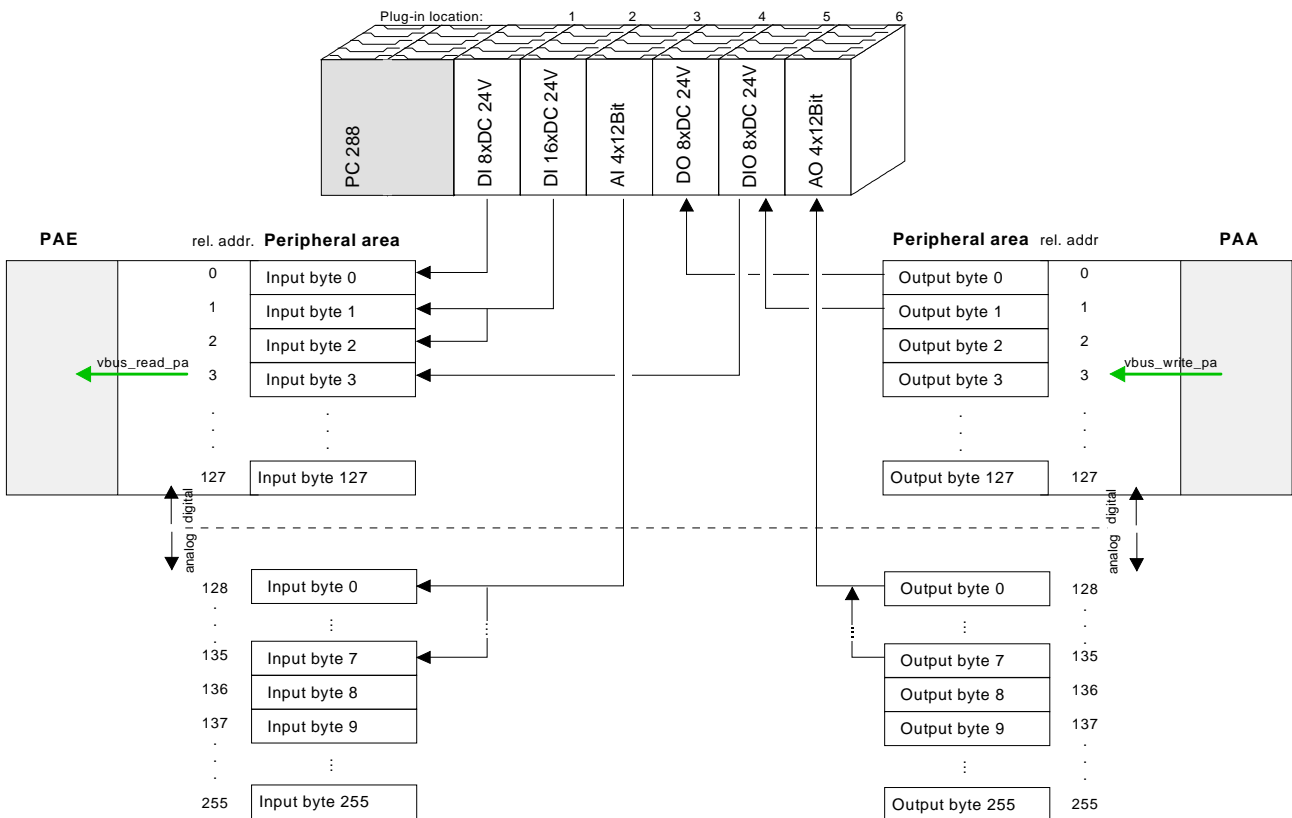
Modifying the allocation by means of *set_address_table*

You may use the *set_address_table* function to replace automatically allocated addresses in your program. For this purpose you have to create a custom allocation table and supply this to the *set_address_table* function. In this manner it is possible to locate also analog modules in the process image and digital modules at addresses above 127!

The new allocation is enabled by means of the *vbus_businit* function.

Please refer to the function descriptions in **vbus_api.h**.

Module configuration by means of *vbus_set_param*

System 200V modules, e.g. analog modules, can be configured by means of up to 16Byte of configuration parameters provided by the PC.

This operation is provided by the *vbus_set_param* function. *vbus_set_param* accesses the respective module directly via the plug-in location number (1...32) and saves the parameters in a buffer.

Plug-in loc. no.:   1   2   3   4   32
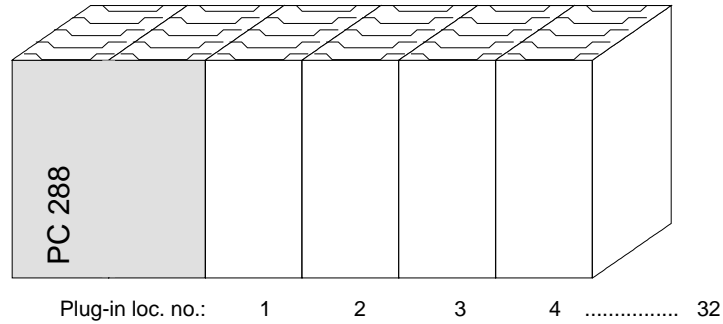
The function *vbus_businit* transfers and activates the new set of parameters.

For more information please refer to the function description contained in **vbus_api.h**.

Note!

Please remember that the delay time of the peripheral modules in the System 200V is app. 2ms unless specified otherwise!

Using the BIOS setup

General   At the start-up of the system, the BIOS version is displayed on the connected monitor. Then the BIOS executes a test of the system components and the memory. At the end of the test the system attempts to boot. Between the start-up and the boot procedure you may access the BIOS setup routine by operating the **[Entf]/[Del]** key.

An appropriate message is displayed on the screen.

Via the setup menu you may configure the hardware of your PC.

BIOS menu   After hitting the [Entf]/[Del] key, the following menu appears:

```
+--------------------------------------------------------------------------------+
|                        System Bios Setup - Utility v4.2                         |
|             (C) 1999 General Software, Inc. All rights reserved                 |
+--------------------------------------------------------------------------------+
|                                                                                |
|                                                                                |
|                                                                                |
|                          Basic CMOS Configuration                              |
|                            VIPA Configuration                                  |
|                         Read Setup values from CMOS                            |
|                     Reset CMOS/Flash to factory defaults                       |
|                          Write to CMOS/Flash and Exit                          |
|                       Exit without changing CMOS/Flash                         |
|                                                                                |
|                                                                                |
|                                                                                |
|                                                                                |
|                                                                                |
+--------------------------------------------------------------------------------+
|                          <Esc> to continue (no save)                           |
|                                                                                |
+--------------------------------------------------------------------------------+
```

With the help of the standard cursor keys you may select the single menu options. You activate the selected sub-menu with [Enter].

Via [ESC] you leave the setup without saving your entries.

Control keys in BIOS

Every dialog box that is accessible via the main menu is controlled by means of the following keys:

[ESC] key

With the [ESC] key the dialog window is closed and you return to the main menu. The altered parameters are stored but not written to the CMOS.

Cursor keys

With the Cursor keys you choose the parameter you want to modify.

[PU]/[PD]

With the keys [PgUp] and [PgDn] or [Bild↑] and [Bild↓] or at the numeric block [+] and [-] you may alter the value of a parameter.

Note!

Please regard, that at the setup level there has not been loaded a driver for the country specific keyboard yet. Modified setup values are only valid and written into CMOS by confirming your changes explicitly with "Y". To obtain Y, you have to push the [Z] key.

Basic CMOS Configuration

This sub-menu provides access to the main settings for your system.

The menu is divided into a number of logical units. You can navigate through these by means of the cursor keys.

```
+------------------------------------------------------------------------------+
|                                                                              |
|                  System Bios Setup - Basic CMOS Configuration                |
|               (C) 1999 General Software, Inc. All rights reserved            |
+---------------------------+-------------------+------------------------------+
|  DRIVE ASSIGNMENT ORDER:  | Date:>Jan 01, 2000 | Typematic Delay  : 250 ms   |
| Drive A: (None)           | Time: 10 : 03 : 25 | Typematic Rate   : 30 cps   |
| Drive B: (None)           | NumLock:  Disabled | Seek at Boot     : None     |
| Drive C: CompactFlash     +------------------+ Show "Hit Del"   : Enabled   |
| Drive D: (None)           | BOOT ORDER:        | Config Box       : Enabled  |
| Drive E: (None)           | Boot 1st: Drive C: | F1 Error Wait    : Enabled  |
| Drive F: (None)           | Boot 2nd: (None)   | Parity Checking  : (Unused) |
| Drive G: (None)           | Boot 3rd: (None)   | Memory Test Tick : Enabled  |
| Drive H: (None)           | Boot 4th: (None)   | Test Above 1 MB  : Disabled |
| Drive I: (None)           | Boot 5th: (None)   | Long Memory Test : (Unused) |
| Drive J: (None)           | Boot 6th: (None)   | Hexadecimal Case : Upper    |
| Drive K: (None)           +------------------+------------------+-----------+
| Boot Method: Boot Sector  | IDE DRIVE GEOMETRY:   Sect  Hds  Cyls | Memory    |
+---------------------------+ Ide 0: 2 = AUTOCONFIG, PHYSICAL       | Base:     |
| FLOPPY DRIVE TYPES:       | Ide 1: Not installed                  |   640KB   |
| Floppy 0: Not installed   | Ide 2: Not installed                  | Ext:      |
| Floppy 1: Not installed   | Ide 3: Not installed                  |   30MB    |
+---------------------------+---------------------------------------+-----------+
|                    U/D/L/R/<CR>/<Tab> to select                              |
|                  or  <PgUp>/<PgDn>/+/+ to modify                             |
+------------------------------------------------------------------------------+
```

Drive Assignment Order and IDE Drive Geometry

This section is used to assign logical drive names to the physical drives.

The VIPA BIOS only provides support for drive "C".

The following settings are valid for "C":

- "None":   if you did **not** insert a CompactFlash® card
- "CompactFlash":   if you have installed a CompactFlash® card.

Note!

All the other drives must be assigned to type "None". Any other setting can cause malfunction of the PC.

Please also note that the settings for "Ide 0" in the section *IDE Drive Geometry* must be changed at the same time as the parameters for drive "C". The following settings are valid:

CompactFlash®	DRIVE ASSIGNMENT ORDER \ Drive C:	IDE DRIVE GEOMETRY \ Ide0:
Installed	CompactFlash®	2 = AUTOCONFIG, PHYSICAL
Not installed	None	Not installed

The integrated DiskOnChip® drive (DOC) is configured by means of the "VIPA Configuration" menu.

Floppy drive types   Here you would normally define the settings for the floppy disk drive. Since the PC 288 does not support floppy disk drives you have to select the type "Not installed"! Otherwise you will encounter long-term delays between the system test and the start-up of the system.

Date, Time, NumLock   Here you enter the current date and time.

The "NumLock" parameter defines the status of the [NumLock] key after the system has booted.

> **Note!**
>
> If the real-time clock has stopped it has to be assumed that the backup battery for the CMOS memory is discharged or defective.
>
> Please contact the VIPA Hotline if this battery has still not accepted a charge after one day.
>
> Your CMOS settings are safe even if the battery is empty. You only need to adjust the clock and the date.

Boot order   This parameter is preset to "Drive C" and it defines the boot sequence.

IDE Drive Geometry   This section defines the geometry settings of the IDE drives.

If you are using a CompactFlash® card you have to enter "autoconfig, physical" for this parameter. If you did not install a CompactFlash® card the parameter must be set to "None".

Typematic Rate/Delay   This parameter defines the keyboard interface and specifies the repetition rate for the characters. You should not change this setting.

Seek at Boot   This option specifies which drives should receive a "SEEK" command before booting the system. The default is "NONE" to ensure that the boot procedure is as quick as possible.

Show "Hit Del"   If this option is active the system will display a message to press [Del] to access the setup menu while the system is booting.

Config Box   This parameter specifies whether the configuration settings should be displayed on screen when the system boots.

F1 Error Wait   If you activate this menu item, the boot process is stopped when an error is detected. You then may decide what action to take. If you press [F1] the system will continue booting. Press [Del] to gain access to the setup menu.

Parity Checking   This menu item is not used.

Memory Test Tick   Turn this option on to sound a test click via the PCs speaker when memory is being tested.

Test Above 1MB   This parameter determines whether the memory above the 1MB limit will be tested by the memory test or not.

Long Memory Test   This menu item is not used.

Hexadecimal Case   This menu item determines the display format that the BIOS uses for hexadecimal numbers. You can either choose "UPPER" (capitals) or "LOWER" (lower case).

Memory Base /   This menu item displays the memory configuration below 1MB (Base
Ext.   Memory) and above 1MB (Extended memory). These parameters are purely for information purposes and they cannot be changed.

VIPA Configuration

This sub-menu is used to define the board-specific settings. You may navigate through the menu by means of the cursor keys.

```
+------------------------------------------------------------------------------+
|                  System BIOS Setup - VIPA Configuration                      |
|             (C) 1999 General Software, Inc. All rights reserved              |
+-------------------------------------+----------------------------------------+
|  VGA Frame Buffer Size    : 1.0 Mb  | VGA Palette Snoop         : Enabled    |
|  Graphic Clock Speed      : 85 MHz  | Watchdog                  : Enabled    |
|  Drive C                  : CF      | Com1 Mode                 : RS232      |
|  L1 Cache                 : Enabled |                                        |
|                                     |                                        |
|                                     |                                        |
|                                     |                                        |
|                                     |                                        |
|  Bios Version: 1.0.0                |                                        |
|  Seriennummer: 040002               |                                        |
|  Ausgabestand: 1                    |                                        |
|  FPGA Version: 10                   |                                        |
|                                     |                                        |
|                                     |                                        |
+-------------------------------------+----------------------------------------+
|                   U/D/L/R/<CR>/<Tab> to select                               |
|                 or  <PgUp>/<PgDn>/+/+ to modify                              |
+------------------------------------------------------------------------------+
```

VGA Frame Buffer Size

This parameter determines the amount of memory that is used as graphic memory for the internal graphic controller.

The respective memory area is no longer available as main memory for the processor.

Graphic Clock Speed

This option determines the clock speed used for the internal graphic controller. This option should always be set to "85MHz".

Drive C

This parameters determines the drive from which the operating system is booted:

"CF"   CompactFlash® (C:) followed by the internal drive (D:)

"DOC"   DiskOnChip® - internal drive (C:) followed by CompactFlash® (D:)

In every case the other drive will be accessible as drive D:.

L1 Cache

This option enables and disables the L1 cache of the processor.

VGA Palette Snoop

This menu item determines whether access to the VGA palette can only occur within the STPC (disabled) or whether it should also be routed to the external PCI bus (enabled).

Watchdog   This option is used to enable or disable a Watchdog that issues an automatic reset after a certain time has elapsed (30s).

If you deactivate the Watchdog in your application program you can ensure that your system has booted without errors. Otherwise the PC is re-booted when the watchdog has expired.

You may define the watchdog time and the watchdog properties in the system register.

Com1 Mode   This parameter determines the physical properties of serial interface COM 1. You may select from:

RS232   RS232C interface

RS422   RS422/485 interface

Version data   The left hand section of the "VIPA Configuration" menu displays hardware specific parameters:

BIOS-Version: The version level of the BIOS

Serial No.:   Every PC is provided with a unique serial number. This serial no. is identical to the serial no. located on the enclosure.

Revision level: Identical to the revision level located on the enclosure.

FPGA Version: The version of the FPGA that controls the V-Bus access.

Note!

You should include this information when you request information from the service department of VIPA GmbH to allow us to help you more effectively.

Note!

The following menu items display a query that is to be answered with "Yes" or "No".

Please note that the keyboard uses the US layout for the BIOS setup, i.e. that you have to press the [Z] key on German keyboards to obtain the letter "Y".

Read Setup values from CMOS

This option loads the most recent settings that were saved to CMOS memory.

Reset CMOS/Flash to factory defaults

This option loads the factory default values into CMOS memory.

If you wish to write these values into the CMOS memory you have to use the menu item "Write to CMOS and Exit" to quit from this function.

Write to CMOS/Flash and Exit

This menu item saves the modified settings to CMOS-RAM.

When the settings have been saved the system is re-started automatically which will reload the modified configuration settings.

Note!

This process can require a few seconds since the data is also saved in the EEPROM.

During this time you may **NOT** turn the system off or issue a manual reset!

Exit without changing CMOS/Flash

When you select this menu item, you quit from the setup menu without saving and activating any settings to CMOS memory or to the EEPROM.

Register description

Address range   The following addresses are occupied by VIPA:

270h - 277h   Watchdog

280h - 28Fh
280h - 284h   reserved
285h   EEPROM Port
286h - 28Dh   reserved
28Eh   Version
28Fh   Device ID = 84h

290h - 297h
290h   WD-Timer
291h   RS232/RS422
292h   C165 control register
293h   Enable register
294h - 297h   reserved

Watchdog   (I/O address range **270h-277h**)

The Watchdog is turned off when the system has started or has been reset and it may be enabled under software control.

The Watchdog register is controlled via I/O address 270h and the following parameters:

Watchdog on   Enter 40h into address 270h
Watchdog off   Enter 50h into address 270h
Watchdog trigger   Enter 60h into address 270h
                         and then
                         70h into address 270h

The Watchdog has to be triggered when the power has been turned on. The triggering time is programmable:

Trigger time   Parameter for triggering time I/O register **290h** R/W (enabled via **293h**)

time   = content of register **290h** x 117ms
content   = "0" Watchdog turned off

Enable   Write access only I/O-Port **293h** for WD-Timer.

The following sequence enables I/O-register **290h** and **292h** for write access:

WR 293h	03h
WR 293h	06h
WR 293h	03h
WR 293h	01h

The following sequence inhibits I/O-register **290h** and **292h** for write access:

WR 293h	03h
WR 293h	06h
WR 293h	03h
WR 293h	00h

Note!
After a reset write access to **290h** and **292h** is inhibited.

Serial number   The serial number is available to the user via registers **271h** and **272h**.

EEPROM   VIPA will supply you with then relevant details on I/O-Port **285h**.

RS232/RS422   Changing the operating mode of COM1 RS232/RS422 I/O-Port **291h** R/W

	"0"	"1"
Bit 0	RS232	RS422/485
Bit 1	RX enable	TX disable
Bit 2	TX disable	RX enable
Bit 3...7	reserved	

C165 control register   The C165 control registers I/O-Port **292h** R/W (enabled via **293h**) are reserved for the download.

Technical data

PC-CPU PC 288

Electrical data	VIPA 288-2BL10	
Power supply	DC 24V (20.4 ... 28.8) via front from ext. power supply	
Current consumption	max. 1.5A	
Output current backplane bus	max. 3.5A	
Status indicators (LED)	by means of LEDs located on the front	
Connectors / interfaces	2pin	power connector
	Mini-DIN	AT-keyboard
	Mini-DIN	mouse
	9pin	COM1: serial interface
	PCMCIA	CompactFlash card Type II
	DVI	interface for display/TFT
	RJ45	twisted pair interface for Ethernet
	ON/Off-switch for power supply	
Battery backup for clock and CMOS	Lithium battery, 30 day backup	
Combination with peripheral modules		
max. no. of modules	32	
max. digital I/Os	32	
max. analog I/Os	16	
Dimensions and weight		
Dimensions (WxHxD) in mm	50.8x76x76	
Weight	170 g	

Chapter 9   Communication processor CP 240

Overview

This chapter contains a description of the construction and the interfaces of the communication processor CP 240. VIPA distributes the communication processor CP 240 with different communication protocols that are explained in the following. Additionally you will find a description of the standard handler blocks that are supplied with the processor.

The following description includes:

- a system overview
- the protocols ASCII, STX/ETX, 3964(R), RK512 and Modbus
- project engineering and deployment of the communication processor
- Standard handler blocks
- Technical data

Content

System overview

**CP 240 with the
protocols ASCII,
STX/ETX, 3964(R)
RK512**
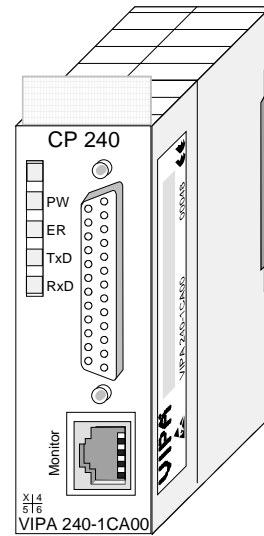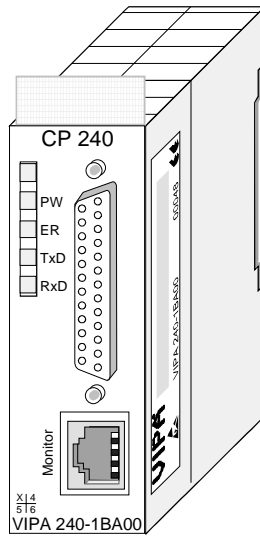
Type	Order no.	Description
CP 240	VIPA 240-1BA00	CP 240 with 20mA/RS232C interface Protocols: ASCII, STX/ETX, 3964(R), RK512
CP 240	VIPA 240-1CA00	CP 240 with RS422/485 interface Protocols: ASCII, STX/ETX, 3964(R), RK512
Diagnostic tool	UPI-FOX2	Diagnostic cable incl. software

**CP 240 with
Modbus protocol**
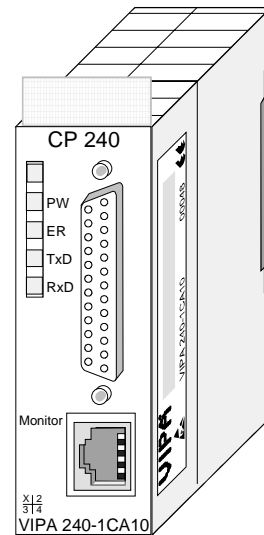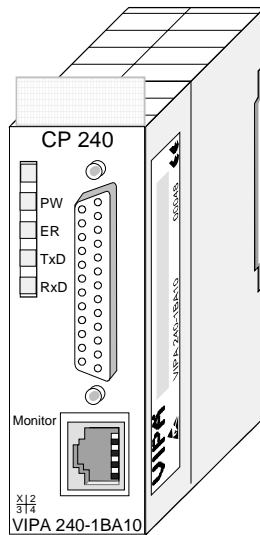
Type	Order no.	Description
CP 240 Modbus	VIPA 240-1BA10	CP with 20mA/RS232C interface Protocol: Modbus
CP 240 Modbus	VIPA 240-1CA10	CP with RS422/485 interface Protocol: Modbus
Diagnostic tool	UPI-FOX2	Diagnostic cable incl. software

Principles ASCII, STX/ETX, 3964(R), RK512

General
The CP 240 modules provide serial interfacing facilities between the processes of different source and destination systems.

The CP 240 modules have an integrated serial interface that may be configured by means of hardware to operate either as RS232C or 20mA resp. RS422 or RS485 interface.

The CP 240 modules obtain the required operating power via the backplane bus.

Protocols
The communication processor supports the ASCII, STX/ETX, 3964(R) and RK512 or Modbus (VIPA 240-1BA10 resp. VIPA 240-1CA10) protocols and procedures.

Diagnostic facilities
The front of the unit provides access to a diagnostic interface for troubleshooting and service purposes. This interface carries the signals RxD and TxD at RS232 levels (TTL levels).

VIPA may supply you with a diagnostic adapter (Order no.: UPI-FOX2) that contains the serial interface between the diagnostic interface and a PC. The software allows analysis of the signal stream and operational tests of your interface.

Parameterization
The CP can be configured by means of 16Byte of configuration data that contain the parameters required by the selected protocol.

Communication
Handler blocks that are supplied with the modules of the CPU-families 21x and 24x by VIPA control the serial communication.

Data transmitted between the CP 240 and a communication partner is transferred via the serial interface in a 9 or a 12Bit character frame. Three different formats are available for every character frame. These formats differ in the number of data bits, with or without parity bit and the number of stop bits.

Character frame	Start bit	Data bits	Parity bit	Stop bit
9Bit	1	7	-	1
10Bit	1	7	-	2
10Bit	1	7	1	1
10Bit	1	8	-	1
11Bit	1	7	1	2
11Bit	1	8	1	1
11Bit	1	8	-	2
12Bit	1	8	1	2

Protocols and procedures

The data transfer between any two communication partners is controlled by means of protocols or procedures as for instance:

- ASCII communication
- STX/ETX
- 3964(R)
- RK512

ASCII

ASCII data communication is one of the simple forms of data exchange that can be compared to a multicast/broadcast function.

Individual messages are separated by means of 2 windows in time. The sending station has to transmit data messages within the character delay time (ZVZ) or receive window that was defined in the receiving station.

The receiving station must acknowledge the receipt of the message within the "time delay after command" (ZNA) or command window that was defined in the sending station.

These time stamps can be used to establish a simple serial communication link between PLC and PLC.

A send command is only flagged as "command completed without errors" (AFOF) when the data has been transferred and the ZNA has expired.

STX/ETX

STX/ETX is a simple protocol employing headers and trailers. The STX/ETX procedure is suitable for the transfer of ASCII characters (20h…7Fh). It does not use block checks (BCC). Any data transferred from the periphery must be preceded by an STX (Start of Text) followed by the data characters. An ETX (End of Text) must be inserted as the terminating character.

The effective data which includes all the characters between STX and ETX are transferred to the CPU when the ETX has been received.

When data is sent from the CPU to a peripheral device, any user data is handed to the CP 240 where it is enclosed with an STX start character and an ETX termination character and transferred to the communication partner.

Message structure:
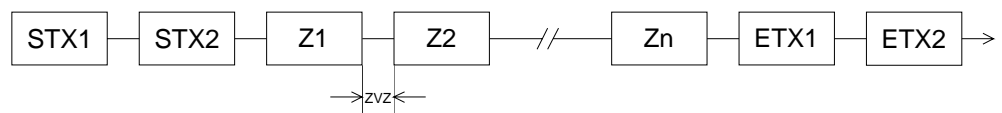
You may define up to 2 start and end characters. It is also possible to specify a ZNA for the sending station.

3964(R)

The 3964(R) procedure controls the data transfer of a point-to-point link between the CP 240 and a communication partner. The procedure adds control characters to the message data during data transfer. These control characters may be used by the communication partner to verify the complete and error free receipt.

The procedure employs the following control characters:

- STX   Start of Text
- DLE   Data Link Escape
- ETX   End of Text
- BCC   Block Check Character (only for 3964R)
- NAK   Negative Acknowledge

Note!

When a DLE is transferred as part of the information it is repeated to distinguish between data characters and DLE control characters that are used to establish and to terminate the connection (DLE duplication). The DLE duplication is reversed in the receiving station.

The 3964(R) procedure requires that a lower priority is assigned to the communication partner. When communication partners issue simultaneous send commands the station with the lower priority will delay its send command.

Procedure

Active partner   Passive partner

STX ──────────────▶

Monitor delayed acknowledgment
◀────────────── DLE

Message-data ──────────▶

DLE ──────────▶

ETX ──────────▶

BCC   *only 3964R* ──────────▶

Monitor delayed acknowledgment
◀────────────── DLE
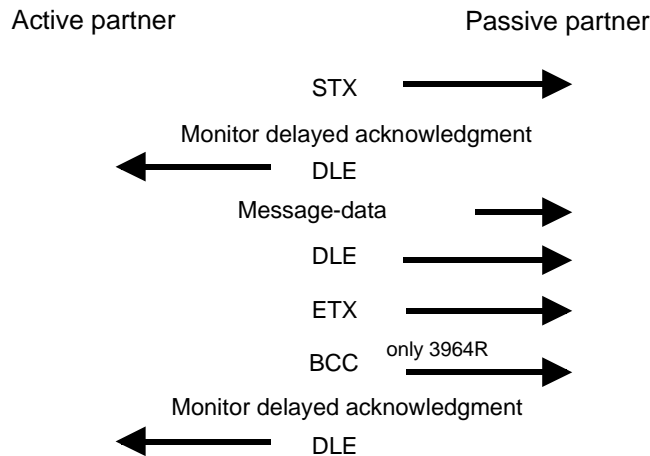
You may transfer a maximum of 250Byte per message.

**3964(R)
with RK512**

The RK512 is an extended form of the 3964(R) procedure. The difference is that a message header is sent ahead of the message data. The header contains data about the size, type and length of the message data.

Procedure

Active partner   Passive partner

	STX ➡
Monitor delayed acknowledgment	
⬅ DLE	
	Message data ➡
	DLE ➡
	ETX ➡
	BCC only 3964R ➡
Monitor delayed acknowledgment	
⬅ DLE	
⬅ STX	
Monitor delayed acknowledgment	
	DLE ➡
⬅ Reaction message	
⬅ DLE	
⬅ ETX	
⬅ only 3964R BCC	
Monitor delayed acknowledgment	
	DLE ➡
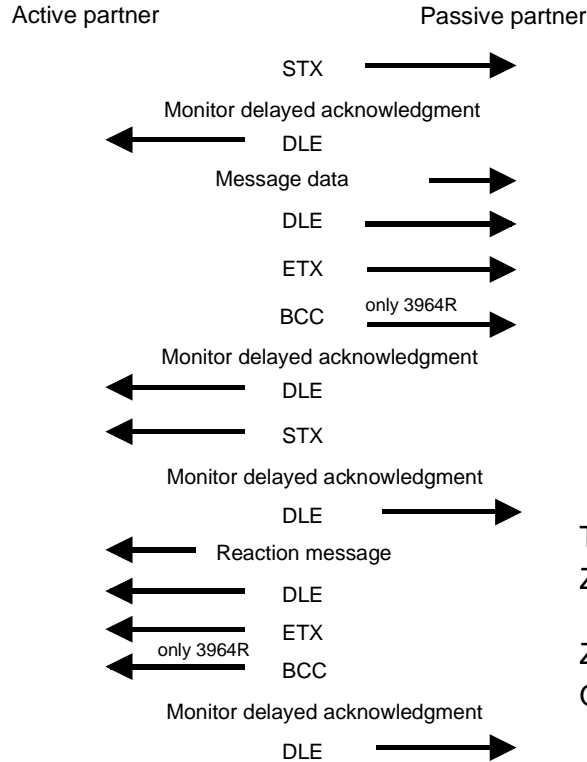
Timeout times:

ZNA (time delay after command)

ZVZ (character delay time)

QVZ (acknowledgment delay time)

Timeout times

The QVZ is monitored between STX and DLE and between BCC and DLE. ZVZ is monitored for the entire period of receiving the message.

When the QVZ expires after an STX, the STX is repeated. This process is repeated 5 times after which the attempt to establish a connection is terminated by the transmission of a NAK. The same sequence is completed when a NAK or any other character follows an STX.

When the QVZ expires after a message (following the BCC-byte) or when a character other than DLE is received the attempt to establish the connection and the message are repeated. This process is also repeated 5 times after which a NAK is transmitted and the attempt is terminated.

Passive operation

When the procedure driver is expecting a connection request and it receives a character that is not equal to STX it will transmit a NAK. The driver does not respond with an answer to the reception of a NAK.

When ZVZ expires during the reception, the driver will send a NAK and wait for another connection request.

The driver also sends a NAK when it receives an STX while it is not ready.

Block check character (BCC-Byte)	The 3964R procedure appends a Block check character to safeguard the transmitted data. The BCC-Byte is calculated by means of an XOR function over the entire data of the message, including the DLE/ETX. When a BCC-Byte is received that differs from the calculated BCC, a NAK is transmitted instead of the DLE.
Initialization conflict	If two stations should simultaneously attempt to issue a connection request within the QVZ then the station with the lower priority will transmit the DLE and change to receive mode.
Data Link Escape (DLE-character)	The driver duplicates any DLE-character that is contained in a message, i.e. the sequence DLE/DLE is sent. During the reception, the duplicated DLEs are saved as a single DLE in the buffer. The message always terminates with the sequence DLE/ETX/BCC (only for 3964R).

The control codes :   02h = STX
                             03h = ETX
                             10h = DLE
                             15h = NAK

Logical message sequence

SEND (transmission of data)
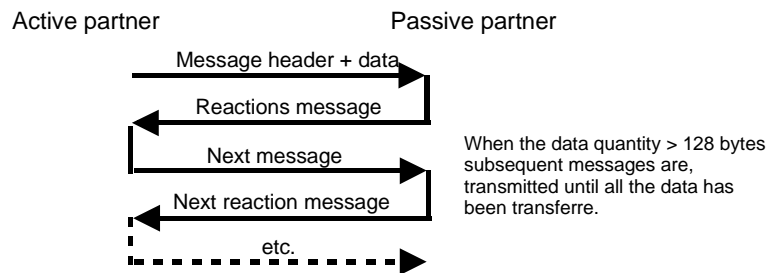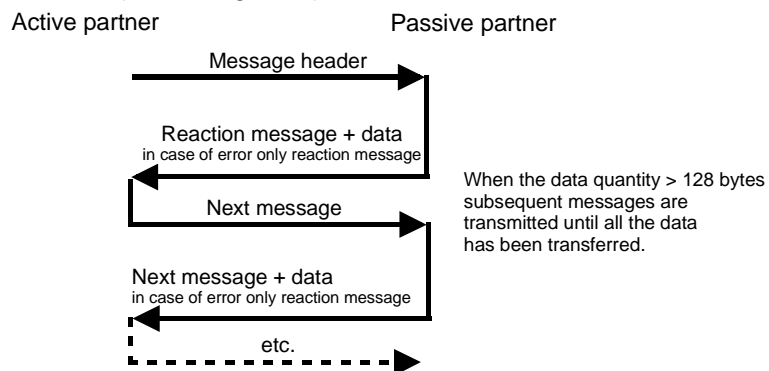
In both cases the procedure will time out after a maximum period of 5s during which a reaction must be received, else the reception is terminated.

Message contents   Every message has a header. Depending on the history of the message traffic, this header will contain all the required information.

Structure of the output message

Sample output message

Active partner   Passive partner

STX →

← DLE

Message header:

00
00
A   Output
D   data
05   in DB 5
01   from DW 1
00
08   8 words
FF   without coordi-
FF   nation flags

1. WORD   01
          02
2. WORD   A0
          B0
          A1
          B2   8 words
          .   data
          .
8. WORD   FF
          FF

DLE →   End of message
ETX →   + Block Check Char
BCC →

← DLE
← STX
DLE →
← 00
← 00   Reaction message
← 00   without errors
← 00

← DLE
← ETX
← BCC

DLE →
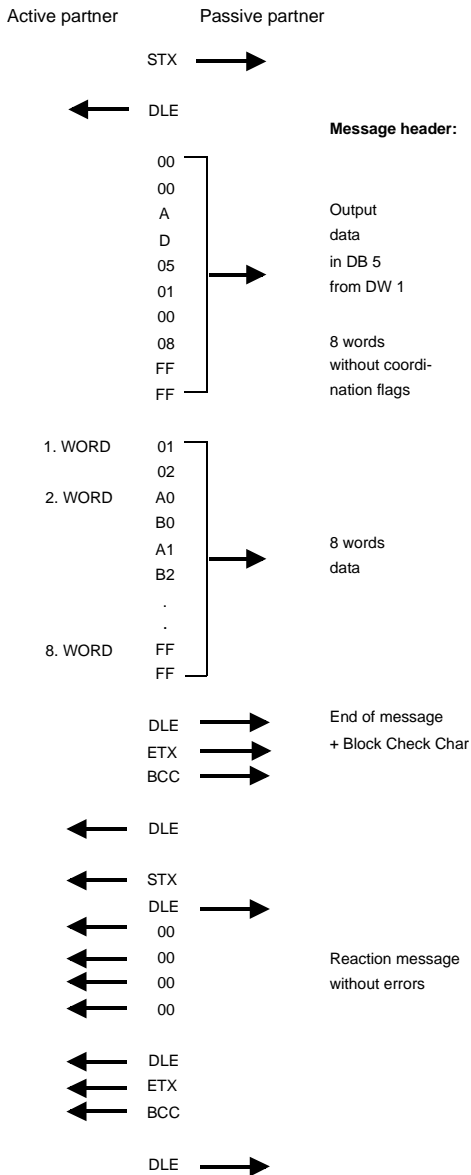
Normal message

Byte		
0	00	Message
1	00	flag
2	A	Output command
3	X	type of data
4	xx	Parameter 1
5	xx	Destination
6	yy	Parameter 2
7	yy	Quantity
8	zz	Parameter 3
9	zz	Coordination flag
10	aa	
-	bb	Data
N	xy	

with N = 10 ... 127

When the data exceeds 128Byte, additional messages will be sent.

Structure of additional messages

Next message

Byte		
0	FF	Flag for
1	00	next message
2	A	Output command
3	X	Data type
4	aa	
-	bb	Data
N	xy	

with N = 4 ... 127

Reaction message

Byte		
0	00	Flag for
1	00	reaction
2	00	message
3	xx	Error code

Next reaction message

Byte		
0	FF	Flag for
1	00	next reaction
2	00	message
3	xx	Error code

**Structure of the
input message**

Sample input message
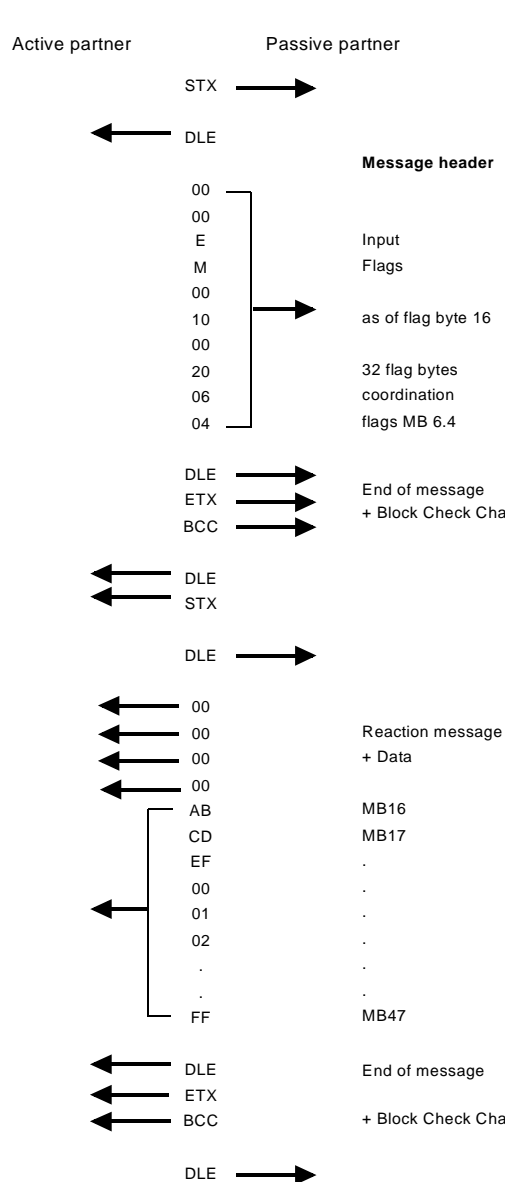
Active partner		Passive partner
STX →		
← DLE		
00	**Message header**	
00		
00		
E	Input	Flags
M		
00		as of flag byte 16
10		
00		32 flag bytes
20		coordination
06		flags MB 6.4
04		
DLE →		End of message
ETX →		
BCC →		+ Block Check Cha
← DLE		
← STX		
DLE →		
← 00		Reaction message
← 00		+ Data
← 00		
← 00		
AB		MB16
CD		MB17
EF		.
00		.
01		.
02		.
.		.
.		.
FF		MB47
← DLE		End of message
← ETX		
← BCC		+ Block Check Cha
DLE →		

Normal message

Byte

0	00	Message
1	00	identifier
2	E	Input command
3	X	Data type
4	xx	Parameter 1
5	xx	Destination
6	yy	Parameter 2
7	yy	Quantity
8	zz	Parameter 3
9	zz	Coordinnation flag

When the data exceeds 128Byte, additional messages will be sent.

Structure of additional messages

Next message

Byte

0	FF	Flag for
1	00	next message
2	E	Input command
3	X	data type

Reaction message

Byte

0	00	Reaction
1	00	message
2	00	flag
3	xx	Error code
4	aa	
-	bb	Data
N	xy	

with N = 4 ... 127

Next reaction message

Byte

0	FF	Flag for next
1	00	reaction
2	00	message
3	xx	Error code
4	aa	
-	bb	Data
N	xy	

with N = 4 ... 127

Coordination flags   The coordination flag is set in the partner PLC in active-mode when a message is being received. This occurs for input as well as for output commands. When the coordination flag has been set and a message with this flag is received, then the respective data is not accepted (or transferred) and a reject message is sent (error code 32h). In this case the user has to reset the coordination flag in the partner PLC.

Principles Modbus

Overview

The Modbus protocol is a communication protocol that defines a hierarchic structure between a master and several slaves.

Physically, Modbus transmits via a serial half-duplex core as point-to-point connection under RS232 or as multi-point connection under RS485.

Master– slave communication

There are no bus conflicts for the master is only able to communicate with one slave at a time. After the master requested a message, it waits for an answer until a adjustable wait period has expired. During waiting is no other communication possible.

Telegram structure

The request telegrams of the master and the respond telegrams of a slave have the same structure:

Start ID	slave address	Function code	Data	Flow control	End ID

Broadcast with slave address = 0

A request may be addressed to a certain slave or send as broadcast message to all slaves. For identifying a broadcast message, the slave address 0 is set.

Only write commands may be send as broadcast.

ASCII, RTU mode

Modbus supports two different transmission modes:

- ASCII mode: Every Byte is transferred in 2 character ASCII code. The data is marked by a start and an end ID. This enables high control at the transmission but needs time.
- RTU mode: Every Byte is transferred as character. Thus enables a higher data through-put than the ASCII mode. Instead of start and end ID, RTU uses a time watcher.

The mode selection is at parameterization.

Modbus at CP 240 from VIPA

The CP 240 module is a communication processor that occupies 16Byte each for in- and output data at a chooseable area in the CPU.

The CP has to be included via the hardware configuration by means of the included GSD file.

The Modbus-CP from VIPA may be deployed as master or as intelligent slave. In master operation the communication takes place via your PLC user application, that requires the SEND and RECEIVE handler blocks.

CP 240 with 20mA/RS232C interface - Construction

Properties

- The order number of the communication processoris: VIPA 240-1BA00 and VIPA 240-1BA10 with Modbus protocol.
- RS232C or 20mA interfacing depending on external connections.
- Interface compatible with SSM BG41-43 with MD26 (20mA/RS232) from VIPA and the Siemens CP525.
- Protocols supported: ASCII, STX/ETX, 3964(R) and RK512 or Modbus
- Active or passive 20mA interface
- 16Byte parameter data
- 8 receive buffers of 256Byte each and 1 send buffer with 256Byte.
- Diagnostic functions via backplane bus.
- Diagnostic interface with TTL levels.
- The serial interface is not isolated from the backplane bus
- Power supply via backplane bus

Properties of the 20mA interface

- Logical levels represented by currents
- Data transfers over distances of up to 1000m depending on baudrate
- Data transfer rate up to 19.2kBaud
- Point-to-point connections (active/passive)
- Bus connection

Options of the 20mA mode:
- Module is active station and supplies line current
- Module is passive station; partner station supplies the line current

Properties of the RS232C interface

- Logical signals as voltage levels
- Point-to-point links with serial full-duplex transfer in 2-wire technology
- Data transfers over distances of up to 15m
- Data transfer rate up to 115kBaud

Construction

```
        CP 240
       ┌─────────┐
       │   ◎     │
       │ PW  ○○  │
       │ ER  ○○  │
    1 ─┤ TxD ○○  ├─ 2
       │ RxD ○○  │
       │     ○○  │
       │     ○○  │
       │         │
       │   ◎     │
       │ ┌────┐  │
  Monitor│    ├─ 3
       │ └────┘  │
       │ X│4     │
       │ 5│6     │
       └─────────┘
     VIPA 240-1BA00
```
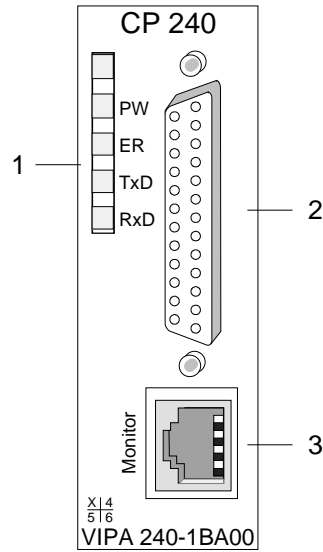
[1]　LED Status indicators
[2]　25pin serial D-type socket
　　　(RS232C or 20mA)
[3]　Diagnostic socket for
　　　troubleshooting purposes

Components

Power supply　　The communication processor receives power via the backplane bus. Please note that the module requires external DC 24V via the D-type socket if it should operate as an active 20mA interface.

Please refer to "Deployment as active 20mA interface" for more detailed information.

LEDs　　The communication processor is provided with 4 LEDs for the purpose of displaying the operating status. The following table depicts the description and the color of these LEDs.

Name	Color	Description
PW	yellow	Indicates that power is available
ER	red	For Modbus this signalizes an internal error
		other protocols: error indicator for
		open circuit lines, overflow, parity or framing errors.
		The error LED is reset automatically after 4s. If diagnostics are enabled the error causes transmission of diagnostic bytes.
TxD	yellow	Transmit data
RxD	yellow	Receive data

Diagnostic interface

The RJ45 socket provides access to the RxD and TxD signals of the serial interface. The signals have already been converted to RS232 levels. The diagnostic interface has the following pin assignment:

Pin	Assignment
1	reserved
2	RxD
3	TxD
4	reserved
5	GND
6	VCC (5V)
7	channel selection
8	channel selection

You may display and analyze the signals by means of a diagnostic cable and software that is available from VIPA (order no.: VIPA-UPI-FOX2).

Note!

ON = 1

OFF = 0

Please remember that you are only able to use the diagnostic facilities when the shown combination is set up on the DIP-switch of the diagnostic cable.

25pin D-type socket
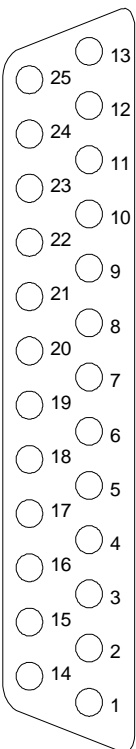
Pin	RS232C	20mA	Pin	RS232C	20mA
25	not connected	not connected	13	reserved	RxD+
24	reserved	Current sink 20mA -Tx	12	reserved	Current srce 20mA +Tx
23	RI	reserved	11	reserved	+24V
22	reserved	GND 24V	10	reserved	TxD+
21	reserved	Current sink 20mA -Rx	9	not conn.	not connected
20	Selection RS232C / 20mA		8	DTR	reserved
19	reserved	TxD-	7	GND	GND
18	CD	reserved	6	DSR	reserved
17	GND	GND	5	CTS	reserved
16	reserved	Current srce 20mA +Rx	4	RTS	reserved
15	+5V	+5V	3	RxD	reserved
14	reserved	RxD-	2	TxD	reserved
			1	shield	shield

Wiring

The communication processor is equipped with a single interface as shown above. This interface can be set to operate either as RS232C or as 20mA interface. The selection of the type of operating mode is controlled by means of pin 20 on the 25-pin socket:

- pin 20 at ground   →   RS232C interface
- pin 20 open   →   20mA interface

In the 20mA mode the interface can be operated in "active" or "passive" mode.

20mA current source

The CP 240 is provided with a 20mA current source for the active mode. This requires a DC 24V power supply via pins 11 (+24V) and 22 (24V ground).

RS232C interface

The CP 240 currently supports the following RS232C signals:

TxD Transmit Data

The transmit data is transferred via the TxD line. When the transmit line is not used the CP 240 holds it at a logical "1".

RxD Receive Data

The receive data arrives via the RxD line. When the receive line is not in use, it must be held at a logical "1" by the transmitting station.
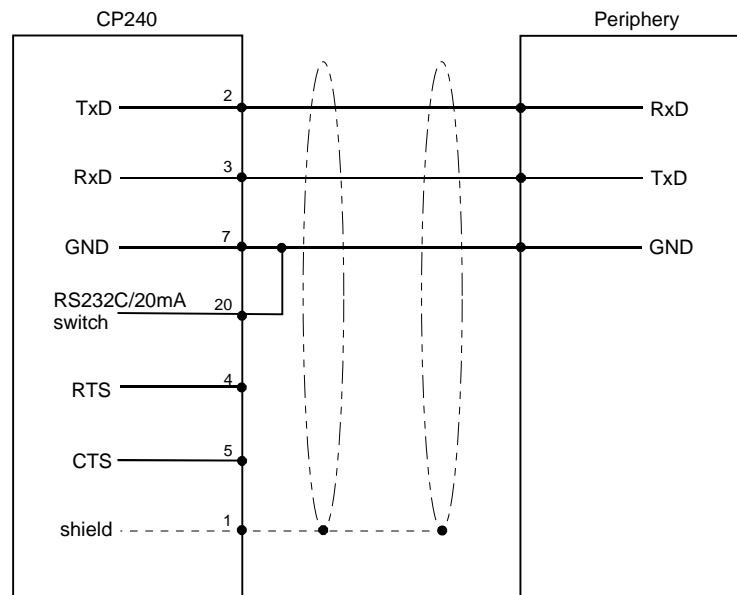
20mA interface   *Options of the 20mA interface*

- Module as passive station, the partner station supplies the line current.
- Module as active station, it supplies the line current.

Passive 20mA interface

When the CP 240 is used with a "passive" 20mA interface, the required current is supplied by the periphery. In this case the CP 240 does not require an external power source.
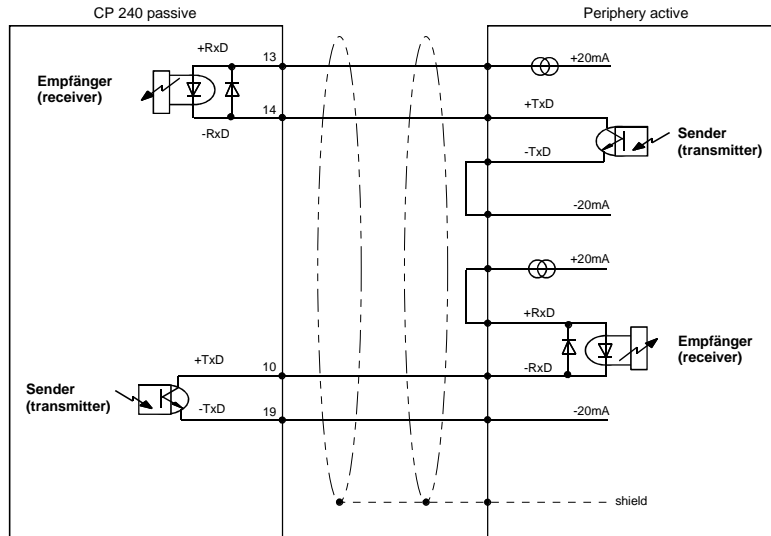
Active 20mA interface

When the CP 240 is used as the "active" 20mA interface, the internal current source supplies the required 20mA. In this case the connected periphery represents the passive station.

Please note that the current source in the CP 240 requires an external source of DC 24V power connected to pin 11 and 22.
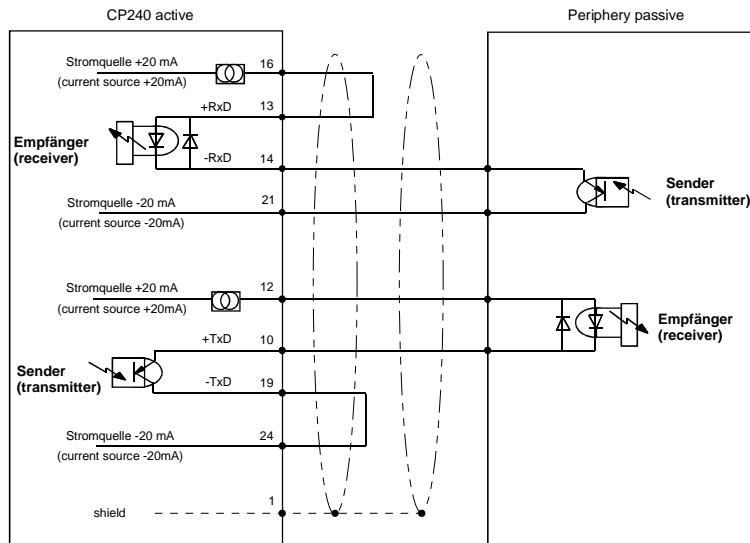
CP 240 with RS422/RS485 interface - Construction

Properties
- The communication processor has the order no.: VIPA 240-1CA00 and VIPA 240-1CA10 with Modbus protocol
- RS422 or RS485 interface
- Interface compatible with SSM BG41-43 with MD21 (RS422/RS485) from VIPA and CP525 from Siemens
- Supports the protocols ASCII, STX/ETX, 3964(R), RK512 or Modbus
- 16Byte parameter data
- 8 receive buffers of 256Byte each and 1 transmit buffer of 256Byte
- Diagnostic function via the backplane bus
- Diagnostic interface employing TTL levels.
- Isolation with respect to the backplane bus
- Power supplied via the backplane bus

RS422 interface
- Logical states are represented by differential voltage levels on two twisted cores
- Point-to-point link with a serial full-duplex transfer in 4-wire technology
- Multidrop connection
- High interference immunity
- Up to 16 partner stations
- Data transfer over distances of up to 1000m
- Data transfer rate up to 115kBaud

RS485 interface
- Logical states are represented by differential voltage levels on two twisted cores
- Serial bus connections by means of a two wire half-duplex link
- Multidrop connections
- High noise immunity
- Up to 32 partner stations
- Data transfer over distances of up to 500m
- Data transfer rate up to 115kBaud

Construction
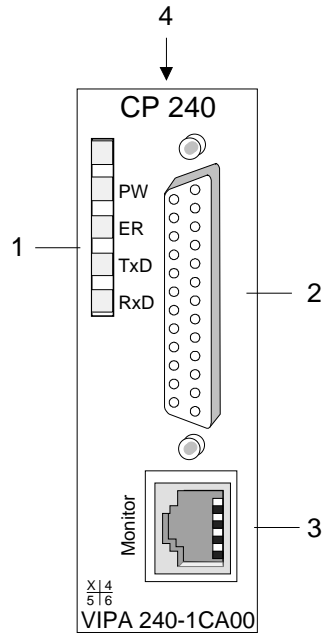
[1]   LED status indicators
[2]   25pin serial D-type socket
      (RS422/485)
[3]   Diagnostic socket for troubleshooting
      purposes
[4]   Switchable terminating resistor

Components

Power supply   The communication processor receives power via the backplane bus.

LEDs   The communication processor is provided with 4 LEDs for the purpose of displaying the operating status. The description and the color of these LEDs is depicted by the following table.

Name	Color	Description
PW	yellow	Indicates that power is available
ER	red	Indicates errors:
		open circuit lines, overflow, parity or framing errors. The error LED is reset automatically after 4s. If diagnostics are enabled the error causes transmission of diagnostic bytes.
TxD	yellow	Transmit data
RxD	yellow	Receive data

Diagnostic interface

The RJ45 socket provides access to the RxD and TxD signals of the serial interface. The signals have already been converted to RS232 levels. The diagnostic interface has the following pin assignment:

Pin	Assignment
1	reserved
2	RxD
3	TxD
4	reserved
5	GND
6	VCC (5V)
7	channel selection
8	channel selection

You may display and analyze the signals by means of a diagnostic cable and software that is available from VIPA (order no.: VIPA-UPI-FOX2).

Note!

ON = 1

OFF = 0

Please remember that you are only able to use the diagnostic facilities when the shown combination is set on the DIP-switch of the diagnostic cable.

25pin D-type socket
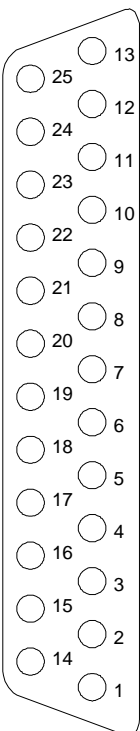
Pin	RS422/485	Pin	RS422/485
25	not connected	13	CTS-
24	not connected	12	CTS+
23	not connected	11	not connected
22	not connected	10	RTS+
21	not connected	9	RTS-
20	not connected	8	RxD+
19	not connected	7	GND
18	not connected	6	RxD-
17	GND iso	5	TxD-
16	not connected	4	TxD+
15	+5V	3	5V iso
14	not connected	2	not connected
		1	shield

Terminating resistor

A 2pin DIP-switch is accessible at the top of the module. This switch connects a 100Ω terminating resistor between the RxD and the TxD lines respectively.

This is necessary in case of longer communication lines or higher data communication rates when the module is located at the physical end of the bus.
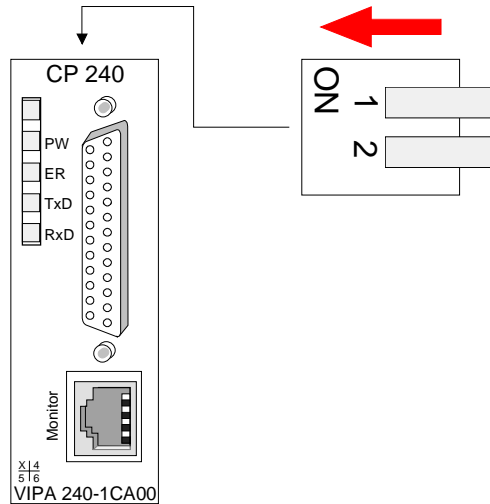
Wiring

The interface may be used for point-to-point links (RS422) or for a bus system where the transmission and reception is carried by the same line (RS485). In this case a bus master controls the operating mode by means of the SEL signals.

RS422 dc coupled
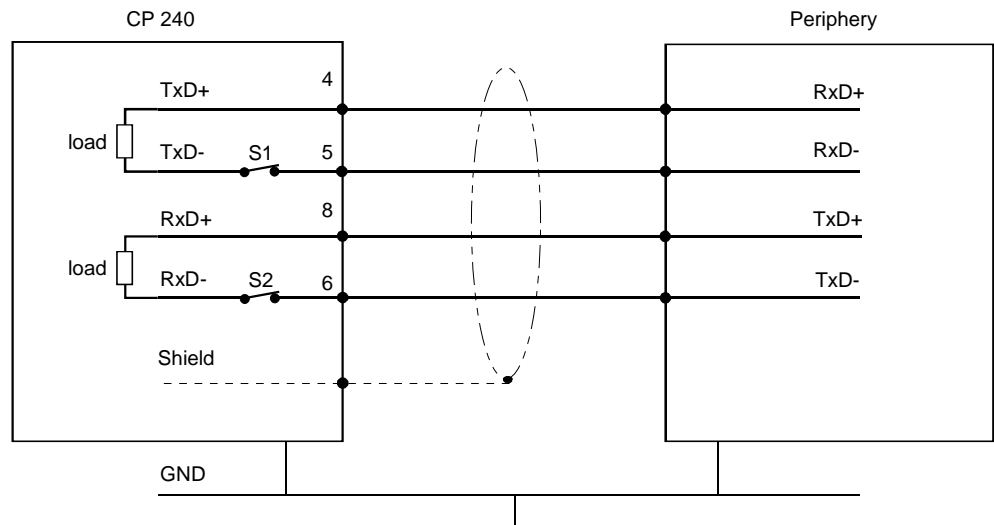
⚠️ **Attention!**

The grounds of the device interfaces must be connected.

RS422 isolated

CP 240

Periphery

5V iso	3	5V iso
TxD+	4	RxD+
load TxD- S1	5	RxD-
RxD+	8	TxD+
load RxD- S2	6	TxD-
GND iso	17	GND iso
Shield		

RS485 dc coupled

CP 240

Periphery

TxD+	4	RxD+/TxD+
RxD+	8	RxD-/TxD-
load TxD- S1	5	
RxD- S2	6	
Shield		

Periphery

RxD+/TxD+
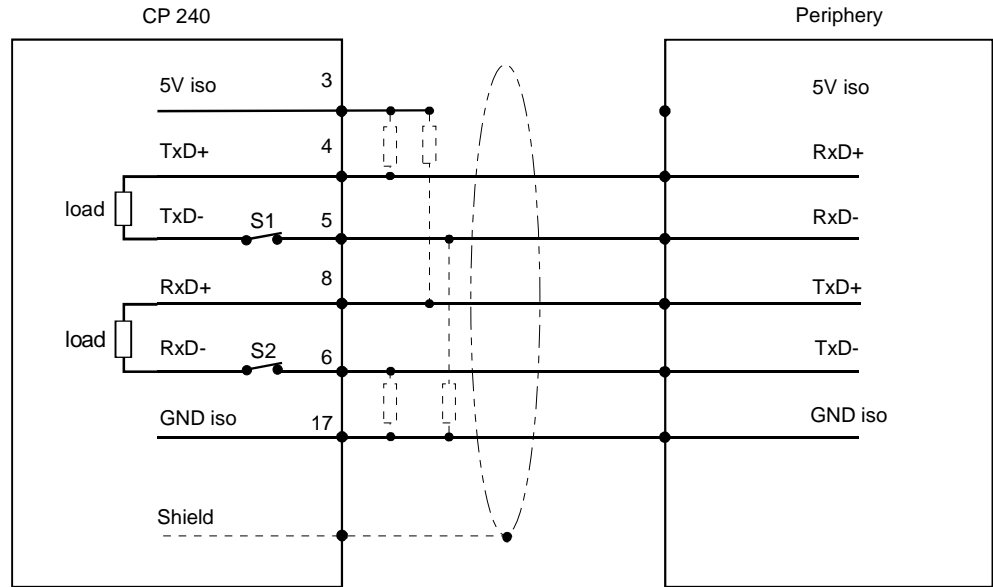
RxD-/TxD-
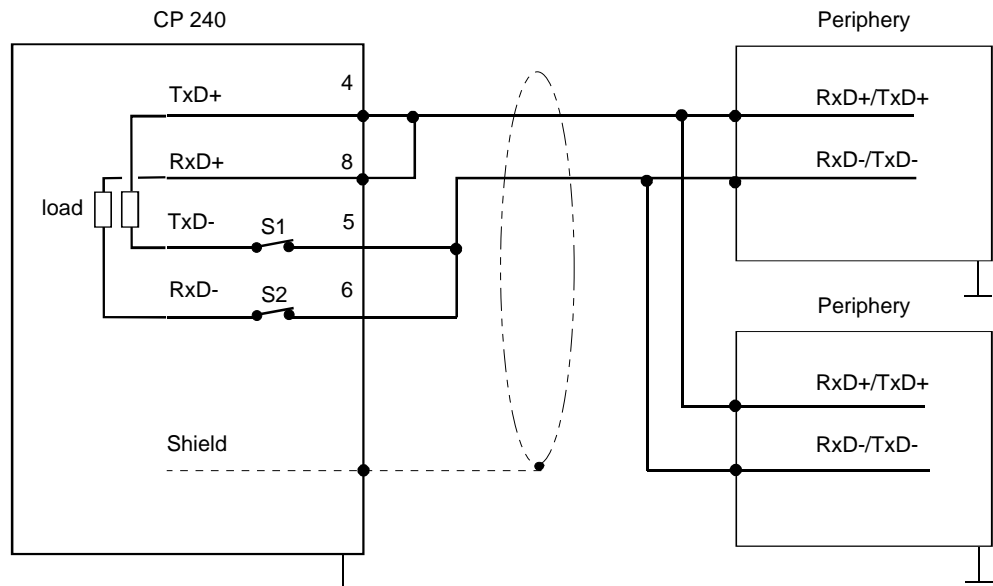
RS485 isolated
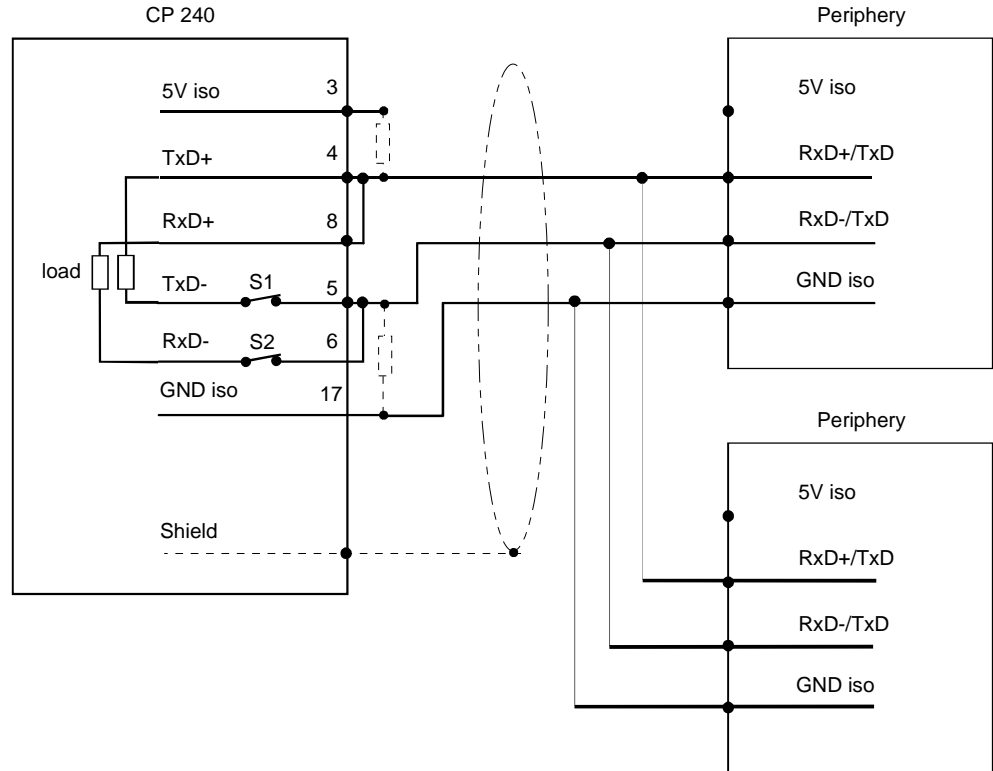
Defined static levels by means of resistors

Pin 3 of the isolated interfaces carries the isolated 5V supply with the respective ground GND on pin 17. You may use this isolated voltage to provide defined static voltage levels on the signaling lines by means of resistors and ensure that reflections are reduced to a minimum.

Parameterization

General

You may configure the CP 240 by means of 16Byte of configuration data. The structure of the parameter data depends on the selected protocol or procedure. Below follows a list of the parameter bytes with the respective default values.

Structure of the parameter bytes for ASCII

Byte	Function	Range	Default parameter
0	Baudrate	0h: Default (9600Baud) 1h: 150Baud 2h: 300Baud 3h: 600Baud 4h: 1200Baud 5h: 1800Baud 6h: 2400Baud 7h: 4800Baud 8h: 7200Baud 9h: 9600Baud Ah: 14400Baud Bh: 19200Baud Ch: 38400Baud Dh: 57600Baud Eh: 115200Baud	0: 9600Baud
1	Protocol	1: ASCII	1 (ASCII)
2	Bit 1/0 data bits	00b: 5 data bits 01b: 6 data bits 10b: 7 data bits 11b: 8 data bits	11b: 8 data bits
	Bit 3/2 Parity	00b: none 01b: odd 11b: even	00b: none
	Bit 5/4 Stop bits	01b: 1 10b: 1.5 11b: 2	01b: 1 Stop bit
	Bit 7/6 Flow control	00b: none 01b: Hardware 10b: XON/XOFF	00b: none
3	Reserved	0	0
4	ZNA (*20ms)	0..255	0
5	ZVZ (*20ms)	0..255	10
6	no. of receive buffers	1..8	1
7...15	reserved		

Structure of parameter bytes for STX/ETX

Byte	Function	Range of values	Default parameters
0	Baudrate	0h:.. Default (9600Baud) 1h:.. 150Baud 2h:.. 300Baud 3h:.. 600Baud 4h:.. 1200Baud 5h:.. 1800Baud 6h:.. 2400Baud 7h:.. 4800Baud 8h:.. 7200Baud 9h:.. 9600Baud Ah: . 14400Baud Bh: . 19200Baud Ch: . 38400Baud Dh: . 57600Baud Eh: . 115200Baud	0: 9600Baud
1	Protocol	2:.... STX/ETX	2 (STX/ETX)
2	Bit 1/0 Data bits	00b: 5 Data bits 01b: 6 Data bits 10b: 7 Data bits 11b: 8 Data bits	11b: 8 Data bits
	Bit 3/2 Parity	00b: none 01b: odd 11b: even	00b: none
	Bit 5/4 Stop bits	01b: 1 10b: 1.5 11b: 2	01b: 1 Stop bit
	Bit 7/6 Flow control	00b: none 01b: Hardware 10b: XON/XOFF	00b: none
3	Reserved	0	0
4	ZNA (*20ms)	0..255	0
5	TMO (*20ms)	0..255	10
6	Number of start flags	0..2	01
7	Start flag 1	0..255	02
8	Start flag 2	0..255	0
9	Number of end flags	0..2	01
10	End flag 1	0..255	03
11	End flag 2	0..255	0
12	not used		
13	not used		
14	not used		
15	not used		

Structure of the parameter bytes for 3964(R) / 3964(R) with RK512

Byte	Function	Range	Default parameters
0	Baudrate	0h: .. Default (9600Baud) 1h: .. 150Baud 2h: .. 300Baud 3h: .. 600Baud 4h: .. 1200Baud 5h: .. 1800Baud 6h: .. 2400Baud 7h: .. 4800Baud 8h: .. 7200Baud 9h: .. 9600Baud Ah: .. 14400Baud Bh: .. 19200Baud Ch: .. 38400Baud Dh: .. 57600Baud Eh: .. 115200Baud	0: 9600Baud
1	Protocol	3: .... 3964 4: .... 3964R 5: .... 3964 + RK512 6: .... 3964R + RK512	3: 3964
2	Bit 1/0 Data bits	00b: 5 Data bits 01b: 6 Data bits 10b: 7 Data bits 11b: 8 Data bits	11b: 8 Data bits
	Bit 3/2 Parity	00b: none 01b: odd 11b: even	00b: none
	Bit 5/4 Stop bits	01b: 1 10b: 1.5 11b: 2	01b: 1 Stop bit
	Bit 7/6 Flow control	00b: none 01b: Hardware 10b: XON/XOFF	00b: none
3	Reserved	0	0
4	ZNA (*20ms)	0..255	0
5	ZVZ (*20ms)	0..255	10
6	QVZ (*20ms)	0..255	25
7	BWZ (*100ms)	0..255	100
8	STX repetitions	0..255	3
9	DBL	0..255	6
10	Priority	0: .... low 1: .... high	0: low
11	reserved	0	0
12	QVZ (*100ms) user acknowledgment RK512	0..255	50
13	not used		
14	not used		
15	not used		

Parameter structure at Modbus

Byte	Function	Range	Default parameter
0	Baudrate	0h: 9600Baud 6h: 2400Baud 7h: 4800Baud 9h: 9600Baud Ah: 14400Baud Bh: 19200Baud Ch: 38400Baud	0h: 9600Baud
1	Protocol	Ah: Modbus master ASCII Bh: Modbus master RTU Ch: Modbus slave ASCII Dh: Modbus slave RTU	Bh: Modbus master RTU
2	Bit 1/0 Data bits	00b: 5 Data bits 01b: 6 Data bits 10b: 7 Data bits 11b: 8 Data bits	11b: 8 Data bits
	Bit 3/2 Parity	00b: none 01b: odd 11b: even	00b: none
	Bit 5/4 Stop bits	01b:.1 10b:.1.5 11b:.2	01b: 1 Stop bit
	Bit 7/6 Flow control	00b:.none 01b:.Hardware 10b:.XON/XOFF	00b: none
3	Reserved	0	0
4	Address	1...255	1
5	Debug	0: Debug off 1: Debug on	0
6...7	Wait period	0: automatic calculation 1 ... 60000: Time in ms	0
8	not connected		
9	not connected		
10	not connected		
11	not connected		
12	not connected		
13	not connected		
14	not connected		
15	not connected		

Note!

If no parameterization is present and the CP 240 is linked-up via auto addressing, the CP has the following default parameters:

Baudrate: 9600Baud, Protocol: ASCII,   data bits: 8, **Parity: even**, Stopbits: 1, Flow control: no, ZNA: 0, ZVZ: 200ms, Receivebuffer: 1

**Parameter
description**

Baudrate   The data communication rate in bit/s (Baud).
(for all protocols) You may select one of the following values:

0h:	Default (9600Baud)
1h:	150Baud
2h:	300Baud
3h:	600Baud
4h:	1200Baud
5h:	1800Baud
6h:	2400Baud
7h:	4800Baud
8h:	7200Baud
9h:	9600Baud
Ah:	14400Baud
Bh:	19200Baud
Ch:	38400Baud
Dh:	57600Baud
Eh:	115200Baud

Default: 0 (9600Baud)

Protocol   The protocol that you wish to employ. This setting determines the further
                      structure of the parameter data. Depending on the chosen CP 240 module
                      the following options are available:

only VIPA 240-1BA00 and VIPA 240-1CA00:
1:	ASCII
2:	STX/ETX
3:	3964
4:	3964R
5:	3964 and RK512
6:	3964R and RK512

only VIPA 240-1BA10 and VIPA 240-1CA10:
Ah:	Modbus master with ASCII
Bh:	Modbus master with RTU
Ch:	Modbus slave with ASCII
Dh:	Modbus slave with RTU

Data communication parameter byte (for all protocols)

Here you define the physical data transfer parameters. The structure of the Byte is as follows:

Byte	Function	Range	Default parameter
2	Bit 1/0 Data bits	00b: 5 Data bits 01b: 6 Data bits 10b: 7 Data bits 11b: 8 Data bits	11b: 8 Data bits
	Bit 3/2 Parity	00b: none 01b: odd 11b: even	00b: none
	Bit 5/4 Stop bits	01b: 1 10b: 1.5 11b: 2	01b: 1 Stop bit
	Bit 7/6 Flow control	00b: none 01b: Hardware 10b: XON/XOFF	00b: none

Data bits

Quantity of *data bits* that represent a character.

Parity

The parity depends on the value and may be even or odd. For the purposes of the parity check, the information bits are expanded by the parity bit. The value of the parity bit ("0" or "1") completes the value of all the bits to obtain a pre-arranged state. If the parity was not specified, the parity bit is set to "1" but it is not included in the assessment.

Stop bits

The stop bits are appended to each character and signify the end of the character.

Flow control

This is a mechanism that synchronizes the data transfer when the transmitting station sends the data faster than it can be processed by the receiving station. Flow control can be hardware- or software-based (XON/XOFF). Hardware flow control employs the RTS and CTS lines and these must therefore be wired accordingly.

Software flow control employs the control characters XON=11h and XOFF=13h. Please remember that your data must not contain these control characters.

Default: 13h (data bits: 8, parity: none, stop bits: 1, flow control: none)

Time delay after command (ZNA)
(for all protocols except Modbus)

The delay time that must expire before a command is executed. The ZNA is specified in units of 20ms.

Range: 0 ... 255   *Default: 0*

Character delay time (ZVZ)
(for ASCII, 3964(R) and RK512)

The character delay time defines the maximum time that may expire between two characters of a single messages during the reception of the message. The ZVZ is defined in units of 20ms.

When the ZVZ=0 the character delay time (ZVZ) will be calculated automatically (about double character time).

Range: 0 ... 255   *Default: 10*

Number of receive buffers
(only for ASCII)

Defines the number of receive buffers. When only 1 receive buffer is available no more data can be received while the receive buffer is occupied. The received data can be redirected into an unused receive buffer when you chain up to a maximum of 8 receive buffers.

Range: 1 ... 8   *Default: 1*

Timeout (TMO)
(only for STX/ETX)

TMO defines the maximum time between two messages. TMO is specified in units of 20ms.

Range: 0 ... 255   *Default: 10*

Number of start flags
(only for STX/ETX)

You can select 1 or 2 start flags. When you select "1" as number of start flags, the contents of the 2nd start flag (byte 8) is ignored.

Range: 0 ... 2   *Default: 1*

Start flag 1 and 2 (STX)
(only for STX/ETX)

The ASCII value of the start character that precedes a message to signify the start of a data transfer. You may select 1 or 2 start characters. When you are using 2 start characters you have to specify "2" at "Number of start flags ".

Start character 1, 2:   *Range: 0 ... 255*   *Default: 2 (flag 1)*
                                                                0 (flag 2)

Number of end flags
(only for STX/ETX)

You can select 1 or 2 end flags. When you select "1" as number of end flags, the contents of the 2nd end flag (byte 11) is ignored.

Range: 0 ... 2   *Default: 1*

End flag 1 and 2 (ETX)
(only for STX/ETX)

The ASCII value of the end character that follows a message to signify the end of the data transfer. You may specify 1 or 2 end characters. When you are using 2 end characters you have to enter a "2" for "number of end flags".

End character 1, 2:   *Range: 0 ... 255*   *Default: 3 (char. 1)*
                                                                0 (char. 2)

**Delayed
acknowledgment
time (QVZ)**
(for 3964(R), RK512)

The delayed acknowledgment time defines the maximum time for the acknowledgment from the partner when the connection is being established. The QVZ is specified in units of 20ms.

Range: 0 ... 255   *Default: 25*

**Block delay time
(BWZ)**
(for 3964(R), RK512)

The BWZ is specified in units of 100ms.

Range: 0 ... 255   *Default: 100*

STX repetitions
(for 3964(R), RK512)

Maximum number of allowed attempts for a CP 240 to establish a connection.

Range: 0 ... 255   *Default: 3*

**Repetitions of
data blocks (DBL)**
(for 3964(R), RK512)

Maximum number of message repetitions (incl. the 1st telegram) if an error occurs.

Range: 0 ... 255   *Default: 6*

Priority
(for 3964(R), RK512)

A communication partner has a high priority when its transmit request supersedes the transmit request of a partner. When the priority is lower, it must take second place after the transmit request of the partner.

The priorities of the two partners must be different for the 3964(R) protocols.

You may select one of the following settings:

   0: low

   1: high   *Default: 0 (low)*

**QVZ user
acknowledgment
RK512**
(only for RK512)

This is the delay time during which an acknowledgment must be received from the partner to indicate that the data was received and processed (reaction message). The QVZ is specified in units of 100ms.

Range: 0 ... 255   *Default: 50*

Address
(only for Modbus)

If the module has slave character, you adjust the Modbus slave address here.

Range: 1...255   *Default: 1*

Debug
(only for Modbus)

This mode is reserved for internal tests. This function should always be deactivated.

Range: 0, 1   *Default: 0*

Access to the CP 240 interface under ASCII, STX/ETX, 3964(R)

The access methods described here are **not** valid for the **Modbus protocol!**

Send and receive data

Data that is written from the CP 240 to the concerning data channel via the backplane bus, is written to the according send buffer (256Byte) and from there put out via the interface.

When the communication processor receives data via the interface, the data is stored in a ring buffer (8x256Byte). The received data may be read from the CPU via the data channel.

Communication via backplane bus

The exchange of received telegrams via the backplane bus happens asynchronously. When a complete telegram has arrived via the serial interface (expiration of the ZVZ), this is stored in a ring buffer of 8x256Byte. The length of the ring buffer determines the max. length of a telegram. There may be stored 8 independent telegrams of 256Byte each. When the buffer is filled up, new telegrams are rejected. A complete telegram is divided into blocks of 12Byte and transferred to the backplane bus. The reassembly of the data blocks has to take place inside the CPU.

Tasks of the CPU

The CPU has to split the telegram to send into blocks of 12Byte and transfer them via the backplane bus to the CP 240. In the CP 240 these blocks are assembled in the send buffer, proofed for completeness and then sent to the serial interface. For the data transfer via the backplane bus is asynchronous, a "software handshake" is used between the CP 240 and the CPU. The register for the data transfer from the CP 240 have a width of 16Byte. The bytes 0 to 3 (word 0 and 2) are reserved for the handshake.

The following picture illustrates this:
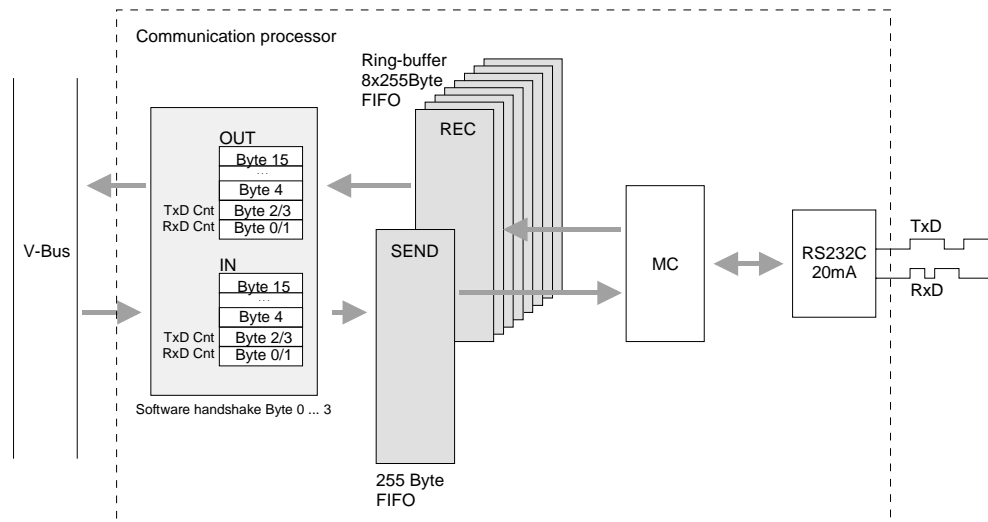
Software handshake

For the deployment of the CP 240 together with a System 200V CPU VIPA offers you a series of standard handler blocks that provide the software handshake comfortable and easy.

At deployment of the CP 240 without handler blocks, the functionality is elucidated with an example of data send and receive.

Example SEND data

For example, a telegram with 30Byte length is to send. The CPU writes the first 12Byte user data of the telegram into the Bytes 4 to 15. Byte 2/3 contain the telegram length, i.e. "30". The CP 240 receives the data via the backplane bus and copies the 12Byte user data into the send buffer. For the acknowledgement of the telegram the CP 240 writes the value "30" back to Byte 2/3 (length of the telegram).

At reception of the "30", the CPU can send further 12Byte user data to Byte 4 to 15 and the rest length of the telegram ("18" Byte) to Byte 2/3 to the CP 240. Again, this stores the user data in the send buffer and sends back the length information ("18") in Byte 2/3 to the CPU.

The CPU receives the "18" and sends the remaining 6Byte user data in the Bytes 4 to 9 and the according rest length ("6") in Byte 2/3 to the CP 240. The user data is stored in the send buffer and the value "6" is send back to the CPU via Byte 2/3.

The CPU receives the "6" and sends back a "0" via Byte 2/3. The CP 240 now initializes the sending of the telegram via the serial interface. After data transfer is completed, the CP 240 sends back a "0" to the CPU via Byte 2/3.

At reception of the "0", the CPU is able to send a new telegram to the CP 240.

Example RECEIVE data

The interface of the CP 240 has e.g. received a telegram with a length of 18Byte via the serial interface. The CP 240 writes the 12Byte user data into the Bytes 4 to 15 of the receive buffer and the telegram length (i.e. "18") into Byte 0/1. The data is transferred to the CPU via the backplane bus. The CPU stores the 12Byte user data and sends back the length value "18" to the CP 240.

At reception of the "18", the CP 240 writes the remaining 6Byte user data into the Bytes 4 to 9 of the receive buffer and the received length of user data ("6") in Bytes 0/1.

Having received the "6", the CP 240 returns the value "0" via Byte 0/1, i.e. the telegram has been completed. The CPU acknowledges with another "0" in Byte 0/1 to the CP 240.

Now the CP 240 may send another telegram to the CPU.

Deployment under Modbus

Overview

You may deploy the CP 240 Modbus as well in master as in slave mode. Independently from this, the module occupies each 16Byte for input and output data at a chooseable area in the CPU.

In master mode, the communication takes place via data blocks by using the SEND/RECEIVE handler blocks. At deployment of blocks you may transfer up to 250Byte user data.

In slave mode, the length of the user data for in- and output is limited to 16Byte. For the deployment of a slave, no handler blocks are required. It has only to be parameterized.

The parameterization is executed during the hardware configuration of the CPU by using the delivered GSD file.

After every start-up of the CPU, this transfers the parameters to the Modbus module. If the parameters are valid, they are adopted. Now the Modbus module is ready for communication.

Operation requirements

The following components are necessary for the deployment of the System 200V Modbus modules:

- VIPA 240-1BA10 resp. VIPA 240-1CA10 (CP 240 Modbus)
- VIPA CPU 21x (programmable in Step®7 from Siemens) or
  VIPA CPU 24x (programmable in Step®5 from Siemens).
- Configuration tool VIPA MC5 or Step®7 Manager (V5.1) from Siemens
- Programming cable for MPI connection (Green Cable from VIPA)
- GSD file **VIPA04D5.gsd** (V1.31 or higher)
- VIPA handler blocks Fx000002_V109.zip
- Modbus cable

Installation

The installation of the Modbus module has the following approach:

1. Install the GSD file **VIPA04D5.gsd** in your configuration tool.
2. Install the VIPA Library **Fx000002_V109.zip** with the handler blocks in the configuration tool.
3. Fix the parameters for the CP 240 and transfer your configuration into your PLC.
4. Connect the Modbus cable.

Configuration via GSD

The address assignment and the parameterization of the Modbus module happens via the STEP®7 Manager from Siemens by means of a virtual Profibus system. For the Profibus interface is standardized through software, the functionality of the module can be guaranteed when you include the GSD file in the STEP®7 Manager from Siemens. You transfer your project into the CPU via MPI.

Include GSD

The following steps are required for including the GSD:

- Copy the delivered VIPA GSD file `VIPA04D5.GSD` (V.1.31 or higher) into your GSD directory ...\siemens\step7\s7data\gsd
- Start the hardware configurator from Siemens
- Close all projects
- Choose **Options** > *Install new GSD*
- Select **VIPA04D5.gsd**

Now the modules of the System 200V from VIPA are integrated in the hardware catalog and may be projected.

Include VIPA library

The VIPA specific SFCs are included to the consignment of the CPUs and the CPs in form of libraries. These are self-extracting exe-files.

When you want to employ VIPA specific SFCs, you have to import them into your project.

The following steps are required:

- Extract the file, execute FX00000z_Vxxx.exe:
  Double-click at FX00000z_Vxxx.exe to start the integrated extracting program. Choose the destination directory and click at <Extract>.

- "Dearchivate" library:
  Start the STEP®7 Manager from Siemens. Via **File** > *Dearchivate* you open a dialog window where you may choose the according archive. You will find the VIPA SFC library in the directory VIPA_S7. The file name is VIPA.ZIP.
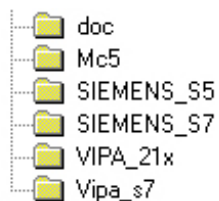
Choose VIPA.ZIP and click at [Open].

- Choose the destination directory where the handling block shall be stored and start the extraction with [OK].

- Open the library and transfer the SFCs into the project:
  After the extraction, open the library. Open your project and copy the required SFCs from the library into the directory "library" of your project. Now your user application allows you access to the VIPA specific handler blocks.

Parameterization   the parameterization takes place via the hardware configuration. The following parameters are at your disposal:
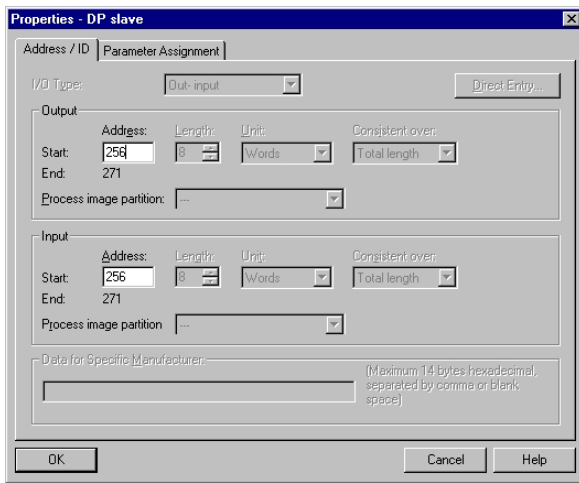
Dialog for address input   Dialog for Modbus parameters
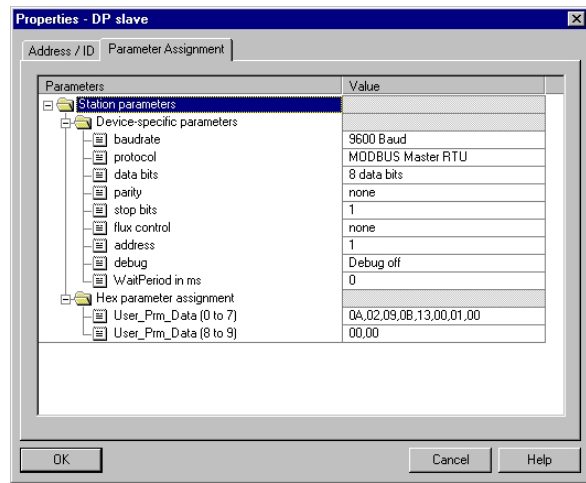
A closer description is to find further above in this chapter.

Master mode   The master mode is selected during parameterization.

By means of the SEND and RECEIVE handler blocks from VIPA you may send resp. receive any Modbus telegram. The telegram structure is the same for the user in ASCII and RTU mode, for telegram start and end flag, check sum and protocol monitoring is handled by the module.

Slave mode   The slave mode is selected during parameterization. Using the slave mode, the module works as intelligent slave, processing up to 16Byte in- and output data.

At deployment as slave, you have to assign a slave address during para-meterization.

Modbus slave function codes   Running in slave mode, the CP 240 Modbus from VIPA is able to process the following function codes:

Code	Command	Description
01h, 02h	Read n Bits	read n bits
03h, 04h	Read n Words Status	read n words
05h	Write one Bit	write one output bit
06h	Write one Word	write one output word
0Fh	Write n Bits	write n bits
10h	Write n Words	write n words

Commissioning   After starting the power supply, the LEDs ER, TxD and RxD at the Modbus module are on. The module signalizes that there are no valid parameters from the CPU. As soon as you switch the CPU to RUN, the Modbus parameters are transferred to the module. If the parameters are valid, the LEDs ER, TxD and RxD are extinguishing. Now the Modbus module is ready for communication.

At deployment in master mode you may execute according write/read commands via your user application.

If the ER-LED remains flashing, an internal error occurred. If this is only a momentary lapse, you may clear it with a STOP-RUN switch of the CPU.

Access to several slaves   When deploying several slaves, bus conflicts are not possible because the master is only able to communicate with one slave at a time. The master sends a command telegram to the slave specified via the address and waits a defined time for the respond telegram of the slave. During the waiting period no other communication is possible.

For the communication with several slaves, a SEND data block for the command telegram and a RECEIVE data block for the respond telegram is required for every slave.

An application with more than one slave would exist of an according number of data blocks with the concerning commands.

These are processed in line:

   1st slave: Send command telegram to slave address 1st slave
                  Receive respond telegram from slave address 1st slave
                  Analyze respond telegram

   2nd slave: Send command telegram to slave address 2nd slave
                  Receive respond telegram from slave address 2nd slave
                  Analyze respond telegram

   ... etc.

A request may be directed to a certain slave or be sent as broadcast message to all slaves. To mark a broadcast message, the slave address "0" is set.

Only write commands may be sent as broadcast.

Note!
After a broadcast, the master does <u>not</u> wait for a respond telegram.

Modbus function codes

Outline   The following Modbus function codes are implemented in slave mode:

Code	Command	Description
01h, 02h	Read n Bits	read n bits
03h, 04h	Read n Words Status	read n words
05h	Write one Bit	write one output bit
06h	Write one Word	write one output word
0Fh	Write n Bits	write n bits
10h	Write n Words	write n words

Note!

The shown check sums CRC at RTU and LRC at ASCII mode are automatically added to every telegram. They are not shown in the data block.

For the Byte sequence in a word is always valid:

1 word	
High Byte	Low Byte

**Read n Bits
01h, 02h**   This function enables the reading from the slave in bits.

Command telegram

Slave address	Function code	Address 1st Bit	Number of Bits	Check sum CRC/LRC
1 Byte	1 Byte	1 word	1 word	1 word

Respond telegram

Slave address	Function code	Number of read Bytes	Data 1st Byte	Data 2nd Byte	...	Check sum CRC/LRC
1 Byte	1 Byte	1 Byte	1 Byte	1 Byte max. 250 Byte		1 word

**Read n Words
03h, 04h**

This function enables the reading from the slave in words.

Command telegram

Slave address	Function code	Address 1. Bit	Number of Words	Check sum CRC/LRC
1 Byte	1 Byte	1 word	1 word	1 word

Respond telegram

Slave address	Function code	Number of read Bytes	Data 1st word	Data 2nd word	...	Check sum CRC/LRC
1 Byte	1 Byte	1 Byte	1 word	1 word max. 125 words		1 word

**Write one Bit
05h**

This function allows you to change one bit in the slave. A status change is via "Status Bit" with following values:

"Status Bit" = 0000h → Bit = 0

"Status Bit" = FF00h → Bit = 1

Command telegram

Slave address	Function code	Address Bit	Status Bit	Check sum CRC/LRC
1 Byte	1 Byte	1 word	1 word	1 word

Respond telegram

Slave address	Function code	Address Bit	Status Bit	Check sum CRC/LRC
1 Byte	1 Byte	1 word	1 word	1 word

**Write one word
06h**

This function sends one word to the slave. This allows you to overwrite a register in the slave.

Command telegram

Slave address	Function code	Address word	Value word	Check sum CRC/LRC
1 Byte	1 Byte	1 word	1 word	1 word

Respond telegram

Slave address	Function code	Address word	Value word	Check sum CRC/LRC
1 Byte	1 Byte	1 word	1 word	1 word

Write n Bits 0Fh   This function writes n Bits to the slave. Please regard that the number of Bits has additionally to be set in Byte.

Command telegram

Slave address	Function code	Address 1. Bit	Number of Bits	Number of Bytes	Data 1st Byte	Data 2nd Byte	...	Check sum CRC/LRC
1 Byte	1 Byte	1 word	1 word	1 Byte	1 Byte	1 Byte	1 Byte	1 word
						max. 250 Byte		

Respond telegram

Slave address	Function code	Address 1. Bit	Number of Bits	Check sum CRC/LRC
1 Byte	1 Byte	1 word	1 word	1 word

Write n Words 10h   This function sends n words to the slave.

Command telegram

Slave address	Function code	Address 1st word	Number of words	Number of Bytes	Data 1st word	Data 2nd word	...	Check sum CRC/LRC
1 Byte	1 Byte	1 word	1 word	1 Byte	1 word	1 word	1 word	1 word
						max. 125 words		

Respond telegram

Slave address	Function code	Address 1. word	Number of words	Check sum CRC/LRC
1 Byte	1 Byte	1 word	1 word	1 word

Example for the deployment under Modbus

Outline

After the installation you may use this sample project for your first steps.

When needed, you may obtain the sample project from VIPA.

During this example, a communication between a master and a slave via Modbus is established. Further we will show how to get easily control over the communication tasks by using the handler blocks.

Requirements

The following components are required for the example:

1 CPU 21x with CP 240 Modbus as master system

Configuration tool STEP®7 Manager from Siemens with transfer cable

1 Modbus slave (like CPU 21x and CP 240 Modbus)

Modbus cable connection

Approach

- Assemble a Modbus system, existing of master system, slave system and Modbus cable.

- Engineer the master side! For this you open the sample project using your configuration tool. Adjust the transfer parameters accordingly.
  Under *Protocol* you select "Modbus Master RTU".
  Edit the OB1 and coordinate the module addresses with the addresses of the parameterization.
  Transfer your project into the CPU 21x.

- Engineer the slave side. For this you open the sample project using your configuration tool. Adjust the parameters of the CP 240 accordingly.
  Under *Protocol* you select "Modbus Slave RTU". Type a slave address in *Address*.
  For the communication under Modbus, the slave doesn't need a PLC application, because source and destination are transferred by the master.

Start project

To start the sample in your configuration tool, execute the following steps:

- Start the STEP®7 Manager from Siemens

- To extract "Modbus.zip", choose **File** > *dearchivate*

- Select the sample file "Modbus.zip" and extract it to destination "s7proj"

- Open the project

Project structure   The project has the following structure:
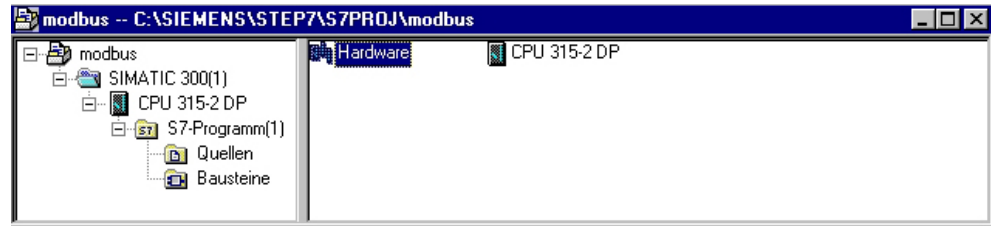
Master project engineering   The example already contains PLC application and the parameters for the Modbus master. You only have to adjust the Modbus parameters.

Parameterization   Start the hardware configurator from Siemens and choose the module 240-1CA10. Via double-click you reach the parameterization:

Dialog for address input
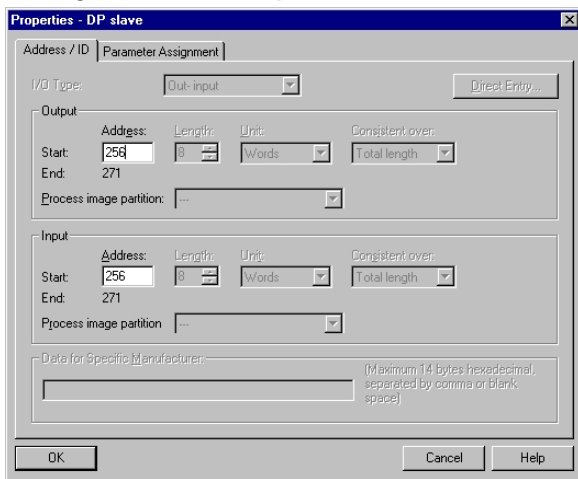
Here you may fix the start address for the 16 input and output Byte in the CPU.

Please regard, that you have to change addresses not only here but also in the according SEND and RECEIVE blocks.

Dialog for Modbus parameters
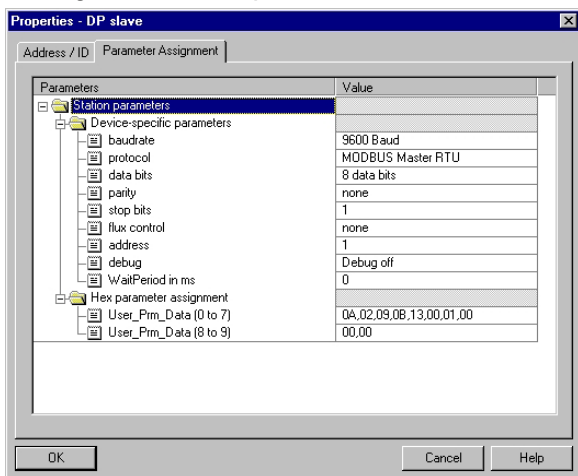
In this part of the parameterization you fix the Modbus parameters.

The following parameters have to be identical for all bus participants: baudrate, data bits, parity, stop bits and flow control.

Under *Protocol* choose "Modbus Master RTU".

Only the slave side needs an address. At the master parameterization the address is ignored.

PLC application   The wanted Modbus commands are defined via your PLC application. The recent example shows the deployment of SEND and RECEIVE in the OB1.

```
OB 1:


   CALL  "SEND_ACII_STX_3964"
     ADR          :=256                     //Start address of the module
     _DB          :=DB10                    //In this data block you create the telegram to send
     ABD          :=W#16#0                  //From this Byte offset the telegram starts in _DB
     ANZ          :=MW12                    //Telegram length (length to send) in Byte
     PAFE         :=MB14                    //Error byte
     FRG          :=M1.0                    //Send initialization (1=start, switches
                                            //to 0 at end of sending)
     GESE         :=MW16                    //internal value
     ANZ_INT      :=MW18                    //internal value
     ENDE_KOM     :=M2.0                    //internal value
     LETZTER_BLOCK:=M2.1                    //internal value
     SENDEN_LAEUFT:=M2.2                    //internal value
     FEHLER_KOM   :=M2.3                    //internal value

   CALL  "RECEIVE_ACII_STX_3964"
     ADR          :=256                     //Start address of the module
     _DB          :=DB11                    //In this data block the
                                            //received telegram is stored
     ABD          :=W#16#0                  //From this Byte offset the telegram starts in _DB
     ANZ          :=MW22                    //Telegram length (received length) in Byte
     EMFR         :=M1.1                    //Receive state (1=Telegram received completely)
     PAFE         :=MB34                    //Error byte
     GEEM         :=MW36                    //internal value
     ANZ_INT      :=MW38                    //internal value
     EMPF_LAEUFT  :=M3.0                    //internal value
     LETZTER_BLOCK:=M3.1                    //internal value
     FEHL_EMPF    :=M3.2                    //internal value

   A     M    1.1                           //As long as receive state=1, no new telegram is send
   R     M    1.1                           //thus the receive state has to be acknowledged with 0
```

Now adjust the addresses that the CP occupies in the CPU if needed in the parameterization and transfer the hardware configuration into your CPU 21x of the master system.

Slave project engineering

For the project engineering of the slave you only have to adjust the Modbus parameters. A PLC application is not required because the source and destination information is supplied in the master telegram.

Parameterization

To parameterize the slave module, open the sample project in your hardware configurator. Select the module 240-1CA10. Via double-click you reach the parameterization.

Dialog for address input
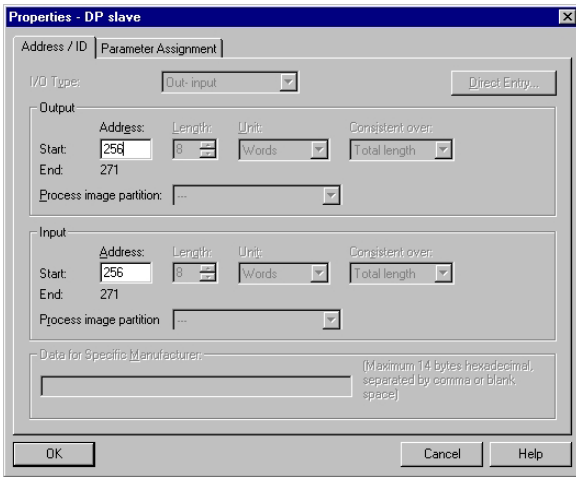
Here you may fix from which address on the 16Byte for in- and output data are stored in the CPU.

Dialog for Modbus parameters
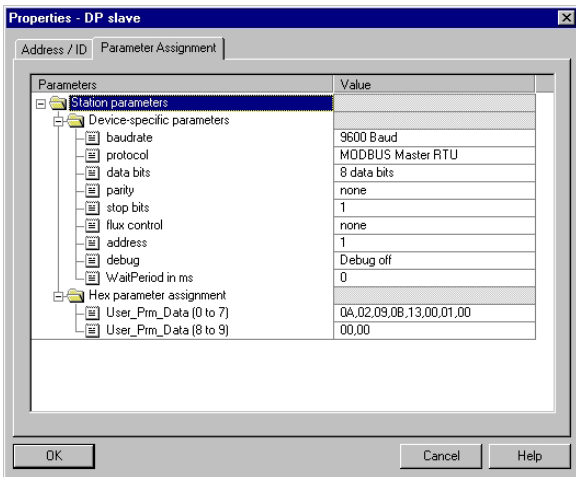
In this part of the parameterization you adjust the Modbus parameters.

The following parameters have to be identical for all bus participants: baudrate, data bits, parity, stop bits and flow control.

Under *Address* type a valid Modbus address for the slave.

Transfer the parameterization into your CPU of the slave system.

Send and receive telegrams

Open the variable table **Table1** of the sample project and go online.

	Address	Disp	Status value	Modify value
1	PEW 256	HEX	W#16#0000	
2	PEW 258	HEX	W#16#0000	
3	MW 12	DEZ	23	23
4	M 1.0	BOOL	false	true
5	MB 2	BIN	2#0000_0000	2#0000_0000
6	MW 22	DEZ	6	
7				
8	DB10.DBD 0	HEX	DW#16#05100000	DW#16#05100000
9	DB10.DBD 4	HEX	DW#16#000810A0	DW#16#000810A0
10	DB10.DBD 8	HEX	DW#16#A1A2A3A4	DW#16#A1A2A3A4
11	DB10.DBD 12	HEX	DW#16#A5A6A7A8	DW#16#A5A6A7A8
12	DB10.DBD 16	HEX	DW#16#A9AAABAC	DW#16#A9AAABAC
13	DB10.DBD 20	HEX	DW#16#ADAEAF00	DW#16#ADAEAF00
14				
15	DB11.DBD 0	HEX	DW#16#05100000	DW#16#00000000
16	DB11.DBD 4	HEX	DW#16#000810A0	DW#16#00000000
17	DB11.DBD 8	HEX	DW#16#00000000	DW#16#00000000
18	DB11.DBD 12	HEX	DW#16#00000000	DW#16#00000000
19	DB11.DBD 16	HEX	DW#16#00000000	DW#16#00000000
20				

tabelle1 -- modbus\SIMATIC 300(1)\CPU 315-2 DP\S7-Programm(1)   ONLINE

Send block DB10

DB10.DBD 0	DW#16#05100000	**Command telegram**
	with 05 →	slave address 05h
	10 →	function code 10h (write n words)
	0000 →	Offset 0000h
DB10.DBD 4	DW#16#000810A0	**Command telegram + 1 data byte**
	with 0008 →	Word count 0008h
	10 →	Byte count 10h
	A0 →	Start 16Byte data with A0h
DB10.DBD 8	DW#16#A1A2A3A4	**data byte 2 ... 5**
DB10.DBD 12	DW#16#A5A6A7A8	**data byte 6 ... 9**
DB10.DBD 16	DW#16#A9AAABAC	**data byte 10 ... 13**
DB10.DBD 20	DW#16#ADAEAF00	**data byte 14 ... 16 + 1Byte not used**
	with ADAEAF →	data byte 14 ... 16
	00 →	not used by the module

Receive block DB11

DB11.DBD 0	DW#16#05100000	**Respond telegram**
	with 05 →	slave address 05h
	10 →	function code 10h (no error)
	0000 →	Offset 0000h
DB11.DBD 4	DW#16#000810A0	**Respond telegram + 1 Data byte**
	with 0008 →	Word count 0008h
	10 →	Byte count 10h
	00 →	Start 16Byte data with 00h (irrelevant for write command)
DB11.DBD 8	DW#16#00000000	**data byte 2 ... 5**
DB11.DBD 12	DW#16#00000000	**data byte 6 ... 9**
DB11.DBD 16	DW#16#00000000	**data byte 10 ... 13**
DB11.DBD 20	DW#16#00000000	**data byte 14 ... 16 + 1 Byte not used**
	with ADAEAF →	data byte 14 ... 16
	00 →	not used by the module

Receive block with error respond

The communication under Modbus knows 2 kinds of error:

- Slave doesn't respond to a master command

  When the slave is not reacting within the defined timeout period, the master writes the following error message into the receive block:

  ERROR01 NO_DATA. In hex notation the following values are shown:

DB11.DBD 0	**DW#16#4552524F**	**Respond telegram**
	with 45 →	45h: E
	52 →	52h: R
	52 →	52h: R
	4F →	4Fh: O
DB11.DBD 4	**DW#16#52000120**	**Respond telegram**
	with 52 →	52h: R
	0001 →	0001h:1 (as word)
	20 →	52h: " "
DB11.DBD 8	**DW#16#4E4F2044**	**Respond telegram**
	with 4E →	45h: N
	4F →	52h: O
	20 →	52h: " "
	44 →	4Fh: D
DB11.DBD 12	**DW#16#41544100**	**Respond telegram**
	with 41 →	45h: A
	54 →	52h: T
	41 →	52h: A
	00 →	00h: empty

.
.
.

- Slave answers with an error message

  If the slave replies an error, the function code with 80h is send back marked with an OR.

DB11.DBD 0	**DW#16#05900000**	**Respond telegram**
	with 05 →	slave address 05h
	90 →	function code 90h (error message because 10h OR 80h = 90h)
	0000 →	rest data is irrelevant because an error was announced

Communication by means of standard handler blocks

Data communication is controlled by means of the handler blocks that are supplied with the hardware.

Note!

Modules with firmware revision level V1.06 or higher require that the handler block SYNCHRON is executed in the respective program. It is not possible to communicate with the CP 240 before the handler block has been executed since it enters a SYNCHRON identifier into the write and the read pointer, which must be acknowledged by the CPU.

Under Modbus the SYNCHRON block is not necessary.

The following blocks are supplied:

for CPU 24x

Name	FBs	Short description
SCP240	FB3	Send block for ASCII, STX/ETX, 3964(R) and Modbus
RCP240	FB4	Receive block for ASCII, STX/ETX, 3964(R) and Modbus
FETCH	FB20	Fetch block only for RK512
SEND	FB22	Send only for RK512
S/R_ALL	FB23	Send - Receive all only for RK512
SYNCHRON	FB25	Synchronization of the CP 240 from firmware rev. V1.06 (not req. For Modbus)

for CPU 21x

Name	FCs	Short description
SEND_ASCII_STX_3964	FC0	Send block for ASCII, STX/ETX, 3964(R) and Modbus
RECEIVE_ASCII_3964	FC1	Receive block for ASCII, STX/ETX, 3964(R) and Modbus
FETCH_RK512	FC2	Fetch block only for RK512
SEND_RK512	FC3	Send only for RK512
S/R_ALL_RK512	FC4	Send - Receive all only for RK512
SYNCHRON_RESET	FC9	Synchronization of the CP 240 from firmware rev. V1.06 (not req. for Modbus)

Standard handler blocks for the CPU 24x

ASCII, STX/ETX or 3964(R) communication

This type of communication procedure is always active, i.e. both partners must handle data transmission and reception in active mode. When data is transmitted neither the destination (transmission) nor the source (reception) are transferred.

Valid commands under ASCII, STX/ETX or 3964(R) are:

SCP240	FB3	(data transmission)
RCP240	FB4	(data reception)

RK512 communication

The linkage procedure RK512 employs a master slave scheme. The master can request data from the slave by means of a FETCH and it can transfer data to the partner by means of a SEND. In this case the message header contains the destination or the source.

To enable the slave to react to jobs issued by the master, a S/R_ALL (Send/Receive_All) must be executed cyclically within the slave.

Valid RK512 commands are:

FETCH	FB20	(request data)
SEND	FB22	(transmit data)
S/R_ALL	FB23	(slave reaction to requests)

Modbus communication

Depending on the chosen operating mode, the Modbus CP may be deployed as master or as slave.

In slave mode no handler blocks are required. In master mode the communication with the slave takes place via SEND and RECEIVE commands. In both cases the CP occupies 16Byte in the CPU for input and output.

Valid commands under Modbus are:

SCP240	FB3	(send data)
RCP240	FB4	(receive data)

SCP240
SEND (FB3)

This FB is used to transfer data to a peripheral unit in ASCII, STX/ETX, 3964(R) and Modbus.

```
                              FB 3
                   ┌─────────────────────────┐
                   │         SCP240          │
                   │                         │
            ───────│  ADR                    │
            ───────│  DB                     │
            ───────│  ABD                    │
            ───────│  ANZ                    │
            ───────│  GESE                   │
            ───────│  STEU                   │
            ───────│  FRG              PAFE  │───────
                   └─────────────────────────┘
```

ADR
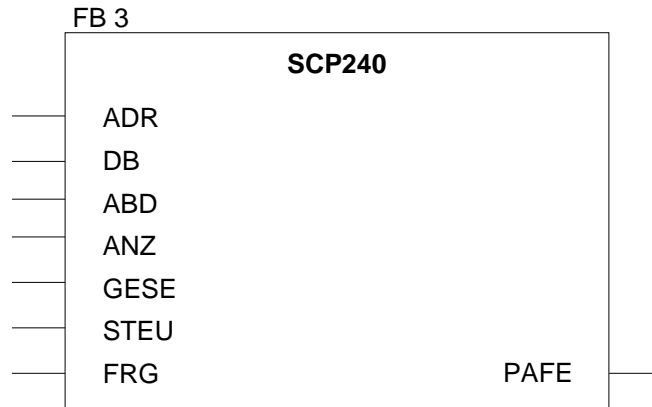
Peripheral address for access to the CP 240 module. You specify the peripheral address for the CP 240 system when you configure the DB1. This address must be located in the range from PY000 ... PY240.

For details please refer to the VIPA CPU 24x Manual HB99.

DB

The number of the data block that contains the transmit data.

ABD

Word variable containing the number of the data word where the transmit data starts.

ANZ

Word variable containing the number of bytes that will be transmitted.

GESE

This is an internal variable that controls the transmission of data. Here you specify a flag word that can be used by the handler block to store internal data.

STEU   Used by the handler block to store internal control bits. You specify a flag byte where the handler block can store its control bits.

FRG   When you set this flag to "1", the data quantity specified in ANZ is transmitted once. Upon completion of the transmission, the bit is set to "0". The block is not executed if this bit contains a "0" when FB 3 is accessed!

PAFE   The bits in this flag byte are set to ”0” when a function completes without error. If an error occurs, an error code is entered here. This error code is cleared to ”0” automatically when the error cause is removed.

                  The following errors may occur:
                  1 = Data block does not exist
                  2 = Data block too short
                  3 = Data block number not within the valid range

**RCP240
RECEIVE (FB4)**

This FB is used to receive data from a peripheral unit in ASCII, STX/ETX, 3964(R) and Modbus mode.

FB 4

```
                    RCP240
        ADR
        DB
        ABD
        ANZ
        GEEM              EMFR
        STEU              PAFE
```
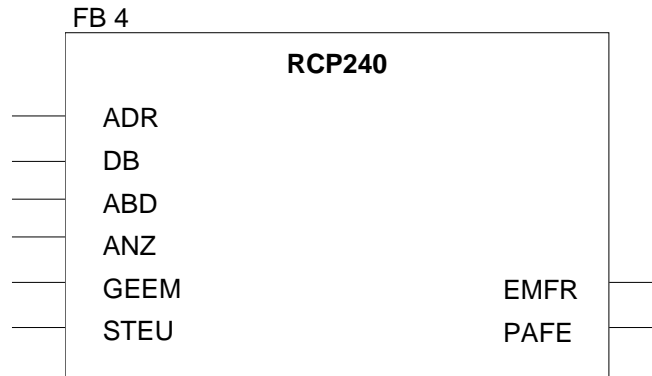
ADR   The peripheral address to access the CP 240 module. You specify the peripheral address of the CP 240 system when you configure DB1. This address is located in the range from PY000 ... PY240.

For details please refer to the VIPA CPU 24x Manual HB99.

DB   The number of the data module where the receive data is stored.

ABD   Word variable containing the number of the data word from where the receive data should be saved.

ANZ   Word variable containing the number of bytes that will be transferred.

GEEM   This is an internal variable that controls the reception of data. Here you specify a flag word that can be used by the handler block to store internal data.

STEU   Used by the handler block to store internal control bits. You specify a flag byte where the handler block can store its control bits.

EMFR   The flag bit EMFR (receive complete) is set when a message has been received completely and when it has been saved in the RECEIVE-DB. This bit is not reset automatically.

PAFE   All the bits in this flag byte are set to "0" when a function completes without error. If an error occurs, an error code is entered here. This error code is cleared to "0" automatically when the error cause is removed.

The following errors can occur:
1 = Data block does not exist
2 = Data block too short
3 = Data block number not within the valid range

**FETCH
request data
via RK512 (FB20)**

This FB is used by a peripheral unit to request data using RK512. This FB is only valid in conjunction with RK512.

```
                        FB 20
                  ┌──────────────────────────┐
                  │          FETCH           │
              ────│ ADR                      │
              ────│ QDB                      │
              ────│ QBDW                     │
              ────│ LANG                     │
              ────│ ZDB                      │
              ────│ ZBDW                     │
              ────│ KOOR                     │
              ────│ STEU                     │
              ────│ ANZ                      │
              ────│ GESE              ANZW   │────
              ────│ EMFR              PAFE   │────
                  └──────────────────────────┘
```

Note!

To enable the slave to react to requests issued by the master, a S/R_ALL (Send/Receive_All) must be executed cyclically within the slave.

ADR

Peripheral address for accessing the CP 240 module. You specify the peripheral address for the CP 240 system when you configure the DB1. This address is located in the range from PY000 ... PY240.

For details please refer to the VIPA CPU 24x Manual HB99.

QDB

The number of the data block that contains the transmit data.

QBDW

Word variable containing the number of the data word where the transmit data starts.

LANG

Word variable containing the number of bytes that will be transferred.

ZDB   The number of the data block where the transmitted data will be stored.

ZBDW   Word variable containing the number of the data word, from where on the received data should be saved.

KOOR   This provides the configuration for the use of a coordination flag. The High Byte contains the byte number, the Low Byte the bit number of the coordination flag. If the coordination flag should not be used, both the High Byte and the Low Byte must be set to "255".

The coordination flag controls the access to the source area:

This flag protects your transmitted data in the partner PLC from being overwritten. When the flag has been reset, the data may be overwritten again.

ANZW   Indicator word. The indicator word occupies a flag word. Status bits are stored in the right-hand byte. When the right-hand byte contains the flag "ready with error", the left-hand byte contains an error number.

STEU   Used by the handler block to store internal control bits. You specify a flag byte where the handler block can store its control bits.

ANZ   Word variable containing the number of bytes that will be transferred.

GESE   This is an internal variable that controls the transmission of data. Here you must specify a flag word that can be used by the handler block to store internal data.

PAFE   All the bits in this flag byte are set to "0" when a function completes without errors. If an error occurs, an error code is entered here. This error code is cleared to "0" automatically when the error cause is removed.

The following errors can occur:

1 = Data block does not exist

2 = Data block too short

3 = Data block number not within the valid range

SEND
send data
via RK512 (FB22)

This FB is used for data output to a peripheral device by means of RK512. This FB is only valid under RK512.

```
              FB 22
          ┌─────────────────────┐
          │        SEND         │
          │                     │
    ───────  ADR                │
    ───────  QDB                │
    ───────  QBDW               │
    ───────  LANG               │
    ───────  ZDB                │
    ───────  ZBDW               │
    ───────  KOOR               │
    ───────  ANZ                │
    ───────  GESE          ANZW  ───────
    ───────  STEU          PAFE  ───────
          └─────────────────────┘
```
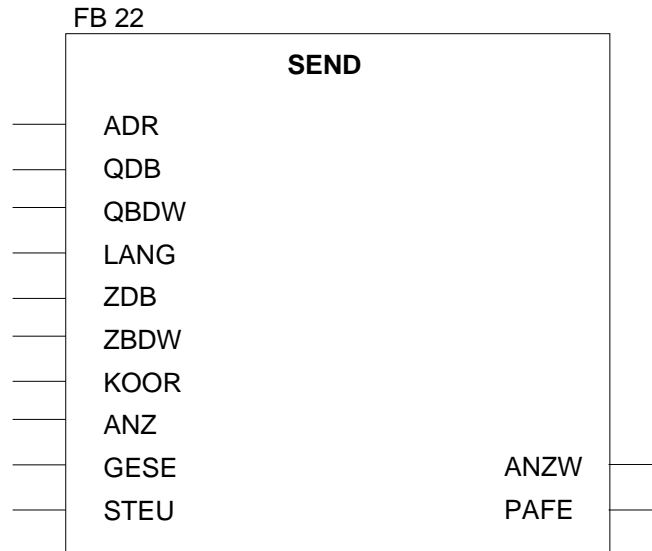
Note!

In order to enable the slave to react on requests from the master, the slave must execute a S/R_ALL (Send/Receive_All) in every cycle.

ADR

Peripheral address for accessing the CP 240 module. You specify the peripheral address for the CP 240 system when you configure the DB1. This address is located in the range from PY000 ... PY240.

For details please refer to the VIPA CPU 24x Manual HB99.

QDB

The number of the data block that contains the transmit data.

QBDW

Word variable containing the number of the data word where the transmit data starts.

LANG

Word variable containing the number of bytes that will be transferred.

ZDB

The number of the data block where the transmitted data will be stored.

ZBDW   Word variable containing the number of the data word from where on the received data should be saved.

KOOR   This provides the configuration of a coordination flag. The High Byte contains the byte number, the Low Byte the bit number of the coordination flag. If the coordination flag should not be used, both, the High Byte and the Low Byte must be set to "255".

The coordination flag controls access to the source area:

When the flag is set, your transmit data in the partner PLC is protected from being overwritten. When the flag is reset, the data may again be overwritten.

STEU   Used by the handler block to store internal control bits. You specify a flag byte where the handler block can store its control bits.

PAFE   All the bits in this flag byte are set to "0" when a function completes without errors. If an error occurs, an error code is entered here. This error code is cleared to "0" automatically when the error cause is removed.

The following errors can occur:

1 = Data block does not exist

2 = Data block too short

3 = Data block number not within the valid range

S/R_ALL	When the system containing the CP 240 is used as slave, this FB must be

**S/R_ALL
reaction to master
request
via RK512 (FB23)**

When the system containing the CP 240 is used as slave, this FB must be executed by the slave CPU cyclically. The CP 240 can only react to the requests issued by the master if this is true. When a FETCH is received, the data is transferred to the master. Data that was received from the master by means of a SEND is accepted and stored, followed by an acknowledgment.

This FB is only valid for the RK512.
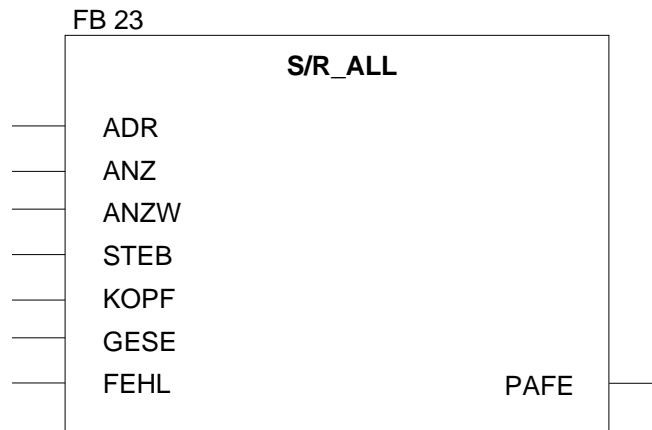
```
                        FB 23
              ┌─────────────────────────┐
              │         S/R_ALL         │
              │                         │
          ────┤ ADR                     │
          ────┤ ANZ                     │
          ────┤ ANZW                    │
          ────┤ STEB                    │
          ────┤ KOPF                    │
          ────┤ GESE                    │
          ────┤ FEHL           PAFE     ├────
              │                         │
              └─────────────────────────┘
```

ADR

Peripheral address for accessing the CP 240 module. You specify the peripheral address for the CP 240 system when you configure the DB1. This address is located in the range from PY000 ... PY240.

For details please refer to the VIPA CPU 24x Manual HB99.

ANZ

Word variable containing the number of bytes that will be transferred.

ANZW

Indicator word. The indicator word occupies a flag word. Status bits are stored in the right-hand byte. When the right-hand byte contains the flag "ready with error", the left-hand byte contains an error number.

STEB

Internal control byte.

KOPF

The start of the 10Byte flag area where the RK512 message header is stored.

GESE   This is an internal variable that controls the transmission of data. Here you specify a flag word that can be used by the handler block to store internal data.

FEHL   Internal control byte.

PAFE   All the bits in this flag byte are set to "0" when a function completes without errors. If an error occurs, the respective error code is stored in this location. This error code is cleared to "0" automatically when the error cause is removed.

The following errors can occur:
1 = Data block does not exist
2 = Data block too short
3 = Data block number not within the valid range

SYNCHRON
Synchronization
(FB25)

This block must be executed in the cyclic portion of the program. This function acknowledges the start-up flag of the CP 240 and is in this way synchronizing CPU and CP. Furthermore it is possible to reset the CP when communication should be interrupted, to ensure that the start-up procedure is synchronized properly.

The SYNCHRON block is not required for Modbus.
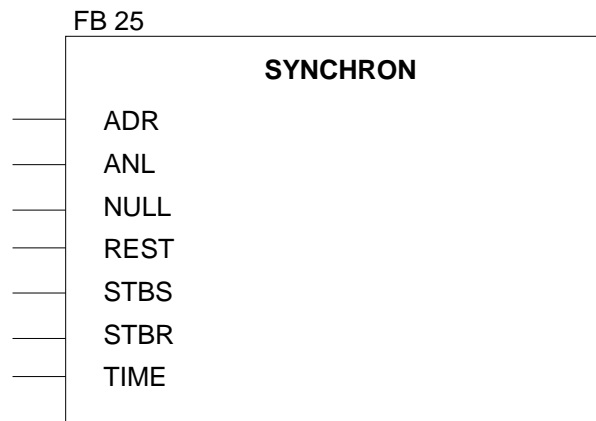
```
FB 25
        ┌─────────────────────┐
        │      SYNCHRON       │
    ────│  ADR                │
    ────│  ANL                │
    ────│  NULL               │
    ────│  REST               │
    ────│  STBS               │
    ────│  STBR               │
    ────│  TIME               │
        └─────────────────────┘
```

ADR

Peripheral address for accessing the CP 240 module. You specify the peripheral address for the CP 240 system when you configure the DB1. This address is located in the range from PY000 ... PY240.

For details please refer to the VIPA CPU 24x Manual HB99.

ANL

The start-up was completed.

This bit informs the HTB that the CPU has executed a STOP/START or POWER-OFF/POWER-ON and that the synchronization is required.

The bit is cleared by the HTB when the synchronization procedure has completed.

NULL

A bit that is used internally for data exchanges with the CP.

REST

Reset of the CP 240.

The CP 240 is reset when the user sets this bit in the PLC program. When this bit is set, the handler block enters the reset flag in the CP and waits until this is acknowledged. The process continues as with the start-up.

STBS   Control bit SEND

Here you specify the flag byte where the control bits for the SEND-FB are saved.

STBR   Control bit RECEIVE

Here you specify the flag byte where the control bits for the RECEIVE-FB are saved.

TIME   Timer for the delay time until the reset has been acknowledged.

**Sample FB25
SYNCHRON:**

In OB21 and OB22, you have to set the bit that was specified in descriptor ANL to "1". When the block detects that a start-up has occurred, it will acknowledge the SYNCHRON flag and clear the control bits of the handler blocks for SEND and RECEIVE resp. FETCH and WRITE. When the synchronization has completed, the block will reset the ANL bit to "0".

FB25 may also be used to reset the CP 240. For this purpose the bit specified for the label REST has to be set. The result is that the FB issues the reset flag to the CP 240 and waits until this is acknowledged.

**Parameter
description FB25**

```
BAUSTEIN#FB25
BSTNAME #SYNCRON
BIB     #102
BEZ     #ADR   D:KF     MODULE ADDRESS
BEZ     #ANL   E:BI     START-UP WAS EXECUTED
BEZ     #NULL  E:BI     WRITE 0 INTO SZ/LZ
BEZ     #REST  E:BI     ISSUE RESET
BEZ     #STBS  E:BY     CONTROL BITS FOR SEND
BEZ     #STBR  E:BY     CONTROL BITS FOR RECEIVE
BEZ     #TIME  T        DELAY TIME FOR START-UP ACKN.
```

**Programming
example**

```
        BAUSTEIN#OB21
        BIB     #6100
00000      :
00002      :AN  M 101.0     Start-up bit is 0
00004      :S   M 101.0     set it to 1
00006      :A   M 101.1     Send zero is 1
00008      :R   M 101.1     and reset it
0000A      :
0000C      :
0000E      :BE
```

```
        BAUSTEIN#OB22
        BIB     #6100
00000      :
00002      :AN  M 101.0     Start-up bit is 0
00004      :S   M 101.0     set it to 1
00006      :A   M 101.1     Send zero is 1
00008      :R   M 101.1     and reset it
0000A      :
0000C      :
0000E      :BE
```

```
            BAUSTEIN#FB223 (cyclic processing FB)
            BSTNAME #P3964
            BIB     #17100
0000A       :
0000C       :JU FB 25
            NAME #SYNCRON
            ADR  =KF +128          Module address
            ANL  =M 101.0          Start-up was executed
            NULL =M 101.1          Send zero to CP (used
                                   internally)
            REST =M 101.2          Reset the CP
            STBS =MB 107           Control bits for Send-FB
            STBR =MB 109           Control bits for Receive-FB
            TIME =T 19             Wait time acknowledgment
0001E       :
00020       :
00022       :A   M 101.0          While Synchron was not
                                   acknowledged
00024       :BEC                  End of program
00026       :                     After Synchron it is possible
                                   to communicate
00028       :L   KB 0
0002A       :T   MW 102
0002C       :
0002E       :JU FB 3
            NAME #SCP240
            ADR  =KF +128
            DB   =DB 10
            ABD  =MW 102
            ANZ  =MW 104
            GESE =MW 106
            STEU =MB 107
            FRG  =M 101.7
            PAFE =MB 108
00042       :
00044       :
00046       :JU FB 4
            NAME #RCP240
            ADR  =KF +128
            DB   =DB 11
            ABD  =MW 102
            ANZ  =MW 114
            GEEM =MW 116
            STEU =MB 109
            EMFR =M 101.6
            PAFE =MB 110
0005A       :
0005C       :BE
```

Standard handler blocks for the CPU 21x

ASCII, STX/ETX or 3964(R) communication
This type of communication procedure is always active, i.e. both partners must handle data transmission and reception in active mode. When data is transmitted neither the destination (transmission) nor the source (reception) are transferred.

Valid commands under ASCII, STX/ETX or 3964(R) are:

SEND_ACII_STX_3964	FC0	(data transmission)
RECEIVE_ACII_STX_3964	FC1	(data reception)

RK512 communication
The linkage procedure RK512 employs a master-slave scheme. The master can request data from the slave by means of a FETCH and it can transfer data to the partner by means of a SEND. In this case the message header contains the destination or the source.

To enable the slave to react to jobs issued by the master, a S/R_ALL (Send/Receive_All) must be executed cyclically within the slave.

Valid RK512 commands are:

FETCH_RK512	FC2	(request data)
SEND_RK512	FC3	(transmit data)
S/R_ALL_RK512	FC4	(slave reaction to requests)

Modbus communication
Depending on the chosen operating mode, the Modbus CP may be deployed as master or as slave.

In slave mode no handler blocks are required. In master mode the communication with the slave takes place via SEND and RECEIVE commands. In both cases the CP occupies 16Byte in the CPU for input and output.

Valid commands under Modbus are:

SEND_ASCII_STX_3964	FC0	(send data)
RECEIVE_ASCII_STX_3964	FC1	(receive data)

SEND_ASCII_ STX_ 3964 (FC 0)	This FC is used to transfer data to a peripheral unit in ASCII, STX/ETX, 3964(R) and Modbus.
	The labels _DB, ADB and ANZ define the transmit slot.
	The bit FRG initiates the transmission of the data. When all the data has been transmitted, the FRG bit is reset by the HTB.

FC 0

```
          ┌─────────────────────────────┐
          │    SEND_ACII_STX_3964        │
        ──┤ ADR                          │
        ──┤ _DB                          │
        ──┤ ABD                          │
        ──┤ ANZ                          │
        ──┤ FRG                          │
        ──┤ GESE                         │
        ──┤ ANZ_INT                      │
        ──┤ ENDE_KOMM                    │
        ──┤ LETZTER_BLOCK                │
        ──┤ SENDEN_LAEUFT                │
        ──┤ FEHLER_KOM            PAFE  ├──
          └─────────────────────────────┘
```
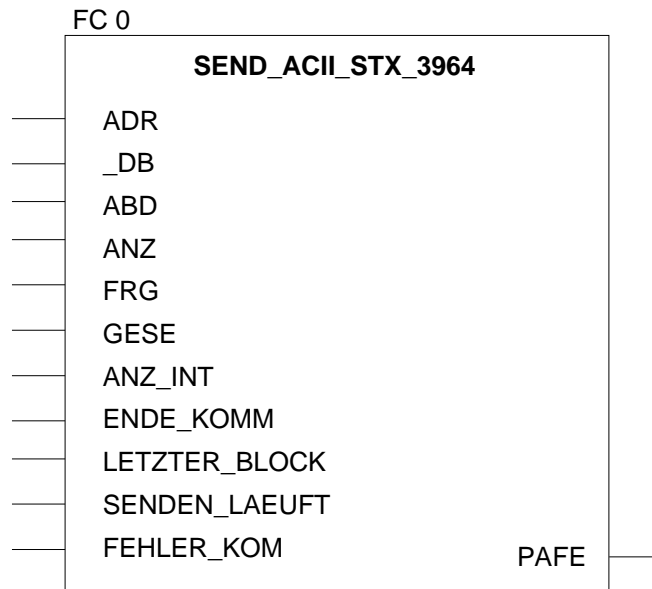
ADR	Int: Peripheral address for accessing the CP 240 module. In your configuration tool you specify the peripheral address that will be used by the system to access the CP 240.
	The address range is PY000 ... PY240.
_DB	Block_DB: the number of the data block that contains the transmit data.
ABD	Word: word variable that contains the number of the data word that contains the characters that will be transmitted.
ANZ	Word: word variable that contains the number of bytes they have been transmitted.

FRG transmit enable   Bool: when this flag bit is set to "1", the data quantity specified in ANZ is transmitted once. After transmission the bit is reset to "0". If this bit is already at "0" when the FC is accessed, the function is skipped immediately!

GESE   Word: quantity of data words that have already been transmitted.

ANZ_INT   Word: specifies the number of bytes to be transmitted.

ENDE_KOM   Bool: communication has been completed.

LETZTER_BLOCK   Bool: last block is transmitted.

SENDEN_LAEUFT   Bool: the data block is transmitted.

FEHLER_KOM   Bool: communication error.

PAFE   Byte: all the bits in this flag byte are set to "0" when a function completes without errors. If an error occurs, the respective error code is stored in this location. This error code is cleared to "0" automatically when the error cause is removed.

                   The following errors can occur:
                   1 = Data block does not exist
                   2 = Data block too short
                   3 = Data block number not within the valid range

RECEIVE_ASCII_ STX_3964 (FC 1)	This FC is provided for the purpose of receiving data from a peripheral device in ASCII, STX/ETX, 3964(R) and Modbus mode.

The labels _DB and ADB define the start of the receive slot.

When output EMFR is set, a new message has been retrieved completely. The length of the message is stored in ANZ. When the message has been analyzed, the user resets this bit. The PLC will not accept any new messages while the bit is "1". Depending on the number of buffers any received messages are saved by the module.
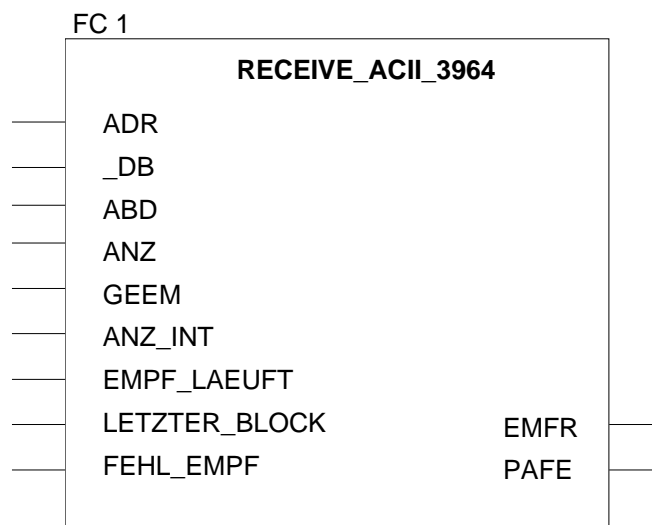
```
                         FC 1
              ┌─────────────────────────────┐
              │      RECEIVE_ACII_3964       │
         ─────┤ ADR                          │
         ─────┤ _DB                          │
         ─────┤ ABD                          │
         ─────┤ ANZ                          │
         ─────┤ GEEM                         │
         ─────┤ ANZ_INT                      │
         ─────┤ EMPF_LAEUFT                  │
         ─────┤ LETZTER_BLOCK       EMFR ├────
         ─────┤ FEHL_EMPF           PAFE ├────
              └─────────────────────────────┘
```

ADR   Int: peripheral address for accessing the CP 240 module. You specify the peripheral address that will be used by the system to access the CP 240 by means of your configuration tool.
The range of the address is PY000 ... PY240.

_DB   Block_DB: the number of the data module where the received data is stored.

ABD   Word: first data word of the receive slot.

ANZ   Word: word variable that contains the number of bytes that were received.

GEEM   Word: the quantity of data that has already been received.

ANZ_INT   Word: length of received data in bytes.

EMPF_LAEUFT   Bool: reception is active.

LETZTER_BLOCK   Bool: the last block has been transmitted.

FEHL_EMPF   Bool: communication error

PAFE   Byte: all the bits in this flag byte are set to "0" when a function completes without errors. If an error occurs, the respective error code is stored in this location. This error code is cleared to "0" automatically when the error cause is removed.

         The following errors can occur:
         1 = Data block does not exist
         2 = Data block too short
         3 = Data block number not within the valid range

**FETCH_RK512
(FC 2)**

Request data by means of RK512

This FC is used to request data from a peripheral device using RK512. This FC can only be used in conjunction with RK512.

The purpose of the FETCH is to request the data from a communication partner. A message containing the source data is transmitted to the partner. The partner then compiles the data and returns them. Now the received data is saved to the specified destination. When the FC is issued, the labels QDB, QBDW, LANG define the source area and the labels ZDB and ZBDW the destination area.

When the FC is called, the control bits are used to check whether a job is present and active or not. When all the control bits are "0", a new FETCH command is initiated. For this purpose the message header is transferred to the CP and a delay is executed to receive the expected acknowledgment along with application data. As long as the partner has not sent the acknowledgment message, the indicator word contains "job active". Only when the CP has signaled the acknowledgment message to the PLC and when the application data has been transferred, the indicator word is set to "job completed" and the communication link to the CP is terminated. In case of communication errors, the CP returns an error number to the PLC. The respective error number is entered into the indicator word and the bit "job completed with errors" is set.

The cyclic portion of the program must process the function until "job completed - with/without - errors" is set in the indicator word.

```
              FC 2
        ┌─────────────────────────────┐
        │       FETCH_RK512           │
        │                             │
    ────┤ ADR                         │
    ────┤ QDB                         │
    ────┤ QBDW                        │
    ────┤ LANG                        │
    ────┤ ZDB                         │
    ────┤ ZBDW                        │
    ────┤ KOOR                        │
    ────┤ ANZ                         │
    ────┤ GESE                        │
    ────┤ KOPF_GESE                   │
    ────┤ WART_DATEN                  │
    ────┤ EMPF_LAEUFT                 │
    ────┤ LETZTER_BLOCK         ANZW  ├────
    ────┤ FEHL_KOM              PAFE  ├────
        └─────────────────────────────┘
```

> **Note!**
> In order to enable the slave to react to requests from the master, the slave must execute a S/R_ALL (Send/Receive_All) cyclically.

ADR   Int: Peripheral address for accessing the CP 240 module. You specify the peripheral address that will be used by the system to access to the CP 240 by means of your configuration tool.

The range of the address is PY000 ... PY240.

QDB   Int: the number of the data block that contains the transmit data.

QBDW   Int: first data word in the source data block.

LANG   Int: length of data in words.

ZDB   Block_DB: destination data block

The number of the data block where the transmitted data is stored.

ZBDW   Int: first data word in the destination data block.

KOOR   Word: coordination byte allocation:

This provides the configuration of the coordination flag. The High Byte must contain the byte number and the Low Byte the bit number of the coordination flag. If the coordination flag should not be used, High Byte and Low Byte must be set to "255".

The coordination flag controls access to the source area:

When the flag is set, your transmit data in the partner PLC is protected from being overwritten. When the flag is reset, the data may be overwritten again.

ANZ   Word: number of bytes received (internal).

GESE   Word: number of bytes received (internal).

KOPF_GESE   Bool: header was transmitted to partner.

WART_DATEN   Bool: wait for data.

EMPF_LAEUFT   Bool: reception active.

LETZTER_BLOCK   Bool: last block was transmitted.

FEHL_KOM   Bool: a communication error has occurred.

ANZW   Word: Indicator word. The indicator word occupies a flag word. Status bits are stored in the right-hand byte. When the right-hand byte contains the flag "ready with error", the left-hand byte contains an error number.

PAFE   Byte: all the bits in this flag byte are set to "0" when a function completes without errors. If an error occurs, the respective error code is stored in this location. This error code is cleared to "0" automatically when the error cause is removed.

The following errors can occur:
1 = Data block does not exist
2 = Data block too short
3 = Data block number not within the valid range

SEND_RK512
Transmit data
via RK512 (FC 3)

The purpose of this FC is to output data to a peripheral device via RK512. This FB is only valid with RK512.

The purpose of the SEND_RK512 is to transmit data from a defined source area of the PLC to a partner and to instruct it where to deposit the received data. The source area is defined by means of the labels QDB, QBDW and LANG. The destination area of the partner is defined by means of the labels ZDB and ZBDW.

When the FC is accessed, the control bits are used to check whether a job is present and active or not. When all the control bits are "0", a new send job is initiated. For this purpose the message consisting of the header and the application data is transferred to the CP and the respective acknowledgment is expected.

While the partner has not sent the acknowledgment message, the indicator word contains "job active". Only when the CP has signaled the acknowledgment message to the PLC, the indicator word is changed to "job completed" and the communication link to the CP will be terminated. In case of communication errors, the CP returns an error number to the PLC. The respective error number is entered into the indicator word and the bit "job completed with errors" is set.

The communication session with the CP is terminated. The cyclic portion of the program must process the function as long as "job completed - with/without - errors" is set in the indicator word.

FC3

```
              ┌─────────────────────────────────┐
              │           SEND_RK512            │
              │                                 │
         ─────┤ ADR                             │
              │                                 │
         ─────┤ QDB                             │
              │                                 │
         ─────┤ QBDW                            │
              │                                 │
         ─────┤ LANG                            │
              │                                 │
         ─────┤ ZDB                             │
              │                                 │
         ─────┤ ZBDW                            │
              │                                 │
         ─────┤ KOOR                            │
              │                                 │
         ─────┤ ANZ                             │
              │                                 │
         ─────┤ GESE                            │
              │                                 │
         ─────┤ KOPF_GESENDET                   │
              │                                 │
         ─────┤ ERSTER_BLOCK                    │
              │                                 │
         ─────┤ SENDE_LAEUFT                    │
              │                                 │
         ─────┤ SENDEN_FERTIG                   │
              │                                 │
         ─────┤ LETZTER_BLOCK          ANZW     ├─────
              │                                 │
         ─────┤ FEHLER                 PAFE     ├─────
              └─────────────────────────────────┘
```

Note!

In order to enable the slave to react to requests from the master, the slave must execute a S/R_ALL (Send/Receive_All) cyclically.

ADR

Int: peripheral address for accessing the CP 240 module. You specify the peripheral address that will be used by the system to access to the CP 240 by means of your configuration tool.

The range of the address is PY000 ... PY240.

QDB

Block_DB: the number of the data block that contains the transmit data.

QBDW

Int: first data word of the send slot.

LANG

Int: quantity of send data.

ZDB

Int: the number of the data block where the transmitted data is stored.

ZBDW

Int: first data word of the receive slot.

KOOR

Word: This provides the configuration of the coordination flag. The High Byte contains the byte number and the Low Byte the bit number of the coordination flag. If the coordination flag should not be used, both the High Byte and the Low Byte must be set to "255".

The coordination flag controls access to the source area:

When the flag is set, your transmit data in the partner PLC is protected from being overwritten. When the flag is reset, the data may be overwritten again.

ANZ

Word: number of bytes transmitted (internal).

GESE

Word: number of bytes transmitted (internal).

KOPF_GESENDET

Bool: header was transmitted to partner.

ERSTER_BLOCK   Bool: the first block of data was transmitted.

SENDE_LAEUFT   Bool: transmission is active.

SENDEN_FERTIG   Bool: data transmission completed.

LETZTER_BLOCK   Bool: last block was transmitted.

FEHLER   a communication error has occurred.

ANZW   Word: indicator word - the indicator word occupies a flag word. The right-hand byte is used to store status bits. The left-hand byte contains the error number if the right-hand byte contains the identifier "completed with error".

PAFE   Byte: All the bits in this flag byte are set to "0", when a function completes without errors. If an error occurs, the respective error code is stored in this location. This error code is cleared to "0" automatically when the error cause is removed.

                        The following errors can occur:
                        1 = Data block does not exist
                        2 = Data block too short
                        3 = Data block number not within the valid range

S/R_ALL_RK512 (FC 4)

The purpose of this block is to process FETCH and SEND jobs from the partner.

When the system is used with the CP 240 as slave, the slave CPU has to access this FC cyclically. This is the only manner in which the CP 240 is able to react to the jobs issued by the master. After a FETCH, the data is collected and transmitted to the master. The data received from the master by a SEND is retrieved, saved and acknowledged.

This FB is only valid in conjunction with RK512.
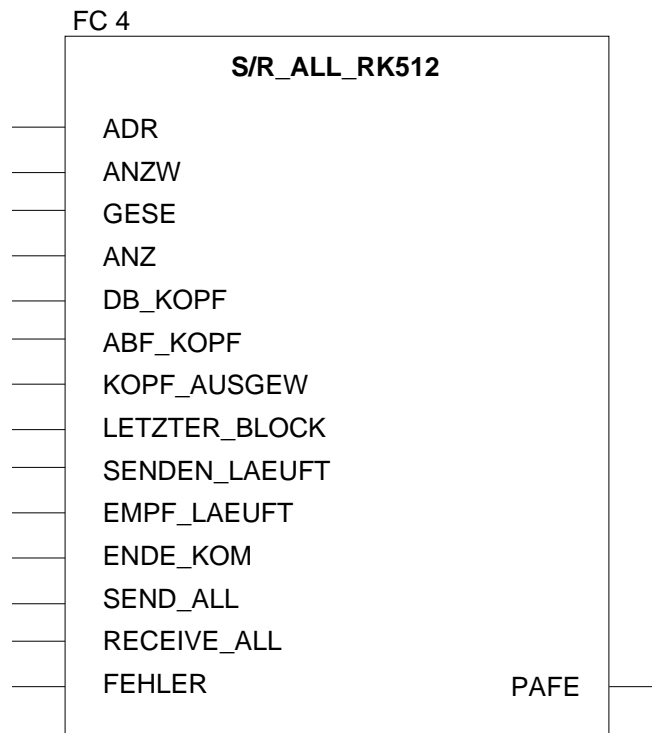
```
        FC 4
   ┌─────────────────────────────┐
   │        S/R_ALL_RK512        │
   │                             │
───┤ ADR                         │
───┤ ANZW                        │
───┤ GESE                        │
───┤ ANZ                         │
───┤ DB_KOPF                     │
───┤ ABF_KOPF                    │
───┤ KOPF_AUSGEW                 │
───┤ LETZTER_BLOCK               │
───┤ SENDEN_LAEUFT               │
───┤ EMPF_LAEUFT                 │
───┤ ENDE_KOM                    │
───┤ SEND_ALL                    │
───┤ RECEIVE_ALL                 │
───┤ FEHLER              PAFE    ├───
   └─────────────────────────────┘
```

ADR

Int: peripheral address for accessing the CP 240 module. You specify the peripheral address that will be used by the system to access to the CP 240 by means of your configuration tool.

The range of the address is PY000 ... PY240.

ANZW

Word: indicator word. The indicator word occupies a flag word. Status bits are stored in the right-hand byte. When the right-hand byte contains the flag "ready with error", the left-hand byte contains an error number.

GESE

Word: number of bytes received (internal).

ANZ   Word: number of bytes received (internal).

ABF_KOPF   Word: first data word in the receive/transmit slot.

KOPF_AUSGEW   Bool: the telegram header has been analyzed.

LETZTER_BLOCK   Bool: last block was transmitted.

SENDEN_LAEUFT   Bool: transmission is active.

EMPF_LAEUFT   Bool: data reception is active.

ENDE_KOM   Bool: the message was transmitted/received completely.

SEND_ALL   Bool: the block operates in SEND_ALL mode.

RECEIV_ALL   Bool: the block operates in RECEIVE_ALL mode.

FEHLER   Bool: a communication error has occurred.

PAFE   Byte: all the bits in this flag byte are set to "0" when a function completes without errors. If an error occurs, the respective error code is stored in this location. This error code is cleared to "0" automatically when the error cause is removed.

                           The following errors can occur:
                           1 = Data block does not exist
                           2 = Data block too short
                           3 = Data block number not within the valid range

**SYNCHRON_
RESET
synchronization
and reset (FC 9)**

This block must be accessed from the cyclic portion of the program. This function acknowledges the start-up flag from the CP 240 to establish synchronism between the CPU and the CP. Furthermore it is possible to reset the CP when communication should be interrupted to ensure that the start-up procedure is synchronized properly.

Start-up

After a reboot or a re-start, the bit defined in label ANL has to be set to "1" for a single cycle to inhibit processing of the SEND-/RECEIVE blocks as long as this bit is not acknowledged by the function.

Reset

Setting the RESET bit, a flag is transferred to the CP that causes this to clear all buffers and pointers. When the CP has completed this action, it sets the SYNCHRON flag. When the CPU has acknowledged this flag, the system can continue communicating.
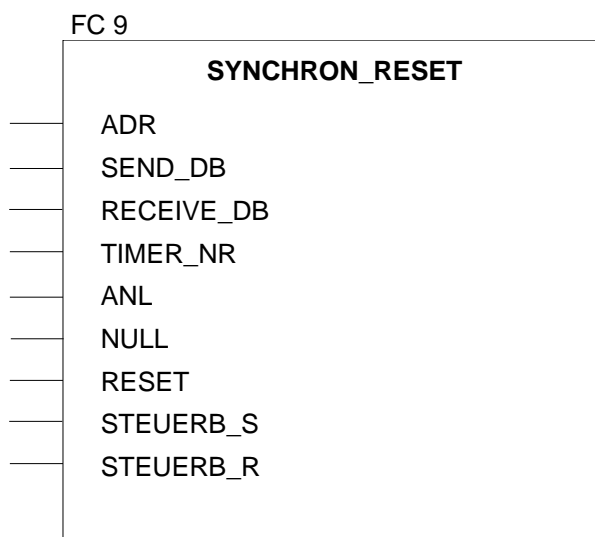
FC 9

```
┌─────────────────────────────────┐
│         SYNCHRON_RESET          │
│                                 │
│   ──── ADR                      │
│   ──── SEND_DB                  │
│   ──── RECEIVE_DB               │
│   ──── TIMER_NR                 │
│   ──── ANL                      │
│   ──── NULL                     │
│   ──── RESET                    │
│   ──── STEUERB_S                │
│   ──── STEUERB_R                │
│                                 │
└─────────────────────────────────┘
```

ADR

Int: peripheral address for accessing the CP 240 module. You specify the peripheral address that will be used by the system to access to the CP 240 by means of your configuration tool.
The range of the address is PY000 ... PY240.

SEND_DB

Block_DB: data block for the data handling over to the CP.

RECEIVE_DB

Block_DB: data block for the data fetch from the CP.

TIMER_NR

Timer: number of the timer for the delay time.

ANL   Bool: the start-up will be executed.

This bit informs the HTB that the CPU has executed a STOP/START or POWER-OFF/POWER-ON and that synchronization is required.

The bit is cleared by the HTB when the synchronization has been completed.

NULL   Bool: send zero to the CP (for internal purposes).

RESET   Bool: reset of the CP 240.

The CP 240 is reset when the user sets this bit in the PLC program. When this bit is set, the handler block enters the RESET flag in the CP and waits until this is acknowledged. The process continues as with the start-up.

STEUERB_S   Byte: control bit for SEND-FC and S/R_ALL-FC.

Here you specify the flag byte where the control bits for the SEND-FC are saved.

STEUERB_R   Byte: control bit for RECEIVE-FC and FETCH-FC.

Here you specify the flag byte where the control bits for the RECEIVE-FC are saved.

Programming example

```
Call the blocks in OB1

        CALL  "DPRD_DAT"              //Read data from modules
         LADDR  :=W#16#100
         RET_VAL:=MW100
         RECORD :=P#DB11.DBX 0.0 BYTE 16
        CALL  FC     9               //call Synchron
         ADR       :=0               //1. DW in SEND/EMPF_DB
         SEND_DB   :=DB10            //Send_DB module
         RECEIVE_DB:=DB11            //Empfang_DB module
         TIMER_NR  :=T2              //Delay time Synchron
         ANL       :=M3.0            //Start-up completed
         NULL      :=M3.1            //Intermediate flag
         RESET     :=M3.2            //Execute module reset
         STEUERB_S :=MB2             //Control bits Sende_FC
         STEUERB_R :=MB1             //Control bits Receive_FC
        A     M      3.0             //No SEND/RECEIVE processing
                                     during start-up

        JC    schr

        CALL  FC     1               //Receive data
         ADR          :=0            //1. DW in SEND/EMPF_DB
         SEND_DB      :=DB10         //Send_DB module
         EMPF_DB      :=DB11         //Empfang_DB module
         _DB          :=DB11         //Empfang_DB message
         ABD          :=W#16#14      //1. DW receive buffer
                                     (DW20)
         ANZ          :=MW10         //Received data quantity
         EMFR         :=M1.0         //Receive completed
         PAFE         :=MB12         //Error byte
         GEEM         :=MW100        //Data used internally
         ANZ_INT      :=MW102        //Data used internally
         empf_laeuft  :=M1.1         //Data used internally
         letzter_block:=M1.2         //Data used internally
         fehl_empf    :=M1.3         //Data used internally
        A     M      1.0             //Receive complete
        R     M      1.0             //clear receive complete
        CALL  FC     0               //Send Data
         ADR          :=0            //1. DW in SEND/EMPF_DB
         SEND_DB      :=DB10         //Send_DB module
         EMPF_DB      :=DB11         //Empfang_DB module
         _DB          :=DB10         //Sende_DB message
         ABD          :=W#16#14      //1. DW send buffer (DW20)
         ANZ          :=MW14         //Send data quantity
         FRG          :=M2.0         //Specify send complete
         PAFE         :=MB16         //Error byte
         GESE         :=MW104        //Data used internally
         ANZ_INT      :=MW106        //Data used internally
         ende_kom     :=M2.1         //Data used internally
         letzter_block:=M2.2         //Data used internally
         senden_laeuft:=M2.3         //Data used internally
         fehler_kom   :=M2.4         //Data used internally

schr: CALL  "DPWR_DAT"               //Write data to module
         LADDR  :=W#16#100
         RECORD :=P#DB10.DBX 0.0 BYTE 16
         RET_VAL:=MW102


Program in start-up OB100
        AN    M      3.0
        S     M      3.0             //CPU will start-up
```

Technical data

**CP 240 with
20mA/RS232C
interface**

Electrical data	VIPA 240-1BA00, VIPA 240-1BA10
Number of channels	1
Power supply	5V via backplane bus
Current consumption	max. 200mA
ext. power supply	24V supply for active 20mA interface connected to pin 11 (+24V) and pin 22 (Ground 24V) of front socket to generate 20mA.
Isolation	none
Status indicator (LEDs)	via LED on the front
Connectors / interfaces	25pin D-type socket for RS232C and 20mA (switchable)
	ASCII transfer, 3964(R), 3964(R) with RK512, Modbus (VIPA 240-1BA10)
Data transfer rate -1BA00	150Baud up to 115kBaud
-1BA10	150Baud up to 38.4kBaud
Stop bits	1, 1.5, 2 (configurable)
Parity	none, even, odd (configurable)
Flow control	none, hardware, XON/XOFF
ZVZ	values from 0 to 5s
Programming data	
Input data	16Byte
Output data	16Byte
Parameter data	8Byte
Diagnostic data	4Byte (none for Modbus)
Dimensions and weight	
Dimensions (WxHxD) in mm	25.4x76x76
Weight	80 g

**CP 240 with
RS422/485
interface**

Electrical data	VIPA 240-1CA00, VIPA 240-1CA10
Number of channels	1
Power supply	5V via backplane bus
Current consumption	max. 200mA
ext. power supply	-
Isolation	>= AC 500V, according to DIN 19258
Status indicator (LEDs)	via LED on the front
Connectors / interfaces	25pin D-type socket for RS422/RS485
	ASCII transfer, 3964(R), 3964(R) with RK512, Modbus (VIPA 240-1CA10)
Data transfer rate -1CA00	150Baud up to 115kBaud
-1CA10	150Baud up to 38.4kBaud
Stop bits	1, 1.5, 2 (configurable)
Parity	none, even, odd (configurable)
Flow control	none, hardware, XON/XOFF
ZVZ	values from 0 to 5s
Programming data	
Input data	16Byte
Output data	16Byte
Parameter data	16Byte
Diagnostic data	4Byte (none for Modbus)
Dimensions and weight	
Dimensions (WxHxD) in mm	25.4x76x76
Weight	80 g

Chapter 10   Counter modules

Overview   This chapter contains information on the interfacing and configuration of the SSI-module FM 250 S.

The different operating modes and counting options are described for the counter module FM 250, i.e. the behavior of the counter when the different input signals are connected.

Below follows a description of:

- SSI module FM 250S
- Counter module FM 250
- Technical data

Contents

System overview

Here follows a summary of the measurement modules that are currently available from VIPA:

SSI-Interface FM 250S, counter module FM 250
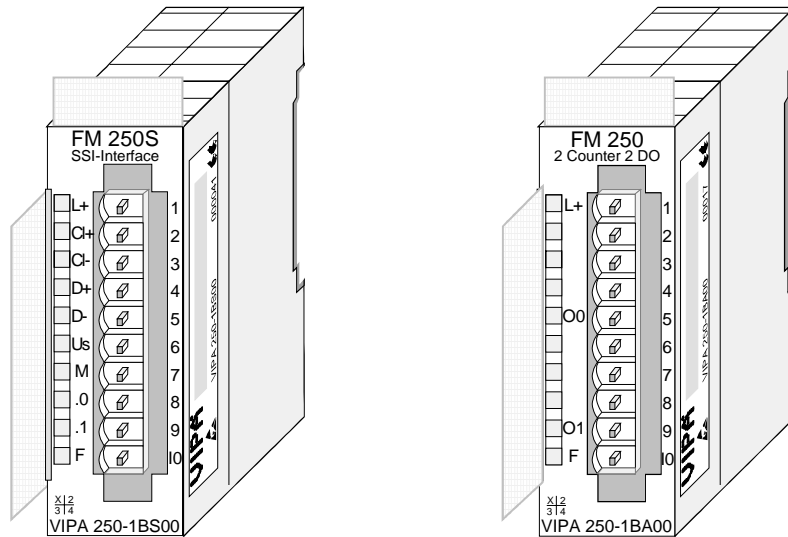
Order data

Type	Order number	Description
FM 250S	VIPA 250-1BS00	SSI-Interface
FM 250	VIPA 250-1BA00	Counter module (2 counter 2 DO)

FM 250S - SSI-Interface - Construction

Principles   The SSI interface is a synchronous serial interface. SSI is the abbreviation for **S**ynchronous **S**erial **I**nterface. The SSI module provides the connection for transducers with absolute coding and a SSI interface.

The module converts the serial information of the transducer into parallel information for the controller. Data can be transferred in gray or in binary code.

Configurable outputs   The interface has connections for the SSI signals clock, data and the transducer supply voltage as well as two additional outputs that may be set or reset when a limit value is exceeded.

Output 0 can also be programmed as hold input. This causes the SSI transducer value to be frozen when a 24V high level is applied to output 0. A low level will cause the transducer to transmit the actual SSI values.

You can also configure the outputs that they will remain set if the BASP signal is active.

Properties
- Wiring does not depend on the length of the data word. The interface always uses 4 wires.
- Maximum security due to the use of symmetrical clock and data signals.
- Secure data acquisition die to the use of single-step gray code (configurable).
- Galvanic isolation of receiver and encoder by means of optocouplers.
- 1 SSI channel
- Direct power supply to the SSI transducer via front-facing connector
- DC 24V power supply
- Baudrate selection between of 100kBaud and 600kBaud
- 2 configurable digital outputs, one may be used as hold input to freeze the current SSI transducer value
- Measured value available in gray or in binary code
- 4Byte of parameter data
- 4Byte of input data
- 4Byte of output data
- Configuration by means of control byte

Construction
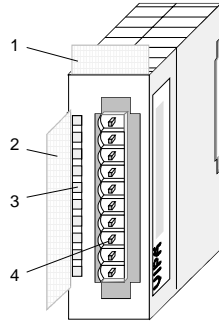
[1]   Label for module name
[2]   Label for bit address with description
[3]   LED status indicator
[4]   Edge connector

**Status indicator
pin assignment**

LED	Description		Pin	Assignment
L+	LED (yellow) Supply voltage available		1	Supply voltage DC +24V
Ci+	LED (green) Clock output		2	CLK+ (Output)
			3	CLK- (Output)
D+	LED (green) Transducer data input		4	Data+ (Input)
			5	Data- (Input)
.0	LED (green) Input/output 0		6	DC 24V SSI transducer supply voltage
			7	Common SSI transducer supply
.1	LED (green) Input/output 1		8	Input/output .0 and hold input
			9	Input/output .1
F	LED (red) Error /overload		10	Common of supply voltage

LEDs   The SSI-Interface has a number of LEDs. The following table explains the significance of these LEDs:

Name	Color	Description
L+	yellow	Indicates that 24V power is available
C+	green	ON when clock pulses are transmitted OFF when hold function has been activated and 24V at I/O .0
D+	green	ON when data is received from the transducer (wiring test)
.0	green	ON when 24V power is available at I/O .0
.1	green	ON when 24V power is available at I/O .1
F	red	ON when short circuit or overload is detected on one of the two I/O .0/.1

Line distances   The baudrate depends on the length of the communication line and on the SSI transducer. Wiring has to consist of screened twisted pair cables. The specifications below are only intended as a guideline.

< 400m:	→	100kBaud
< 100m:	→	300kBaud
< 50m:	→	600kBaud

Wiring diagram
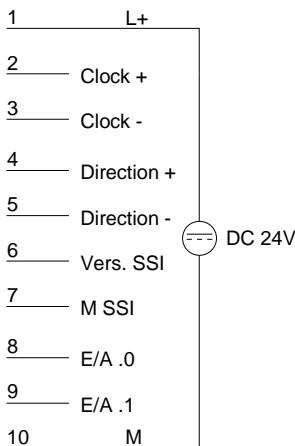
The SSI interface has an internal power supply. This power supply requires a voltage of DC 24V via L+ and M.

The supply voltage provides power to the interface electronics as well as the SSI transducer connected with DC 24V to pin 6 and 7.

Block diagram
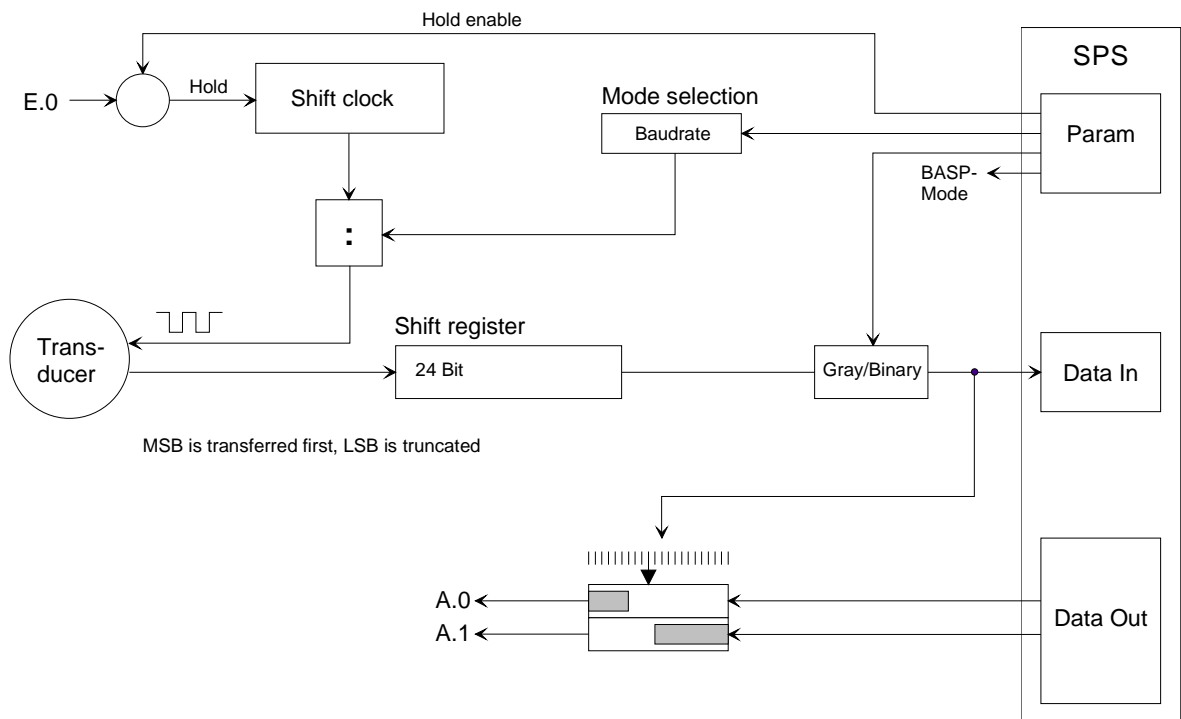
Configuration data   4Byte of configuration data are transferred. In these bytes you define the baudrate, the coding and the analysis of the combined I/O .0 as well as the BASP signal.

The structure of the configuration data is as follows:

Byte	Bit 0 ... Bit 7
0	Bit 0 ... Bit 7: reserved
1	Bit 0 ... Bit 7: reserved
2	Baudrate 0: 300kBaud (default) 1: 100kBaud 2: 300kBaud 3: 600kBaud 4...255: 300kBaud
3	Bit 0: Coding 0: Binary code (default) 1: Gray code Bit 2: SSI format 0: Multiturn (24 bit) 1: Singleturn (12 bit) Bit 4: Hold function 0: deactivate 1: activate Bit 7: BASP signal 0: ignore 1: analyze

Parameter   **Baudrate**

The transducer connected to the SSI channel transmits serial data. It requires a clock pulse from the SSI interface. The baudrate defines this clock. You may choose a value of 100, 300 or 600kBaud. The default setting is 300kBaud.

Coding   The gray code is a different form of binary code. The principle of the gray code is that two neighboring gray numbers will differ in exactly one single bit.

When the gray code is used, transmission errors can be detected easily as neighboring characters may only be different in a single location.

Table of rules for the gray code:

Decimal	Gray Code
0	0 0 0 0
1	0 0 0 1
2	0 0 1 1
3	0 0 1 0
4	0 1 1 0
5	0 1 1 1
6	0 1 0 1
7	0 1 0 0
8	1 1 0 0
9	1 1 0 1
10	1 1 1 1
11	1 1 1 0
12	1 0 1 0
13	1 0 1 1
14	1 0 0 1
15	1 0 0 0

i.e. the last digit of the number results from the vertical repetition of the sequence "0 11 0", the penultimate digit results from the repetition "00 1111 00", the third-last number from the repetition of 4x"0", 8x"1" and again 4x"0", etc. (see columns in the table!).

Hold function

Here you define that I/O .0 should be used as hold input. When you have activated this function, the current transducer value will be stored when I/O .0 is connected to 24V. The transducer value is only updated when the 24V level is removed from I/O .0.

In this case you have to be aware that I/O .0 operates only in input mode.

BASP signal

BASP is a German abbreviation for command output inhibited, i.e. all outputs are reset and inhibited as long as the BASP signal is applied via the backplane bus. You may disable the evaluation of the BASP signals by setting this bit. This means that the outputs will remain set.

Access to the SSI Interface

Input data (Data In)

The input data from the SSI transducer has a length of 4Byte. Byte 0 can be used as an I/O status indicator for the. Data is supplied in binary or in gray code, depending on the selected mode.

Byte	Data In
0	Bit 0: Status I/O .0 Bit 1: Status I/O .0 Bit 2-7: reserved
1	SSI transducer value: HB
2	SSI transducer value: MB
3	SSI transducer value: LB

Output data (Data Out)

Data Out provides the option of controlling the 2 I/O ports on the SSI interface depending on the value of a transducer input. Output data consists of 4Byte.

The SSI transducer stores 8Byte of output data, i.e. you may define two comparative values along with the respective control byte.

In the control byte you are able to specify how the reference value should affect which output. The status of the I/Os is signaled via the input bytes.

The following table shows the assignment of these output bytes.

Byte	Data Out

0	Bit 0-1: set point value
	    00: no set point value
	    01: for output 0
	    10: for output 1
	    11: for both outputs
	Bit 2: reserved
	Bit 3: set conditions for output
	    0: when actual value exceeds comparison value
	    1: when actual value is less than comparison value
	Bit 4-7: reserved

1	Comparison value: HB
2	Comparison value: MB
3	Comparison value: LB

FM 250 - Counter module - Construction
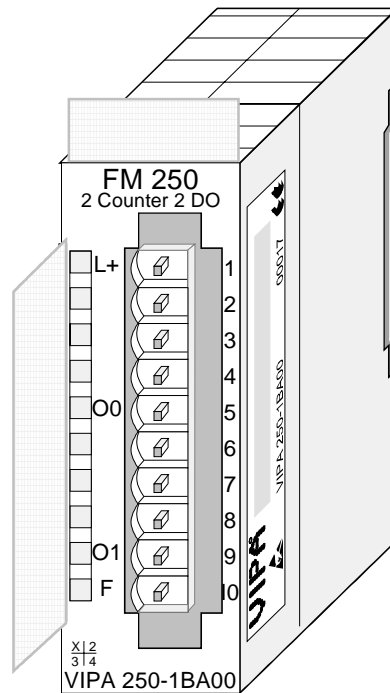
Note!

The following information is only applicable to counter modules with *order no.: VIPA 250-1BA00 and a revision level 5 and higher*.

The counter module accepts the signals from transducers connected to the module and processes these pulses in accordance with the selected mode of operation. The module has 2/4 channels with a data resolution of 32/16Bit each.

These modules provide 36 counter modes and two 24V outputs they are controlled in accordance with the selected mode.

Properties

- two 32Bit channels / four 16Bit channels (depending on the mode)
- DC 24V supply voltage or via backplane bus
- freely configurable DC 24V outputs (0.5A max.)
- Counters and compare registers are loaded by means of a control byte
- Standard up-down counter with a resolution of 32Bit or 16Bit
- Compare and auto-reload functions
- Different modes for encoder pulses
- Pulse-width measurements and frequency measurements

Construction
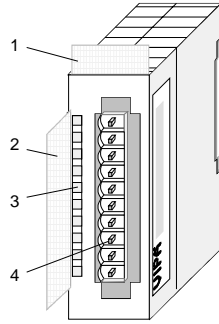
[1]   Label for module name
[2]   Label for bit address with description
[3]   LED status indicator
[4]   Edge connector

Status indicator
pin assignment

LED	Description
L+	LED (yellow) Supply voltage available
O0	LED (green) Output counter 0
O1	LED (green) Output counter 1
F	LED (red) Error /overload
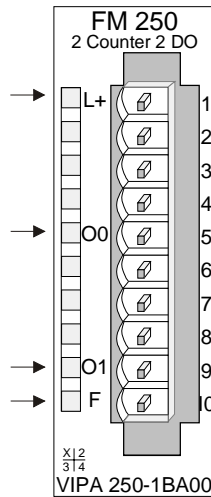
Pin	Assignment
1	Supply voltage +24V DC
2	IN1 input 1 counter 0/1
3	IN2 input 2 counter 0/1
4	IN3 input 3 counter 0/1
5	OUT0 output counter 0/1
6	IN4 input 4 counter 2/3
7	IN5 input 5 counter 2/3
8	IN6 input 6 counter 2/3
9	OUT1 output counter 2/3
10	Common of supply voltage

FM 250
2 Counter 2 DO

VIPA 250-1BA00

Block diagram
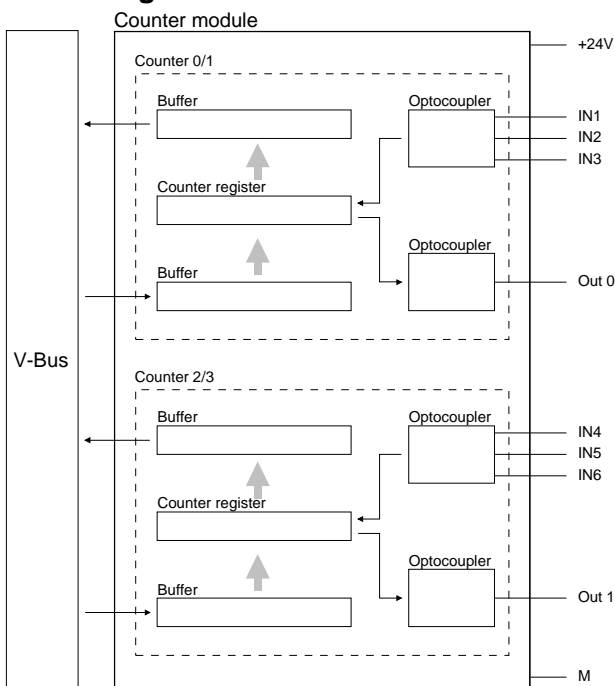
Input internal circuit
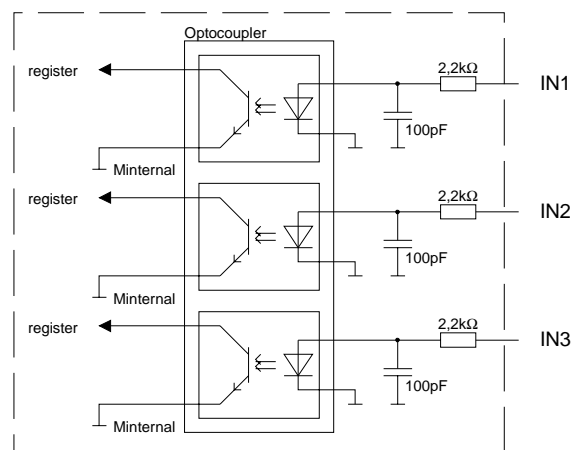
Access to the counter module

The module has 2/4 channels with a resolution of 32/16Bit each. You may use parameters to specify the mode for each channel res. channel pair. The pin assignment for the channel depends upon the selected mode (see description of modes).

10 data bytes are required for the data input and output. Data output to a counter channel requires 10Byte, for example for defaults or for comparison values. In the latter case Byte 9 (control) is used to initiate a write operation into the required counter register. The respective values are transferred into the counter registers when they are toggled ($0\rightarrow1$).

The 10th byte (status byte) controls the behavior of the counter during a restart of the next higher master module. You may set the counter level to remanent by means of a combination of Bits 0 and 1; i.e. the original counter level will not be reset when the next higher master module restarts.

The following combinations are possible:

Bit 0=1, Bit 1=0   counter value is remanent during restart
Bit 0=x, Bit 1=1   counter value is reset during restart (default)

You may check your settings at any time by reading Byte 10 of the output data.

Data sent to module

00h	DE0
01h	DE1
02h	DE2
03h	DE3
04h	DE4
05h	DE5
06h	DE6
07h	DE7
08h	Control
09h	Status

Counter 0/1 (DE0...DE3)
Counter 2/3 (DE4...DE7)

Data received from module

00h	DA0
01h	DA1
02h	DA2
03h	DA3
04h	DA4
05h	DA5
06h	DA6
07h	DA7
08h	
09h	Status

Counter 0/1 (DA0...DA3)
Counter 2/3 (DA4...DA7)
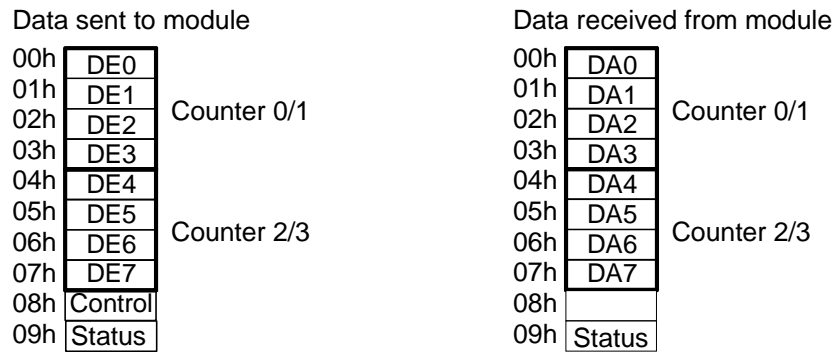
Configuration parameters

The configuration parameters consist of 2Byte. You use these bytes to define the operating mode of each channel by means of a mode number. This chapter contains a detailed description of the different modes further below. The different combinations of the various modes are available from the table on the next page. The procedure for the transfer of parameter bytes is available from the description for the System 200V bus coupler or the master system.

7   0   bit no.

Parameter byte 1   Mode (0 ... 38) counter 0/1

7   0   bit no.

Parameter byte 2   Mode (0 ... 38) counter 2/3
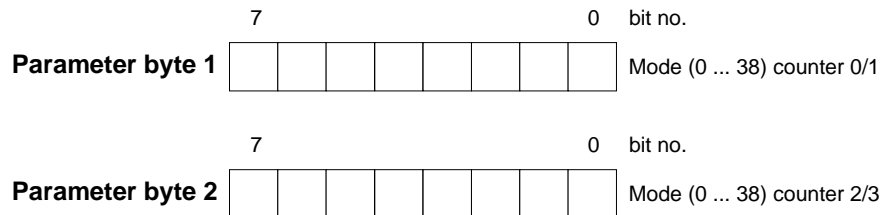
Summary of counter modes and interfacing

Mode	may be combi ned	Function	IN1	IN2	IN3	IN4	IN5	IN6	OUT0	OUT1	Auto Re-load	Com-pare Load
				Counter 0/1			Counter 2/3					
0	yes	32bit counter	RES	CLK	DIR	RST	CLK	DIR	=0	=0	no	=0
1	yes	Encoder 1 edge	RES	A	B	RST	A	B	=0	=0	no	=0
3	yes	Encoder 2 edges	RES	A	B	RST	A	B	=0	=0	no	=0
5	yes	Encoder 4 edges	RES	A	B	RST	A	B	=0	=0	no	=0
				Counter 1 counter 0			Counter 3 counter 2					
8	yes	2x16bit counter up/up	-	CLK	CLK	-	CLK	CLK	-	-	no	no
9	yes	2x16bit counter down/up	-	CLK	CLK	-	CLK	CLK	-	-	no	no
10	yes	2x16bit counter up/down	-	CLK	CLK	-	CLK	CLK	-	-	no	no
11	yes	2x16bit counter down/down	-	CLK	CLK	-	CLK	CLK	-	-	no	no
				Counter 0/1			Counter 2/3					
12	yes	32bit counter up + gate	RES	CLK	Gate	RST	CLK	Gate	=comp	=comp	no	yes
13	yes	32bit counter down + gate	RES	CLK	Gate	RST	CLK	Gate	=comp	=comp	no	yes
14	yes	32bit counter up + gate	RES	CLK	Gate	RST	CLK	Gate	=comp	=comp	yes	yes
15	yes	32bit counter down + gate	RES	CLK	Gate	RST	CLK	Gate	=comp	=comp	yes	yes
				Combination of counter 0 ... 3								
16	no	Frequency measurement	RES	CLK	Start	Stop	-	-	Meas. active	Meas. compl.	no	yes
17	no	Period measurement	RES	CLK	Start	Stop	-	-	Meas. active	Meas. compl.	no	yes
18	no	Frequency measurement with gate output	RES	CLK	Start	Stop	-	-	Meas. gate	$\overline{\text{Meas. gate}}$	no	yes
19	no	Period measurement with gate output	RES	CLK	Start	Stop	-	-	Meas. gate	$\overline{\text{Meas. gate}}$	no	yes
				Counter 0/1			Counter 2/3					
6	yes	Pulse low, 50kHz with Direction Input	RES	Pulse	DIR	RES	Pulse	DIR	-	-		
20	yes	Pulse low, prog. time base with Direction Input	RES	Pulse	DIR	RES	Pulse	DIR	-	-		
21	yes	Pulse low, up, prog. time base with Gate	RES	Pulse	Gate	RES	Pulse	Gate	-	-		
22	yes	Pulse high, up, prog. time base with Gate	RES	Pulse	Gate	RES	Pulse	Gate	-	-		
				Counter 0/1			Counter 2/3					
23	yes	One Shot, up, Set	RES	CLK	Gate	RES	CLK	Gate	1 if active	1 if active	no	yes
24	yes	One Shot, down, Set	RES	CLK	Gate	RES	CLK	Gate	1 if active	1 if active	no	yes
25	yes	One Shot, up, Reset	RES	CLK	Gate	RES	CLK	Gate	0 if active	0 if active	no	yes
26	yes	One Shot, down, Reset	RES	CLK	Gate	RES	CLK	Gate	0 if active	0 if active	no	yes
				Counter 0/1			Counter 2/3					
27	yes	32 bit counter	Gate/R$^\uparrow$	CLK	DIR	Gate/R$^\uparrow$	CLK	DIR	=0	=0	no	=0
28	yes	Encoder 1 edge	Gate/R$^\uparrow$	A	B	Gate/R$^\uparrow$	A	B	=0	=0	no	=0
29	yes	Encoder 2 edges	Gate/R$^\uparrow$	A	B	Gate/R$^\uparrow$	A	B	=0	=0	no	=0
30	yes	Encoder 4 edges	Gate/R$^\uparrow$	A	B	Gate/R$^\uparrow$	A	B	=0	=0	no	=0

Continue...

... Continue

Mode	may be combi ned	Function	IN1	IN2	IN3	IN4	IN5	IN6	OUT0	OUT1	Auto Re-load	Com-pare Load
				Counter 0/1			Counter 2/3					
31	yes	32Bit counter up+Gate	RES$^\uparrow$	CLK	Gate	RES$^\uparrow$	CLK	Gate	=comp	=comp	no	yes
32	yes	32Bit counter down+Gate	RES$^\uparrow$	CLK	Gate	RES$^\uparrow$	CLK	Gate	=comp	=comp	no	yes
33	yes	32Bit counter up+Gate	RES$^\uparrow$	CLK	Gate	RES$^\uparrow$	CLK	Gate	=comp	=comp	yes	yes
34	yes	32Bit counter down+Gate	RES$^\uparrow$	CLK	Gate	RES$^\uparrow$	CLK	Gate	=comp	=comp	yes	yes
				Counter 0/1			Counter 2/3					
35	yes	32Bit counter	Gate	CLK	DIR	Gate	CLK	DIR	=0	=0	no	=0
36	yes	Encoder 1 edge	Gate	A	B	Gate	A	B	=0	=0	no	=0
37	yes	Encoder 2 edges	Gate	A	B	Gate	A	B	=0	=0	no	=0
38	yes	Encoder 4 edges	Gate	A	B	Gate	A	B	=0	=0	no	=0

Due to technical advances the revision level and the functionality of the counter module was conti-nuously expanded. Below follows a list that allocates the different modes to the revision level:

Mode 0-5	revision level 3	Mode 6, 20-26	revision level 6/7
Mode 0-17	revision level 4	Mode 27-30	revision level 8/9
Mode 0-19	revision level 5	Mode 31-38	revision level 10

Terminology

RES   RESET signal that has to be LOW during the measuring process. A HIGH level (level triggered) erases one or both counters, depending on the selected mode.

RES$^\uparrow$ The counter is reseted by the rising edge of this signal (edge triggered).

CLK   The clock signal from the connected transducer.

Start or Stop   A HIGH level starts or stops the counter. When the start level is active, the counter will start with the next CLK pulse that corresponds to the selected mode.

DIR   In mode 0 the level of the DIR signal determines the direction of the counting process.
LOW level: count up
HIGH level: count down

Auto Reload   The Auto Reload function transfers a user-defined value into the counter when the counter reaches the number contained in the compare register.

Compare Load   You may use the compare function to specify an stop value for the counter. Depending on the selected mode an output is activated or the counter is re-started when it reaches this value.

Gate   Gate signal enabling the counter.

Gate/R$^\uparrow$ The counter is reseted by the rising edge of this signal. As long as the signal is at "1", the counter is released.

(Gate = level triggered; R$^\uparrow$ = edge triggered)

Measurement gate   Status indicator of the counter activity - is set to a HIGH level after the 1st CLK signal and LOW level after the last CLK signal (mode 18 ... 19).

Pulse   The pulse width of the introduced signal is determined by means of the internal time base.

Fref   Reference or clock frequency that is set permanently to 50kHz in mode 6.

The clock frequency "Fref" for counter modes 20, 21, 22 is programmable:

Parameter	Fref
0	10MHz
1	1MHz
2	100kHz
3	10kHz

Counter modes

Mode 0
32Bit counter

2x 32Bit Counter. You determine the direction by means of the DIR input (IN3 or IN6). Every rising or falling edge of the input clock signal increments or decrements the counter. During the counting process the RES signal must be at a LOW level. If the RES signal is at a HIGH level, the counter is cleared. When the counter reaches zero, output OUT of the respective counter is active for a minimum period of 100ms, even if the counter should continue counting. If the counter stops at zero, the output remains active.

Pin assignment
access to counter
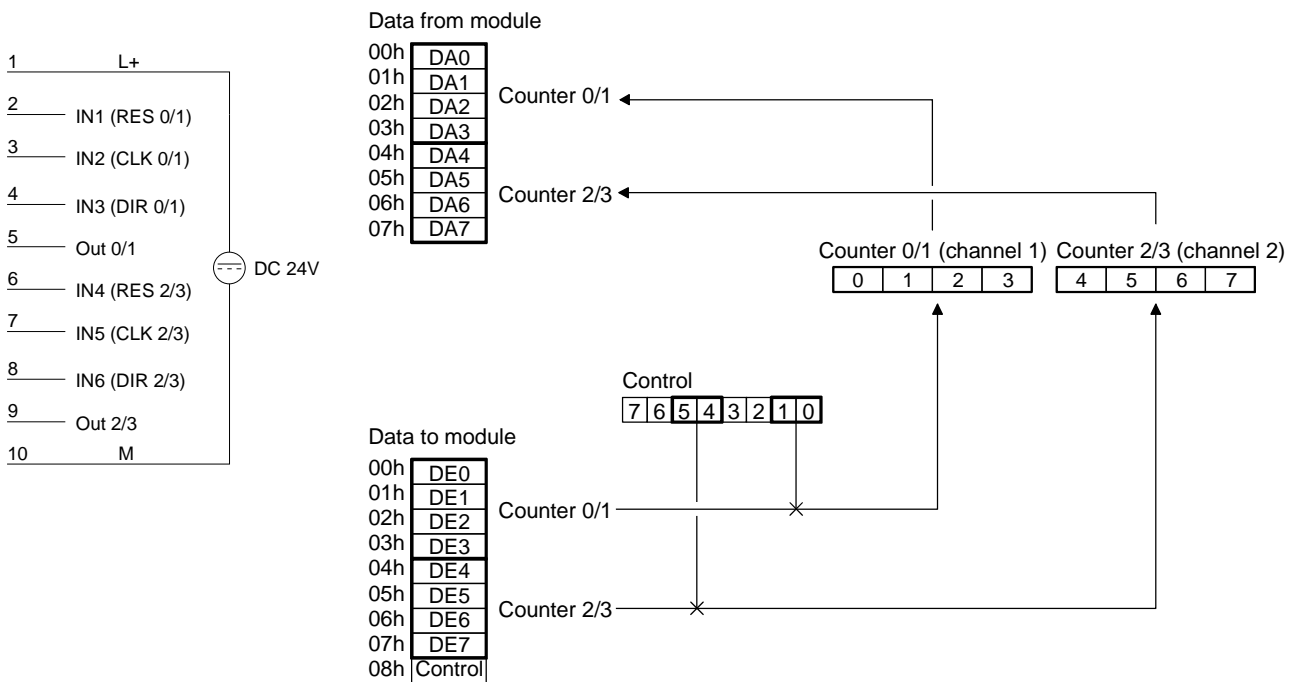
Up counter   In mode 0, a LOW level at the DIR input configures the counter for counting up.

Timing diagram of the counter 0/1 example:
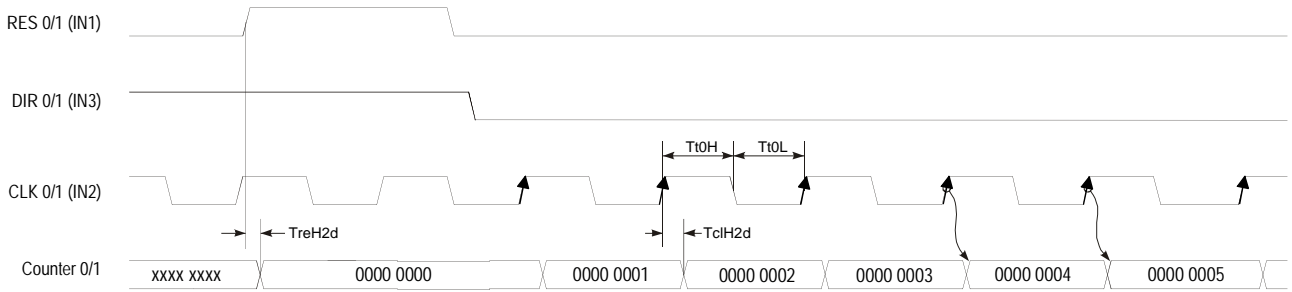
Down counter   In mode 0, a HIGH level at the DIR input configures the counter for counting down.

Timing diagram of the counter 0/1 example:
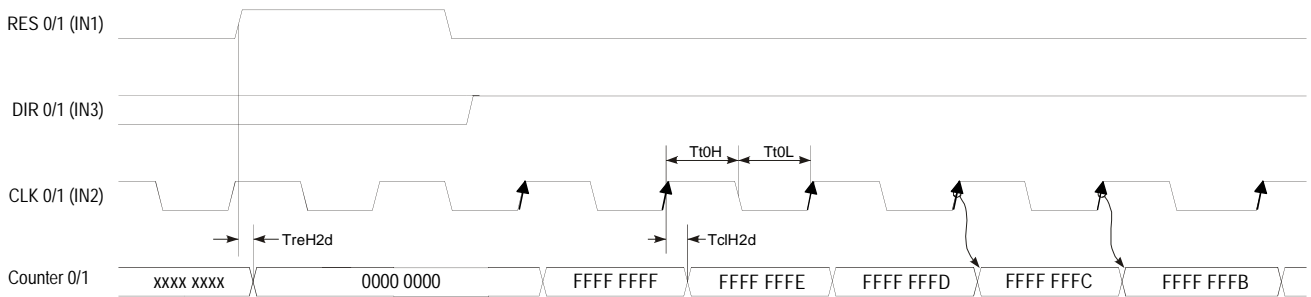
Mode 1
Encoder 1 edge

In mode 1 you may configure an encoder for one of the channels. Depending on the direction of rotation this encoder will increment or decrement the internal counter with every falling edge. The RES input has to be at a LOW level during the counting process. A HIGH level clears the counter. When the counter reaches zero, output OUT of the respective counter is active for a minimum period of 100ms, even if the counter continues counting. If the counter stops at zero the output remains active.

Pin assignment
access to counter
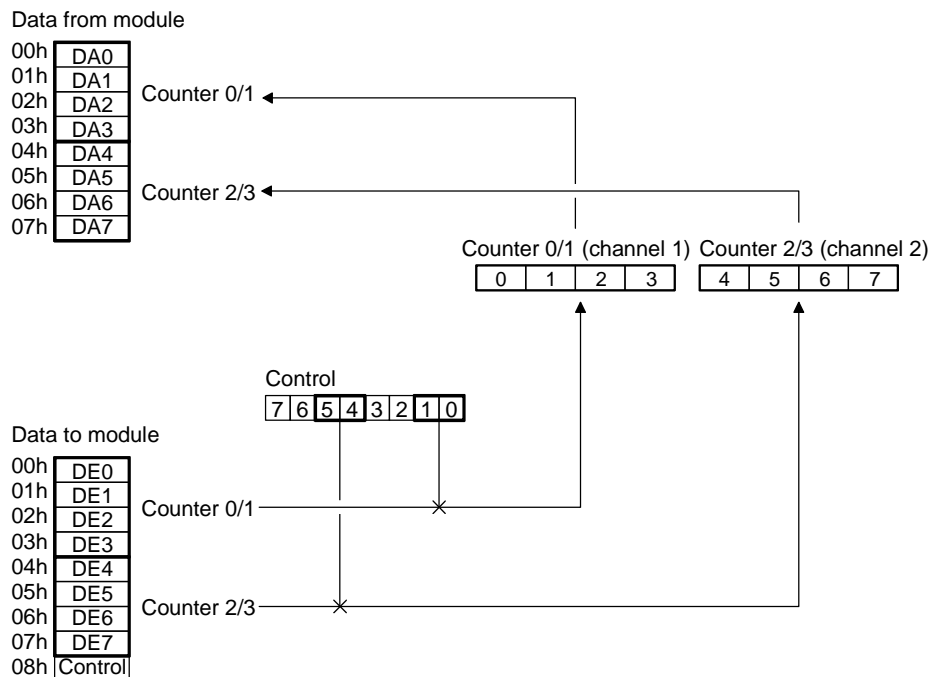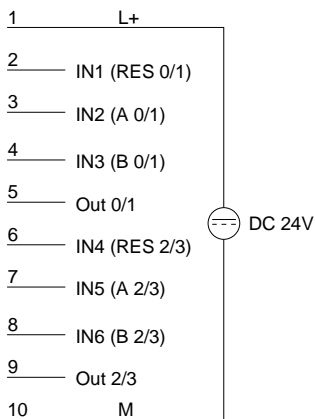
Up counter

Every falling edge of the signal at input A increments the counter if input B is at HIGH level at this moment.

Timing diagram for the counter 0/1 example:

Down counter

Every rising edge of the signal at input A decrements the internal counter if input B is at HIGH level at this moment.

Timing diagram for the counter 0/1 example:

Mode 3
Encoder 2 edges

Every rising or falling edge of the signal at input A changes the counter by 1. The direction of the count depends on the level of the signal applied to input B. RES has to be at a LOW level during the counting process. A HIGH level clears the counter. When the counter reaches zero, output OUT of the respective counter is active for a minimum period of 100ms, even if the counter continues counting. If the counter stops at zero the output remains active.

Pin assignment
access to counter

Up counter   The counter is incremented by the rising edge of signal A if input B is at a LOW level or by the falling edge of input A when input B is at a HIGH level.

Timing diagram for the counter 0/1 example:

Down-counter   The counter is decremented by the rising edge of signal A if input B is at a HIGH level or by the falling edge of input A when input B is at a LOW level.

Timing diagram for the counter 0/1 example:

Mode 5
Encoder 4 edges

Every rising or falling edge at inputs A or B increments or decrements the counter. The direction depends on the level applied to the other input (B or A). RES has to be at a LOW level during the counting process. A HIGH level clears the counter. When the counter reaches zero, output OUT of the respective counter is active for a minimum period of 100ms, even if the counter continues counting. If the counter stops at zero, the output remains active.

Pin assignment
access to counter

Up counter

The counter is incremented when a rising edge is applied to B while input A is at a HIGH level or if a falling edge is applied to B when input A is at a LOW level. Alternatively it is also incremented when a rising edge is applied to A when input B is at a LOW level or by a falling edge at A when input B is at a HIGH level.

Timing diagram for the counter 0/1 example:

Down counter

The counter is decremented when a rising edge is applied to B while input A is at a LOW level or if a falling edge is applied to B when input A is at a HIGH level. Alternatively it is also decremented when a rising edge is applied to A when input B is at a HIGH level or by a falling edge at input A when input B is at a LOW level.

Timing diagram for counter 0/1 example:

**Mode 8 ... 11
two input counter
function**

In this mode each channel provides 2 counters of 16Bit each. The rising edge of the input clock CLK x increments or decrements the respective counter. In this mode each counter can also be preset to a certain value by means of a control bit. Outputs are not available. A RESET is also not available. The following combinations are possible for every channel:

Mode 8 - counter 0/1 up, counter 2/3 up

Mode 9 - counter 0/1 down, counter 2/3 up

Mode 10 - counter 0/1 up, counter 2/3 down

Mode 11 - counter 0/1 down, counter 2/3 down

**Pin assignment
access to counter**
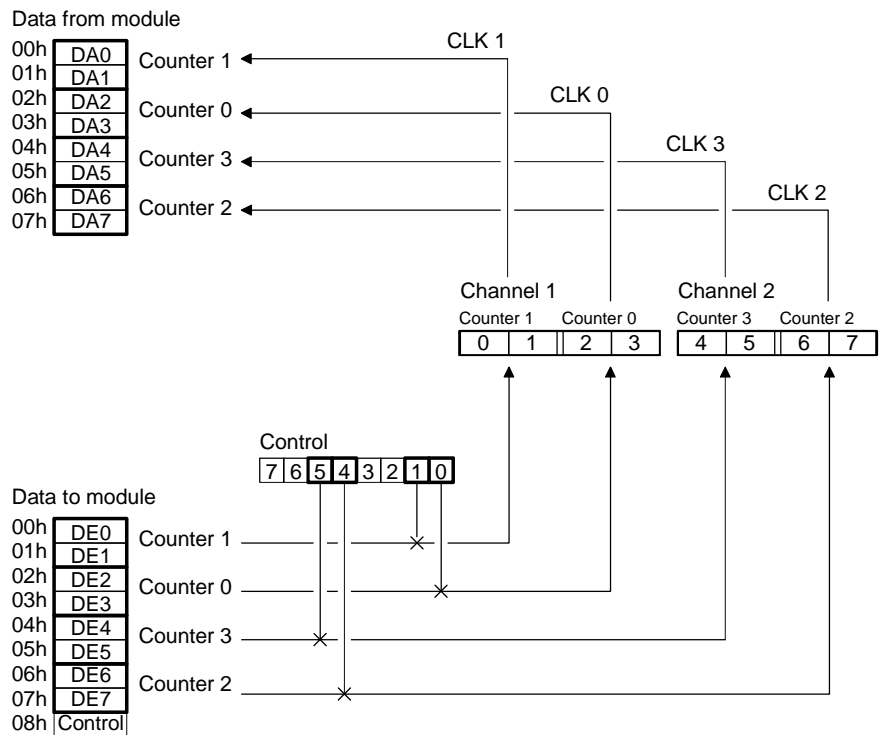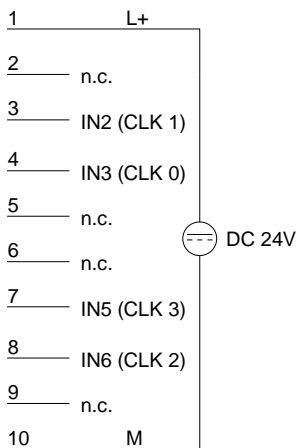
Timing diagram   Below follows a timing diagram depicting an example of counter 0 and counter 1 in mode 8:
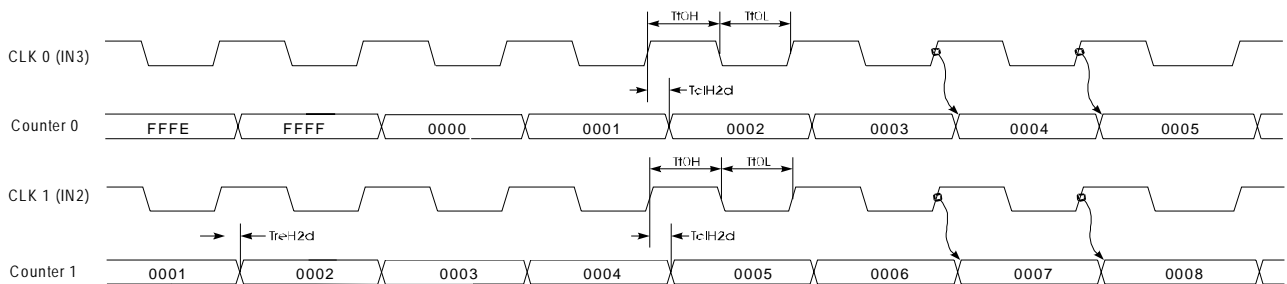
**Mode 12 and 13
32bit counter with
gate**

In mode 12 and mode 13 you can implement a 32Bit counter that is controlled by a gating signal (Gate). The direction of counting depends on the selected mode. Every rising edge of the input signal increments or decrements the counter provided that the GATE signal is at HIGH level. RES has to be LOW during the counting process. A HIGH level clears the counter. When the counter reaches the value that was previously loaded into the compare register, output OUT is set active for a minimum period of 100ms while the counter continues counting.

Mode 12 - 32Bit counter up + gate with compare

Mode 13 - 32Bit counter down + gate with compare

**Pin assignment access
to counter**
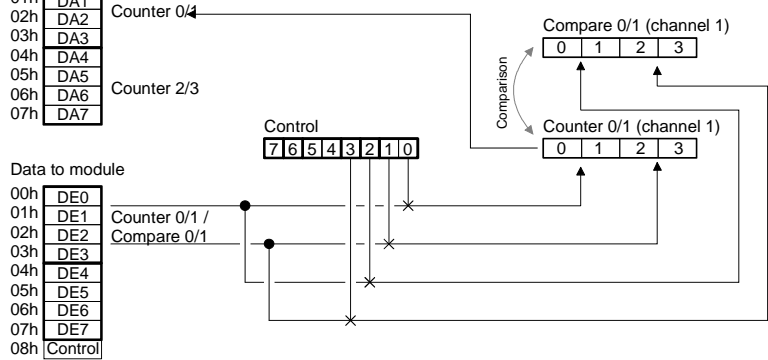
Timing diagram

Below follows an example of a timing diagram of counter 0/1 in mode 12:

**Mode 14 and 15
32Bit counter with
gate and auto
reload**

Modes 14 and 15 operate in the same manner as mode 12 and 13 with the addition of an Auto Reload function. The "Auto Reload" is used to define a value in the load register that is used to preset the counter automatically when it reaches the compare value.

A HIGH pulse applied to RES clears the counter to 0000 0000. A HIGH level applied to GATE enables the counter so that is incremented/decremented by every rising edge of the CLK signal. As long as GATE is HIGH, the counter will count every rising edge of the signal applied to CLK until the count is one less than the value entered into COMPARE. The next pulse overwrites the counter with the value contained in the load register. This process continues until GATE is set to a LOW level. When an auto reload occurs, the status of the respective output changes.

The RES signal only resets the counter but not the outputs.

Mode 14 - 32Bit counter up + gate with compare and auto reload

Mode 15 - 32Bit counter down + gate with compare and auto reload

**Pin assignment
access to counter**
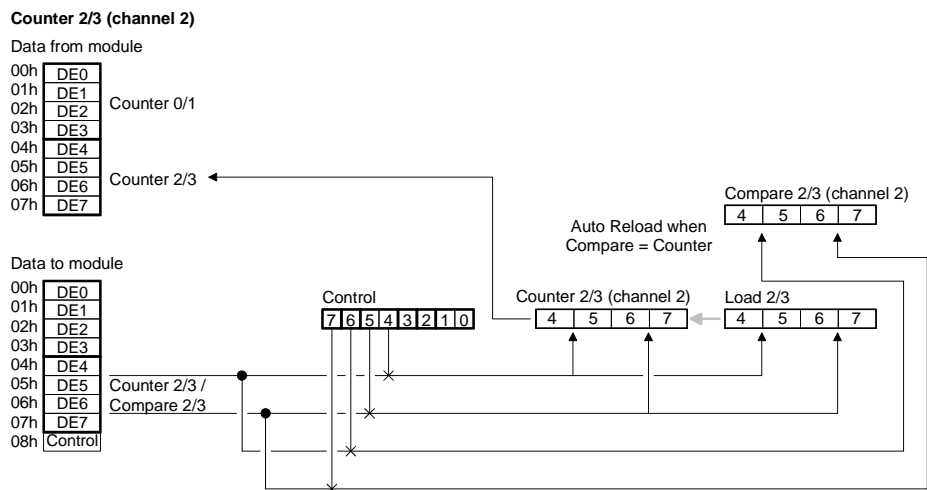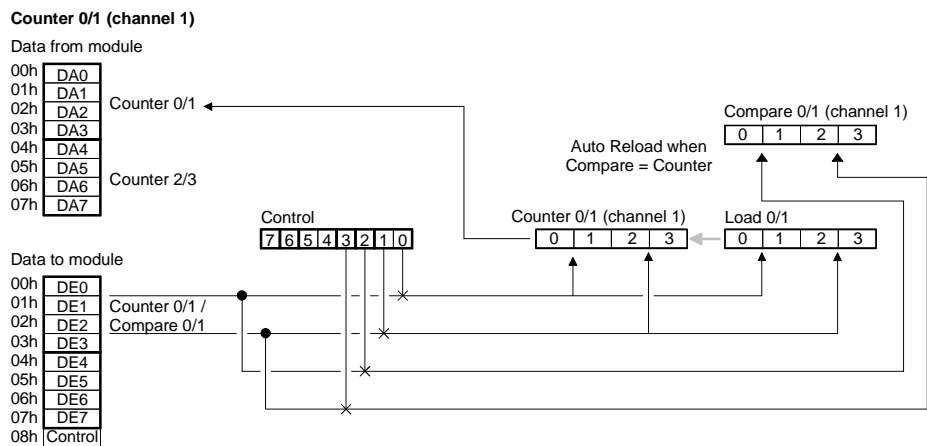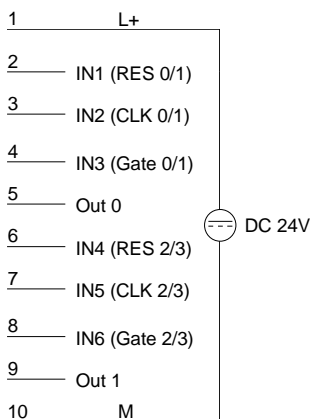
Example   This example is intended to explain the operation of the counters in mode 14 and 15.

A HIGH pulse applied to RES clears the counter to 0000 0000. A HIGH level applied to GATE enables the counter. As long as GATE is HIGH the counter will count every rising edge of the signal applied to CLK until the count is one less than the value entered into COMPARE. In this example the counter counts to 0000 0004 followed immediately by an auto reload, i.e. the counter is preset to the contents of the load register (in this case 0000 0002). The state of output OUT 0 changes every time an auto reload is executed.

In this example the counter counts from 0000 0002 to 0000 0004 as long as the GATE input is at a HIGH level.

Every load operation changes the status of output OUT 0.

**Mode 16
frequency
measurement**

In this mode it is possible to determine the frequency of the signal that is applied to the CLK input. Counter 0/1 is provided with a reference signal by means of DE7 and a gate time that is controlled indirectly by the value n to determine the duration for which counter 2/3 is enabled. The value of n has a range from 1 to 2^{32}-1 and it is loaded into the COMPARE register.

When enabled by the rising edge of the signal applied to Start, counter 0/1 counts reference pulses of the reference clock generator from the first rising edge of the CLK signal.

During this time counter 2/3 counts every rising edge of the CLK signal. Both counters are stopped when counter 0/1 reaches the COMPARE value or when a HIGH level is applied to Stop. You may calculate the frequency by means of the formula shown below.

This mode can not be combined with other modes!

**Pin assignment
access to counter**
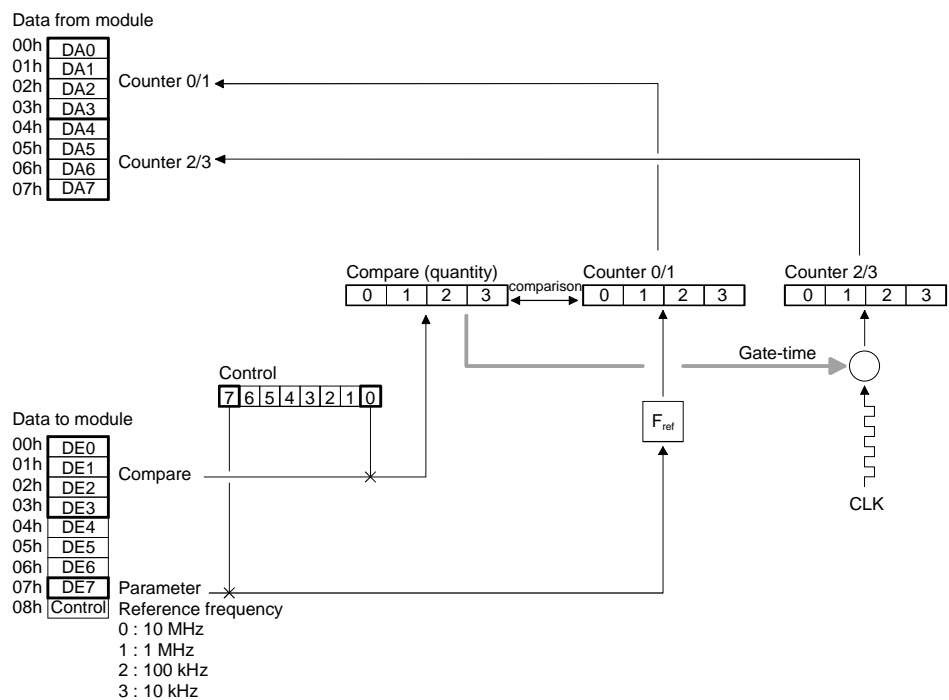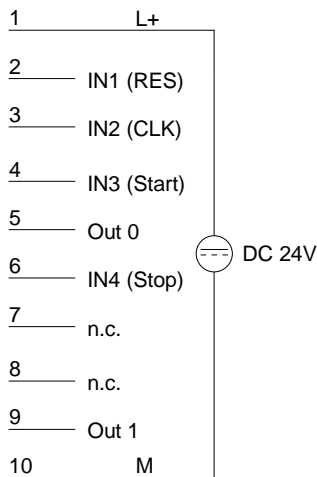
**Frequency
calculation**

When the measurement has been completed you may calculate the frequency as follows:

$$Frequency = \frac{Fref \cdot m}{n}$$

where *Fref*: reference frequency (supplied in DE7 with control bit 7)

   m: counter 2/3 contents (number of CLK pulses)

   n: number of reference frequency pulses in counter 0/1 (equal to COMPARE, if the operation was not terminated prematurely by means of Stop)

Timing diagram

RES (IN1)	
Start (IN3)	
Stop (IN4)	
CLK (IN2)	
Counter 2/3	xxx 0 1 2 3 *m*
Counter 0/1	xxx 0 *n*
Out0 (meas. active)	
Out1 (end of meas.)	
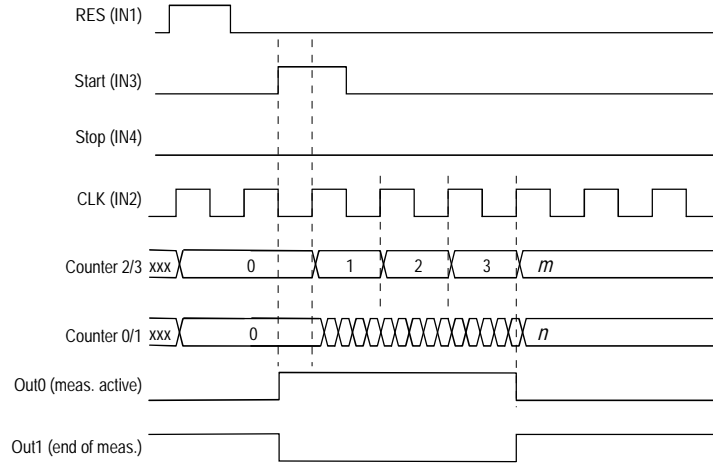
Example

Quantity = 1 000 000 pulses
Reference frequency = 1MHz

Control
7 6 5 4 3 2 1 0
1 0 0 0 0 0 0 1

Data to module

DE0	00h
DE1	0Fh
DE2	42h
DE3	40h
DE4	DE4
DE5	DE5
DE6	DE6
DE7	01h
DE8	Control

Compare

Compare
| 00h | 0Fh | 42h | 40h |
Number = 1000 000

Parameter

F_{ref}

Reference
frequency 1 MHz
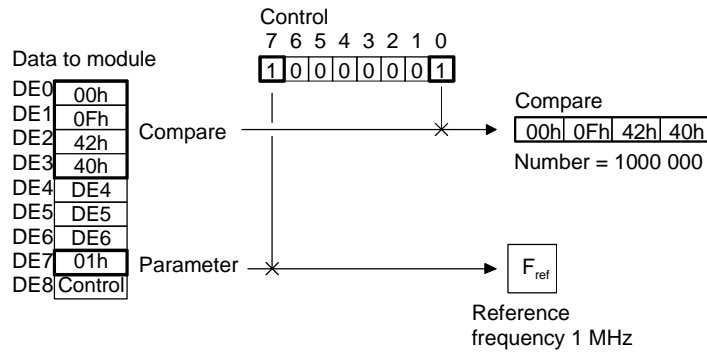
Using a frequency of 1MHz and 1 000 000 pulses will return 1Hz, i.e. when
the measurement is completed, counter 2/3 contains the frequency directly
- no conversion is required.

Note!

Counter 2/3 will indicate the exact frequency if you choose *Fref* and *n* so
that the formula returns 1Hz precisely.

**Mode 17
period
measurement**

This mode is used to determine the average period of n measuring intervals of a signal that is connected to the CLK input. For this purpose you supply a reference clock to counter 2/3 by means of DE7 and indirectly a gate time defined by the value of n for which counter 2/3 is enabled. The value of n has a range from 1 to 2^{32}-1 and it is loaded into the COMPARE register.

The measurement period begins when a rising edge is applied to Start. During this period counter 2/3 counts reference pulses from the reference clock generator starting with the first rising edge of the CLK signal.

In the mean time counter 0/1 counts every rising edge of the CLK signal. Both counters are stopped when the count in counter 0/1 reaches the Compare value or when Stop is set to a HIGH level. You may then calculate the average period by means of the formula shown below.

This mode can not be combined with other modes!

**Pin assignment
access to counter**
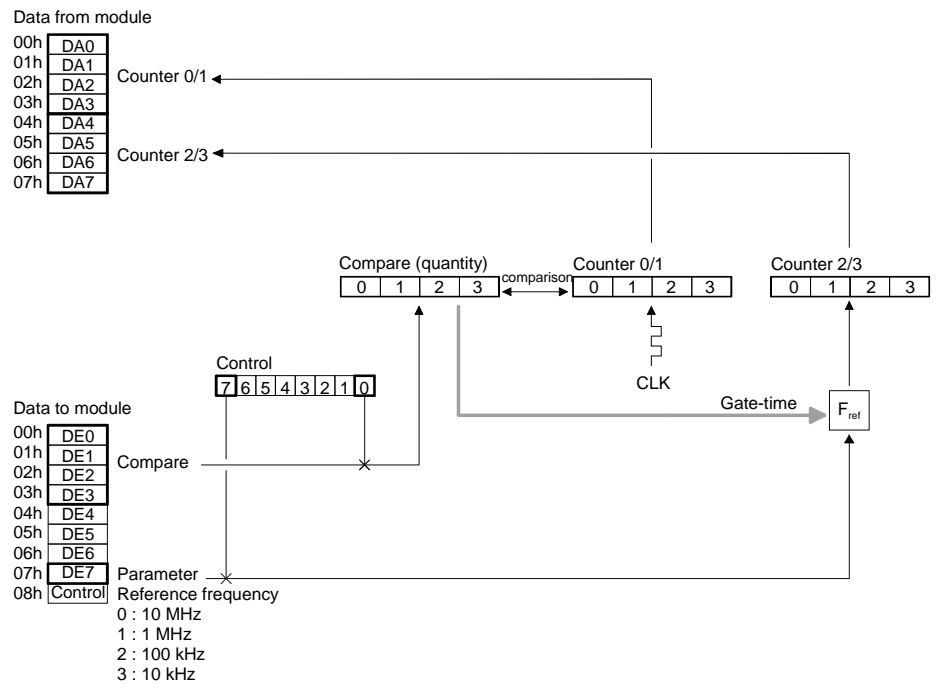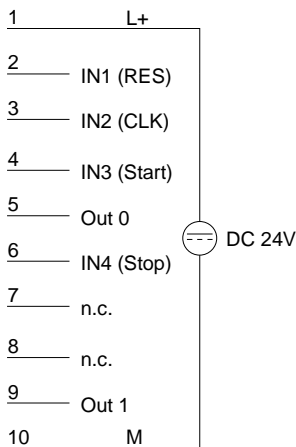
Period calculation   When the measurement has been completed, you may calculate the period as follows:

$$Period = \frac{m}{Fref \cdot n}$$

where *Fref*: reference frequency (supplied in DE7 with control bit 7)

m: contents of counter 2/3 (counts reference clock pulses)

n: number of CLK pulses in counter 0/1 (corresponds to COM-PARE, provided it was not terminated prematurely by Stop)

Timing diagram:
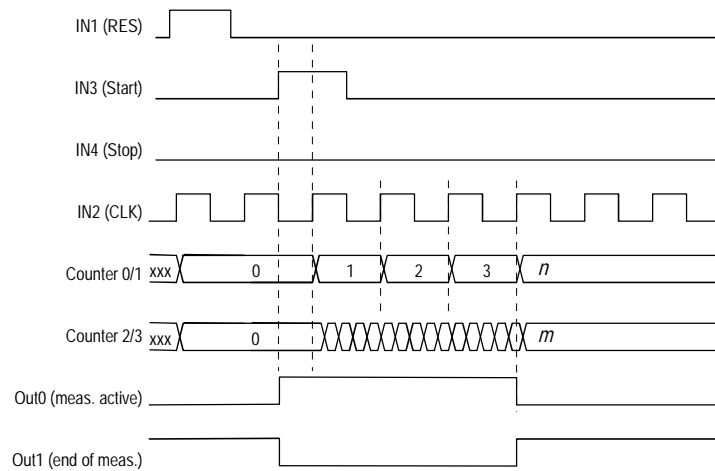
**Mode 18
frequency
measurement with
gate output**

The operation of mode 18 is similar to mode 16. The only difference is the manner in which OUT 0 and OUT 1 are controlled. In this case OUT 0 is only activated when the counting operation starts and it is deactivated when counting ends, i.e. OUT 0 provides an indication of the internal gate. OUT 1 provides the inverted status of the gate.

This mode can not be combined with other modes!

**Pin assignment
access to counter**
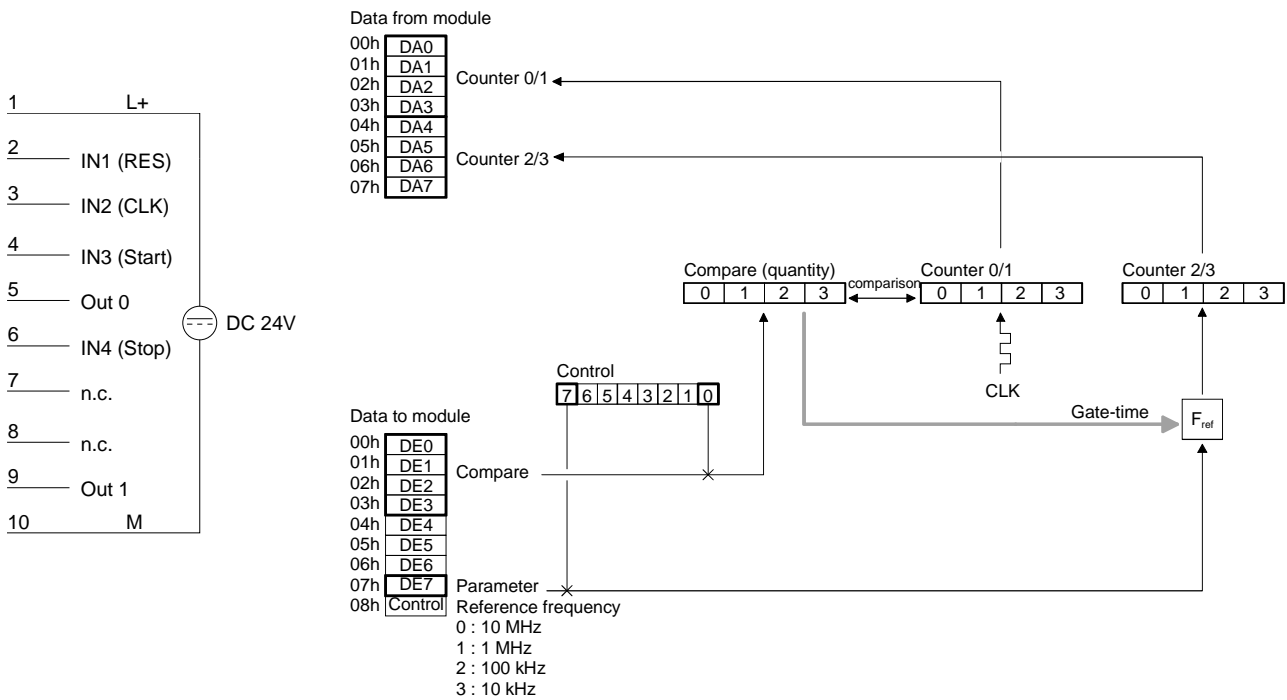
**Frequency
calculation**

When the measurement has been completed, you may calculate the frequency as follows:

$$Frequency = \frac{Fref \cdot m}{n}$$

where *Fref*: reference frequency (supplied in DE7 with control bit 7)

      m: contents of counter 2/3 (CLK pulse count)

      n: number of pulses of the reference frequency in counter 0/1 (corresponds to COMPARE provided it was not terminated prematurely by Stop)

Note!

Counter 2/3 will indicate the exact frequency if you choose *Fref* and *n* so that the formula returns 1Hz precisely.

For example when the applied frequency is 1MHz and the number of pulses is 1 000 000 the result will be 1Hz, i.e. counter 2/3 contains the precise frequency after the measurement - this does not require further conversion.

Timing diagram:
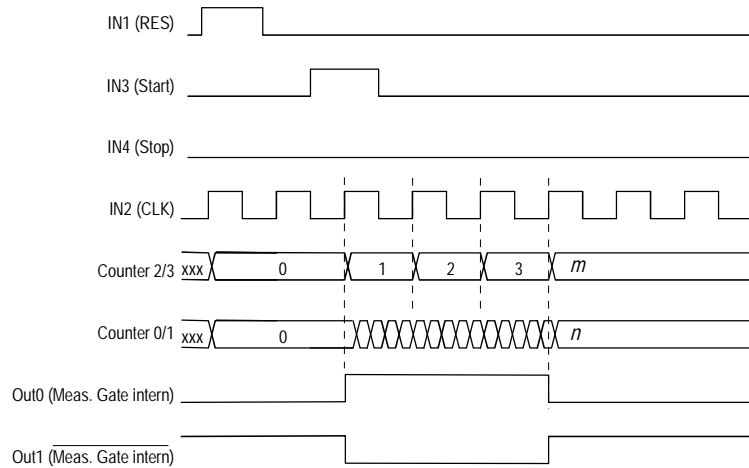
Example

Pulse count = 1 000 000
Reference frequency = 1MHz
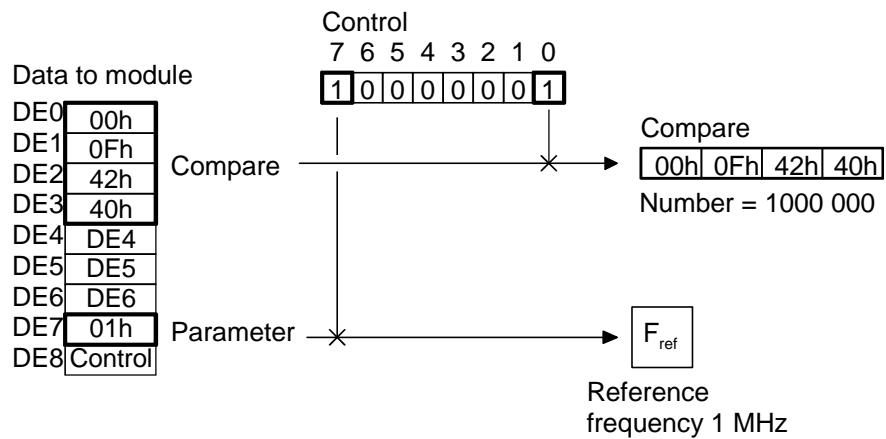
**Mode 19
period
measurement with
gate output**

The operation of mode 19 is identical to mode 17. The only difference is the manner in which OUT 0 and OUT 1 are controlled. Other than for mode 17, OUT 0 is only activated when the counting operation starts and it is deactivated when counting ends, i.e. OUT 0 provides an indication of the internal gate. OUT 1 provides the inverted status of the gate.

This mode can not be combined with other modes!

**Pin assignment
access to counter**
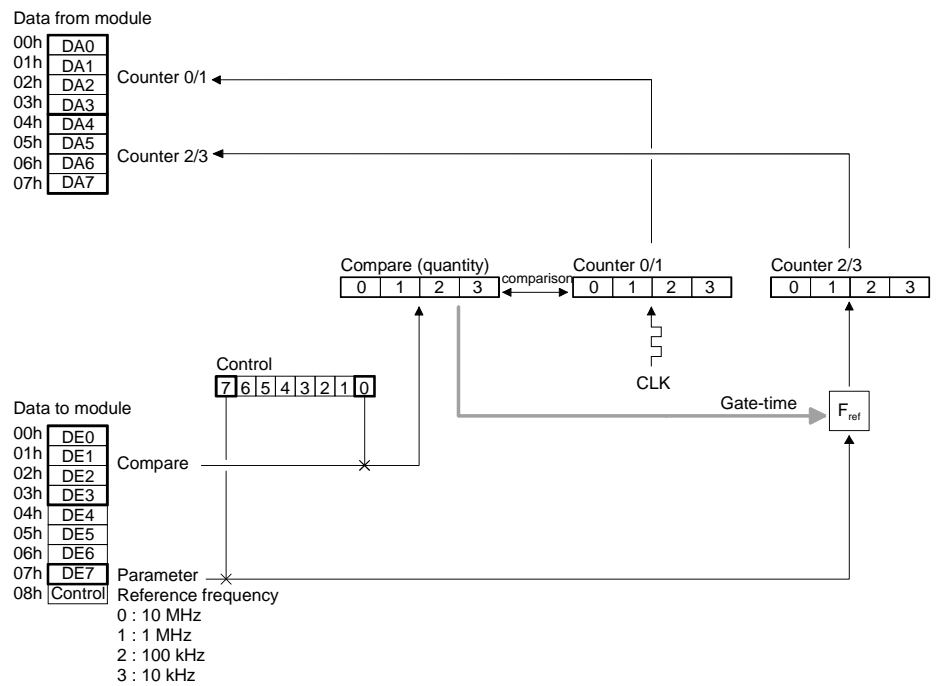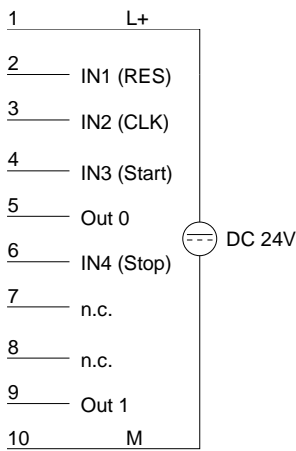
Period calculation   When the measurement has been completed you may calculate the mean period as follows:

$$Period = \frac{m}{Fref \cdot n}$$

where *Fref*: reference frequency (supplied in DE7 with control bit 7)

   m: contents of counter 2/3 (reference clock pulse count)

   n: number of CLK pulses in counter 0/1 (corresponds to COMPARE, provided it was not terminated prematurely by Stop)

Timing diagram:
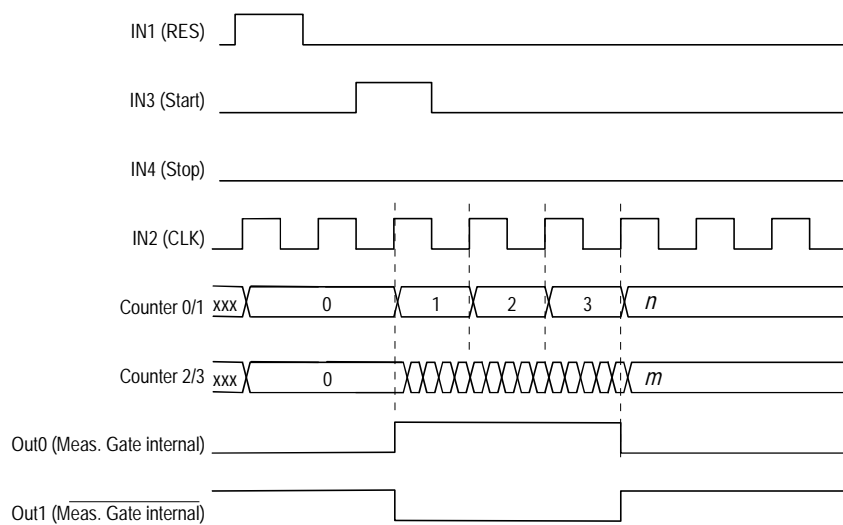
**Mode 6
pulse measuring,
Pulse LOW, 50kHz
with direction
control**

The pulse width of a signal connected to the CLK input is determined by means of an internal time base and saved. The measurement is started with the falling edge of the input signal and it is stopped by the rising edge of the input. This saves the value in 20μs units in a buffer from where it may be retrieved (corresponds to Fref = 50kHz).

Input DIR determines the counting direction of the counter. If DIR is at a LOW level the counter counts up. A HIGH level lets the counter count down.

The input RES has to be at a LOW level. A HIGH at this input would clear the counter.

With the rising edge of the signal pulse, a result is transferred into the DA area; the result remains available until it is overwritten by the next new result.

Signals Out 0 or Out 1 are not modified.

**Pin assignment
access to counter**
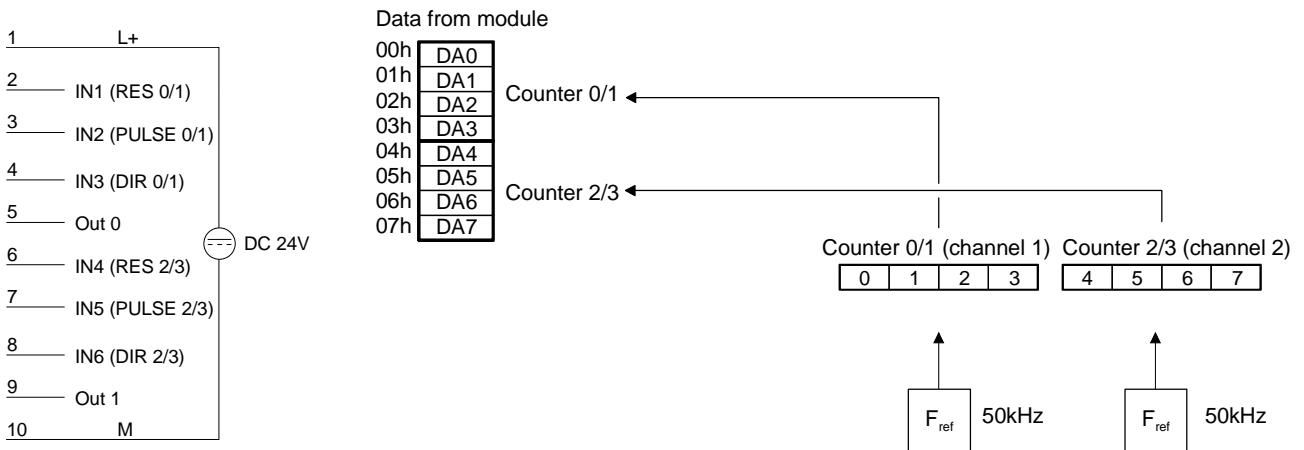
Up counter The RES signal and the DIR signal are reset. The measurement is started by the falling edge at input PULSE and the counter is clocked up by the 50kHz clock. The rising edge of the signal at input PULSE terminates the count operation and the result is transferred into the result register. The result is available to the PLC. The value remains in the result register until a new measurement has been completed which overwrites the register.
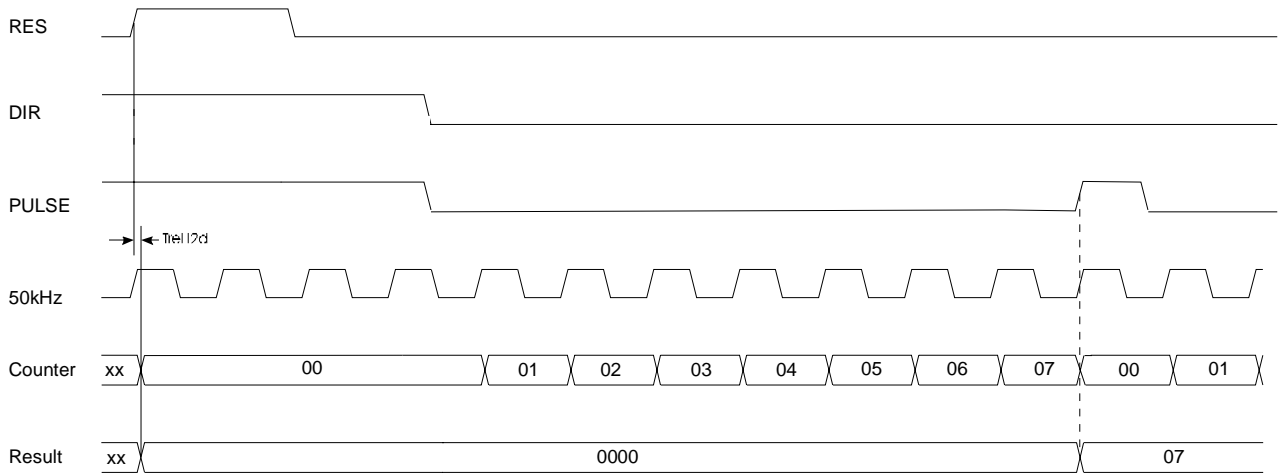
Down counter The RES signal is reset and the DIR signal is placed at a HIGH level. The measurement is started by the falling edge at input PULSE and the counter is clocked down by the 50kHz clock. The rising edge of the signal at input PULSE terminates the count operation and the result is transferred into the result register. The result is available to the PLC. The value remains in the result register until a new measurement has been completed which overwrites the register.
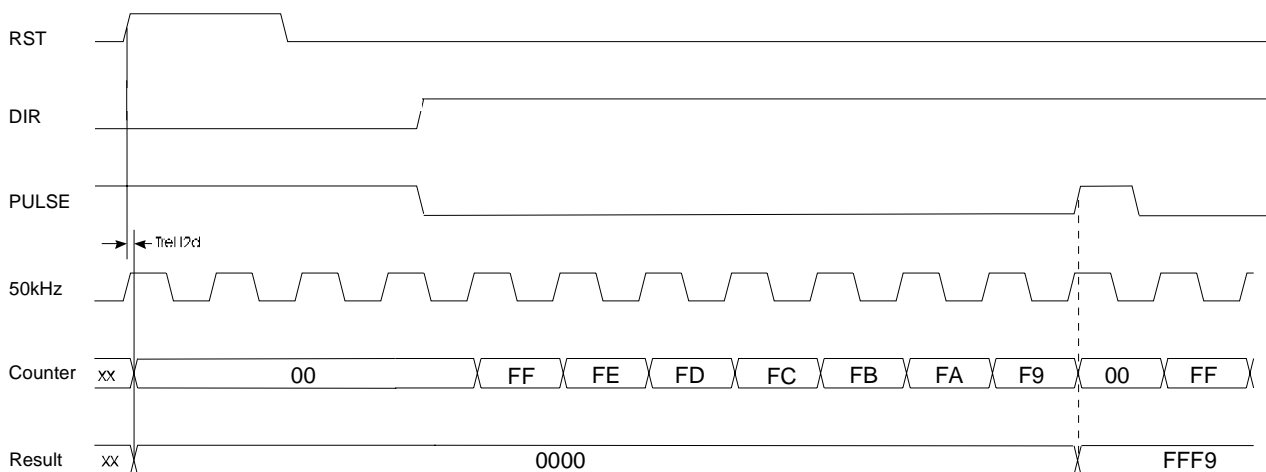
Mode 20
pulse
measurements,
pulse down

prog. time base with direction control

The pulse width of a signal that is applied to the PULSE input is determined by means of an internal time base. The measurement is started by the falling edge of the input signal and ends with the rising edge. The rising edge of the measured signal stores the resulting pulse width in units of $1/F_{ref}$, that may me retrieved again.

Input DIR controls the direction of the count. When DIR is held at a LOW level the counter counts up. When DIR is at a HIGH level the counter counts down.

RES has to be held at LOW during the counting operation. A HIGH level clears the counter.

F_{ref} is programmable.

The OUT signal is not changed.

Pin assignment
access to counter
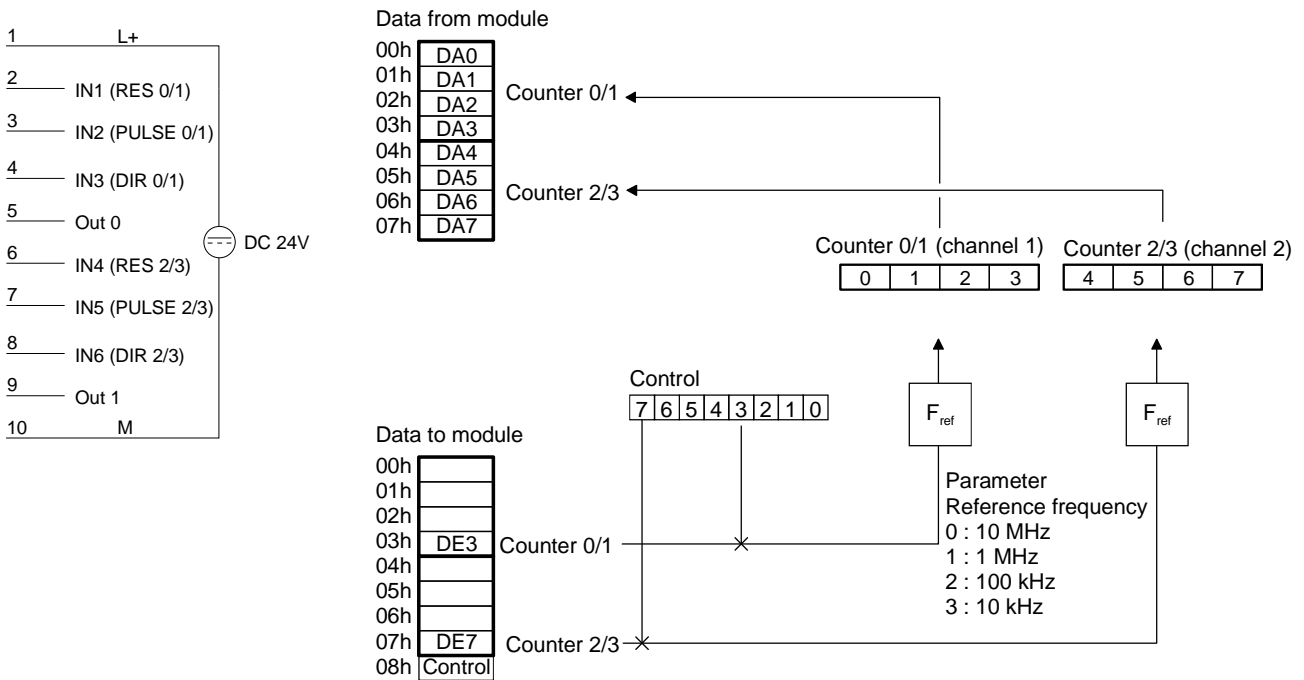
Up counter   The RES signal and the DIR signal are set to LOW. Subsequently the measurement is started with the falling edge of PULSE and the counter counts up in accordance with the selected time base. A rising edge at PULSE terminates the counting operation and the accumulated count is transferred into the result register. The result register is available to the PLC. The value remains in the result register until a new measurement has been completed and the register is changed by the new result.
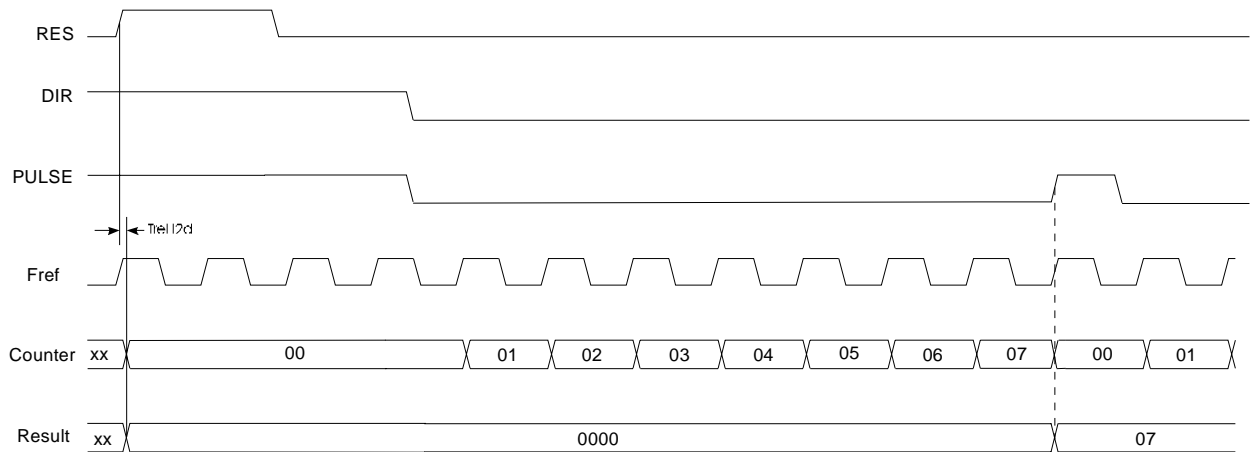
Down counter   The RES signal is set to LOW and the DIR signal to HIGH. Subsequently the measurement is started with the falling edge of PULSE and the counter counts down in accordance with the selected time base. A rising edge at PULSE terminates the counting operation and the accumulated count is transferred into the result register. The result register is available to the PLC. The value remains in the result register until a new measurement has been completed and the register is changed by the new result.
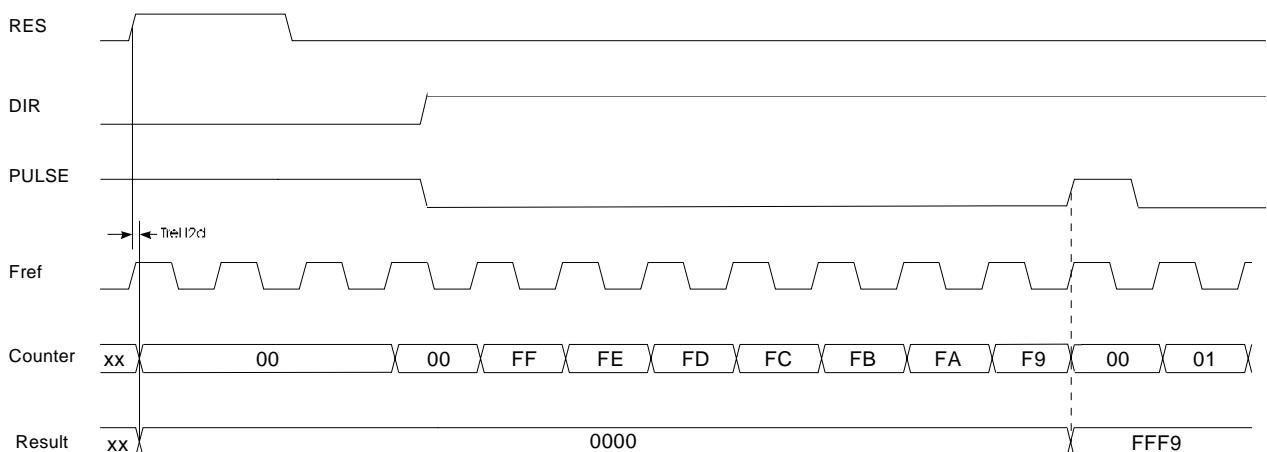
**Mode 21
pulse width
measurement,
pulse LOW**

Direction up, prog. time base, with release

The pulse width of a signal applied to the PULSE input is determined by means of a programmable time base (Fref). The measurement starts with the falling edge of the input signal and it is stopped by the rising edge of the input signal. The rising edge of the input signal saves the resulting pulse width in units of 1/Fref. This is available to other devices.

A condition for the function is that a HIGH level is applied to the GATE input.

Input RES must be at a LOW level. A HIGH level at this input would clear the counter.

The OUT signal is not modified.

**Pin assignment
access to counter**

Up counter   The RES signal is set to zero. The measurement can only be started when the GATE signal is at a HIGH level. The measurement is started with the falling edge of PULSE and the counter counts up in accordance with the selected time base. A rising edge at PULSE terminates the counting operation and the accumulated count is transferred into the result register. The result register is available to the PLC. The value remains in the result register until a new measurement has been completed and the register is changed by the new result.
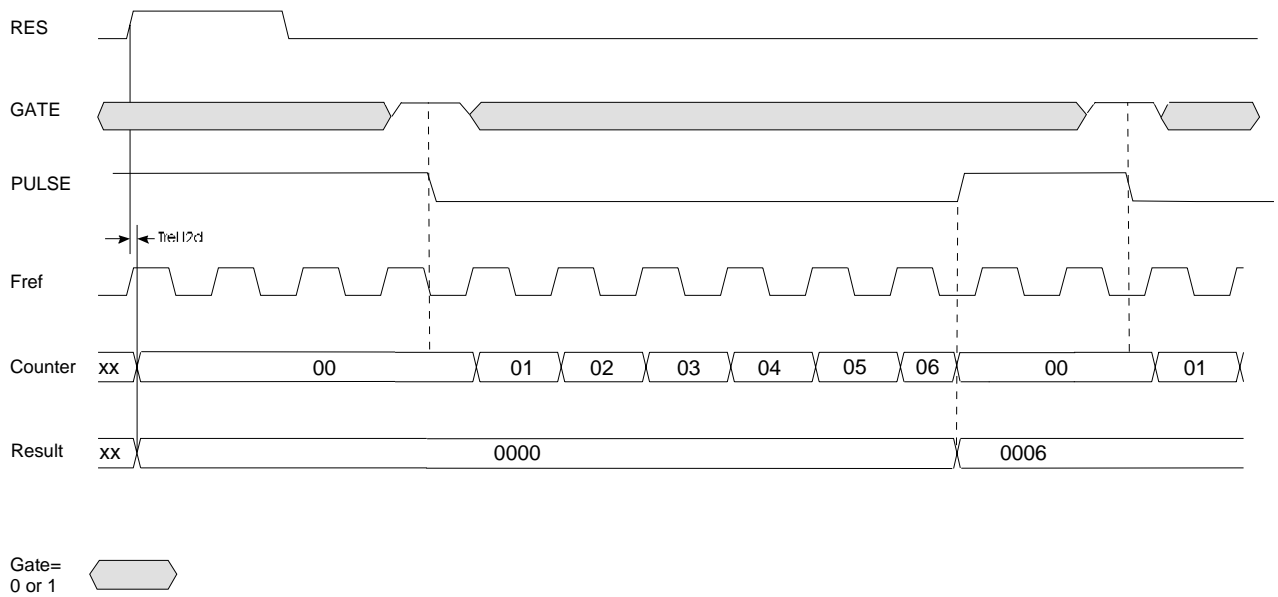
**Mode 22
pulse width
measurement,
pulse HIGH**

Direction up, prog. time base, with release

The pulse width of a signal applied to the PULSE input is determined by means of a programmable time base (Fref). The measuring starts with the rising edge of the input signal and ends with the falling edge. The rising edge of the input signal saves the resulting pulse width in units of 1/Fref. This is available to other devices.

A condition for the function is that a HIGH level is applied to the GATE.

Input RES must be at a LOW level. A HIGH level at this input would clear the counter.

The OUT signal is not modified.

**Pin assignment
access to counter**
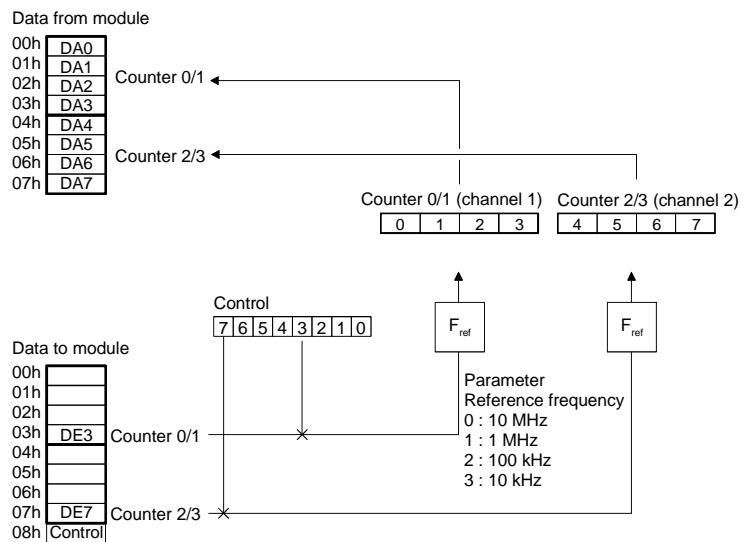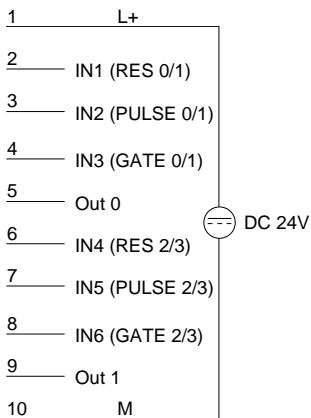
Up counter   The RES signal is set to zero. The measuring only starts if the GATE signal is set to HIGH with the rising edge at PULSE. A falling edge at PULSE terminates the counting operation and the accumulated count is transferred into the result register. The result register is available to the PLC. The value remains in the result register until a new measurement has been completed and the register is changed by the new result.

RES

GATE

PULSE

Tref l2d

Fref

Counter xx | 00 | 01 | 02 | 03 | 04 | 05 | 06 | 00 | 01

Result xx | 0000 | 0006
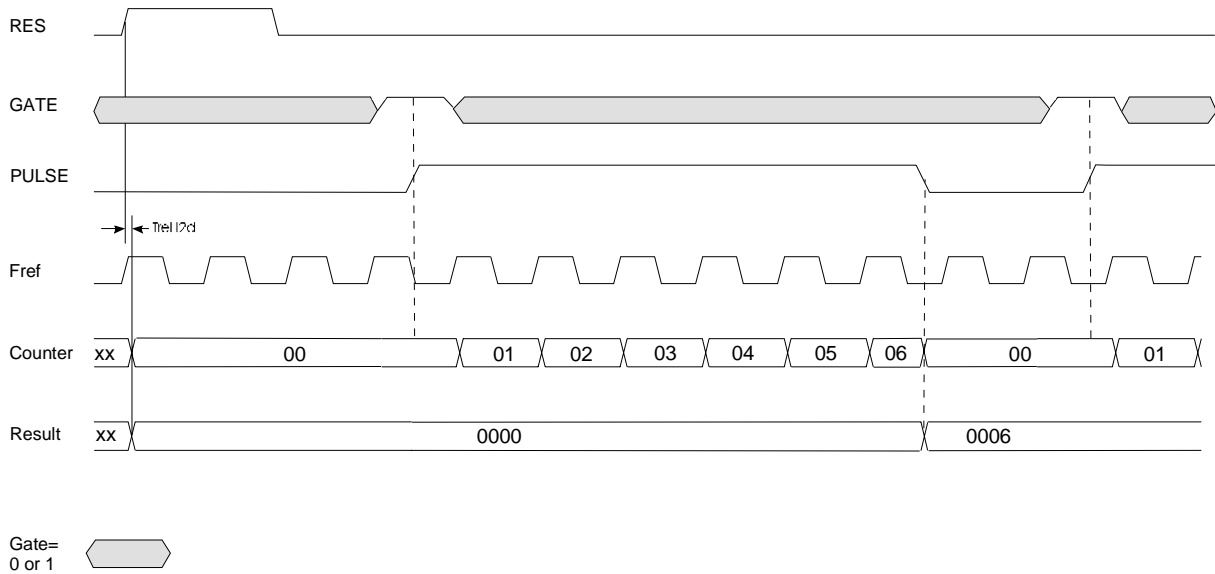
Gate=
0 or 1

**Mode 23
One Shot, count
up, with release,
output signal**

In mode 23 you may implement one 32Bit counter per channel, each one controlled by a GATE signal. Every rising edge of the input clock increments the counter by 1 as long as the signal applied to GATE is HIGH. RES must be at a LOW level. A HIGH level clears the counter. The counter is started by loading. Starting the counter, the output OUT is set active (HIGH). OUT is cleared when the value entered into COMPARE is reached. The counter will continue the count operation after the value in COMPARE was reached.

Mode 23 - One Shot, up with Gate input, Output set

**Pin assignment
access to counter**
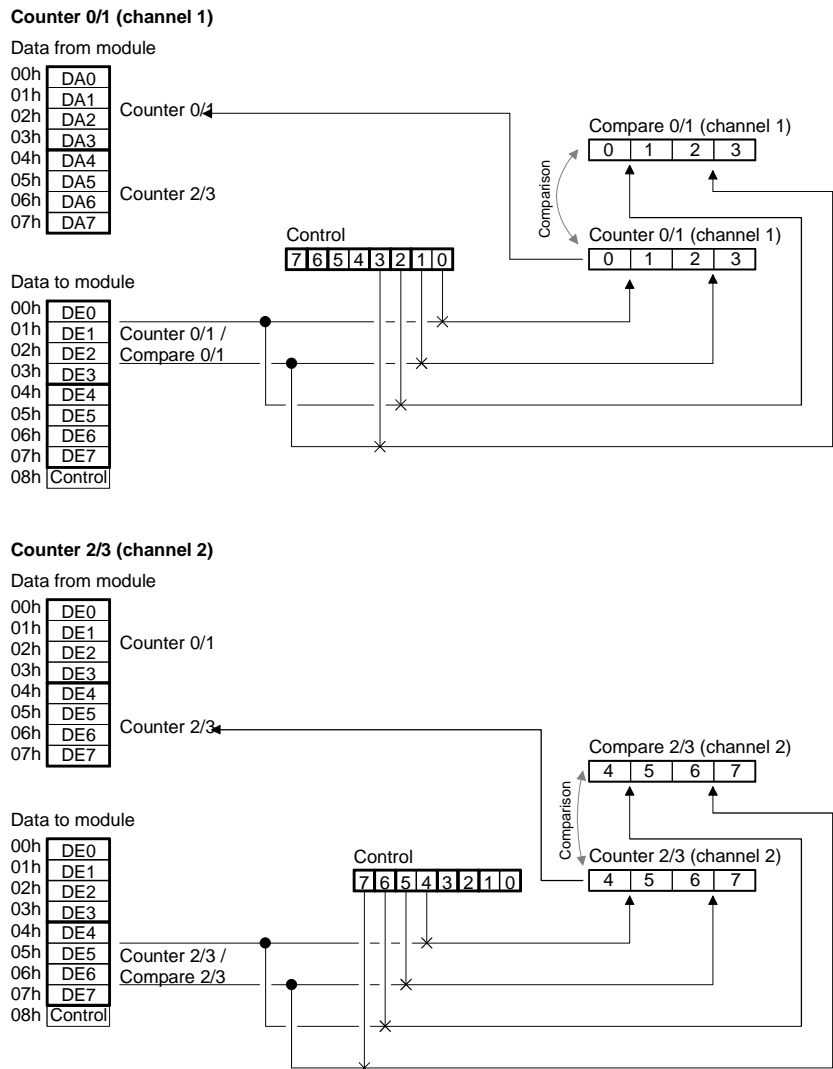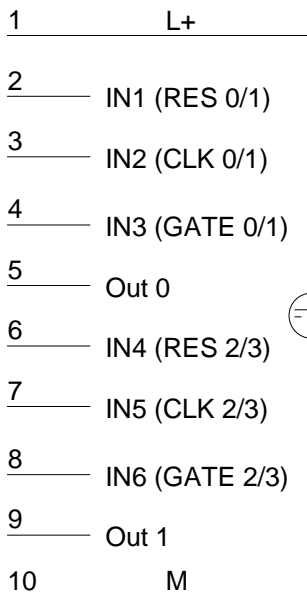
Timing diagram   Example of counter 0/1 in mode 23:
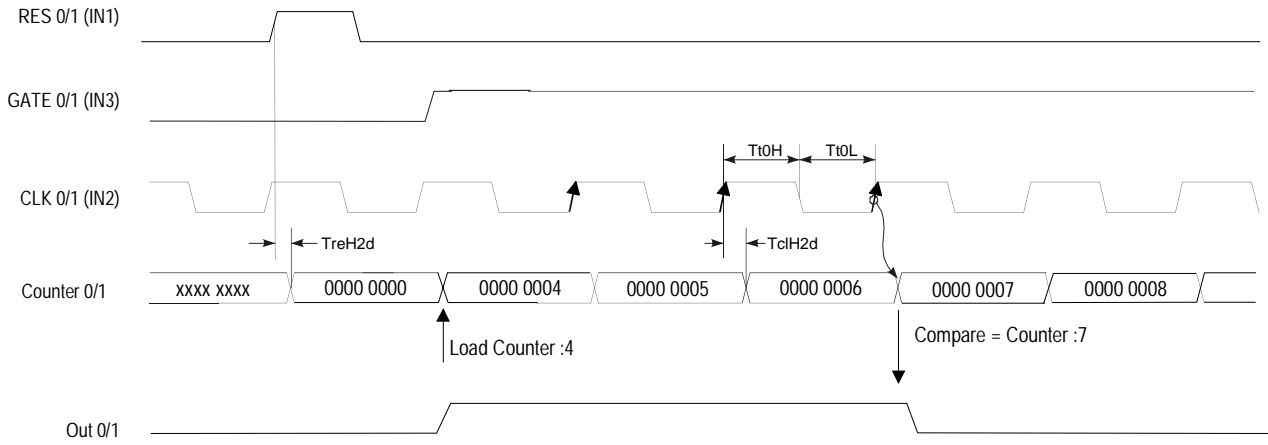
Mode 24
One Shot, count down, with gate, output signal

In mode 24 you may implement one 32Bit counter per channel, each one controlled by the signal applied to the GATE input. Every rising edge of the input clock decrements the counter by 1 as long as the signal applied to GATE is HIGH. RES must be at a LOW level. A HIGH level at this input would clear the counter. The counter is started by loading. Starting the counter, the output OUT is set active (HIGH). OUT is cleared when the value entered into COMPARE is reached. The counter will continue the count operation after the value in COMPARE was reached.

Mode 24 - One Shot, down with Gate-Input, Output set

Pin assignment access to counter
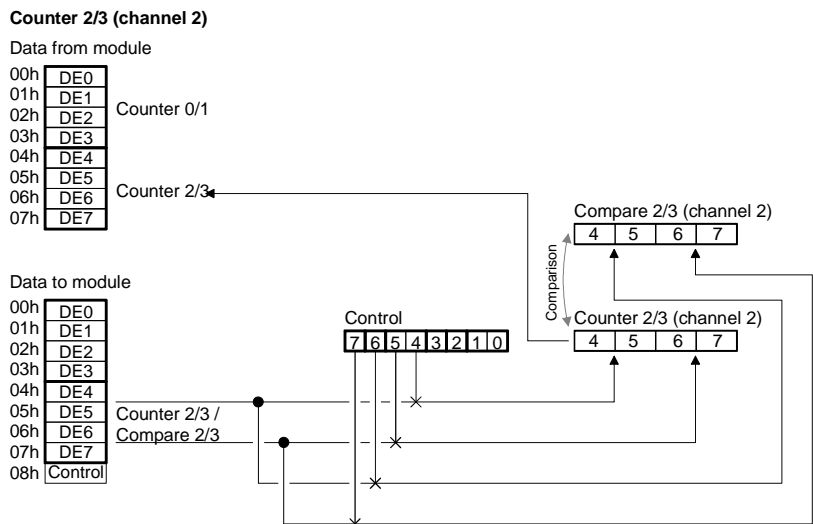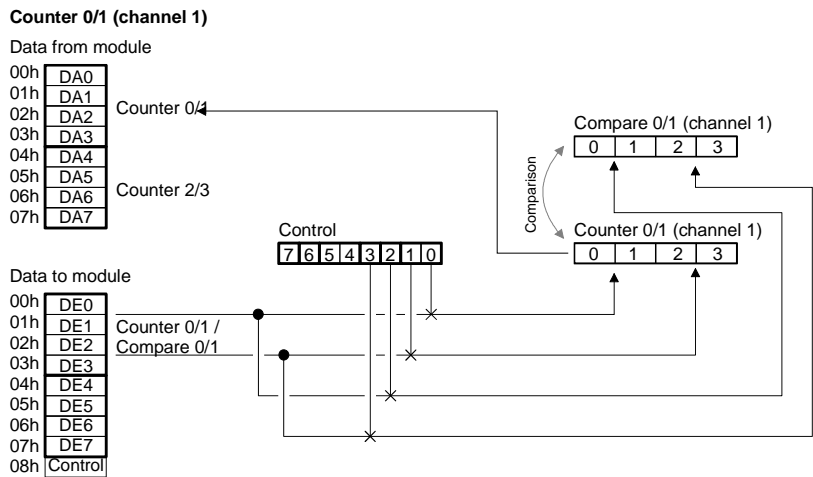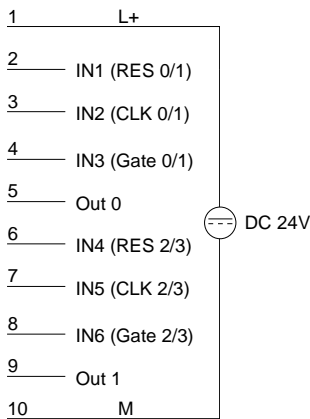
Timing diagram   Example of counter 0/1 in mode 24:
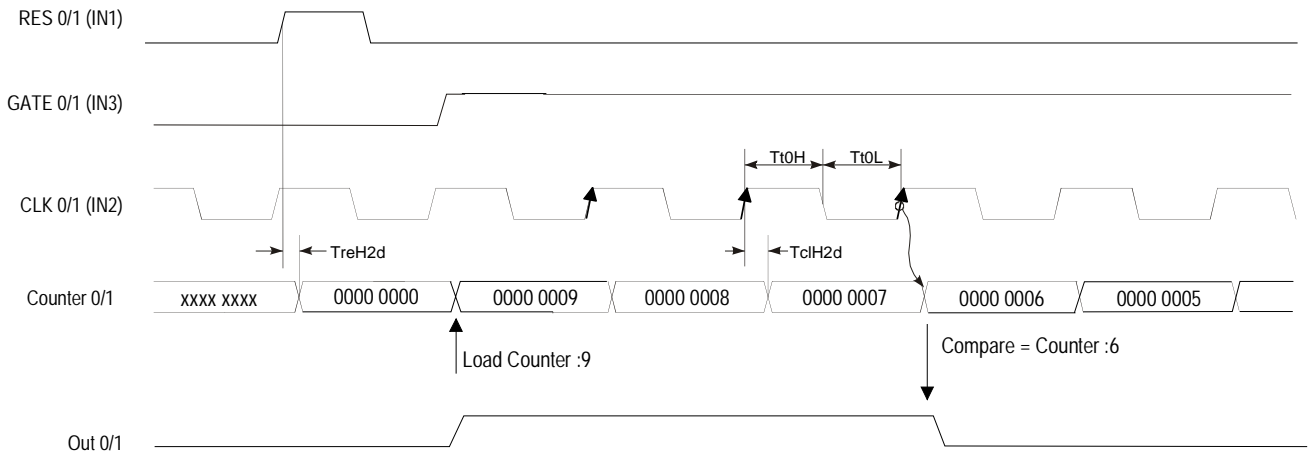
Mode 25
One Shot, count up, with reset signal

In mode 25 you may implement one 32Bit counter per channel, each one controlled by the signal applied to the GATE input. Every rising edge of the input clock increments the counter by 1 as long as the signal applied to GATE is HIGH. RES must be at a LOW level. A HIGH level at this input would clear the counter. The counter is started by loading. Starting the counter, the output OUT is set active (LOW). OUT becomes HIGH when the value entered into COMPARE is reached.

Mode 25 One Shot, count up, Reset

Pin assignment access to counter

Timing diagram   Example of counter 0/1 in mode 25:

RES 0/1 (IN1)

GATE 0/1 (IN3)

CLK 0/1 (IN2)

| | TtOH | TtOL | |

TreH2d

TclH2d

Counter 0/1   xxxx xxxx   0000 0000   0000 0004   0000 0005   0000 0006   0000 0007   0000 0008

Load Counter :4

Compare = Counter 7

Out 0/1

Load Counter
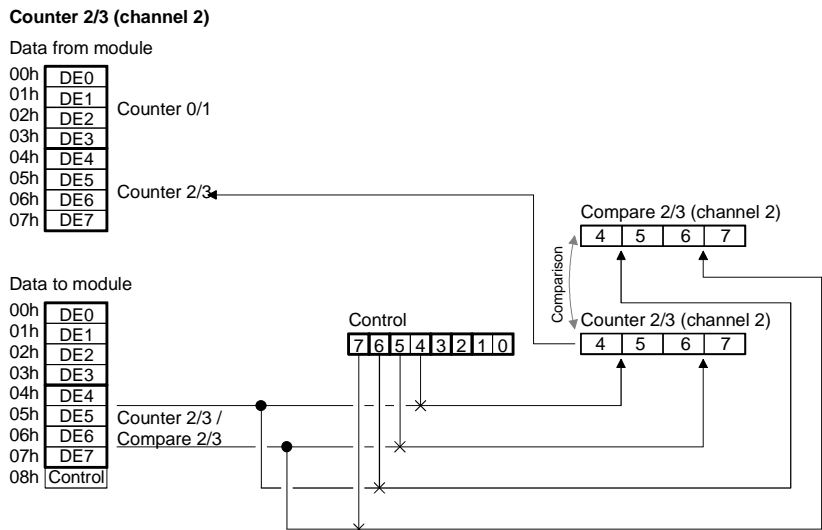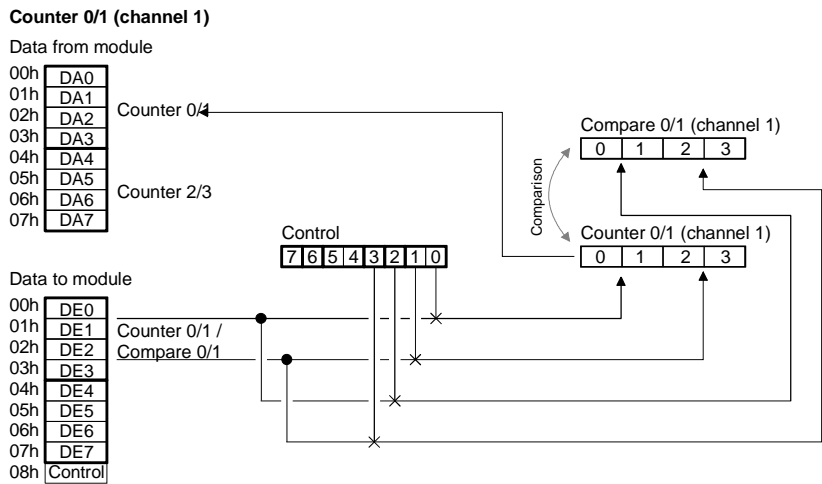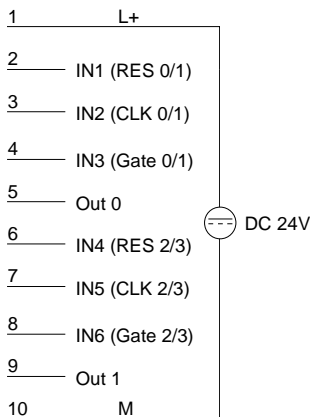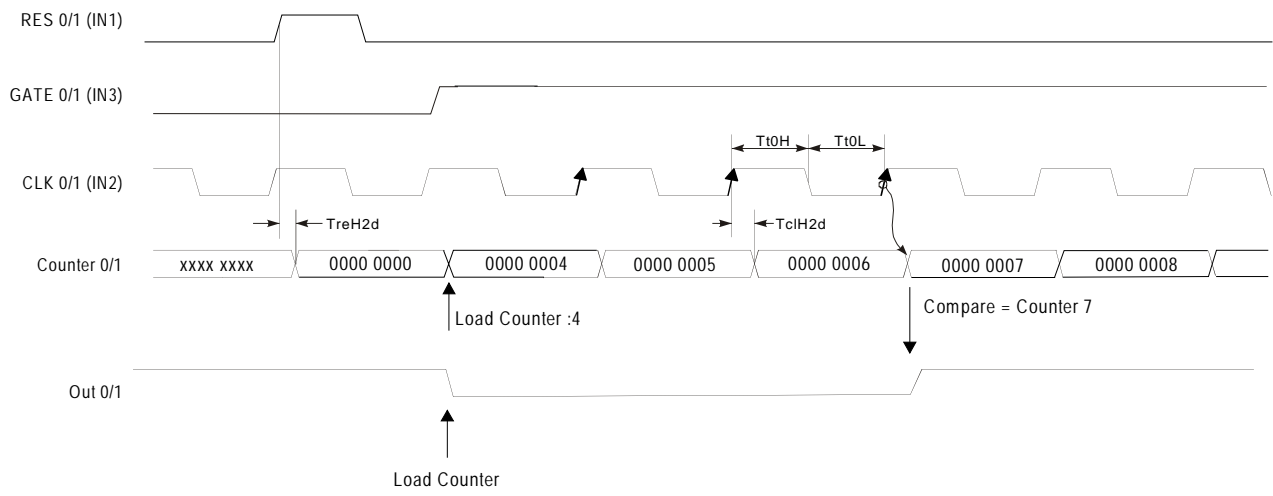
**Mode 26
One Shot, count
down, with reset
signal**

In mode 26 you may implement one 32Bit counter per channel, each one controlled by the signal applied to the GATE input. Every rising edge of the input clock decrements the counter by 1 as long as the signal applied to GATE is HIGH. RES must be at a LOW level. A HIGH level at this input would clear the counter. The counter is started by loading. Starting the counter, the output OUT is set active (LOW). OUT becomes HIGH when the value entered into COMPARE is reached.

Mode 26 - One Shot, down, Reset

**Pin assignment
access to counter**
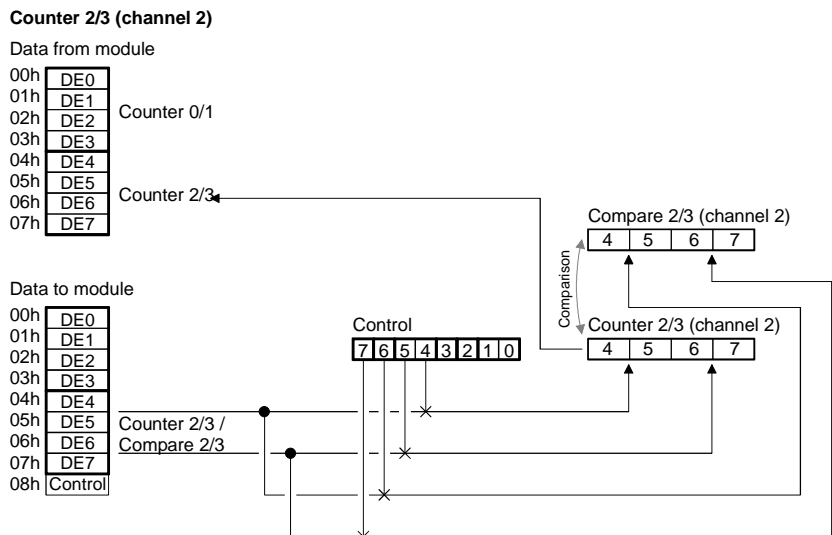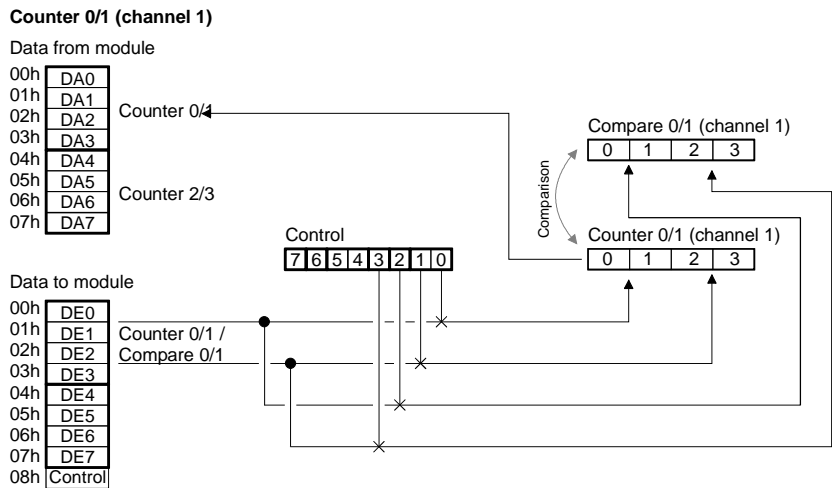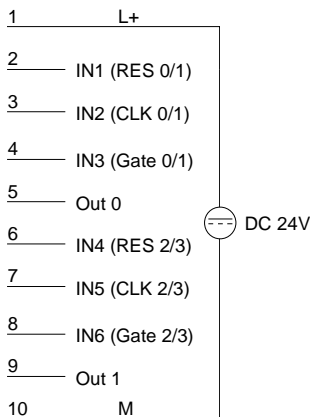
Timing diagram   Example of counter 0/1 in mode 26:
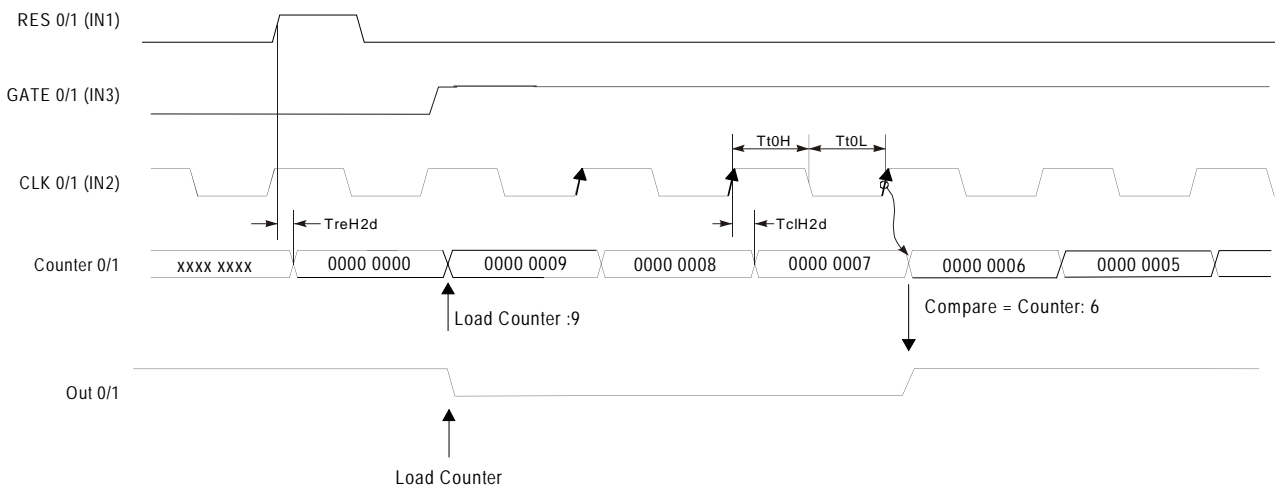
**Mode 27
32Bit counter**

You determine the direction by means of the DIR input (IN3 or IN6). Every rising or falling edge of the input clock signal increments or decrements the counter. The rising edge of the signal Gate/R$^\uparrow$ resets the counter. During the count process, the signal Gate/R$^\uparrow$ has to be HIGH. When the signal Gate/R$^\uparrow$ becomes "0", the counter value remains valid. When the counter reaches zero, output OUT of the respective counter is active for a minimum period of 100ms, even if the counter should continue counting. If the counter stops at zero, the output remains active.
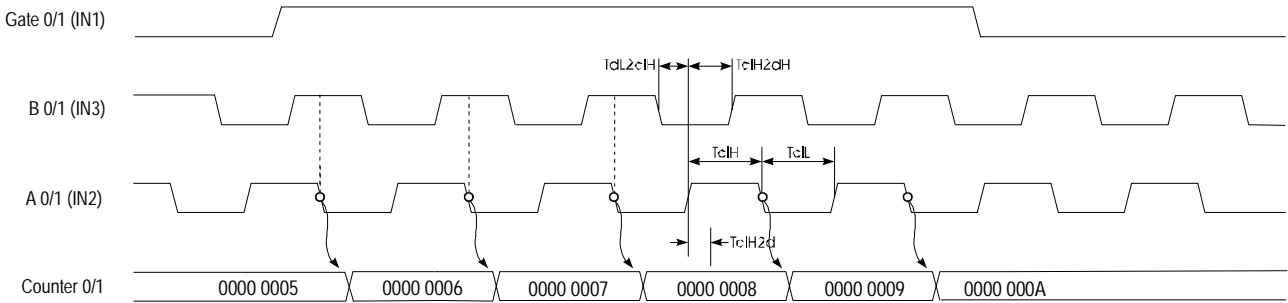
**Pin assignment
access to counter**
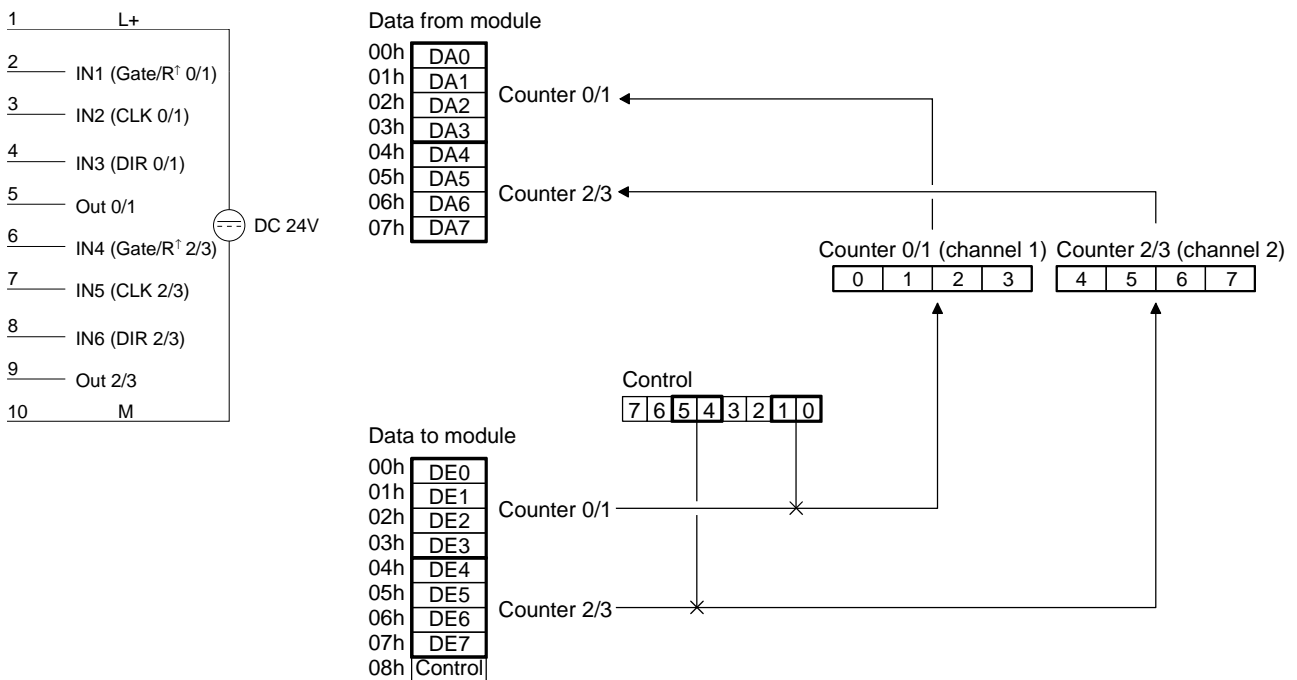
Up counter   In mode 27, a LOW level at the DIR input configures the counter for counting up.

Timing diagram of the counter 0/1 example:

Gate/R↑ 0/1 (IN1)

Reset

DIR 0/1 (IN3)

TtoH   TtoL

CLK 0/1 (IN2)

TclH2d

Counter 0/1   xxxx   0000   0000 0001   0000 0002   0000 0003   0000 0004
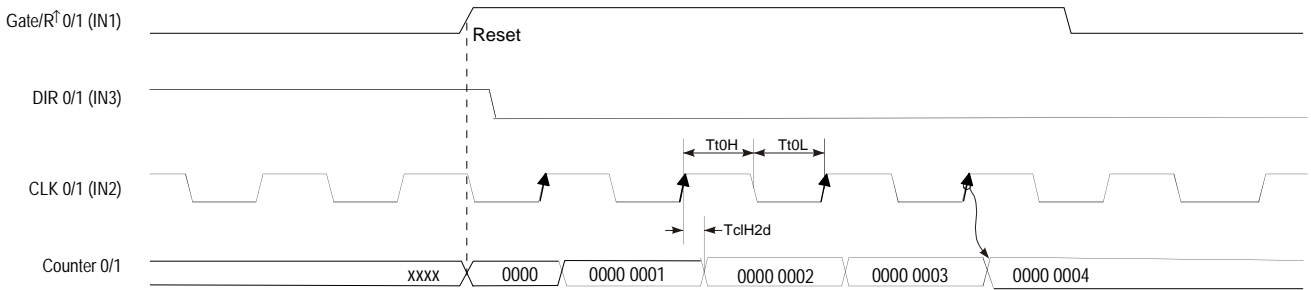
Down counter   In mode 27, a HIGH level at the DIR input configures the counter for counting down.

Timing diagram of the counter 0/1 example:

Gate/R↑ 0/1 (IN1)

Reset

DIR 0/1 (IN3)

TtoH   TtoL

CLK 0/1 (IN2)

TclH2d

Counter 0/1   xxxx   0000   FFFF FFFF   FFFF FFFE   FFFF FFFD   FFFF FFFC
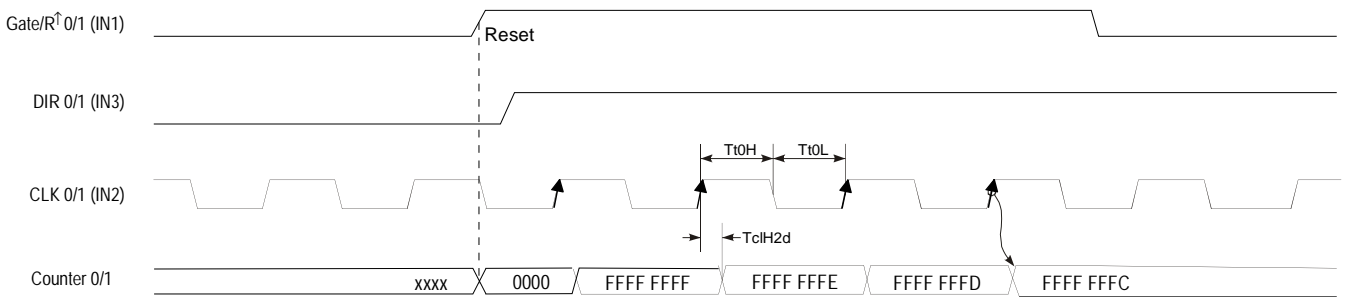
Mode 28
Encoder 1 edge

In mode 28 you may configure an encoder for one of the channels. Depending on the direction of rotation this encoder will increment or decrement the internal counter with every falling edge. The rising edge of the signal Gate/R$^\uparrow$ resets the counter. During the count process, the signal Gate/R$^\uparrow$ has to be HIGH. When the signal Gate/R$^\uparrow$ becomes "0", the counter value remains valid. When the counter reaches zero, output OUT of the respective counter is active for a minimum period of 100ms, even if the counter continues counting. If the counter stops at zero the output remains active.

Pin assignment
access to counter

Up counter   Every falling edge of the signal at input A increments the counter if input B
                       is at HIGH level at this moment.

                       Timing diagram for the counter 0/1 example:

Down counter   Every rising edge of the signal at input A decrements the internal counter if
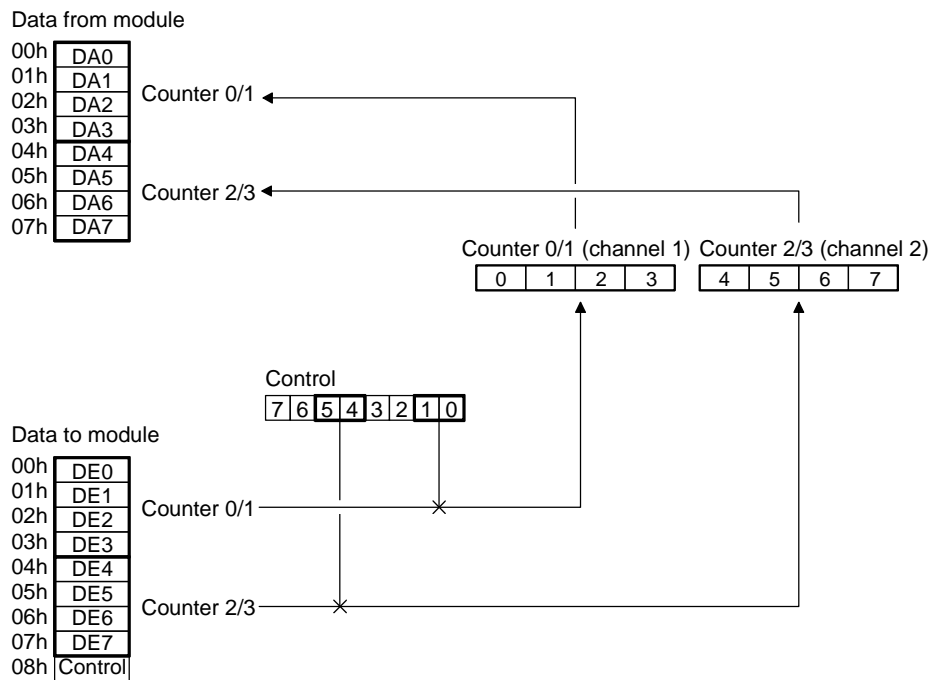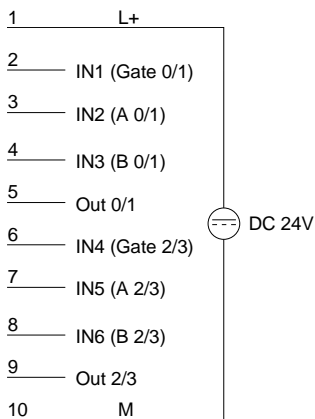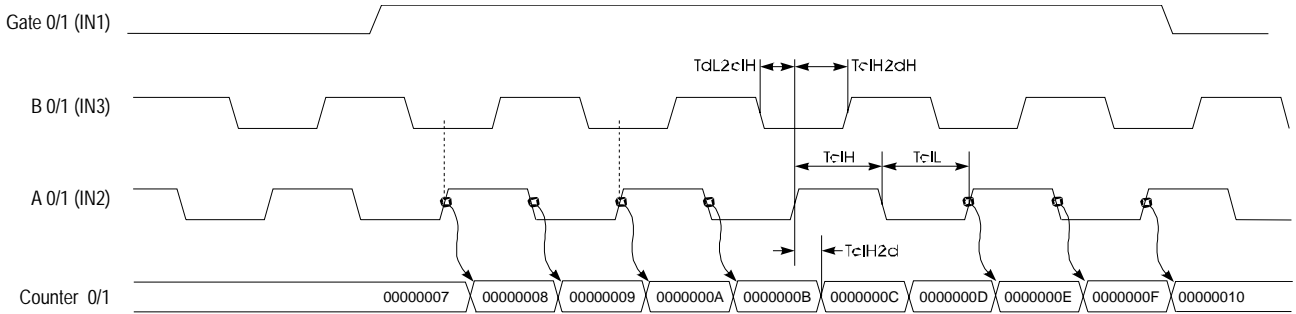   input B is at HIGH level at this moment.

                       Timing diagram for the counter 0/1 example:

Mode 29
Encoder 2 edges

Every rising or falling edge of the signal at input A changes the counter by 1. The direction of the count depends on the level of the signal applied to input B. The rising edge of the signal Gate/R$^\uparrow$ resets the counter. During the count process, the signal Gate/R$^\uparrow$ has to be HIGH. When the signal Gate/R$^\uparrow$ becomes "0", the counter value remains valid. When the counter reaches zero, output OUT of the respective counter is active for a minimum period of 100ms, even if the counter continues counting. If the counter stops at zero the output remains active.

Pin assignment
access to counter

Up counter

The counter is incremented by the rising edge of signal A if input B is at a LOW level or by the falling edge of input A when input B is at a HIGH level.
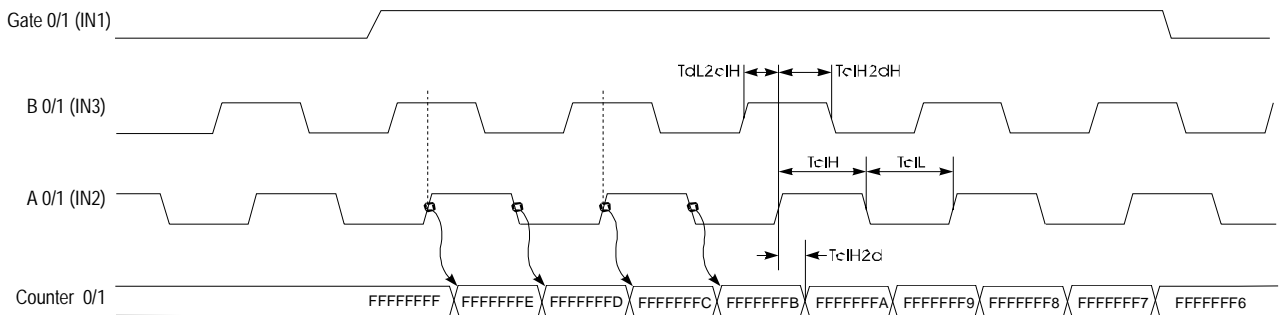
Timing diagram for the counter 0/1 example:

Down-counter

The counter is decremented by the rising edge of signal A if input B is at a HIGH level or by the falling edge of input A when input B is at a LOW level.
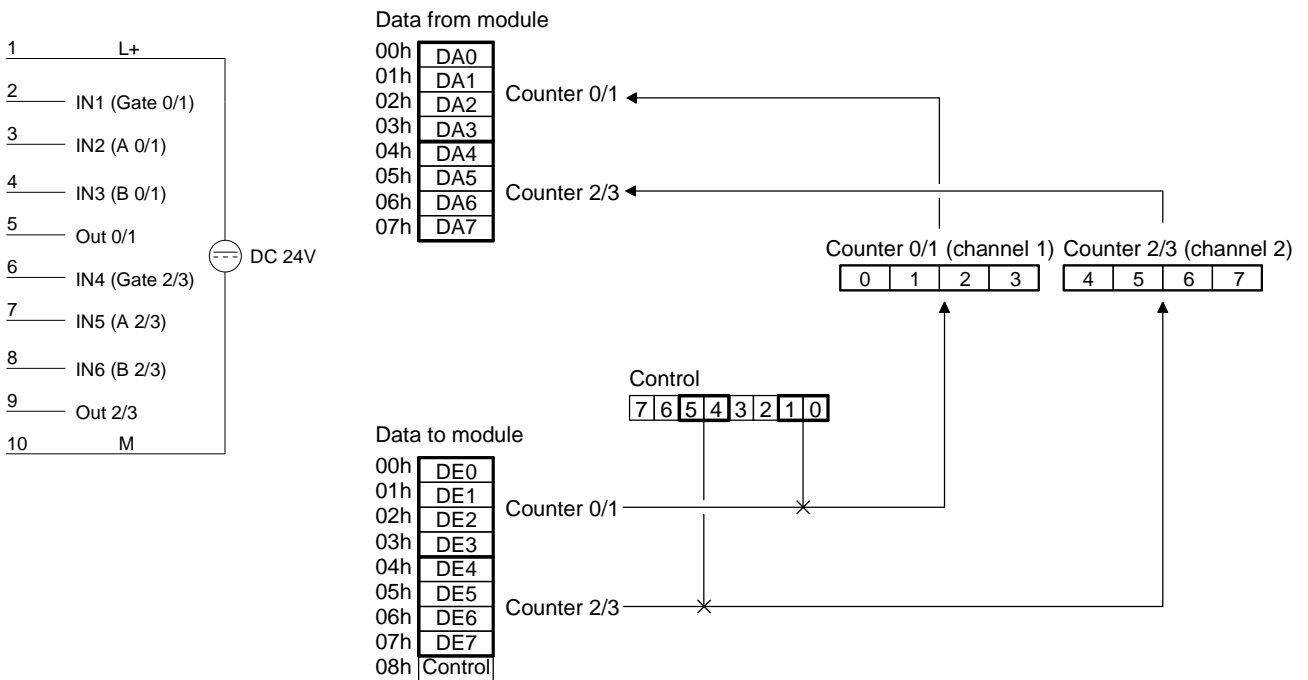
Timing diagram for the counter 0/1 example:

Mode 30
Encoder 4 edges

Every rising or falling edge at inputs A or B increments or decrements the counter. The direction depends on the level applied to the other input (B or A). The rising edge of the signal Gate/R$^\uparrow$ resets the counter. During the count process, the signal Gate/R$^\uparrow$ has to be HIGH. When the signal Gate/R$^\uparrow$ becomes "0", the counter value remains valid. When the counter reaches zero, output OUT of the respective counter is active for a minimum period of 100ms, even if the counter continues counting. If the counter stops at zero, the output remains active.
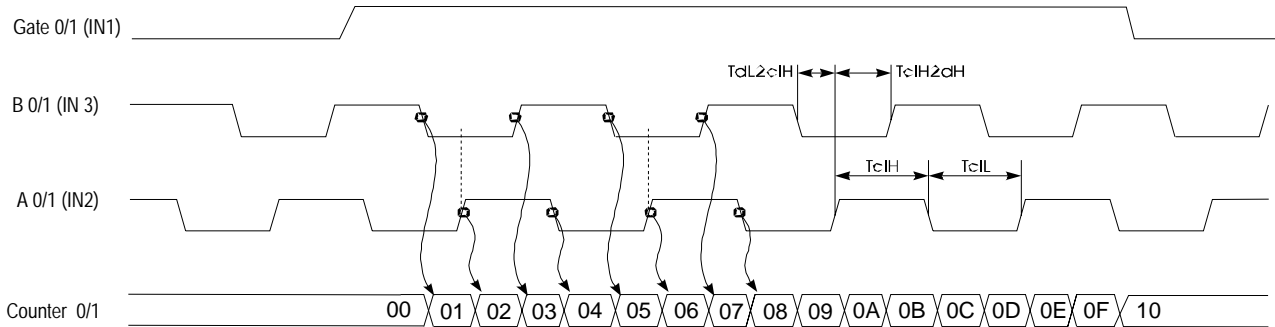
Pin assignment
access to counter

Pin	Signal
1	L+
2	IN1 (Gate/R$^\uparrow$ 0/1)
3	IN2 (A 0/1)
4	IN3 (B 0/1)
5	Out 0/1
6	IN4 (Gate/R$^\uparrow$ 2/3)
7	IN5 (A 2/3)
8	IN6 (B 2/3)
9	Out 2/3
10	M

DC 24V

Data from module

00h	DA0	
01h	DA1	Counter 0/1
02h	DA2	
03h	DA3	
04h	DA4	
05h	DA5	Counter 2/3
06h	DA6	
07h	DA7	

Counter 0/1 (channel 1)   Counter 2/3 (channel 2)

| 0 | 1 | 2 | 3 | | 4 | 5 | 6 | 7 |

Control

| 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 |

Data to module

00h	DE0	
01h	DE1	Counter 0/1
02h	DE2	
03h	DE3	
04h	DE4	
05h	DE5	Counter 2/3
06h	DE6	
07h	DE7	
08h	Control	

Up counter   The counter is incremented when a rising edge is applied to B while input A is at a HIGH level or if a falling edge is applied to B when input A is at a LOW level. Alternatively it is also incremented when a rising edge is applied to A when input B is at a LOW level or by a falling edge at A when input B is at a HIGH level.
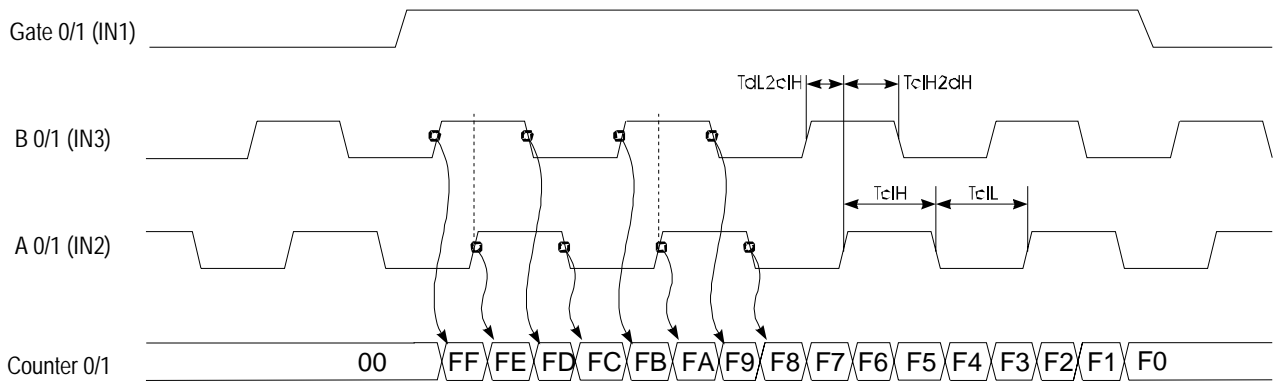
Timing diagram for the counter 0/1 example:

Down counter   The counter is decremented when a rising edge is applied to B while input A is at a LOW level or if a falling edge is applied to B when input A is at a HIGH level. Alternatively it is also decremented when a rising edge is applied to A when input B is at a HIGH level or by a falling edge at input A when input B is at a LOW level.

Timing diagram for counter 0/1 example:

Mode 31 and 32 32bit counter with gate

In mode 31 and mode 32 you can implement a 32Bit counter that is controlled by a gating signal (Gate). The direction of counting depends on the selected mode. Every rising edge of the input signal increments or decrements the counter provided that the GATE signal is at HIGH level. A rising edge of RES$^\uparrow$ clears the counter. When the counter reaches the value that was previously loaded into the compare register, output OUT is set active for a minimum period of 100ms while the counter continues counting.

Mode 31 - 32Bit counter up + gate with compare

Mode 32 - 32Bit counter down + gate with compare

Pin assignment access to counter
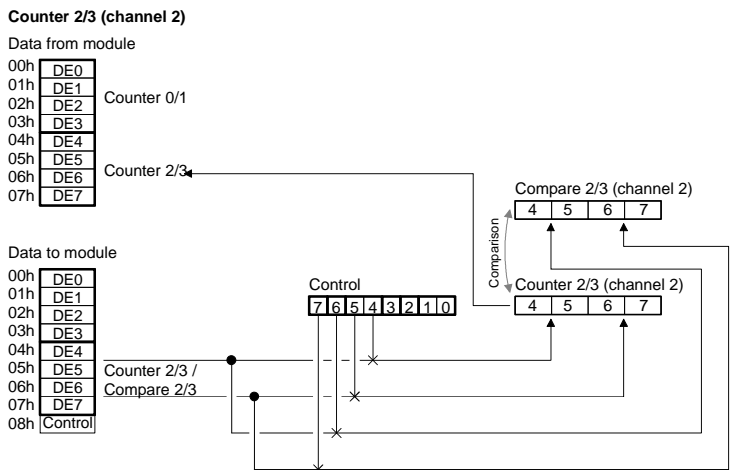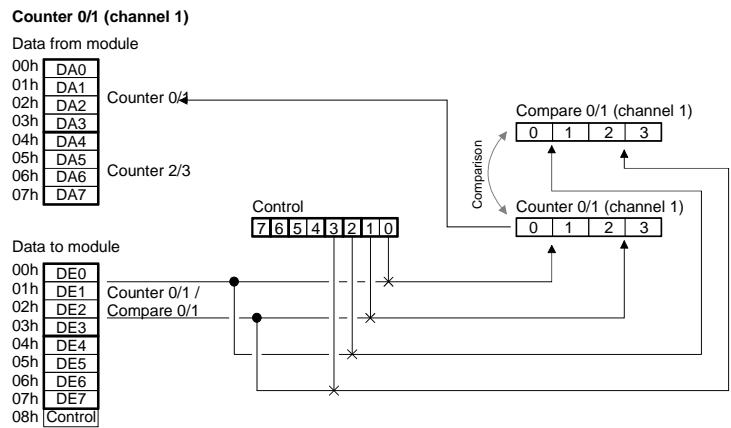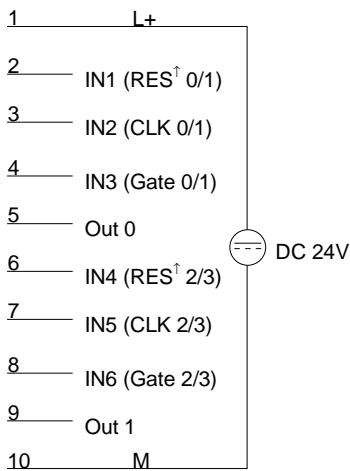
Timing diagram

Below follows an example of a timing diagram of counter 0/1 in mode 31:
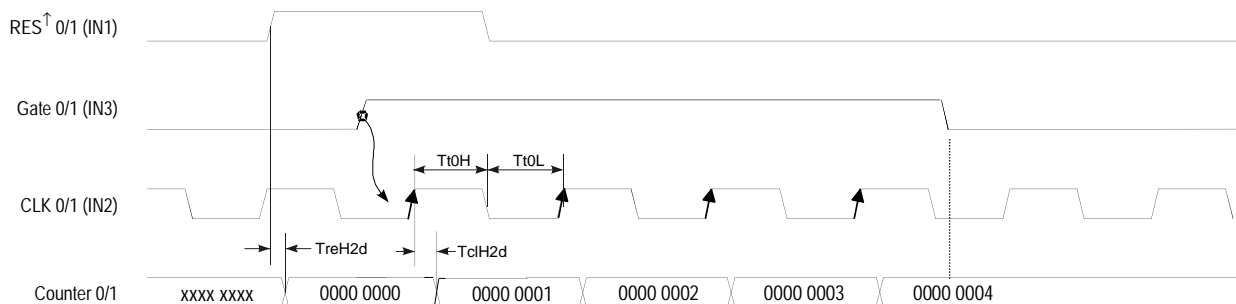
Mode 33 and 34 32Bit counter with gate and auto reload

Modes 33 and 34 operate in the same manner as mode 31 and 32 with the addition of an Auto Reload function. The "Auto Reload" is used to define a value in the load register that is used to preset the counter automatically when it reaches the compare value.

A rising edge of RES$^{\uparrow}$ clears the counter to 0000 0000. A HIGH level applied to GATE enables the counter so that is incremented/decremented by every rising edge of the CLK signal. As long as GATE is HIGH, the counter will count every rising edge of the signal applied to CLK until the count is one less than the value entered into COMPARE. The next pulse overwrites the counter with the value contained in the load register. This process continues until GATE is set to a LOW level. When an auto reload occurs, the status of the respective output changes.

The RES$^{\uparrow}$ signal only resets the counter but not the outputs.

Mode 33 - 32Bit counter up + gate with compare and auto reload

Mode 34 - 32Bit counter down + gate with compare and auto reload

Pin assignment access to counter
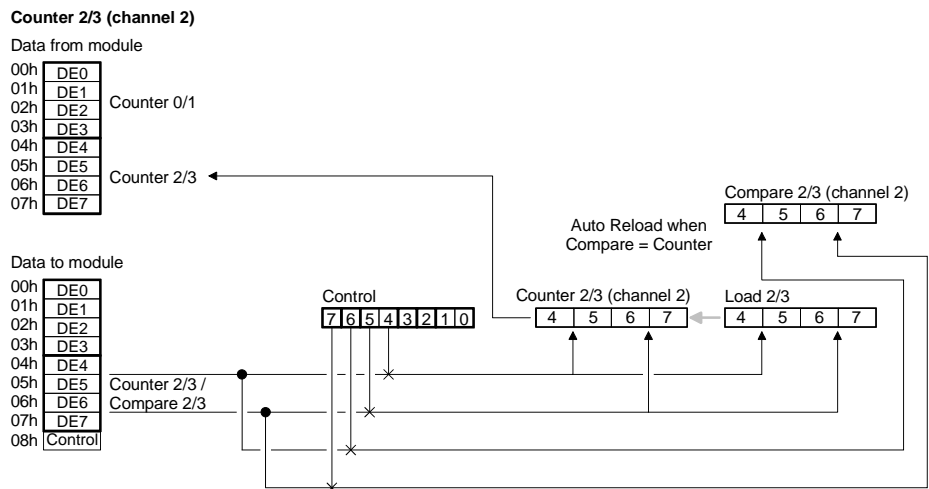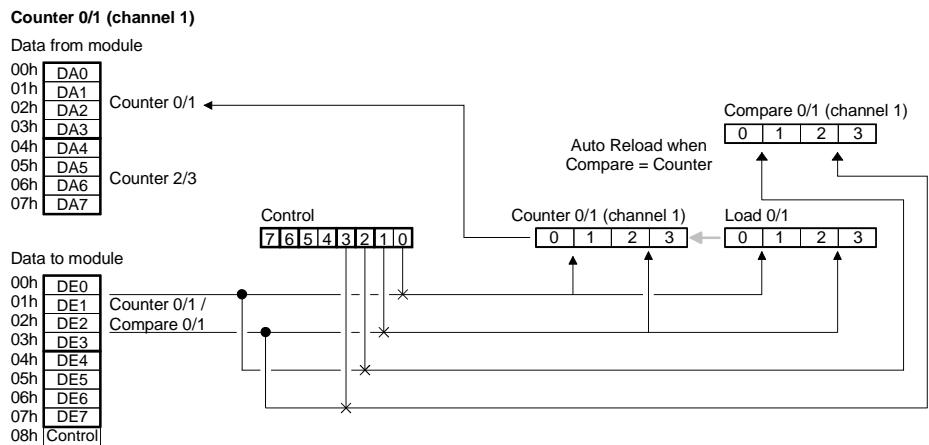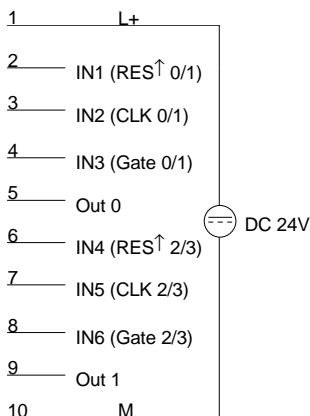
Example

This example is intended to explain the operation of the counters in mode 33 and 34.

A rising edge of RES$^{\uparrow}$ clears the counter to 0000 0000. A HIGH level applied to GATE enables the counter. As long as GATE is HIGH the counter will count every rising edge of the signal applied to CLK until the count is one less than the value entered into COMPARE. In this example the counter counts to 0000 0004 followed immediately by an auto reload, i.e. the counter is preset to the contents of the load register (in this case 0000 0002). The state of output OUT 0 changes every time an auto reload is executed.

In this example the counter counts from 0000 0002 to 0000 0004 as long as the GATE input is at a HIGH level.

Every load operation changes the status of output OUT 0.

Mode 35
32Bit counter

You determine the direction by means of the DIR input (IN3 or IN6). Every rising or falling edge of the input clock signal increments or decrements the counter. During the count process, the signal Gate has to be HIGH. When the signal Gate becomes "0", the counter value remains valid. When the counter reaches zero, output OUT of the respective counter is active for a minimum period of 100ms, even if the counter should continue counting. If the counter stops at zero, the output remains active.

Pin assignment
access to counter
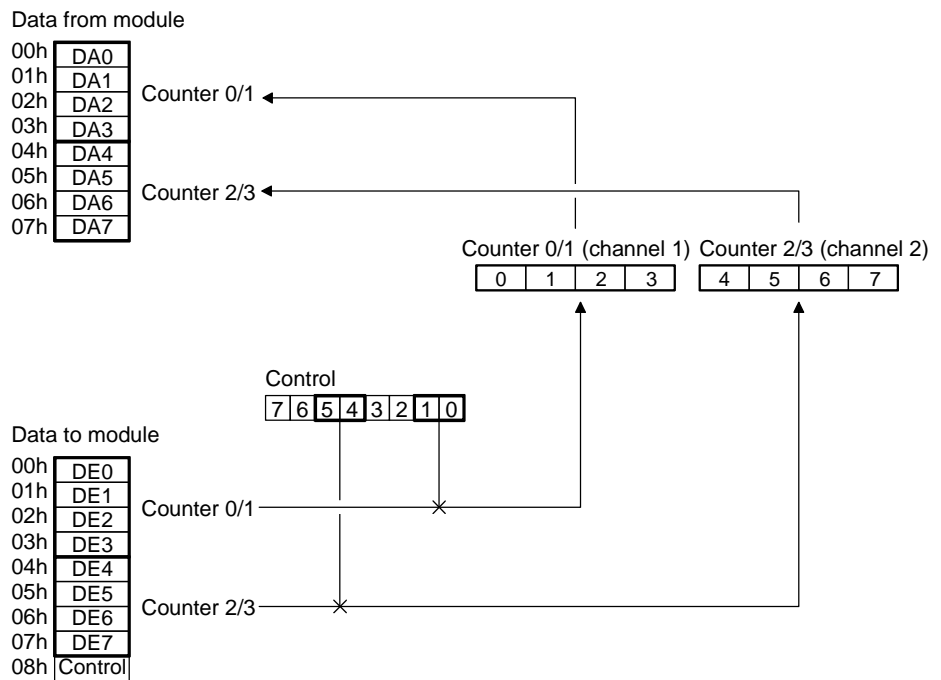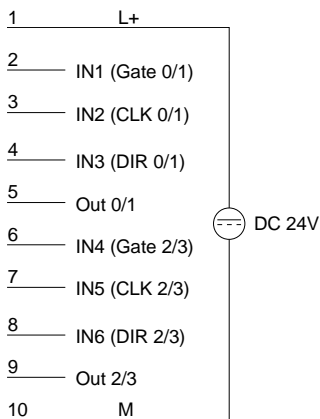
Up counter   In mode 35, a LOW level at the DIR input configures the counter for
                        counting up.

                        Timing diagram of the counter 0/1 example:

Gate 0/1 (IN1)

DIR 0/1 (IN3)

                                                          TtoH   TtoL

CLK 0/1 (IN2)

                                                   TclH2d

Counter 0/1

                        0005   0000 0006   0000 0007   0000 0008   0000 0009
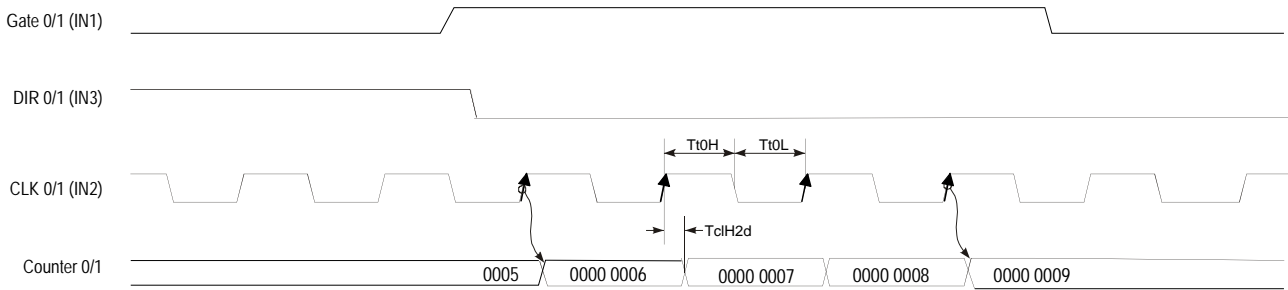
Down counter   In mode 35, a HIGH level at the DIR input configures the counter for
                        counting down.

                        Timing diagram of the counter 0/1 example:

Gate 0/1 (IN1)

DIR 0/1 (IN3)

                                                          TtoH   TtoL

CLK 0/1 (IN2)

                                                   TclH2d

Counter 0/1

                        FFFF FFF7   FFFF FFF6   FFFF FFF5   FFFF FFF4   FFFF FFF3
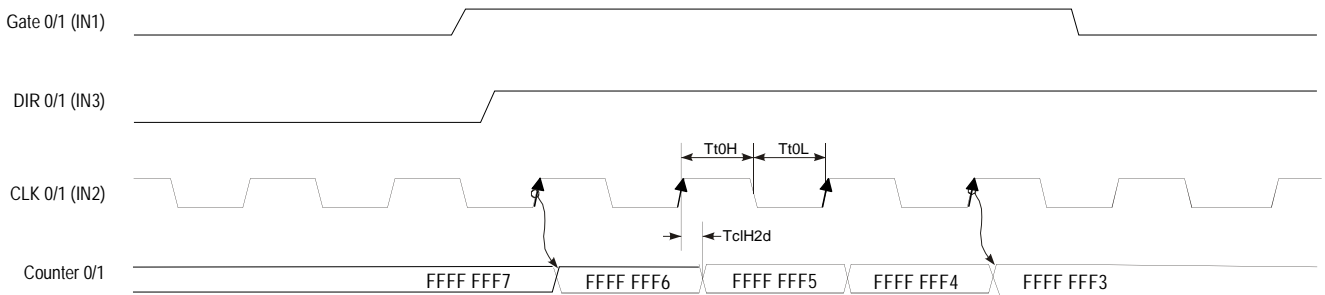
Mode 36
Encoder 1 edge

In mode 36 you may configure an encoder for one of the channels. Depending on the direction of rotation this encoder will increment or decrement the internal counter with every falling edge. During the count process, the signal Gate has to be HIGH. When the signal Gate becomes "0", the counter value remains valid. When the counter reaches zero, output OUT of the respective counter is active for a minimum period of 100ms, even if the counter continues counting. If the counter stops at zero the output remains active.

Pin assignment
access to counter
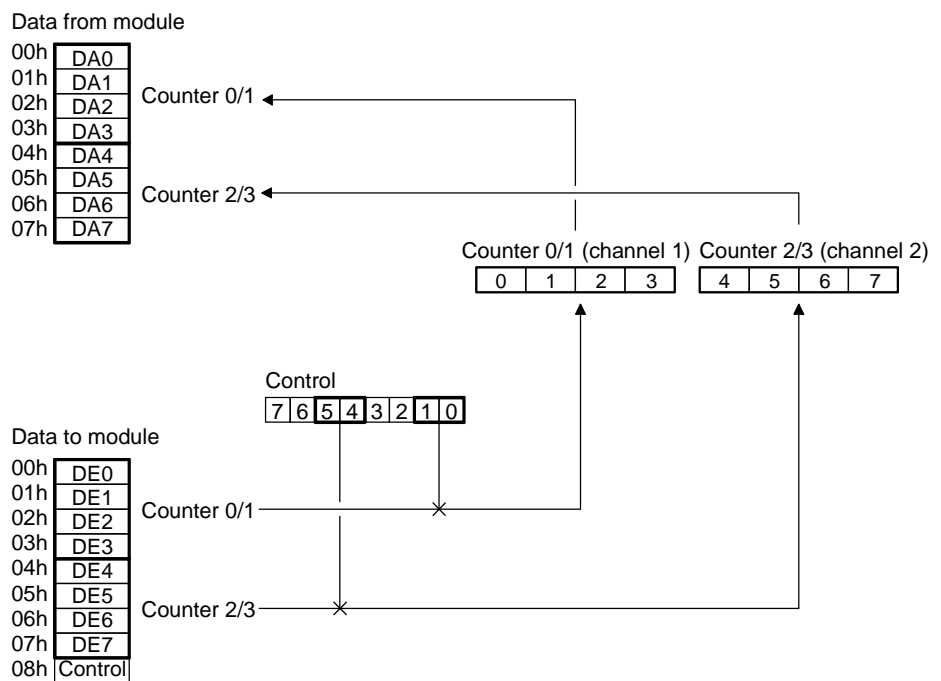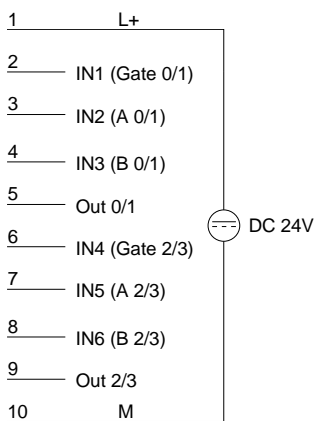
Up counter   Every falling edge of the signal at input A increments the counter if input B
                      is at HIGH level at this moment.

                      Timing diagram for the counter 0/1 example:

Down counter   Every rising edge of the signal at input A decrements the internal counter if
                      input B is at HIGH level at this moment.

                      Timing diagram for the counter 0/1 example:

**Mode 37
Encoder 2 edges**

Every rising or falling edge of the signal at input A changes the counter by 1. The direction of the count depends on the level of the signal applied to input B. During the count process, the signal Gate has to be HIGH. When the signal Gate becomes "0", the counter value remains valid. When the counter reaches zero, output OUT of the respective counter is active for a minimum period of 100ms, even if the counter continues counting. If the counter stops at zero the output remains active.

**Pin assignment
access to counter**

Up counter   The counter is incremented by the rising edge of signal A if input B is at a LOW level or by the falling edge of input A when input B is at a HIGH level.

Timing diagram for the counter 0/1 example:

Down-counter   The counter is decremented by the rising edge of signal A if input B is at a HIGH level or by the falling edge of input A when input B is at a LOW level.

Timing diagram for the counter 0/1 example:

Mode 38
Encoder 4 edges

Every rising or falling edge at inputs A or B increments or decrements the counter. The direction depends on the level applied to the other input (B or A). During the count process, the signal Gate has to be HIGH. When the signal Gate becomes "0", the counter value remains valid. When the counter reaches zero, output OUT of the respective counter is active for a minimum period of 100ms, even if the counter continues counting. If the counter stops at zero, the output remains active.

Pin assignment
access to counter

Up counter   The counter is incremented when a rising edge is applied to B while input A
                        is at a HIGH level or if a falling edge is applied to B when input A is at a
                        LOW level. Alternatively it is also incremented when a rising edge is
                        applied to A when input B is at a LOW level or by a falling edge at A when
                        input B is at a HIGH level.

                        Timing diagram for the counter 0/1 example:

Down counter   The counter is decremented when a rising edge is applied to B while input
                        A is at a LOW level or if a falling edge is applied to B when input A is at a
                        HIGH level. Alternatively it is also decremented when a rising edge is
                        applied to A when input B is at a HIGH level or by a falling edge at input A
                        when input B is at a LOW level.

                        Timing diagram for counter 0/1 example:

Technical data

SSI module
FM 250S

Electrical data	VIPA 250-1BS00
Number of channels	1
Number of outputs	2
Current consumption	200mA via backplane bus
Isolation	yes
SSI interface	Transducer supply voltage
Signal cable	RS422, isolated
Clock	RS422, isolated
Baudrate	configurable:
	100 / 300 / 600kBaud (default: 300kBaud)
Signal voltage "0"	-5 ... 7V
Signal voltage "1"	13 ... 36V
Output stage	24V DC high side switch 0.5A
Ext. power supply	24V DC (18 ... 28.8V)
Status indicator	by means of LEDs located on the front
Programming specifications	
Input data	4Byte
Output data	4Byte, 8Byte buffer in the module
Parameter data	4Byte
Diagnostic data	-
Dimensions and weight	
Dimensions (WxHxD)	25.4x76x76mm
Weight	100g

Counter module
FM 250

Electrical data	VIPA 250-1BA00
Number of counters	2 res. 4
Counter resolution	32Bit res. 16Bit
Number of operating modes	36
Counter frequency	max. 1MHz
Current consumption	80mA via backplane bus
Isolation	yes
Output stage	DC 24V high side switch 0.5A
Ext. power supply	DC 24V (18 ... 28.8V)
Signal voltage "0"	-30 ... 5V
Signal voltage "1"	13 ... 30V
Status indicator	via LEDs located on the front
Programming specifications	
Input data	10Byte
Output data	10Byte
Parameter data	2Byte
Diagnostic data	-
Dimensions and weight	
Dimensions (WxHxD)	25.4x76x76mm
Weight	100g

Chapter 11 MotionControl Modules

Outline

This chapter contains information about the installation, the data transfer and the operating modes of the MotionControl modules.

The following text describes:

- Installation
- Parameterization
- Data transfer
- Technical data

Content

System Overview

General

The MotionControl modules described here are modules for machine drives with a high pulse rate.

The modules may be used for point-to-point positioning as well as for complex drive outlines with need for a high level of precision, dynamics and speed.

Depending on the module you may control stepper motors or servo drives.

MotionControl modules
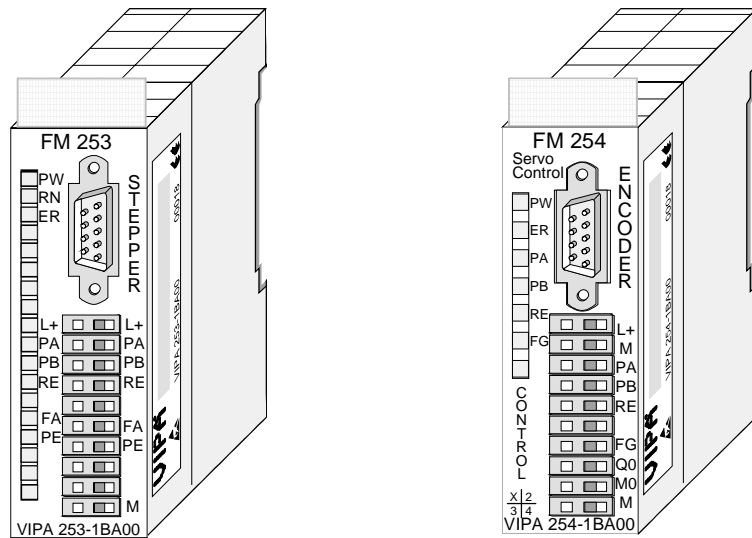
Order data

Type	Order number	Description	Page
FM 253	VIPA 253-1BA00	MotionControl Module Stepper	11-3
FM 254	VIPA 254-1BA00	MotionControl Module Servo	11-23

FM 253 - MotionControl Stepper

Properties

The FM 253 is a positioning module for controlling a stepper motor.

The module works independently and is controlled via an according user application at the CPU.

The module has the following characteristics:

- Microprocessor controlled positioning module for controlling a 1axis drive with stepper motor.
- Operating round and linear axis
- Different operating modes
- The module works independently and is controlled via an user application at the System 200V.
- The parameterization data is stored in the internal Flash memory. There is no battery required.
- The module contains 3 inputs for connecting end switches and is able to control 2 outputs. The states of the in-/outputs are additionally shown via LEDs.

Application areas

The module may be employed for simple positioning tasks as well as for complex drive outlines with a need for a high level of precision at the positioning.

Stepper motors are employed where a maximum torque at low rotational speed is required and the target position shall be reached and held without overshoot.

Operating modes

The operating mode is preset via your application program. The module supports the following operating modes:

- Positioning operating absolute
- Positioning operating relative
- Reference run
- Permanent run axis
- Set position
- Edit motor parameters
- Delete errors
- Read inputs

FM 253 - MotionControl Stepper - Construction

Front view
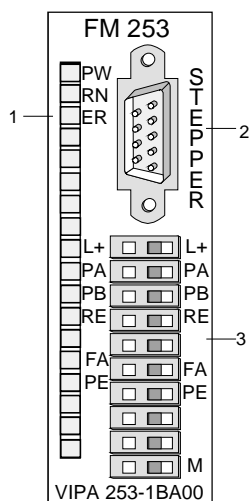
[1]   LED Status monitor
[2]   Plug for drive
[3]   Connection for supply voltage, end switch and outputs

Components

LEDs

The FM 253 has some LEDs at the front used for status monitoring.

The usage and the according colors of these LEDs are shown in the following table:

Label	Color	Description
PW	Yellow	DC 24V supply voltage is applied
RN	Green	RUN: control active
ER	Red	Internal error
L+	Yellow	DC 24V supply voltage for outputs is applied
PA	Green	Limit value A overrun, input PA is set
PB	Green	Limit value B overrun, input PB is set
RE	Green	Reference point overrun
FA	Green	Drive in run
PE	Green	Drive reached position

Stepper interface   Via this interface your stepper motor is connected. The interface appears as 9pin D-type-plug and works with RS422 level. It has the following pin assignment:
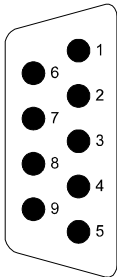
9pin D-type-plug

Pin	Assignment
1	PULSE_P: (+) pulse output
2	DIR_P: (+) direction signal
3	ENABLE_P: (+) release signal
4	READY+: (+) readiness message
5	GND: ground
6	PULSE_N: (-) pulse output
7	DIR_N: (-) direction signal
8	ENABLE_N: (-) release signal
9	READY-: (-) readiness message

Control interface   The control interface provides connection possibilities for end switches and output elements. The interface has the following pin assignment:

Pin	Assignment
1	Supply voltage DC 24V for outputs
2	Input: end switch PA
3	Input: end switch PB
4	Input: reference switch
5	reserved
6	Output: axis in motion
7	Output: position reached
8	reserved
9	reserved
10	Ground 24V

FM 253 - Connecting a drive

Connection stepper motor

The connection of a stepper motor is exclusively via the stepper interface.

Connection of supply voltage, end switch and output units
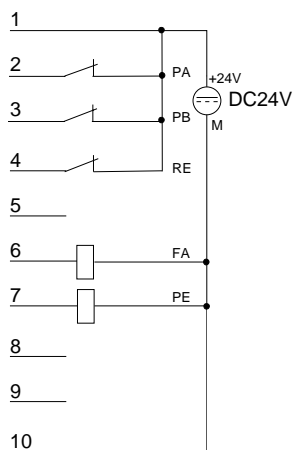
Voltage supply

The module itself is provided via the back plane bus. The deployment of the integrated digital outputs requires an additional voltage supply. The connection of an additional DC 24V supply voltage takes place via the clamps 1 and 10 of the control interface.

Inputs for end switches

You may connect up to 3 end switches (opener) to the module.

At terminals 2 and 3 (PA and PB) you connect the end switches with which you limit the distance. As soon as one of these switches is operated, the drive is stopped immediately and may only be driven into the other direction.

Terminal 4 is for the connection of the reference switch which is responsible for the tuning with the FM 253 module.

Outputs

The module contains 2 outputs that are only controlled by the module:

- FA - drive in run (clamp 6)
- PE - drive reached position (clamp 7)

The states of the outputs are shown via the according LEDs.

Cabling
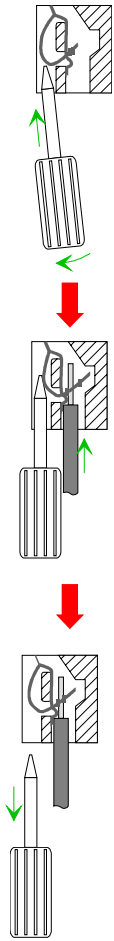
The end switches and the outputs are to connect at the control interface. Herefore a 10pin plug with CageClamp technology from WAGO is used. The cabling with CageClamps is very fast and in opposite to screw connections vibration secure.

You may connect cores with a core cross-section from $0.08mm^2$ up to $1.5mm^2$.

The cabling is analog to the big CageClamps of the System 200V.

Push the spring in the <u>square</u> opening with a fitting screwdriver more inside and insert the core into the <u>rectangular</u> opening.

By releasing the screwdriver the core is securely fixed.
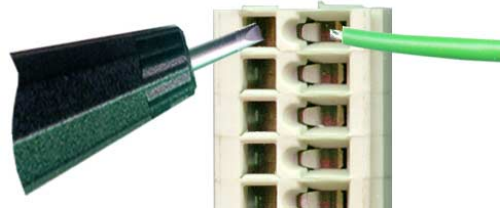
FM 253 - Data transfer >> FM 253

Drive data

The MotionControl Stepper module fetches a data block from the CPU cyclically and analyzes it.

The data block has a length of 16Byte and the following structure:

Byte No.	Content	Length
0-3	Scheduled position	4Byte
4-7	Scheduled frequency	4Byte
8-9	Reserved	
10	Mode	1Byte
11	Index	1Byte
12-15	Variable parameters	4Byte

Via the MODE-Byte the contents of the data block are specified. The following functions may be initiated via the MODE-Byte:

Mode (Byte 10)

Bit 7 ... Bit 0	Preset in Byte	Response in Byte
00: Idle-Mode - no status change of the drive, serves for parameter changes	-	-
01: Positioning relative - driving the preset number of steps	0-3: rel. set position	-
02: Reference run - calibration of the drive		
03: Permanent run axis - drive runs with scheduled frequency	15: Parameter bits 4-7: set frequency	- -
04: Read inputs - responds with the end switches states	-	15: State
05: Motor parameters - transmits parameters depending on index	11: Index, 12-15: Parameter	-
06: Set position - sets the recent position in the module without moving the drive	0-3: Set position	-
07: Delete error - deletes the error bit activated with 1	14-15: Error bit	-
08: Positioning absolute - drive to scheduled position	0-3: abs. set position	-

Parameter transfer (Mode = 05h)

Via **Index (Byte 11)** you set the parameter which value may be predefined via **Byte 12-15**. The value is transferred to the module by setting the **Mode 05h in Byte 10**.

More detailed information follows below.

FM 253 - Parameterization

Overview

The parameter data is transferred to the module together with the drive data in the 16Byte sized data block. For the parameterization you type the parameter to change in the **Index-Byte (Byte 11)** via the **Index-No.**.

The new value is fixed in **Byte 12-15**.

As soon as you set the **Mode-Byte (Byte 10)** to **05h**, the parameter is transferred to the module.

> Please regard, that new parameters are only taken over when there has been a mode change before. For this you switch into the IDLE-Mode (MODE-Byte 10 = 00h) after every parameter transfer.

Store parameters in the Flash

The parameters that you transfer to the module are stored in the RAM. As long as the module is supplied with voltage, the parameters are preserved. Via the index no. 97h you also have the possibility to store the parameters in the internal Flash.

So the parameters are available again after PowerOn.

Parameterization via FCs

You get FCs from VIPA that should make the deployment of the FM 253 easier. For example you may parameterize your module via the FCs 201 and 202.

The control of the drive functions via FC 200. Via this FC you may access all modes except "Set parameters".

Context of the parameters

The following illustration shows the important contexts of the parameters. The assignment of the according index no. is to find in the table below.
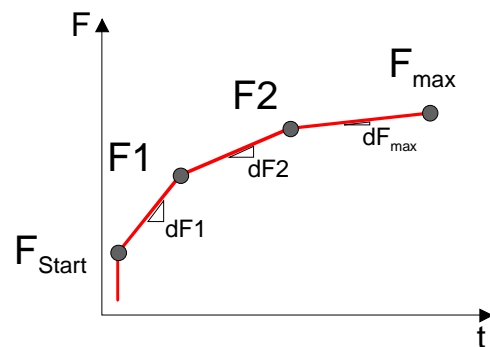
Set index at parameter

Via the index no. you fix the parameter in Byte 11, where the value may be preset in Byte 12-15.

Index	Parameter	Unit	Value range	Default	Description
00h	Fstart	Hz	UINT32	200	Start frequency
01h	F1	Hz	UINT32	4000	Limit frequency 1
02h	dF1	Hz	UINT32	100	Acceleration of Fstart $\Rightarrow$ F1
03h	F2	Hz	UINT32	10000	Limit frequency 2
04h	dF2	Hz	UINT32	60	Acceleration of F1 $\Rightarrow$ F2
05h	Fmax	Hz	UINT32	30000	Maximum drive frequency
06h	dFmax	Hz	UINT32	40	Acceleration of F2 $\Rightarrow$ Fmax
07h	Fpos	Hz	UINT32	30000	Frequency at positioning
08h	Fref	Hz	UINT32	1000	Frequency for reference run
10h	Fist	Hz	UINT32	-	Recent motor frequency (read only)
11h	Fsoll	Hz	UINT32	-	Recent set frequency (read only)
13h	FTarget	Hz	UINT32	-	Target frequency (read only)
97h				-	Store parameters in Flash
98h				-	Read parameters from Flash (State like after PowerON)
99h				-	Load default parameters

Note!

When setting parameters for the drive, you should remember the following rules:

- **dF1** should always be **smaller** than **Fstart**
- **dF2** should be the **half** of **dF1**
- **dFmax** should be the **half** of **dF2**

For this the following context appears:

$$4 \cdot dF_{max} = 2 \cdot df2 = dF1 < F_{Start}$$

Wrong inputs are partly corrected by the firmware of the module.

FM 253 - Operating modes

Overview

By setting according bits in the MODE-Byte you may set the following operating modes described below:

- IDLE-Mode
- Positioning relative / absolute
- Permanent run
- Set position
- Reference run

IDLE-Mode

Default: Byte 10 = 00h

In the IDLE-Mode no state change of the drive occurs. For new data is only taken over by the module after an state change, you may initiate a mode change by jumping into the IDLE-Mode and back again.

Via the IDLE-Mode you may e.g. start a new order, for a mode change is recognized by the jump into the IDLE-Mode.

The operating mode IDLE should always be called when no action shall be initiated. For initiating an action you normally branch into another mode only for a short time and switch then back to the IDLE-Mode.

Positioning relative

Default: Byte 10 = 01h, Byte 0-3 = relative set position

At the relative positioning a predefined number of steps is added to the recent position and then approached.

Herefore you have to predefine the position offset (number of steps) as relative scheduled position in Byte 0-3 and then set the **Mode (Byte10) to 01h.**

By setting the Byte 10 to 01h the relative positioning starts.

For acceleration and frequency of the drive, the values set in the parameters are used. If there are no presetting, the default values are used.

As long as the drive is operating, the output **"Axis in run"** is set. After reaching the position this output is cleared and the output **"Position reached"** is set.

Positioning absolute

Default: Byte 10 = 08h, Byte 0-3 = absolute set position

At the absolute positioning an absolute scheduled position is approached.

Herefore you have to predefine the position (number of steps) as absolute scheduled position in Byte 0-3 and then set the **Mode (Byte 10) to 08h**.

By setting the Byte 10 to 08h the absolute positioning starts.

For acceleration and frequency of the drive, the values set in the parameters are used. If there are no presetting, the default values are used. As long as the drive is operating, the output **"Axis in run"** is set. After reaching the position this output is cleared and the output **"Position reached"** is set.

Permanent run

Default: Byte 10 = 03h, Byte 4-7 = Scheduled frequency

At permanent run the axis rotates with the set frequency until it is changed.

Herefore you have to predefine the rotational speed as set frequency in Byte 4-7 and then set **Mode (Byte10) to 03h.**

By setting Byte 10 to 03h the drive starts and rotates with the given frequency until a new frequency value is set.

A new frequency is only taken over at mode change. This is reachable by changing into the IDLE-Mode (Byte 10 = 00h) after the start-up of the drive. Now type the new scheduled frequency and set Byte 10 back to 03h. The drive is set to the new frequency immediately.

For acceleration of the drive, the values set in the parameters are used. If there are no presetting, the default values are used.

As long as the drive is operating, the output **"Axis in run"** is set. By presetting 00h as scheduled frequency (mode change required) the drive stops and the output is set back.

Stop drive by permanent run and set frequency = 00h

By setting a scheduled frequency of 00h in Byte 4-7 and the mode 03h in Byte 10 you may stop the drive at any time.

Note!

Please regard, that a frequency change is only recognized by the module via a mode change. This is also valid for stopping the drive. For a mode change, use the short time jump to the IDLE-Mode.

Set position

Default: Byte 10 = 06h, Byte 0-3: Position value

In the operating mode "Set position" you may assign a new value to the recent actual value.

Herefore you predefine the new value in Byte 0-3 and then set the MODE-Byte 10 to 06h.

Reference run   Default: Byte 10 = 02h, Byte 15 = Control bits for reference run

The reference run supports the calibration of your drive system. The reference point should be inside the drive outline.

Before starting a reference run you have to specify the type of the reference run and the direction to run to in Byte 15.

By setting Byte 10 to 02h, the drive starts with its reference run.

As frequency the reference frequency set in the parameters are used. If there are no parameters, the default values are used.

There are 6 different possibilities for the reference drive that are predefined via Byte 15:

- Reference run to reference switch and delete position counter
- Reference run to reference switch and keep position counter
- Reference run to end switch B and delete position counter
- Reference run to end switch B and keep position counter
- Reference run to end switch A and delete position counter
- Reference run to end switch A and keep position counter

Control bits for   The control bits in Byte 15 have the following assignment:
the reference run

Byte 15	Parameter
Bit 0	1: Direction forward 0: Direction backward
Bit 1	1: delete position after reference run 0: keep position after reference run
Bit 2	Reference run to reference switch
Bit 3	Reference run to end switch B
Bit 4	Reference run to end switch A

Note!

When starting a reference run, please regard, that you always have to set a direction via Bit 0 and that you may set only one bit in the Bits 2...4!

Reference run to reference switch

The reference run starts always with the speed predefined in FREF. The direction has to be preset in the variable parameter (Byte 15, Bit 0). As soon as the ascending edge of the reference switch is recognized, the motor slows down to FSTART.

Depending on the reference speed the drive may overrun the reference switch or not during slow down.

The following 4 drives to the reference switch are possible:

1. Motor comes from the left side, slows down inside the reference switch and drives backward with FSTART until the descending edge of the reference switch is recognized.

2. Motor comes from the left side, overruns the reference switch during slow down and drives backward with FSTART over the ascending edge until the descending edge of the reference switch is recognized.

3. Motor comes from the right side, slows down inside the reference switch and drives with FSTART until the descending edge of the reference switch is recognized.

4. Motor comes from the left side, overruns the reference switch during slow down, it changes the rotational direction and drives with FSTART until the ascending edge of the reference switch is recognized, switches the direction again and drives on until the descending edge of the reference switch is recognized.
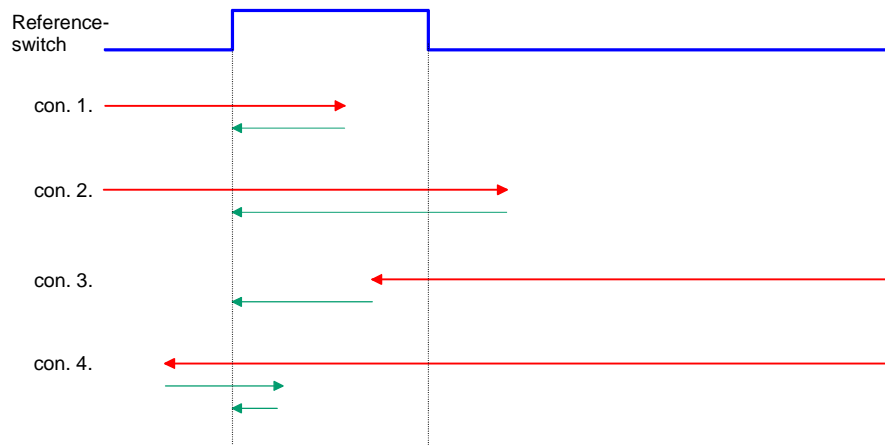
Reference run to end switch

You may limit your distance via the end switches A and B.

At the reference run to end switch the drive starts and drives with the preset speed FREF and the predefined rotational direction until the according end switch gets active, stops abruptly, changes its rotational direction and drives with FSTART until the end switch is inactive again.

Note!

If you use the reference run to end switch, you have to regard, that there is enough space behind the end switch for the motor to slow down!

FM 253 - Data transfer >> CPU

Respond message   The MotionControl Stepper module sends a data block to the CPU cyclically that contains several information about the recent state of the drive. The data block has a length of 16Byte and the following structure:

Byte no.	Content	Length
0-3	actual position	4 Byte
4-7	actual frequency	4 Byte
8-9	error messages	2 Byte
10	actual mode	1 Byte
11	state	1 Byte
12-15	data of variables	4 Byte

Actual position, actual frequency   Via this two parameters the actual position and frequency of your drive is always shown.

Error messages   The recently recognized errors are monitored via the error bits of Byte 8-9. The errors remain active until the according Bits are set back.

As long as an error is still valid, the according error bit is set again after the reset.

The following error messages are used:

Error byte (Byte 8-9)

Byte 9	Description
Bit 0	Error in the internal state administration
Bit 1	System has been booted (always after PowerON)
Bit 2	Error at proofing Flash parameters, motor parameters not valid
Bit 3	This function is not permitted during motor run
Bit 4	Motor is recently blocked
Bit 5	Error at positioning the motor
Bit 6	End switch is/was active
Bit 7	Frequency has been limited to F_{MAX}
Byte 8	
0	General error at the motor

**Set back
error messages**

For deleting an active error (Byte 8-9) you have to set the according error bit in the variables parameter (Byte 14-15) to "1".

As soon as you set the **Mode (Byte 10) to 07h**, the according errors in the module are set back. You may also set back several error messages at the same time. FFFFh in Byte 14-15 for example sets back all errors.

Recent mode

Here you always find the mode that your FM 253 has at the moment.

The following modes may be shown:

Mode (Byte 10)

Byte	Mode
10	00h: IDEL
	01h: Positioning relative
	02h: Reference run
	03h: Permanent run axis
	04h: Read inputs
	05h: Change motor parameters
	06h: Set position
	07h: Delete error
	08h: Positioning absolute

State

The STATE-Byte shows you the state of the drive.

The following state messages may be shown:

State (Byte 11)

Byte 11	State
Bit 0	1: Drive in run 0: Drive in stop
Bit 1	1: Direction forward 0: Direction backward
Bit 2	1: Drive in position 0: Drive not in position

Read inputs

For reading the inputs, the **Mode (Byte 10)** is set **to 04h** and now the module shows the state of the end switches and the reference switch in the variables data (Byte 15).

Inputs (Byte 15)

Byte 15	Input
Bit 0	State PA end switch (1: operated, 0: not operated)
Bit 1	State PB end switch (1: operated, 0: not operated)
Bit 2	State RE reference switch (1: operated, 0: not operated)

FM 253 - Handling blocks

Overview

There are different handling blocks available with the FM 253 to make the usage of the module more comfortable. The following handling blocks are available for the FM 253 at this time:

Block	Description
FC 200	Control drive
FC 201	Adjustment of a parameter
FC 202	Adjustment of all drive parameters (Index 0...9)

FC 200 Control drive

This FC serves the control of your drive by transferring the drive data to the module through setting the according mode.

With this FC you may transfer all modes except "Set parameters" and the according parameters to the module.

Data transfer to FM 253 with SET_MODE = 1

- Set the mode.
- Give data to the according parameters.
- Start the transfer by setting SET_MODE to 1. When the mode is started, the module SET_MODE is set back at the next cycle and shows the actual data of the FM 253.

Data transfer to CPU with SET_MODE = 0

At the call of the FC 200 with SET_MODE = 0, the actual data of the FM 253 is shown via the labels ACT_POSITION, ACT_FREQUENCY, ACT_MODE, ERROR, STATE and VAR_DATA.

It is convenient to store the single values in a data block. In the following example we used DB5 for this purpose.

Parameters

Address	Declaration	Name	Type	Start value	Comment
0.0	in	ADDRESS	INT		Set basic address
2.0	in	SET_POSITION	DINT		Transfer position values
6.0	in	SET_FREQUENCY	DINT		Transfer frequency at permanent run
10.0	in	VARIABLES	DWORD		Transfer variables at reference run
14.0	in	MODE	INT		Transfer mode to change
16.0	out	ACT_POSITION	DINT		Response actual position
20.0	out	ACT_FREQUENCY	DINT		Response actual frequency
24.0	out	ERROR	INT		Error word
26.0	out	ACT_MODE	INT		Response actual mode
28.0	out	STATE	BYTE		Response status bits
30.0	out	VAR_DATA	DWORD		Response variables
34.0	in_out	SET_MODE	BOOL		Start function

ADDRESS   Start address from where on the FM 253 is stored in the CPU.

SET_POSITION   In mode 01, 06 and 08 you fix the scheduled position for the drive here.

SET_FREQUENZ   In mode 03 you fix the scheduled rotational speed as set frequency.

VARIABLES   Fix here the control bits for the reference run (MODE = 02) and for setting the errors back (MODE = 07).

The control bits for the reference run have the following assignment:

Control bits

VARIABLE-Byte	Parameter
Bit 0	1: Direction forward 0: Direction backward
Bit 1	1: after reference run delete position 0: after reference run keep position
Bit 2	Reference run to reference switch
Bit 3	Reference run to end switch B
Bit 4	Reference run to end switch A

An overview over the error-bit-assignment follows below.

MODE   With this parameter you transfer the mode to the FM 253. The following modes are possible:

Mode

Value	Description	Default in	Response in
00	Idle-Mode - no status change of the drive, serves for parameter changes	-	-
01	Positioning relative - driving the preset number of steps	SET_POSITION	-
02	Reference run - calibration of the drive	VARIABLES	-
03	Permanent run axis - drive runs with scheduled frequency	SET_FREQUENCY	-
04	Read inputs - responds with the end switches states	-	VAR_DATA
06	Set position - sets the recent position in the module without moving the drive	SET_POSITION	-
07	Delete error - deletes the error bit activated with 1	VARIABLES	-
08	Positioning absolute - drive to scheduled position	SET_POSITION	-

ACT_POSITION,   Via those parameters the recent actual position and actual frequency of
ACT_FREQUENCY   your drive is shown.

ERROR   Here you may find error messages if occurred. The errors remain active
until the error cause is removed and the according bits are set back. The
following error messages may occur:

Error messages

ERROR-Byte 1	Description
Bit 0	Error in the internal state administration
Bit 1	System booted (always after PowerON)
Bit 2	Error at validating the Flash parameters, motor parameters not valid
Bit 3	Function is not available during motor run
Bit 4	Motor is blocked
Bit 5	Error at positioning the motor
Bit 6	End switch is/was active
Bit 7	Frequency has been limited to F_{MAX}
ERROR-Byte 0	
0	General error at the motor

The clearing of the error messages takes place via MODE = 07 and
VARIABLE = Error bytes.

ACT_MODE   Responds the mode in which the module is at this moment.

STATE   The STATE-Byte shows you information about the state of the drive. The
following state messages may occur:

State

STATE-Byte	State
Bit 0	1: Drive in run 0: Drive in stop
Bit 1	1: Direction forward 0: Direction backward
Bit 2	1: Drive in position 0: Drive not in position

VAR_DATA

In VAR_DATA the state of the inputs is returned after you requested this by MODE = 04. For reading the inputs the **Mode 4** is set and now the module shows the state of the end switches and the reference switch in the variables data (Byte 15).

Inputs

VAR_DATA-Byte	Input
Bit 0	State PA end switch (1: operated, 0: not operated)
Bit 1	State PB end switch (1: operated, 0: not operated)
Bit 2	State RE reference switch (1: operated, 0: not operated)

SET_MODE

After you defined the according parameters the data is transferred to your module via SET_MODE = 1.

When the mode has been started, the module sets back again the SET_MODE in the next cycle and returns the actual data of the FM 253.

Example

```
DB 5
DBD  0 Position          DINT   L#0       Position value
DBD  4 Frequency         DINT   L#0       Frequency for permanent run
DBW  8 reserve           WORD   W#16#0
DBW 10 MODE              INT    0         Mode
DBW 12 Index             INT    0         Index default
DBD 14 Variable_PARAM    DWORD  DW#16#0   Var. for Ref.run/Param...
DBW 18 Reserve1          WORD   W#16#0
DBD 20 Act_Position      DINT   L#0       actual position
DBD 24 Act_Frequency     DINT   L#0       actual frequency
DBW 28 Error             INT    0         error monitor
DBW 30 ACT_Mode          INT    0         actual mode
DBW 32 State             BYTE   B#16#0    State response
DBD 34 VAR_DATA          DWORD  DW#16#0   Return parameter/data


CALL  FC 200                    //FC for Stepper module
   ADDRESS       :=128          //Module address
   SET_POSITION :=DB5.DBD 0     //DBD with position for abs/rel
   SET_FREQUENCY:=DB5.DBD 4     //DBD with frequency for permanent run
   VARIABLES    :=DB5.DBD14     //Delete data for Ref_Run/Del error
   MODE         :=DB5.DBW10     //Mode default for new order
   SET_MODE     :=M1.0          //Start order
   ACT_POSITION :=DB5.DBD20     //actual position
   ACT_FREQUENCY :=DB5.DBD24    //actual frequency
   ERROR        :=DB5.DBW28     //Monitor error
   ACT_MODE     :=DB5.DBW30     //actual mode
   STATE        :=DB5.DBW32     //State bits from module
   VAR_DATA     :=DB5.DBD34     //Return of values
                                    e.g. read inputs
```

**FC 201 -
set a parameter**

With the FC 201 it is possible to set a parameter at the FM 253.

Parameter

Address	Declaration	Name	Type	Start value	Comment
0.0	in	ADDRESS	INT		Fixed basic address
2.0	in	INDEX	INT		Transfer INDEX for parameters
4.0	in	PARAMETER	DWORD		Transfer parameter value
	out				
8.0	in_out	SET_PARA	BOOL		Start parameter transfer

ADDRESS

Start address from where on the FM 253 is stored in the CPU.

INDEX

Via INDEX you fix the parameter where the value is set in PARAMETER.

Index	Parameter	Unit	Value range	Default	Description
00h	Fstart	Hz	UINT32	200	Start frequency
01h	F1	Hz	UINT32	4000	Limit frequency 1
02h	dF1	Hz	UINT32	100	Acceleration from Fstart $\Rightarrow$ F1
03h	F2	Hz	UINT32	10000	Limit frequency 2
04h	dF2	Hz	UINT32	60	Acceleration from F1 $\Rightarrow$ F2
05h	Fmax	Hz	UINT32	30000	Maximum drive frequency
06h	dFmax	Hz	UINT32	40	Acceleration from F2 $\Rightarrow$ Fmax
07h	Fpos	Hz	UINT32	30000	Frequency at positioning
08h	Fref	Hz	UINT32	1000	Frequency for reference run
10h	Fist	Hz	UINT32	-	Actual motor frequency (read only)
11h	Fsoll	Hz	UINT32	-	Actual sched. frequency (read only)
13h	FTarget	Hz	UINT32	-	Target frequency (read only)
97h				-	Store parameters in Flash
98h				-	Read parameters from Flash (State like after PowerON)
99h				-	Load default parameters

PARAMETER

Here you type the value of the parameter specified via INDEX.

SET_PARA

After you filled the according parameters, the parameter is transferred to your module via SET_PARA = 1. After the transfer SET_PARA is set back automatically.

Parameterize   Via the FC 202 you may adjust all relevant parameters of the FM 253.
FC 202 - FM 253

Parameter

Address	Declaration	Name	Type	Start value	Comment
0.0	in	DATA_DB	BLOCK_DB		Data block with parameters
2.0	in	ADDRESS	INT		Module address
	out				
4.0	in_out	START	BOOL		Start parameter transfer
4.1	in_out	RUN	BOOL		Transfer single runs

DATA_DB   Please fix here the data block where your parameters are stored.
                     The DB has the following structure:

```
DBD  0 Fstart        DINT   L#0   Start frequency
DBD  4 F1            DINT   L#0   Limit frequency 1
DBD  8 F2            DINT   L#0   Limit frequency 2
DBD 12 Fmax          DINT   L#0   Maximum drive frequency
DBD 16 dF1           DINT   L#0   Acceleration Fstart --> F1
DBD 20 dF2           DINT   L#0   Acceleration F1 --> F2
DBD 24 dFmax         DINT   L#0   Acceleration F2 --> Fmax
DBD 28 Fpos          DINT   L#0   Frequency at positioning
DBD 32 Fref          DINT   L#0   Frequency at reference run
DBD 36 StepRepeat    DINT   L#0   Step between frequency calculation
```

ADDRESS   Start address from where on the FM 253 is stored in the CPU.

START   After you created the DB you may transfer your parameters to your module
                     via START = 1.
                     As soon as all parameters are transferred, START is set back again.

RUN   This variable stores one cycle spreading state and it is responsible for the
                     single parameter transfer.

FM 254 - MotionControl Servo

Features

- Microprocessor controlled positioning module for drives with an analog set point interface (±10V control voltage)
- 7 operating modes
- closed-loop position control
- The module operates independently and it is controlled by means of an application program in the System 200V.
- Data is saved in Flash-RAM. No backup battery is required.

Application areas

The positioning module can be employed for simple position control tasks as well as profile-controlled drive outlines that meet the most stringent requirements with respect to dynamics, accuracy and speed.

Due to the various modes of operation the module can also be employed for positioning applications on machines that employ very high clock rates.

Typical applications:

- Production and transportation equipment, transfer lines and assembly lines
- Presses
- Woodworking machines
- Handling equipment
- Feeder devices
- Packing machines
- Auxiliary actuators for lathes and milling machines

FM 254 - MotionControl Servo - Construction

Front view

FM 254
Servo
Control

PW
ER
PA
PB
RE
FG

ENCODER

1

CONTROL

L+
M
PA
PB
RE
FG
Q0
M0
M

X | 2
3 | 4

2

3

VIPA 254-1BA00
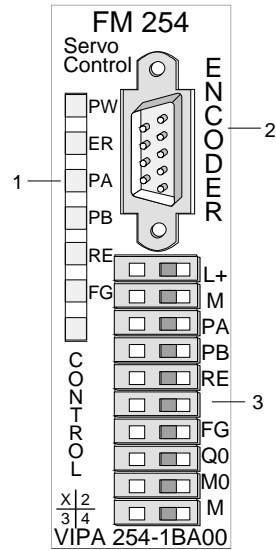
[1]   LED status indicators
[2]   Encoder interface
[3]   Connector for supply
      voltage, drive, end switch
      and outputs

Components

LEDs

The positioning module FM 254 has 7 status indicator LEDs.

The following table contains the description and the respective color of these LEDs.

Label	Color	Description
PW	Yellow	24V DC supply voltage is applied
ER	Red	internal error
PA	Green	Limit value A overrun, input PA is set
PB	Green	Limit value B overrun, input PB is set
RE	Green	Reference point overrun
FG	Green	Drive released
	Yellow	Blinking always when supply voltage is applied (Heartbeat - 2Hz)

Note!

If the PW-LED is not on during operation, this may depend on a short circuit in the DC 24V voltage supply.

Please control also the connections of the encoder plug.

If the LED remains off even when you disconnect the encoder plug, the module has a defect.

Encoder interface   *9pin D-type plug*
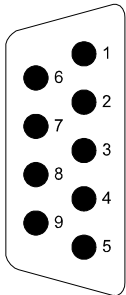
Pin	Assignment
1	+24V encoder power
2	+5V encoder power
3	R+ clock input null pulse
4	B+ clock input
5	A+ clock input
6	Ground encoder power
7	R- clock input null pulse
8	B- clock input
9	A- clock input

Control interface

Pin	Assignment
1	DC 24V supply voltage
2	Ground 24V
3	Input for start switch (low active)
4	Input for end switch (low active)
5	Input for reference switch (low active)
6	reserved
7	Output regulator release
8	Analog output ground
9	Analog output +
10	Screen

FM 254 - Connecting a drive with encoder

Connection of an encoder

The encoder is wired to the 9pin D-type connector located at the front. The module supplies the encoder with the required DC 24V and DC 5V voltages.

The following figure shows the connection of an encoder:
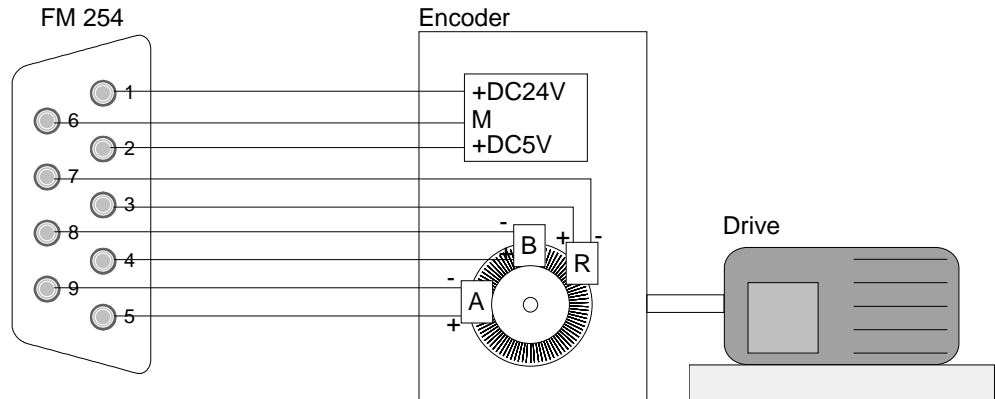
Connection of supply voltage, drive, end switch and outputs

Power supply

The module requires a power supply of DC 24V via pins 1 and 2.

End switches

You may connect up to 3 end switches (opener) to the module.

The end switches for the extremes of the distance are connected to terminals 3 and 4. The drive will be stopped immediately as soon as one of these switches is operated. In this situation may only be driven into the opposite direction.

The reference switch is connected to terminal 5. This is required to tune the drive to the positioning module.

The end switch that stops the drive in the mode hardware-controlled run is also connected to terminal 5.

Outputs

The module has 2 outputs that are controlled directly by the module. At present, however, only the output "Controller Enable" (pin 7) is available. The second output is intended for future expansion. You enable the output by setting bit 0 in the traversing data.

Drive

Pin 8 and 9 supply an analog signal for ±10V regulator control.
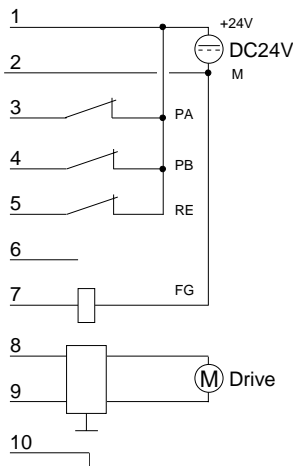
Cabling
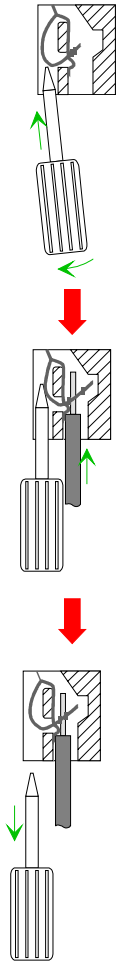
The drive and the end switches are to connect at the control interface. Herefore a 10pin plug with CageClamp technology from WAGO is used. The cabling with CageClamps is very fast and in opposite to screw connections vibration secure.

You may connect cores with a core cross-section from $0.08mm^2$ up to $1.5mm^2$.

The cabling is analog to the big CageClamps of the System 200V.

Push the spring in the <u>square</u> opening with a fitting screwdriver more inside and insert the core into the <u>rectangular</u> opening.

By releasing the screwdriver the core is securely fixed.

FM 254 - Summary of parameters and transfer values

The following table lists all the parameters and transfer values. A block diagram depicts the interaction between the parameters.

Overview

Value	Size	Unit	Physical range
Destination position Set position Actual position	32Bit	$\dfrac{1 \text{ rotation}}{2^{16}}$	0.0 ... 65535.9999 revs.
Maximum rpm.	16Bit	1/min	100 ... 6000 1/min
Acceleration time Delay time	16Bit	10 ms	10 ms ... 100 s
P-amplification	16Bit	0.1	0.0 ... 1000.0
Pre-control factor	16Bit	0.1	0.0 ... 1.0
Encoder increments	16Bit	1	10 ... 10000
Operating mode	16Bit	binary coding	

Block diagram
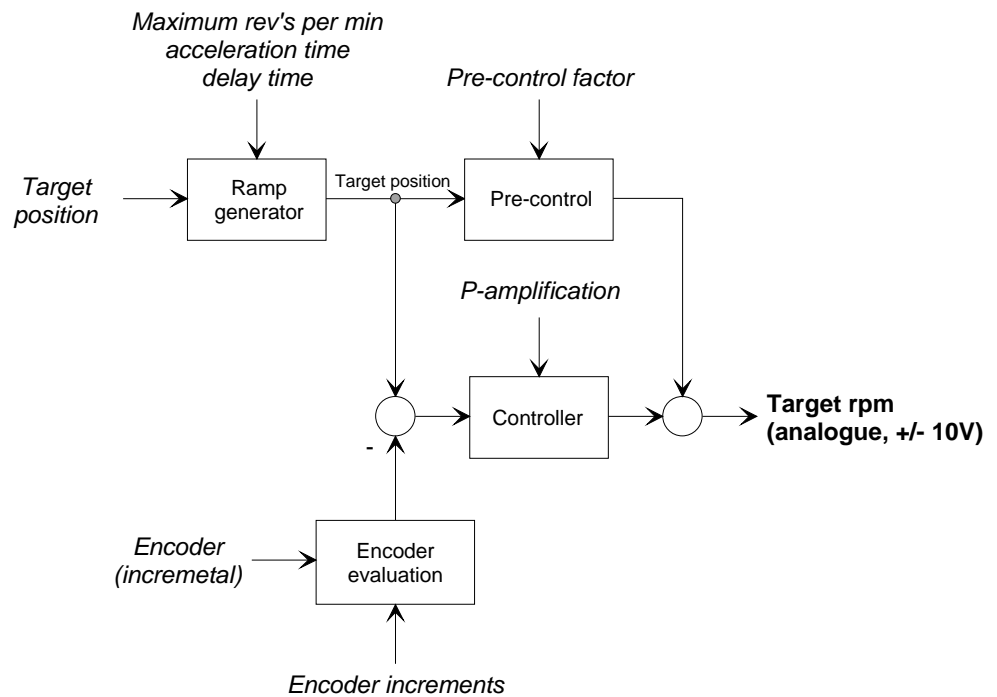
FM 254 - Parameterization

When commissioning the MotionControl Servo module it requires 16Byte of parameter data. These have the following structure:

Parameter data (write only)

Byte no.	Name	Length	Range	Unit
1, 0	Maximum rotat. speed	2Byte	100 ... 6000	1/min
3, 2	reserved	2Byte	-	-
5, 4	reserved	2Byte	-	-
7, 6	P-amplification	2Byte	0.0 ... 1000.0	0.1
9, 8	Pre-control factor	2Byte	0.0 ... 1.0	0.1
11, 10	Encoder increments	2Byte	10 ... 10000	1
13, 12	Reference rot. speed	2Byte	100 ... 6000	1/min
14	Pos. reached window	1Byte	0 ... 255	1INK
15	Drag distance	1Byte	4 ... 1020	4INK

Parameter description

Maximum rotational speed

Defines the maximum rotations for your drive.

P-amplification, Pre-control factor

These values control the regulation properties.

Encoder increments

This parameter matches your MotionControl Servo module to the encoder.

Reference rotational speed

This value for the rotational speed is used for the reference run that is required by the MotionControl Servo module to re-acquire parameters for the control path.

Pos-reached-window

When the target position has been reached, this position is maintained by continuous control of the drive. The drive is never stopped.

You can specify a window by entering certain increments into the *Pos-reached-window.* These define the tolerance by which the actual value may differ from the target position before the drive is controlled, i.e. when the drive is stationary.

Drag distance

This parameter defines the drag error or the difference between the actual and the set value, which causes the drive to be stopped.

FM 254 - Data transfer >> FM 254

Traversing data   The CPU can control the MotionControl Servo module by writing the following values into the FM 254 module:

Byte no.	Name	Length	Range	Unit
3, 2, 1, 0	Target position	4Byte	32 Bit Integer	Encoder increments
5, 4	Control bytes	2Byte		
7, 6	Rot. speed	2Byte	100 ... 6000	1/min
9, 8	Acceleration time	2Byte	1 ... 10000	10ms
13, 12 ,11, 10	Parameter field	4Byte		
15, 14	Field identifier	2Byte		

Control bytes (Byte 4 and Byte 5)

Byte	Bit 7 ... Bit 0
4	Bit 0: Enable Bit 1: Operating mode reference run positive Bit 2: Operating mode reference run negative Bit 3: Operating mode hardware-controlled run positive Bit 4: Operating mode hardware-controlled run negative Bit 5: Operating mode incremental dimension Bit 6: Operating mode infinite incremental dimension Bit 7: Taking over target position
5	Bit 0: reserved Bit 1: Non-maintained command mode direction of rotation pos. Bit 2: Non-maintained command mode direction of rotation neg. Bit 7 ... Bit 3: reserved

These operating modes are described below.

Parameter field and Field identifiers (Byte 10 ... Byte 14)

You can send additional parameters with the traversing data to the MotionControl Servo module by specifying a field identifier. The parameters for the respective field identifier must be entered into the parameter field (Byte 10...13).

The FM 254 will use the default settings shown below if you do not transfer any field identifiers.

Field ident.	Description	Range	Unit	Default setting
FF01h	Software end switch (+)	32Bit Integer	Encoder increments	7FFF.FFFF
FF02h	Software start switch(-)	32Bit Integer	Encoder increments	8000.0001
FF03h	Rot. speed at non-main-tained command mode	100 ... 6000	1/min	Reference rot. speed
FF04h	Delay time	1 ... 10000	10ms	Acceleration time

FM 254 - Operating modes

Overview   The following operating modes can be selected by setting the respective bit in the control byte:

- Positioning operation (positioning to an absolute target position)
- Reference run (system calibration)
- Hardware run (drive to reference switch)
- Incremental run (use addition to approach a relative target)
- Infinite incremental run (relative traversal without counter overflow)
- Non-maintained command mode

Positioning mode

Operation   During the positioning operation the absolute target position is only transferred to the FM 254, if the bit "Taking over target position" is set.

If a new position is specified with the enable bit set, the drive moves to the respective position $\pm$ POS-REACHED-WINDOW with the values that were previously specified for the rotational speed and the acceleration/delay and sets the "Position reached"-Bit. After transferring the parameters for the traversal, you can start the drive by setting the enable bit. During the traversal the module indicates the direction of rotation by setting bit 1 or 2.

Should the deviation between set and actual position exceed the window specified for the drag error, the positioning operation is terminated and the motor is stopped. The program is notified by means of an active drag error bit 0 in Byte 5. You can clear the drag error bit by resetting the enable bit. This also sets the set position to the actual position.

The drive is also stopped if soft- or hardware switches are passed that terminate the traversal distance.

The operation can be continued at any time by setting the enable bit.

The acceleration/delay time can be modified before a new command is issued.

It is always possible to specify a new value for the rotational speed by modifying the traversing data. If the rotational speed is changed while movement is taking place, the new value is attained respecting the current acceleration/delay times.

Control bytes   The control bytes that you use to specify this operating mode are an integral part of the traversal data.

A general description of the traversal data is available on pages 11-30.

Byte	Bit 7 ... Bit 0
4	Bit 0: enable (drive is started)
	Bit 6 ... Bit 1: 0
	Bit 7: irrelevant
5	Irrelevant

Reference run

Operation

The reference run calibrates your drive system. The point of reference should be located on the path of traversal.

Start the reference run:
- Set the enable bit.
- Release the reference run by means of the bit "Reference run positive" or "Reference run negative".
  - → The drive will travel to the point of reference using the reference rotational speed specified in the parameter set.
  - → As soon as the point of reference is passed, the reference switch is operated (LED RE is turned off).
  - → The position of the point of reference is recorded in memory.
  - → The drive is reversed up to the next encoder zero pulse.

This concludes the reference run and the bit "Reference detected" is set.

Note!

Please remember that a set position is not required for operating mode "Reference run". The set position is ignored.

Control bytes

The control bytes that you use to select this operating mode are included in the traversing data.

A general description of the traversal data is available on pages 11-30.

Byte	Bit 7 ... Bit 0
4	Bit 0: enable (drive is started)
	Bit 2 ... Bit 1: 01: reference run positive
	10: reference run negative
	Bit 6 ... Bit 3: 0
	Bit 7: irrelevant
5	Irrelevant

Hardware run

Operation   This mode is only used to approach a target position until the drive is stopped by an overrun end switch. The end switch must be connected to the reference switch input.

The traversal is governed by the values that were specified for rotational speed and acceleration or delay times. After the end switch is reached the respective position is stored internally and the drive is stopped with the specified delay time.

When the drive has stopped, it is reversed to the position of the end switch where it is stopped finally. At this point bit 3 is set to indicate "Position reached". For the reverse movement the MotionControl Servo module uses the reference rotational speed specified in the parameterization.

A new traversal can be initiated by toggling the bits "enable" and "HW ref. positive".

The acceleration/delay time can be modified before a new job is initiated.

If the rotational speed is altered when during the traversal, the new value is achieved by means of the current acceleration/delay time values.

Note!

Please remember that a set position is not required for operating mode "Hardware run". The set position is ignored.

Control bytes   The control bytes that you use to select this operating mode are included in the traversing data.

A general description of the traversal data is available on pages 11-30.

Byte	Bit 7 ... Bit 0
4	Bit 0: enable (drive is started)
	Bit 2 ... Bit 1: 0
	Bit 4 ... Bit 3: 01: Hardware run positive
	10: Hardware run negative
	Bit 6 ... 5: 0
	Bit 7: irrelevant
5	Irrelevant

Incremental run

Operation

The incremental mode makes use of relative positions, i.e. the value supplied as set position is added to the actual position.

When the enable bit is set, the drive travels in a positive or negative direction for the specified relative value. The drive uses the predefined values for rotational speed and acceleration to travel to the new position. If the position is negative the drive will be reversed.

You can modify the acceleration/delay time before you initiate a new job.

If the rotational speed is altered when during the traversal, the new value is achieved by means of the current acceleration/delay time values.

Control bytes

The control bytes that you use to select this operating mode are included in the traversing data.

A general description of the traversal data is available on pages 11-30.

Byte	Bit 7 ... Bit 0
4	Bit 0: enable (drive is started)
	Bit 4 ... Bit 1: 0
	Bit 5: 1 (Incremental run)
	Bit 6: 0
	Bit 7: irrelevant
5	Irrelevant

**Infinite
incremental
mode**

Operation

In this mode the position supplied as a value is approached as a relative position when enabled. When the position is reached, the set and the actual position are set to zero. You can use this mode to move the drive in one direction without counter overflow condition.

You can modify the acceleration/delay time before you initiate a new job.

You may specify a new value for the rotational speed at any time. If the rotational speed is altered during the traversal, the new value is achieved by means of the current acceleration/delay time values.

Control bytes

The control bytes that you use to select this operating mode are included in the traversing data.

A general description of the traversal data is available on pages 11-30.

Byte	Bit 7 ... Bit 0
4	Bit 0: enable (drive is started)
	Bit 5 ... Bit 1: 0
	Bit 6: 1 (Infinite incremental run)
	Bit 7: irrelevant
5	Irrelevant

**Non-maintained
command mode**

Operation

The drive is released by setting Bit 0 in Byte 4 (enable) with before opposed rotational speed and acceleration. By setting Bit 1 or Bit 2 in Byte 5, a rotation direction is given and the drive starts. The drive stops as soon as Bit 1 or Bit 2 of Byte 5 is set back.

Control bytes

The control bytes that you use to select this operating mode are included in the traversing data.

A general description of the traversal data is available on pages 11-30.

Byte	Bit 7 ... Bit 0
4	Bit 0: enable (drive is started)
5	Bit 0: V1.08 - Reset counter at non-maintained command mode (edge 0 after 1 sets back the actual position to zero) *1) Bit 1: 1 direction of rotation positive Bit 2: 1 direction of rotation negative

Note!

*1) The reset of the counter may only be executed in the non-maintained command mode. During positioning mode the regulator would throw a drag error because of the jumping actual value.

FM 254 - Data transfer >> CPU

The following values are transferred cyclically by the MotionControl Servo module to the CPU and stored.

Byte no.	Name	Length	Range	Unit
3, 2, 1, 0	Set position	4Byte	32Bit Integer	Encoder increments
7, 6, 5, 4	Actual position	4Byte	32Bit Integer	Encoder increments
9, 8	Set rotational speed	2Byte	100 ... 6000	1/min
11, 10	Operating mode	2Byte	binary coded	
13, 12	reserved	2Byte	-	-
15, 14	Reply field identifier	2Byte		hex

Operating state

Byte	Bit 7 ... Bit 0
10	Bit 0: enable issued
	Bit 1: clockwise rotation
	Bit 2: anticlockwise rotation
	Bit 3: position reached
	Bit 4: HW start switch operated
	Bit 5: HW end switch operated
	Bit 6: HW reference switch operated
	Bit 7: Reference detected
11	Bit 0: Drag error detected
	Bit 4: SW end switch anticlockwise rotation
	Bit 5: SW end switch clockwise rotation
	Bit 7 ... 1: irrelevant

Example

If the MotionControl Servo module was addressed starting at peripheral address PY128 in your CPU, you may obtain the "set position" from PY128 to PY131.

Other values follow these values in the peripheral area in accordance with the list above.

For example, the 2Byte for the "Operating state" are located at PY138...PY139.

Technical data

**MotionControl
Stepper
FM 253**

Electrical data	VIPA 253-1BA00
Number of axis	1
Voltage supply	DC 24V (20.4 ... 28.8) via front from ext. power supply
Current consumption backplane bus	typ. 320mA, max. 500mA
Status monitor	via LEDs at the frontside
Connectors / Interfaces	
"Drive"-Interface	Output for pulse, direction and release with RS422
Max. Impulse frequency	200kHz
Digital inputs	
Number	3
Function	2 end switch, reference switch
Signal voltage "0"	0 ... 5V
Signal voltage "1"	15 ... 28.8V
Digital outputs	
Number	2
Function	"axis in motion", "position reached"
Output current	1A protected against sustained short circuits
Potential separation	yes
Programming data	
Input data	16Byte
Output data	16Byte
Dimensions and weight	
Dimensions (WxHxD) in mm	25.4x76x76
Weight	80g

MotionControl
Servo module
FM 254

Electrical data	VIPA 254-1BA00
Voltage supply	DC 24V (20.4 ... 28.8) via front from ext. power supply
Current consumption	200mA
Current consumption backplane bus	100mA
Status indicator	via LEDs on the frontside
Connectors / interfaces	
Encoder	Incremental encoder
Signal voltages	5V as per RS 422
Supply voltage	5.2V / 300mA
	24V / 300mA
Input frequency and line length	1MHz max. with 10m screened line
	500kHz max. with 35m screened line
Control	
Set point output	-10 ... +10V
Digital inputs	
Number	3
Supply voltage	DC 24V
Digital outputs	
Number	1
Potential separation	no
Output current	0.5A
Lamp load	5W
Programming data	
Input data	16Byte
Output data	16Byte
Parameter data	16Byte
Diagnostic data	-
Dimensions and Weight	
Dimensions (WxHxD) in mm	25.4x76x76
Weight	80g

Chapter 12   Power supplies

Overview   This chapter contains descriptions of the System 200V power supplies.

Below follows a description of the:
- Power supply 2A
- Power supply 2A with terminal module
- Installation and wiring
- Technical data

Contents

Safety precautions

Appropriate use   The power supplies were designed and constructed:

- to supply DC 24V to the System 200V components
- to be installed on a t-rail along with System 200V components
- to operate as DC 24V stand-alone power supply
- for installation in a cabinet with sufficient ventilation
- for industrial applications

The following precautions apply to applications employing the System 200V power supplies.

Danger!
- The power supplies must be installed in protected environments that are only accessible to properly qualified maintenance staff!

- The power supplies are not certified for applications in explosive environments (EX-zone)!

- You have to disconnect the power supply from the main power source before commencing installation or maintenance work, i.e. before you start to work on a power supply or the supply cable the main supply line must be disconnected (disconnect plugs, on permanent installations the respective fuse has to be turned off)!

- Only properly qualified electrical staff is allowed to install, connect and/or modify electrical equipment!

- To provide a sufficient level of ventilation and cooling to the power supply components whilst maintaining the compact construction it was not possible to protect the unit from incorrect handling and a proper level of fire protection. For this reason the required level of fire protection must be provided by the environment where the power supply is installed (e.g. installation in a switchboard that satisfies the fire protection rules and regulations)!

- Please adhere to the national rules and regulations of the location and/or country where the units are installed (installation, safety precautions, EMC ...).

System overview

The System 200V power supplies are provided with a wide-range input that is connectable to AC 100 ... 240V. The output voltage is DC 24V at 2A/48W.

Since all inputs and outputs are located on the front of the unit and since the enclosure is isolated from the backplane bus you may install the power supply along with the System 200V on the same t-rail or you can use it as a separate external power supply.

The following power supplies are currently available:
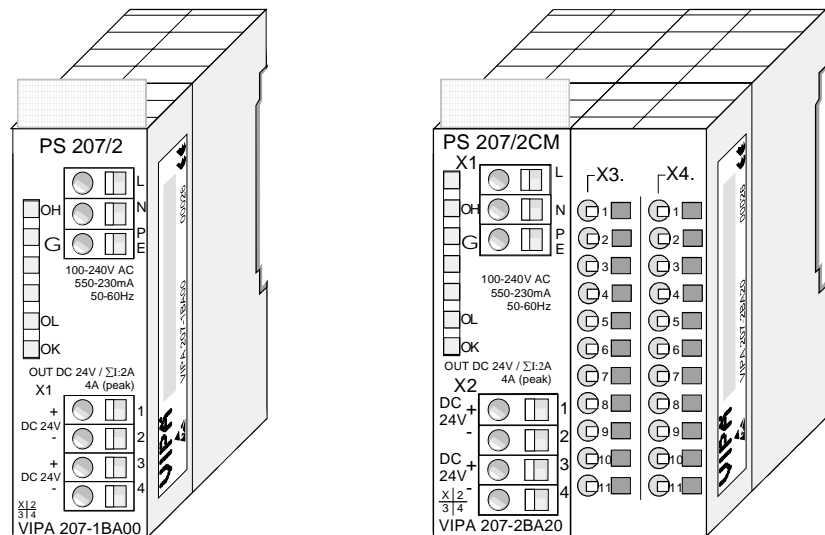
Order data

Order number	Description
VIPA 207-1BA00	Power supply PS 207/2 primary AC 100...240V, secondary DC 24V, 2A, 48W
VIPA 207-2BA20	Power supply PS 207/2CM primary AC 100...240V, secondary DC 24V, 2A, 48W with terminal module 2x11 clamps

PS 207/2 - Power supply - Construction

Properties   The power supply is distinguished by the following properties:

- Wide-range input AC 100...240V without manual intervention
- Output voltage DC 24V, 2A, 48W
- Can be installed on a t-rail together with other System 200V compo-
  nents or as stand-alone device
- Protection from short-circuits, overload and open circuits
- Typically 90% efficiency at I_{rated}

Construction
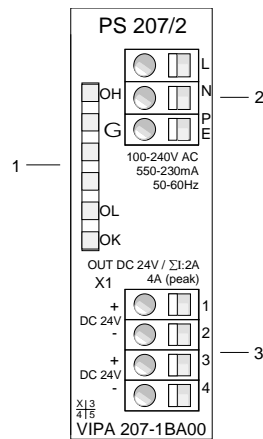
[1]   LED status indicator
[2]   AC IN 100 ... 240V
[3]   DC OUT 24V, 2A, 48W

LEDs   The front of the power supply carries 3 LEDs for troubleshooting purposes.
                        The following table lists the significance and the respective color.

Name	Color	Description
OH	red	Overheat: turned on by excessive temperatures
OL	yellow	Overload: turned on when the total current exceeds the maximum capacity of app. 3A.
OK	green	Turned on when the power supply operates properly and supplies DC 24V power.

Note!

Only one LED is on at unit operation.

When all the LEDs are extinguished while the power supply is operational, a short circuit is present or the power supply has failed.

**Connector
wiring**

**Input voltage
INPUT
AC 100...240V**

L
N
G   P
E

100-240V AC
550-230mA
50-60Hz

The power supply must be connected to a source of AC power via the input connector.

A fuse protects the input from overloads.

**Output voltage
OUTPUT
DC 24V, 2A**
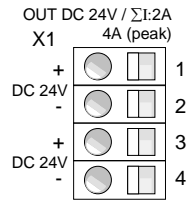
OUT DC 24V / ∑I:2A
X1   4A (peak)

+   1
DC 24V
-        2

+   3
DC 24V
-        4

Two connectors are provided for connection to System 200V modules that require an external source of DC 24V .

Both outputs are protected against short circuits and have an output voltage of DC 24V with a total current of 2A max.

Block diagram
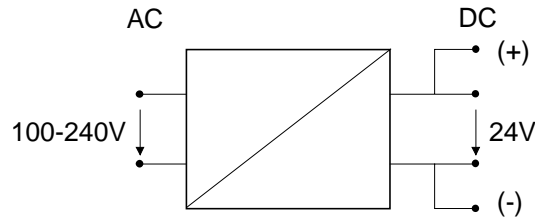
AC   DC
                              • (+)

100-240V   24V

                              • (-)

Danger!

- You need to disconnect the power supply from the main power source before commencing installation or maintenance work, i.e. before you start to work on a power supply or the supply cable, the main supply line must be disconnected (disconnect plugs, on permanent installations, the respective fuse has to be turned off)!

- Only properly qualified electrical staff is allowed to install, connect and/or modify electrical equipment!

PS 207/2CM - Power supply with Clamps - Construction

Properties   The power supply is distinguished by the following properties:

- Wide-range input AC 100...240V without manual intervention
- Output voltage DC 24V, 2A, 48W
- Installable on a t-rail together with other System 200V components or as stand-alone device
- Protection from short-circuits, overload and open circuits
- Typically 90% efficiency at I_{rated}
- Terminal module with 2x11 clamps

Construction

	Description
[1]	AC IN 100 ... 240V
[2]	LED Status monitor
[3]	DC OUT 24V, 2A
[4]	2x11 clamps
	X3 red
	X4 blue

LED's   The front of the power supply carries 3 LEDs for troubleshooting purposes. The following table lists the significance and the respective color.

Name	Color	Description
OH	red	Overheat: turned on by excessive temperatures
OL	yellow	Overload: turned on when the total current exceeds the maximum capacity of app. 3A.
OK	green	Turned on when the power supply operates properly and supplies DC 24V power.

⚠ **Note!**

Only one LED is on at unit operation.

When all the LEDs are extinguished while the power supply is operational, a short circuit is present or the power supply has failed.

**Connector
wiring**

**Input voltage
INPUT
AC 100...240V**

L
N
P
E

G

100-240V AC
550-230mA
50-60Hz

The power supply has to be connected to a source of AC power via the input connector.

A fuse protects the input from overloads.

**Output voltage
OUTPUT
DC 24V, 4A**

OUT DC 24V / ∑I:2A
X1   4A (peak)

+
DC 24V   1
-               2

+
DC 24V   3
-               4

Two connectors are provided for connection to System 200V modules that require an external source of DC 24V.

Both outputs are protected against short circuits protected and have an output voltage of DC 24V with a total current of max. 2A.

Block diagram
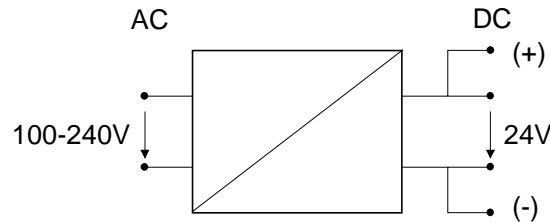
AC   DC

                                (+)

100-240V   24V

                                (-)

⚠ **Danger!**

- You need to disconnect the power supply from the main power source before commencing installation or maintenance work, i.e. before you start to work on a power supply or the supply cable the main supply line has to be disconnected (disconnect plugs, on permanent installations the respective fuse must be turned off)!

- Only properly qualified electrical staff is allowed to install, connect and/or modify electrical equipment!

Installation

Installation   The power supplies may be installed by two different methods:

- You may install the power supply along with System 200V modules on the same T-rail. In this case the power supply can only be installed at one end of your System 200V since the backplane bus would otherwise be interrupted.
The power supplies are not connected to the backplane bus.

- Installed as stand-alone power supply on a T-rail.

Please ensure proper and sufficient ventilation for the power supply when you select the installation location.

Danger!
- The power supplies have to be installed in protected environments that are only accessible to properly qualified maintenance staff!

- You need to disconnect the power supply from the main power source before commencing installation or maintenance work, i.e. before you start to work on a power supply or the supply cable, the main supply line must be disconnected (disconnect plugs, on permanent installations, the respective fuse must be turned off)!

- Only properly qualified electrical staff is allowed to install, connect and/or modify electrical equipment!

- To provide a sufficient level of ventilation and cooling to the power supply components whilst maintaining the compact construction, it was not possible to protect the unit from incorrect handling and a proper level of fire protection. For this reason the required level of fire protection must be provided by the environment where the power supply is installed (e.g. installation in a switchboard that satisfies the fire protection rules and regulations)!

- Please adhere to the national rules and regulations of the location and/or country where the units are installed (installation, safety precautions, EMC ...).

Wiring

Wiring

The connections to the power supply are provided by spring-clip terminals.

The terminals are able to accommodate wires of a diameter from $0.08mm^2$ to $2.5mm^2$. You may use flexible multi-strand wires as well as solid conductors.

Wiring by means of spring-clip terminals
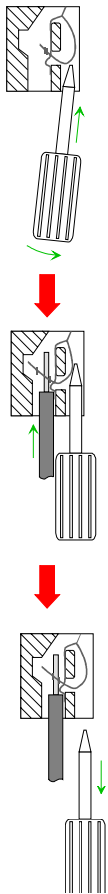
Connect cables to the spring-clip contacts as follows:
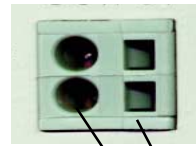
Square opening for screwdriver

Round opening for wires

The sequence shown on the left explains the steps that you have to follow to wire the power supply.

- Insert a suitable screwdriver at a slight angle into the square hole as shown.

- Push and hold the screwdriver in the opposite direction to open the spring contact.

- Insert the stripped end of the interconnecting wire into the round hole. You may use wires of a diameter of $0.08mm^2$ to $2.5mm^2$.

- When you remove the screwdriver the inserted wire is clamped and connected securely by the spring-clip contact.

Danger!

- You have to disconnect the power supply from the main power source before commencing installation or maintenance work, i.e. before you start to work on a power supply or the supply cable, the main supply line has to be disconnected (disconnect plugs, on permanent installations, the respective fuse must be turned off)!

- Only properly qualified electrical staff is allowed to install, connect and/or modify electrical equipment!

Technical data

**Power supply
PS 207, 2A, 48W**

Electrical data	VIPA 207-1BA00
Rated input voltage	AC 100...240V
Frequency	50Hz / 60Hz
Rated input current	0.24A / AC 230V
- power on surge	max. 30A
Buffer time (at a mains voltage AC $\geq$150V)	min.10 ms
Rated output voltage	DC 24V $\pm$ 5 %
- residual ripple	< 100 mV$_{ss}$ incl. spikes
- open-circuit protection	yes
Rated output current	2A (48W); 4A (peak)
Efficiency	typ. 90% at I$_{rated}$
Power dissipation	5W at nominal load
No load power	1.5W
Status indicators (LED)	via LEDs located on the front
Operating conditions	
Operating temperature	0°C...55°C (linear derating from 40°C to 55°C with 1.3W/°C)
Storage	- 25°C...+ 85°C
EMC	DIN EN 61000 / Part 4-8
Certification/CE	yes
General protection	Short circuit; overload; over temperature IP 20
Installation	DIN rail
Terminals	Spring-clip Input L, N, PE Output 2xDC 24V in parallel
Dimensions and Weight	
Dimensions (WxHxD)	25.4x76x76mm
Weight	250 g
Order data	
AC 100V-240V DC 24V / 2A	VIPA 207-1BA00

**Power supply
PS 207/2CM,
2A, 48W**

Electrical data	VIPA 207-2BA20
Rated input voltage	AC 100...240V
Frequency	50Hz / 60Hz
Rated input current	0.5A / AC 230V
- power on surge	max. 30A
Buffer time (at a mains voltage AC ≥150V)	min.10ms
Rated output voltage	DC 24V ± 5 %
- residual ripple	< 100 mV$_{ss}$ incl. spikes
- open circuit protection	yes
Rated output current	2A (48W);3A (peak)
Efficiency	typ. 90% at I$_{rated}$
Power dissipation	5W at the nominal load
No load power	1.5W
Status indicators (LED)	via LEDs located on the front
Operating conditions	
Operating temperature	0°C...55°C (linear derating from 40°C to 55°C with 1.2W/°C)
Storage	- 25°C...+ 85°C
EMC	DIN EN 61000 / Part 4-8
Certification/CE	yes
General protection	Short circuit; overload; over temperature IP 20
Installation	DIN-rail
Terminals	Spring-clip Input L, N, PE Output 2xDC 24V in parallel
Terminal module	
Number of rows	2
Number of clamps per row	11
Maximum clamp current	10A
Dimensions and Weight	
Dimensions (WxHxD)	50.8x76x76mm
Weight	300 g
Ordering details	
AC 100V - 240V DC 24V / 2A	VIPA 207-2BA20

Chapter 13   Digital input modules

Overview   This chapter contains a description of the construction and the operating of the VIPA digital input modules.

Below follows a description of:
- A system overview of the digital input modules
- Properties
- Constructions
- Interfacing and schematic diagram
- Technical data

Contents   **Topic**   **Page**

System overview

**Input modules
SM 221**

Here follows a summary of the digital input modules that are currently available from VIPA:
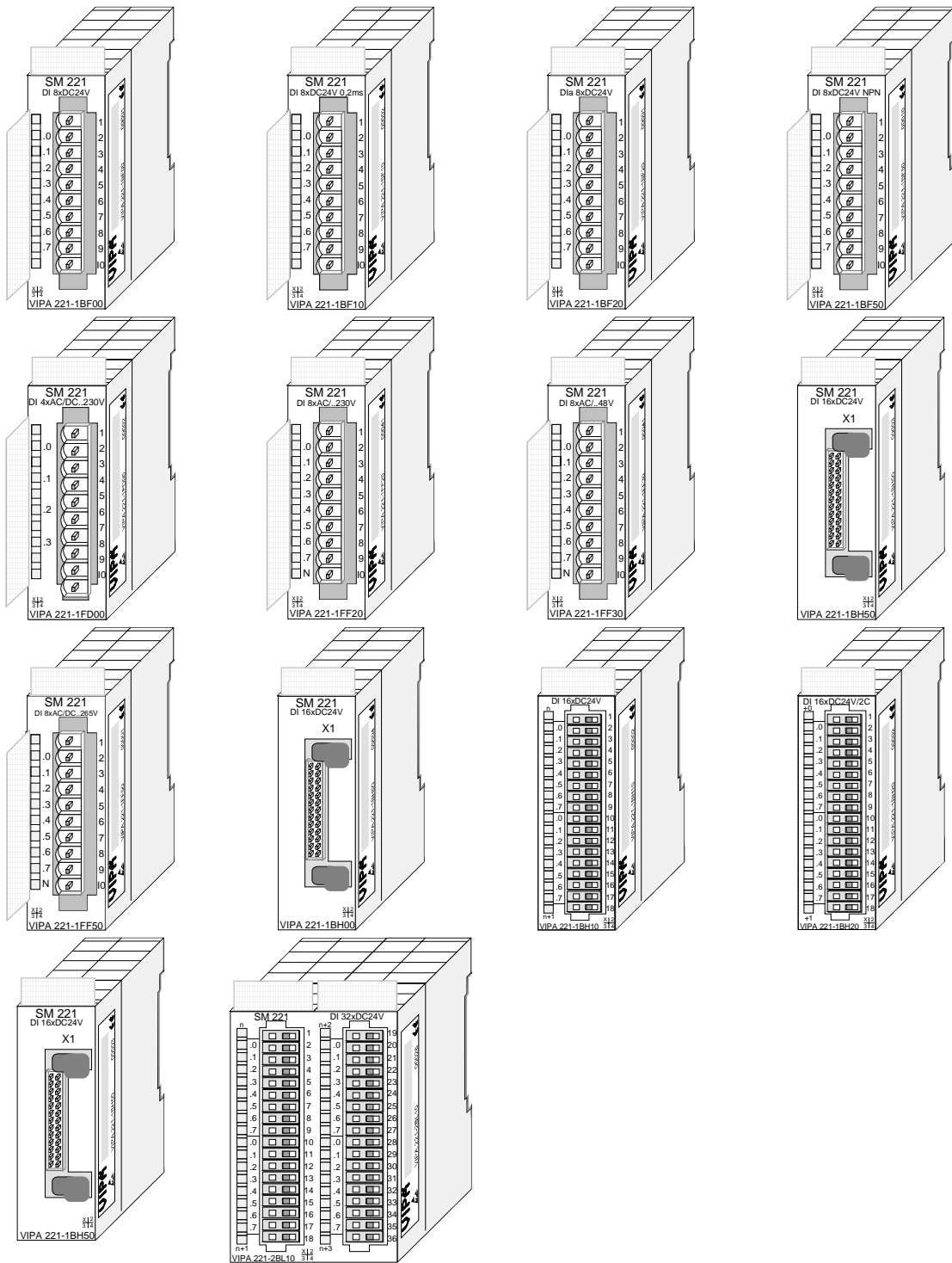
**Order data
input modules**

| Type	Order number	Page
DI 8xDC 24V	VIPA 221-1BF00	13-4
DI 8xDC 24V 0.2ms	VIPA 221-1BF10	13-6
DIa 8xDC 24V	VIPA 221-1BF20	13-8
DI 8xDC 24V NPN	VIPA 221-1BF50	13-10
DI 4xAC/DC 90...230V	VIPA 221-1FD00	13-12
DI 8xAC/DC 60...230V	VIPA 221-1FF20	13-14
DI 8xAC/DC 24...48V	VIPA 221-1FF30	13-16
DI 8xAC 240V	VIPA 221-1FF40	13-18
DI 8xAC/DC 180...265V	VIPA 221-1FF50	13-20
DI 16xDC 24V with UB4x	VIPA 221-1BH00	13-22
DI 16xDC 24V	VIPA 221-1BH10	13-24
DI 16xDC 24V/1C	VIPA 221-1BH20	13-26
DI 16xDC 24V NPN	VIPA 221-1BH50	13-37
DI 32xDC 24V	VIPA 221-2BL10	13-39

DI 8xDC 24V

Order data   DI 8xDC 24V   VIPA 221-1BF00

Description   The digital input accepts binary control signals from the process and pro-
                     vides an electrically isolated interface to the central bus system. The mo-
                     dule has 8 channels, each one with a light emitting diode to indicate the
                     status of the channel.

Properties   • 8 floating inputs, isolated from the backplane bus
                     • DC 24V nominal input voltage
                     • Suitable for standard switches and proximity switches
                     • Status indicator for each channel by means of an LED

Construction

[1]	Label for module description
[2]	Label for the bit address with description
[3]	LED status indicator
[4]	Connector edge

**Status indicator
pin assignment**

LED	Description
.0... .7	LEDs (green) E.0 to E.7 A "1" signal level is recognized as of app. 15V and the respective LED is turned on

SM 221
DI 8xDC24V

X | 2
3 | 4

VIPA 221-1BF00

Pin	Assignment
1	not connected
2	Input E.0
3	Input E.1
4	Input E.2
5	Input E.3
6	Input E.4
7	Input E.5
8	Input E.6
9	Input E.7
10	Ground

Wiring and schematic diagram

Wiring diagram
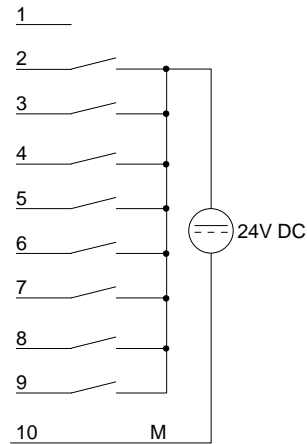
Schematic diagram
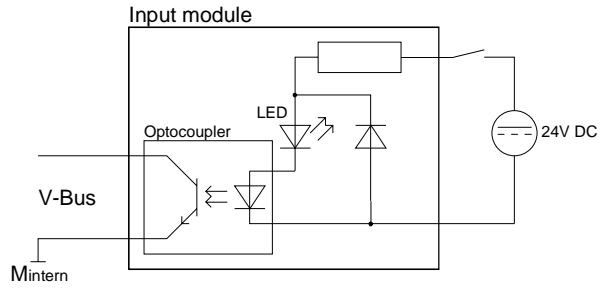
Technical data

Electrical data	VIPA 221-1BF00
Number of inputs	8
Nominal input voltage	DC 24V (18 ... 28.8V)
Signal voltage "0"	0 ... 5V
Signal voltage "1"	15 ... 28.8V
Input filter time delay	3ms
Input current	typ. 7mA
Power supply	5V via backplane bus
Current consumption via backp. bus	20mA
Isolation	500Vrms
	(field voltage - backplane bus)
Status indicator	via LEDs located on the front
Programming specifications	
Input data	1Byte
Output data	-
Parameter data	-
Diagnostic data	-
Dimensions and weight	
Dimensions (WxHxD) in mm	25.4x76x76
Weight	50g

DI 8xDC 24V 0.2ms

Order data   DI 8xDC 24V 0.2ms   VIPA 221-1BF10

Description   The digital input accepts binary control signals from the process level and provides an electrically isolated interface to the central bus system. The module has 8 channels, each one with a light emitting diode to indicate the status of the channel.

Properties   • 8 floating inputs, isolated from the backplane bus

• Delay time 0.2ms

• DC 24V nominal input voltage

• Suitable for standard switches and proximity switches

• Status indicator for each channel by means of an LED

Construction

[1]   Label for module description
[2]   Label for the bit address with description
[3]   LED status indicator
[4]   Edge connector

**Status indicator
pin assignment**

LED	Description		Pin	Assignment
.0... .7	LEDs (green)		1	not connected
	E.0 to E.7		2	Input E.0
	A "1" signal level is recognized as of app. 15V and the respective LED is turned on		3	Input E.1
			4	Input E.2
			5	Input E.3
			6	Input E.4
			7	Input E.5
			8	Input E.6
			9	Input E.7
			10	Ground

SM 221
DI 8xDC24V 0.2ms

.0
.1
.2
.3
.4
.5
.6
.7

1
2
3
4
5
6
7
8
9
I0

X 2
3 4

VIPA 221-1BF10

Wiring and schematic diagram

Wiring diagram

Schematic diagram

Technical data

Electrical data	VIPA 221-1BF10
Number of inputs	8
Nominal input voltage	DC 24V (18 ... 28.8V)
Signal voltage "0"	0 ... 5V
Signal voltage "1"	15 ... 28.8V
Input filter time delay	0.2ms
Input current	typ. 7mA
Power supply	5V via backplane bus
Current consumption via backplane bus	20mA
Isolation	500Vrms
	(field voltage - backplane bus)
Status indicator	via LEDs located on the front
Programming specifications	
Input data	1Byte
Output data	-
Parameter data	-
Diagnostic data	-
Dimensions and weight	
Dimensions (WxHxD) in mm	25.4x76x76
Weight	50g

DIa 8xDC 24V

Order data	DIa 8xDC 24V	VIPA 221-1BF20

Description

The digital alarm input module accepts the binary control signals from the process level and provides an electrically isolated interface to the central bus system.

All inputs are configurable as alarms. With the rising edge of the input, the alarm is activated. The alarm calls the OB 40 in the CPU. If this OB isn't available, the OB85 is called. If this OB is also not programmed, the CPU switches to STOP.

The module has 8 channels, each one with a light emitting diode to indicate the status of the channel.

Properties

- 8 alarm inputs, isolated from the backplane bus
- nominal input voltage DC 24V
- suited for urgent signals (switches and proximity switches)
- Status indicator for each channel by means of an LED

Construction

[1]	Label for module description
[2]	Label for the bit address with description
[3]	LED status indicator
[4]	Edge connector

Status indicator pin assignment

LED	Description		Pin	Assignment
.0... .7	LEDs (green) E.0 to E.7 A "1" signal level is recognized as of app. 15V and the respective LED is turned on	SM 221 DIa 8xDC24V	1	not connected
			2	Input E.0
			3	Input E.1
			4	Input E.2
			5	Input E.3
			6	Input E.4
			7	Input E.5
			8	Input E.6
			9	Input E.7
		VIPA 221-1BF20	10	Ground
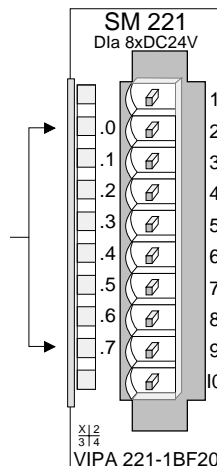
Wiring and schematic diagram

Wiring diagram

Schematic diagram

Note!

The module may be deployed in the System 200V starting from CPU firmware versions:

CPU 21x:	Version 2.2.1
CPU 24x:	Version 3.0.6

The deployment with lower firmware versions causes error messages and a CPU switch to STOP!

Technical data

Electrical data	VIPA 221-1BF20
Number of alarm inputs	8
Nominal input voltage	DC 24V (18 ... 28.8V)
Signal voltage "0"	0 ... 5V
Signal voltage "1"	15 ... 28.8V
Input filter time delay	3ms
Input current	typ. 7mA
Power supply	5V via backplane bus
Current consumption via backplane bus	140mA
Isolation	500Vrms
	(field voltage - backplane bus)
Status indicator	via LEDs located on the front
Programming specifications	
Input data	1Byte
Output data	-
Parameter data	-
Diagnostic data	-
Dimensions and weight	
Dimensions (WxHxD) in mm	25.4x76x76
Weight	50g

DI 8xDC 24V NPN

**Order data**   DI 8xDC 24V NPN   VIPA 221-1BF50

Description   The digital input accepts binary control signals from the process and provides an electrically isolated interface to the central bus system. The module has 8 channels, each one with a light emitting diode to indicate the status of the channel. The input becomes active when it is connected to ground.

Properties
- 8 floating inputs, isolated from the backplane bus
- Active low input (signal level "1" when input is at ground)
- DC 24V nominal input voltage
- Suitable for standard switches and proximity switches
- Status indicator for each channel by means of an LED

Construction
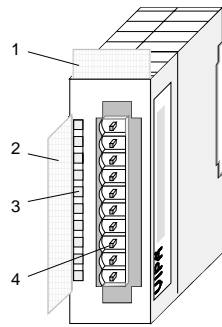
[1]   Label for module description
[2]   Label for the bit address with description
[3]   LED status indicator
[4]   Edge connector

**Status indicator
pin assignment**

LED	Description		Pin	Assignment
.0... .7	LEDs (green) E.0 to E.7 when an input is at ground a "1" is detected and the respective LED is turned on	SM 221 DI 8xDC24V	1	+DC 24V
			2	Input E.0
			3	Input E.1
			4	Input E.2
			5	Input E.3
			6	Input E.4
			7	Input E.5
			8	Input E.6
			9	Input E.7 / Ground
		VIPA 221-1BF50	10	reserved
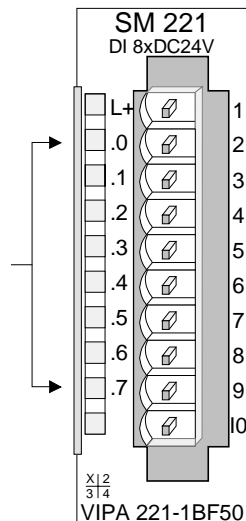
Wiring and schematic diagram

Wiring diagram
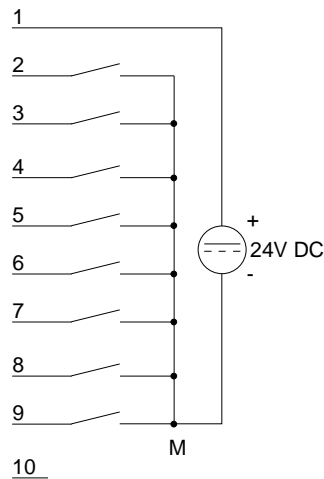
Schematic diagram
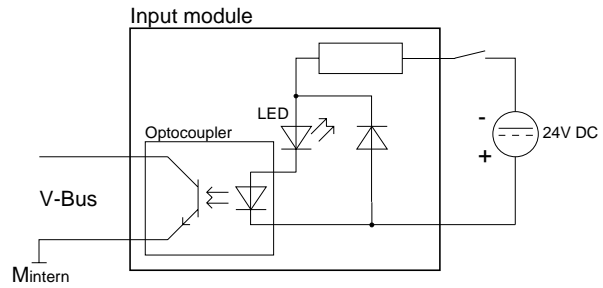
Technical data

Electrical data	VIPA 221-1BF50
Number of inputs	8
Nominal input voltage	DC 24V (18 ... 28.8V)
Signal voltage "0"	15 ... 28.8V
Signal voltage "1"	0 ... 5V
Input filter time delay	3ms
Input current	typ. 7mA
Power supply	5V via backplane bus
Current consumption via backplane bus	20mA
Isolation	500Vrms
	(field voltage - backplane bus)
Status indicator	via LEDs located on the front
Programming specifications	
Input data	1Byte
Output data	-
Parameter data	-
Diagnostic data	-
Dimensions and weight	
Dimensions (WxHxD) in mm	25.4x76x76
Weight	50g

DI 4xAC/DC 90...230V

Order data   DI 4xAC/DC 90...230V   VIPA 221-1FD00

Description   The digital input accepts binary control signals from the process and provides an electrically isolated interface to the central bus system.

The module has 4 channels and the respective status is displayed by means of LEDs.

Properties
- 4 floating inputs, isolated from the backplane bus and from each other
- Status indicator for each channel by means of an LED
- Nominal input voltage 90 ... 230V AC/DC

Construction
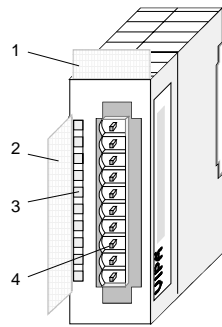
[1]	Label for module description
[2]	Label for the bit address with description
[3]	LED status indicator
[4]	Edge connector

Status indicator pin assignment

LED	Description		Pin	Assignment
.0	LEDs (green)		1	not connected
.1	E.0 to E.3		2	E.0
.2	from app. DC 80V or AC		3	Neutral conductor E.0
.3	65V (50Hz) a signal "1" is detected and the respective LED is turned on		4	E.1
			5	Neutral conductor E.1
			6	E.2
			7	Neutral conductor E.2
			8	E.3
			9	Neutral conductor E.3
			10	not connected
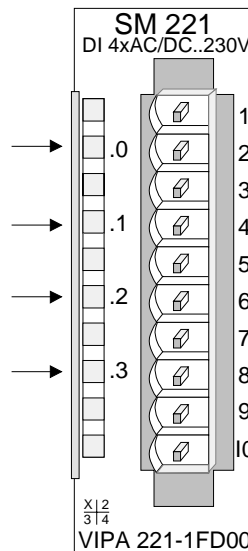
SM 221
DI 4xAC/DC..230V

VIPA 221-1FD00

Wiring and schematic diagram

Wiring diagram

Schematic diagram

1

2

3

4

5

6

7

8

9

10
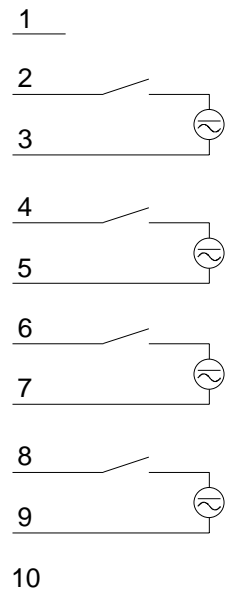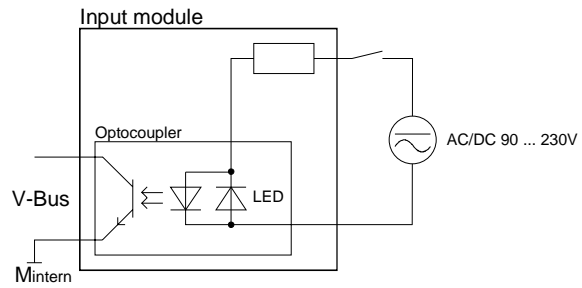
Technical data

| Electrical data	VIPA 221-1FD00
Number of inputs	4
Nominal input voltage	AC/DC 90 ... 230V
Signal voltage "0"	AC/DC 0 ... 35V
Signal voltage "1"	AC/DC 90 ... 230V
Input filter time delay	25ms
Frequency of input voltage	50 ... 60Hz
Input resistance	136kΩ
Power supply	5V via backplane bus
Current consumption via backplane bus	80mA
Isolation	500Vrms
	(field voltage - backplane bus)
Status indicator	via LEDs located on the front
Programming specifications	
Input data	1Byte (Bit 0 ... Bit 3)
Output data	-
Parameter data	-
Diagnostic data	-
Dimensions and weight	
Dimensions (WxHxD) in mm	25.4x76x76
Weight	50g

DI 8xAC/DC 60...230V

Order data   DI 8xAC/DC 60...230V   VIPA 221-1FF20

Description   The digital input accepts binary control signals from the process and provides an electrically isolated interface to the central bus system.

The module has 8 channels, each one with a light emitting diode to indicate the status of the channel.

Properties
- 8 inputs, isolated from the backplane bus
- Nominal input voltage 60 ... 230V AC/DC
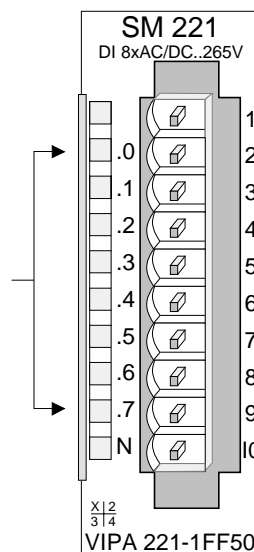- Status indicator for each channel by means of an LED
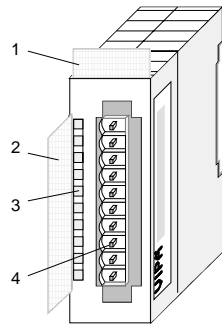
Construction

[1]   Label for module description
[2]   Label for the bit address with description
[3]   LED status indicator
[4]   Edge connector

Status indicator pin assignment
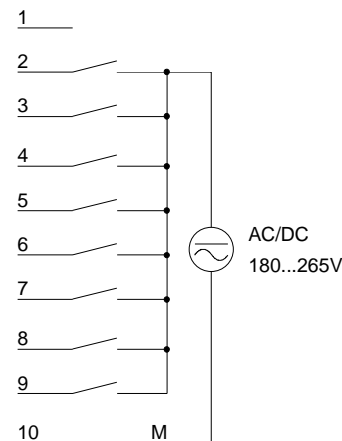
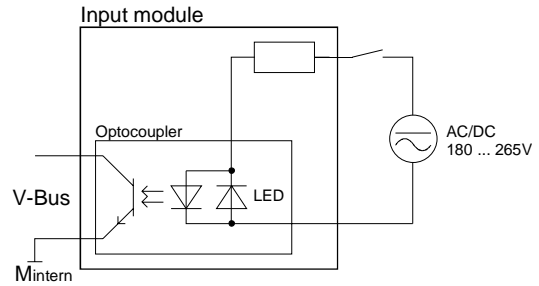| LED	Description		Pin	Assignment
.0... .7	LEDs (green) E.0 to E.7 from app. DC 55V or AC 45V (50Hz) a signal "1" is detected and the respective LED is turned on		1	not connected
			2	Input E.0
			3	Input E.1
			4	Input E.2
			5	Input E.3
			6	Input E.4
			7	Input E.5
			8	Input E.6
			9	Input E.7
			10	Neutral conductor
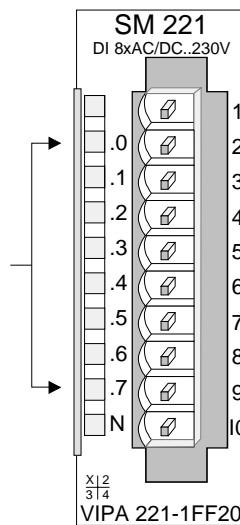
Wiring and schematic diagram

Wiring diagram
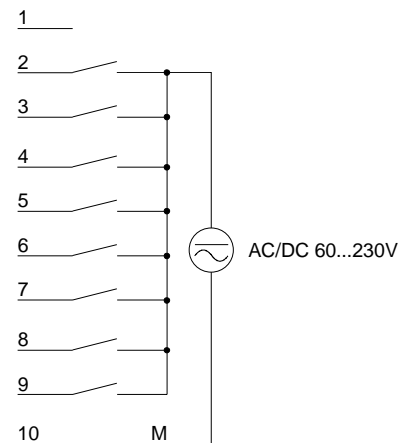
Schematic diagram
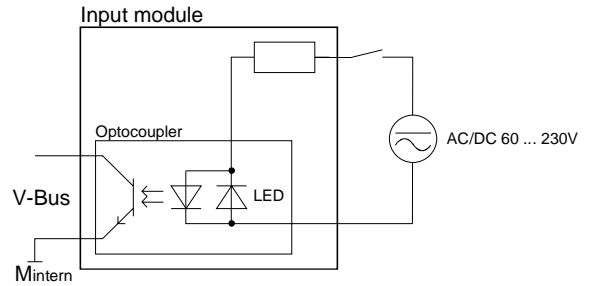
Technical data

Electrical data	VIPA 221-1FF20
Number of inputs	8
Nominal input voltage	AC/DC 60 ... 230V
Signal voltage "0"	AC/DC 0 ... 35V
Signal voltage "1"	AC/DC 60 ... 230V
Input filter time delay	25ms
Frequency of input voltage	50 ... 60Hz
Input resistance	136kΩ
Power supply	5V via backplane bus
Current consumption via backplane bus	80mA
Isolation	500Vrms (field voltage - backplane bus)
Status indicator	via LEDs located on the front
Programming specifications	
Input data	1Byte
Output data	-
Parameter data	-
Diagnostic data	-
Dimensions and weight	
Dimensions (WxHxD) in mm	25.4x76x76
Weight	50g

DI 8xAC/DC 24...48V

Order data   DI 8xAC/DC 24...48V   VIPA 221-1FF30

Description   The digital input accepts binary control signals from the process and
                        provides an electrically isolated interface to the central bus system.

                        The module has 8 channels, each one with a light emitting diode to indicate
                        the status of the channel.

Properties   • 8 floating inputs, isolated from the backplane bus

                        • Nominal input voltage AC/DC 24 ... 48V

                        • Status indicator for each channel by means of an LED

Construction

[1]   Label for module description
[2]   Label for the bit address with
      description
[3]   LED status indicator
[4]   Edge connector

**Status indicator
pin assignment**

LED	Description		Pin	Assignment
.0... .7	LEDs (green)		1	not connected
	E.0 to E.7		2	Input E.0
	from app. DC 14V or AC		3	Input E.1
	12V (50Hz) a signal "1" is		4	Input E.2
	detected and the		5	Input E.3
	respective LED is turned		6	Input E.4
	on		7	Input E.5
			8	Input E.6
			9	Input E.7
			10	Neutral conductor

Wiring and schematic diagram

Wiring diagram

Schematic diagram

Technical data

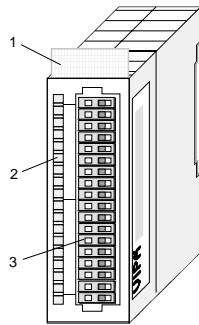| Electrical data	VIPA 221-1FF30
Number of inputs	8
Nominal input voltage	AC/DC 24 ... 48V
Signal voltage "0"	AC/DC 0 ... 8V
Signal voltage "1"	AC/DC 18 ... 48V
Input filter time delay	25ms
Frequency of input voltage	50 ... 60Hz
Input resistance	16.4kΩ
Power supply	5V via backplane bus
Current consumption via backplane bus	80mA
Isolation	500Vrms
	(field voltage - backplane bus)
Status indicator	via LEDs located on the front
Programming specifications	
Input data	1Byte
Output data	-
Parameter data	-
Diagnostic data	-
Dimensions and weight	
Dimensions (WxHxD) in mm	25.4x76x76
Weight	50g

DI 8xAC 240V

Order data   DI 8xAC 240V   VIPA 221-1FF40

Description   The digital input accepts binary control signals from the process and provides an electrically isolated interface to the central bus system.

                         The module has 8 channels, each one with a light emitting diode to indicate the status of the channel.

                         In a defined voltage range, the signal state of the respective input is not modified (Hysterese).

Properties   • 8 floating inputs, isolated from the backplane bus

                         • Nominal input voltage AC 240V

                         • Status indicator for each channel by means of an LED

                         • Hysterese

                         • Current consumption 20mA per channel

Construction
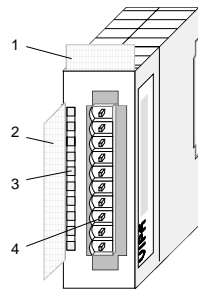
[1]   Label for module description
[2]   Label for the bit address with description
[3]   LED status indicator
[4]   Edge connector

**Status indicator
pin assignment**

LED	Description		Pin	Assignment
			1	not connected
.0... .7	LEDs (green)		2	Input E.0
	E.0 to E.7		3	Input E.1
	from app. AC 190 V (50Hz) the signal "1" is detected and the respective LED is turned on		4	Input E.2
			5	Input E.3
			6	Input E.4
			7	Input E.5
			8	Input E.6
			9	Input E.7
			10	Neutral conductor
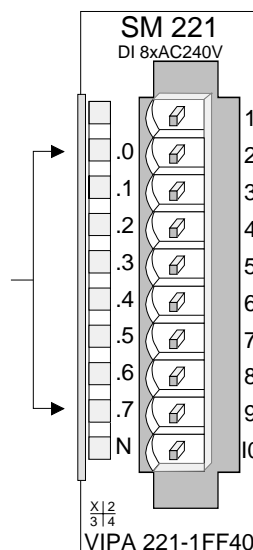
SM 221
DI 8xAC240V

VIPA 221-1FF40

Wiring and schematic diagram

Wiring diagram
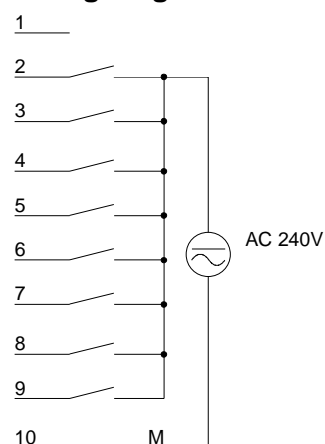
Schematic diagram
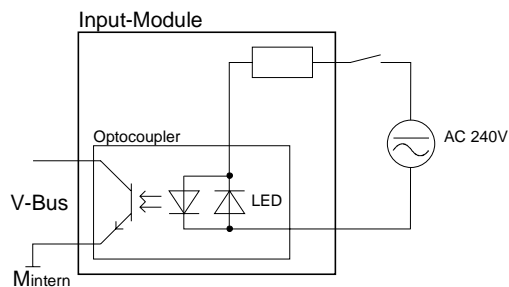
Note!

This module is specified for voltages of max. AC 260V.

If inductive loads occur on the network, this load has to be filtered either directly at the module or at the according device, for example by using a snubber network.

Technical data

Electrical data	VIPA 221-1FF40
Number of inputs	8
Nominal input voltage	AC 240V
Current consumption per channel	20mA
Signal voltage "0"	AC 0 ...70V
Hysterese	AC 90 ... 160V
Signal voltage "1"	AC 190 ... 260V
Input filter time delay	25ms
Frequency of input voltage	50Hz
Input resistance	136kΩ
Power supply	5V via backplane bus
Current consumption via backplane bus	80mA
Isolation	500Vrms
	(field voltage - backplane bus)
Status indicator	via LEDs located on the front
Programming specifications	
Input data	1Byte
Output data	-
Parameter data	-
Diagnostic data	-
Dimensions and weight	
Dimensions (WxHxD) in mm	25.4x76x76
Weight	ca. 50g

DI 8xAC/DC 180...265V

Order data   DI 8xAC/DC 180...265V   VIPA 221-1FF50

Description   The digital input accepts binary control signals from the process and provides an electrically isolated interface to the central bus system.

The module has 8 channels, each one with a light emitting diode to indicate the status of the channel.

Properties
- 8 floating inputs, isolated from the backplane bus
- Nominal input voltage AC/DC 180...265V
- Status indicator for each channel by means of an LED
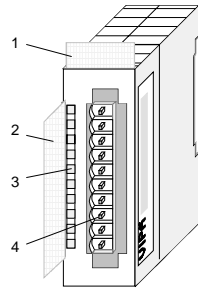
Construction

[1]	Label for module description
[2]	Label for the bit address with description
[3]	LED status indicator
[4]	Edge connector

Status indicator pin assignment

LED	Description		Pin	Assignment
.0... .7	LEDs (green) E.0 to E.7 from app. DC 150V resp. AC 170V (50Hz) the signal "1" is detected and the respective LED is turned on		1	not connected
			2	Input E.0
			3	Input E.1
			4	Input E.2
			5	Input E.3
			6	Input E.4
			7	Input E.5
			8	Input E.6
			9	Input E.7
			10	Neutral conductor

Wiring and schematic diagram

Wiring diagram

```
1  ____
2      ○/  ●
3      ○/  ●
4      ○/  ●
5      ○/  ●
6      ○/  ●        (~) AC/DC
7      ○/  ●            180...265V
8      ○/  ●
9      ○/
10         M
```

Schematic diagram

Input module

Optocoupler

V-Bus

M intern

AC/DC 180 ... 265V

LED

Technical data

Electrical data	VIPA 221-1FF50
Number of inputs	8
Nominal input voltage	AC/DC 180...265V
Signal voltage "0"	AC/DC 0 ...150V
Signal voltage "1"	AC/DC 180 ... 265V
Input filter time delay	25ms
Frequency of input voltage	50 ... 60Hz
Input resistance	136kΩ
Power supply	5V via backplane bus
Current consumption via backplane bus	30mA
Isolation	500Vrms (field voltage - backplane bus)
Status indicator	via LEDs located on the front
Programming specifications	
Input data	1Byte
Output data	-
Parameter data	-
Diagnostic data	-
Dimensions and weight	
Dimensions (WxHxD) in mm	25.4x76x76
Weight	50g

DI 16xDC 24V with UB4x

Order data   DI 16xDC 24V   VIPA 221-1BH00

Description   The digital input accepts binary control signals from the process and provides an electrically isolated interface to the central bus system. This module requires a UB4x-converter. It has 16 channels that indicate the respective status via LEDs on the UB4x. The module has to be connected to the converter module (DEA-UB4x) by means of a flattened round cable (DEA-KB91C).

Properties
- 16 inputs, isolated from the backplane bus
- DC 24V nominal input voltage
- Suitable for standard switches and proximity switches
- Status indicator for each channel by means of a LED located on the conversion module UB4x

Construction
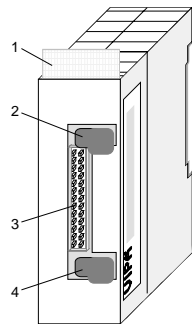
[1]   Label for module description
[2]   Clip
[3]   Recessed connector for the interface to a conversion module UB4x via the flattened round cable
[4]   Clip

Status indicator on UB4x

LED	Description
0... .15	LEDs (yellow)
	E.0 to E.7 High
	E.0 to E.7 Low
	A "1" signal level is recognized as of app. 15V and the respective LED is turned on
L+ L-	LED (green)
	Supply voltage available

Pin assignment module

Connector	Pin	Assignment
	23...26	Supply voltage +DC 24V
	22	Input E.0
	21	Input E.1
	.	.
	.	.
	.	.
	8	Input E.14
	7	Input E.15
	1...6	Supply voltage Ground
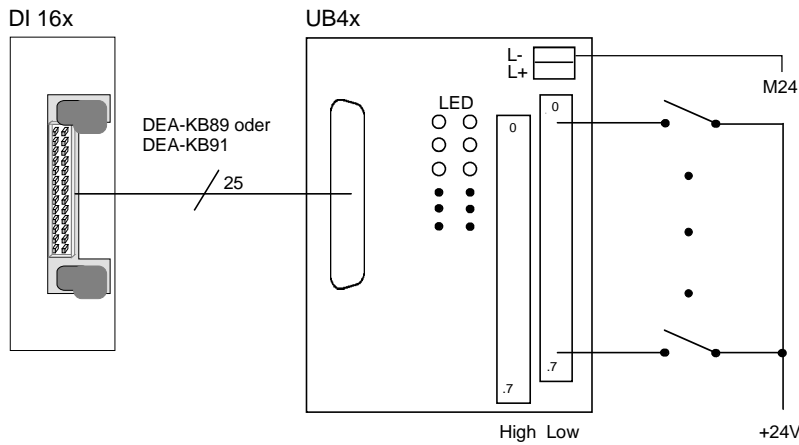
Interface to UB4x   **Schematic diagram module**
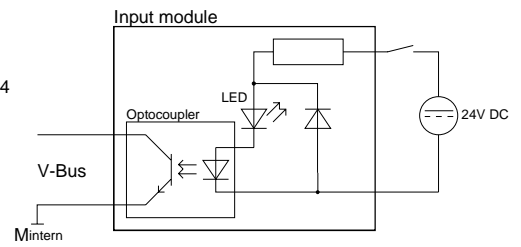
Technical data

Electrical data	VIPA 221-1BH00
Number of inputs	16
Nominal input voltage	DC 24V (18 ... 28.8V)
Signal voltage "0"	0 ... 5V
Signal voltage "1"	15 ... 28.8V
Input filter time delay	3ms
Input current	typ. 7mA
Power supply	5V via backplane bus
Current consumption via backplane bus	20mA
Isolation	500Vrms
	(field voltage - backplane bus)
Status indicator	via LEDs located on the UB4x
Programming specifications	
Input data	2Byte
Output data	-
Parameter data	-
Diagnostic data	-
Dimensions and weight	
Dimensions (WxHxD) in mm	25.4x76x76
Weight	50g

DI 16xDC 24V

Order data   DI 16xDC 24V   VIPA 221-1BH10

Description   The digital input accepts binary control signals from the process and provides an electrically isolated interface to the central bus system. It has 16 channels that indicate the respective status by means of LEDs.

Properties   • 16 inputs, isolated from the backplane bus

                 • DC 24V nominal input voltage

                 • Suitable for standard switches and proximity switches

                 • Status indicator for each channel by means of an LED

Construction

[1]   Label for module description
[2]   LED status indicator
[3]   Edge connector

Status indicator connector assignment

LED	Description		Pin	Assignment
.0 7	LEDs (green) E.0 to E.7 (per byte) A "1" signal level is recognized as of app. 15V and the respective LED is turned on		1	not connected
			2	Input E.0
			3	Input E.1
			4	Input E.2
			.	.
			.	.
			.	.
			15	Input E.13
			16	Input E.14
			17	Input E 15
			18	Ground

Wiring and schematic diagram

Wiring diagram
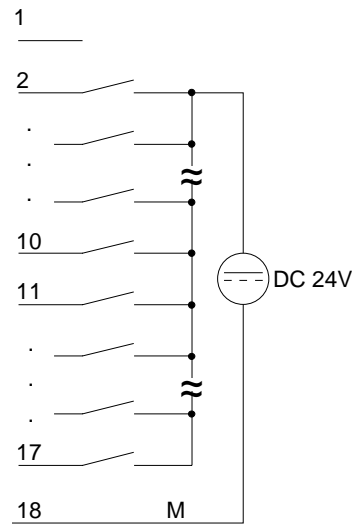
Schematic diagram
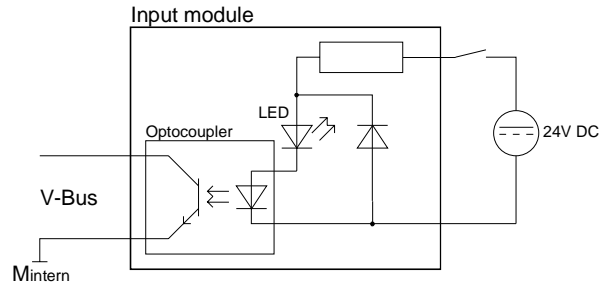
Technical data

Electrical data	VIPA 221-1BH10
Number of inputs	16
Nominal input voltage	DC 24V (18 ... 28.8V)
Signal voltage "0"	0 ... 5V
Signal voltage "1"	15 ... 28.8V
Input filter time delay	3ms
Input current	typ. 7mA
Power supply	5V via backplane bus
Current consumption via backplane bus	30mA
Isolation	500Vrms
	(field voltage - backplane bus)
Status indicator	via LEDs located on the front
Programming specifications	
Input data	2Byte
Output data	-
Parameter data	-
Diagnostic data	-
Dimensions and weight	
Dimensions (WxHxD) in mm	25.4x76x76
Weight	50g

DI 16xDC24V/1C

Order data   DI 16xDC24V/1C   VIPA 221-1BH20

Description   The digital input accepts binary control signals from the process and provides an electrically isolated interface to the central bus system. It has 16 channels that indicate the respective status by means of LEDs. Additionally, the first two channels may head for counters.

Properties
- 16 inputs, isolated from the backplane bus
- 2 inputs of this configurable as one counter, frequency or period measurement
- Pull up abbr. pull down resistors are inside, so sensors with positive and negative logic can be connected.
- Suitable for standard switches and proximity switches
- Status indicator for each channel by means of an LED

Construction
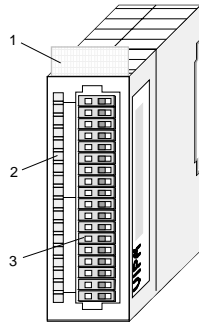
[1]   Label for module name
[2]   LED status indicator
[3]   Edge connector

Status indicator connector assignment

LED	Description		Pin	Assignment
.0 7	LEDs (green) E.0 to E.7 (per byte) A "1" signal level is recognized as of app. 15V and the respective LED is turned on		1	L+ DC 24V or Ground[*]
			2	Input E.0 / Counter (A)
			3	Input E.1 / Counter (B)
			4	Input E.2
			.	.
			.	.
			.	.
			15	Input E.13
			16	Input E.14
			17	Input E 15
			18	Ground

*) DC 24V or Ground to connect sensors with positive or negative logic at E.0 or E.1

Circuit and schematic diagram

Wiring diagram
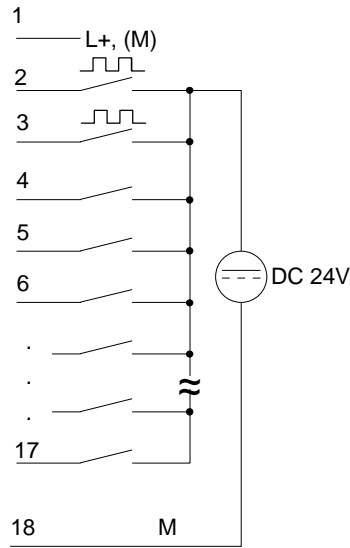
Schematic diagram

Input E.0, E.1 (negative logic)
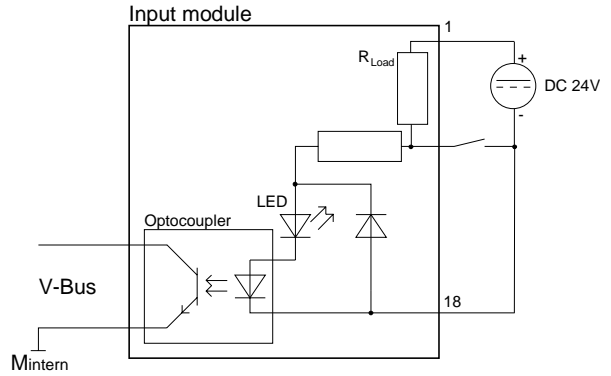
Input E.0, E.1 (positive logic)
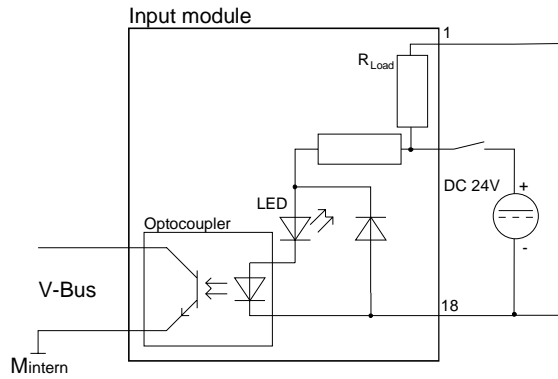
Input E.2 … E.15
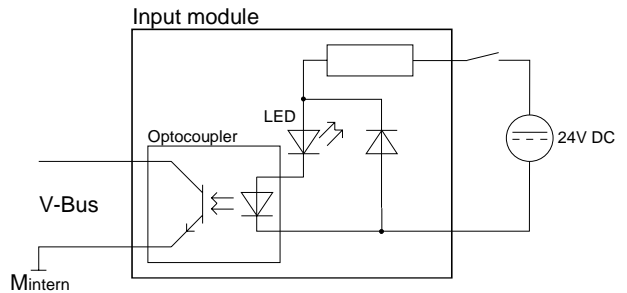
Note!

The inputs E.0 and E.1 have also internal pull up (-down) resistors, which lead to pin 1 of the connector strip.

You can connect the sensors with negative logic output directly to the inputs E.0 and E.1. Here you have to supply pin 1 with DC 24V.

Connect pin 1 to Ground (bridge to pin 18) when E.0 and E.1 are used as "normal" inputs with positive logic.

Overview Module Functions

The Counter Module is a 16Bit digital input module for System 200V combined with a one-channel 32Bit counter.

Inputs DI [0] and DI [1] are used as 'normal' process inputs and as counter inputs (signal A and signal B) simultaneously.
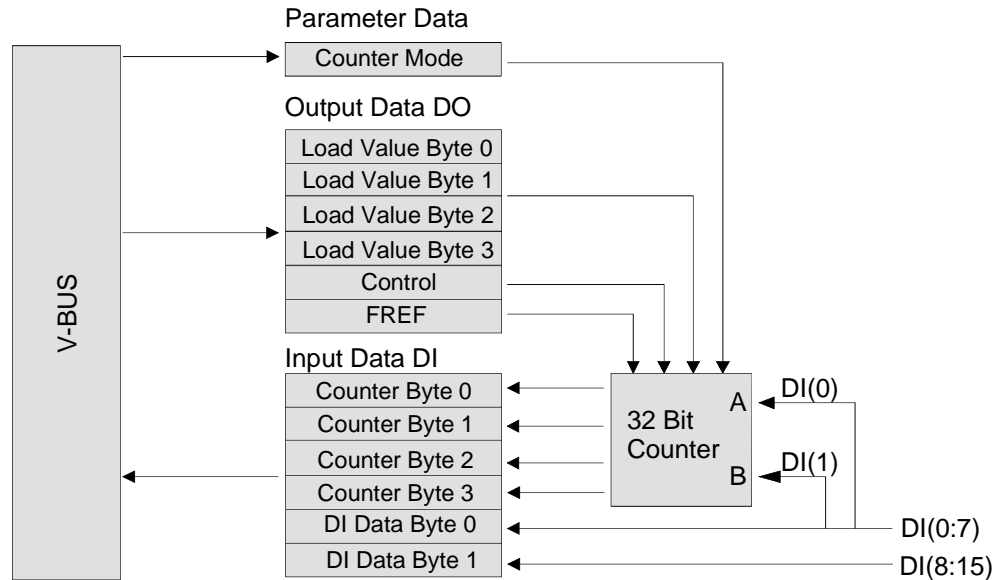
By writing DO data to the module, you may preset a counter value as well as a reference frequency. The activation of this values is via control byte.

By means of 1Byte parameter data, you may set the counter mode. There are 5 counter modes supported. By read access at the according bytes of the input data, the counter state is shown.

The counting is started res. stopped via the control byte (SW gate).

Count Range / Limit values

The counter module can count up and down. The count value is 32Bit wide and is to be interpreted as of type unsigned integer. Therefore the count limits are given as:

Lower Count Limit	Upper Count Limit
0	$+ 4.294.967.295 \quad (2^{32} - 1)$

Load Value   It is possible to specify a load value for the counter. After loading the counter starts counting up res. down from this new value to the upper res. lower limit value. After receiving a new counting pulse, the counter jumps to the lower (counting up) res. upper limit (counting down) and starts the counting again.

In the operation mode "Frequency Measurement" the load value is used to define the time window of the measurement.

The load mechanism is controlled via the bit LOAD in the control byte.

Continuous Counting
In all counter modes, a continuous counter function is used as described in the following paragraphs and as shown in figure.

If the counter reaches the upper count limit when counting up and a further count pulse is received, the counter jumps to the lower count limit and starts to add the count pulses again, meaning it counts continuously.

If the counter reaches the lower count limit when counting down and a further count pulse is received, the counter jumps to the upper count limit and continues to count down from there.

The count range in all modes is 0 to +4.294.967.295 and cannot be changed. The counter starts to count at 0 when a complete restart (Power-On Reset or VBUS-Reset) is executed on the module or the counter is cleared by setting bit CLEAR in the control byte.
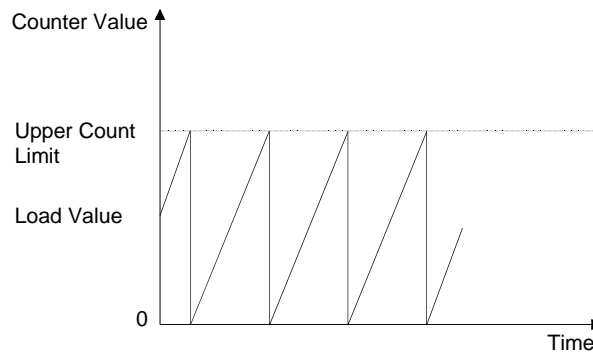
Counter activation via Software Gate	Many applications require that the count can be started or stopped at a defined time depending on other events. This starting and stopping of the count process is done via a software gate function. If the gate is opened, count pulses can reach the counter and the count is started. If the gate is closed, count pulses can no longer reach the counter and the count is stopped.
	The software gate is controlled via the bits START and STOP in the Control Byte. Setting the bit START will open the software gate whereas setting the bit STOP will close the software gate.
Module access	For input and output data, the module occupies each 6Byte in the address area. For setting the counter mode there are 1Byte parameter data at disposal.
	Loading the counter res. presetting of a reference frequency is via a control byte by typing the wanted value into the output address area and setting the Bit 2 of the control byte to activate the counter.
	You may see the counter value and the state of the inputs in the input address area. Also during count operation you may call all input channels.
Input data DI data bytes	The module has 6Byte input data that can be accessed by direct reading. Input bytes 0 to 3 are assigned to the 32Bit counter value whereas bytes 4 and 5 are assigned to the 16Bit digital inputs.

Byte	Bit 7 ... 0
0	Counter Value Byte 0
1	Counter Value Byte 1
2	Counter Value Byte 2
3	Counter Value Byte 3
4	DI Data Byte 0 (E.7 ... E.0)
5	DI Data Byte 1 (E.15 ... E.8)

**Output data
DO data bytes**

The module has 6Byte output data.

Byte 0 to 3 are assigned to a load value according to the selected counter mode. Byte 4 is used as control byte for the counter.

Byte 5 selects a reference frequency for the counter modes "Frequency Measurement" and "Period Measurement".

Byte	Bit 7 ... 0
0	Load Value Byte 0
1	Load Value Byte 1
2	Load Value Byte 2
3	Load Value Byte 3
4	Control Byte
5	Reference Frequency

Control Byte:

Bit	Function
0	'1' = START counter (the software gate is open)
1	'1' = STOP counter (the software gate is closed)
2	'1' = LOAD counter
3	'1' = CLEAR counter
4	
...	reserved
7	

Reference Frequency Selection:

Value	Reference Frequency
00h	16 MHz
01h	8 MHz
02h	4 MHz
03h	1 MHz
04h	100 kHz
05h	10 kHz
06h	1 kHz
07h	100 Hz
others	not allowed

Parameter Data   The module has 1Byte parameter data for selecting the counter mode.

Byte	Bit 7 ... 0
0	Counter Mode

Counter Mode Selection:

Value	Counter Mode
00h	Quadruple Pulse Evaluation
01h	Pulse and Direction Evaluation
02h	Clock Up / Clock Down Evaluation
03h	Frequency Measurement
04h	Period Measurement
others	not allowed

Counter Modes

Quadruple Pulse Evaluation (Mode 00h)

Quadruple evaluation means that the rising and falling edges of A and B are evaluated; whether up or down count pulses are generated depends on which channel hurries first.

In this counting mode E.0 and E.1 have the following assignment and function:

E.0 as channel A: If channel A hurries in front, the counter counts up.

E.1 as channel B: If channel B hurries in front, the counter counts down.
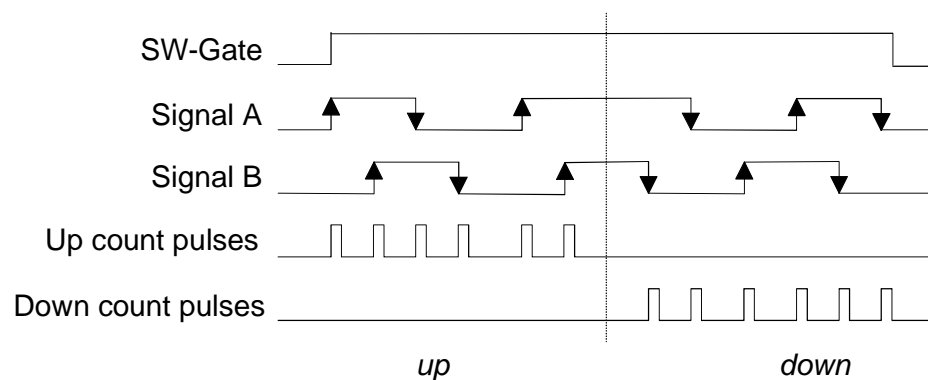
Pulse and Direction Evaluation Mode (01h)

Every rising edge of A is evaluated. Channel B defines the counter direction.

In this counting mode E.0 and E.1 have the following assignment and function:

E.0 as channel A: Clock pulse for the counter at rising edge.

E.1 as channel B: Defines the counter direction (0 = up, 1 = down)
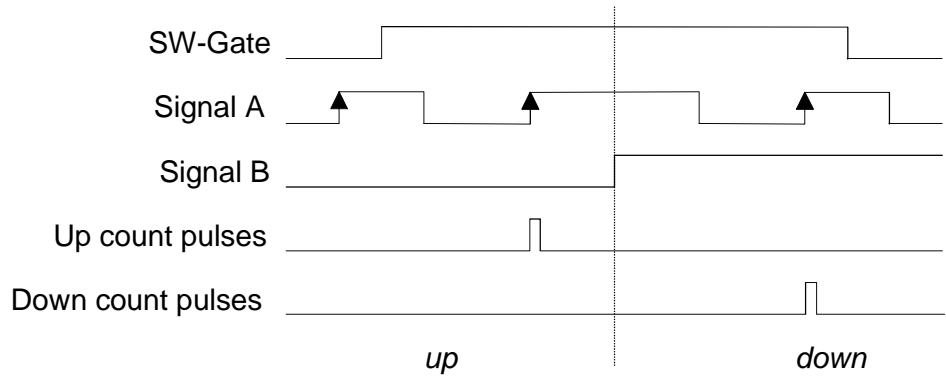
Clock Up / Clock Down Evaluation (Mode 02h)

The rising edges of channel A and B are evaluated. The counter is incremented with every rising edge of A and decremented with every rising edge of B.

In this counting mode E.0 and E.1 have the following assignment and function:

E.0 as channel A: Clock up pulse for the counter at rising edge.

E.1 as channel B: Clock down pulse for the counter at rising edge.
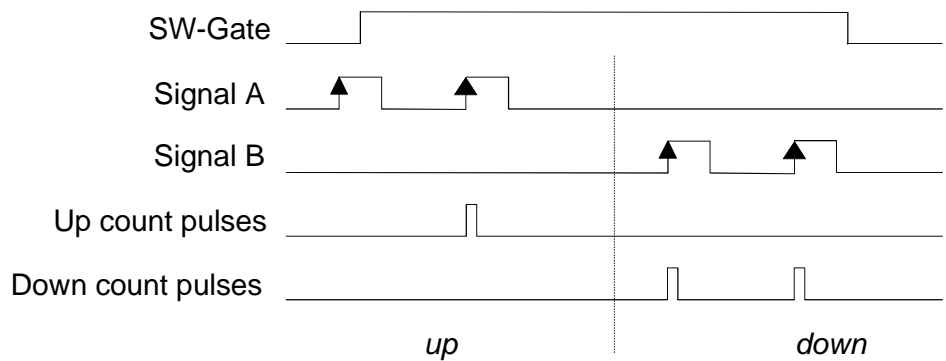
Frequency Measurement (Mode 03h)

In frequency measurement mode, the module counts the number of rising edges of channel A received within a specified time window.

Channel B is not used in this mode.

The time window T_W is specified indirectly by selecting a reference frequency with DO byte 5 and defining a load value in DO bytes 0 to 3:

$$T_W = \frac{1}{\text{Reference Frequency}} * Load\ Value$$

By setting the Bit 2 of the control byte, the time window is transferred. When the counter is enabled (software gate is open), the reference counter is started with the first rising edge of channel A and is incremented with every rising edge of the reference clock.

When the reference counter reaches the load value (time T_W has expired), the current counter value is copied to DI byte 0 to 3 and can be read.

Then the counter and the reference counter is cleared automatically and the next frequency measurement is started with the next rising edge of channel A. If there aren't at least two rising edges of channel A within the time window T_W , the counter value will be read as 0 for this measurement.

Frequency measurement is started and ended by using the software gate, that is as long as the software gate is open, the frequency of channel A is measured.

The counter can be cleared at any time by CLEAR='1' in the Control Byte while the load value stays valid until a new value is loaded or a Reset is detected.

The recent frequency can be computed by using the following formula:

$$Frequency = \text{Reference Frequency} * \frac{Counter\ Value}{Load\ Value}$$
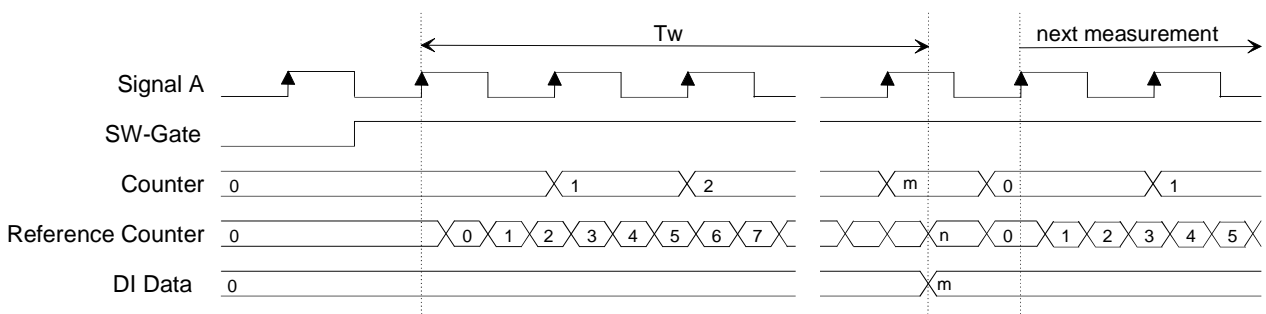
Example:

Reference Frequency :	1 MHz
Load Value (n) :	1.000.000
Counter Value (m) :	10.000

$$Frequency = 1\ MHz * \frac{10.000}{1.000.000} = 10\ kHz$$

**Period
Measurement
(Mode 04h)**

With very small frequencies, it is convenient to measure the period instead of the frequency. In the operating mode "Period Measurement", the time between two rising edges of channel A is measured by counting the number of rising edges of the selected reference clock occurring between two rising edges of channel A. Channel B is not used in this mode.

Period measurement is started and ended by using the software gate, that is: as long as the software gate is open the period of channel A is measured continuously. The counter can be cleared at any time by CLEAR='1' in the Control Byte. The period measurement will then start again with the next rising edge of channel A.

The recent signal period can be computed by using the following formula:

$$Period = \frac{1}{Reference\ Frequency} * Counter\ Value$$
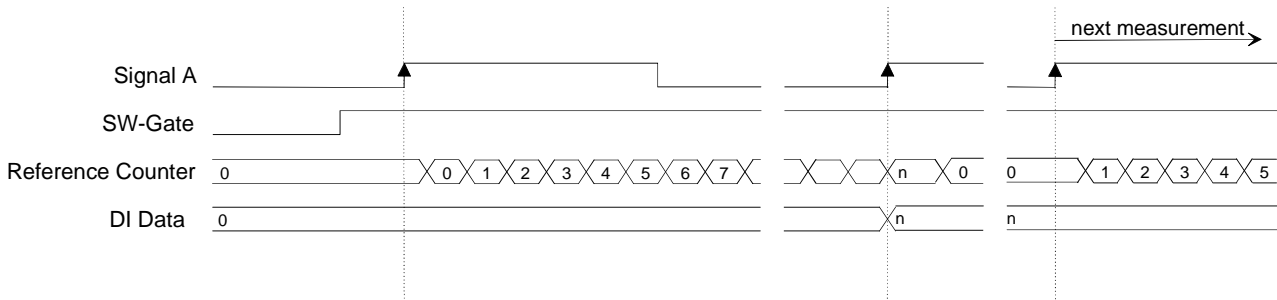
Example: Reference Frequency :   1 MHz
Counter Value (n) :   10.000

$$Period = \frac{1}{1\,MHz} * 10.000 = 10\,ms$$

Note!

The counter value stays valid until the next measurement is completed or the counter is cleared.

If the next measurement is never completed (e.g. because the second rising edge of channel A never occurs), you will always see the 'old' counter value and <u>not</u> the current value of the Reference Counter.

Technical data

Electrical data	VIPA 221-1BH20
Number of inputs	16
Counter	1 (2 inputs A, B)
Rated input voltage	DC 24V (18 ... 28.8V)
Signal voltage "0"	0 ... 5V
Signal voltage "1"	15 ... 28.8V
Input filter time delay	3ms
Input filter counter	100µs
Max. frequency	100kHz
Input current	typ. 7mA
Power supply	5V via backplane bus
Current consumption via backplane bus	100mA
Isolation	500Vrms
	(field voltage - backplane bus)
Status indicator	via LEDs located on the front
Programming specifications	
Input data	6 Byte
Output data	6 Byte
Parameter data	1 Byte
Diagnostic data	-
Dimensions and weight	
Dimensions (WxHxD) in mm	25.4 x 76 x 76
Weight	50g

DI 16xDC 24V NPN

Order data   DI 16xDC 24V NPN   VIPA 221-1BH50

Description   The digital input accepts binary control signals from the process and provides an electrically isolated interface to the central bus system. The input becomes active when it is connected to ground.

Properties   • 16 inputs, isolated from the backplane bus
                       • Active low input (signal level "1" when input is at ground)
                       • DC 24V nominal input voltage
                       • Suitable for standard switches and proximity switches

Construction
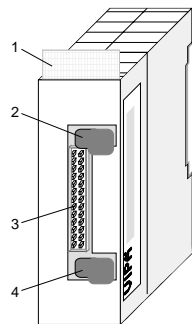
[1]   Label for module description
[2]   Clip
[3]   Recessed connector for the interface input
[4]   Clip

Pin assignment

Connector	Pin	Assignment
26 ... 25	23...26	Supply voltage +DC 24V
	22	Input E.0
	21	Input E.1
	.	.
	.	.
	.	.
	8	Input E.14
	7	Input E.15
4 ... 3 / 2 ... 1	1...6	Supply voltage Ground

Wiring and schematic diagram

Wiring diagram

```
23...26        L+
          (--) DC 24V

22
 .
 .                ≈
 .
15
14
 .
 .                ≈
 .
 7
1...6          M
```

Schematic diagram

```
        Input module
                          [resistor]
                                    |
 Optocoupler          [diode]       M
                                 (--) DC 24V
V-Bus                               L+

M internal
```
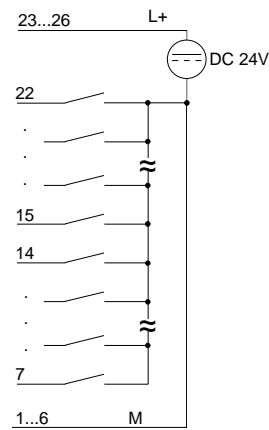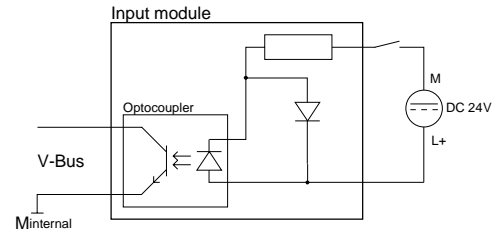
Technical data

Electrical data	VIPA 221-1BH50
Number of inputs	16
Nominal input voltage	DC 24V (18 ... 28.8V)
Signal voltage "0"	15 ... 28.8V
Signal voltage "1"	0 ... 5V
Input filter time delay	3ms
Input current	typ. 7mA
Power supply	5V via backplane bus
Current consumption via backplane bus	20mA
Isolation	500Vrms (field voltage - backplane bus)
Status indicator	-
Programming specifications	
Input data	2Byte
Output data	-
Parameter data	-
Diagnostic data	-
Dimensions and weight	
Dimensions (WxHxD) in mm	25.4x76x76
Weight	50g

DI 32xDC 24V

Order data   DI 32xDC 24V   VIPA 221-2BL10

Description   The digital input accepts binary control signals from the process and provides an electrically isolated interface to the central bus system It has 32 channels that indicate the respective status by means of LEDs.

Properties   • 32 inputs, isolated from the backplane bus

• DC 24V nominal input voltage

• Suitable for standard switches and proximity switches

• Status indicator for each channel by means of an LED

Construction

[1]   Label for module description
[2]   LED status indicator
[3]   Edge connector

**Status indicator
pin assignment**

LED	Description		Pin	Assignment
.0 7	LEDs (green) E.0 to E.7 (per byte) A "1" signal level is recognized as of app. 15V and the respective LED is turned on		1	Not connected
			2...17	Input E.0...E.15
			.	.
			.	.
			.	.
			18	Ground
			19	Not connected
			.	.
			.	.
			.	.
			20 ... 35	Input E.16...E.31
			36	Ground

Wiring and schematic diagram

Wiring diagram
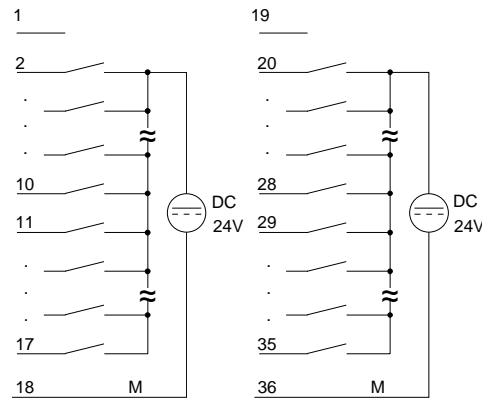
Schematic diagram
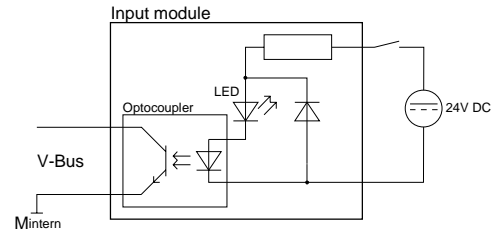
Technical data

Electrical data	VIPA 221-2BL10
Number of inputs	32
Nominal input voltage	DC 24V (18 ... 28.8V)
Signal voltage "0"	0 ... 5V
Signal voltage "1"	15 ... 28.8V
Input filter time delay	3ms
Input current	typ. 7mA
Power supply	5V via backplane bus
Current consumption via backplane bus	50mA
Isolation	in 2 groups of 16 inputs each 500Vrms (field voltage - backplane bus)
Status indicator	via LEDs located on the front
Programming specifications	
Input data	4Byte
Output data	-
Parameter data	-
Diagnostic data	-
Dimensions and weight	
Dimensions (WxHxD) in mm	50.8x76x76
Weight	50g

Chapter 14   Digital output modules

Overview

This chapter contains a description of the construction and the operation of the VIPA digital output modules.

Below follows a description of:
- A system overview of the digital output modules
- Properties
- Construction
- Interfacing and schematic diagrams
- Technical data

Content

System overview

**Output modules
SM 222**

Here follows a summary of the digital output modules that are currently available from VIPA:

DC 24V output modules
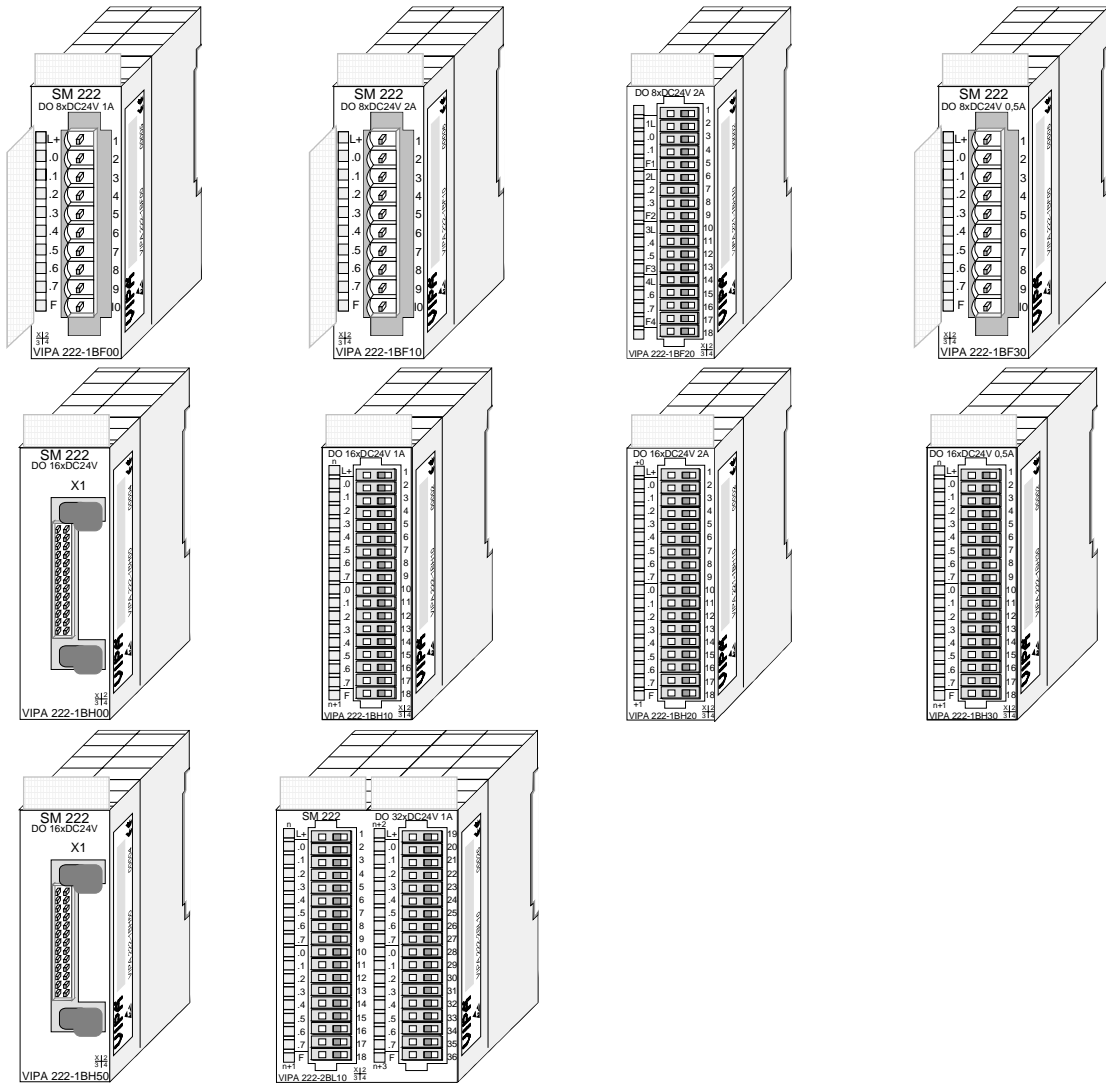
**Order data
DC 24V
output modules**

Type	Order number	Page
DO 8xDC 24V 1A	VIPA 222-1BF00	14-4
DO 8xDC 24V 2A	VIPA 222-1BF10	14-6
DO 8xDC 24V 2A floating 4 á 2	VIPA 222-1BF20	14-8
DO 8xDC 24V 0,5A	VIPA 222-1BF30	14-10
DO 16xDC 24V 0.5A with UB4x	VIPA 222-1BH00	14-12
DO 16xDC 24V 1A	VIPA 222-1BH10	14-14
DO 16xDC 24V 2A	VIPA 222-1BH20	14-16
DO 16xDC 24V 0,5A	VIPA 222-1BH30	14-18
DO 16xDC 24V 0,5A NPN	VIPA 222-1BH50	14-20
DO 32xDC 24V 1A	VIPA 222-2BL10	14-22

Relay output modules

SM 222
DO 8xRELAIS

1
.0 2
.1 3
.2 4
.3 5
.4 6
.5 7
.6 8
.7 9
    10

X1 2
3 4

VIPA 222-1HF00

SM 222
DO 4xRELAIS

1
.0 2
    3
.1 4
    5
.2 6
    7
.3 8
    9
    10

X1 2
3 4

VIPA 222-1HD10

SM 222
DO 4xRELAIS bi.

1
.0 2
    3
.1 4
    5
.2 6
    7
.3 8
    9
    10
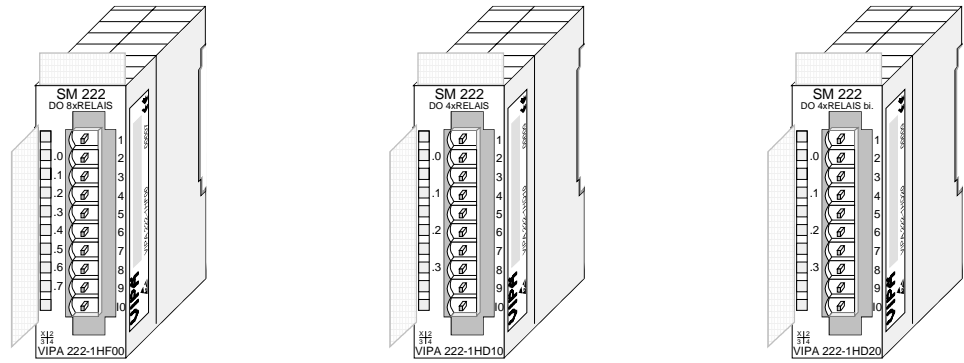
VIPA 222-1HD20

Order data relay output modules

Type	Order number	Page
DO 8xRelay COM	VIPA 222-1HF00	14-24
DO 4xRelay	VIPA 222-1HD10	14-26
DO 4xRelay bistable	VIPA 222-1HD20	14-28

Solid-state output modules

SM 222
DO 8xSolid State

1
.0 2
.1 3
.2 4
.3 5
.4 6
.5 7
.6 8
.7 9
    10

X1 2
3 4

VIPA 222-1FF00

SM 222
DO 4xSolid State

1
.0 2
    3
.1 4
    5
.2 6
    7
.3 8
    9
    10

X1 2
3 4
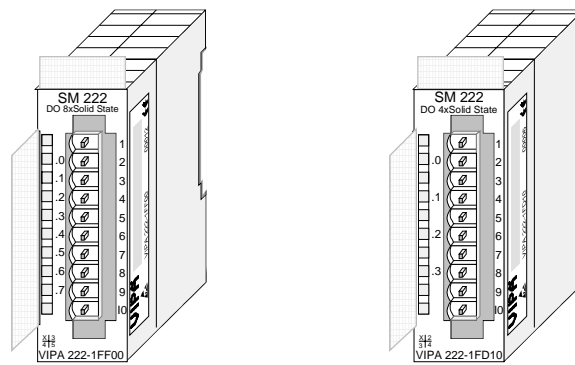
VIPA 222-1FD10

Order data solid-state output modules

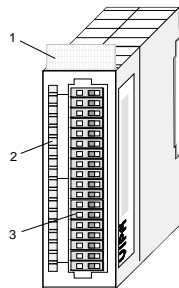| Type	Order number	Page
DO 8xSolid State COM	VIPA 222-1FF00	14-30
DO 4xSolid State	VIPA 222-1FD10	14-32

DO 8xDC 24V 1A

Order data   DO 8xDC 24V 1A   VIPA 222-1BF00

Description   The digital output module accepts binary control signals from the central bus system and transfers them to the process level via outputs. The module requires a supply of DC 24V via the front-facing connector. It provides 8 channels and the status of each channel is displayed by means of an LED.

Properties
- 8 outputs, isolated from the backplane bus
- DC 24V supply voltage
- 1A output current
- Suitable for magnetic valves and DC contactors
- LEDs for supply voltage and error message
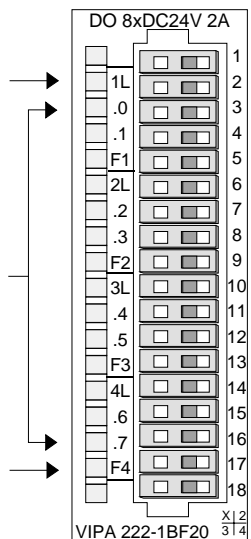- Active channel indication by means of an LED

Construction

[1]   Label for module description
[2]   Label for the bit address with description
[3]   LED status indicator
[4]   Edge connector

Status indicator pin assignment

LED	Description		Pin	Assignment
L+	LED (yellow) Supply voltage available		1	DC 24V supply voltage
.0... .7	LEDs (green) A.0 to A.7 when an output is active the respective LED is turned on		2	Output A.0
			3	Output A.1
			4	Output A.2
			5	Output A.3
			6	Output A.4
F	LED (red) Overload, overheat or short circuit error		7	Output A.5
			8	Output A.6
			9	Output A.7
			10	Supply ground

Wiring and schematic diagram

Wiring diagram

Schematic diagram

Technical data

Electrical data	VIPA 222-1BF00
Number of outputs	8
Nominal load voltage	DC 24V (18...35V) from ext. power supply
No-load current consumption at L+ (all A.x=off)	10mA
Current consumption via backplane bus	50mA
Output current per channel	1A protected against sustained short circuits
Total current	8A
Voltage supply	5V via backplane bus
Isolation	500Vrms
	(field voltage - backplane bus)
Status indicator	via LEDs located on the front
Programming specifications	
Input data	-
Output data	1 Byte
Parameter data	-
Diagnostic data	-
Dimensions and weight	
Dimensions (WxHxD) in mm	25.4x76x76
Weight	50g

DO 8xDC 24V 2A

Order data   DO 8xDC 24V 2A   VIPA 222-1BF10

Description   The digital output module accepts binary control signals from the central bus system and transfers them to the process level via outputs. The module requires a DC 24V supply via the connector located on the front. It provides 8 channels and the status of each channel is displayed by means of an LED. The maximum load current per output is 2A.

Properties
- 8 outputs, isolated from the backplane bus
- DC 24V supply voltage
- Output current 2A
- Suitable for magnetic valves and DC contactors
- LEDs for supply voltage and error message
- Active channel indication by means of an LED

Construction

[1]   Label for module description
[2]   Label for the bit address with description
[3]   LED status indicator
[4]   Edge connector

Status indicator pin assignment

LED	Description		Pin	Assignment
L+	LED (yellow) Supply voltage available		1	DC 24V supply voltage
.0... .7	LEDs (green) A.0 to A.7 when an output becomes active the respective LED is turned on		2	Output A.0
			3	Output A.1
			4	Output A.2
			5	Output A.3
			6	Output A.4
			7	Output A.5
F	LED (red) Overload, overheat, short circuit error		8	Output A.6
			9	Output A.7
			10	Supply ground
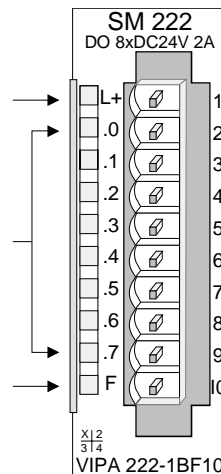
SM 222
DO 8xDC24V 2A

L+
.0
.1
.2
.3
.4
.5
.6
.7
F

1
2
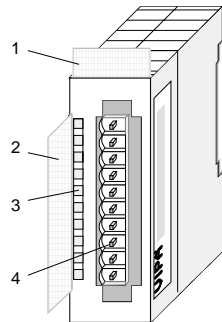3
4
5
6
7
8
9
I0

X 2
3 4
VIPA 222-1BF10

Wiring and schematic diagram

Wiring diagram
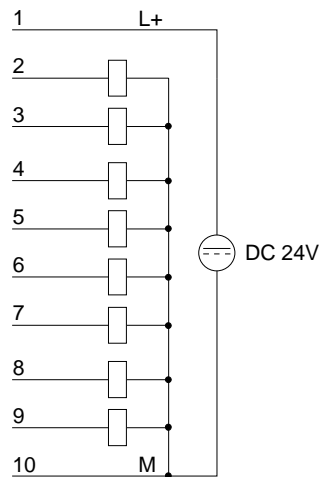
Schematic diagram
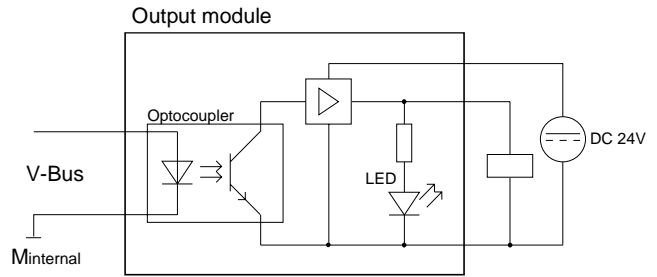
Technical data

Electrical data	VIPA 222-1BF10
Number of outputs	8
Nominal load voltage	DC 24V (18...35V) from ext. power supply
No-load current consumption at L+ (all A.x=off)	10mA
Output current per channel	2A protected against sustained short circuits
Total current	10A
Current consumption via backplane bus	50mA
Voltage supply	5V via backplane bus
Isolation	500Vrms
	(field voltage - backplane bus)
Status indicator	via LEDs located on the front
Programming specifications	
Input data	-
Output data	1Byte
Parameter data	-
Diagnostic data	-
Dimensions and weight	
Dimensions (WxHxD) in mm	25.4x76x76
Weight	50g

DO 8xDC 24V 2A separated 4 á 2

Order data   DO 8xDC 24V 2A   VIPA 222-1BF20

Description   The digital output module accepts binary control signals from the central
                        bus system and transfers them to the process level via outputs. The
                        module requires a DC 24V supply via the connector located on the front. It
                        provides 8 channels and the status of each channel is displayed by means
                        of an LED. The maximum load current per output is 2A.

Properties   • 8 outputs, isolated from the backplane bus

                        • Potential separation in 4 groups á 2 outputs

                        • DC 24V supply voltage

                        • Output current 2A

                        • Suitable for magnetic valves and DC contactors

                        • LEDs for supply voltage and error message

                        • Active channel indication by means of an LED

Construction

[1]   Label for module description
[2]   LED status indicator
[3]   Edge connector

**Status indicator
pin assignment**

LED	Description		Pin	Assignment
			1	not used
1L...4L	LED (yellow)		2	Supply voltage 1L+
	Supply voltage available		3	Output A.0
	LEDs (green)		4	Output A.1
.0... .7	A.0 to A.7 (green)		5	Ground 1M
	when an output becomes		6	Supply voltage 2L+
	active the respective LED is		7	Output A.2
	turned on		8	Output A.3
			9	Ground 2M
F1...F4	LED (red)		...	...
	Overload, overheat, short		14	Supply voltage 4L+
	circuit error		15	Output A.6
			16	Output A.7
			17	Ground 4M
			18	not used

DO 8xDC24V 2A

1L
.0
.1
F1
2L
.2
.3
F2
3L
.4
.5
F3
4L
.6
.7
F4

VIPA 222-1BF20

**Wiring and
schematic
diagram**

Wiring diagram
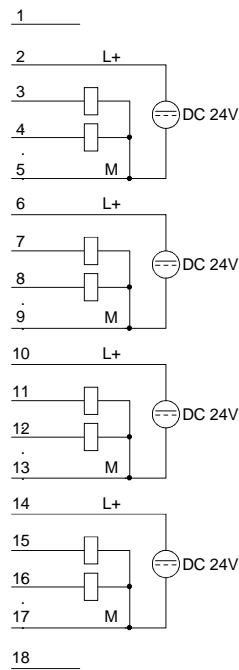
Schematic diagram
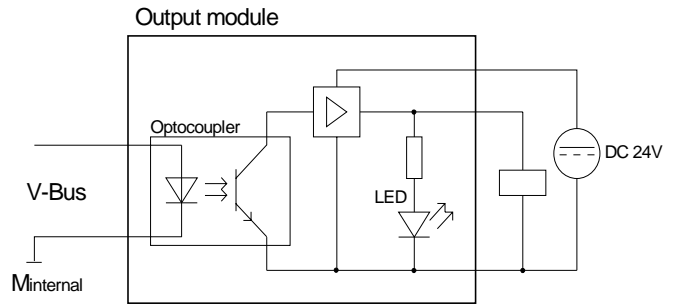
Technical data

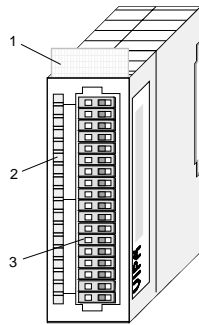| Electrical data	VIPA 222-1BF20
Number of outputs	8
Nominal load voltage	DC 24V (18...35V) from ext. power supply
No-load current consumption at L+ (all A.x=off)	10mA
Current consumption via backplane bus	50mA
Output current per channel	2A protected against sustained short circuits
Voltage supply	5V via backplane bus
Isolation	500Vrms
	(field voltage - backplane bus)
Status indicator	via LEDs located on the front
Programming specifications	
Input data	-
Output data	1Byte
Parameter data	-
Diagnostic data	-
Dimensions and weight	
Dimensions (WxHxD) in mm	25.4x76x76
Weight	50g

DO 8xDC 24V 0,5A

Order data   DO 8xDC 24V 0,5A   VIPA 222-1BF30

Description   The digital output module accepts binary control signals from the central bus system and transfers them to the process level via outputs. The module requires a supply of DC 24V via the front-facing connector. It provides 8 channels and the status of each channel is displayed by means of an LED.

Properties
- 8 outputs, isolated from the backplane bus
- DC 24V supply voltage
- 0,5A output current
- Suitable for magnetic valves and DC contactors
- LEDs for supply voltage and error message
- Active channel indication by means of an LED

Construction

[1]   Label for module description
[2]   Label for the bit address with description
[3]   LED status indicator
[4]   Edge connector

Status indicator pin assignment

LED	Description
L+	LED (yellow)
	Supply voltage available
.0... .7	LEDs (green)
	A.0 to A.7 when an output is active the respective LED is turned on
F	LED (red)
	Overload, overheat or short circuit error

Pin	Assignment
1	DC 24V supply voltage
2	Output A.0
3	Output A.1
4	Output A.2
5	Output A.3
6	Output A.4
7	Output A.5
8	Output A.6
9	Output A.7
10	Supply ground

Wiring and schematic diagram

Wiring diagram

```
1        L+
2
3
4
5                  DC 24V
6
7
8
9
10       M
```

Schematic diagram

Output module

Optocoupler

V-Bus

M internal

LED

DC 24V

Technical data

Electrical data	VIPA 222-1BF30
Number of outputs	8
Nominal load voltage	DC 24V (18...35V) from ext. power supply
No-load current consumption at L+ (all A.x=off)	10mA
Current consumption via backplane bus	50mA
Output current per channel	0,5A protected against sustained short circuits
Total current	4A
Voltage supply	5V via backplane bus
Isolation	500Vrms
	(field voltage - backplane bus)
Status indicator	via LEDs located on the front
Programming specifications	
Input data	-
Output data	1 Byte
Parameter data	-
Diagnostic data	-
Dimensions and weight	
Dimensions (WxHxD) in mm	25.4x76x76
Weight	50g

DO 16xDC 24V 0.5A with UB4x

Order data   DO 16xDC 24V 0.5A   VIPA 222-1BH00

Description   The digital output module accepts binary control signals from the central bus system and transfers them to the process level via outputs. The module requires 24V via the connector on the front. It has 16 channels and the status of each channel is displayed by means of an LED. This module requires a converter (DEA-UB4x). The module must be connected to the converter module by means of a flattened round cable (DEA-KB91C).

Properties
- 16 outputs, isolated from the backplane bus
- DC 24V supply voltage
- Output current 0.5A
- Suitable for magnetic valves and DC contactors
- LEDs for supply voltage and error message
- Active channel indication by means of a LED located on converter module UB4x

Construction
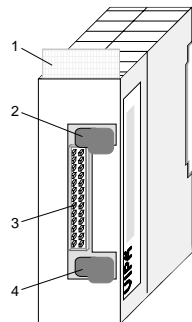
[1] Label for module description
[2] Clip
[3] Recessed connector for the interface to a conversion module UB4x via the flattened round cable
[4] Clip

Status indicator on UB4x

LED	Description
0... .15	LEDs (yellow) A.0 to A.7 High A.0 to A.7 Low when an output is active the respective LED is turned on
L+ L-	LED (green) Supply voltage available

Pin assignment module

Connector	Pin	Assignment
	23...26	DC 24V supply voltage
	22	Output A.0
	21	Output A.1
	.	.
	.	.
	.	.
	8	Output A.14
	7	Output A.15
	1...6	Supply ground

Interfacing of UB4x   **Schematic diagram**
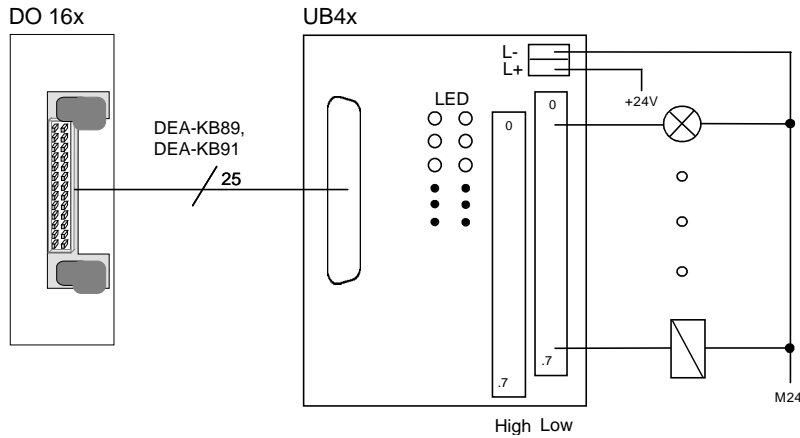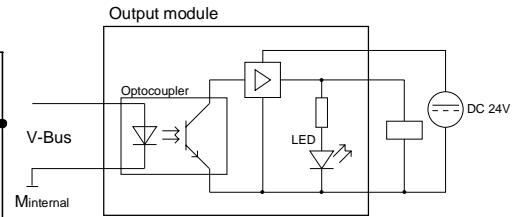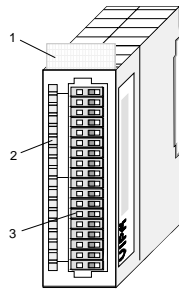

Technical data

Electrical data	VIPA 222-1BH00
Number of outputs	16
Nominal load voltage	DC 24V (18 ... 35V) via ext. power supply
No-load current consumption at L+ (all A.x=off)	10mA
Current consumption via backplane bus	100mA
Output current per channel	0.5A protected against sustained short circuits
Voltage supply	5V via backplane bus
Isolation	500Vrms
	(field voltage - backplane bus)
Status indicator	via LEDs located on the UB4x
Programming specifications	
Input data	-
Output data	2Byte
Parameter data	-
Diagnostic data	-
Dimensions and weight	
Dimensions (WxHxD) in mm	25.4x76x76
Weight	50g

DO 16xDC 24V 1A

Order data   DO 16xDC 24V 1A   VIPA 222-1BH10

Description   The digital output module accepts binary control signals from the central bus system and transfers them to the process level via outputs. The module requires 24V via the connector on the front. It has 16 channels and the status of each channel is displayed by means of an LED.

Properties
- 16 outputs, isolated from the backplane bus
- DC 24V supply voltage
- 1A output current rating
- Suitable for magnetic valves and DC contactors
- LEDs for supply voltage and error message
- Active channel indication by means of an LED

Construction

[1]   Label for module description
[2]   LED status indicator
[3]   Edge connector

**Status indicator
pin assignment**

LED	Description
L+	LED (yellow)
	Supply voltage available
A.0 ... A.7	LEDs (green)
	A.0 to A.7 (per Byte)
	when an output is active the respective LED is turned on
F	LED (red)
	Overload, overheat or short circuit error

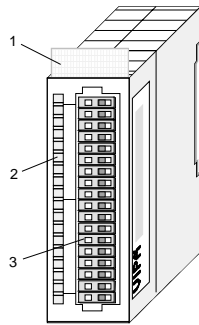| Pin	Assignment
1	DC 24V supply voltage
2	Output A.0
3	Output A.1
.	.
.	.
.	.
16	Output A.14
17	Output A.15
18	Supply ground
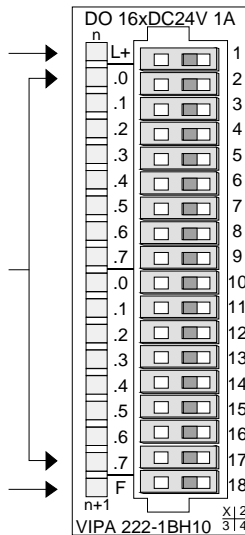
Wiring and schematic diagram

Wiring diagram
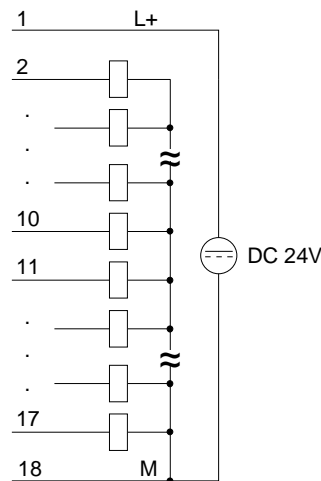
Schematic diagram
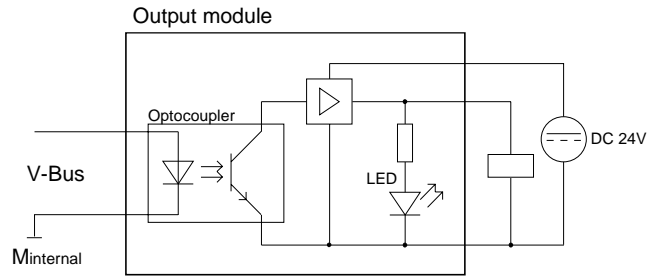
Technical data

Electrical data	VIPA 222-1BH10
Number of outputs	16
Nominal load voltage	DC 24V (18 ... 35V) via ext. power supply
No-load current consumption at L+ (all A.x=off)	10mA
Current consumption via backplane bus	80mA
Output current per channel	1A protected against sustained short circuits
Total current	10A
Voltage supply	5V via backplane bus
Isolation	500Vrms
	(field voltage - backplane bus)
Status indicator	via LEDs located on the front
Programming specifications	
Input data	-
Output data	2Byte
Parameter data	-
Diagnostic data	-
Dimensions and weight	
Dimensions (WxHxD) in mm	25.4x76x76
Weight	50g

DO 16xDC 24V 2A

Order data   DO 16xDC 24V 2A   VIPA 222-1BH20

Description   The digital output module accepts binary control signals from the central bus system and transfers them to the process level via outputs. The module requires 24V via the connector on the front. It has 16 channels and the status of each channel is displayed by means of an LED.

Properties
- 16 outputs, isolated from the backplane bus
- DC 24V supply voltage
- 2A output current rating
- Suitable for magnetic valves and DC contactors
- LEDs for supply voltage and error message
- Active channel indication by means of an LED

Construction

[1]   Label for module description
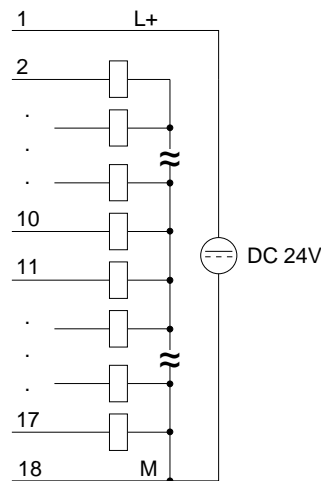[2]   LED status indicator
[3]   Edge connector

**Status indicator
pin assignment**

LED	Description		Pin	Assignment
L+	LED (yellow)		1	DC 24V supply voltage
	Supply voltage available		2	Output A.0
A.0 ... A.7	LEDs (green)		3	Output A.1
	A.0 to A.7 (per Byte)		.	.
	when an output is active the respective LED is turned on		.	.
			.	.
F	LED (red)		16	Output A.14
	Overload, overheat or short circuit error		17	Output A.15
			18	Supply ground

Wiring and schematic diagram

Wiring diagram

Schematic diagram

Technical data

| Electrical data	VIPA 222-1BH20
Number of outputs	16
Nominal load voltage	DC 24V (18 ... 35V) via ext. power supply
No-load current consumption at L+ (all A.x=off)	10mA
Current consumption via backplane bus	100mA
Output current per channel	2A protected against sustained short circuits
max. total current	10A
Voltage supply	5V via backplane bus
Isolation	500Vrms
	(field voltage - backplane bus)
Status indicator	via LEDs located on the front
Programming specifications	
Input data	-
Output data	2Byte
Parameter data	-
Diagnostic data	-
Dimensions and weight	
Dimensions (WxHxD) in mm	25.4x76x76
Weight	50g

DO 16xDC 24V 0,5A

Order data   DO 16xDC 24V 0,5A   VIPA 222-1BH30

Description   The digital output module accepts binary control signals from the central bus system and transfers them to the process level via outputs. The module requires 24V via the connector on the front. It has 16 channels and the status of each channel is displayed by means of an LED.

Properties
- 16 outputs, isolated from the backplane bus
- DC 24V supply voltage
- 0,5A output current rating
- Suitable for magnetic valves and DC contactors
- LEDs for supply voltage and error message
- Active channel indication by means of an LED

Construction

[1]   Label for module description
[2]   LED status indicator
[3]   Edge connector

**Status indicator
pin assignment**

LED	Description		Pin	Assignment
L+	LED (yellow)		1	DC 24V supply voltage
	Supply voltage available		2	Output A.0
A.0 ... A.7	LEDs (green)		3	Output A.1
	A.0 to A.7 (per Byte)		.	.
	when an output is active the respective LED is turned on		.	.
			.	.
F	LED (red)		16	Output A.14
	Overload, overheat or short circuit error		17	Output A.15
			18	Supply ground

DO 16xDC24V 0,5A
n
L+   1
.0   2
.1   3
.2   4
.3   5
.4   6
.5   7
.6   8
.7   9
.0   10
.1   11
.2   12
.3   13
.4   14
.5   15
.6   16
.7   17
F   18
n+1   X 2
              3 4
VIPA 222-1BH30

Wiring and schematic diagram

Wiring diagram

```
1        L+
2    ┌─[ ]─┐
.    ├─[ ]─┤
.    ├─[ ]─┤ ≈
.    ├─[ ]─┤
10   ├─[ ]─┤
11   ├─[ ]─┤
.    ├─[ ]─┤
.    ├─[ ]─┤ ≈
.    ├─[ ]─┤
17   ├─[ ]─┘
18       M
```

(═) DC 24V

Schematic diagram

Output module

Optocoupler

V-Bus

$M_{internal}$

LED

(═) DC 24V

Technical data

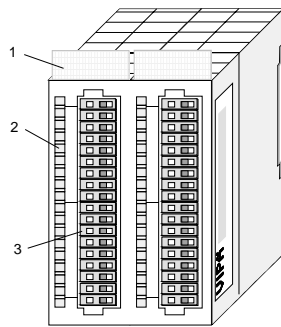| Electrical data	VIPA 222-1BH30
Number of outputs	16
Nominal load voltage	DC 24V (18 ... 35V) via ext. power supply
No-load current consumption at L+ (all A.x=off)	10mA
Current consumption via backplane bus	80mA
Output current per channel	0,5A protected against sustained short circuits
Total current	5A
Voltage supply	5V via backplane bus
Isolation	500Vrms
	(field voltage - backplane bus)
Status indicator	via LEDs located on the front
Programming specifications	
Input data	-
Output data	2Byte
Parameter data	-
Diagnostic data	-
Dimensions and weight	
Dimensions (WxHxD) in mm	25.4x76x76
Weight	50g

DO 16xDC 24V 0.5A NPN

Order data   DO 16xDC 24V 0.5A NPN   VIPA 222-1BH50

Description   The digital output module accepts binary control signals from the central bus system and controls the connected loads at the process level via Misfit outputs. It provides 16 channels that operate as Low-Side switches and that are interconnected via the load voltage. Low-Side switches are suitable for the control of grounds. When a short circuit occurs between the switched line and ground the result is that the load is activated until the short circuit has been removed. Short circuits do not place an additional load on the supply voltage.

Properties   • 16 Low-Side outputs

• Maximum external load voltage DC 32V

• Output current per channel 0.5A

• Suitable for small motors, lamps, magnetic valves and contactors

Construction
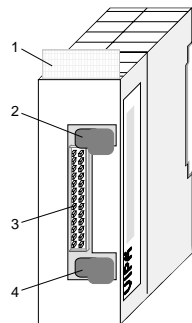
[1]   Label for module description

[2]   Clip

[3]   Recessed connector for the interface to a outputconnection

[4]   Clip

Pin assignment   **Connector**   **Pin**   **Assignment**

23...26	DC 24V supply voltage
22	Output A.0
21	Output A.1
.	.
.	.
.	.
8	Output A.14
7	Output A.15
1...6	Supply ground

Wiring and schematic diagram

Wiring diagram
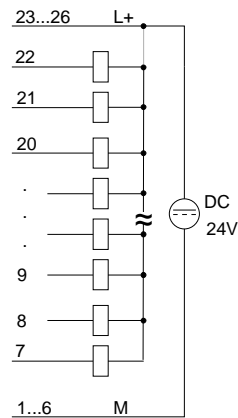
Schematic diagram
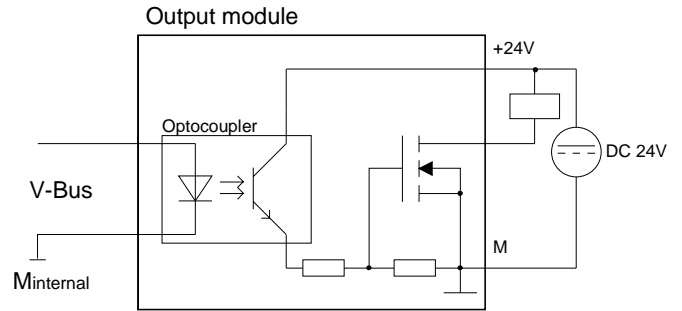
Attention!

This module is not deployable with UB4x from VIPA without technical intervention. For deploying the module with a converter module from VIPA, please call the VIPA Hotline

Technical data

Electrical data	VIPA 222-1BH50
Number of outputs	16 via Low-Side
Nominal load voltage	max. DC 24V
max. Output current per channel	0.5A
Current consumption via backplane bus	100mA
Voltage supply	5V via backplane bus
	24V ±25% at external
Isolation	500Vrms
	(field voltage - backplane bus)
Switching rate	20kHz max.
Status indicator	-
Programming specifications	
Input data	-
Output data	2Byte
Parameter data	-
Diagnostic data	-
Dimensions and weight	
Dimensions (WxHxD) in mm	25.4x76x76
Weight	80g

DO 32xDC 24V 1A

Order data   DO 32xDC 24V 1A   VIPA 222-2BL10

Description   The digital output module accepts binary control signals from the central bus system and transfers them to the process level via outputs. The module requires 24V via the connector on the front. It provides 32 channels and the status of each channel is displayed by means of LEDs.

Properties
- 32 outputs, isolated from the backplane bus
- DC 24V supply voltage
- Output current per channel 1A
- Suitable for magnetic valves and DC contactors
- LEDs for supply voltage and error message
- Active channel indication by means of an LED

Construction

[1]   Label for module description
[2]   LED status indicator
[3]   Edge connector

Status indicator pin assignment

LED	Description
L+	LED (yellow) Supply voltage available
.0 7	LEDs (green) A.0 to A.7 (per Byte) when an output is active the respective LED is turned on
F	LED (red) Overload, overheat or short circuit error

Pin	Assignment
1	DC 24V supply voltage
2	Output A.0
3	Output A.1
...	...
17	Output A.15
18	Supply ground
19	DC 24V supply voltage
20	Output A.16
...	...
34	Output A.30
35	Output A.31
36	Supply ground
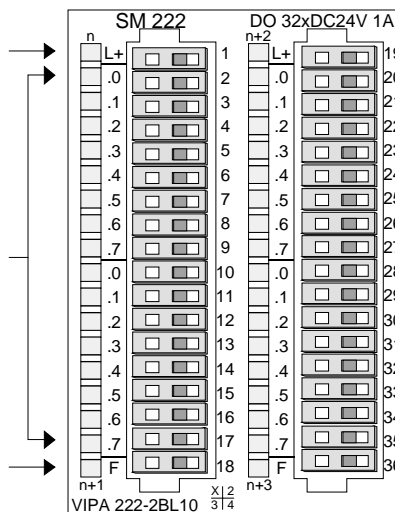
Wiring and schematic diagram

Wiring diagram
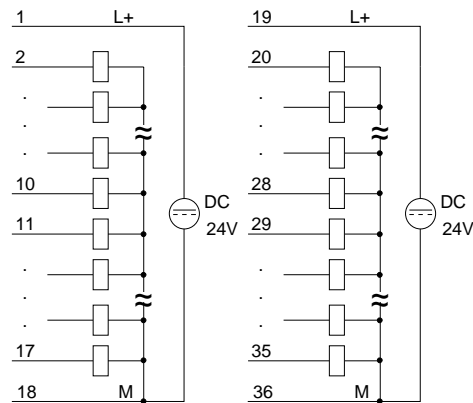
Schematic diagram
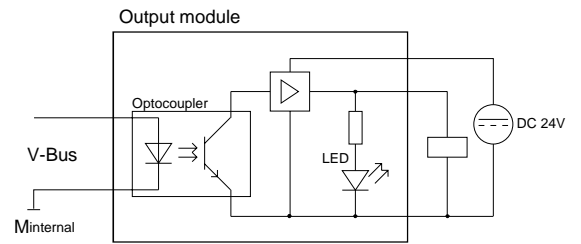
Technical data

Electrical data	VIPA 222-2BL10
Number of outputs	32 (at groups to 16)
Nominal load voltage	DC 24V (18 ... 35V) from ext. power supply
No-load current consumption at L+ (all A.x=off)	15mA
Current consumption via backplane bus	140mA
max. Output current per channel	1A protected against sustained short circuits
max. Contact load	10A
Voltage supply	5V via backplane bus
	in 2 groups of 16 outputs each
Isolation	500Vrms
	(field voltage - backplane bus)
Status indicator	via LEDs located on the front
Programming specifications	
Input data	-
Output data	4Byte
Parameter data	-
Diagnostic data	-
Dimensions and weight	
Dimensions (WxHxD) in mm	50.8x76x76
Weight	50g

DO 8xRelay COM

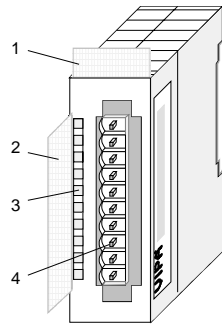**Order data**   DO 8xRelay COM   VIPA 222-1HF00

Description   The digital output module accepts binary control signals from the central bus system and controls the connected loads at the process level via relay outputs. The module derives power from the backplane bus. The load voltage must be connected to terminal 1. When the total current exceeds 8A you have to balance the load current between terminals 1 and 10. The module has 8 channels and the status of each channel is displayed by means of an LED.

Properties
- 8 relay outputs
- Power supply via backplane bus
- External load voltage AC 230V / DC 30V
- Output current per channel 5A (AC 230V / DC 30V)
- Suitable for motors, lamps, magnetic valves and DC contactors
- Active channel indication by means of LED

Construction

[1]   Label for module description
[2]   Label for the bit address with description
[3]   LED status indicator
[4]   Edge connector

**Status indicator
pin assignment**

LED	Description
.0... .7	LEDs (green) A.0 to A.7 when an output is active the respective LED is turned on

Pin	Assignment
1	Supply voltage L
2	Relay output. A.0
3	Relay output. A.1
4	Relay output. A.2
5	Relay output. A.3
6	Relay output. A.4
7	Relay output. A.5
8	Relay output. A.6
9	Relay output. A.7
10	Supply voltage L
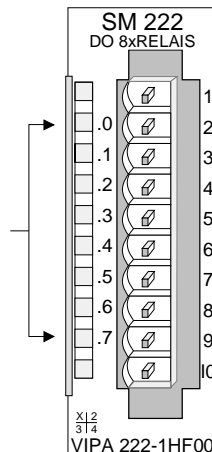
Wiring and schematic diagram
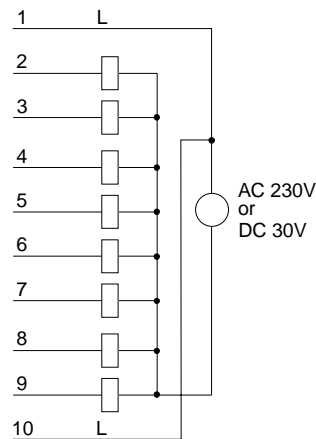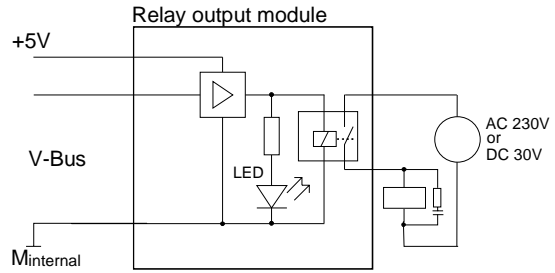
Wiring diagram

Schematic diagram

Note: When using inductive load please take an suitable protector
(see installation guidelines).

Maximum load
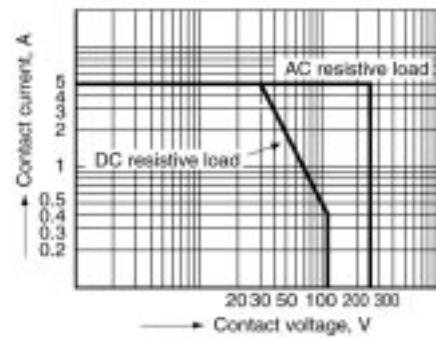
Service life
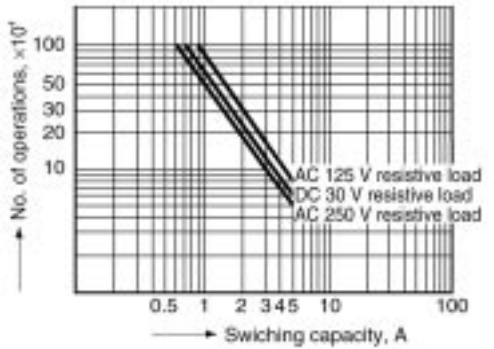
Technical data

Electrical data	VIPA 222-1HF00
Number of outputs	8 via relay
Nominal load voltage	max. AC 230V or DC 30V
No-load current consumption at L+ (all A.x=off)	-
Current consumption via backp. bus	270mA
Total current	with 1 L: max. 8A with 2 L: max. 16A
max. output current per channel	AC 230V: 5A / DC 30V: 5A
Voltage supply	5V via backplane bus
Isolation	500Vrms (field voltage-backpl. bus)
Switching rate	max. 100Hz
Status indicator	via LEDs located on the front
Programming specifications	
Input data	-
Output data	1Byte
Parameter data	-
Diagnostic data	-
Dimensions and weight	
Dimensions (WxHxD) in mm	25.4x76x76
Weight	80g

DO 4xRelay

Order data   DO 4xRelay   VIPA 222-1HD10

Description   The digital output module accepts binary control signals from the central bus system and controls the connected loads at the process level via relay outputs. The module derives power from the backplane bus. The module has 4 isolated channels that operate as switches and the status of each channel is displayed by means of a LED. Power required by active loads must be supplied externally.

Properties

- 4 galvanically isolated relay outputs
- Power supply via backplane bus
- External load voltage AC 230V / DC 30V (may be mixed)
- Max. output current per channel 5A (AC 230V / DC 30V)
- Suitable for motors, lamps, magnetic valves and DC contactors
- Active channel indication by means of an LED

Construction

[1]   Label for module description
[2]   Label for the bit address with description
[3]   LED status indicator
[4]   Edge connector

**Status indicator
pin assignment**

LED	Description		Pin	Assignment
.0... .3	LEDs (green) A.0 to A.3 when an output is active the respective LED is turned on		1	not connected
			2+3	Relay output A.0
			4+5	Relay output A.1
			6+7	Relay output A.2
			8+9	Relay output A.3
			10	not connected

Wiring and schematic diagram
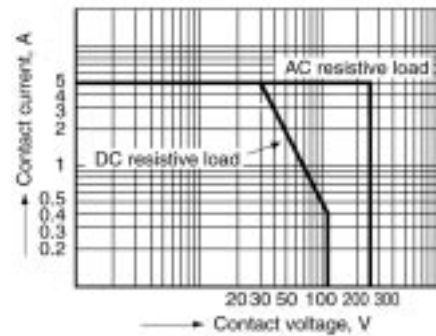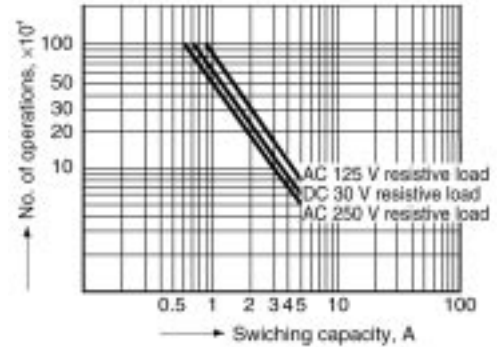
Wiring diagram

Schematic diagram

Note: When using inductive load please take an suitable protector (see installation guidelines).

Maximum load

Service life

Technical data

Electrical data	VIPA 222-1HD10
Number of outputs	4 via relay
Nominal load voltage	AC 230V or max. DC 30V
max. Output current	AC 230V: 5A / DC 30V: 5A
Current consumption via backplane bus	150mA
Voltage supply	5V via backplane bus
Isolation	500Vrms (field voltage - backplane bus)
Switching rate	max. 100Hz
Status indicator	via LEDs located on the front
Programming specifications	
Input data	-
Output data	1Byte (Bit 0 ... Bit 3)
Parameter data	-
Diagnostic data	-
Dimensions and weight	
Dimensions (WxHxD) in mm	25.4x76x76
Weight	80g

DO 4xRelay bistable

Order data   DO 4xRelay bistable   VIPA 222-1HD20

Description   The digital output module accepts binary control signals from the central bus system and controls the connected loads at the process level via bistable relay outputs. The module derives power from the backplane bus. The module has 4 channels that operate as switches. The status of the respective switch is retained if the power from the controlling system fails.

Properties
- 4 galvanically isolated relay outputs
- Power supply via backplane bus
- External load voltage AC 230V / DC 30V (may be mixed)
- Max. Output current per channel 16A (AC 230V / DC 30V)
- Suitable for motors, lamps, magnetic valves and DC contactors

Construction
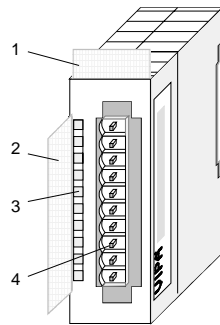
[1]   Label for module description
[2]   Label for the bit address with description
[3]   LEDs (not used)
[4]   Edge connector

**Output byte /
Pin assignment**

Bit	Description
Bit 0	set A.0
Bit 1	set A.1
Bit 2	set A.2
Bit 3	set A.3
Bit 4	reset A.0
Bit 5	reset A.1
Bit 6	reset A.2
Bit 7	reset A.3
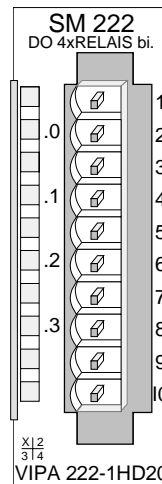
Setting the Bits 0...3 activates the concerning channel.
Setting Bits 4..7 causes a reset of the concerning channel after min. 50ms.
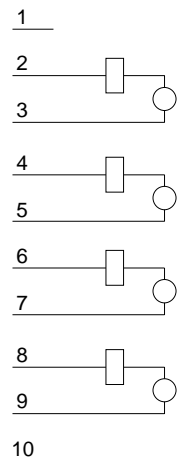
SM 222
DO 4xRELAIS bi.

.0
.1
.2
.3

X | 2
3 | 4
VIPA 222-1HD20

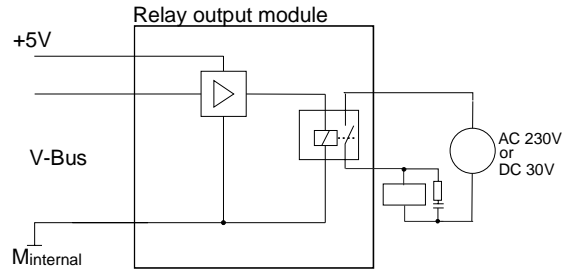| Pin	Assignment
1	not connected
2+3	Relay output. A.0
4+5	Relay output. A.1
6+7	Relay output. A.2
8+9	Relay output. A.3
10	not connected

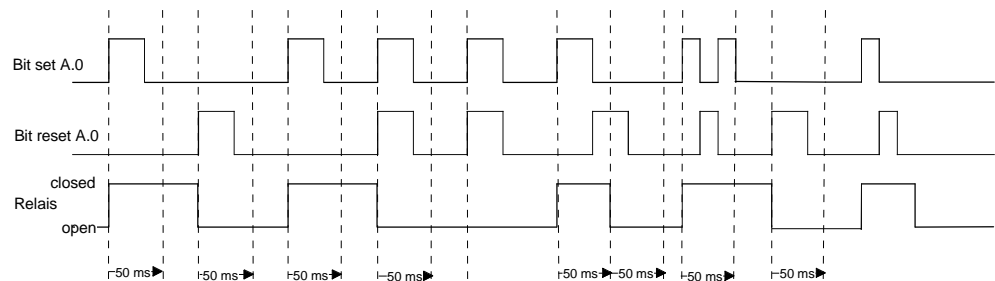**Wiring and schematic diagram**

Wiring diagram

Schematic diagram

Note: When using inductive load please take an suitable protector (see installation guidelines).

Signaling diagram

Note!
Please remember that a relay output that has been set may only be reset after at least 50ms when the set-signal has been removed.

Technical data

| Electrical data	VIPA 222-1HD20
Number of outputs	4 via relay
Nominal load voltage	AC 230V or DC 30V
max. Output current per channel	AC 230V: 16A / DC 30V: 16A
Current consumption via backplane bus	40mA
Voltage supply	5V via backplane bus
Isolation	500Vrms (field voltage-backpl. bus)
Switching rate	max. 100Hz
Status indicator	-
Programming specifications	
Input data	-
Output data	1Byte
Parameter data	-
Diagnostic data	-
Dimensions and weight	
Dimensions (WxHxD) in mm	25.4x76x76
Weight	80g

DO 8xSolid State COM

Order data   DO 8xSolid State COM   VIPA 222-1FF00

Description   The solid-state output module accepts binary control signals from the central bus system and controls the connected loads at the process level via solid-state relay outputs. The module derives power from the backplane bus. The module has 8 channels that are interconnected via the load voltage that act as switches and display the status by means of LEDs. Solid-state relays change state when the load voltage passes through zero (AC).

Properties
- 8 solid-state outputs with active channel indication by means of a LED
- Extended service life due to the fact that the load voltage (provided this is AC) is switched when it passes through zero
- External load voltage AC 230V or DC 400V
- Max. output current per channel 0.5A (AC 230V / DC 400V)
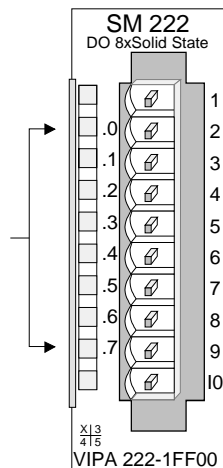- Suitable for small motors, lamps, magnetic valves and contactors
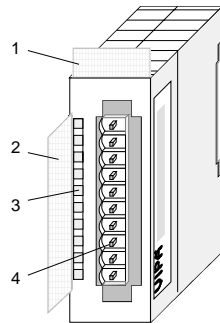
Construction

[1]   Label for module description
[2]   Label for the bit address with description
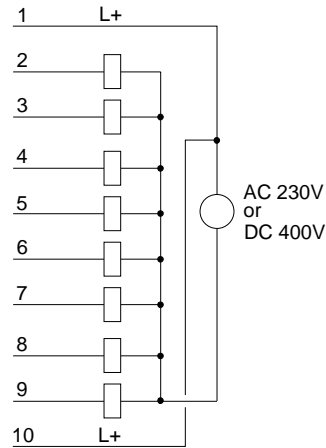[3]   LED status indicator
[4]   Edge connector

Status indicator pin assignment

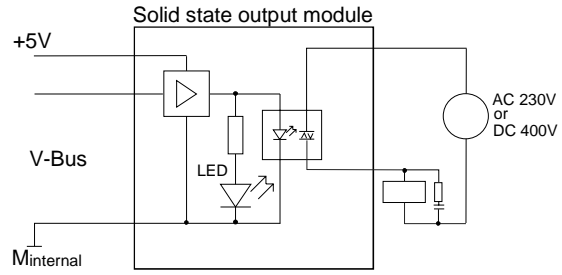| LED	Description		Pin	Assignment
.0 7	LEDs (green) A.0 to A.7 when an output is active the respective LED is turned on		1	Supply voltage
			2	Output A.0
			3	Output A.1
			4	Output A.2
			5	Output A.3
			6	Output A.4
			7	Output A.5
			8	Output A.6
			9	Output A.7
			10	Supply voltage

Wiring and schematic diagram

Wiring diagram

Schematic diagram

Note: When using inductive load please take an suitable protector (see installation guidelines).

Technical data

| Electrical data	VIPA 222-1FF00
Number of outputs	8 via solid-state
Nominal load voltage	AC 230V or DC 400V
max. Output current per channel	AC 230V: 0.5A / DC 400V: 0.5A
Contact resistance	typ. 2.1Ω , max. 3.2Ω
Current consumption via backplane bus	140mA
Voltage supply	5V via backplane bus
Isolation	500Vrms
	(field voltage - backplane bus)
Switching rate	max. 100Hz
Status indicator	via LEDs located on the front
Programming specifications	
Input data	-
Output data	1Byte (Bit 0 ... Bit 7)
Parameter data	-
Diagnostic data	-
Dimensions and weight	
Dimensions (WxHxD) in mm	25.4x76x76
Weight	80g

DO 4xSolid State

Order data   DO 4xSolid State   VIPA 222-1FD10

Description   The solid-state output module accepts binary control signals from the central bus system and controls the connected loads at the process level via solid-state relay outputs. The module derives power from the backplane bus. The module has 4 separate channels that operate as switches and display the status by means of LEDs. Active loads must be supplied with external power.

Properties
- 4 galvanically isolated solid-state outputs
- Power supply via backplane bus
- External load voltage AC 230V or DC 400V
- Max. output current per channel 0.5A (AC 230V / DC 400V)
- Suitable for motors, lamps, magnetic valves and contactors
- Active channel indication by means of an LED
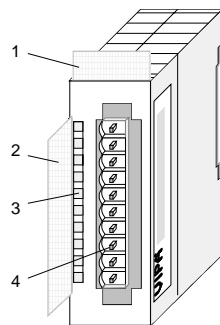
Construction

[1]   Label for module description
[2]   Label for the bit address with description
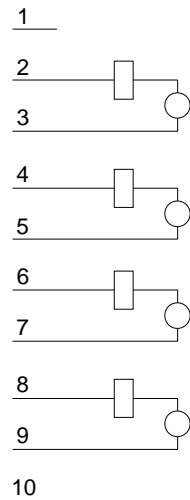[3]   LED status indicator
[4]   Edge connector

**Status indicator
pin assignment**

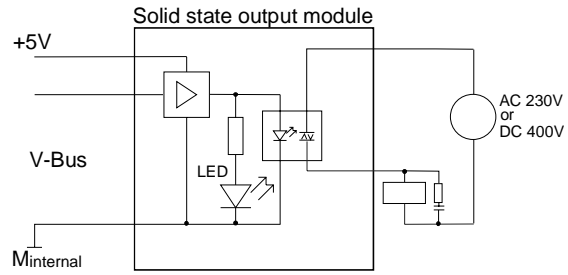| LED	Description		Pin	Assignment
.0... .3	LEDs (green) A.0 to A.3 when an output is active the respective LED is turned on		1	not connected
			2+3	Output A.0
			4+5	Output A.1
			6+7	Output A.2
			8+9	Output A.3
			10	not connected
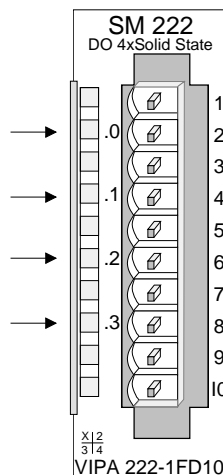
Wiring and schematic diagram

Wiring diagram

Schematic diagram

Note: When using inductive load please take an suitable protector (see installation guidelines).

Technical data

Electrical data	VIPA 222-1FD10
Number of outputs	4 via solid state
Nominal load voltage	AC 230V or DC 400V
max. output current per channel	AC 230V: 0.5A / DC 400V: 0.5A
Current consumption via backplane bus	100mA
Voltage supply	5V via backplane bus
Isolation	500Vrms
	(field voltage - backplane bus)
Switching rate	max. 100Hz
Status indicator	via LEDs located on the front
Programming specifications	
Input data	-
Output data	1Byte (Bit 0 ... Bit 3)
Parameter data	-
Diagnostic data	-
Dimensions and weight	
Dimensions (WxHxD) in mm	25.4x76x76
Weight	80g

Chapter 15   Digital input/output modules

Overview   This chapter contains a description of the construction and the operation of the VIPA digital input/output modules.

Below follows a description of:
- A system overview of the digital input/output modules
- Properties
- Construction
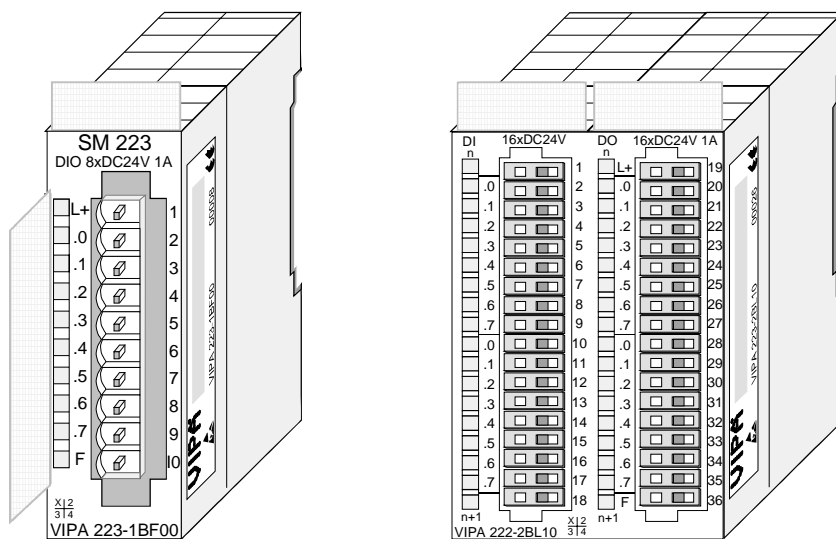- Interfacing and schematic diagram
- Technical data

System overview

**Input/output
modules SM 223**

Here follows a summary of the digital input/output modules that are currently available from VIPA:

**Order data
input/output
modules**

Type	Order number	Page
DIO 8xDC 24V 1A	VIPA 223-1BF00	15-3
DI 16xDC 24V, DO 16xDC 24V 1A	VIPA 223-2BL10	15-5

Security hints for DIO modules

Attention!

Please regard that the voltage applied to an output channel must be ≤ the voltage supply applied to L+.

Due to the parallel connection of in- and output channel per group, a set output channel may be supplied via an applied input signal.

Thus, a set output remains active even at power-off of the voltage supply with the applied input signal.

Non-observance may cause module demolition.

DIO 8xDC 24V 1A

Order data   DIO 8xDC 24V 1A   VIPA 223-1BF00

Description   This module is a combination module. It has 8 channels that may be used as input or as output channel. The status of the channels is displayed by means of LEDs. Every channel is provided with a diagnostic function, i.e. when an output is active the respective input is set to "1". When a short circuit occurs at the load, the input is held at "0" and the error is detectable by analyzing the input.

Properties
- 8 channels, isolated from the backplane bus (as input or output)
- Diagnostic function
- Nominal input voltage DC 24V / supply voltage DC 24V
- Output current 1A
- LED error display for overload, overheat or short circuit
- Active channels displayed by means of LED

Construction
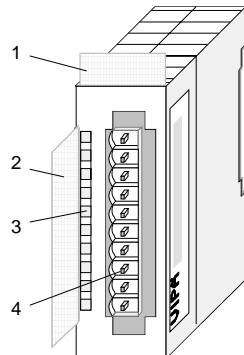
[1]   Label for the module description
[2]   Label for the bit address with description
[3]   LED status indicator
[4]   Edge connector

Status indicator pin assignment

LED	Description
L+	LED (yellow) Supply voltage available
.0 7	LEDs (green) when the input signal is "1" or the output is active the respective LED is turned on
F	LED (red) Overload, overheat or short circuit error
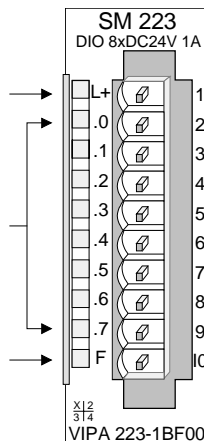
Pin	Assignment
1	+DC 24V supply voltage
2	Channel K.0
3	Channel K.1
4	Channel K.2
5	Channel K.3
6	Channel K.4
7	Channel K.5
8	Channel K.6
9	Channel K.7
10	Supply ground

Wiring and schematic diagram

Wiring diagram
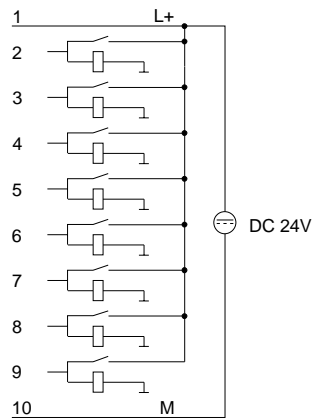
Schematic diagram

Technical data

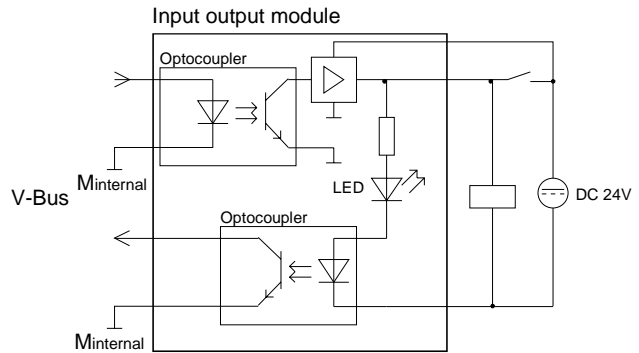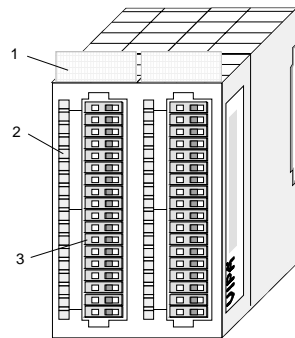| Electrical data	VIPA 223-1BF00
Number of channels	8
Rated load voltage	DC 24V (18...35V) via ext. power supply
No-load current consumption at L+ (all A.x=off)	50mA
Output current per channel	1A protected against short circuits
Total output current	12A
Nominal input voltage	DC 24V (18 ... 28,8V)
Signal voltage "0"	0 ... 5V
Signal voltage "1"	15 ... 28,8V
Input filter time delay	3ms
Input current	typ. 7mA
Voltage supply	5V via backplane bus
Current consumption via backplane bus	65mA
Data width in the process image	1Byte PAA, 1Byte PAE
Status indicator	via LEDs located on the front
Programming specifications	
Input data	1Byte
Output data	1Byte
Parameter data	-
Diagnostic data	-
Dimensions and weight	
Dimensions (WxHxD) in mm	25.4x76x76
Weight	50g

DI 16xDC 24V, DO 16xDC 24V 1A

Order data   DI 16xDC 24V, DO 16xDC 24V 1A   VIPA 223-1BL10

Description   The module has 32 channels that are isolated from the backplane bus. 16 channels operate as inputs and 16 as outputs. The status of the channels is displayed by means of LEDs.

Properties
- 32 channels, of these 16 input and 16 output channels
- Nominal input voltage DC 24V
- Supply voltage DC 24V(external) for outputs
- Output current 1A per channel
- LED error display for overload, overheat or short circuit
- Active channels displayed by means of an LED

Construction

[1]   Label for the module description

[2]   Label for the bit address with description

[3]   LED status indicator

[4]   Edge connector

**Status indicator
pin assignment**

LED	Description		Pin	Assignment
L+	LED (yellow)		1	not connected
	Supply voltage available		2	Input E.0
.0 7	LED (green)		.	.
	E.0 ... E.7 (per Byte)		.	.
	A.0 ... A.7 (per Byte)		.	.
	when the signal (input)		17	Input E.15
	is "1" or the output is		18	Ground for inputs
	active, the respective		19	Supply voltage +24V
	LED is turned on		20	Output A.0
F	LED (red)		.	.
	Overload, overheat or		.	.
	short circuit error		35	Output A.15
			36	Supply voltage ground outputs
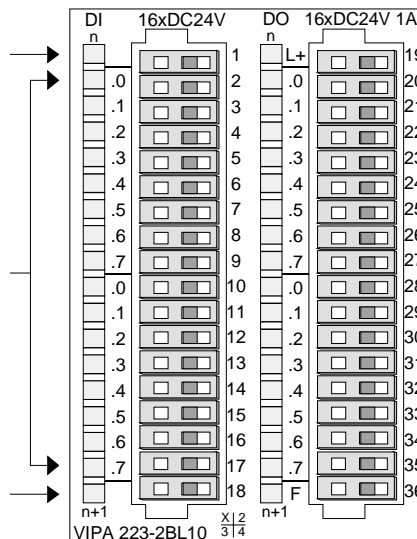
Wiring and schematic diagram

Wiring diagram
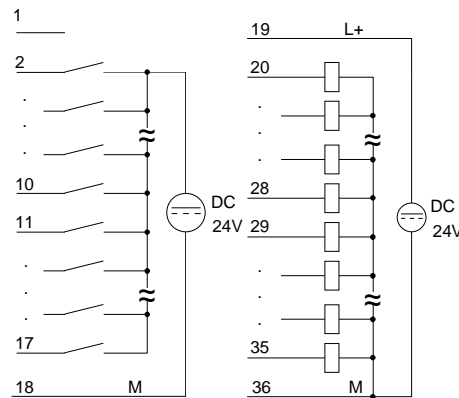
Schematic diagram
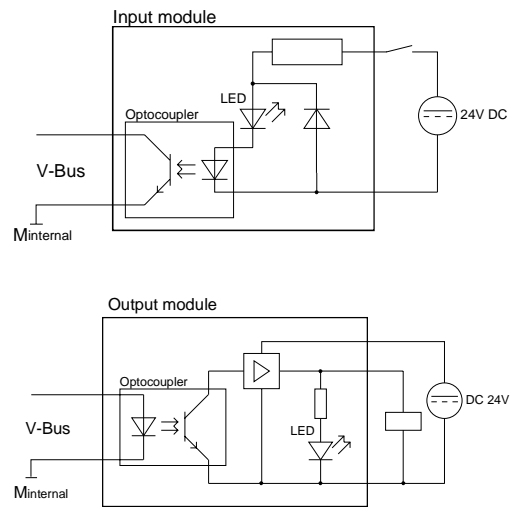
Technical data

Electrical data	VIPA 223-2BL10
Number of channels	32
Rated load voltage	DC 24V (18...35V) via ext. power source
No-load current consumption at L+ (all A.x=off)	10mA
Output current per channel	1A protected against short circuits
max. contact load per connector	10A
Nominal input voltage	DC 24V (18 ... 28,8V)
Signal voltage "0"	0 ... 5V
Signal voltage "1"	15 ... 28,8V
Input filter time delay	3ms
Input current	typ. 7mA
Voltage supply	5V via backplane bus
Current consumption via backplane bus	100mA
Data width in the process image	2Byte PAA, 2Byte PAE
Status indicator	via LEDs located on the front
Programming specifications	
Input data	2Byte
Output data	2Byte
Parameter data	-
Diagnostic data	-
Dimensions and weight	
Dimensions (WxHxD) in mm	50.8x76x76
Weight	100g

Chapter 16   Analog input modules

Overview   This chapter contains a description of the construction and the operation of the VIPA analog input modules.

Below follows a description of:
- A system overview of the analog input modules
- Properties
- Constructions
- Interfacing and schematic diagram
- Technical data

Contents

System overview

**Input modules
SM 231**

Here follows a summary of the analog input modules that are currently available from VIPA:
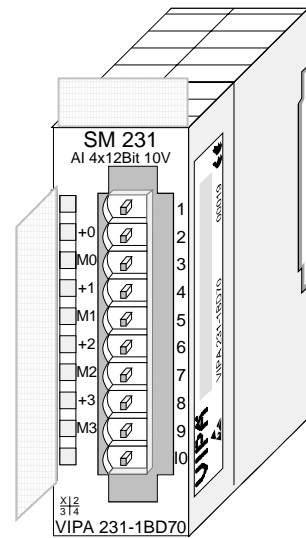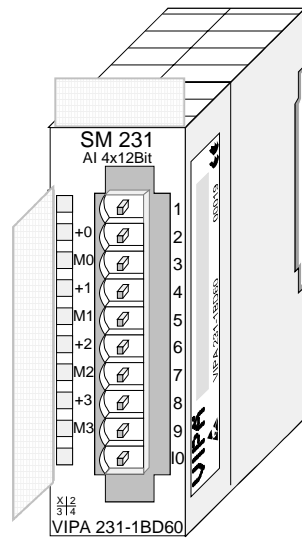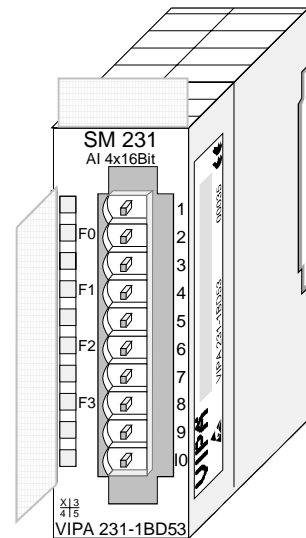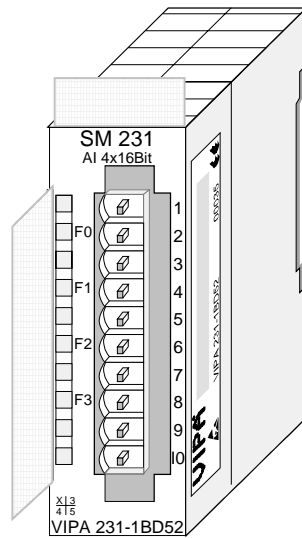
**Order data
input modules**

Type	Order number	Page
AI4x16Bit, Multiinput	VIPA 231-1BD52	16-5
AI4x16Bit, Multiinput	VIPA 231-1BD53	16-16
AI4x12Bit, 4 ... 20mA, isolated	VIPA 231 -1BD60	16-30
AI4x12Bit, ±10V, isolated	VIPA 231-1BD70	16-33

**Input modules
SM 231**

AI 4x16Bit f

VIPA 231-1FD00

AI 8x16Bit
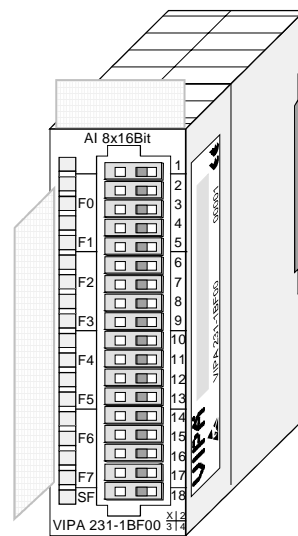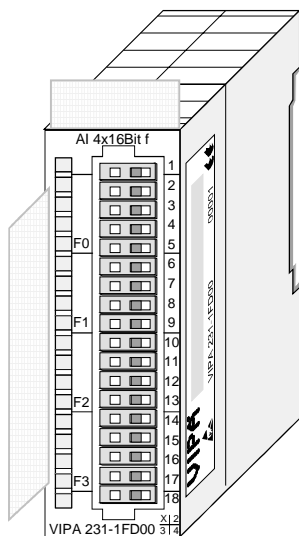
VIPA 231-1BF00

**Order data
input modules**

Type	Order number	Page
AI4x16Bit f	VIPA 231-1FD00	16-36
AI8x16Bit	VIPA 231-1BF00	16-46

General

Cabling for analog signals

You should only use screened twisted-pair cable when you are connecting analog signals. These cables reduce the effect of electrical interference. The screen of the analog signal cable should be grounded at both ends. When there are potential differences between the cable ends, there may flow a current will to equalize the potential difference. This current could interfere with the analog signals. Under these circumstances it is advisable to ground the screen of the signal cable at one end only.

Connecting test probes

Our analog input modules provide a large number of input configurations for 2- and 4wire transducers.

Please remember that transducers require an external power source. You have to connect an external power supply in line with any 2wire transducer. The following diagram explains the connection of 2- and 4wire transducers:
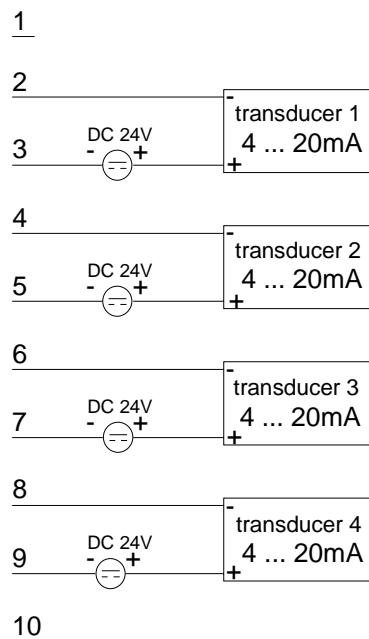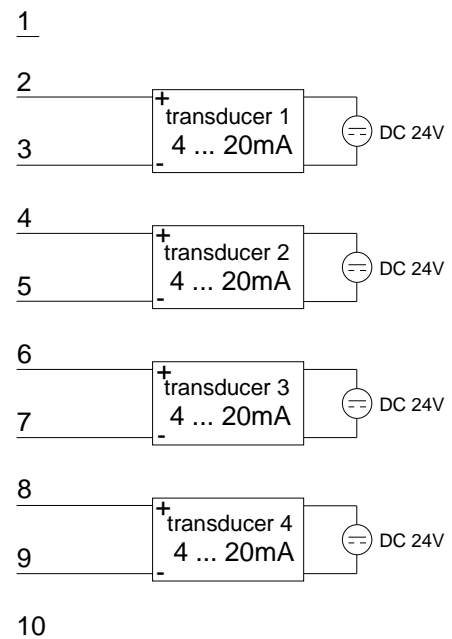
Note!

Please ensure that you connect transducers with the correct polarity!
Unused inputs should be short circuited by placing a link between the positive pole and the common ground for the channel.

Parameterization and diagnosis during runtime

By using the SFCs 55, 56 and 57 you may change the parameters of the analog modules during runtime via the CPU 21x.

For diagnosis evaluation during runtime, you may use the SFCs 51 and 59. They allow you to request detailed diagnosis information and to react to it.

AI 4x16Bit, multiinput

Order data   AI 4x16Bit multiinput   VIPA 231-1BD52

Description   The module has 4 inputs that you may configure individually. The module requires a total of 8 input data bytes in the process image (2Byte per channel).

Isolation between the channels on the module and the backplane bus is provided by means of DC/DC converters and optocouplers.

Properties
- the different channels are individually configurable and may be turned off
- the common signal inputs of the channels are not isolated from each other and the permitted potential difference is up to 5V
- LED for cable break and over current in sensor circuits
- diagnostic function

Construction

[1]   Label for module description
[2]   Label for the bit address with description
[3]   LED status indicator
[4]   Edge connector

Status indicators pin assignment

LED	Description
F0 ... F3	LED (red): turned on when an open circuit exists on the 4...20mA sensor circuits
	blinks when the current > 40mA at all current sensor circuits
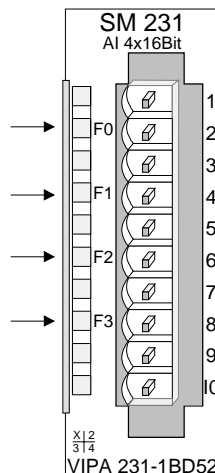
Pin	Assignment
1	For four-wire systems channel 0
2	+ channel 0
3	Channel 0 common
4	+ channel 1
5	Channel 1 common
6	+ channel 2
7	Channel 2 common
8	+ channel 3
9	Channel 3 common
10	For 4wire systems channel 2

Wiring diagrams   The following illustration shows the connection options for the different measuring ranges. The assignment to the measuring ranges is to find in the column "Conn." of the table "Function no. assignment" on the next pages.

Note!

Please note that the module 231-1BD52 was developed from the VIPA 231-1BD50. The measuring function no longer starts at 00h but it is offset by one to 01h. The measurement function no. 00h does not affect permanently stored configuration data.

Attention!

The following circumstances may cause damages at the analog module:

- The external supply of the input (current/voltage) must not be present as long as the backplane bus of the CPU is still without current supply!
- Parameterization and connection of the input must be congruent!
- You must not apply a voltage >15V to the input!

Attention!

Temporarily not used inputs have to be connected with the concerning ground at activated channel. When deactivating unused channels by means of FFh, this is not required.

Note!

Every channel is individual parameterizable. For the parameterization 10Byte parameterization data are available. They are stored permanently and remain in memory during power-off.

Function no. assignment   The assignment of a function no. to a certain channel happens during parameterization. The function no. 00h does not influence the function no. stored in the permanent parameterization data.

Assigning FFh deactivates the according channel.

No.	Function	Measurement range / representation	Tolerance	Conn.
00h	Does not affect permanently stored configuration data			
01h	Pt100 in two-wire mode	-200 .. +850°C **/** in units of 1/10°C, two's complement	[1][2][3] ±1°C	(3)
02h	Pt1000 in two-wire mode	-200 .. +500°C **/** in units of 1/10°C, two's complement	[1][2][3] ±1°C	(3)
03h	NI100 in two-wire mode	-50 .. +250°C **/** in units of 1/10°C, two's complement	[1][2][3] ±1°C	(3)
04h	NI1000 in two-wire mode	-50 .. +250°C **/** in units of 1/10°C, two's complement	[1][2][3] ±1°C	(3)
05h	Resistance measurement 60Ohm two-wire	- **/** 60Ω= final value (32767)	[1][2][3] ±0.2% of final value	(3)
06h	Resistance measurement 600Ohm two-wire	- **/** 600Ω = final value (32767)	[1][2][3] ±0.1% of final value	(3)
07h	Resistance measurement 3000Ohm two-wire	- **/** 3000Ω = final value (32767)	[1][2][3] ±0.1% of final value	(3)
08h	Resistance measurement 6000Ohm two-wire	- / 6000Ω = final value (32767)	[1][2][3] ±0.1% of final value	(3)
09h	Pt100 via four-wire connection	-200 .. +850°C **/** in units of 1/10°C, two's complement	[1][2] ±0.5°C	(4)
0Ah	Pt1000 via four-wire connection	-200 .. +500°C **/** in units of 1/10°C, two's complement	[1][2] ±0.5°C	(4)
0Bh	NI100 via four-wire connection	-50 .. +250°C **/** in units of 1/10°C, two's complement	[1][2] ±0.5°C	(4)
0Ch	NI1000 via four-wire connection	-50 .. +250°C **/** in units of 1/10°C, two's complement	[1][2] ±0.5°C	(4)
0Dh	Resistance measurement 60Ohm four-wire	- **/** 60Ω= final value (32767)	[1][2] ±0.1% of final value	(4)
0Eh	Resistance measurement 600Ohm four-wire	- **/** 600Ω= final value (32767)	[1][2] ±0.05% of final value	(4)
0Fh	Resistance measurement 3000Ohm four-wire	- **/** 3000Ω = final value (32767)	[1][2] ±0.05% of final value	(4)
10h	Thermo element type J , externally compensated	-210 °C .. 850 °C **/** in units of 1/10°C, two's complement	[1][2][4] ±1°C	(2)

continue ...

continue ...

11h	Thermo element type K, externally compensated	-270 °C .. 1200 °C *I* in units of 1/10°C, two's complement	[1][2][4] ±1.5°C	(2)
12h	Thermo element type N, externally compensated	-200 °C .. 1300 °C *I* in units of 1/10°C, two's complement	[1][2][4] ±1.5°C	(2)
13h	Thermo element type R, externally compensated	-50 °C .. 1760 °C *I* in units of 1/10°C, two's complement	[1][2][4] ±4°C	(2)
14h	Thermo element type T, externally compensated	-270 °C .. 400 °C *I* in units of 1/10°C, two's complement	[1][2][4] ±1.5°C	(2)
15h	Thermo element type S, externally compensated	-50 °C .. 1760 °C *I* in units of 1/10°C, two's complement	[1][2][4] ±5°C	(2)
18h	Thermo element type J, internally compensated	-210 °C .. 850 °C *I* in units of 1/10°C, two's complement	[1][2][5] ±1.5°C	(2)
19h	Thermo element type K, internally compensated	-270 °C .. 1200 °C *I* in units of 1/10°C, two's complement	[1][2][5] ±2°C	(2)
1Ah	Thermo element type N, internally compensated	-200 °C .. 1300 °C *I* in units of 1/10°C, two's complement	[1][2][5] ±2°C	(2)
1Bh	Thermo element type R, internally compensated	-50 °C .. 1760 °C *I* in units of 1/10°C, two's complement	[1][2][5] ±5°C	(2)
1Ch	Thermo element type T, internally compensated	-270 °C .. 400 °C *I* in units of 1/10°C, two's complement	[1][2][5] ±2°C	(2)
1Dh	Thermo element type S, internally compensated	-50 °C .. 1760 °C *I* in units of 1/10°C, two's complement	[1][2][4] ±5°C	(2)
27h	Voltage 0...50mV Siemens S7-format	0...50mV *I* 59.25mV = max. range before over range (32767) 0...50mV = nominal value (0...27648) two's complement	[1] ±0.1% of final value	(1)
28h	Voltage ±10V Siemens S7-format	±11.85V *I* 11.85V= max. value before over range (32767) -10...10V= nominal range (-27648...27648) -11.85V= min. value before under range (-32767) two's complement	[1] ±0.05% of final value	(1)
29h	Voltage ±4V Siemens S7-format	±4.74V *I* 4.74V = max. value before over range (32767) -4...4V = rated range (-27648...27648) -4.74V = min. value before under range (-32767) two's complement	[1] ±0.05% of final value	(1)
2Ah	Voltage ±400mV Siemens S7-format	±0.474V *I* 474mV = max. value before over range (32767) -400...400mV = rated range (-27648...27648) -474mV = min. value before under range (-32767) two's complement	[1] ±0.1% of final value	(1)
2Bh	Voltage ±10V Siemens S5-format	±11.85V *I* 12.5V = max. value before over range (20480) -10...10V = rated range (-16384...16384) -12.5V = min. value before under range (-20480) value and sign	[1] ±0.2% of final value	(1)

continue ...

continue ...

2Ch	Current ±20mA Siemens S7-format	±23.70mA / 23.70mA = max. value before over range (32767) -20...20mA = rated value (-27648...27648) -23.70mA = min. value before under range (-32767) two's complement	[1] ±0.05% of final value	(1)
2Dh	Current 4...20mA Siemens S7-format	1.185 .. +22.96mA / 22.96mA = max. value before over range (32767) 4...20mA = rated range (0...27648) 0mA = min. value before under range (-5530) two's complement	[1] ±0.05% of final value	(1)
2Eh	Current 4...20mA Siemens S5-format	1.185 .. +22.96mA / 22.96mA = max. value before over range (20480) 20mA = rated range (0...16384) 0mA = min. value before under range (-4096) value and sign	[1] ±0.2% of final value	(1)
2Fh	Current ±20mA Siemens S5-format	±23.70mA / 23.70mA = max. value before over range (19456) -20...20mA = rated value (-16384...16384) -23.70mA = min. value before under range (-19456) value and sign	[1] ±0.05% of final value	(1)
32h	Resistance measurement 6000Ohm four-wire	- / 6000Ω= final value (32767)	[1][2] ±0.05% of final value	(4)
33h	Resistance measurement 6000Ohm four-wire	- / 6000Ω= final value (6000)	[1][2] ±0.05% of final value	(4)
35h	Resistance measurement 60Ohm two-wire	- / 60Ω= final value (6000)	[1][2][3] ±0.2% of final value	(3)
36h	Resistance measurement 600Ohm two-wire	- / 600Ω = final value (6000)	[1][2][3] ±0.1% of final value	(3)
37h	Resistance measurement 3000Ohm two-wire	- / 3000Ω = final value (30000)	[1][2][3] ±0.1% of final value	(3)
38h	Resistance measurement 6000Ohm two-wire	- / 6000Ω = final value (6000)	[1][2][3] ±0.1% of final value	(3)
[6]3Ah	Current ±20mA S5-Format from Siemens	±23.70mA / 23.70mA = max. value before over range (19456) -20...20mA = nominal range (-16384...16384) -23.70mA = min. value before under range (-19456) two's complement	[1] ±0.05% of final value	(1)
[6]3Bh	Voltage ±10V S5-Format from Siemens	±11.85V / 12.5V = max. value before over range (20480) -10...10V = nominal range (-16384...16384) -12.5V = min. value before under range (-20480) two's complement	[1] ±0.2% of final value	(1)
3Dh	Resistance measurement 60Ohm four-wire	- / 60Ω= final value (6000)	[1][2] ±0.1% of final value	(4)

continue ...

continue...

3Eh	Resistance measurement 600Ohm four-wire	- / 600Ω= final value (6000)	[1][2] ±0.05% of final value	(4)
3Fh	Resistance measurement 3000Ohm four-wire	- / 3000Ω = final value (30000)	[1][2] ±0.05% of final value	(4)
57h	Voltage 0...50mV	0...50mV / 59.25mV = max. value before over range (5925) 0...50mV = rated range (0...5000) two's complement	[1] ±0.1% of final value	(1)
58h	Voltage ±10V	±11.85V / 11.85V= max. value before over range (11850) -10...10V= rated range (-10000...10000) -11.85V= min. value before under range (-11850) two's complement	[1] ±0.05% of final value	(1)
59h	Voltage ±4V	±4.74V / 4.74V = max. value before over range (4740) -4...4V = rated range (-4000...4000) -4.74V = min. value before under range (-4740) two's complement	[1] ±0.05% of final value	(1)
5Ah	Voltage ±400mV	±474mV / 474mV = max. value before over range (4740) -400...400mV = rated range (-4000...4000) -474mV = min. value before under range (-4740) two's complement	[1] ±0.1% of final value	(1)
5Ch	Current ±20mA	±23.70mA / 23.70mA = max. value before over range (23700) -20...20mA = rated value (-20000...20000) -23.70mA = min. value before under range (-23700) two's complement	[1] ±0.05% of final value	(1)
5Dh	Current 4...20mA	1.185 .. +22.96mA / 22.96mA = max. value before over range (18960) 4...20mA = rated range (0...16000) 0mA = min. value before under range (-4000) two's complement	[1] ±0.05% of final value	(1)
FFh	Channel not active (turned off)			

[1]   measured at an environmental temperature of 25°C, velocity of 15 conversions/s

[2]   excluding errors caused by transducer inaccuracies

[3]   excluding errors caused by contact resistance and line resistance

[4]   the compensation of the neutralization must be implemented externally

[5]   the compensation for the neutralization is implemented internally by including the temperature of the front plug. The thermal conductors have to be connected directly to the front plug, and where necessary these must be extended by means of thermo element extension cables

[6]   starting from hardware release 11

> **Note!**
>
> The module is preset to the range "±10V voltage".

Numeric notation in S5 from Siemens

In S5 format, the input data are stored in one word. The word consists of the binary value and the information bits.

Numeric notation:

Byte	Bit 7 ... Bit 0

0	Bit 0: overflow bit
	        0: value within measuring range
	        1: measuring range overrun
	Bit 1: error bit (set at internal error)
	Bit 2: activity bit (always 0)
	Bit 3 ... 7: binary measured value

1	Bit 0 ... 6: binary measured value
	Bit 7: sign
	        0 positive
	        1 negative

+/- 10V (two's complement)

Voltage	Decimal	Hex
-10V	-16384	C000
-5V	-8192	E000
0V	0	0000
5V	8192	2000
10V	16384	4000

+/- 10V (value and sign)

Voltage	Decimal	Hex
-10V	-16384	C000
-5V	-8192	A000
0V	0	0000
5V	8192	2000
10V	16384	4000

4....20mA (value and sign)

Current	Decimal	Hex
4mA	0	0000
12mA	8192	2000
20mA	16384	4000

+/- 20mA (two's complement)

Current	Decimal	Hex
-20mA	-16384	C000
-10mA	-8192	E000
0mA	0	0000
10mA	8192	2000
20mA	16384	4000

+/- 20mA (value and sign)

Current	Decimal	Hex
-20mA	-16384	C000
-10mA	-8192	A000
0mA	0	0000
10mA	8192	2000
20mA	16384	4000

Formulas for the calculation:

$$Value = 16384 \cdot \frac{U}{10}, \quad U = Value \cdot \frac{10}{16384}$$

U: voltage, Value: Decimal value

Numeric notation

Numeric notation

Formula for the calculation:

$$Value = 16384 \cdot \frac{I}{20}, \quad I = Value \cdot \frac{20}{16384}$$

I: Current, Value: Decimal value

Numeric notation

Numeric notation in S7 from Siemens

Analog values are represented as a two's complement value.

Numeric notation:

Byte	Bit 7 ... Bit 0
0	Bit 0 ... 7: binary measured value
1	Bit 0 ... 6: binary measured value
	Bit 7: sign
	0 positive
	1 negative

+/- 10V

Voltage	Decimal	Hex
-10V	-27648	9400
-5V	-13824	CA00
0V	0	0
5V	13824	3600
10V	27648	6C00

Formulas for the calculation:

$$Value = 27648 \cdot \frac{U}{10}, \quad U = Value \cdot \frac{10}{27648}$$

U: voltage, Value: decimal value

0...10V

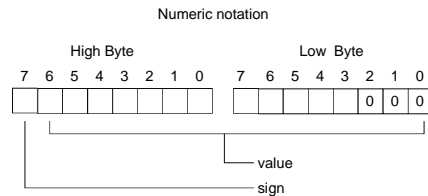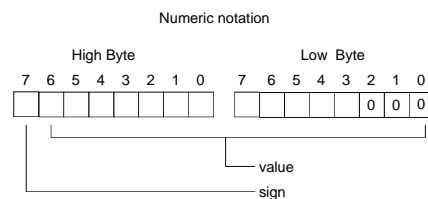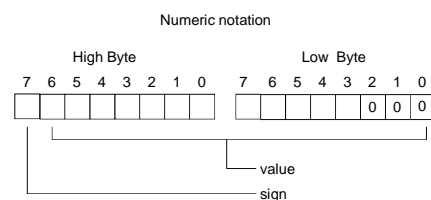| Voltage	Decimal	Hex
0V	0	0000
5V	13824	3600
10V	27648	6C00

Formulas for the calculation:

$$Value = 27648 \cdot \frac{U}{10}, \quad U = Value \cdot \frac{10}{27648}$$

U: voltage, Value: decimal value

1...5V

Voltage	Decimal	Hex
1V	0	0
3V	13824	3600
5V	27648	6C00

Formulas for the calculation:

$$Value = 27648 \cdot \frac{U-1}{4}, \quad U = Value \cdot \frac{4}{27648} + 1$$

U: voltage, Value: decimal value

+/-4V

Voltage	Decimal	Hex
-4V	-27648	9400
0V	0	0
4V	27648	6C00

Formulas for the calculation:

$$Value = 27648 \cdot \frac{U}{4}, \quad U = Value \cdot \frac{4}{27648}$$

U: voltage, Value: decimal value

+/-400mV

Voltage	Decimal	Hex
-400mV	-27648	9400
0V	0	0
400mV	27648	6C00

Formulas for the calculation:

$$Value = 27648 \cdot \frac{U}{400}, \quad U = Value \cdot \frac{400}{27648}$$

U: voltage, Value: decimal value

4....20mA

Current	Decimal	Hex
4mA	0	0
12mA	13824	3600
20mA	27648	6C00

Formulas for the calculation:

$$Value = 27648 \cdot \frac{I-4}{16}, \quad I = Value \cdot \frac{16}{27648} + 4$$

I: current, Value: decimal value

+/- 20mA

Current	Decimal	Hex
-20mA	-27648	9400
-10mA	-13824	CA00
0mA	0	0
10mA	13824	3600
20mA	27648	6C00

Formulas for the calculation:

$$Value = 27648 \cdot \frac{I}{20}, \quad I = Value \cdot \frac{20}{27648}$$

I: current, Value: decimal value

Measurement data acquisition

During a measurement the data is stored in the data input area. The table above shows the allocation of the data to a measured value as well as the respective tolerance.

The following figure shows the structure of the data input area:

Data input area:

Byte	Bit 7 ... Bit 0
0	High-Byte channel 0
1	Low-Byte channel 0
2	High-Byte channel 1
3	Low-Byte channel 1
4	High-Byte channel 2
5	Low-Byte channel 2
6	High-Byte channel 3
7	Low-Byte channel 3

Note!

Only channels 0 and 2 are used in four-wire systems.

Parameter data

You may configure every channel individually. 10Byte are available for the configuration data. Configuration parameters are stored in permanent memory and they will be retained even if power is turned off.

The following table show the structure of the parameter area:

Parameter area:

Byte	Bit 7 ... Bit 0	Default
0	Diagnostic alarm byte: Bit 0 ... 5: reserved Bit 6: 0: diagnostic alarm inhibited 1: diagnostic alarm enabled Bit 7: reserved	00h
1	reserved	00h
2	Function no. channel 0 (see table)	2Dh
3	Function no. channel 1 (see table)	2Dh
4	Function no. channel 2 (see table)	2Dh
5	Function no. channel 3 (see table)	2Dh
6	Option byte channel 0	00h
7	Option byte channel 1	00h
8	Option byte channel 2	00h
9	Option byte channel 3	00h

Parameters   *Diagnostic alarm*

The diagnostic alarm is enabled by means of Bit 6 of Byte 0. In this case an error a 4Byte diagnostic message will be issued to the master system.

Function no.

Here you have to enter the function number of your measurement function for every channel. The allocation of the function number to a measurement function is available from the table above.

Option byte

Here you may specify the conversion rate. In addition selection and envelope functions have been implemented.

Note!

Please note that the resolution is reduced when conversion rate is increased due to the shorter integration time.

The format of the data transfer remains the same. The only difference is that the lower set of bits (LSBs) loose significance for the analog value.

Structure of the option byte:

Byte	Bit 7 ... Bit 0	Resolution	Default
6 ... 9	Option byte:		00h
	Bit 0 ... 3: rate*		
	0000 15 conversions/s	16	
	0001 30 conversions/s	16	
	0010 60 conversions/s	15	
	0011 123 conversions/s	14	
	0100 168 conversions/s	12	
	0101 202 conversions/s	10	
	0110 3.7 conversions/s	16	
	0111 7.5 conversions/s	16	
	Bit 4 ... 5: Selection function		
	00 deactivated		
	01 use 2 of 3 values		
	10 use 4 of 6 values		
	Bit 6 ... 7: Envelope function		
	00 deactivated		
	01 envelope $\pm$ 8		
	10 envelope ±16		

*) These specifications apply to 1channel operation. For multi-channel operations, the conversion rate per channel can be calculated by dividing the specified conversion rate by the number of active channels.

Diagnostic data   As soon as you activated the alarm release in Byte 0 of the parameter area, 4 diagnostic Bytes with fixed content are transferred to the superordinated system in case of an error. Please note that analog modules only use the first two bytes for diagnostic purposes. The remaining two byte are not used. The structure of the diagnostic bytes is as follows:

Diagnostic data:

Byte	Bit 7 ... Bit 0	Default
0	Bit 0: Module malfunction Bit 1: constant 0 Bit 2: external error Bit 3: channel error present Bit 4 ... 7: reserved	-
1	Bit 0 ... 3 class of module 0101 analog module Bit 4: channel information available	-
2 ... 3	not assigned	-

Technical data

Electrical data	VIPA 231-1BD52
Number of inputs	4 differential inputs
Input resistance	> 2MΩ (voltage range)
	< 50Ω (current range)
measuring range	
- Thermo element	Type J, K, N, R, S, T
- Resistance thermometer	Pt100, Pt1000, NI100, NI1000
- Resistance measuring	60Ω, 600Ω, 3kΩ
- Voltage measuring	0...50mV, 0...10V, ±4mV, ±4V, ±10V
- Current measuring	4...20mA, ±20mA
Power supply	5V via backplane bus
Current consumption	240mA via backplane bus
Isolation	500Vrms
	(field voltage - backplane bus)
Status indicators	via LEDs on the front
Programming specifications	
Input data	8Byte (1 word per channel)
Output data	-
Parameter data	10Byte
Diagnostic data	4Byte
Process alarm data	-
Dimensions and weight	
Dimensions (WxHxD)	25.4x76x76mm
Weight	100g

AI 4x16Bit, multiinput

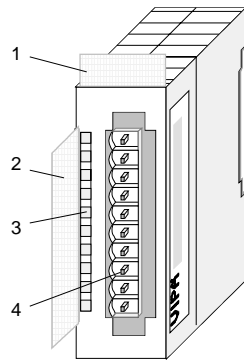|		
Order data	AI 4x16Bit multiinput	VIPA 231-1BD53

Description   The module has 4 inputs that you may configure individually. The module requires a total of 8 input data bytes in the process image (2Byte per channel).

Isolation between the channels on the module and the backplane bus is provided by means of DC/DC converters and optocouplers.

Properties
- the different channels are individually configurable and may be turned off
- the common signal inputs of the channels are not isolated from each other and the permitted potential difference is up to 5V
- LED for cable break and over current in sensor circuits
- diagnostic function

Construction

[1]   Label for module description
[2]   Label for the bit address with description
[3]   LED status indicator
[4]   Edge connector

**Status indicators
pin assignment**

LED	Description
F0 ... F3	LED (red): turned on when an open circuit exists on the 4...20mA sensor circuits

Pin	Assignment
1	For four-wire systems channel 0
2	+ channel 0
3	Channel 0 common
4	+ channel 1
5	Channel 1 common
6	+ channel 2
7	Channel 2 common
8	+ channel 3
9	Channel 3 common
10	For 4wire systems channel 2

Wiring diagrams   The following illustration shows the connection options for the different measuring ranges. The assignment to the measuring ranges is to find in the column "Conn." of the table "Function no. assignment" on the next pages.

Note!

Please note that the module 231-1BD53 was developed from the VIPA 231-1BD50. The measuring function no longer starts at 00h but it is offset by one to 01h. The measurement function no. 00h does not affect permanently stored configuration data.

Attention!
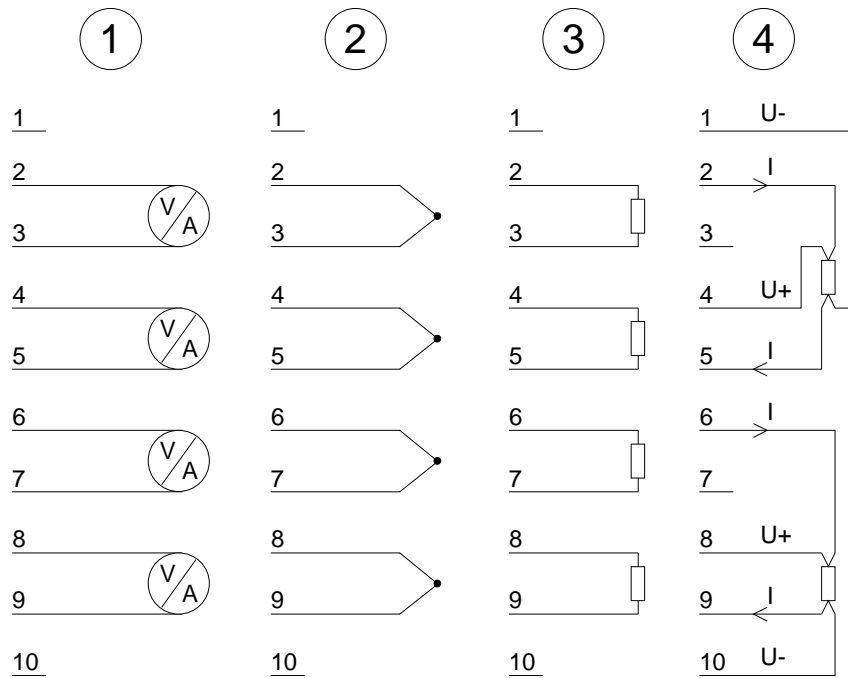
The following circumstances may cause damages at the analog module:

- The external supply of the input (current/voltage) must not be present as long as the backplane bus of the CPU is still without current supply!
- Parameterization and connection of the input must be congruent!
- You must not apply a voltage >15V to the input!

Attention!

Temporarily not used inputs have to be connected with the concerning ground at activated channel. When deactivating unused channels by means of FFh, this is not required.

Note!

Every channel is individual parameterizable. For the parameterization 10Byte parameterization data are available. They are stored permanently and remain in memory during power-off.

Function no. assignment   The assignment of a function no. to a certain channel happens during parameterization. The function no. 00h does not influence the function no. stored in the permanent parameterization data.

Assigning FFh deactivates the according channel.

No.	Function	Measurement range / representation	Tolerance	Conn.
00h	Does not affect permanently stored configuration data			
01h	Pt100 in two-wire mode	-200 .. +850°C **/** in units of 1/10°C, two's complement	[1][2][3] ±1°C	(3)
02h	Pt1000 in two-wire mode	-200 .. +500°C **/** in units of 1/10°C, two's complement	[1][2][3] ±1°C	(3)
03h	NI100 in two-wire mode	-50 .. +250°C **/** in units of 1/10°C, two's complement	[1][2][3] ±1°C	(3)
04h	NI1000 in two-wire mode	-50 .. +250°C **/** in units of 1/10°C, two's complement	[1][2][3] ±1°C	(3)
05h	Resistance measurement 60Ohm two-wire	- **/** 60Ω= final value (32767)	[1][2][3] ±0.2% of final value	(3)
06h	Resistance measurement 600Ohm two-wire	- **/** 600Ω = final value (32767)	[1][2][3] ±0.1% of final value	(3)
07h	Resistance measurement 3000Ohm two-wire	- **/** 3000Ω = final value (32767)	[1][2][3] ±0.1% of final value	(3)
08h	Resistance measurement 6000Ohm two-wire	- / 6000Ω = final value (32767)	[1][2][3] ±0.1% of final value	(3)
09h	Pt100 via four-wire connection	-200 .. +850°C **/** in units of 1/10°C, two's complement	[1][2] ±0.5°C	(4)
0Ah	Pt1000 via four-wire connection	-200 .. +500°C **/** in units of 1/10°C, two's complement	[1][2] ±0.5°C	(4)
0Bh	NI100 via four-wire connection	-50 .. +250°C **/** in units of 1/10°C, two's complement	[1][2] ±0.5°C	(4)
0Ch	NI1000 via four-wire connection	-50 .. +250°C **/** in units of 1/10°C, two's complement	[1][2] ±0.5°C	(4)
0Dh	Resistance measurement 60Ohm four-wire	- **/** 60Ω= final value (32767)	[1][2] ±0.1% of final value	(4)
0Eh	Resistance measurement 600Ohm four-wire	- **/** 600Ω= final value (32767)	[1][2] ±0.05% of final value	(4)
0Fh	Resistance measurement 3000Ohm four-wire	- **/** 3000Ω = final value (32767)	[1][2] ±0.05% of final value	(4)
10h	Thermo element type J , externally compensated	-210 °C .. 850 °C **/** in units of 1/10°C, two's complement	[1][2][4] ±1°C	(2)

continue ...

11h	Thermo element type K, externally compensated	-270 °C .. 1200 °C **/** in units of 1/10°C, two's complement	[1][2][4] ±1.5°C	(2)
12h	Thermo element type N, externally compensated	-200 °C .. 1300 °C **/** in units of 1/10°C, two's complement	[1][2][4] ±1.5°C	(2)
13h	Thermo element type R, externally compensated	-50 °C .. 1760 °C **/** in units of 1/10°C, two's complement	[1][2][4] ±4°C	(2)
14h	Thermo element type T, externally compensated	-270 °C .. 400 °C **/** in units of 1/10°C, two's complement	[1][2][4] ±1.5°C	(2)
15h	Thermo element type S, externally compensated	-50 °C .. 1760 °C **/** in units of 1/10°C, two's complement	[1][2][4] ±5°C	(2)
18h	Thermo element type J, internally compensated	-210 °C .. 850 °C **/** in units of 1/10°C, two's complement	[1][2][5] ±1.5°C	(2)
19h	Thermo element type K, internally compensated	-270 °C .. 1200 °C **/** in units of 1/10°C, two's complement	[1][2][5] ±2°C	(2)
1Ah	Thermo element type N, internally compensated	-200 °C .. 1300 °C **/** in units of 1/10°C, two's complement	[1][2][5] ±2°C	(2)
1Bh	Thermo element type R, internally compensated	-50 °C .. 1760 °C **/** in units of 1/10°C, two's complement	[1][2][5] ±5°C	(2)
1Ch	Thermo element type T, internally compensated	-270 °C .. 400 °C **/** in units of 1/10°C, two's complement	[1][2][5] ±2°C	(2)
1Dh	Thermo element type S, internally compensated	-50 °C .. 1760 °C **/** in units of 1/10°C, two's complement	[1][2][4] ±5°C	(2)
27h	Voltage 0...50mV Siemens S7-format	0...50mV **/** 59.25mV = max. range before over range (32767) 0...50mV = nominal value (0...27648) two's complement	[1] ±0.1% of final value	(1)
28h	Voltage ±10V Siemens S7-format	±11.85V **/** 11.85V= max. value before over range (32767) -10...10V= nominal range (-27648...27648) -11.85V= min. value before under range (-32767) two's complement	[1] ±0.05% of final value	(1)
29h	Voltage ±4V Siemens S7-format	±4.74V **/** 4.74V = max. value before over range (32767) -4...4V = rated range (-27648...27648) -4.74V = min. value before under range (-32767) two's complement	[1] ±0.05% of final value	(1)
2Ah	Voltage ±400mV Siemens S7-format	±474mV **/** 474mV = max. value before over range (32767) -400...400mV = rated range (-27648...27648) -474mV = min. value before under range (-32767) two's complement	[1] ±0.1% of final value	(1)
2Bh	Voltage ±10V Siemens S5-format	±11.85V **/** 12.5V = max. value before over range (20480) -10...10V = rated range (-16384...16384) -12.5V = min. value before under range (-20480) value and sign	[1] ±0.2% of final value	(1)

---

continue ...

2Ch	Current ±20mA Siemens S7-format	±23.70mA **/** 23.70mA = max. value before over range (32767) -20...20mA = rated value (-27648...27648) -23.70mA = min. value before under range (-32767) two's complement	[1] ±0.05% of final value	(1)
2Dh	Current 4...20mA Siemens S7-format	1.185 .. +22.96mA / 22.96mA = max. value before over range (32767) 4...20mA = rated range (0...27648) 0mA = min. value before under range (-5530) two's complement	[1] ±0.05% of final value	(1)
2Eh	Current 4...20mA Siemens S5-format	1.185 .. +22.96mA / 22.96mA = max. value before over range (20480) 20mA = rated range (0...16384) 0mA = min. value before under range (-4096) value and sign	[1] ±0.2% of final value	(1)
2Fh	Current ±20mA Siemens S5-format	±23.70mA / 23.70mA = max. value before over range (19456) -20...20mA = rated value (-16384...16384) -23.70mA = min. value before under range (-19456) value and sign	[1] ±0.05% of final value	(1)
32h	Resistance measurement 6000Ohm four-wire	- / 6000Ω= final value (32767)	[1][2] ±0.05% of final value	(4)
33h	Resistance measurement 6000Ohm four-wire	- / 6000Ω= final value (6000)	[1][2] ±0.05% of final value	(4)
35h	Resistance measurement 60Ohm two-wire	- / 60Ω= final value (6000)	[1][2][3] ±0.2% of final value	(3)
36h	Resistance measurement 600Ohm two-wire	- / 600Ω = final value (6000)	[1][2][3] ±0.1% of final value	(3)
37h	Resistance measurement 3000Ohm two-wire	- / 3000Ω = final value (30000)	[1][2][3] ±0.1% of final value	(3)
38h	Resistance measurement 6000Ohm two-wire	- / 6000Ω = final value (6000)	[1][2][3] ±0.1% of final value	(3)
3Ah	Current ±20mA S5-Format from Siemens	±23.70mA / 23.70mA = max. value before over range (19456) -20...20mA = nominal range (-16384...16384) -23.70mA = min. value before under range (-19456) two's complement	[1] ±0.05% of final value	(1)
3Bh	Voltage ±10V S5-Format from Siemens	±11.85V / 12.5V = max. value before over range (20480) -10...10V = nominal range (-16384...16384) -12.5V = min. value before under range (-20480) two's complement	[1] ±0.2% of final value	(1)
3Dh	Resistance measurement 60Ohm four-wire	- **/** 60Ω= final value (6000)	[1][2] ±0.1% of final value	(4)

continue...

3Eh	Resistance measurement 600Ohm four-wire	- *I* 600Ω= final value (6000)	[1][2] ±0.05% of final value	(4)
3Fh	Resistance measurement 3000Ohm four-wire	- *I* 3000Ω = final value (30000)	[1][2] ±0.05% of final value	(4)
57h	Voltage 0...50mV	0...50mV *I* 59.25mV = max. value before over range (5925) 0...50mV = rated range (0...5000) two's complement	[1] ±0.1% of final value	(1)
58h	Voltage ±10V	±11.85V *I* 11.85V= max. value before over range (11850) -10...10V= rated range (-10000...10000) -11.85V= min. value before under range (-11850) two's complement	[1] ±0.05% of final value	(1)
59h	Voltage ±4V	±4.74V *I* 4.74V = max. value before over range (47400) -4...4V = rated range (-40000...40000) -4.74V = min. value before under range (-47400) two's complement	[1] ±0.05% of final value	(1)
5Ah	Voltage ±400mV	±474mV *I* 474mV = max. value before over range (47400) -400...400mV = rated range (-40000...40000) -474mV = min. value before under range (-47400) two's complement	[1] ±0.1% of final value	(1)
5Ch	Current ±20mA	±23.70mA *I* 23.70mA = max. value before over range (23700) -20...20mA = rated value (-20000...20000) -23.70mA = min. value before under range (-23700) two's complement	[1] ±0.05% of final value	(1)
5Dh	Current 4...20mA	1.185 .. +22.96mA *I* 22.96mA = max. value before over range (18960) 4...20mA = rated range (0...16000) 0mA = min. value before under range (-4000) two's complement	[1] ±0.05% of final value	(1)
FFh	Channel not active (turned off)			

[1]   measured at an environmental temperature of 25°C, velocity of 15 conversions/s

[2]   excluding errors caused by transducer inaccuracies

[3]   excluding errors caused by contact resistance and line resistance

[4]   the compensation of the neutralization must be implemented externally

[5]   the compensation for the neutralization is implemented internally by including the temperature of the front plug. The thermal conductors have to be connected directly to the front plug, and where necessary these must be extended by means of thermo element extension cables

Note!

The module is preset to the range "±10V voltage".

**Numeric notation
in S5 from
Siemens**

In S5 format, the input data are stored in one word. The word consists of the binary value and the information bits.

Numeric notation:

Byte	Bit 7 ... Bit 0
0	Bit 0: overflow bit 0: value within measuring range 1: measuring range overrun Bit 1: error bit (set at internal error) Bit 2: activity bit (always 0) Bit 3 ... 7: binary measured value
1	Bit 0 ... 6: binary measured value Bit 7: sign 0 positive 1 negative

+/- 10V (two's complement)

Voltage	Decimal	Hex
-10V	-16384	C000
-5V	-8192	E000
0V	0	0000
5V	8192	2000
10V	16384	4000

+/- 10V (value and sign)

Voltage	Decimal	Hex
-10V	-16384	C000
-5V	-8192	A000
0V	0	0000
5V	8192	2000
10V	16384	4000

4....20mA (value and sign)

Current	Decimal	Hex
4mA	0	0000
12mA	8192	2000
20mA	16384	4000

+/- 20mA (two's complement)

Current	Decimal	Hex
-20mA	-16384	C000
-10mA	-8192	E000
0mA	0	0000
10mA	8192	2000
20mA	16384	4000

+/- 20mA (value and sign)

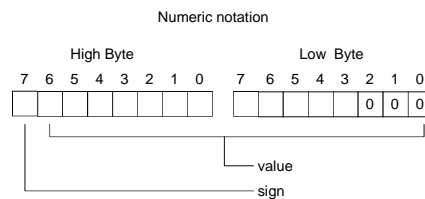| Current	Decimal	Hex
-20mA	-16384	C000
-10mA	-8192	A000
0mA	0	0000
10mA	8192	2000
20mA	16384	4000

Formulas for the calculation:

$$Value = 16384 \cdot \frac{U}{10}, \quad U = Value \cdot \frac{10}{16384}$$
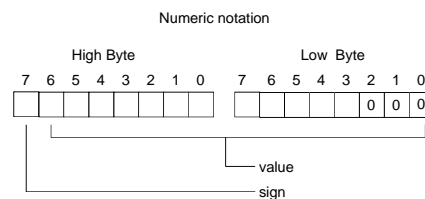
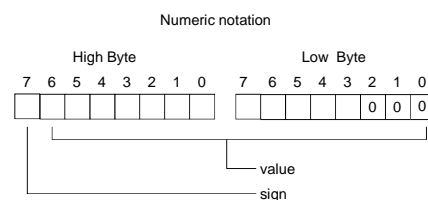U: voltage, Value: Decimal value

Numeric notation

Numeric notation

Formula for the calculation:

$$Value = 16384 \cdot \frac{I}{20}, \quad I = Value \cdot \frac{20}{16384}$$

I: Current, Value: Decimal value

Numeric notation

Numeric notation in S7 from Siemens

Analog values are represented as a two's complement value.

Numeric notation:

Byte	Bit 7 ... Bit 0
0	Bit 0 ... 7: binary measured value
1	Bit 0 ... 6: binary measured value
	Bit 7: sign
	0 positive
	1 negative

+/- 10V

Voltage	Decimal	Hex
-10V	-27648	9400
-5V	-13824	CA00
0V	0	0
5V	13824	3600
10V	27648	6C00

Formulas for the calculation:

$$Value = 27648 \cdot \frac{U}{10}, \quad U = Value \cdot \frac{10}{27648}$$

U: voltage, Value: decimal value

0...10V

Voltage	Decimal	Hex
0V	0	0000
5V	13824	3600
10V	27648	6C00

Formulas for the calculation:

$$Value = 27648 \cdot \frac{U}{10}, \quad U = Value \cdot \frac{10}{27648}$$

U: voltage, Value: decimal value

1...5V

Voltage	Decimal	Hex
1V	0	0
3V	13824	3600
5V	27648	6C00

Formulas for the calculation:

$$Value = 27648 \cdot \frac{U-1}{4}, \quad U = Value \cdot \frac{4}{27648} + 1$$

U: voltage, Value: decimal value

+/-4V

Voltage	Decimal	Hex
-4V	-27648	9400
0V	0	0
4V	27648	6C00

Formulas for the calculation:

$$Value = 27648 \cdot \frac{U}{4}, \quad U = Value \cdot \frac{4}{27648}$$

U: voltage, Value: decimal value

+/-400mV

Voltage	Decimal	Hex
-400mV	-27648	9400
0V	0	0
400mV	27648	6C00

Formulas for the calculation:

$$Value = 27648 \cdot \frac{U}{400}, \quad U = Value \cdot \frac{400}{27648}$$

U: voltage, Value: decimal value

4....20mA

Current	Decimal	Hex
4mA	0	0
12mA	13824	3600
20mA	27648	6C00

Formulas for the calculation:

$$Value = 27648 \cdot \frac{I-4}{16}, \quad I = Value \cdot \frac{16}{27648} + 4$$

I: current, Value: decimal value

+/- 20mA

Current	Decimal	Hex
-20mA	-27648	9400
-10mA	-13824	CA00
0mA	0	0
10mA	13824	3600
20mA	27648	6C00

Formulas for the calculation:

$$Value = 27648 \cdot \frac{I}{20}, \quad I = Value \cdot \frac{20}{27648}$$

I: current, Value: decimal value

Measurement data acquisition

During a measurement the data is stored in the data input area. The table above shows the allocation of the data to a measured value as well as the respective tolerance.

The following figure shows the structure of the data input area:

Data input area:

Byte	Bit 7 ... Bit 0
0	High-Byte channel 0
1	Low-Byte channel 0
2	High-Byte channel 1
3	Low-Byte channel 1
4	High-Byte channel 2
5	Low-Byte channel 2
6	High-Byte channel 3
7	Low-Byte channel 3

Note!

Only channels 0 and 2 are used in four-wire systems.

Parameter data   10Byte of parameter data are available for the configuration. These parameters are stored in non-volatile memory and are available after the unit has been powered off.

The following table shows the structure of the parameter data:

Parameter area:

Byte	Bit 7 ... Bit 0	Default
0	Wire break recognition and diag. alarm: Bit 0: Wire break recognition channel 0 0: deactivated 1: activated Bit 1: Wire break recognition channel 1 0: deactivated 1: activated Bit 2: Wire break recognition channel 2 0: deactivated 1: activated Bit 3: Wire break recognition channel 3 0: deactivated 1: activated Bit 4 ... 5: reserved Bit 6: 0: diagnostic alarm inhibited 1: diagnostic alarm enabled Bit 7: reserved	00h
1	Bit 0 ... 7: reserved	00h
2	Function-no. channel 0	28h
3	Function-no. channel 1	28h
4	Function-no. channel 2	28h
5	Function-no. channel 3	28h
6	Option-Byte channel 0	00h
7	Option-Byte channel 1	00h
8	Option-Byte channel 2	00h
9	Option-Byte channel 3	00h

Parameters   *Wire break recognition*

Via the Bits 0 to 3 of Byte 0, the wire break recognition is activated.

Wire break is recognized at all measuring ranges except voltage and ±20mA current measuring.

If the current underruns 0.8mA in 4...20mA current measuring, a wire break is detected. With activated wire break recognition and diagnostic alarm, a diagnostic message is sent to the superordinated system.

Diagnostic alarm

With the help of Bit 6 of Byte 0, you may release the diagnostic alarm. In case of an error, the *record set 0* with a size of 4Byte is transferred to the superordinated system.

More detailed information is to find below under "Diagnostic data".

Function No.

Here you set the function no. of your measuring function for every channel. Please see the according table above.

Option-Byte

Here you may set the transducer velocity for every input channel. Please regard that a higher transducer velocity causes a lower resolution because of the lower integration time.

The data transfer format remains unchanged. Only the lower Bits (LSBs) are not longer relevant for the analog value.

Structure Option-Byte:

Byte	Bit 7 ... Bit 0	Resolution	Default
6 ... 7	Bit 0 ... 3: Velocity per channel*		00h
	0000 15 conversions/s	16	
	0001 30 conversions/s	16	
	0010 60 conversions/s	15	
	0011 123 conversions/s	14	
	0100 168 conversions/s	12	
	0101 202 conversions/s	10	
	0110 3,7 conversions/s	16	
	0111 7,5 conversions/s	16	
	Bit 4 ... 5: Selection function		
	00 deactivated		
	01 use 2 of 3 values		
	10 use 4 of 6 values		
	Bit 6 ... 7: Envelope function		
	00 deactivated		
	01 envelope ± 8		
	10 envelope ±16		

*)   These specifications apply to 1channel operation. For multi-channel operations, the conversion rate per channel can be calculated by dividing the specified conversion rate by the number of active channels.

Diagnostic data   The diagnostic data uses 12Byte and are stored in the record sets 0 and 1 of the system data area.

When you enable the diagnostic alarm in Byte 0 of the parameter area, modules will transfer *record set 0* to the superordinated system when an error is detected.

Record set 0 has a predefined content and a length of 4Byte. The content of the record set may be read in plain text via the diagnostic window of the CPU.

For extended diagnosis during runtime, you may evaluate the 12Byte wide *record set 1* via the SFCs 51 and 59.

Evaluate   At present diagnosis, the CPU interrupts the user application and branches
diagnosis   into the OB82. This OB gives you detailed diagnostic data via the SFCs 51 and 59 when programmed correctly.

After having processed the OB82, the user application processing is continued. Until leaving the OB82, the data remain consistent.

Record set 0   *Byte 0 to 3:*

Record set 0 (Byte 0 to 3):

Byte	Bit 7 ... Bit 0	Default
0	Bit 0: Module malfunction Bit 1: reserved Bit 2: External error Bit 3: Channel error present Bit 4 ... 6: reserved Bit 7: Wrong parameters in the module	00h
1	Bit 0 ... 3: Module class 0101 Analog module Bit 4: Channel information present Bit 5 ... 7: reserved	15h
2	reserved	00h
3	reserved	00h

Record set 1

Byte 0 to 11:

The *record set 1* contains the 4Byte of record set 0 and additional 8Byte module specific diagnostic data.

The diagnostic bytes have the following assignment:

Record set 1 (Byte 0 to 11):

Byte	Bit 7 ... Bit 0	Default
0 ... 3	Content record set 0 (see page before)	-

4	Bit 0 ... 6: Channel type
	    70h: Digital input
	    71h: Analog input
	    72h: Digital output
	    73h: Analog output
	    74h: Analog in-/output
	Bit 7: reserved
		71h

5	Bit 0 ... 7: Number of diagnostic bits of the module per channel	08h
6	Bit 0 ... 7: Number of identical channels of a module	04h
7	Bit 0: Channel error Channel 0 Bit 1: Channel error Channel 1 Bit 2: Channel error Channel 2 Bit 3: Channel error Channel 3 Bit 4 ... 7: reserved	00h
8	Bit 0: Wire break Channel 0 Bit 1: Parameterization error Channel 0 Bit 2: Measuring range underflow Channel 0 Bit 3: Measuring range overflow Channel 0 Bit 4 ... 7: reserved	00h
9	Bit 0: Wire break Channel 1 Bit 1: Parameterization error Channel 1 Bit 2: Measuring range underflow Channel 1 Bit 3: Measuring range overflow Channel 1 Bit 4 ... 7: reserved	00h
10	Bit 0: Wire break Channel 2 Bit 1: Parameterization error Channel 2 Bit 2: Measuring range underflow Channel 2 Bit 3: Measuring range overflow Channel 2 Bit 4 ... 7: reserved	00h
11	Bit 0: Wire break Channel 3 Bit 1: Parameterization error Channel 3 Bit 2: Measuring range underflow Channel 3 Bit 3: Measuring range overflow Channel 3 Bit 4 ... 7: reserved	00h

Technical data

Electrical Data	VIPA 231-1BD53							
Number of inputs	4							
Voltage supply	DC 5V via backplane bus							
Current consumption	backplane bus: 110mA							
Ranges	Pt100, Pt1000, NI100, NI1000, 60Ω, 600Ω, 3000Ω, 6000Ω							
	Thermo element (J, K, N, R, T, S),							
	±10V, ±4V, ±400mV, 0 ... 50mV							
	±20mA, 4 ... 20mA							
Input resistant	100kΩ (Voltage)							
	50Ω (Current)							
Analog value calculation inputs	Calculation time/Resolution (per channel)							
Parameterized velocity (Hz)	3.7	7.5	15	30	60	123	168	202
Basic calculation time (ms)	268	135	69	35,5	19	10	8	6.75
Additional calculation time (executed once per cycle) (ms)	10	10	10	10	10	10	10	10
Additional calculation time for wire break recognition (ms)	6.5	6.5	6.5	6.5	6.5	6.5	6.5	6.5
Resolution in Bit	16	16	16	16	15	14	12	10
Electrical Data								
Data for choosing an encoder								
- Voltage input	100 kΩ							
- Current input	50 Ω							
Diagnose alarm	parameterizable							
Potential separation	500Vrms (field voltage – backplane bus)							
Status monitor	Via LEDs at the front side							
Programming specifications								
Input data	4Byte (1 Word per channel)							
Parameter data	10Byte							
Diagnostic data	12Byte							
Measurements and Weight								
Measurements (WxHxD)	25.4x76x76mm							
Weight	100g							

AI 4x12Bit, 4 ... 20mA, isolated

Order data   AI 4x12Bit, 4...20mA, isolated   VIPA 231-1BD60

Description   The module has 4 inputs that are permanently configured to measure current signals (4 ... 20mA). This module requires a total of 8Byte of the process image for the input data (2Byte per channel).

The measured values are returned in S5 format from Siemens. DC/DC converters and isolation amplifiers are employed to provide electrical isolation for the channels of the module with respect to the backplane bus and between the different channels.

Properties
- 4 inputs, channels isolated from the backplane bus and from each other (galvanic isolation of the channels by means of isolation amplifiers)
- Permanently configured for current measurements
- No parameterization required
- Suitable for transducers with 4 ... 20mA outputs
- LEDs to indicate wire break

Construction
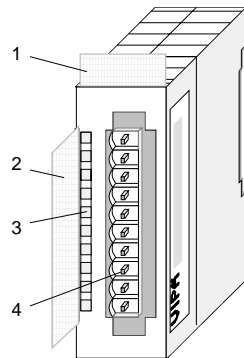
[1]   Label for the name of the module

[2]   Label for the bit address with description

[3]   LED status indicator

[4]   Edge connector

Status indicator pin assignment

LED	Description		Pin	Assignment
+0 ... +3	LED (red) wire break detection These LEDs is turned on when the transducer is disconnected.		1	
			2	pos. connection Ch. 0
			3	Channel 0 common
			4	pos. connection Ch.1
			5	Channel 1 common
			6	pos. connection Ch.2
			7	Channel 2 common
			8	pos. connection Ch.3
			9	Channel 3 common
			10	
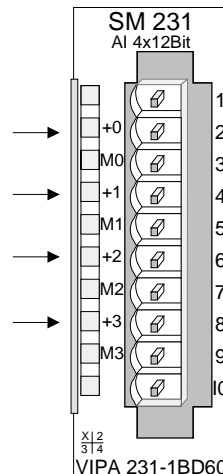
Wiring and schematic diagram

Wiring diagram   **Schematic diagram**
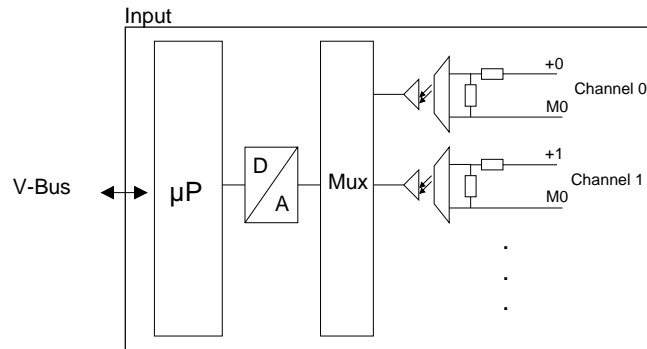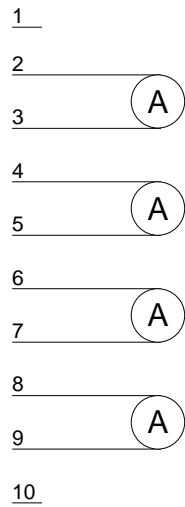
Wire break recognition

The wire break recognition is always active. In case of a wire break res. when no encoder is connected, the LED of the according channel is turned on. The module has no diagnostic ability.

Numeric notation

Input data in Siemens S5 format is stored in a word. The word contains the binary value and information bits:

Numeric notation:

Byte	Bit 7 ... Bit 0
0	Bit 0: overflow bit
	0: value within measuring range
	1: measuring range exceeded
	Bit 1: error bit (set at internal error)
	Bit 2: activity bit (always 0)
	Bit 3 ... 7: **binary measured value** (see table below)
1	Bit 0 ... 6: **binary measured value** (see table below)
	Bit 7: sign
	0 positive
	1 negative

The following table shows the allocation of binary values to the respective measured values.

Numeric notation in Siemens S5 format

Measured value in mA	Units	Binary measured value	T	E	Ü	Range
24.0	2560	0 1 0 1 0 0 0 0 0 0 0 0 0	0	0	0	overdrive region
20.016	2049	0 1 0 0 0 0 0 0 0 0 0 0 1	0	0	0	
20.0	2048	0 1 0 0 0 0 0 0 0 0 0 0 0	0	0	0	nominal range
19.98	2047	0 0 1 1 1 1 1 1 1 1 1 1 1	0	0	0	
12.0	1024	0 0 1 0 0 0 0 0 0 0 0 0 0	0	0	0	
8.0	512	0 0 0 1 0 0 0 0 0 0 0 0 0	0	0	0	
6.0	256	0 0 0 0 1 0 0 0 0 0 0 0 0	0	0	0	
5.0	128	0 0 0 0 0 1 0 0 0 0 0 0 0	0	0	0	
4.016	2	0 0 0 0 0 0 0 0 0 0 0 1 0	0	0	0	
4.008	1	0 0 0 0 0 0 0 0 0 0 0 0 1	0	0	0	
4	0	0 0 0 0 0 0 0 0 0 0 0 0 0	0	0	0	
3.984	-2	1 1 1 1 1 1 1 1 1 1 1 1 0	0	0	0	Underdrive region
3.0	-128	1 1 1 1 1 1 0 0 0 0 0 0 0	0	0	0	
2.0	-256	1 1 1 1 1 0 0 0 0 0 0 0 0	0	0	0	
1.0	-384	1 1 1 1 0 1 0 0 0 0 0 0 0	0	0	0	
0.0	-512	1 1 1 1 0 0 0 0 0 0 0 0 0	0	0	0	

Technical data

Electrical data	VIPA 231-1BD60
Number of inputs	4 individually isolated
Current measuring range	4 ... 20mA
Input filter time delay	3ms
Input resistance	20Ω
Power supply	5V via backplane bus
Current consumption	280mA via backplane bus
Isolation	yes, every channel separately, isolation tested at 500Vrms
Status indicators	via LEDs on the front
Programming specifications	
Input data	8Byte (1 word per channel)
Output data	-
Parameter data	-
Diagnostic data	-
Process alarm data	-
Dimensions and weight	
Dimensions (WxHxD)	25.4x76x76mm
Weight	120g

AI 4x12Bit, ±10V, isolated

Order data   AI 4x12Bit, ±10V, isolated   VIPA 231-1BD70

Description   The module has 4 inputs that are permanently configured to measure voltage signals (±10V). This module requires a total of 8Byte of the process image for the input data (2Byte per channel).

The measured values are returned in S5 format from Siemens. DC/DC converters and isolation amplifiers are employed to provide electrical isolation for the channels of the module with respect to the backplane bus and between the different channels.

Properties   • 4 inputs, channels isolated from the backplane bus and from each other (Galvanic isolation of the channels by means of isolation amplifiers)

• Permanently configured for voltage measurements

• No parameterization required

• Suitable for transducers with ±10V outputs

Construction
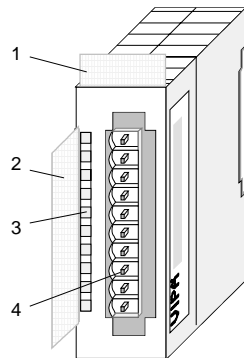
[1]   Label for the name of the module

[2]   Label for the bit address with description

[3]   LED status indicator

[4]   Edge connector

Pin assignment
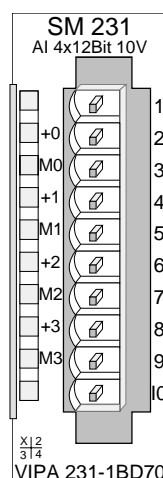
Pin	Assignment
1	
2	pos. connection Channel 0
3	Channel 0 common
4	pos. connection Channel 1
5	Channel 1 common
6	pos. connection Channel 2
7	Channel 2 common
8	pos. connection Channel 3
9	Channel 3 common
10	

**Wiring and
schematic
diagram**

Wiring diagram   **Schematic diagram**

Numeric notation   Input data in Siemens S5 format is stored in a word. The word contains the
binary value and information bits:

Numeric notation:

Byte	Bit 7 ... Bit 0
0	Bit 0: overflow bit
	0: value within measuring range
	1: measuring range exceeded
	Bit 1: error bit (set at internal error)
	Bit 2: activity bit (always 0)
	Bit 3 ... 7: **binary measured value** (see table below)
1	Bit 0 ... 6: **binary measured value** (see table below)
	Bit 7: sign
	0 positive
	1 negative

The following table shows the allocation of binary values to the respective
measured values.

Numeric notation in Siemens S5 format

Measured value in V	Units	Binary measured value	T	E	Ü	Range
12,5	2560	0 1 0 1 0 0 0 0 0 0 0 0	0	0	0	overdrive region
10,005	2049	0 1 0 0 0 0 0 0 0 0 0 1	0	0	0	
10,0	2048	0 1 0 0 0 0 0 0 0 0 0 0	0	0	0	nominal range
5	1024	0 0 1 0 0 0 0 0 0 0 0 0	0	0	0	
2,5	512	0 0 0 1 0 0 0 0 0 0 0 0	0	0	0	
1,25	256	0 0 0 0 1 0 0 0 0 0 0 0	0	0	0	
0,625	128	0 0 0 0 0 1 0 0 0 0 0 0	0	0	0	
0,005	1	0 0 0 0 0 0 0 0 0 0 0 1	0	0	0	
0	0	0 0 0 0 0 0 0 0 0 0 0 0	0	0	0	
-0,005	-1	1 1 1 1 1 1 1 1 1 1 1 1	0	0	0	
-0,625	-128	1 1 1 1 1 1 0 0 0 0 0 0	0	0	0	
-1,25	-256	1 1 1 1 1 0 0 0 0 0 0 0	0	0	0	
-2,5	-512	1 1 1 1 0 0 0 0 0 0 0 0	0	0	0	
-5	-1024	1 1 1 0 0 0 0 0 0 0 0 0	0	0	0	
-10,0	-2048	1 1 0 0 0 0 0 0 0 0 0 0	0	0	0	
-10,005	-2049	1 0 1 1 1 1 1 1 1 1 1 1	0	0	0	Underdrive region
-12	-2560	1 0 1 1 0 0 0 0 0 0 0 0	0	0	0	

Technical data

Electrical data	VIPA 231-1BD70
Number of inputs	4 individually isolated
Voltage measuring range	±10V
Input filter time delay	3ms
Input resistance	83.5kΩ
Power supply	5V via backplane bus
Current consumption	300mA via backplane bus
Isolation	yes, every channel separately, isolation tested at 500Vrms
Status indicators	via LEDs on the front
Programming specifications	
Input data	8Byte (1 word per channel)
Output data	-
Parameter data	-
Diagnostic data	-
Process alarm data	-
Dimensions and weight	
Dimensions (WxHxD)	25.4x76x76mm
Weight	120g

AI 4x16Bit f

**Order data**   AI 4x16Bit f   VIPA 231-1FD00

Description   The module has 4 fast (f=fast) inputs that you may configure individually.
                       The module requires a total of 8 input data bytes in the process image
                       (2Byte per channel).

                       Isolation between the channels on the module and the backplane bus is
                       provided by means of DC/DC converters and optocouplers.

Properties   • Using all 4 channels, the cycle time is < 1ms
                       • the different channels are individually configurable and can be turned off
                       • LED for signaling wire break in current loop operation
                       • Diagnostic function
                       • Resolution 16Bit

Construction
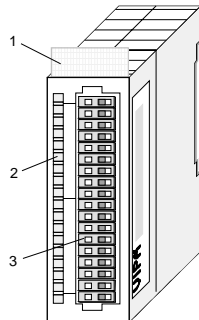
[1]   Label for the name of the module
[2]   LED status indicator
[3]   Edge connector

Status indicator
pin assignment

LED   Description   **Wiring diagram**

F0 ... F3   LED (red):
            is on if the measured current
            value exceeds the range
            4...20mA (cable break or
            overload).
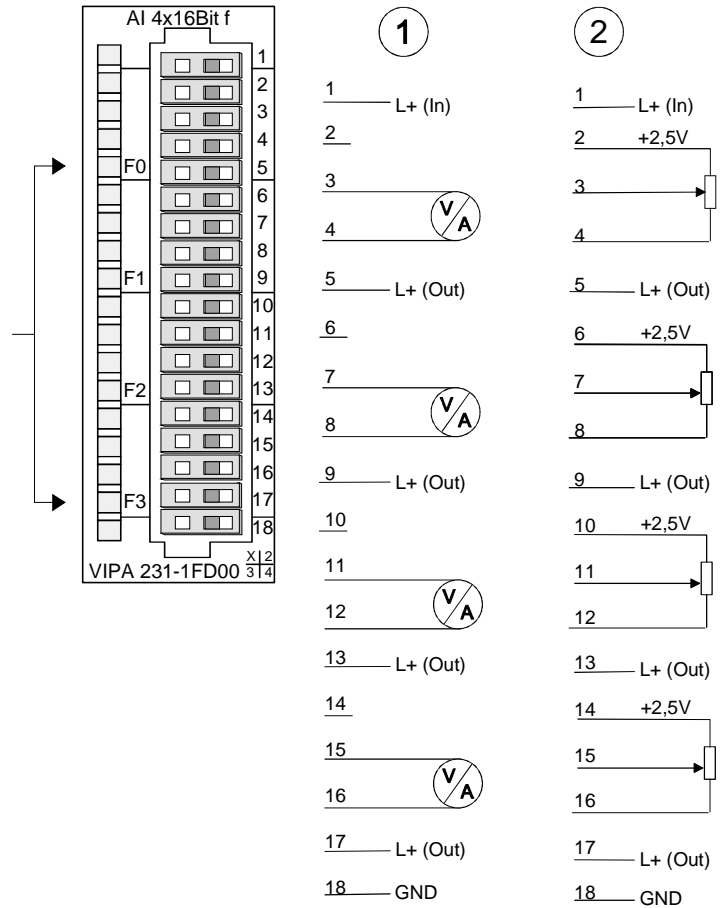
The internal resistance R_i of the 2,5V voltage source is 100Ω. For a connection of a voltage divider the following equivalent circuit is valid:
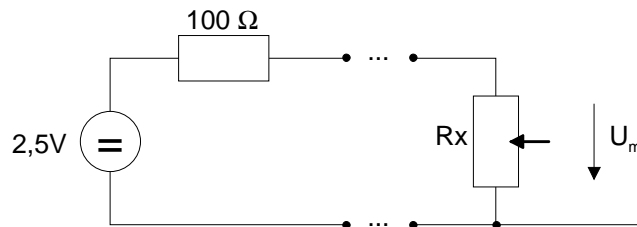
Note!

Unused inputs on activated channels have to be connected to the respective ground. This is not necessary when the unused channels are turned off by means of FFh.

**Function no.
allocation**

The assignment of a function no. to a certain channel happens during parameterization. The function no. 00h does not influence the function no. stored in the permanent parameterization data.

Assigning FFh deactivates the according channel.

No.	Function	Measurement range / representation	Tolerance	Conn.
00h	Does not affect permanently stored configuration data			
28h	Voltage ±10V S7-Format from Siemens	-10V ... -9.9V (-27648 ... -27371) [1] -9.9 ... 9.9 (-27370 ... 27370) -10...10V= rated range (-27648...27648) 9.9 ... 10V (27371 ... 27648) [1]	0,2% of final value	(1), (2)
29h	Voltage ±4V S7-Format from Siemens	±4.70V *I* 4.70V = max. value before over range (32511) -4...4V = rated range (-27648...27648) -4.70V = min. value before under range (-32512) two's complement	0,2% of final value	(1), (2)
2Ah	Voltage ±400mV S7-Format from Siemens	±470mV *I* 470mV = max. value before over range (32511) -400...400mV = rated range(-27648...27648) -470mV = min. value before under range (-32512) two's complement	0,4% of final value	(1)
2Ch	Current ±20mA S7-Format from Siemens	±23.51mA *I* 23.51mA = max. value before over range (32511) -20...20mA = rated range (-27648...27648) -23.51mA = min. value before under range (-32512) two's complement	0,2% of final value	(1)
2Dh	Current 4...20mA S7-Format from Siemens	1.185 .. +22.81mA *I* 22.81mA = max. value before over range (32511) 4...20mA = rated range (0...27648) 1.18mA = min. value before under range (-4864) two's complement	0,5% of final value	(1)
58h	Voltage ±10V	-10 ... -9.9V (-10000 ... -9901) [1] -9,9 ... 9.9V (-9900 ... 9900) -10...10V= rated range(-10000...10000) 9.9 ... 10V (9901 ... 10000) [1]	0,2% of final value	(1), (2)
59h	Voltage ±4V	±4.95V *I* 4,95V = max. value before over range (4950) -4...4V = rated range (-4000...4000) -4.95V = min. value before under range (-4950) two's complement	0,2% of final value	(1), (2)
5Ah	Voltage ±400mV	±495mV *I* 495mV = max. value before over range (4950) -400...400mV = rated range (-4000...4000) -495mV = min. value before under range (-4950) two's complement	0,4% of final value	(1)
5Ch	Current ±20mA	±25mA *I* 25mA = max. value before over range (25000) -20...20mA = rated range (-20000...20000) -25mA = min. value before under range(-25000) two's complement	0,2% of final value	(1)
5Dh	Current 4...20mA	0.8 .. +24.00mA *I* 24.00mA = End over range (20000) 4...20mA = rated range (0...16000) 0,8mA = min. value before under range (-3200) two's complement	0,5% of final value	(1)
FFh	Channel not active (turned off)			

[1])   depends on calibration factor and is not guaranteed.

Note!

The module is preset to the range "±10V voltage" in S7 format from Siemens.

Numeric notation in S7 from Siemens

Analog values are represented as a two's complement value.

Numeric notation:

Byte	Bit 7 ... Bit 0
0	Bit 0 ... 7: binary measured value
1	Bit 0 ... 6: binary measured value
	Bit 7: sign
	0 positive
	1 negative

+/- 10V

Voltage	Decimal	Hex
-10V	-27648	9400
-5V	-13824	CA00
0V	0	0
5V	13824	3600
10V	27648	6C00

Formulas for the calculation:

$$Value = 27648 \cdot \frac{U}{10}, \quad U = Value \cdot \frac{10}{27648}$$

U: voltage, Value: decimal value

+/-4V

Voltage	Decimal	Hex
-4V	-27648	9400
0V	0	0
4V	27648	6C00

Formulas for the calculation:

$$Value = 27648 \cdot \frac{U}{4}, \quad U = Value \cdot \frac{4}{27648}$$

U: voltage, Value: decimal value

+/-400mV

Voltage	Decimal	Hex
-400mV	-27648	9400
0V	0	0
400mV	27648	6C00

Formulas for the calculation:

$$Value = 27648 \cdot \frac{U}{400}, \quad U = Value \cdot \frac{400}{27648}$$

U: voltage, Value: decimal value

4....20mA

Current	Decimal	Hex
4mA	0	0
12mA	13824	3600
20mA	27648	6C00

Formulas for the calculation:

$$Value = 27648 \cdot \frac{I-4}{16}, \quad I = Value \cdot \frac{16}{27648} + 4$$

I: current, Value: decimal value

+/- 20mA

Current	Decimal	Hex
-20mA	-27648	9400
-10mA	-13824	CA00
0mA	0	0
10mA	13824	3600
20mA	27648	6C00

Formulas for the calculation:

$$Value = 27648 \cdot \frac{I}{20}, \quad I = Value \cdot \frac{20}{27648}$$

I: current, Value: decimal value

Measurement data acquisition	During a measurement the data is stored in the data input area. The table above shows the allocation of the data to a measured value as well as the respective tolerance.

The following figures show the structure of the data input area:

Data input area:

Byte	Bit 7 ... Bit 0
0	High-Byte channel 0
1	Low-Byte channel 0
2	High-Byte channel 1
3	Low-Byte channel 1
4	High-Byte channel 2
5	Low-Byte channel 2
6	High-Byte channel 3
7	Low-Byte channel 3

Parameter data	You may configure every channel individually. 32Byte are available for the configuration data. Configuration parameters are stored in permanent memory and they will be retained even if power is turned off.

The following table show the structure of the parameter area:

Parameter area:

Byte	Bit 7 ... Bit 0	Default
0	Diagnostic alarm byte: Bit 0 ... 5: reserved Bit 6: 0: diagnostic alarm inhibited 1: diagnostic alarm enabled Bit 7: reserved	00h
1	Limit value monitoring: Bit 0: limit value monitoring channel 0 Bit 1: limit value monitoring channel 1 Bit 2: limit value monitoring channel 2 Bit 3: limit value monitoring channel 3 Bit 4 ... 7: reserved	00h
2	Function no. channel 0 (see table)	28h
3	Function no. channel 1 (see table)	28h
4	Function no. channel 2 (see table)	28h
5	Function no. channel 3 (see table)	28h
6-9	reserved	00h

Continue ...

... Continue parameter area

Byte	Bit 7 ... Bit 0	Default
10	Bit 0 ... 2: mean value 000: disabled 001: mean value over 2 values 010: mean value over 4 values 011: mean value over 8 values 100: mean value over 16 values 101, 011, 111: disabled Bit 3 ... 7: reserved	00h
11-15	reserved	00h
16	channel 0, upper limit, High-Byte	7Fh
17	channel 0, upper limit, Low-Byte	FFh
18	channel 0, lower limit, High-Byte	80h
19	channel 0, lower limit, Low-Byte	00h
20	channel 1, upper limit, High-Byte	7Fh
21	channel 1, upper limit, Low-Byte	FFh
22	channel 1, lower limit, High-Byte	80h
23	channel 1, lower limit, Low-Byte	00h
24	channel 2, upper limit, High-Byte	7Fh
25	channel 2, upper limit, Low-Byte	FFh
26	channel 2, lower limit, High-Byte	80h
27	channel 2, lower limit, Low-Byte	00h
28	channel 3, upper limit, High-Byte	7Fh
29	channel 3, upper limit, Low-Byte	FFh
30	channel 3, lower limit, High-Byte	80h
31	channel 3, lower limit, Low-Byte	00h

Diagnostic data   The diagnostic data have a size of 12Byte and are stored in the record sets 0 and 1 of the system data area.

As soon as you activated the alarm release in Byte 0 of the parameter area, in case of an error *record set 0* is transferred to the superordinated system.

Record set 0 has a fixed content and a length of 4Byte. The contents of *record set 0* may be monitored in plain text via the diagnosis window of the CPU.

For extended diagnostic purposes during runtime, you may evaluate the *record set 1* with a size of 12Byte via the SFCs 51 and 59.

Evaluate diagnosis   At a diagnostic task the CPU interrupts the user application and branches into OB82. With according programming, you may request in this OB with the SFCs 51 and 59 detailed diagnostic information and react on it.

After execution of the OB82, the processing of the user application is continued. The diagnostic data remains consistent until leaving the OB82.

Record set 0   *Byte 0 to 3:*

Record set 0 (Byte 0 to 3):

Byte	Bit 7 ... Bit 0	Default
0	Bit 0: error in module Bit 1: reserved Bit 2: external error Bit 3: channel error Bit 4 ... 6: reserved Bit 7: wrong parameter in module	00h
1	Bit 0 ... 3: module class 0101 analog module Bit 4: channel information present Bit 5 ... 7: reserved	15h
2	not used	00h
3	Bit 0 ... 5: reserved Bit 6: missing (lost) process alarm (see process alarm) Bit 7: reserved	00h

Record set 1   *Byte 0 to 11:*

Record set 1 contains the 4Byte of record set 0 and 8Byte module specific diagnostic data.

The diagnostic bytes have the following assignment:

Record set 1 (Byte 0 to 11):

Byte	Bit 7 ... Bit 0	Default
0 ... 3	content of record set 0 (see page above)	-
4	Bit 0 ... 6: channel type 　　　70h: digital input 　　　71h: analog input 　　　72h: digital output 　　　73h: analog output Bit 7: reserved	71h
5	Bit 0 ... 7: number of diagnostic output bits per channel	04h
6	Bit 0 ... 7: number of similar channels of a module	04h
7	Bit 0: channel error channel 0 Bit 1: channel error channel 1 Bit 2: channel error channel 2 Bit 3: channel error channel 3 Bit 4 ... 7: reserved	00h
8	Bit 0: reserved Bit 1: parameterization error channel 0 Bit 2 ... 4: reserved Bit 5: parameterization error channel 1 Bit 6, 7: reserved	00h
9	Bit 0: reserved Bit 1: parameterization error channel 2 Bit 2 ... 4: reserved Bit 5: parameterization error channel 3 Bit 6, 7: reserved	00h
10 ... 11	reserved	00h

Process alarm   The upper and the lower limit value is parameterizable for every channel. Please regard during parameterization that you have to enable the limit value monitoring in parameter byte 1.

If the signal is beyond the defined operation range, a process alarm is initialized. In the CPU, the process alarm block (OB40) is called.

The 4Byte of process alarm additional information are used as follows:

Process alarm additional information

Byte	Bit 7 ... Bit 0	Default
0	Bit 0: upper limit exceeded channel 0	00h
	Bit 1: upper limit exceeded channel 1	
	Bit 2: upper limit exceeded channel 2	
	Bit 3: upper limit exceeded channel 3	
	Bit 4 ... 7: reserved	
1	Bit 0: lower limit underrun channel 0	00h
	Bit 1: lower limit underrun channel 1	
	Bit 2: lower limit underrun channel 2	
	Bit 3: lower limit underrun channel 3	
	Bit 4 ... 7: reserved	
2	reserved	00h
3	reserved	00h

Note!

When a process alarm has not yet been acknowledged by the CPU and a new process alarm of the same type occurs at this channel, a diagnostic alarm is initialized, containing the information "Process alarm missing/lost" (diagnostic data Byte 3).

Technical data

Electrical data	VIPA 231-1FD00
Number of inputs	4 differential inputs
Cycle time (all channels)	< 1ms
measuring range	
- Voltage measuring	±400mV, ±4V, ±10V
- Current measuring	4...20mA, ±20mA
Input resistance	> 2MΩ (voltage range)
	< 57Ω (current range)
Power supply	5V via backplane bus
Current consumption	300mA via backplane bus
Isolation	500Vrms
	(field voltage - backplane bus)
Status indicators	via LEDs on the front
Programming specifications	
Input data	8Byte (1 word per channel)
Output data	-
Parameter data	32Byte
Diagnostic data	12Byte
Process alarm data	4Byte
Dimensions and weight	
Dimensions (WxHxD)	25.4x76x76mm
Weight	100g

AI 8x16Bit

Order data   AI 8x16Bit   VIPA 231-1BF00

Description   The analog input module transfers analog signals from the process into
                       digital signals for the internal processing.

                       As transducer you may connect thermo couplers type J, K, T and
                       resistance thermometer Pt100.

                       The modules has 8 inputs that you may configure in groups of two
                       channels individually.

Properties   • 8 analog inputs

                       • wire break detection

                       • resolution 15Bit + sign

Construction
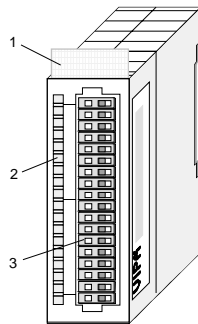
[1]   Label for the name of the
      module

[2]   LED status indicator

[3]   Edge connector

Status indicator
pin assignment

LED	Description		Pin	Assignment
F0...F7	LED (red): error for each channel		1	not connected
			2	pos. connection K.0
			3	Channel 0 common
SF	LED (red): sum error		4	pos. connection K.1
			5	Channel 1 common
			6	pos. connection K.2
			7	Channel 2 common
			8	pos. connection K.3
			9	Channel 3 common
			10	pos. connection K.4
			11	Channel 4 common
			12	pos. connection K.5
			13	Channel 5 common
			14	pos. connection K.6
			15	Channel 6 common
			16	pos. connection K.7
			17	Channel 7 common
			18	not connected
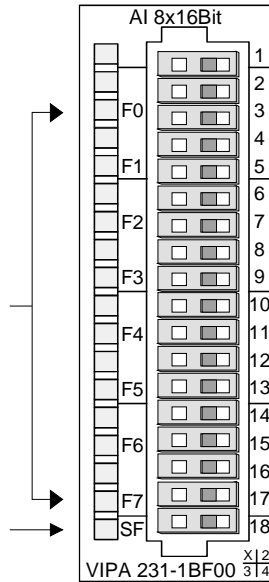
AI 8x16Bit

F0
F1
F2
F3
F4
F5
F6
F7
SF

VIPA 231-1BF00 X|2
3|4

1
2
3
4
5
6
7
8
9
10
11
12
13
14
15
16
17
18

Note!

Unused inputs on activated channels have to be connected to the respective ground. This is not necessary when the unused channels are turned off by means of FFh.

**Connection
diagram**
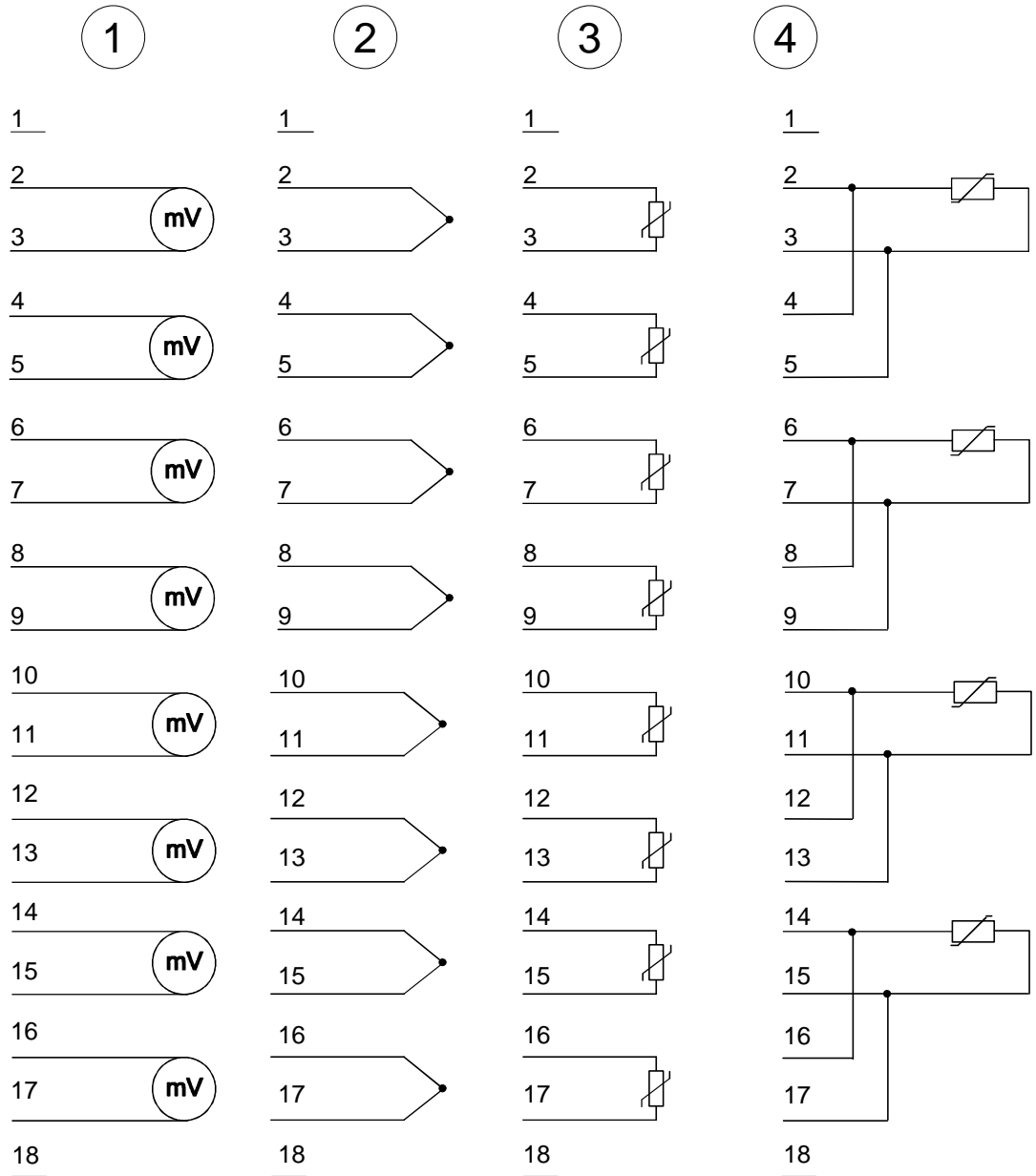
Function no. assignment

The assignment of a function no. to a certain channel happens during parameterization. The function no. 00h does not influence the function no. stored in the permanent parameterization data. Assigning FFh deactivates the according channel.

No.	Function	Measurement range / representation	Tolerance ref. to nominal range	Conn.
00h	Does not affect permanently stored configuration data			
01h	RTD Pt100 in two-wire mode	-200 .. +850°C **/** in units of 1/10°C, two's complement	[1][2][3] ±0.1%	(3)
61h	RTD Pt100 in two-wire mode	-328 .. 1562°F in units of 1/10°F, two's complement	[1][2][3] ±0.1%	(3)
09h	RTD Pt100 via four-wire connection	-200 .. +850°C **/** in units of 1/10°C, two's complement	[1][2] ±0.1%	(4)
69h	RTD Pt100 via four-wire connection	-328 .. 1562°F in units of 1/10°F, two's complement	[1][2] ±0.1%	(4)
10h	Thermo element type J, externally compensated	0 °C .. 1000 °C **/** in units of 1/10°C, two's complement	[1][2][4] ±0.1%	(2)
40h	Thermo element type J, externally compensated	32 .. 1832°F in units of 1/10°F, two's complement	[1][2][4] ±0.1%	(2)
11h	Thermo element type K, externally compensated	0 °C .. 1300 °C **/** in units of 1/10°C, two's complement	[1][2][4] ±0.1%	(2)
41h	Thermo element type K, externally compensated	32 .. 2372°F in units of 1/10°F, two's complement	[1][2][4] ±0.1%	(2)
14h	Thermo element type T, externally compensated	-200 °C .. +400 °C **/** in units of 1/10°C, two's complement	[1][2][4]-200..-60.1 ±0.5% -60...400 ±0,2%	(2)
44h	Thermo element type T, externally compensated	-328 .. 752°F in units of 1/10°F, two's complement	[1][2][4]-328...-76,1 ±0.5% -76...752 ±0,2%	(2)
18h	Thermo element type J, internally compensated	0 °C .. 1000 °C **/** in units of 1/10°C, two's complement	[1][2][5] ±1,0%	(2)
48h	Thermo element type J, internally compensated	32-1832°F in units of 1/10°F, two's complement	[1][2][5] ±1,0%	(2)
19h	Thermo element type K, internally compensated	0 °C .. 1300 °C **/** in units of 1/10°C, two's complement	[1][2][5] ±1,0%	(2)
49h	Thermo element type K, internally compensated	32-2372°F in units of 1/10°F, two's complement	[1][2][5] ±1,0%	(2)
1Ch	Thermo element type T, internally compensated	-200 °C .. +400 °C **/** in units of 1/10°C, two's complement	[1][2][5] ±2,0%	(2)
4Ch	Thermo element type T, internally compensated	-328 .. 752°F in units of 1/10°F, two's complement	[1][2][5] ±2,0%	(2)
26h	Voltage 0...60mV	0...60mV = nominal range (0-27648)	[1] ±0.1%	(1)
56h	Voltage 0...60mV	0...60mV = nominal range (0-6000) in units of 1/100mV	[1] ±0.1%	(1)
FFh	Channel not active (off)			

[1] measured at an ambient temperature of 25°C, velocity of 15 conversions/s

[2] excluding errors caused by transducer inaccuracies

[3] excluding errors caused by contact resistance and line resistance

[4] the compensation of the neutralization has to be implemented externally

[5] the compensation for the neutralization is implemented internally by including the temperature of the front plug. The thermal conductors have to be connected directly to the front plug, and where necessary these have to be extended by means of thermo element extension cables.

Measurement data acquisition

During a measurement, the data is stored in the data input area. The table above shows the allocation of the data to a measured value as well as the respective tolerance.

The following figures show the structure of the data input area:

Data input area:

Byte	Bit 7 ... Bit 0
0	High-Byte channel 0
1	Low-Byte channel 0
2	High-Byte channel 1
3	Low-Byte channel 1
4	High-Byte channel 2
5	Low-Byte channel 2
6	High-Byte channel 3
7	Low-Byte channel 3
8	High-Byte channel 4
9	Low-Byte channel 4
10	High-Byte channel 5
11	Low-Byte channel 5
12	High-Byte channel 6
13	Low-Byte channel 6
14	High-Byte channel 7
15	Low-Byte channel 7

Note!

Only channels 0, 2, 4 and 6 are used in four-wire systems.

Parameter data   You may configure the channels in groups of two individually. 10Byte are available for the configuration data. Configuration parameters are stored in permanent memory and they will be retained even if power is turned off.

The following table show the structure of the parameter area:

Parameter area:

Byte	Bit 7 ... Bit 0	Default
0	Diagnostic alarm byte: Bit 0: 0: wire break recognition channel 0/1 off 1: wire break recognition channel 0/1 on Bit 1: 0: wire break recognition channel 2/3 off 1: wire break recognition channel 2/3 on Bit 2: 0: wire break recognition channel 4/5 off 1: wire break recognition channel 4/5 on Bit 3: 0: wire break recognition channel 6/7 off 1: wire break recognition channel 6/7 on Bit 4, 5: reserved Bit 6: 0: diagnostic alarm inhibited 1: diagnostic alarm enabled Bit 7: reserved	0Fh
1	reserved	00h
2	Function no. channel 0/1 (see table)	26h
3	Function no. channel 2/3 (see table)	26h
4	Function no. channel 4/5 (see table)	26h
5	Function no. channel 6/7 (see table)	26h
6	Option Byte channel 0/1	00h
7	Option Byte channel 2/3	00h
8	Option Byte channel 4/5	00h
9	Option Byte channel 6/7	00h

Parameter   *Diagnostic alarm*

The diagnostic alarm is enabled by means of Bit 6 of Byte 0. In this case an error a 4Byte diagnostic message will be issued to the master system.

Function no.

Here you have to enter the function number of your measurement function for 2 channels. The allocation of the function number to a measurement function is available from the table above.

Option-Byte

Here you may specify for 2 channels the conversion rate.

Note!

Please note that the resolution is reduced when conversion rate is increased due to the shorter integration time.

The format of the data transfer remains the same. The only difference is that the lower set of bits (LSBs) loose significance for the analog value.

Structure of the option byte:

Byte	Bit 7 ... Bit 0	Resolution	Default
6 ... 9	Option byte:		00h
	Bit 0 ... 3: rate*		
	0000 15 conversions/s	16	
	0001 30.1 conversions/s	16	
	0010 60 conversions/s	15	
	0011 123.2 conversions/s	14	
	0100 168.9 conversions/s	12	
	0101 202.3 conversions/s	10	
	0110 3.76 conversions/s	16	
	0111 7.51 conversions/s	16	
	Bit 4 ... 7: reserved		

*) These specifications apply to 1channel operation. For multi-channel operations the conversion rate per channel can be calculated by dividing the specified conversion rate by the number of active channels.

Diagnostic data   The diagnostic data have a size of 12Byte and are stored in the record sets 0 and 1 of the system data area.

As soon as you activated the alarm release in Byte 0 of the parameter area, in case of an error *record set 0* is transferred to the superordinated system.

Record set 0 has a fixed content and a length of 4Byte. The contents of *record set 0* may be monitored in plain text via the diagnosis window of the CPU.

For extended diagnostic purposes during runtime, you may evaluate the *record set 1* with a size of 12Byte via the SFCs 51 and 59.

Evaluate diagnosis   At a diagnostic task the CPU interrupts the user application and branches into OB82. With according programming, you may request in this OB with the SFCs 51 and 59 detailed diagnostic information and react on it.

After execution of the OB82, the processing of the user application is continued. The diagnostic data remains consistent until leaving the OB82.

Record set 0   *Byte 0 to 3:*

Record set 0 (Byte 0 to 3):

Byte	Bit 7 ... Bit 0	Default
0	Bit 0: error in module Bit 1: reserved Bit 2: external error Bit 3: channel error Bit 4 ... 6: reserved Bit 7: wrong parameter in module	00h
1	Bit 0 ... 3: module class 0101 analog module Bit 4: channel information present Bit 5 ... 7: reserved	15h
2	not used	00h
3	Bit 0 ... 5: reserved Bit 6: missing (lost) process alarm (see process alarm) Bit 7: reserved	00h

Record set 1

Byte 0 to 11:

Record set 1 contains the 4Byte of record set 0 and 8Byte module specific diagnostic data.

The diagnostic bytes have the following assignment:

Record set 1 (Byte 0 to 11):

Byte	Bit 7 ... Bit 0	Default
0 ... 3	content of record set 0 (see page above)	-
4	Bit 0 ... 6: channel type 70h: digital input 71h: analog input 72h: digital output 73h: analog output Bit 7: reserved	71h
5	Bit 0 ... 7: number of diagnostic output bits per channel	04h
6	Bit 0 ... 7: number of similar channels of a module	04h
7	Bit 0: Channel error channel 0 Bit 1: Channel error channel 1 Bit 2: Channel error channel 2 Bit 3: Channel error channel 3 Bit 4: Channel error channel 4 Bit 5: Channel error channel 5 Bit 6: Channel error channel 6 Bit 7: Channel error channel 7	00h
8	Bit 0: Wire break channel 0 Bit 1: Parameterization error channel 0 Bit 2: Measuring range underflow channel 0 Bit 3: Measuring range overflow channel 0 Bit 4: Wire break channel 1 Bit 5: Parameterization error channel 1 Bit 6: Measuring range underflow channel 1 Bit 7: Measuring range overflow channel 1	00h
9	Bit 0: Wire break channel 2 Bit 1: Parameterization error channel 2 Bit 2: Measuring range underflow channel 2 Bit 3: Measuring range overflow channel 2 Bit 4: Wire break channel 3 Bit 5: Parameterization error channel 3 Bit 6: Measuring range underflow channel 3 Bit 7: Measuring range overflow channel 3	00h

... Continue Record set 1 (Byte 0 to 11)

Byte	Bit 7 ... Bit 0	Default
10	Bit 0: Wire break channel 4	00h
	Bit 1: Parameterization error channel 4	
	Bit 2: Measuring range underflow channel 4	
	Bit 3: Measuring range overflow channel 4	
	Bit 4: Wire break channel 5	
	Bit 5: Parameterization error channel 5	
	Bit 6: Measuring range underflow channel 5	
	Bit 7: Measuring range overflow channel 5	
11	Bit 0: Wire break channel 6	00h
	Bit 1: Parameterization error channel 6	
	Bit 2: Measuring range underflow channel 6	
	Bit 3: Measuring range overflow channel 6	
	Bit 4: Wire break channel 7	
	Bit 5: Parameterization error channel 7	
	Bit 6: Measuring range underflow channel 7	
	Bit 7: Measuring range overflow channel 7	

Technical data

Electrical data	VIPA 231-1BF00
Number of inputs	8
Input resistance	> 2MΩ
measuring range	
- Thermo element	Type J, K, T
- Resistance thermometer	Pt100
- Voltage measuring	0...60mV
Power supply	5V via backplane bus
Current consumption	280mA via backplane bus
Isolation	500Vrms
	(field voltage - backplane bus)
Dissipation power	typ. 1.3W
Status indicators	via LEDs on the front
Programming specifications	
Input data	16Byte (1 word per channel)
Output data	-
Parameter data	10Byte
Diagnostic data	12Byte
Process alarm data	-
Dimensions and weight	
Dimensions (WxHxD)	25.4x76x76mm
Weight	120g

Chapter 17   Analog output modules

Overview   This chapter contains a description of the construction and the operation of the VIPA analog output modules.

Below follows a description of:
- A system overview of the analog output modules
- Properties
- Constructions
- Interfacing and schematic diagram
- Technical data

Contents   **Topic**   **Page**

System overview

**Output modules
SM 232**

Here follows a summary of the analog output modules that are currently available from VIPA:
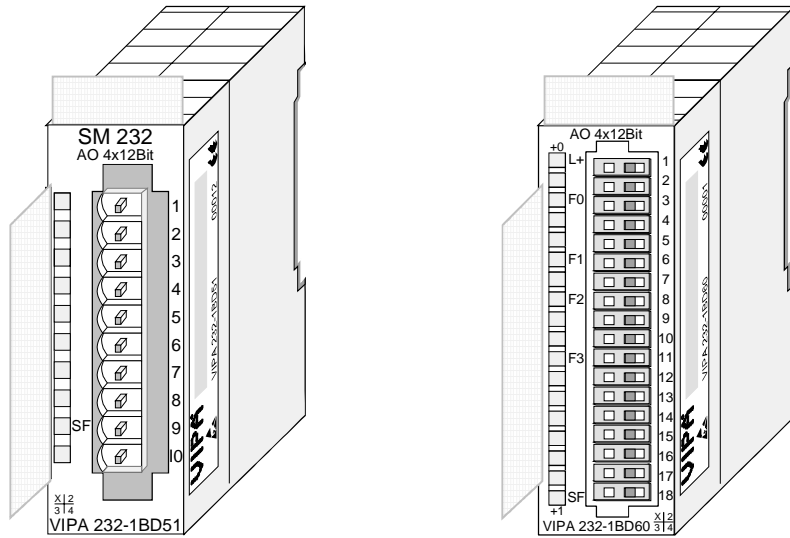
**Order data
output modules**

Type	Order number	Page
AO 4x12Bit, multi-output	VIPA 232-1BD51	17-4
AO 4x12Bit f, multi-output	VIPA 232-1BD60	17-13

General

Cabling for analog signals

You should only use screened twisted-pair cable when you are connecting analog signals. These cables reduce the effect of electrical interference. The screen of the analog signal cable should be grounded at both ends. In situations with different electrical potentials, it is possible that a current will flow to equalize the potential difference. This current could interfere with the analog signals. Under these circumstances it is advisable to ground the screen of the signal cable at one end only.

Connecting loads and actuators

Due to the fact that actuators also require a source of external power they may be connected to actuators by means of 2 wires or 4 wires. Where control signals are supplied to 2wire actuators a power supply has to be connected in series with the control cable. 4wire actuators are connected to an external power source.

Note!

Please ensure that you connect actuators to the correct polarity!

Unused output terminals are not connected!

Parameterization and diagnosis during runtime

By using the SFCs 55, 56 and 57 you may change the parameters of the analog modules during runtime via the CPU 21x.

For diagnosis evaluation during runtime, you may use the SFCs 51 and 59. They allow you to request detailed diagnosis information and to react to it.

AO 4x12Bit, Multi-output

Order data   AO 4x12Bit Multi-output   VIPA 232-1BD51

Description   This module provides 4 outputs that can be configured individually. The module occupies a total of 8Byte of output data (2Byte per channel) in the process image. These values have to be defined as left justified two's complement entries.

Galvanic isolation between the channels on the module and the backplane bus is provided by means of DC/DC converters and optocouplers. The module requires an external supply of DC 24V.

Properties
- 4 outputs with common ground
- Outputs with individually configurable functions
- Suitable for connection to actuators requiring ±10V, 1 ... 5V, 0 … 10V, ±20mA, 4 … 20mA or 0 ... 20mA inputs
- Diagnostic LED and diagnostic function
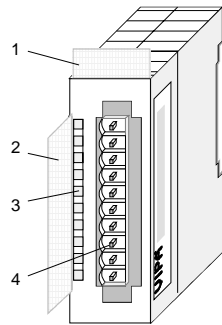
Construction

[1]   Label for the name of the module
[2]   Label for the bit address with description
[3]   LED status indicator
[4]   Edge connector

Status indicator pin assignment

LED	Description		Pin	Assignment
SF	Diagnostic LED (red) turned on by:		1	DC 24V supply voltage
			2	+ Channel 0
	- a short circuit is detected at the control voltage output		3	Channel 0 common
			4	+ Channel 1
	- an open circuit is detected on the current output line		5	Channel 1 common
			6	+ Channel 2
	- wrong parameter at module		7	Channel 2 common
			8	+ Channel 3
	- the module does not receive supply voltage		9	Channel 3 common
			10	Supply voltage common
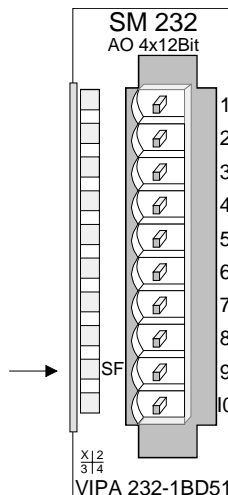
**Wiring and
schematic
diagram**

Wiring diagram
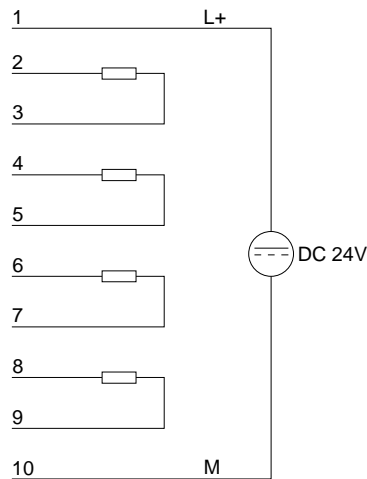
Schematic diagram
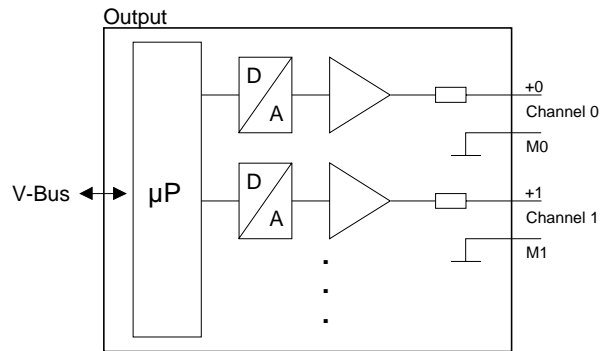
**Function no.
allocation**

No.	Function	Output range
00h	Does not affect permanently stored configuration data	
01h	Voltage ±10V Siemens S5-format (two's complement)	±12.5V 12.5V = max. value before over range (20480) -10...10V = rated range (-16384...16384) -12.5V = min. value before under range (-20480)
02h	Voltage 1...5V Siemens S5-format (two's complement)	0...6V 6V = max. value before over range (20480) 1...5V = rated range (0...16384) 0V = min. value before under range (-4096)
05h	Voltage 0...10V Siemens S5-format (two's complement)	0...12.5V 12.5V = max. value before over range (20480) 0...10V = rated range (0...16384) no under range available
09h	Voltage ±10V Siemens S7-format (two's complement)	±11.76V 11.76V= max. value before over range (32511) -10V...10V = rated range (-27648...27648) -11.76 = min. value before under range (-32512)
0Ah	Voltage 1...5V Siemens S7-format (two's complement)	0...5.704V 5.704V = max. value before over range (32511) 1...5V = rated range (0...27648) 0V = min. value before under range (-6912)
0Dh	Voltage 0...10V Siemens S7-format (two's complement)	0...11.76V 11.76V = max. value before over range (32511) 0...10V = rated range (0...27648) no under range available

... continue

No.	Function	Output range
03h	Current ±20mA Siemens S5-format (two's complement)	±25mA 25mA = max. value before over range (20480) -20...20mA = rated range (-16384...16384) -25mA = min. value before under range (-20480)
04h	Current 4...20mA Siemens S5-format (two's complement)	0...24mA 24mA = max. value before over range (20480) 4...20mA = rated range (0...16384) 0mA = min. value before under range (-4096)
06h	Current 0...20mA Siemens S5-format (two's complement)	0...25mA 25mA = max. value before over range (20480) 0...20mA = rated range (0...16384) no under range available
0Bh	Current ±20mA Siemens S7-format (two's complement)	±23.52mA 23.52mA = max. value before over range (32511) -20...20mA = rated range (-27648...27648) -23.52mA = min. value before under range (-32512)
0Ch	Current 4...20mA Siemens S7-format (two's complement)	0...22.81mA 22.81mA = max. value before over range (32511) 4...20mA = rated range (0...27648) 0mA = min. value before under range (-6912)
0Eh	Current 0...20mA Siemens S7-format (two's complement)	0...23.52mA 23.52mA = max. value before over range (32511) 0...20mA = rated range (0...27648) no under range available
FFh	Channel not active (turned off)	

Note!

- The module is preset to the range "±10V voltage" in S7-format from Siemens.
- When cross over or underdrive range all modes return the value 0.

Numeric notation in Siemens S5-format

In Siemens S5-format, input data is saved in a word. The word consists of the binary value and the information bits.

Numeric notation:

Byte	Bit 7 ... Bit 0
0	Bit 0: overflow bit 0: value within measuring range 1: measuring range exceeded Bit 1: error bit (set by internal errors) Bit 2: activity bit (always 0) Bit 3 ... 7: binary measured value
1	Bit 0 ... 6: binary measured value Bit 7: sign 0 positive 1 negative

+/- 10V

Voltage	Decimal	Hex
-10V	-16384	C000
-5V	-8192	E000
0V	0	0
5V	8192	2000
10V	16384	4000

Formulas for the calculation:

$$Value = 16384 \cdot \frac{U}{10}, \quad U = Value \cdot \frac{10}{16384}$$

U: voltage, Value: decimal value

0...10V

Voltage	Decimal	Hex
0V	0	0000
5V	8192	2000
10V	16384	4000

Formulas for the calculation:

$$Value = 16384 \cdot \frac{U}{10}, \quad U = Value \cdot \frac{10}{16384}$$

U: voltage, Value: decimal value

1...5V

Voltage	Decimal	Hex
1V	0	0
3V	8192	2000
5V	16384	4000

Formulas for the calculation:

$$Value = 16384 \cdot \frac{U-1}{4}, \quad U = Value \cdot \frac{4}{16384} + 1$$

U: voltage, Value: decimal value

4....20mA

Current	Decimal	Hex
4mA	0	0
12mA	8192	2000
20mA	16384	4000

Formulas for the calculation:

$$Value = 16384 \cdot \frac{I-4}{16}, \quad I = Value \cdot \frac{16}{16384} + 4$$

I: current, Value: decimal value

+/- 20mA

Current	Decimal	Hex
-20mA	-16384	C000
-10mA	-8192	E000
0mA	0	0
10mA	8192	2000
20mA	16384	4000

Formulas for the calculation:

$$Value = 16384 \cdot \frac{I}{20}, \quad I = Value \cdot \frac{20}{16384}$$

I: current, Value: decimal value

0...20mA

Current	Decimal	Hex
0mA	0	0
10mA	8192	2000
20mA	16384	4000

Formulas for the calculation:

$$Value = 16384 \cdot \frac{I}{20}, \quad I = Value \cdot \frac{20}{16384}$$

I: current, Value: decimal value

Numeric notation in Siemens S7-format   The analog values is represented in two's complement format.

Numeric representation:

Byte	Bit 7 ... Bit 0
0	Bit 0 ... 7: binary measured vale
1	Bit 0 ... 6: binary measured vale Bit 7: sign 0 positive 1 negative

+/- 10V

Voltage	Decimal	Hex
-10V	-27648	9400
-5V	-13824	CA00
0V	0	0
5V	13824	3600
10V	27648	6C00

Formulas for the calculation:

$$Value = 27648 \cdot \frac{U}{10}, \quad U = Value \cdot \frac{10}{27648}$$

U: voltage, Value: decimal value

0...10V

Voltage	Decimal	Hex
0V	0	0000
5V	13824	3600
10V	27648	6C00

Formulas for the calculation:

$$Value = 27648 \cdot \frac{U}{10}, \quad U = Value \cdot \frac{10}{27648}$$

U: voltage, Value: decimal value

1...5V

Voltage	Decimal	Hex
1V	0	0
3V	13824	3600
5V	27648	6C00

Formulas for the calculation:

$$Value = 27648 \cdot \frac{U-1}{4}, \quad U = Value \cdot \frac{4}{27648} + 1$$

U: voltage, Value: decimal value

4....20mA

Current	Decimal	Hex
4mA	0	0
12mA	13824	3600
20mA	27648	6C00

Formulas for the calculation:

$$Value = 27648 \cdot \frac{I-4}{16}, \quad I = Value \cdot \frac{16}{27648} + 4$$

I: current, Value: decimal value

+/- 20mA

Current	Decimal	Hex
-20mA	-27648	9400
-10mA	-13824	CA00
0mA	0	0
10mA	13824	3600
20mA	27648	6C00

Formulas for the calculation:

$$Value = 27648 \cdot \frac{I}{20}, \quad I = Value \cdot \frac{20}{27648}$$

I: current, Value: decimal value

0...20mA

Current	Decimal	Hex
0mA	0	0
10mA	13824	3600
20mA	27648	6C00

Formulas for the calculation:

$$Value = 27648 \cdot \frac{I}{20}, \quad I = Value \cdot \frac{20}{27648}$$

I: current, Value: decimal value

Data output

The value of the output data is entered into the data output area. For every channel you may configure the relationship between the output value and the respective current or voltage by means of a function no.

The following table shows the structure of the data output area:

Data output area:

Byte	Bit 7 ... Bit 0
0	High-Byte channel 0
1	Low-Byte channel 0
2	High-Byte channel 1
3	Low-Byte channel 1
4	High-Byte channel 2
5	Low-Byte channel 2
6	High-Byte channel 3
7	Low-Byte channel 3

Note!

When new values are transferred from the CPU to the module, the module needs one cycle to update all outputs abbr. if the analog values change within this cycle, these are at least available at the concerning outputs at the end of the next following cycle.

Parameter data

6Byte of parameter data are available for the configuration data. These parameters are stored in non-volatile memory and are available after the unit has been powered off.

The following table shows the structure of the parameter data:

Parameter area:

Byte	Bit 7 ... Bit 0
0	Diagnostic alarm byte: Bit 0 ... 5: reserved Bit 6: 0: diagnostic alarm inhibited 1: diagnostic alarm enabled Bit 7: reserved
1	reserved
2	Function-no. channel 0
3	Function-no. channel 1
4	Function-no. channel 2
5	Function-no. channel 3

Parameter   *Diagnostic alarm*

You can enable diagnostic alarms by means of Bit 6 of Byte 0. When an error occurs 4 diagnostic bytes are transmitted to the master system.

Function no.

Here you enter the function no. of the output function for every channel. The relationship between the function number and the output functions is available from the function no. allocation table.

Diagnostic data   When you enable alarms in Byte 0 of the parameter area, modules will transfer 4 diagnostic bytes with pre-defined contents to your master in case of an error. Please note that analog modules only use the first two bytes for diagnostic purposes. The remaining bytes are not used.

The structure of the diagnostic bytes is as follows:

Diagnostic data:

Byte	Bit 7 ... Bit 0
0	Bit 0: Module malfunction
	Bit 1: reserved
	Bit 2: External error
	Bit 3: Channel error present (wire break/short circuit)
	Bit 4 ... 6: reserved
	Bit 7: Wrong parameter at module
1	Bit 0 ... 3: class of module
	0101 analog module
	Bit 4: channel information available
	Bit 5 ... 7: reserved
2	not assigned
3	not assigned

Technical data

Electrical data	VIPA 232-1BD51
Number of output channels	4
Supply voltage	DC 24V
- Inverse polarity protection	yes
Potential separation	
- between channels and backplane bus	yes
Isolation proofed with	500Veff
Current consumption	
- via backplane bus	max. 70mA
- from load voltage L+ (without load)	max. 60mA
Short circuit current	30mA
Analog value calculation output channels	
Resolution (incl. Overdrive region)	
±10V, ±20mA	11Bit + sign
4 ... 20mA, 1 ... 5V	10Bit
0 ... 10V, 0 ... 20mA	11Bit
Cycle time	450µs
Boot time	
- impedance load	0.05ms
- capacitive load	0.5ms
- inductive load	0.1ms
Error limits output channels	
Usage error limit (whole temperature range, referring to input range)	
±10V	0.2%
0 ... 10V	0.4%
1 ... 5V	0.5%
±20mA	0.3%
0 ... 20mA	0.6%
4 ... 20mA	0.7%
Data for choosing an actuator	
Burden resistance (in nominal range of the output)	
at voltage outputs	
- impedance load	min. 1kΩ
- capacitive load	max. 1µF
at current outputs	
- impedance load	max. 500Ω
- capacitive load	max. 10mH

...Continue Technical Data

... Continue Technical Data

States, Alarms, Diagnosis	
Diagnosis alarm	parameterizable
Diagnosis functions	parameterizable
Sum error monitor	red LED SF
Diagnostic information readable	possible
Programming specifications	
Input data	-
Output data	8Byte (1 word per channel)
Parameter data	6Byte
Diagnostic data	4Byte
Dimensions and weight	
Dimensions (WxHxD)	25.4x76x76mm
Weight	100g

AO 4x12Bit f, multioutput

Order data   AO 4x12Bit f multioutput   VIPA 232-1BD60

Description   This module provides 4 outputs that may be configured individually. The module occupies a total of 8Byte of output data (2Byte per channel) in the process image.

Galvanic isolation between the channels on the module and the backplane bus is provided by means of DC/DC converters and optocouplers. The module requires an external supply of DC 24V.

Properties
- Using all 4 channels, the cycle time is < 600µs
- 4 outputs with common grounds
- Outputs with individually configurable functions
- Suitable for actuators requiring ±10V, 0 … 10V, -10V ... 0, 0 ... 20mA inputs
- Diagnostic LED and diagnostic function
- Resolution 12Bit

Construction
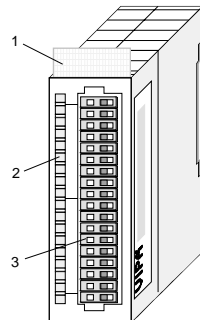
[1]   Label for the name of the module
[2]   LED status indicator
[3]   Edge connector

**Status indicator
pin assignment**

LED	Description
L+	LED (yellow) Supply voltage available
F0...F3	LED (green) for active channel
SF	LED (red) collective indication error

AO 4x12Bit

+0

L+

F0

F1

F2

F3

SF

+1

VIPA 232-1BD60
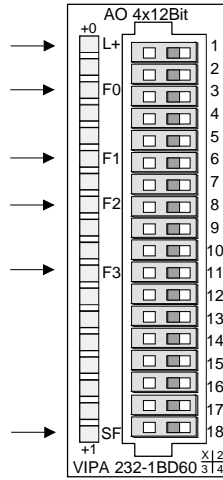
Pin	Assignment
1	DC 24V supply voltage
2	+ Channel 0
3	Channel 0 common
4	Screen Channel 0, 1
5	+ Channel 1
6	Channel 1 common
7	+ Channel 2
8	Channel 2 common
9	Screen Channel 2, 3
10	+ Channel 3
11	Channel 3 common
12...17	not connected
18	Supply voltage common

**Wiring and
schematic
diagram**

Wiring diagram

Schematic diagram

Function no. allocation

The assignment of a function no. to a certain channel happens during parameterization. The function no. 00h does not influence the function no. stored in the permanent parameterization data.

Assigning FFh deactivates the according channel.

No.	Function	Output range
00h	Does not affect permanently stored configuration data	
01h	Voltage ±10V Siemens S5-format	±12.5V 12.5V = max. value before over range (20480) -10...10V = rated range (-16384...16384) -12.5V = min. value before under range (-20480)
05h	Voltage 0...10V Siemens S5-format	0...12.5V 12.5V = max. value before over range (20480) 0...10V = rated range (0...16384) no under range available
06h	Current 0...20mA Siemens S5-format	0...25mA 25mA = max. value before over range (20480) 0...20mA = rated range (0...16384) no under range available
07h	Voltage -10...0V Siemens S5-format	-12.5V...0V -12.5V = min. value before under range (-20480) -10V...0 = rated range (-16384...0) no over range available
09h	Voltage ±10V Siemens S7-format (two's complement)	±11.76V 11.76V= max. value before over range (32511) -10V...10V = rated range (-27648...27648) -11.76 = min. value before under range (-32512)
0Dh	Voltage 0...10V Siemens S7-format (two's complement)	0...11.76V 11.76V = max. value before over range (32511) 0...10V = rated range (0...27648) no under range available
0Eh	Current 0...20mA Siemens S7-format (two's complement)	0...23.52mA 23.52mA = max. value before over range (32511) 0...20mA = rated range (0...27648) no under range available
0Fh	Voltage -10V...0V Siemens S7-format (two's complement)	-11.76V...0V -11.76V = min. value before under range (-32512) -10V...0 = rated range (-27648...0) no over range available
FFh	Channel not active (turned off)	

Note!

In all modes the value is 0 when over range or under range occurs.

The internal resistance of calibration for voltage ranges is 2.7 kΩ.

The internal resistance of calibration for current ranges is 35 Ω.

The module is at factory preset to the range "±10V voltage" in S7-format from Siemens.

Numeric notation in Siemens S5 format

In Siemens S5 format, input data is saved into a word. The word consists of the binary value and the information bits.

Numeric notation:

Byte	Bit 7 ... Bit 0
0	Bit 0: overflow bit 0: value within measuring range 1: measuring range exceeded Bit 1: error bit (set by internal errors) Bit 2: activity bit (always 0) Bit 3 ... 7: binary measured value
1	Bit 0 ... 6: binary measured value Bit 7: sign 0 positive 1 negative

+/- 10V

Voltage	Decimal	Hex
-10V	-16384	C000
-5V	-8192	E000
0V	0	0
5V	8192	2000
10V	16384	4000

Formulas for the calculation:

$$Value = 16384 \cdot \frac{U}{10}, \quad U = Value \cdot \frac{10}{16384}$$

U: voltage, Value: decimal value

0...10V

Voltage	Decimal	Hex
0V	0	0000
5V	8192	2000
10V	16384	4000

Formulas for the calculation:

$$Value = 16384 \cdot \frac{U}{10}, \quad U = Value \cdot \frac{10}{16384}$$

U: voltage, Value: decimal value

-10...0V

Voltage	Decimal	Hex
-10V	-16384	C000
-5V	-8192	E000
0V	0	0000

Formulas for the calculation:

$$Value = 16384 \cdot \frac{U}{10}, \quad U = Value \cdot \frac{10}{16384}$$

U: voltage, Value: decimal value

0....20mA

Current	Decimal	Hex
0mA	0	0
10mA	8192	2000
20mA	16384	4000

Formulas for the calculation:

$$Value = 16384 \cdot \frac{I-4}{16}, \quad I = Value \cdot \frac{16}{16384} + 4$$

I: current, Value: decimal value

Numeric notation in Siemens S7 format

The analog values is represented in two's complement format.

Numeric representation:

Byte	Bit 7 ... Bit 0
0	Bit 0 ... 7: binary measured vale
1	Bit 0 ... 6: binary measured vale
	Bit 7: sign
	0 positive
	1 negative

+/- 10V

Voltage	Decimal	Hex
-10V	-27648	9400
-5V	-13824	CA00
0V	0	0
5V	13824	3600
10V	27648	6C00

Formulas for the calculation:

$$Value = 27648 \cdot \frac{U}{10}, \quad U = Value \cdot \frac{10}{27648}$$

U: voltage, Value: decimal value

0...10V

Voltage	Decimal	Hex
0V	0	0000
5V	13824	3600
10V	27648	6C00

Formulas for the calculation:

$$Value = 27648 \cdot \frac{U}{10}, \quad U = Value \cdot \frac{10}{27648}$$

U: voltage, Value: decimal value

-10...0V

Voltage	Decimal	Hex
-10V	-27648	9400
-5V	-13824	CA00
0V	0	0000

Formulas for the calculation:

$$Value = 27648 \cdot \frac{U-1}{4}, \quad U = Value \cdot \frac{4}{27648} + 1$$

U: voltage, Value: decimal value

0....20mA

Current	Decimal	Hex
0mA	0	0
10mA	13824	3600
20mA	27648	6C00

Formulas for the calculation:

$$Value = 27648 \cdot \frac{I-4}{16}, \quad I = Value \cdot \frac{16}{27648} + 4$$

I: current, Value: decimal value

Data output   The value of the output data has to be entered into the data output area. For every channel you may configure the relationship between the output value and the respective current or voltage by means of a function no.

The following table shows the structure of the data output area:

Data output area:

Byte	Bit 7 ... Bit 0
0	High-Byte channel 0
1	Low-Byte channel 0
2	High-Byte channel 1
3	Low-Byte channel 1
4	High-Byte channel 2
5	Low-Byte channel 2
6	High-Byte channel 3
7	Low-Byte channel 3

Parameter data   6Byte of parameter data are available for the configuration. These parameters are stored in non-volatile memory and are available after the unit has been powered off.

The following table shows the structure of the parameter data:

Parameter area:

Byte	Bit 7 ... Bit 0
0	Diagnostic alarm byte: Bit 0 ... 5: reserved Bit 6: 0: diagnostic alarm inhibited 1: diagnostic alarm enabled Bit 7: reserved
1	reserved
2	Function no. channel 0
3	Function no. channel 1
4	Function no. channel 2
5	Function no. channel 3

Parameter   *Diagnostic alarm*

You enable diagnostic alarms by means of Bit 6 of Byte 0. When an error occurs, 4 diagnostic bytes are transmitted to the master system.

Function no.

Here you enter the function no. of the output function for every channel. The relationship between the function number and the output functions is available from the function no. allocation table.

Diagnostic data   When you enable alarms in Byte 0 of the parameter area, modules will transfer 4 diagnostic bytes with pre-defined contents to your master if an error occurs. Please note that analog modules only use the first two bytes for diagnostic purposes. The remaining two bytes are not used.

The structure of the diagnostic bytes is as follows:

Diagnostic data:

Byte	Bit 7 ... Bit 0	Default
0	Bit 0: Module malfunction	-
	Bit 1: Constant 0	
	Bit 2: External error	
	Bit 3: Channel error present	
	Bit 4: External auxiliary supply error	
	Bit 5: Open circuit of current out	
	Short circuit of voltage out	
	Bit 6: reserved	
	Bit 7: Wrong parameter at the module	
1	Bit 0 ... 3: class of module	-
	0101 analog module	
	Bit 4: channel information available	
2	not assigned	-
3	not assigned	-

Technical data

Electrical data	VIPA 232-1BD60
Number of outputs	4
Cycle time (all 4 channel)	< 600µs
Voltage range	±10V, 0 ... 10V, -10V ... 0V
Current range	0 ... 20mA
Actuator resistance	min. 500Ω (voltage range)
	max. 500Ω (current range)
Short circuit current	30mA
Power supply	5V via backplane bus
	24V ±20% externally
Current consumption	via backplane bus: 50mA
	DC 24V externally: 200mA
Isolation	500Vrms
	(field voltage - backplane bus)
Status indicators	via LEDs on the front
Programming specifications	
Input data	-
Output data	8Byte (1 word per channel)
Parameter data	6Byte
Diagnostic data	4Byte
Dimensions and weight	
Dimensions (WxHxD)	25.4x76x76mm
Weight	100g

Chapter 18   Analog input/output modules

Overview   This chapter contains a description of the construction and the operation of the VIPA analog input/output modules.

Below follows a description of:
- A system overview of the analog input/output modules
- Properties
- Construction
- Wiring and schematic diagram
- Parameter data
- Function number allocation
- Technical data

System overview

Input/output modules SM 234

Here follows a summary of the analog input/output modules that are currently available from VIPA:
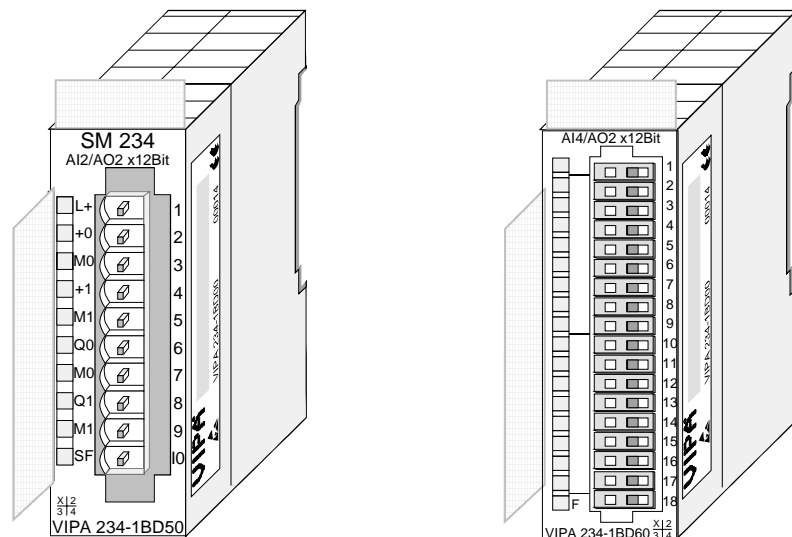
Order data input/output modules

Type	Order number	Page
AI2/AO 2x12Bit, multiin-/output	VIPA 234-1BD50	18-4
AI4/AO 2x12Bit, multiin-/output	VIPA 234-1BD60	18-19

Security note for range allocation

Attention!

Please regard that the described modules have no hardware protection against wrong parameterization. The allocation of the according measuring res. output range is only during project engineering.

For example, the modules may be damaged when you connect a voltage at parameterized current measuring.

Please be extremely careful during project engineering.

General

Cabling for analog signals

You should only use screened twisted-pair cable for analog signals. These cables reduce the effect of electrical interference. The screen of the analog signal cable should be grounded at both ends. In situations where the cable ends are at different electrical potentials, it is possible that a current will flow to equalize the potential difference. This current could interfere with the analog signals. Under these circumstances it is advisable to ground the screen of the signal cable at one end only.

Connecting transducers

Our analog modules provide a large number of configuration options suitable for 2wire and 4wire transducers. Please remember that transducers require an external power source. You have to connect an external power supply in line with any 2wire transducer.

The following diagram explains the connection of 2- and 4wire transducers:

2wire interfacing

4wire interfacing

Connecting loads and actuators

Due to the fact that actuators also require a source of external power, they may also be connected with 2 or 4 wires. Where control signals are supplied to 2wire actuators a power supply has to be connected in series with the control cable. 4wire actuators need an external power source.

Note!

Please ensure that you connect actuators to the correct polarity!

Unused output terminals must not be connected!

Parameterization and diagnosis during runtime

By using the SFCs 55, 56 and 57 you may change the parameters of the analog modules during runtime via the CPU 21x.

For diagnosis evaluation during runtime, you may use the SFCs 51 and 59. They allow you to request detailed diagnosis information and to react to it.

AI 2/AO 2x12Bit - Multiin-/output

Order data   AI 2/AO 2x12Bit Multiin-/output   VIPA 234-1BD50

Description   This module has 2 analog inputs and 2 analog outputs that may be
                        configured individually. The module occupies a total of 4Byte of input and
                        4Byte of output data.

                        Galvanic isolation between the channels on the module and the backplane
                        bus is provided by means of DC/DC converters and optocouplers. The
                        module requires an external supply of DC 24V.

Properties   • 2 inputs and 2 outputs with common ground

                        • In-/Outputs with individually configurable functions

                        • Suitable for encoder res. actuators with in- res. output ranges of:
                          ±10V, 1...5V, 0...10V, ±20mA, 0...20mA or 4...20mA

                        • Diagnostic LED

Construction

[1]   Label for the name of
      the module

[2]   Label for the bit address
      with description

[3]   LED status indicator

[4]   Edge connector

**Status indicator
Pin assignment**

LED	Description		Pin	Assignment
			1	DC 24V supply voltage
L+	LED (yellow)		1	DC 24V supply voltage
	Supply voltage present		2	pos. connection E.0
			3	Ground Channel 0
			4	pos. connection E.1
			5	Ground Channel 1
SF	Sum error LED (red)		6	pos. connection A.2
	turned on as soon as an		7	Ground Channel 2
	channel error is detected		8	pos. connection A.3
	res. an entry in the		9	Ground Channel 3
	diagnostic bytes happened		10	Supply voltage Ground

Circuit and schematic diagram
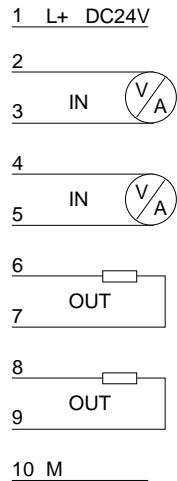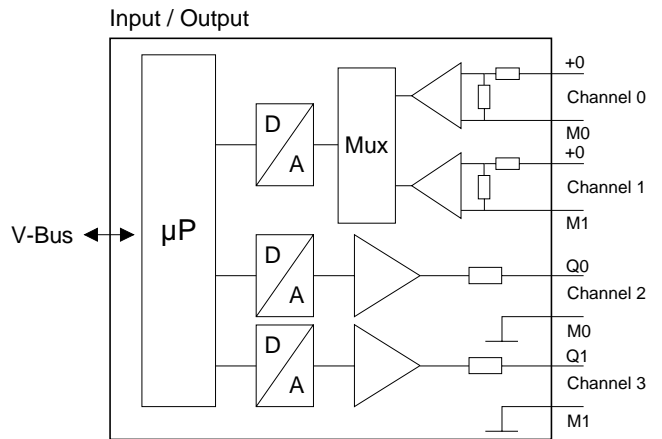
Circuit diagram

1   L+   DC24V

2

3   IN   (V/A)

4

5   IN   (V/A)

6

7   OUT

8

9   OUT

10 M

Schematic diagram

Input / Output

μP — V-Bus

D/A   Mux

+0
Channel 0
M0
+0
Channel 1
M1

D/A

Q0
Channel 2
M0

D/A

Q1
Channel 3
M1

Attention!

Temporarily not used inputs have to be connected with the concerning ground at activated channel. When deactivating unused channels by means of FFh, this is not required.

Note!

Every channel is individually parameterizable. For the parameterization 12Byte parameterization data are available. They are stored permanently and remain in memory during power-off.

**Function no.
assignment
Input range
(channel 0, ch. 1)**

The assignment of a function no. to a certain channel happens during parameterization. The function no. 00h does not influence the function no. stored in the permanent parameterization data.

Assigning FFh deactivates the according channel.

Note!

When exceeding the overdrive region, the value 7FFFh (32767) is thrown, at underrun of the underdrive region the value is 8000h (-32768).

No.	Function	Measuring range / representation
00h	Does not affect permanently stored configuration data.	
3Bh	Voltage ±10V Siemens S5-format	±12.5V **/** 12.5V = End overdrive region (20480) -10...10V = nominal range (-16384...16384) -12.5V = End underdrive region (-20480) two's complement
2Bh	Voltage ±10V Siemens S5-format	±12.5V **/** 12.5V = End overdrive region (20480) -10...10V = nominal range (-16384...16384) -12.5V = End underdrive region (-20480) Value and sign
72h	Voltage 1...5V Siemens S5-format	0...6V 6V = End overdrive region (20480) 1...5V = nominal range (0...16384) 0V = End underdrive region (-4096) Value and sign
75h	Voltage 0...10V Siemens S5-format	0...12.5V 12.5V = End overdrive region (20480) 0...10V = nominal range (0...16384) no underdrive region available
28h	Voltage ±10V Siemens S7-format	±11.76V **/** 11.76V= End overdrive region (32511) -10...10V= nominal range (-27648...27648) -11.76V= End underdrive region (-32512) two's complement
7Ah	Voltage 1...5V Siemens S7-format	0...5.704V 5.704V = End overdrive region (32511) 1...5V = nominal range (0...27648) 0V = End underdrive region (-6912) two's complement

... continue function no. input channel 0, 1

7Dh	Voltage 0...10V Siemens S7-format	0...11.76V 11.76V= End overdrive region (32511) 0...10V = nominal range (0...27648) no underdrive region available
3Ah	Current ±20mA Siemens S5-format	±25.0mA **/** 25.0mA = End overdrive region (20480) -20...20mA = nominal range (-16384...16384) -25.0mA = End underdrive region (-20480) two's complement
2Fh	Current ±20mA Siemens S5-format	±25.0mA **/** 25.0mA = End overdrive region (20480) -20...20mA = nominal range (-16384...16384) -25.0mA = End underdrive region (-20480) value and sign
2Eh	Current 4...20mA Siemens S5-format	0.8...+24.0mA **/** 24.0mA = End overdrive region(20480) 4 ... 20mA = nominal range (0...16384) 0.8mA = End underdrive region (-3277) value and sign
76h	Current 0...20mA Siemens S5-format	0...25mA 25mA = End overdrive region (20480) 0...20mA = nominal range (0...16384) no underdrive region available
2Ch	Current ±20mA Siemens S7-format	±23.51mA **/** 23.51mA = End overdrive region (32511) -20...20mA = nominal range (-27648...27648) -23.51mA = End underdrive region (-32512) two's complement
2Dh	Current 4...20mA Siemens S7-format	1.185...+22.81mA **/** 22.81mA = End overdrive region (32511) 4...20mA = nominal range (0...27648) 1.18mA = End underdrive region (-4864) two's complement
7Eh	Current 0...20mA Siemens S7-format	0...23.52mA 23.52mA = End overdrive region (32511) 0...20mA = nominal range (0...27648) no underdrive region available
FFh	Channel not active (turned off)	

Note!

The module is preset to the range "±10V voltage" in S7-format from Siemens.

Function no. assignment output range Channel 2, Ch. 3

The assignment of a function no. to a certain channel happens during parameterization. The function no. 00h does not influence the function no. stored in the permanent parameterization data.

Assigning FFh deactivates the according channel.

Note!

When exceeding the predefined range, 0V res. 0A is shown as value!

No.	Function	Output or input range
00h	Does not affect permanently stored configuration data	
01h	Voltage ±10V Siemens S5-format	±12.5V 12.5V = End overdrive region (20480) -10...10V = nominal range (-16384...16384) -12.5V = End underdrive region (-20480)
02h	Voltage 1...5V Siemens S5-format	0...6V 6V = End overdrive region (20480) 1...5V = nominal range (0...16384) 0V = End underdrive region (-4096)
05h	Voltage 0...10V Siemens S5-format	0...12.5V 12.5V = End overdrive region (20480) 0...10V = nominal range (0...16384) no underdrive region available
09h	Voltage ±10V Siemens S7-format	±11.76V 11.76V= End overdrive region (32511) -10V...10V = nominal range (-27648...27648) -11.76 = End underdrive region (-32512) two's complement
0Ah	Voltage 1...5V Siemens S7-format	0...5.704V 5.704V = End overdrive region (32511) 1...5V = nominal range (0...27648) 0V = End underdrive region (-6912) two's complement
0Dh	Voltage 0...10V Siemens S7-format	0...11.76V 11.76V= End overdrive region (32511) 0...10V = nominal range (0...27648) no underdrive region available
03h	Current ±20mA Siemens S5-format	±25.0mA 25mA = End overdrive region (20480) -20...20mA = nominal range (-16384...16384) -25mA = End underdrive region (20480)
04h	Current 4...20mA Siemens S5-format	0...24mA 24mA = End overdrive region (20480) 4...20mA = nominal range (0...16384) 0mA = End underdrive region (-4096)

... continue function no. output channel 2, 3

06h	Current 0...20mA Siemens S5-format	0...25mA 25mA = End overdrive region (20480) 0...20mA = nominal range (0...16384) no underdrive region available
0Bh	Current ±20mA Siemens S7-format	±23.52mA 23.52mA = End overdrive region (32511) -20...20mA = nominal range (-27648...27648) -23.52mA = End underdrive region (-32512) two's complement
0Ch	Current 4...20mA Siemens S7-format	0...22.81mA 22.81mA = End overdrive region (32511) 4...20mA = nominal range (0...27648) 0mA = End underdrive region (-6912) two's complement
0Eh	Current 0...20mA Siemens S7-format	0...23.52mA 23.52mA = End overdrive region (32511) 0...20mA = nominal range (0...27648) no underdrive region available
FFh	Channel not active (turned off)	

Numeric notation in Siemens S5 format

In Siemens S5 format, input data is saved into a word. The word consists of the binary value and the information bits.

Numeric notation:

Byte	Bit 7 ... Bit 0
0	Bit 0: overflow bit
	0: value within measuring range
	1: measuring range exceeded
	Bit 1: error bit (set by internal errors)
	Bit 2: activity bit (always 0)
	Bit 3 ... 7: binary measured value
1	Bit 0 ... 6: binary measured value
	Bit 7: sign
	0 positive
	1 negative

+/- 10V (two's complement)

Voltage	Decimal	Hex
-10V	-16384	C000
-5V	-8192	E000
0V	0	0000
5V	8192	2000
10V	16384	4000

+/- 10V (value and sign)

Voltage	Decimal	Hex
-10V	-16384	C000
-5V	-8192	A000
0V	0	0000
5V	8192	2000
10V	16384	4000

4 ... 20mA / 1 ... 5V (value and sign)

Current / Voltage	Decimal	Hex
4mA / 1V	0	0000
12mA / 3V	8192	2000
20mA / 5V	16384	4000

+/- 20mA (two's complement)

Current	Decimal	Hex
-20mA	-16384	C000
-10mA	-8192	E000
0mA	0	0000
10mA	8192	2000
20mA	16384	4000

+/- 20mA (value and sign)

Current	Decimal	Hex
-20mA	-16384	C000
-10mA	-8192	A000
0mA	0	0000
10mA	8192	2000
20mA	16384	4000

Formulas for the calculation:

$$Value = 16384 \cdot \frac{U}{10}, \quad U = Value \cdot \frac{10}{16384}$$

U: voltage, Value: Decimal value

Numeric notation

Numeric notation

Formula for the calculation:

$$Value = 16384 \cdot \frac{I}{20}, \quad I = Value \cdot \frac{20}{16384}$$

I: Current, Value: Decimal value

Numeric notation

Numeric notation in Siemens S7 format

The analog values are represented in two's complement format.

Numeric representation:

Byte	Bit 7 ... Bit 0
0	Bit 0 ... 7: binary measured vale
1	Bit 0 ... 6: binary measured vale
	Bit 7: sign
	0 positive
	1 negative

+/- 10V

Voltage	Decimal	Hex
-10V	-27648	9400
-5V	-13824	CA00
0V	0	0
5V	13824	3600
10V	27648	6C00

Formulas for the calculation:

$$Value = 27648 \cdot \frac{U}{10}, \quad U = Value \cdot \frac{10}{27648}$$

U: voltage, Value: decimal value

0...10V

Voltage	Decimal	Hex
0V	0	0000
5V	13824	3600
10V	27648	6C00

Formulas for the calculation:

$$Value = 27648 \cdot \frac{U}{10}, \quad U = Value \cdot \frac{10}{27648}$$

U: voltage, Value: decimal value

1...5V

Voltage	Decimal	Hex
1V	0	0
3V	13824	3600
5V	27648	6C00

Formulas for the calculation:

$$Value = 27648 \cdot \frac{U-1}{4}, \quad U = Value \cdot \frac{4}{27648} + 1$$

U: voltage, Value: decimal value

+/-4V

Voltage	Decimal	Hex
-4V	-27648	9400
0V	0	0
4V	27648	6C00

Formulas for the calculation:

$$Value = 27648 \cdot \frac{U}{4}, \quad U = Value \cdot \frac{4}{27648}$$

U: voltage, Value: decimal value

+/-400mV

Voltage	Decimal	Hex
-400mV	-27648	9400
0V	0	0
400mV	27648	6C00

Formulas for the calculation:

$$Value = 27648 \cdot \frac{U}{400}, \quad U = Value \cdot \frac{400}{27648}$$

U: voltage, Value: decimal value

4....20mA

Current	Decimal	Hex
4mA	0	0
12mA	13824	3600
20mA	27648	6C00

Formulas for the calculation:

$$Value = 27648 \cdot \frac{I-4}{16}, \quad I = Value \cdot \frac{16}{27648} + 4$$

I: current, Value: decimal value

+/- 20mA

Current	Decimal	Hex
-20mA	-27648	9400
-10mA	-13824	CA00
0mA	0	0
10mA	13824	3600
20mA	27648	6C00

Formulas for the calculation:

$$Value = 27648 \cdot \frac{I}{20}, \quad I = Value \cdot \frac{20}{27648}$$

I: current, Value: decimal value

**Data input/
data output range**

For in- and output range, 4Byte are available with the following assignment:

Data input range:

During the measuring, the measuring values are stored in the data input area.

Byte	Bit 7 ... Bit 0
0	High-Byte channel 0
1	Low-Byte channel 0
2	High-Byte channel 1
3	Low-Byte channel 1

Note!

At 3wire res. 4wire measuring, only channel 0 is used.

Data output range:

For output of the data you set a value in the data output area.

Byte	Bit 7 ... Bit 0
0	High-Byte channel 2
1	Low-Byte channel 2
2	High-Byte channel 3
3	Low-Byte channel 3

Parameter data   12Byte of parameter data are available for the configuration. These parameters are stored in non-volatile memory and are available after the unit has been powered off.

The following table shows the structure of the parameter data:

Parameter area:

Byte	Bit 7 ... Bit 0	Default
0	Wire break recognition and diag. alarm: Bit 0: Wire break recognition channel 0 0: deactivated 1: activated Bit 1: Wire break recognition channel 1 0: deactivated 1: activated Bit 2 ... 5: reserved Bit 6: 0: diagnostic alarm inhibited 1: diagnostic alarm enabled Bit 7: reserved	00h
1	reserved Bit 0: reserved Bit 1: reserved Bit 2: CPU-Stop reaction for channel 2 0: Set replacement value channel 2[*)] 1: Store last value channel 2 Bit 3: CPU-Stop reaction for channel 3 0: Set replacement value channel 3 1: Store last value channel 3 Bit 4 ... 7: reserved	00h
2	Function-no. channel 0 (see table input ranges)	28h
3	Function-no. channel 1 (see table input ranges)	28h
4	Function-no. channel 2 (see table input ranges)	09h
5	Function-no. channel 3 (see table input ranges)	09h
6	Option-Byte channel 0	00h
7	Option-Byte channel 1	00h
8	High-Byte replacement value channel 2	00h
9	Low-Byte replacement value channel 2	00h
10	High-Byte replacement value channel 3	00h
11	Low-Byte replacement value channel 3	00h

[*)] If you want to get 0A res. 0V as output value at CPU-STOP, you have to set the following replacement values at current output (4...20mA) res. voltage output (1...5V):

E500h for the S7-format from Siemens and F000h for the S5-format from Siemens.

Parameters   *Wire break recognition*

The wire break recognition is on at the measuring range 4 .. 20mA. Via the Bits 0 and 1 of Byte 0, the wire break recognition is activated.

If the current underruns 0.8mA in 4...20mA current measuring, a wire break ist detected. With activated wire break recognition and diagnostic alarm, a diagnostic message is sent to the superordinated system.

Diagnostic alarm

With the help of Bit 6 of Byte 0, you may release the diagnostic alarm. In case of an error, the *record set 0* with a size of 4Byte is transferred to the superordinated system.

More detailed information is to find below under "Diagnostic data".

CPU-Stop reaction and replacement value

With Bit 2 and 3 of Byte 1 and Byte 8 ... 11 you may set the reaction of the module at CPU-Stop for every output channel.

Via Byte 8 ... 11 you predefine a replacement value for the output channel as soon as the CPU switches to Stop.

By setting Bit 2 res. 3, the last output value remains in the output at CPU-Stop. A reset sets the replacement value.

Function No.

Here you set the function no. of your measuring res. output function for every channel. Please see the according table above.

Option-Byte

Here you may set the transducer velocity for every input channel. Please regard that a higher transducer velocity causes a lower resolution because of the lower integration time.

The data transfer format remains unchanged. Only the lower Bits (LSBs) are not longer relevant for the analog value.

Structure Option-Byte:

Byte	Bit 7 ... Bit 0	Resolution	Default
6 ... 7	Bit 0 ... 3: Velocity per channel		00h
	0000 15 conversions/s	16	
	0001 30 conversions/s	16	
	0010 60 conversions/s	15	
	0011 123 conversions/s	14	
	0100 168 conversions/s	12	
	0101 202 conversions/s	10	
	0110 3,7 conversions/s	16	
	0111 7,5 conversions/s	16	
	Bit 4 ... 7: reserved		

Diagnostic data
The diagnostic data uses 12Byte and are stored in the record sets 0 and 1 of the system data area.

When you enable the diagnostic alarm in Byte 0 of the parameter area, modules will transfer *record set 0* to the superordinated system when an error is detected.

Record set 0 has a predefined content and a length of 4Byte. The content of the record set may be read in plain text via the diagnostic window of the CPU.

For extended diagnosis during runtime, you may evaluate the 12Byte wide *record set 1* via the SFCs 51 and 59.

Evaluate diagnosis
At present diagnosis, the CPU interrupts the user application and branches into the OB82. This OB gives you detailed diagnostic data via the SFCs 51 and 59 when programmed correctly.

After having processed the OB82, the user application processing is continued. Until leaving the OB82, the data remain consistent.

Record set 0
Byte 0 to 3:

Record set 0 (Byte 0 to 3):

Byte	Bit 7 ... Bit 0	Default
0	Bit 0: Module malfunction	00h
	Bit 1: reserved	
	Bit 2: External error	
	Bit 3: Channel error present	
	Bit 4: external supply voltage is missing	
	Bit 5 ... 6: reserved	
	Bit 7: Wrong parameters in the module	
1	Bit 0 ... 3: Module class	15h
	0101 Analog module	
	Bit 4: Channel information present	
	Bit 5 ... 7: reserved	
2	reserved	00h
3	reserved	00h

Record set 1   *Byte 0 to 11:*

The *record set 1* contains the 4Byte of record set 0 and additional 8Byte module specific diagnostic data.

The diagnostic bytes have the following assignment:

Record set 1 (Byte 0 to 11):

Byte	Bit 7 ... Bit 0	Default
0 ... 3	Content record set 0 (see page before)	-
4	Bit 0 ... 6: Channel type 70h: Digital input 71h: Analog input 72h: Digital output 73h: Analog output 74h: Analog in-/output Bit 7: reserved	74h
5	Bit 0 ... 7: Number of diagnostic bits of the module per channel	08h
6	Bit 0 ... 7: Number of identical channels of a module	04h
7	Bit 0: Channel error Channel 0 Bit 1: Channel error Channel 1 Bit 2: Channel error Channel 2 Bit 3: Channel error Channel 3 Bit 4 ... 7: reserved	00h
8	Bit 0: Wire break Channel 0 Bit 1: Parameterization error Channel 0 Bit 2: Measuring range underflow Channel 0 Bit 3: Measuring range overflow Channel 0 Bit 4 ... 7: reserved	00h
9	Bit 0: Wire break Channel 1 Bit 1: Parameterization error Channel 1 Bit 2: Measuring range underflow Channel 1 Bit 3: Measuring range overflow Channel 1 Bit 4 ... 7: reserved	00h
10	Bit 0: Wire break at current output res. short circuit at voltage output Channel 2 Bit 1: Parameterization error Channel 2 Bit 2 ... 7: reserved	00h
11	Bit 0: Wire break at current output res. short circuit at voltage output Channel 3 Bit 1: Parameterization error Channel 3 Bit 2 ... 7: reserved	00h

Technical data

Electrical Data	VIPA 234-1BD50							
Number of in-/outputs	2/2							
Voltage supply	DC5V über Rückwandbus							
	DC24V (20,4 ... 28,8V)							
Current consumption	Rückwandbus: 100mA							
	DC 24V extern: 110mA							
Short circuit current	30mA							
Analog value calculation inputs	Calculation time/Resolution (per channel)							
Parameterized velocity (Hz)	3,7	7,5	15	30	60	123	168	202
Basic calculation time (ms)	268	135	69	35,5	19	10	8	6,75
Additional calculation time (executed once per cycle) (ms)	10	10	10	10	10	10	10	10
Additional calculation time for wire break recognition (ms)	6,5	6,5	6,5	6,5	6,5	6,5	6,5	6,5
Resolution in Bit	16	16	16	16	15	14	12	10
Analog value calculation outputs	Resolution (incl. overdrive region)							
±10V, ±20mA	11Bit + Vorzeichen							
4 ... 20mA, 1 ... 5V	10Bit							
0 ... 10V, 0 ... 20mA	11Bit							
Cycle time	2,5ms							
Settling time								
- Ohm resistive load	0,05ms							
- Capacitive load	0,5ms							
- Inductive load	0,1ms							
Error limits	Measuring range				Tolerance			
- Voltage in-/output	±10V				±0,2%			
	0 ... 10V				±0,4%			
	1 ... 5V				±0,6%			
- Current in-/output	±20mA				±0,3%			
	0 ... 20mA				±0,6%			
	4 ... 20mA				±0,8%			

continue ...

... continue technical data

Electrical Data	
Data for choosing an encoder	
- Voltage input	100 kΩ
- Current input	50 Ω
Data for choosing an actuator	Load resistor
- Voltage outputs	Ohm resistive load - min. 1 kΩ
	Capacitive load - max. 1μF
- Current outputs	Ohm resistive load - max. 500 Ω
	Capacitive load - max. 10 mH
Diagnose alarm	parameterizable
Potential separation	500Vrms
	(field voltage – backplane bus)
Status monitor	Via LED's at the front side
Parameter data	
Input data	4Byte (1 Word per channel)
Output data	4Byte (1 Word per channel)
Parameter data	12Byte
Diagnostic data	12Byte
Measurements and Weight	
Measurements (WxHxD)	25,4x76x76mm
Weight	100g

AI 4/AO 2x12Bit - Multiin-/output

Order data   AI 4/AO 2x12Bit Multiin-/output   VIPA 234-1BD60

Description   This module has 4 analog inputs and 2 analog outputs that may be configured individually. The module occupies a total of 8Byte of input and 4Byte of output data. Galvanic isolation between the channels on the module and the backplane bus is provided by means of DC/DC converters and optocouplers.

Properties
- 4inputs and 2 outputs with common ground
- In-/Outputs with individually configurable functions
- Channel 0 to 2 suitable for encoder with input ranges of:
  voltage ±10V, ±4V, ±400mV
  current ±20mA, 4...20mA
- Channel 3 suitable for encoder with input ranges of:
  Pt100, Pt1000, NI100, NI1000
  resistant measuring 600Ω, 3000Ω
- Channel 4 to 5 Suitable for actuators with output ranges of:
  ±10V, 1 ... 5V, 0 ... 10V, ±20mA, 0 ... 20mA or 4 ... 20mA

Construction

[1]   Label for the name of the module
[2]   LED status indicator
[3]   Edge connector

Status indicator
Pin assignment

LED	Description
F	Sum error LED (red) turned on as soon as an channel error is detected res. an entry in the diagnostic bytes happened

Pin	Assignment
1	DC 24V supply voltage
2	Voltage measuring Ch. 0
3	Current measuring Ch. 0
4	Ground Channel 0
5	Voltage measuring Ch. 1
6	Current measuring Ch. 1
7	Ground Channel 1
8	Voltage measuring Ch. 2
9	Current measuring Ch. 2
10	Ground channel 2
11	Measuring Ch. 3 (Pt, Ni, R)
12	Ground 3
13	Q0 output channel 4
14	M4 output channel 4
15	Q1 output channel 5
16	M5 output channel 5
18	Ground Supply voltage

AI4/AO2 x12Bit

VIPA 234-1BD60

Circuit and schematic diagram

Circuit diagram

Schematic diagram

Attention!

Temporarily not used inputs have to be connected with the concerning ground at activated channel. When deactivating unused channels by means of FFh, this is not required.

Note!

Every channel is individually parameterizable. For the parameterization 16Byte parameterization data are available. They are stored permanently and remain in memory during power-off.

**Access to the
module**

By including the GSD cpu_21x.gsd into your hardware configurator the module is available at the hardware catalog.

The module is projected by using the 1st part of the module 238-2BC00 (238-2BC00 (1/2)) from VIPA.

You can find this part after gsd installation at *Additional filed devices > I/O > VIPA_System_200V > VIPA_CPU21x*

16Byte of parameter data are available for the configuration. These parameters are stored in non-volatile memory and are available after the unit has been powered off.

**Data input/
data output range**

For data input 8Bytes and for data output 4Bytes are available with the following assignment:

Data input range:

During the measuring, the measuring values are stored in the data input area.

Byte	Bit 7 ... Bit 0
0	High-Byte channel 0
1	Low-Byte channel 0
2	High-Byte channel 1
3	Low-Byte channel 1
4	High-Byte channel 2
5	Low-Byte channel 2
6	High-Byte channel 3
7	Low-Byte channel 3

Data output range:

For output of the data you set a value in the data output area.

Byte	Bit 7 ... Bit 0
0	High-Byte channel 4
1	Low-Byte channel 4
2	High-Byte channel 5
3	Low-Byte channel 5

Parameter data   16Byte of parameter data are available for the configuration. These parameters are stored in non-volatile memory and are available after the unit has been powered off.

The following table shows the structure of the parameter data:

Parameter area:

Byte	Bit 7 ... Bit 0	Default
0	Wire break recognition channel 0 Bit 0: 0 = deactivated 1 = activated Wire break recognition channel 1 Bit 1: 0 = deactivated 1 = activated Wire break recognition channel 2 Bit 2: 0 = deactivated 1 = activated Wire break recognition channel 3 Bit 3: 0 = deactivated 1 = activated Bit 4, 5: reserved Diagnostic alarm Bit 6: 0 = diagnostic alarm inhibited 1 = diagnostic alarm enabled Bit 7: reserved	00h
1	Bit 0 … 3: reserved CPU-Stop reaction for channel 4 Bit 4: 0 = Set replacement value channel 4[*] 1 = Store last value channel 4 CPU-Stop reaction for channel 5 Bit 5: 0 = Set replacement value channel 5 1 = Store last value channel 5 Bit 6, 7: reserved	00h
2	Function-no. channel 0 (see table input ranges)	28h
3	Function-no. channel 1 (see table input ranges)	28h
4	Function-no. channel 2 (see table input ranges)	28h
5	Function-no. channel 3 (see table input ranges)	01h
6	Option-Byte channel 0 (see table next page)	00h
7	Option-Byte channel 1 (see table next page)	00h
8	Option-Byte channel 2 (see table next page)	00h
9	Option-Byte channel 3 (see table next page)	00h
10	Function-no. channel 4 (see table output ranges)	09h
11	Function-no. channel 5 (see table output ranges)	09h
12	High-Byte replacement value channel 4	00h
13	Low-Byte replacement value channel 4	00h
14	High-Byte replacement value channel 5	00h
15	Low-Byte replacement value channel 5	00h

[*]   If you want to get 0A res. 0V as output value at CPU-STOP, you have to set the following replacement values at current output (4...20mA) res. voltage output (1...5V):

E500h for the S7-format from Siemens.

Parameters

Wire break recognition

The wire break recognition is on at the measuring range 4 .. 20mA. Via the Bits 0 and 3 of Byte 0, the wire break recognition is activated.

If the current underruns 0.8mA in 4...20mA current measuring, a wire break is detected. With activated wire break recognition and diagnostic alarm, a diagnostic message is sent to the superordinated system.

Diagnostic alarm

With the help of Bit 6 of Byte 0, you may release the diagnostic alarm. In case of an error, the *record set 0* with a size of 4Byte is transferred to the superordinated system.

More detailed information is to find below under "Diagnostic data".

CPU-Stop reaction and replacement value

With Bit 4 and 5 of Byte 1 and Byte 12 ... 15 you may set the reaction of the module at CPU-Stop for every output channel.

Via Byte 12 ... 15 you predefine a replacement value for the output channel as soon as the CPU switches to Stop.

By setting Bit 4 res. 5, the last output value remains in the output at CPU-Stop. A reset sets the replacement value.

Function No.

Here you set the function no. of your measuring res. output function for every channel. Please see the according table above.

Meas. cycle

Here you may set the transducer velocity for every input channel. Please regard that a higher transducer velocity causes a lower resolution because of the lower integration time.

The data transfer format remains unchanged. Only the lower Bits (LSBs) are not longer relevant for the analog value.

Structure Meas. cycle:

Byte	Bit 7 ... Bit 0	Resolution	Default
6 ... 7	Bit 0 ... 3: Velocity per channel		00h
	0000 15 conversions/s	16	
	0001 30 conversions/s	16	
	0010 60 conversions/s	15	
	0011 120 conversions/s	14	
	0100 170 conversions/s	12	
	0101 200 conversions/s	10	
	0110 3,7 conversions/s	16	
	0111 7,5 conversions/s	16	
	Bit 4 ... 7: reserved		

**Function no.
assignment
Input range
(channel 0 … 2)**

The assignment of a function no. to a certain channel happens during parameterization. The function no. 00h does not influence the function no. stored in the permanent parameterization data.

Assigning FFh deactivates the according channel.

Note!

When exceeding the overdrive region, the value 7FFFh (32767) is thrown, at underrun of the underdrive region the value is 8000h (-32768).

No.	Function	Measuring range / representation	Connection
00h	Does not affect permanently stored configuration data.		
28h	Voltage ±10V Siemens S7-format	±11.76V **/** 11.76V= End overdrive region (32511) -10...10V= nominal range (-27648...27648) -11.76V= End underdrive region (-32512) two's complement	(1)
29h	Voltage ±4V Siemens S7-format	±4,70V **/** 4.70V= End overdrive region (32511) -4...4V= nominal range (-27648...27648) -4,70V= End underdrive region (-32512) two's complement	(1)
2Ah	Voltage ±400mV Siemens S7-format	±470mV **/** 470mV= End overdrive region (32511) -400...400mV= nominal range (-27648...27648) -470mV= End underdrive region (-32512) two's complement	(1)
2Ch	Current ±20mA Siemens S7-format	±23.51mA **/** 23.51mA = End overdrive region (32511) -20...20mA = nominal range (-27648...27648) -23.51mA = End underdrive region (-32512) two's complement	(2)
2Dh	Current 4...20mA Siemens S7-format	1.185...+22.81mA **/** 22.81mA = End overdrive region (32511) 4...20mA = nominal range (0...27648) 1.18mA = End underdrive region (-4864) two's complement	(2)
FFh	Channel not active (turned off)		

Note!

You can find the type of connection at the "Circuit diagram" above.

**Function no.
assignment
Input range
(channel 3)**

The assignment of a function no. to a certain channel happens during parameterization. The function no. 00h does not influence the function no. stored in the permanent parameterization data.

Assigning FFh deactivates the according channel.

Note!

When exceeding the overdrive region, the value 7FFFh (32767) is thrown, at underrun of the underdrive region the value is 8000h (-32768).

No.	Function	Measuring range / representation	Conn.
00h	Does not affect permanently stored configuration data.		
01h	Pt100 in two-wire mode	-200 .. +850°C **/** in units of 1/10°C, two's complement	(1, 2)
02h	Pt1000 in two-wire mode	-200 .. +500°C **/** in units of 1/10°C, two's complement	(1, 2)
03h	NI100 in two-wire mode	-50 .. +250°C **/** in units of 1/10°C, two's complement	(1, 2)
04h	NI1000 in two-wire mode	-50 .. +250°C **/** in units of 1/10°C, two's complement	(1, 2)
06h	Resistance measurement 600Ohm two-wire	- **/** 600Ω = Limit value (32767)	(1, 2)
07h	Resistance measurement 3000Ohm two-wire	- **/** 3000Ω = Limit value (32767)	(1, 2)
FFh	Channel not active (turned off)		

Function no. assignment output range Channel 4, Ch. 5

The assignment of a function no. to a certain channel happens during parameterization. The function no. 00h does not influence the function no. stored in the permanent parameterization data.

Assigning FFh deactivates the according channel.

Note!

When exceeding the predefined range, 0V res. 0A is shown as value!

No.	Function	Output range
00h	Does not affect permanently stored configuration data	
09h	Voltage ±10V Siemens S7-format	±11.76V 11.76V= End overdrive region (32511) -10V...10V = nominal range (-27648...27648) -11.76 = End underdrive region (-32512) two's complement
0Ah	Voltage 1...5V Siemens S7-format	0...5.704V 5.704V = End overdrive region (32511) 1...5V = nominal range (0...27648) 0V = End underdrive region (-6912) two's complement
0Dh	Voltage 0...10V Siemens S7-format	0...11.76V 11.76V= End overdrive region (32511) 0...10V = nominal range (0...27648) no underdrive region available
0Bh	Current ±20mA Siemens S7-format	±23.52mA 23.52mA = End overdrive region (32511) -20...20mA = nominal range (-27648...27648) -23.52mA = End underdrive region (-32512) two's complement
0Ch	Current 4...20mA Siemens S7-format	0...22.81mA 22.81mA = End overdrive region (32511) 4...20mA = nominal range (0...27648) 0mA = End underdrive region (-6912) two's complement
0Eh	Current 0...20mA Siemens S7-format	0...23.52mA 23.52mA = End overdrive region (32511) 0...20mA = nominal range (0...27648) no underdrive region available
FFh	Channel not active (turned off)	

Numeric notation in Siemens S7 format

The analog values are represented in two's complement format.

Numeric representation:

Byte	Bit 7 ... Bit 0
0	Bit 0 ... 7: binary measured vale
1	Bit 0 ... 6: binary measured vale
	Bit 7: sign
	0 positive
	1 negative

+/- 10V

Voltage	Decimal	Hex
-10V	-27648	9400
-5V	-13824	CA00
0V	0	0
5V	13824	3600
10V	27648	6C00

Formulas for the calculation:

$$Value = 27648 \cdot \frac{U}{10}, \quad U = Value \cdot \frac{10}{27648}$$

U: voltage, Value: decimal value

0...10V

Voltage	Decimal	Hex
0V	0	0000
5V	13824	3600
10V	27648	6C00

Formulas for the calculation:

$$Value = 27648 \cdot \frac{U}{10}, \quad U = Value \cdot \frac{10}{27648}$$

U: voltage, Value: decimal value

1...5V

Voltage	Decimal	Hex
1V	0	0
3V	13824	3600
5V	27648	6C00

Formulas for the calculation:

$$Value = 27648 \cdot \frac{U-1}{4}, \quad U = Value \cdot \frac{4}{27648} + 1$$

U: voltage, Value: decimal value

+/-4V

Voltage	Decimal	Hex
-4V	-27648	9400
0V	0	0
4V	27648	6C00

Formulas for the calculation:

$$Value = 27648 \cdot \frac{U}{4}, \quad U = Value \cdot \frac{4}{27648}$$

U: voltage, Value: decimal value

+/-400mV

Voltage	Decimal	Hex
-400mV	-27648	9400
0V	0	0
400mV	27648	6C00

Formulas for the calculation:

$$Value = 27648 \cdot \frac{U}{400}, \quad U = Value \cdot \frac{400}{27648}$$

U: voltage, Value: decimal value

4....20mA

Current	Decimal	Hex
4mA	0	0
12mA	13824	3600
20mA	27648	6C00

Formulas for the calculation:

$$Value = 27648 \cdot \frac{I-4}{16}, \quad I = Value \cdot \frac{16}{27648} + 4$$

I: current, Value: decimal value

+/- 20mA

Current	Decimal	Hex
-20mA	-27648	9400
-10mA	-13824	CA00
0mA	0	0
10mA	13824	3600
20mA	27648	6C00

Formulas for the calculation:

$$Value = 27648 \cdot \frac{I}{20}, \quad I = Value \cdot \frac{20}{27648}$$

I: current, Value: decimal value

Diagnostic data   The diagnostic data uses 12Byte and are stored in the record sets 0 and 1 of the system data area.

When you enable the diagnostic alarm in Byte 0 of the parameter area, modules will transfer *record set 0* to the superordinated system when an error is detected.

Record set 0 has a predefined content and a length of 4Byte. The content of the record set may be read in plain text via the diagnostic window of the CPU.

For extended diagnosis during runtime, you may evaluate the 12Byte wide *record set 1* via the SFCs 51 and 59.

Evaluate diagnosis   At present diagnosis, the CPU interrupts the user application and branches into the OB82. This OB gives you detailed diagnostic data via the SFCs 51 and 59 when programmed correctly.

After having processed the OB82, the user application processing is continued. Until leaving the OB82, the data remain consistent.

Record set 0   *Byte 0 to 3:*

Record set 0 (Byte 0 to 3):

Byte	Bit 7 ... Bit 0	Default
0	Bit 0: Module malfunction Bit 1: reserved Bit 2: External error Bit 3: Channel error present Bit 4: external supply voltage is missing Bit 5 ... 6: reserved Bit 7: Wrong parameters in the module	00h
1	Bit 0 ... 3: Module class 0101 Analog module Bit 4: Channel information present Bit 5 ... 7: reserved	15h
2	reserved	00h
3	reserved	00h

Record set 1

Byte 0 to 11:

The *record set 1* contains the 4Byte of record set 0 and additional 8Byte module specific diagnostic data.

The diagnostic bytes have the following assignment:

Record set 1 (Byte 0 to 11):

Byte	Bit 7 ... Bit 0	Default
0 ... 3	Content record set 0 (see page before)	-
4	Bit 0 ... 6: Channel type 70h: Digital input 71h: Analog input 72h: Digital output 73h: Analog output 74h: Analog in-/output Bit 7: reserved	74h
5	Bit 0 ... 7: Number of diagnostic bits of the module per channel	04h
6	Bit 0 ... 7: Number of identical channels of a module	06h
7	Bit 0: Channel error Channel 0 Bit 1: Channel error Channel 1 Bit 2: Channel error Channel 2 Bit 3: Channel error Channel 3 Bit 4: Channel error Channel 4 Bit 5: Channel error Channel 5 Bit 6, 7: reserved	00h
8	Bit 0: Wire break Channel 0 Bit 1: Parameterization error Channel 0 Bit 2: Measuring range underflow Channel 0 Bit 3: Measuring range overflow Channel 0 Bit 4: Wire break Channel 1 Bit 5: Parameterization error Channel 1 Bit 6: Measuring range underflow Channel 1 Bit 7: Measuring range overflow Channel 1	00h
9	Bit 0: Wire break Channel 2 Bit 1: Parameterization error Channel 2 Bit 2: Measuring range underflow Channel 2 Bit 3: Measuring range overflow Channel 2 Bit 4: Wire break Channel 3 Bit 5: Parameterization error Channel 3 Bit 6: Measuring range underflow Channel 3 Bit 7: Measuring range overflow Channel 3	00h
10	Bit 0: Wire break at current output res. short circuit at voltage output Channel 4 Bit 1: Parameterization error Channel 4 Bit 2, 3: reserved Bit 4: Wire break at current output res. short circuit at voltage output Channel 5 Bit 5: Parameterization error Channel 5 Bit 6, 7: reserved	00h
11	reserved	00h

Technical Data

Electrical Data	VIPA 234-1BD60							
Number of Current-/Voltage input	3							
Number of resistance input	1							
Number of outputs	2							
Voltages, Currents, Potentials								
Constant current for resistance encoder	1.5mA							
Potential separation								
- between channels and backplane	yes							
Isolation proofed with	DC 500V							
Supply voltage	DC 5V via backplane bus (next release with DC 24V by front connector)							
Current consumption								
- via backplane bus	Max. 600mA							
Analog value calculation input channels	Calculation time/Resolution (per channel)							
Parameterized velocity (Hz)	15	30	60	30	120	200	3.7	7.5
Basic calculation time (ms)	69	35.5	19	10	8	6.75	268	135
Resolution in Bit	16	16	15	14	12	10	16	16
Analog value calculation output channels								
Resolution (incl. Overdrive region)								
±10V, ±20mA	11Bit + sign							
4 ... 20mA, 1 ... 5V	10Bit							
0 ... 10V, 0 ... 20mA	11Bit							
Cycle time	1,5ms							
Boot time								
- impedance load	0.3ms							
- capacitive load	1.0ms							
- inductive load	0.5ms							
Error limits output channels								
Usage error limit (whole temperature range, referring to input range)								
	Measuring range				Tolerance			
At voltage input	400mV-10V				±0,3%			
At current input	±20mA				±0,4%			
	4 ... 20mA				±1,0%			
Resistance	600Ω-3000Ω				±0,4%			
Resistance thermometer	Pt100, Pt1000				±0,4%			
	Ni100, Ni1000				±0,6%			

... continue

Error limits input channels		
Usage error limit (during temperature is 25°C, referring to input range)		
	Measuring range	Tolerance
Voltage input	400mV-10V	±0,2%
Current input	±20mA	±0,2%
	4 ... 20mA	±0,5%
Resistance	600Ω - 3000Ω	±0,2%
Resistance thermometer	Pt100, Pt1000	±0,2%
	Ni100, Ni1000	±0,3%
Error limits output channels		
Usage error limit (whole temperature range, referring to input range)		
	Measuring range	Tolerance
Voltage output	±10V	±0.4%
	0 ... 10V	±0.6%
	1 ... 5V	±0.8%
Current output	±20mA	±0.3%
	0 ... 20mA	±0.6%
	4 ... 20mA	±0.8%
Error limits output channels		
Usage error limit (during temperature is 25°C, referring to input range)		
	Measuring range	Tolerance
Voltage output	±10V	±0.2%
	0 ... 10V	±0.3%
	1 ... 5V	±0.4%
Current output	±20mA	±0.3%
	0 ... 20mA	±0.4%
	4 ... 20mA	±0.5%
States, Alarms, Diagnosis		
Diagnosis alarm	parameterizable	
Diagnosis functions		
- Sum error monitor	red LED (F)	
- Diagnostic information readable	possible	
Data for choosing an encoder		
Voltage input		
- 50mV – 400mV	10MΩ	
- 4V – 10V	100kΩ	
Current input	33 Ω	

... continue

Data for choosing an actuator	
Burden resistance (in nominal range of the output)	
At voltage outputs	
- impedance load	min. 1 kΩ
- capacitive load	max. 1μF
At current output	
- impedance load	max. 500 Ω
- capacitive load	max. 10 mH
Parameter data	
Input data	8Byte (1 Word per channel)
Output data	4Byte (1 Word per channel)
Parameter data	16Byte
Diagnostic data	12Byte
Dimensions and weight	
Dimensions (WxHxD) in mm	50.8x76x76mm
Weight	100g

Chapter 19   System expansion modules

Overview

The chapter contains a description of additional components and accessories that are available from VIPA for the System 200V.

The general overview is followed by the description of the combination module that includes a digital in-/output module with counter function and an analog in-/output module.

After that follows the description of the bus expansion module that is used to split a single System 200V row over up to 4 rows.

The 4port fast Ethernet mini switch completes the System 200V network technology.

The chapter concludes with the terminal modules. These modules provide connection facilities for signaling cables as well as supply voltages for your System 200V.

Below follows a description of:

- System overview of additional components
- combination module SM 238
- Bus expansion with IM 260 and IM 261
- 4port mini switch CM 240
- Terminal module CM 201

Contents

Overview

**Combination
module**

**Ordering data
Combination
module**

Type	Order number	Description
SM 238C	VIPA 238-2BC00	Digital in-/output DI 16xDC 24V with counters 30kHz Analog in-/output AI 3xU/I and AI 1xPT100x12Bit / AO 2x12Bit COM

Bus expansion
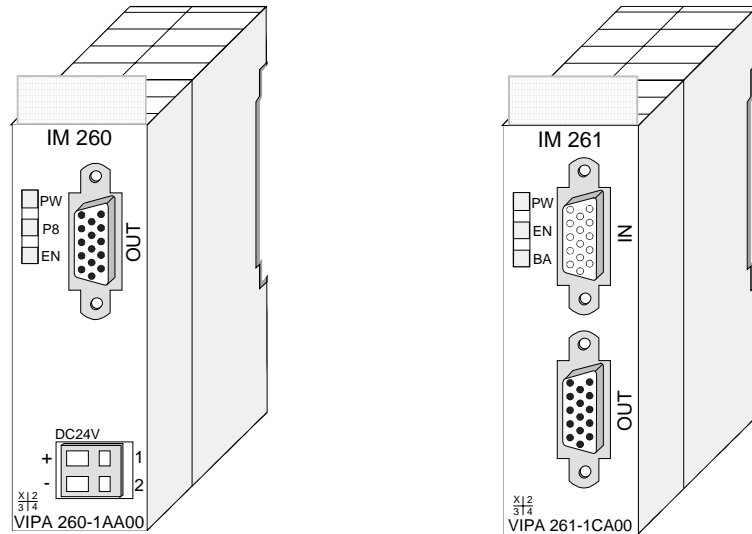
Ordering data

Type	Order number	Description
IM 260	VIPA 260-1AA00	Basic interface row 1
IM 261	VIPA 261-1CA00	Interface for rows 2 ... 4
Cable 0.5m	VIPA 260-1XY05	Interconnecting cable, 0.5m length
Cable 1m	VIPA 260-1XY10	Interconnecting cable, 1m length
Cable 1.5m	VIPA 260-1XY15	Interconnecting cable, 1.5m length
Cable 2m	VIPA 260-1XY20	Interconnecting cable, 2m length
Cable 2.5m	VIPA 260-1XY25	Interconnecting cable, 2.5m length

Terminal module
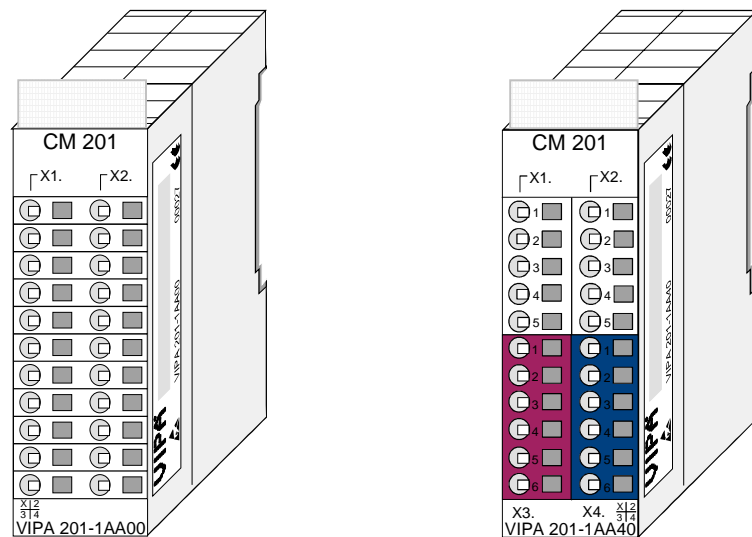
Ordering data terminal modules

Type	Order number	Description
CM 201	VIPA 201-1AA00	Dual terminals gray/gray
CM 201	VIPA 201-1AA10	Dual terminals green-yellow/gray
CM 201	VIPA 201-1AA20	Dual terminals red/blue
CM 201	VIPA 201-1AA40	Quad terminals gray/red/blue

4port mini switch
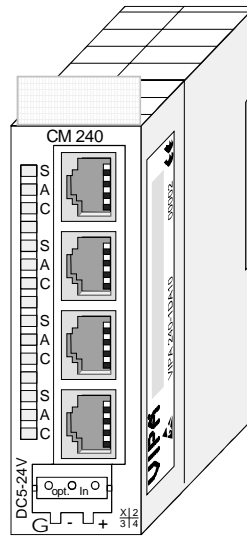
Ordering data
4port mini switch

Type	Order number	Description
CM 240	VIPA 240-1DA10	4port mini switch
	VIPA 970-0CM00	optional front-facing connector at external power supply DC 5-24V

Note order number change!

Because of an order number alteration there are the following changes for the 4port mini switch:

Old Order no.	New Order no.
243-1DA10	240-1DA10

Combination module - SM 238C

Structure

The combination module includes a digital in-/output module with counter function and an analog in-/output module.

The following components are integrated:

- Analog input: 3xU/I, 1xPT100x12Bit
- Analog output: AO 2x12Bit COM
- Digital input: 16(12)xDC24V with parameterizable counter functions
- Digital output: 0(4)xDC24V 1A
- Counter: max. 3 counter with the operating modes: endless, single or periodic counting.

For the project engineering, the delivered GSD vipa_21x.gsd is required. For the module has a digital and an analog part, you have to configure for each one component during the hardware configuration.

After the installation of the GSD, these are listed in the hardware catalog as:

238-2BC00 (1/2) AI4/AO2*12Bit

238-2BC00 (2/2) Counter

The control of the counter happens via digital input channels. For the counter you may configure alarms that influence one digital output channel per counter.

Note

The combination module can only be used together with a CPU 21x! The max. number of modules at one CPU is limited to 2.

The operation at a bus coupler is not permitted.

Ordering data

DI 16xDC24V / AI 4/AO 2x12Bit Combination module   VIPA 238-2BC00
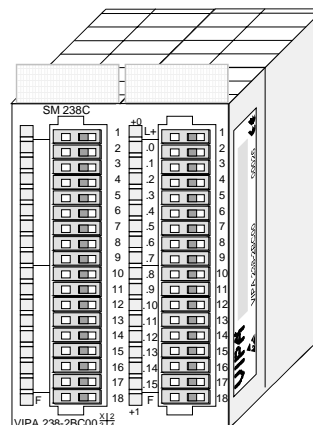
Analog In-/ Output	This module has 4 analog inputs and 2 analog outputs that may be configured individually. The module occupies a total of 8Byte of input and 4Byte of output data.
	Galvanic isolation between the channels on the module and the backplane bus is provided by means of DC/DC converters and optocouplers.

Properties

- 4inputs and 2 outputs with common ground

- In-/Outputs with individually configurable functions

- Channel 0 to 2 suitable for encoder with input ranges of:
  voltage ±10V, ±4V, ±400mV
  current ±20mA, 4...20mA

- Channel 3 suitable for encoder with input ranges of:
  Pt100, Pt1000, NI100, NI1000
  resistant measuring 600Ω, 3000Ω

- Channel 4 to 5 Suitable for actuators with output ranges of:
  ±10V, 1 ... 5V, 0 ... 10V, ±20mA, 0 ... 20mA or 4 ... 20mA

Construction

[1]   Label for the name of the module

[2]   LED status indicator

[3]   Edge connector

Status indicator
Pin assignment

LED	Description
F	Sum error LED (red)
	turned on as soon as an channel error is detected res. an entry in the diagnostic bytes happened

Pin	Assignment
1	DC 24V supply voltage [*]
2	Voltage measuring Ch. 0
3	Current measuring Ch. 0
4	Ground Channel 0
5	Voltage measuring Ch. 1
6	Current measuring Ch. 1
7	Ground Channel 1
8	Voltage measuring Ch. 2
9	Current measuring Ch. 2
10	Ground channel 2
11	Measuring Ch. 3 (Pt, Ni, R)
12	Ground 3
13	Q0 output channel 4
14	M4 output channel 4
15	Q1 output channel 5
16	M5 output channel 5
18	Ground Supply voltage [*]

SM 238C

VIPA 238-2BC00

[*]   The Module is only supplied by backplane. The next release will be supplied with DC 24V by front connector.

Circuit and schematic diagram
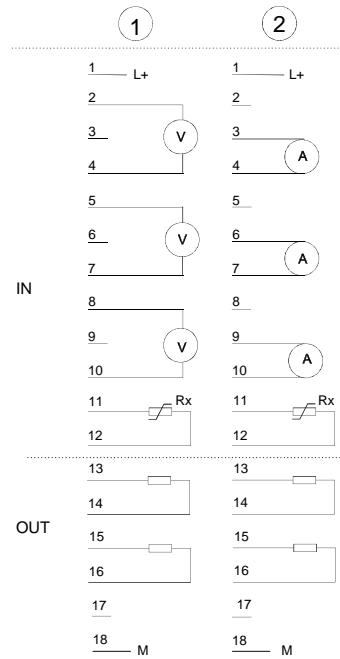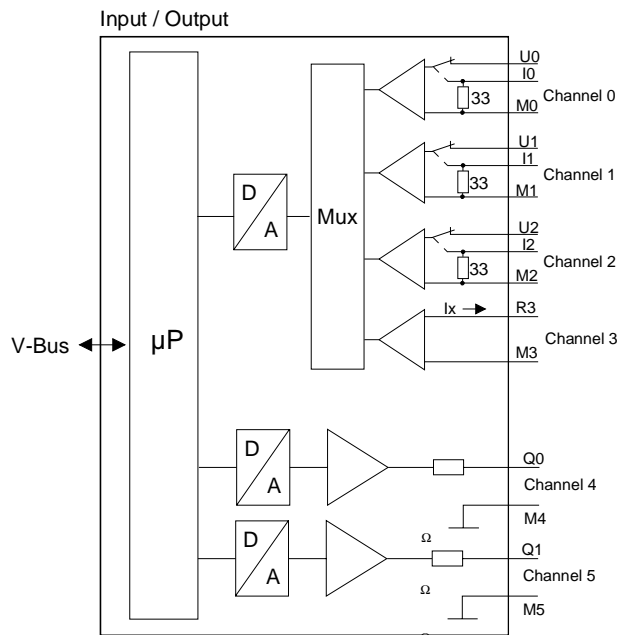
Circuit diagram

Schematic diagram

Attention!

Temporarily not used inputs have to be connected with the concerning ground at activated channel. When deactivating unused channels by means of FFh, this is not required.

Note!

Every channel is individually parameterizable. For the parameterization 16Byte parameterization data are available. They are stored permanently and remain in memory during power-off.

Access to the analog part

By including the GSD cpu_21x.gsd into your hardware configurator the module is available via the hardware catalog.

Please take care that you always configure both module parts in the sequence:

238-2BC00 (1/2) AI4/AO2*12Bit

238-2BC00 (2/2) Counter

You may employ a max. of 2 combination modules at one CPU 21x!

Overview

16Byte of parameter data are available for the configuration. These parameters are stored in non-volatile memory and are available after the unit has been powered off.

Data input/ data output range

For data input 8Bytes and for data output 4Bytes are available with the following assignment:

Data input range:

During the measuring, the measuring values are stored in the data input area.

Byte	Bit 7 ... Bit 0
0	High-Byte channel 0
1	Low-Byte channel 0
2	High-Byte channel 1
3	Low-Byte channel 1
4	High-Byte channel 2
5	Low-Byte channel 2
6	High-Byte channel 3
7	Low-Byte channel 3

Data output range:

For output of the data you set a value in the data output area.

Byte	Bit 7 ... Bit 0
0	High-Byte channel 4
1	Low-Byte channel 4
2	High-Byte channel 5
3	Low-Byte channel 5

Parameter data   16Byte of parameter data are available for the configuration. These parameters are stored in non-volatile memory and are available after the unit has been powered off.

The following table shows the structure of the parameter data:

Parameter area:

Byte	Bit 7 ... Bit 0	Default
0	Wire break recognition channel 0 Bit 0: 0 = deactivated 1 = activated Wire break recognition channel 1 Bit 1: 0 = deactivated 1 = activated Wire break recognition channel 2 Bit 2: 0 = deactivated 1 = activated Wire break recognition channel 3 Bit 3: 0 = deactivated 1 = activated Bit 4, 5: reserved Diagnostic alarm Bit 6: 0 = diagnostic alarm inhibited 1 = diagnostic alarm enabled Bit 7: reserved	00h
1	Bit 0 … 3: reserved CPU-Stop reaction for channel 4 Bit 4: 0 = Set replacement value channel 4[*] 1 = Store last value channel 4 CPU-Stop reaction for channel 5 Bit 5: 0 = Set replacement value channel 5 1 = Store last value channel 5 Bit 6, 7: reserved	00h
2	Function-no. channel 0 (see table input ranges)	28h
3	Function-no. channel 1 (see table input ranges)	28h
4	Function-no. channel 2 (see table input ranges)	28h
5	Function-no. channel 3 (see table input ranges)	01h
6	Option-Byte channel 0 (see table next page)	00h
7	Option-Byte channel 1 (see table next page)	00h
8	Option-Byte channel 2 (see table next page)	00h
9	Option-Byte channel 3 (see table next page)	00h
10	Function-no. channel 4 (see table output ranges)	09h
11	Function-no. channel 5 (see table output ranges)	09h
12	High-Byte replacement value channel 4	00h
13	Low-Byte replacement value channel 4	00h
14	High-Byte replacement value channel 5	00h
15	Low-Byte replacement value channel 5	00h

[*] If you want to get 0A res. 0V as output value at CPU-STOP, you have to set the following replacement values at current output (4...20mA) res. voltage output (1...5V):

E500h for the S7-format from Siemens.

Parameters

Wire break recognition

The wire break recognition is on at the measuring range 4 .. 20mA. Via the Bits 0 and 3 of Byte 0, the wire break recognition is activated.

If the current underruns 0.8mA in 4...20mA current measuring, a wire break is detected. With activated wire break recognition and diagnostic alarm, a diagnostic message is sent to the superordinated system.

Diagnostic alarm

With the help of Bit 6 of Byte 0, you may release the diagnostic alarm. In case of an error, the *record set 0* with a size of 4Byte is transferred to the superordinated system.

More detailed information is to find below under "Diagnostic data".

CPU-Stop reaction and replacement value

With Bit 4 and 5 of Byte 1 and Byte 12 ... 15 you may set the reaction of the module at CPU-Stop for every output channel.

Via Byte 12 ... 15 you predefine a replacement value for the output channel as soon as the CPU switches to Stop.

By setting Bit 4 res. 5, the last output value remains in the output at CPU-Stop. A reset sets the replacement value.

Function No.

Here you set the function no. of your measuring res. output function for every channel. Please see the according table above.

Meas. cycle

Here you may set the transducer velocity for every input channel. Please regard that a higher transducer velocity causes a lower resolution because of the lower integration time.

The data transfer format remains unchanged. Only the lower Bits (LSBs) are not longer relevant for the analog value.

Structure Meas. cycle:

Byte	Bit 7 ... Bit 0	Resolution	Default
6 ... 7	Bit 0 ... 3: Velocity per channel		00h
	0000 15 conversions/s	16	
	0001 30 conversions/s	16	
	0010 60 conversions/s	15	
	0011 120 conversions/s	14	
	0100 170 conversions/s	12	
	0101 200 conversions/s	10	
	0110 3,7 conversions/s	16	
	0111 7,5 conversions/s	16	
	Bit 4 ... 7: reserved		

**Function no.
assignment
Input range
(channel 0 … 2)**

The assignment of a function no. to a certain channel happens during parameterization. The function no. 00h does not influence the function no. stored in the permanent parameterization data.

Assigning FFh deactivates the according channel.

Note!

When exceeding the overdrive region, the value 7FFFh (32767) is thrown, at underrun of the underdrive region the value is 8000h (-32768).

No.	Function	Measuring range / representation	Connection
00h	Does not affect permanently stored configuration data.		
28h	Voltage ±10V Siemens S7-format	±11.76V **/** 11.76V= End overdrive region (32511) -10...10V= nominal range (-27648...27648) -11.76V= End underdrive region (-32512) two's complement	(1)
29h	Voltage ±4V Siemens S7-format	±4.70V **/** 4.70V= End overdrive region (32511) -4...4V= nominal range (-27648...27648) -4.70V= End underdrive region (-32512) two's complement	(1)
2Ah	Voltage ±400mV Siemens S7-format	±470mV **/** 470mV= End overdrive region (32511) -400...400mV= nominal range (-27648...27648) -470mV= End underdrive region (-32512) two's complement	(1)
2Ch	Current ±20mA Siemens S7-format	±23.51mA **/** 23.51mA = End overdrive region (32511) -20...20mA = nominal range (-27648...27648) -23.51mA = End underdrive region (-32512) two's complement	(2)
2Dh	Current 4...20mA Siemens S7-format	1.185...+22.81mA **/** 22.81mA = End overdrive region (32511) 4...20mA = nominal range (0...27648) 1.18mA = End underdrive region (-4864) two's complement	(2)
FFh	Channel not active (turned off)		

Note!

You can find the type of connection at the "Circuit diagram" above.

**Function no.
assignment
Input range
(channel 3)**

The assignment of a function no. to a certain channel happens during parameterization. The function no. 00h does not influence the function no. stored in the permanent parameterization data.

Assigning FFh deactivates the according channel.

Note!

When exceeding the overdrive region, the value 7FFFh (32767) is thrown, at underrun of the underdrive region the value is 8000h (-32768).

No.	Function	Measuring range / representation	Conn.
00h	Does not affect permanently stored configuration data.		
01h	Pt100 in two-wire mode	-200 .. +850°C **/** in units of 1/10°C, two's complement	(1, 2)
02h	Pt1000 in two-wire mode	-200 .. +500°C **/** in units of 1/10°C, two's complement	(1, 2)
03h	NI100 in two-wire mode	-50 .. +250°C **/** in units of 1/10°C, two's complement	(1, 2)
04h	NI1000 in two-wire mode	-50 .. +250°C **/** in units of 1/10°C, two's complement	(1, 2)
06h	Resistance measurement 600Ohm two-wire	- **/** 600Ω = Limit value (32767)	(1, 2)
07h	Resistance measurement 3000Ohm two-wire	- **/** 3000Ω = Limit value (32767)	(1, 2)
FFh	Channel not active (turned off)		

Function no. assignment output range Channel 4, Ch. 5

The assignment of a function no. to a certain channel happens during parameterization. The function no. 00h does not influence the function no. stored in the permanent parameterization data.

Assigning FFh deactivates the according channel.

Note!

When exceeding the predefined range, 0V res. 0A is shown as value!

No.	Function	Output or input range
00h	Does not affect permanently stored configuration data	
09h	Voltage ±10V Siemens S7-format	±11.76V 11.76V= End overdrive region (32511) -10V...10V = nominal range (-27648...27648) -11.76 = End underdrive region (-32512) two's complement
0Ah	Voltage 1...5V Siemens S7-format	0...5.704V 5.704V = End overdrive region (32511) 1...5V = nominal range (0...27648) 0V = End underdrive region (-6912) two's complement
0Dh	Voltage 0...10V Siemens S7-format	0...11.76V 11.76V= End overdrive region (32511) 0...10V = nominal range (0...27648) no underdrive region available
0Bh	Current ±20mA Siemens S7-format	±23.52mA 23.52mA = End overdrive region (32511) -20...20mA = nominal range (-27648...27648) -23.52mA = End underdrive region (-32512) two's complement
0Ch	Current 4...20mA Siemens S7-format	0...22.81mA 22.81mA = End overdrive region (32511) 4...20mA = nominal range (0...27648) 0mA = End underdrive region (-6912) two's complement
0Eh	Current 0...20mA Siemens S7-format	0...23.52mA 23.52mA = End overdrive region (32511) 0...20mA = nominal range (0...27648) no underdrive region available
FFh	Channel not active (turned off)	

Numeric notation in Siemens S7 format

The analog values are represented in two's complement format.

Numeric representation:

Byte	Bit 7 ... Bit 0
0	Bit 0 ... 7: binary measured vale
1	Bit 0 ... 6: binary measured vale
	Bit 7: sign
	0 positive
	1 negative

+/- 10V

Voltage	Decimal	Hex
-10V	-27648	9400
-5V	-13824	CA00
0V	0	0
5V	13824	3600
10V	27648	6C00

Formulas for the calculation:

$$Value = 27648 \cdot \frac{U}{10}, \quad U = Value \cdot \frac{10}{27648}$$

U: voltage, Value: decimal value

0...10V

Voltage	Decimal	Hex
0V	0	0000
5V	13824	3600
10V	27648	6C00

Formulas for the calculation:

$$Value = 27648 \cdot \frac{U}{10}, \quad U = Value \cdot \frac{10}{27648}$$

U: voltage, Value: decimal value

1...5V

Voltage	Decimal	Hex
1V	0	0
3V	13824	3600
5V	27648	6C00

Formulas for the calculation:

$$Value = 27648 \cdot \frac{U-1}{4}, \quad U = Value \cdot \frac{4}{27648} + 1$$

U: voltage, Value: decimal value

+/-4V

Voltage	Decimal	Hex
-4V	-27648	9400
0V	0	0
4V	27648	6C00

Formulas for the calculation:

$$Value = 27648 \cdot \frac{U}{4}, \quad U = Value \cdot \frac{4}{27648}$$

U: voltage, Value: decimal value

+/-400mV

Voltage	Decimal	Hex
-400mV	-27648	9400
0V	0	0
400mV	27648	6C00

Formulas for the calculation:

$$Value = 27648 \cdot \frac{U}{400}, \quad U = Value \cdot \frac{400}{27648}$$

U: voltage, Value: decimal value

4....20mA

Current	Decimal	Hex
4mA	0	0
12mA	13824	3600
20mA	27648	6C00

Formulas for the calculation:

$$Value = 27648 \cdot \frac{I-4}{16}, \quad I = Value \cdot \frac{16}{27648} + 4$$

I: current, Value: decimal value

+/- 20mA

Current	Decimal	Hex
-20mA	-27648	9400
-10mA	-13824	CA00
0mA	0	0
10mA	13824	3600
20mA	27648	6C00

Formulas for the calculation:

$$Value = 27648 \cdot \frac{I}{20}, \quad I = Value \cdot \frac{20}{27648}$$

I: current, Value: decimal value

Diagnostic data   The diagnostic data uses 12Byte and are stored in the record sets 0 and 1 of the system data area.

When you enable the diagnostic alarm in Byte 0 of the parameter area, modules will transfer *record set 0* to the superordinated system when an error is detected.

Record set 0 has a predefined content and a length of 4Byte. The content of the record set may be read in plain text via the diagnostic window of the CPU.

For extended diagnosis during runtime, you may evaluate the 12Byte wide *record set 1* via the SFCs 51 and 59.

Evaluate diagnosis   At present diagnosis, the CPU interrupts the user application and branches into the OB82. This OB gives you detailed diagnostic data via the SFCs 51 and 59 when programmed correctly.

After having processed the OB82, the user application processing is continued. Until leaving the OB82, the data remain consistent.

Record set 0   *Byte 0 to 3:*

Record set 0 (Byte 0 to 3):

Byte	Bit 7 ... Bit 0	Default
0	Bit 0: Module malfunction Bit 1: reserved Bit 2: External error Bit 3: Channel error present Bit 4: external supply voltage is missing Bit 5 ... 6: reserved Bit 7: Wrong parameters in the module	00h
1	Bit 0 ... 3: Module class 0101 Analog module Bit 4: Channel information present Bit 5 ... 7: reserved	15h
2	reserved	00h
3	reserved	00h

Record set 1   *Byte 0 to 11:*

The *record set 1* contains the 4Byte of record set 0 and additional 8Byte module specific diagnostic data.

The diagnostic bytes have the following assignment:

Record set 1 (Byte 0 to 11):

Byte	Bit 7 ... Bit 0	Default
0 ... 3	Content record set 0 (see page before)	-

4	Bit 0 ... 6: Channel type
	    70h: Digital input
	    71h: Analog input
	    72h: Digital output
	    73h: Analog output
	    74h: Analog in-/output
	Bit 7: reserved
		74h

5	Bit 0 ... 7: Number of diagnostic bits of the module per channel	04h
6	Bit 0 ... 7: Number of identical channels of a module	06h
7	Bit 0: Channel error Channel 0 Bit 1: Channel error Channel 1 Bit 2: Channel error Channel 2 Bit 3: Channel error Channel 3 Bit 4: Channel error Channel 4 Bit 5: Channel error Channel 5 Bit 6, 7: reserved	00h
8	Bit 0: Wire break Channel 0 Bit 1: Parameterization error Channel 0 Bit 2: Measuring range underflow Channel 0 Bit 3: Measuring range overflow Channel 0 Bit 4: Wire break Channel 1 Bit 5: Parameterization error Channel 1 Bit 6: Measuring range underflow Channel 1 Bit 7: Measuring range overflow Channel 1	00h
9	Bit 0: Wire break Channel 2 Bit 1: Parameterization error Channel 2 Bit 2: Measuring range underflow Channel 2 Bit 3: Measuring range overflow Channel 2 Bit 4: Wire break Channel 3 Bit 5: Parameterization error Channel 3 Bit 6: Measuring range underflow Channel 3 Bit 7: Measuring range overflow Channel 3	00h
10	Bit 0: Wire break at current output res. short circuit at voltage output Channel 4 Bit 1: Parameterization error Channel 4 Bit 2, 3: reserved Bit 4: Wire break at current output res. short circuit at voltage output Channel 5 Bit 5: Parameterization error Channel 5 Bit 6, 7: reserved	00h
11	reserved	00h

Digital Input

The digital input accepts binary control signals from the process and provides an electrically isolated interface to the central bus system. It has 16 channels that indicate the respective status by means of LEDs. Additionally, the first 12 inputs may control 3 counter.

Properties

- 16 inputs, isolated from the backplane bus
  whereof 4 inputs are switchable as outputs

- 3 configurable counter (continuously, once and periodically) parameterizable via the first 12 inputs / 3 counter outputs parameterizable

- Status indicator for each channel by means of an LED
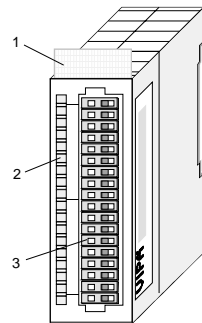
Construction

[1]   Label for module description
[2]   LED status indicator
[3]   Edge connector

Status indicator connector assignment

LED	Description		Assignment Pin	Counter activated	Counter deactivated
L+	LED (yellow) Supply voltage available		1	Power supply DC 24V	
			2	Input Counter (A1)	E.0 (Byte 3.0)
.0...15	LEDs (green)		3	Input Counter (B1)	E.1 (Byte 3.1)
	when the input signal is "1" or the output is active the respective LED is turned on		4	Input Counter (A2)	E.2 (Byte 7.0)
			5	Input Counter (B2)	E.3 (Byte 7.1)
			6	Input Counter (A3)	E.4 (Byte 11.0)
			7	Input Counter (B3)	E.5 (Byte 11.1)
			8	Input E.6: Byte 12.0: Gate 1	
F	LED (red) Overload, overheat or short circuit error		9	Input E.7: Byte 12.4: Latch 1	
			10	Input E.8: Byte 12.1: Gate 2	
			11	Input E.9: Byte 12.5: Latch 2	
			12	Input E.10: Byte 12.2: Gate 3	
			13	Input E.11: Byte 12.6: Latch 3	
			14	E/A.12 Counter out 1 (Byte 12.0) / Input (Byte 15.0)	
			15	E/A.13 Counter out 2 (Byte 12.1) / Input (Byte 15.1)	
			16	E/A.14 Counter out 3 (Byte 12.2) / Input (Byte 15.2)	
			17	E/A.15 Output (Byte 12.3) / Input (Byte 15.3)	
			18	Ground	

Wiring and schematic diagram

Wiring diagram

1 —— L+
2 (A1)
3 (B1)
4 (A2)
5 (B2)
6 (A3)
7 (B3)
8 (G1)
9 (L1)
10 (G2)
11 (L2)
12 (G3)
13 (L3)
14
15
16
17
18   M

Schematic diagram

Input module

Optocoupler
LED
V-Bus
M intern
24V DC

In-/Out module

Optocoupler
M intern
V-Bus
LED
Optocoupler
DC 24V
M intern
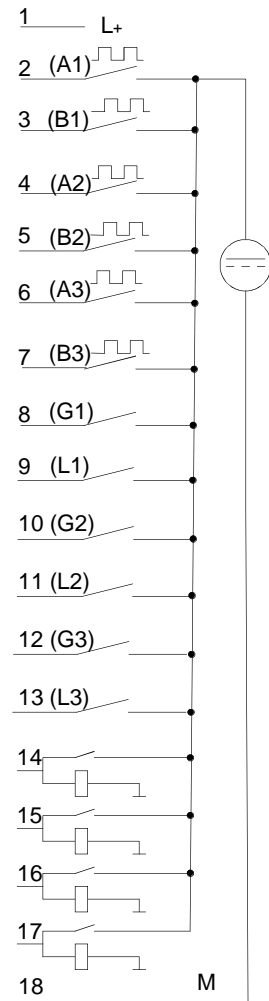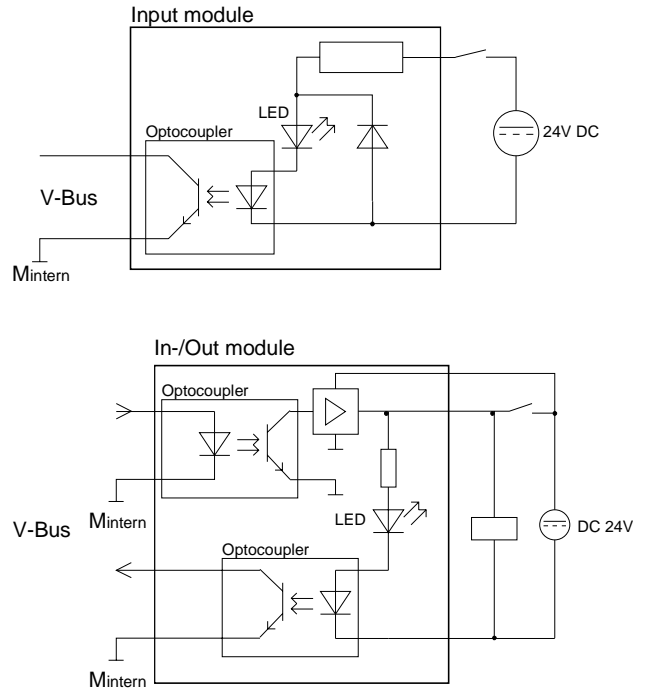
Function of the counter

The combination module has 3 parameterizable integrated counter that are controlled via the input channels. During the counter process, the counter signal is registered and evaluated. Operating mode and additional functions are set via the parameterization.

Operating modes

You may count forwards and backwards choosing between the following operating modes:

- Endless counting e.g. for distance measuring with incremental encoders
- Single counting e.g. for article counting to a maximum limit
- Periodic counting e.g. for applications with repeated counter processes.

For every counter parameterizable additional functions are available like gate function, latch function, comparison, hysteresis and process alarm.

Counter inputs (connections)

For every counter, the following inputs are available:

Pulse/A (A1)

Pulse input for counter signal res. line A of an encoder. Here you may connect encoders with 1-, 2- or 4-thread evaluation.

Direction/B (B1)

Here you connect the direction signal res. line B of the encoder.

You may invert the direction signal by parameterization.

Latch (L1)

A positive edge at the digital input „Latch" stores the recent internal counter value.

HW Gate (G1)

You start the counter via the digital input „Hardware gate".

Counter output

Every counter has an assigned output channel. You may set the following behavior for the according output channel via the parameterization:

- No comparison: output is not called
- Counter value $\geq$ comparison value: output is set
- Counter value $\leq$ comparison value: output is set
- Pulse at comparison value: output is set for a parameterizable pulse
                                        duration

Additional functions

The additional functions listed in the following can be set for every counter via the parameterization:

- Gate function

  The gate function serves the start, stop and interruption of a counter function

- Latch function

  As soon as a positive edge is registered at the latch input, a recent counter value is stored in the latch register.

- Comparison

  You may set a comparison value that activates a digital output res. throws a process alarm depending on the recent counter value.

- Hysteresis

  By setting a hysteresis you may prevent a continuous toggling of an output if the value of an encoder signal fluctuates around a comparison value.

- Alarm

  For the following events you may parameterize an alarm:

  - status change of the HW gate

  - Over- res. underrun

  - Reaching a comparison value

  - Loss of a counter pulse

Schematic structure

The illustration shows how the additional functions influence the counter behavior. The following pages give you a more detailed explanation of the additional functions:
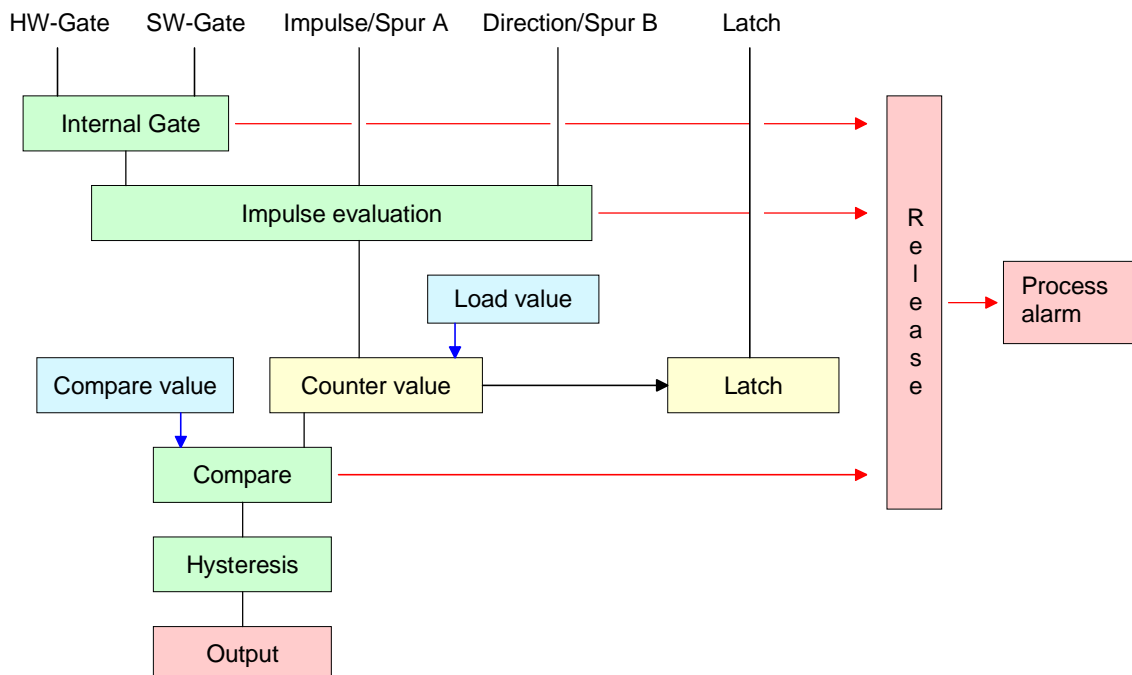
Gate function   The activation res. deactivation of a counter happens via an internal gate.
                              The gate consists of a software gate (SW gate) and a hardware gate (HW
                              gate). The SW gate is controlled via your user application by sending a
                              16Byte "output image" to your counter. The HW gate is controlled via an
                              input channel.

                              Only when both gates are in state "1", the counter can be activated. The
                              parameterization allows you to deactivate the HW gate thus enables the
                              counter activation exclusively via the SW gate.

                              Gate function Abort and Interrupt

                              The parameterization defines if the gate interrupts or aborts the counter
                              process.

                              · At *abort function* the counter starts counting with the load value after
                                gate restart.
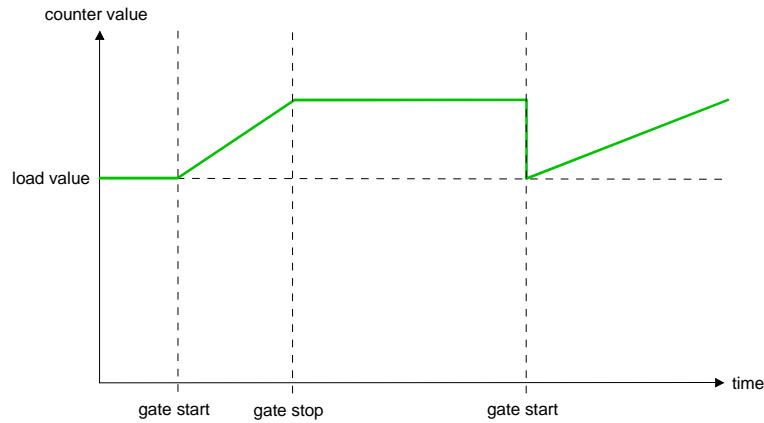
                              · At *interrupt function*, the counter starts counting with the last recent
                                counter value after gate restart.
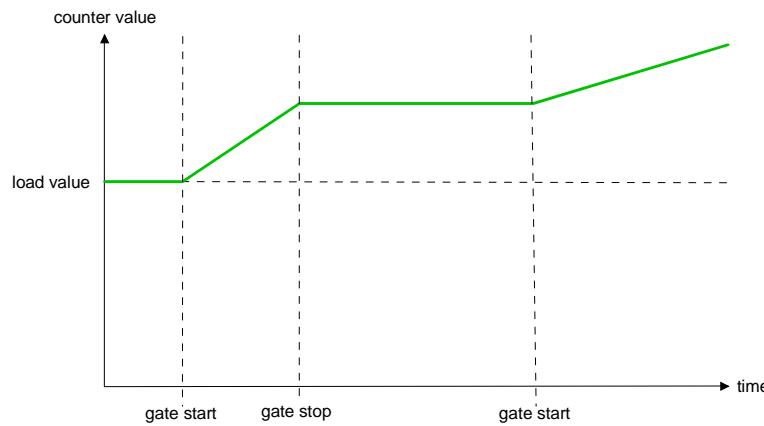
Latch function

As soon as a positive edge at the "latch input" results from the counter process, a recent counter value is stored in the according latch register.

The "input image" gives you access to the latch register.

Compare function

The parameterization presets the behavior of the counter output:

- No comparison
- Counter value $\geq$ comparison value
- Counter value $\leq$ comparison value
- Pulse at comparison value

No comparison

The output is set like a normal output.

Counter value $\geq$ comparison value

If the counter value is equal or higher than the comparison value, the output is set.

Counter value $\leq$ comparison value

If the counter value is smaller or equal than the comparison value, the output is set.

Pulse at comparison value

When the counter reaches the comparison value, the output is set active for the parameterized pulse duration.

If you've set a main counter direction, the output is only set off the main counter direction at reaching the comparison value.

Pulse duration

The pulse duration tells for what time the output is set. It can be preset in steps of 2ms between 0 and 510ms. Please regard that the counter pulse times must be higher than the minimum toggle times of the digital output.

If the pulse duration = 0, the output is set active until the comparison condition is not longer fulfilled.

The pulse duration starts with the setting of the according digital output. The inaccuracy of the pulse duration is smaller than 1ms.

There is no finish triggering of the pulse duration if the comparison value is not met for a short time during a pulse output.

Hysteresis

The hysteresis serves the avoidance of many toggle processes of the output and the alarm, if the counter value is in the range of the comparison value.

You may set a range of 0 to 255. The settings 0 and 1 deactivate the hysteresis. The hysteresis also influences the over- and underflow.

An activated hysteresis remains active after a change. The new hysteresis range is taken over at the next reach of the comparison value.

Alarm

Via the parameterization you may define the following triggers for an alarm:

- Status change of the HW gate
- Over- / underrun
- Reaching a comparison value
- Loss of a counter pulse

Access to the digital part

By including the GSD cpu_21x.gsd into your hardware configurator the module is available via the hardware catalog.

Please take care that you always configure both module parts in the sequence:

> **238-2BC00 (1/2) AI4/AO2*12Bit**
>
> **238-2BC00 (2/2) Counter**

You may employ a max. of 2 combination modules at one CPU 21x!

Overview

The digital part has to be provided with 63Byte *parameter* data. Here you define among others:

- Alarm behavior
- Assignment I/O
- Counter operating mode res. behavior
- Start value for load value, end value and comparison value register

The control of the counter happens via a 16Byte *output image* that is transferred from the CPU to the module. Here you may use commands to load values to res. read them from counter registers that are send to the CPU via the input image.

Information about counter is available via the *input image* where the content is influenced via commands of the output image.

Parameterization   The parameterization happens in the hardware configurator. Here 63Byte parameter data are transferred consisting of following components:

Byte	Description
0 ... 2	Basic parameter (Alarm behavior, assignment I/O)
3 ... 22	Counter parameter counter 1
23 ... 42	Counter parameter counter 2
43 ... 62	Counter parameter counter 3

Basic parameter   The basic parameters allow you to control the alarm behavior of the digital
(Byte 0 ... 2)   part and the assignment of the I/O channels that can be accessed by the
                     according counter as output.

Byte	Beschreibung
0	Alarm generation 0 = no 1 = yes
1	Alarm selection 00h = None 01h = Diagnostics 02h = Process alarm 03h = Diagnostics- und Process alarm

2	Assignment of the in-/output channels.
	Here you define the assignment of the 4 I/O channels.
	If an I/O channel is used as input, you may output the status of the input via Byte 15 of the input image.
	For the operation as output, a detailed definition of the control is required in the parameter section of the according counter.
	Bit 0: 0 = Input .12
	        1 = Output .12 / Counter output .12
	Bit 1: 0 = Input .13
	        1 = Output .13 / Counter output .13
	Bit 2: 0 = Input .14
	        1 = Output .14 / Counter output .14
	Bit 3: 0 = Input .15
	        1 = Output .15

Counter parameter   The parameters for the counter 1 to 3 consist of 3 identical parameter
(Byte 3 ... 22)   groups with each a size of 20Byte.

                       For every counter you may set a function and start data.

Byte	Description
3	Z1: Funktion 00h = continuously 01h = once 02h = periodically 03h = off If the counter is deactivated, the further parameters of this counter are ignored and the according I/O channel is set as "normal" output if you want to use this channel as output.
4	Z1: Signal evaluation Bit 0...1: 00b = Impulse/Direction (Impulse at A1 / Direction at B1) 01b = Rotary encoder single (at A1 and B1) 10b = Rotary encoder double (at A1 and B1) 11b = Rotary encoder quadruple (at A1 and B1) Z1: Counter direction inverted Bit 7: 0 =Off Count direction at B1 not inverted 1 = On Count direction at B1 inverted
5	Z1: Main counting direction 0 = no (no limitation of the counter range) 1 = up (Upper limitation of the counter range) The counter counts from the load value to the parameterized end value in positive direction and jumps then back again to the load value with the next following encoder pulse. 2 = down (lower limitation of the counter range) The counter counts from the load value to the parameterized end value in negative direction and jumps then back again to the load value with the next following encoder pulse.
6	Z1: Gate function (Behavior at interruption and gate restart) Bit 0: 0 = abort (counter process starts with load value) Bit 0: 1 = interrupt (counter process continues with counter value) Z1: HW gate (Hardware gate via input E.6) Bit 7: 0 = Off (Counter starts with set SW gate) 1 = On (Counter only starts with set HW and SW gate)
7	Z1: Behavior of the output 0 = no comparison (Output is not influenced by counter) 1 = if counter value $\geq$ comparison value, set output 2 = if counter value $\leq$ comparison value, set output 3 = gives a pulse to the output as soon as the comparison value has been reached. The pulse duration is configured via Byte 9.

Continue...

... Continue

8	Z1: Hysteresis 0 = off 1 = off 2 ... 255:The hysteresis serves the avoidance of many toggle processes of the output and the alarm, if the counter value is in the range of the comparison value. 0 and 1 are deactivating the hysteresis.
9	Z1: Pulse duration (Pulse duration for the output) 0 = Counter value = comparison value (without delay) 1 = 2ms 2 = 4ms ... 255 = 510ms Only even values are permitted.

10	Z1: Alarm masking
	Bit 0: 0 = deactivated
	      1 = Alarm at opening the HW gate
	Bit 1: 0 = deactivated
	      1 = Alarm at closing HW gate
	Bit 2: 0 = deactivated
	      1 = Alarm at over-/underrun
	Bit 3: 0 = deactivated
	      1 = Alarm at reaching comparison value
	Bit 4: 0 = deactivated
	      1 = Alarm at counter pulse loss

11 ... 14	Z1: Load value (Presetting a load value) Here you may load counter 1 with a value
15 ...18	Z1: Limit value (Presetting a limit value) The limit value for counter 1 is not relevant if there is no main counting direction defined (forwards or backwards).
19 ... 22	Z1: Compare value (Presetting a comparison value) The counter value is compared with the comparison value and depending on that the behavior of the according output of counter 1 is controlled.

Data to digital part (output image)   The digital part gets its data from the CPU in form of a 16Byte data block. The data block has the following structure:

Byte	Description
0 ... 3	Value Counter 1
4 ... 7	Value Counter 2
8 ... 11	Value Counter 3
12	Bit 0: Output Bit .12 / Counter output 1 [1] Bit 1: Output Bit .13 / Counter output 2 Bit 2: Output Bit .14 / Counter output 3 Bit 3: Output Bit .15 Bit 4: Software Gate Counter 1 Bit 5: Software Gate Counter 2 Bit 6: Software Gate Counter 3 Bit 7: not evaluated
13	Command for counter 1
14	Command for counter 2
15	Command for counter 3

Command overview   By means of the Axh commands, a value set under "Value counter ..." is transferred to the according register of a counter.

The following commands are available:
- A0h: Set counter value
- A1h: Set load value
- A2h: Set comparison value
- A3h: Set end value
- A4h: Set latch value
- A5h: Set latch value
- A6h: Set value of pulse duration [2]
- A7h: reserved

The following commands cause the counter to send back a certain register value in the input image:
- 80h: counter value
- 81h: load value
- 82h: comparison value
- 83h: end value
- 84h: Latch (latch value)
- 85h: latch value
- 86h: pulse duration value
- 87h: reserved

Note
Please regard that a command can only be executed if you transfer a 0xh command to the counter before.

---

[1]   The outputs may only be used as outputs if you parameterized them as outputs in the basic parameterization.

[2]   Before changing the pulse duration, you have to deactivate the hysteresis function!

Data from digital part (input image)

The module send back a 16Byte input image that maps into the memory area of the CPU. The structure of input data depends on counter activation:

Byte	Counter activated	Counter deactivated
0 ... 3	Image counter 1	Byte 0 ... 2: 0 Byte 3: Bit 0: E.0 Bit 1: E.1
4 ... 7	Image counter 2	Byte 4 ... 6: 0 Byte 7: Bit 0: E.2 Bit 1: E.3
8 ... 11	Image counter 3	Byte 8 ... 10: 0 Byte 11: Bit 0: E.4 Bit 1: E.5
12	Gate/Latch Bit 0: E.6: Status input HW gate counter 1 Bit 1: E.8: Status input HW gate counter 2 Bit 2: E.10: Status input HW gate counter 3 Bit 3: always 0 Bit 4: E.7: Status input Latch 1 Bit 5: E.9: Status input Latch 2 Bit 6: E.11: Status input Latch 3 Bit 7: always 0	
13	Internal gate / last counter direction If the counter operating mode is set to "off", these Bits are "0". Bit 0: Status internal gate 1 Bit 1: Status internal gate 2 Bit 2: Status internal gate 3 Bit 4: 0= counter direction counter 1 down 1= counter direction counter 1 up Bit 5: 0= counter direction counter 2 down 1= counter direction counter 2 up Bit 6: 0= counter direction counter 3 down 1= counter direction counter 3 up Bit 3, 7: always 0	0
14	Status of the counter outputs If the counter operating mode is set to "off", these Bits are "0". Bit 0: Status output A.12 Bit 1: Status output A.13 Bit 2: Status output A.14 Bit 3: Status output A.15 Bit 4 ... 7: always 0	0
15	Status inputs If the channel is set as output, the according Bit is "0" Bit 0: Status input E.12 Bit 1: Status input E.13 Bit 2: Status input E.14 Bit 3: Status input E.15 Bit 4 ... 7: always 0	

Counter functions

For the counter, the following operating modes are available:

- Count endless – Distance measuring with incremental encoder
- Count once – Count to a maximum limit
- Count periodic– Count with repeated counter process

The operating modes "Count once" and "Count periodic" allow you to transfer the counter limits as start res. end value via the parameterization.

Maximum counter frequency

At employment of all 3 counter, every counter may use a frequency of max. 30kHz.

If you employ only 1 counter channel, the counter supports a max. frequency of 100kHz.

Main counting direction

The parameterization allows you to define a main counting direction for every counter.

If you choose "none", the complete counting range is available:

	Valid value range
Lower count limit	- 2 147 483 648 (-2^{31})
Upper count limit	+ 2 147 483 647 (2^{31}-1)

Main counting direction forward

Upper restriction of the count range. The counter counts 0 res. load value in positive direction until the parameterized end value –1 and jumps then back to the load value with the next following encoder pulse.

Main counting direction backwards

Lower restriction of the count range. The counter counts from the parameterized start- res. load value in negative direction to the parameterized end value +1 and jumps then back to the start value with the next following encoder pulse.

Abort - interrupt

Abort count process

The count process starts after closing and restart of the gate beginning with the load value.

Interrupt count process

The count process continuous after closing and restart of the gate beginning with the last recent counter value.

Continuously   In this operating mode, the counter counts from 0 res. from the load value.

When the counter counts forward and reaches the upper count limit and another counting pulse in positive direction arrives, it jumps to the lower count limit and counts from there on.

When the counter counts backwards and reaches the lower count limit and another counting pulse in negative direction arrives, it jumps to the upper count limit and counts from there on.

The count limits are set to the maximum count range.

	Valid value range
Lower count limit	- 2 147 483 648 (-2^{31})
Upper count limit	+ 2 147 483 647 (2^{31}-1)
Counter value	- 2 147 483 648 (-2^{31}) to + 2 147 483 647 (2^{31}-1)
Load value	- 2 147 483 647 (-2^{31}+1) to + 2 147 483 646 (2^{31}-2)
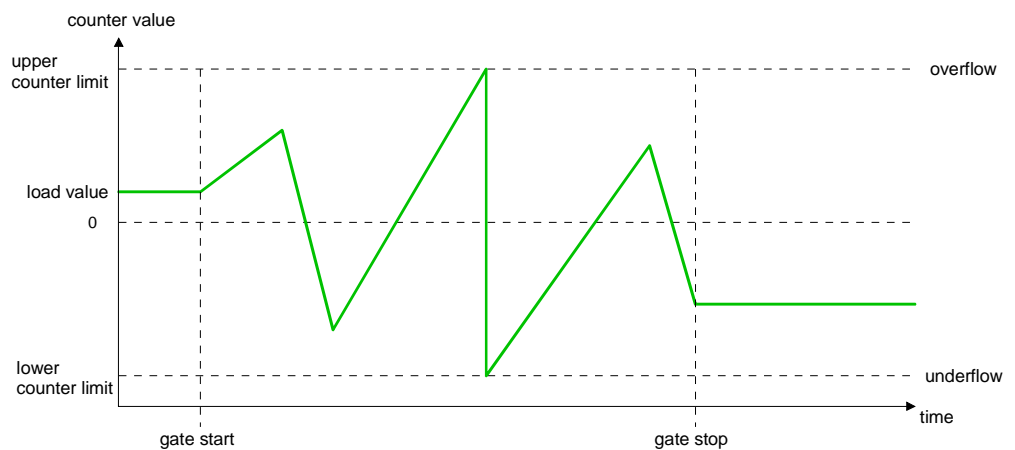
Once   *No main counting direction*

- The counter counts once starting with the load value.
- You may count forward and backwards.
- The count limits are set to the maximum count range.
- At over- or underrun at the count limits, the counter jumps to the according other count limit and counts from there on. The gate is automatically closed.
- To restart the count process, you must create a positive edge of the gate.
- At interrupting gate control, the count process continuous with the last recent counter value.
- At aborting gate control, the counter starts with the load value.

	Valid value range
Lower count limit	- 2 147 483 648 (-2^{31})
Upper count limit	+ 2 147 483 647 (2^{31}-1)
Counter value	- 2 147 483 648 (-2^{31}) to + 2 147 483 647 (2^{31}-1)
Load value	- 2 147 483 647 (-2^{31}+1) to + 2 147 483 646 (2^{31}-2)

Interrupting gate control:
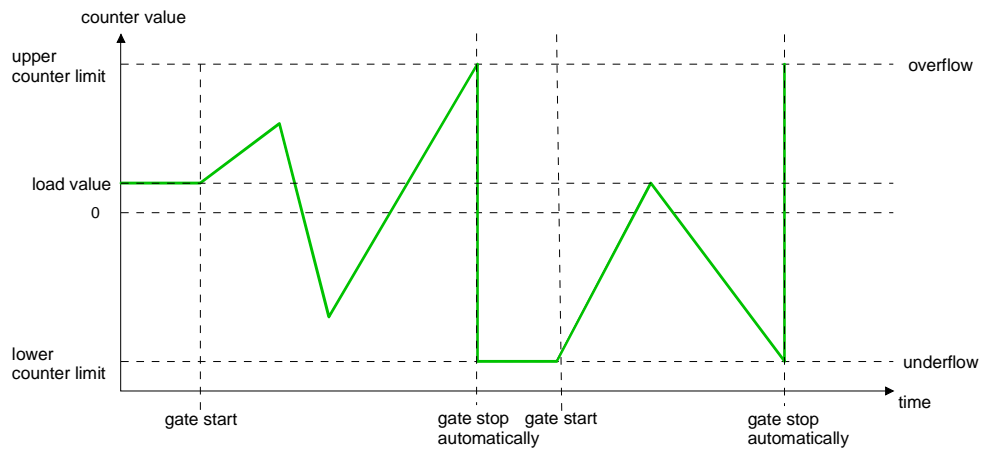
Aborting gate control:
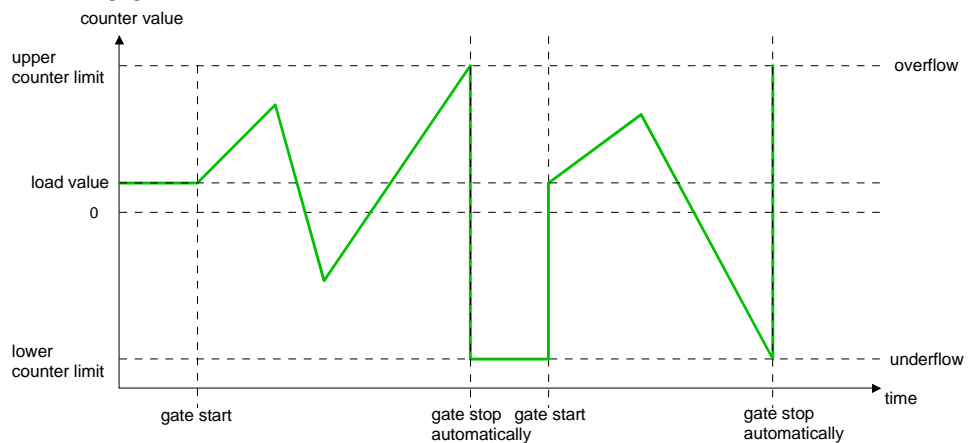
Main counting direction forward

- The counter counts starting with the load value.

- When the counter reaches the end value −1 in positive direction, it jumps to the load value at the next positive count pulse and the gate is automatically closed.

- To restart the count process, you must create a positive edge of the gate. The counter starts with the load value.

	Valid value range
Limit value	- 2 147 483 646 (-2^{31}+1) to + 2 147 483 646 (2^{31}-1)
Lower count limit	- 2 147 483 648 (-2^{31})
Counter value	- 2 147 483 648 (-2^{31}) to end value -1
Load value	- 2 147 483 648 (-2^{31}) to end value -2
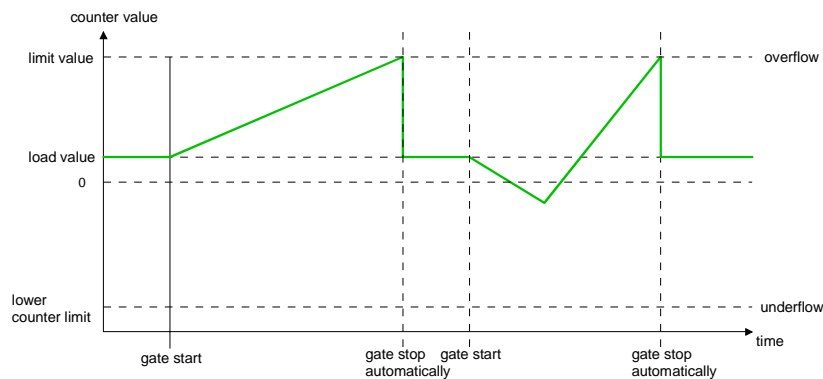
Main counting direction backwards

- The counter counts starting with the load value.

- When the counter reaches the end value in negative direction, it jumps to the load value at the next negative count pulse and the gate is automatically closed.

- To restart the count process, you must create a positive edge of the gate. The counter starts with the load value.

	Valid value range
Limit value	- 2 147 483 646 (-2^{31}+1) to + 2 147 483 646 (2^{31}-1)
Upper count limit	+2 147 483 646 (2^{31}-1)
Counter value	- 2 147 483 646 (-2^{31}+1) to + 2 147 483 646 (-2^{31}-1)
Load value	- 2 147 483 646 (-2^{31}+1) to + 2 147 483 646 (-2^{31}-1)
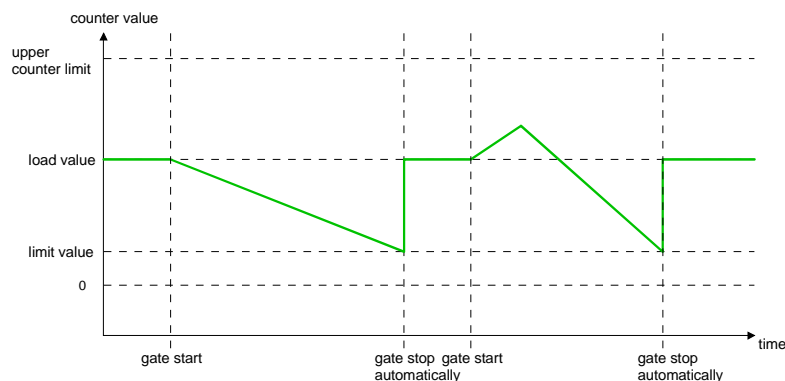
Periodically

No main counting direction:

- The counter counts starting with the load value.
- At over- or underrun at the count limits, the counter jumps to the according other count limit and counts from there on.
- The count limits are set to the maximum count range.

	Valid value range
Lower count limit	- 2 147 483 648 (-2^{31})
Upper count limit	+ 2 147 483 647 (2^{31}-1)
Counter value	- 2 147 483 648 (-2^{31}) to + 2 147 483 647 (2^{31}-1)
Load value	- 2 147 483 647 (-2^{31}+1) to + 2 147 483 646 (2^{31}-2)

Main counting direction forward

- The counter counts starting with the load value.
- When the counter reaches the end value –1 in positive direction, it jumps to the load value at the next positive count pulse.

	Valid value range
Limit value	- 2 147 483 647 (-2^{31}+1) to + 2 147 483 647 (2^{31}-1)
Lower count limit	- 2 147 483 648 (-2^{31})
Counter value	- 2 147 483 648 (-2^{31}) to end value -1
Load value	- 2 147 483 648 (-2^{31}) to end value -2
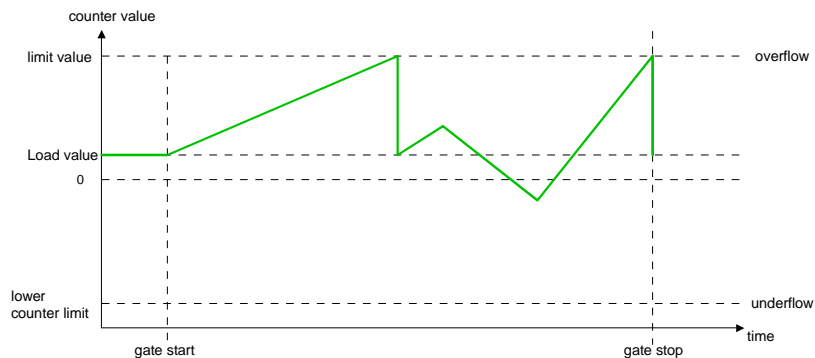
Main counting direction backwards

- The counter counts starting with the load value.

- When the counter reaches the end value in negative direction, it jumps to the load value at the next negative count pulse.

- You may exceed the upper count limit.

	Valid value range
Limit value	- 2 147 483 647 (-2^{31}+1) to + 2 147 483 647 (2^{31}-1)
Upper count limit	+2 147 483 647 (2^{31}-1)
Counter value	- 2 147 483 647 (-2^{31}+1) to +2 147 483 647 (2^{31}-1)
Load value	- 2 147 483 647 (-2^{31}+1) to +2 147 483 647 (2^{31}-1)
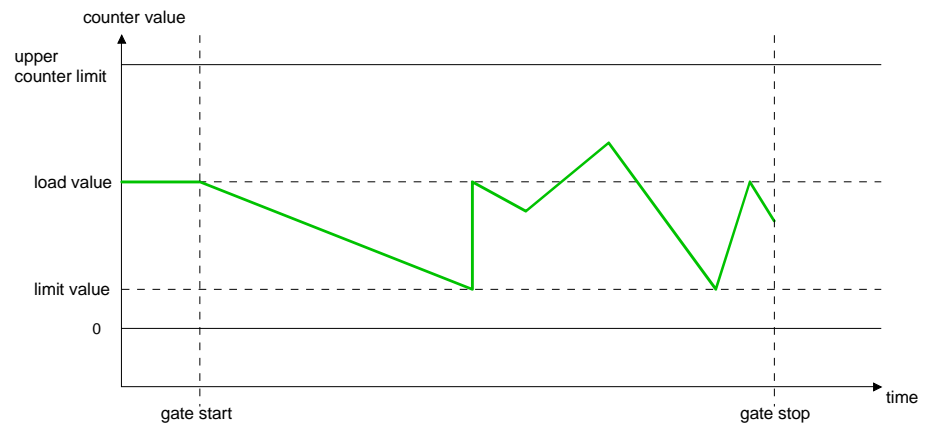
Technical Data

Analog In-/Output

Electrical Data	VIPA 238-1BC00							
Number of Current-/Voltage input	3							
Number of resistance input	1							
Number of outputs	2							
Voltages, Currents, Potentials								
Constant current for resistance encoder	1.5mA							
Potential separation								
- channel / backplane	yes							
Isolation proofed with	DC 500V							
Supply voltage	DC 5V via backplane bus (next release with DC 24V by front connector)							
Current consumption								
- via backplane bus	Max. 600mA							
Analog value calculation input channels	Calculation time/Resolution (per channel)							
Parameterized velocity (Hz)	15	30	60	30	120	200	3.7	7.5
Basic calculation time (ms)	69	35.5	19	10	8	6.75	268	135
Resolution in Bit	16	16	15	14	12	10	16	16
Analog value calculation output channels								
Resolution (incl. Overdrive region)								
±10V, ±20mA	11Bit + sign							
4 ... 20mA, 1 ... 5V	10Bit							
0 ... 10V, 0 ... 20mA	11Bit							
Cycle time	1,5ms							
Boot time								
- impedance load	0.3ms							
- capacitive load	1.0ms							
- inductive load	0.5ms							
Error limits output channels								
Usage error limit (whole temperature range, referring to input range)								
	Measuring range				Tolerance			
At voltage input	400mV-10V				±0,3%			
At current input	±20mA				±0,4%			
	4 ... 20mA				±1,0%			
Resistance	600Ω-3000Ω				±0,4%			
Resistance thermometer	Pt100, Pt1000				±0,4%			
	Ni100, Ni1000				±0,6%			

... continue Technical Data

Error limits input channels		
Usage error limit (during temperature is 25°C, referring to input range)		
	Measuring range	Tolerance
Voltage input	400mV-10V	±0,2%
Current input	±20mA	±0,2%
	4 ... 20mA	±0,5%
Resistance	600Ω - 3000Ω	±0,2%
Resistance thermometer	Pt100, Pt1000	±0,2%
	Ni100, Ni1000	±0,3%
Error limits output channels		
Usage error limit (whole temperature range, referring to input range)		
	Measuring range	Tolerance
Voltage output	±10V	±0.4%
	0 ... 10V	±0.6%
	1 ... 5V	±0.8%
Current output	±20mA	±0.3%
	0 ... 20mA	±0.6%
	4 ... 20mA	±0.8%
Error limits output channels		
Usage error limit (during temperature is 25°C, referring to input range)		
	Measuring range	Tolerance
Voltage output	±10V	±0.2%
	0 ... 10V	±0.3%
	1 ... 5V	±0.4%
Current output	±20mA	±0.3%
	0 ... 20mA	±0.4%
	4 ... 20mA	±0.5%
States, Alarms, Diagnosis		
Diagnosis alarm	parameterizable	
Diagnosis functions		
- Sum error monitor	red LED (F)	
- Diagnostic information readable	possible	
Data for choosing an encoder		
Voltage input		
- 50mV – 400mV	10MΩ	
- 4V – 10V	100kΩ	
Current input	33 Ω	

continue Technical Data...

...continue Technical Data

Data for choosing an actuator	
Burden resistance (in nominal range of the output)	
At voltage outputs	
- impedance load	min. 1 kΩ
- capacitive load	max. 1µF
At current output	
- impedance load	max. 500 Ω
- capacitive load	max. 10 mH
Parameter data	
Input data	8Byte (1 Word via channel)
Output data	4Byte (1 Word via channel)
Parameter data	16Byte
Diagnostic data	12Byte
Dimensions and weight	
Dimensions (WxHxD) in mm	50.8x76x76mm
Weight	100g

Digital Input

Elektrical Data	VIPA 238-1BC00
Number of inputs	16
Counter	3 (2 inputs each A, B)
Nominal input voltage	DC 24V (18 ... 28,8V)
Signal voltage "0"	0 ... 5V
Signal voltage "1"	15 ... 28,8V
Input filter time delay	3ms
Input filter pulse input	100µs
Frequency	max. 30kHz
Input current	typ. 7mA
Supply voltage	5V via backplane bus
Current consumpion via backplane bus	100mA
Isolation	500Veff
	(field voltage - backplane bus)
Status monitor	via LEDs at the front side
Parameter data	
Input data	16Byte
Output data	16Byte
Parameter data	63Byte
Diagnostic data	-

Bus expansion IM 260, IM 261

The system consisting of IM 260, IM 261 and interconnecting cables is an expansion option that you use to split the System 200V over up to 4 rows.

This system may only be installed in a centralized System 200V where a PC 288 or a CPU is employed as the master station!

For bus expansion purposes you always have to include the basic interface IM 260. The basic interface may then be connected to up to 3 additional System 200V rows by means of the appropriate interconnecting cables and the IM 261 interfacing module for rows.

Please note!   Certain rules and regulations have to be observed when the bus expansion modules are being employed:

- The bus expansion may only be used in conjunction with the PC 288 (VIPA 288-2BL10) or a CPU (combi-CPUs are also permitted). The system must never be employed in decentralized systems, e.g. behind a Profibus-DP slave!
- The system caters for a maximum of 4 rows.
- Every row can carry a maximum of 16 peripheral modules.
- The max. total quantity of 32 peripheral modules may not be exceeded.
- In critical environments the total length of interconnecting cables should not exceed a max. of 2m.
- Every row may derive a max. current of 1.5A from the backplane bus, while the total current is limited to 4A.
- At least one peripheral module <u>must</u> be installed next to the IM 260 basic interface!

Construction   The following figure shows the construction of a bus expansion under observance of the installation requirements and rules:
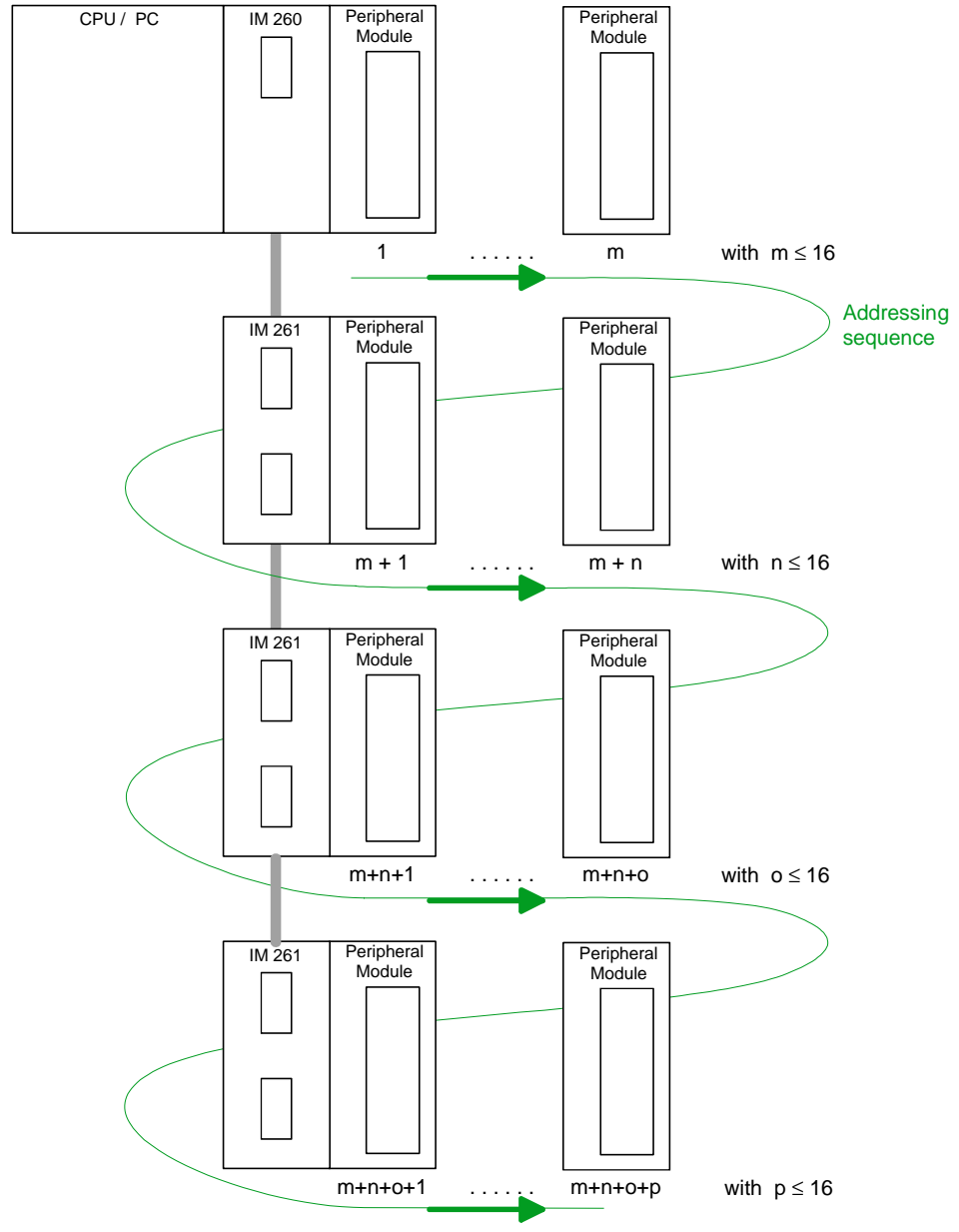
Where: $m + n + o + p \leq 32$

Note!

The bus expansion may only be used in conjunction with the PC 288 (VIPA 288-2BL10) or a CPU (combi-CPUs are also permitted)!

The bus expansion module is supported as of the following minimum firmware revision levels:

CPU compatible with Siemens STEP[®]5: from Version 2.07

CPU compatible with Siemens STEP[®]7: from Version 1.0

CPU for IEC 61131-3:   from Version 1.0

Status indicator Basic interface IM 260

LED	Color	Description
PW	yellow	Supply voltage available
P8	yellow	Supply voltage for subsequent rows is active
EN	yellow	Backplane bus communications active
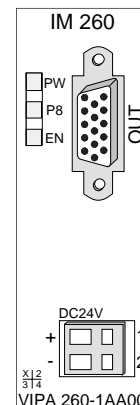
Status indicator row interface IM 261

LED	Color	Description
PW	yellow	Supply voltage available via IM 260
EN	yellow	Backplane bus communication active
BA	red	Outputs inhibited (BASP) is active
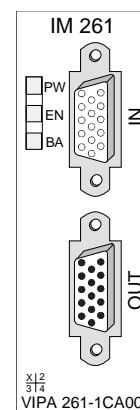
Ordering data Cables

Type	Order number	Description
Cable 0.5m	VIPA 260-1XY05	Interconnecting cable, 0.5m length
Cable 1m	VIPA 260-1XY10	Interconnecting cable, 1m length
Cable 1.5m	VIPA 260-1XY15	Interconnecting cable, 1.5m length
Cable 2m	VIPA 260-1XY20	Interconnecting cable, 2m length
Cable 2.5m	VIPA 260-1XY25	Interconnecting cable, 2.5m length

Technical data

Electrical data	VIPA 260-1AA00	VIPA 261-1CA00
Power supply	24V DC via front	-
Current consumption	1.9A	-
Current consumption backplane bus	30mA	-
Power supply backplane bus at IM 261	-	max. 1.5A per row (max. total 4A)
max. cable distance betw. 1st and last row	2.5m	
Dimensions and weight		
Dimensions (WxHxD) in mm	25.4x76x76	25.4x76x76
Weight	80g	50g

4port mini switch CM 240

Ordering data   4port mini switch CM 240   VIPA 240-1DA10

                        Attention: the 4port mini switch had the order no. 243-1DA10 before!

Overview   The 4port mini switch completes the System 200V network technology.

                        Auto-Negotiation, Speed-Auto-Sensing and the Auto-MDI/MDIX-Crossover for every port enable the module for "plug & play".

                        The module is provided with the needed operating voltage via the backplane bus. Alternatively you may supply the module via the front.

                        The status indication of the 4 ports happens via LEDs on the front side.

Properties
- 4 ports for 10 res. 100MBit/s,
- "plug and play" through Auto-MDI/MDIX-crossover for 100BASE-TX and 10BASE-T,
- Auto-Negotiation and Speed-Auto-Sensing
- for every port automatic switch between 10 and 100MBit/s res. half- and full-duplex operation
- LEDs for activity, speed and collision
- Supports IEEE 802.3, IEEE 802.3u and IEEE 802.3x
- Extra high performance up to 150m at UTP (unscreened twisted-pair cable)
- Back-pressure-based flow control at half-duplex operation
- Pause-frame-based flow control at full-duplex operation
- Store-and-forward switching mode
- Shared memory based switch

**Front view
CM 240**

[1]   LED Status monitoring
[2]   twisted-pair Ports for Ethernet
[3]   Power supply external
[4]   DIL switch for security function
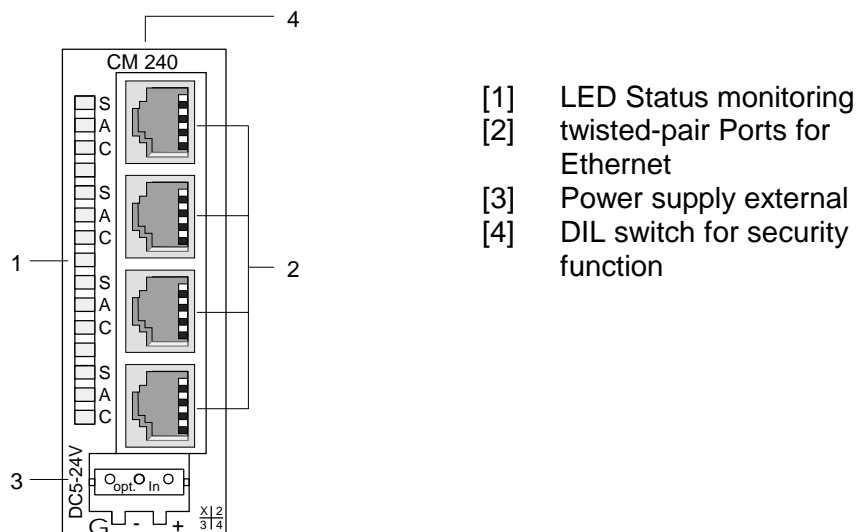
Components

LEDs

For every twisted-pair jack there are 3 LEDs at the front side. The LEDs have the following function:

Name	Color	Function	Description
S	green	Speed	on: 100MBit, off: 10MBit
A	yellow	Activity	on: physically connected, off: no physical connection
			blinking: shows bus activity
C	yellow	Collision	on: full-duplex operation active,
			off: half-duplex operation active
			blinking: Collision detected

Power supply
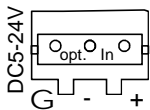
The power supply takes place via the backplane bus of the System 200V. You may also deploy the switch as stand-alone device. Here you have to provide it with external DC 5...24V.

The plug for connecting an external power supply is under a flap that you have to break out.

For connecting an external power supply there is a connection jack available from VIPA under the order number VIPA 970-0CM00.

Attention!

The power supply has to take place either internal via backplane bus or external.

A simultaneous supply must be avoided!

Twisted-pair ports   The twisted-pair jacks are used to build-up a twisted-pair network in star topology. This allows you to connect up to 4 Ethernet components, where 1 connection has to be deployed as uplink port to the ongoing network.

The uplink port is detected automatically as long as you haven't activated the security function via DIL switch.

DIL switch for security function   The activation of the security function prevents the listening between the lower three twisted-pair jacks. Precondition in this case is the uplink via the upper twisted-pair port.

To activate the security function there is a DIL switch on the upper side of the module on the platine with the following function:

Switch 1	on:	Security function deactivated (Default)
	off:	Security function active
Switch 2		no function at the moment

Technical data

Electrical Data	VIPA 240-1DA10
Number of ports	4
Current consumption via backplane bus	460mA
Power supply (intern)	DC 5V, via backplane bus
Power supply (extern)	optional connection jack VIPA 970-0CM00 DC 5...24V
Status monitor	via LEDs at the front side
Interface	
	RJ45 twisted-pair, UTP, S/FTP
Dimensions and Weight	
Dimensions (WxHxD) in mm	25.4x76x76
Weight	50g

Terminal module CM 201

2 x 11 pole

The terminal module is available under order no.: VIPA 201-1AA00.

This module is a complementary module providing 2- or 3wire connection facilities. The module is not connected to the system bus.

Properties

- 2 separate rows of 11 electrically interconnected terminals.
- No connection to the system bus.
- Maximum terminal current 10A.

Construction and schematic diagram

Construction
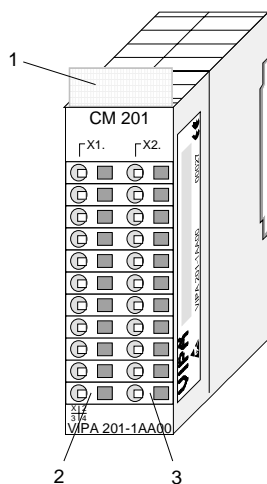
Description

[1] Label
[2] 1st terminal strip
[3] 2nd terminal strip

Schematic diagram
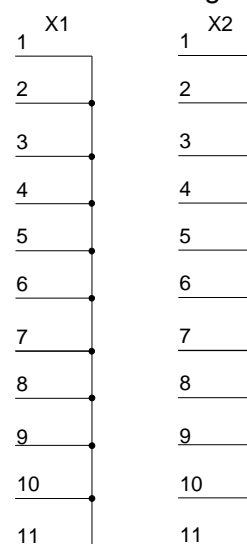
Technical data

Electrical data	VIPA 201-1AA00	VIPA 201-1AA10	VIPA 201-1AA20
Number of rows	2	2	2
Number of terminals per row	11	11	11
Maximum terminal current	10A	10A	10A
Terminal color	gray/gray	green-yellow/gray	red/blue
Dimensions and weight			
Dimensions (WxHxD) in mm	25.4x76x76	25.4x76x76	25.4x76x76
Weight	50g	50g	50g

2 x 5 pole   The terminal module has the order no: VIPA 201-1AA40.

2 x 6 pole   This module is a complementary module providing 2- or 3wire connection facilities. The module is not connected to the system bus.

Properties
- 4 separate rows with 2 x 5 and 2 x 6 electrically interconnected terminals.
- No connection to the system bus.
- Maximum terminal current 10A.

Construction and schematic diagram

Construction
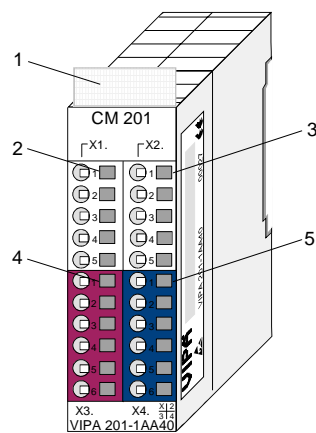
Description

[1] Label
[2] 1st terminal strip
[3] 2nd terminal strip
[4] 3rd terminal strip
[5] 4th terminal strip

Schematic diagram
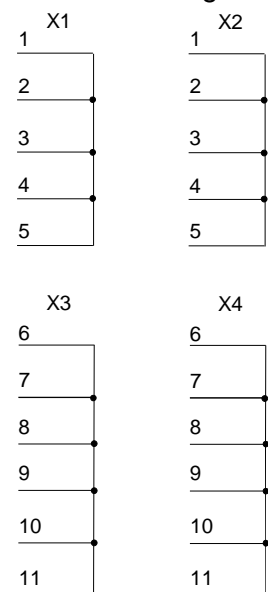
Technical data

Electrical data	VIPA 201-1AA40
Number of rows	2
Number of terminals per row	5 + 6
Maximum terminal current	10A
Terminal color	gray/red/blue
Dimensions and weight	
Dimensions (WxHxD) in mm	25.4x76x76
Weight	50g

Chapter 20   Assembly and installation guidelines

Overview   This chapter contains the information required to assemble and wire a controller consisting of Systems 200V components.

Below follows a description of:
- a general summary of the components
- steps required for the assembly and for wiring
- table for the assembly Regarding the current consumption
- EMC guidelines for assembling the System 200V

Overview

General   The modules are installed on a carrier rail. A bus connector provides inter-
connections between the modules. This bus connector links the modules
via the backplane bus of the modules and it is placed into the profile rail
that carries the modules.

Profile rail   You may use the following standard 35mm profile rail to mount the System
200V modules:
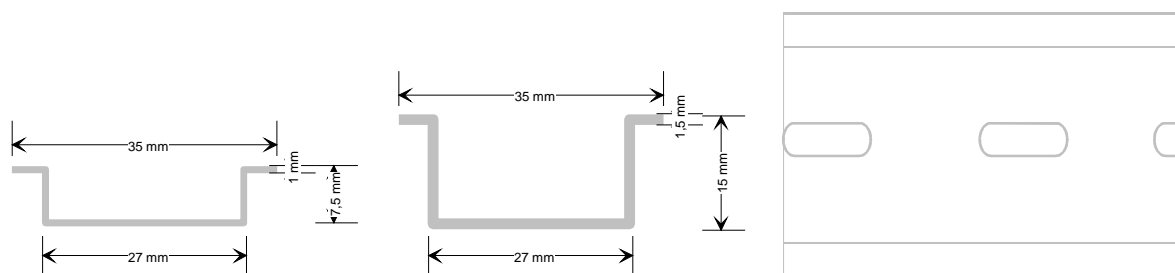
Bus connector   System 200V modules communicate via a backplane bus connector. The
backplane bus connector is isolated and available from VIPA in of 1-, 2-, 4-
or 8tier width.

The following figure shows a 1tier connector and a 4tier connector bus:
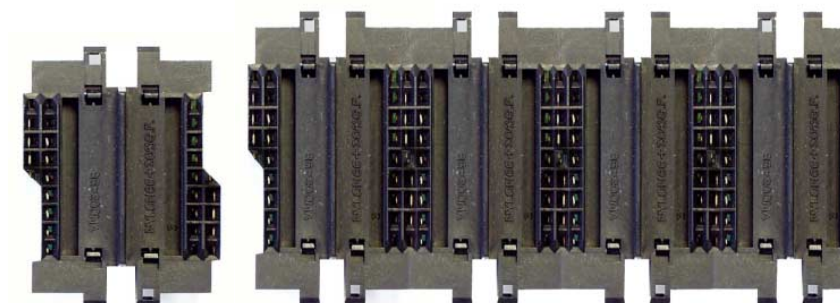
The bus connector is isolated and has to be inserted into the profile rail
until it clips in its place and the bus connections protrude from the rail.

Order data

Type	Order number	Description
Bus connector	VIPA 290-0AA10	Bus connector 1tier width
Bus connector	VIPA 290-0AA20	Bus connector 2tier width
Bus connector	VIPA 290-0AA40	Bus connector 4tier width
Bus connector	VIPA 290-0AA80	Bus connector 8tier width
Profile rail	VIPA 290-0AF30	35x15mm, 530mm length 1.5mm gauge, punctured

Profile rail installation

The following figure shows the installation of a 4tier width bus connector in a profile rail and the plug-in locations for the modules.

The different plug-in locations are defined by guide rails.
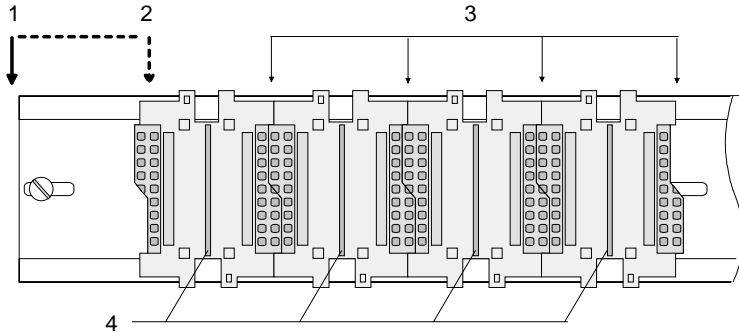
[1]   Header module like PC, CPU, bus coupler, if double width
[2]   Main module (single width)
[3]   Peripheral module
[4]   Guide rails

Note

A maximum of 32 modules can be connected at the back plane bus.

Take attention that here the **maximum sum current** of **3,5A** is not exeeded.

Please install modules with a high current consumption directly beside the header module.

The chapter "Assembly and installation guidelines" contains an overview over the current consumptions.
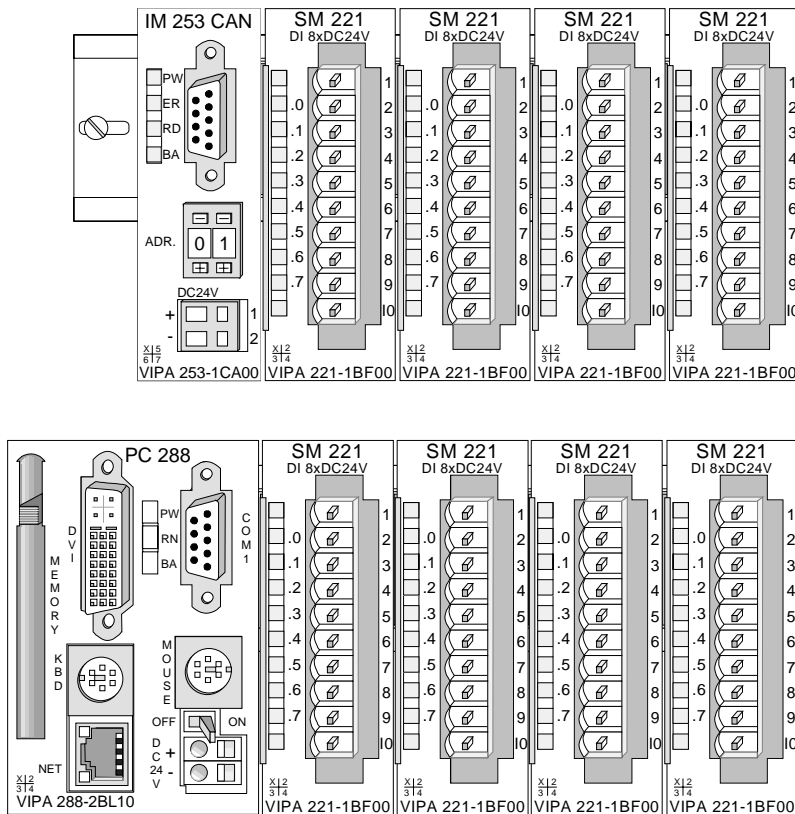
Assembly

Please follow these rules during the assembly!

- Turn off the power supply before you insert or remove any modules!
- Make sure that a clearance of at least 60mm exists above and 40mm below the bus rail.
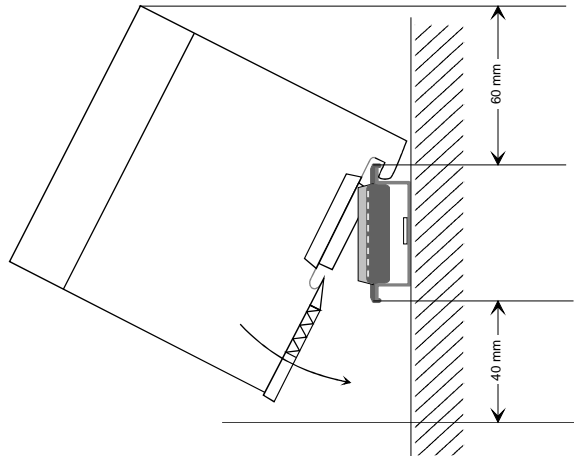
- Every row must be completed from left to right and it has to start with a header module (PC, CPU, and bus coupler).
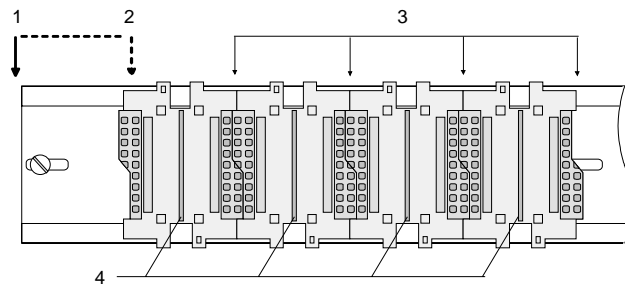
[1]	Header module like PC, CPU, bus coupler, if double width
[2]	Header module (single width)
[3]	Peripheral module
[4]	Guide rails

- Modules are to install adjacent to each other. Gaps are not permitted between the modules since this would interrupt the backplane bus.
- A module is only installed properly and connected electrically when it has clicked into place with an audible click.
- Plug-in locations after the last module may remain unoccupied.

Note!

A maximum of 32 modules can be connected at the back plane bus. Take attention that here the maximum **sum current** of **3,5A** is not exeeded.

Assembly regarding the current consumption

- Use bus connectors as long as possible
- Sort the modules with a high current consumption right beside the header module. The following table shall help you:

Current consumption of the peripheral modules

Order no.	Module	Current consumption
Digital input modules SM 221		
VIPA 221-1BF00	DI 8xDC24V	20mA
VIPA 221-1BF10	DI 8xDC24V (0,2ms)	20mA
VIPA 221-1BF20	DI 8xDC24V Alarm	140mA
VIPA 221-1BF50	DI 8xDC24V NPN	20mA
VIPA 221-1FD00	DI 4xAC/DC 90...230V	80mA
VIPA 221-1FF20	DI 8xAC/DC 60...230V	80mA
VIPA 221-1FF30	DI 8xAC/DC 24...60V	80mA
VIPA 221-1FF40	DI 8xAC 230V, 20mA	80mA
VIPA 221-1FF50	DI 8xAC/DC 180...265V	30mA
VIPA 221-1BH00	DI 16xDC 24V, UB4x	20mA
VIPA 221-1BH10	DI 16xDC 24V	30mA
VIPA 221-1BH20	DI 16xDC 24V, 1 Counter, 100kHz	100mA
VIPA 221-1BH50	DI 16xDC 24V, NPN	20mA
VIPA 221-2BL10	DI 32xDC 24V	50mA
Digital output modules SM 222		
VIPA 222-1BF00	DO 8xDC 24V, 1A	50mA
VIPA 222-1BF10	DO 8xDC 24V, 2A	50mA
VIPA 222-1BF20	DO 8xDC 24V, 2A, floating	50mA
VIPA 222-1BF30	DO 8xDC 24V, 0,5A	50mA
VIPA 222-1BH00	DO 16xDC 24V, 0,5A, UB4x	100mA
VIPA 222-1BH10	DO 16xDC 24V, 1A	80mA
VIPA 222-1BH20	DO 16xDC 24V, 2A	100mA
VIPA 222-1BH30	DO 16xDC 24V, 0,5A	80mA
VIPA 222-1BH50	DO 16xDC 24V, 0,5A, NPN	100mA
VIPA 222-2BL10	DO 32xDC 24V, 1A	140mA
VIPA 222-1HF00	DO 8xrelay	270mA
VIPA 222-1HD10	DO 4xrelay, floating	150mA
VIPA 222-1HD20	DO 4xrelay, floating, bistable	40mA
VIPA 222-1FF00	DO 8xrelay, Solid State	140mA
VIPA 222-1FD10	DO 4xrelay, Solid State	100mA

... continue

Order no.	Module	Current consumption
Digital in-/output modules SM 223		
VIPA 223-1BF00	DIO 8xDC 24V, 1A	65mA
VIPA 223-2BL10	DI 16xDC 24V, DO 16xDC 24V, 1A	100mA
Analog input modules SM 231		
VIPA 231-1BD52	AI 4x16Bit, Multiinput	240mA
VIPA 231-1BD53	AI 4x16Bit, Multiinput	110mA
VIPA 231-1BD60	AI 4x12Bit, 4...20mA	280mA
VIPA 231-1BF00	AI 8x16Bit, (2L) 4x16Bit (4L)	280mA
VIPA 231-1FD00	AI 4x16Bit f, U/I	300mA
Analog output modules SM 232		
VIPA 232-1BD51	AO 4x12Bit	70mA
VIPA 232-1BD60	AO 4x12Bit f	50mA
Analog in-/output modules SM 234		
VIPA 234-1BD50	AI/AO 2x12Bit, Multiin-/output	110mA
VIPA 234-1BD60	AI 4/AO 2x12Bit, Multiin-/output	600mA
Additional modules		
VIPA 208-1CA01	IM 208CAN - CANopen master	250mA
VIPA 208-1DP01	IM 208DP for CPU 21x	450mA
VIPA 208-2DP10	IM 208DPO	500mA
VIPA 240-1BA00	CP 240, RS232C	200mA
VIPA 240-1BA10	CP 240, RS232C, Modbus	200mA
VIPA 240-1CA00	CP 240, RS422/485	200mA
VIPA 240-1CA10	CP 240, RS422/485, Modbus	200mA
VIPA 240-1DA10	CM 240, 4port Mini-Switch	460mA
VIPA 250-1BA00	Counter 2x32Bit FM 250	80mA
VIPA 250-1BS00	SSI-Modul FM250S	200mA
VIPA 253-1BA00	MotionControl Stepper FM 253	200mA
VIPA 254-1BA00	MotionControl Servo FM 254	295mA

Assembly procedure

The following sequence represents the assembly procedure as viewed from the side.
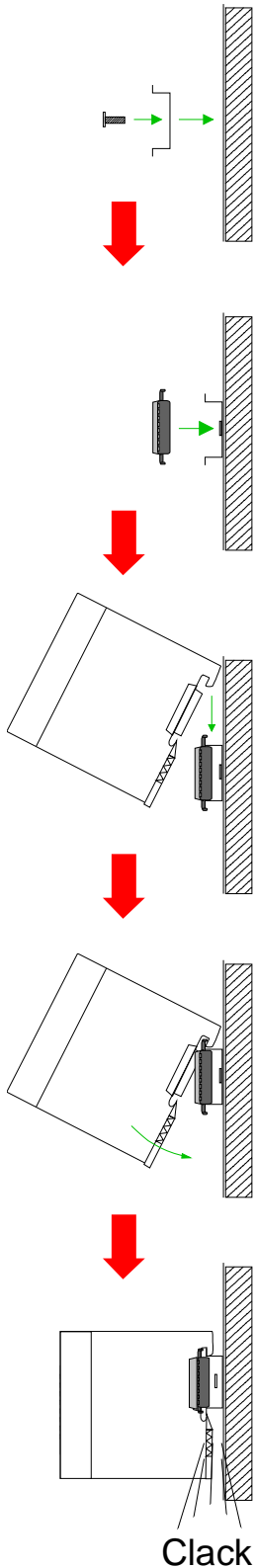
- Install the profile rail. Please ensure that you leave a module installation clearance of at least 60mm above the rail and at least 40mm below the rail.

- Press the bus connector into the rail until it clips securely into place and the bus-connectors protrude from the profile rail. This provides the basis for the installation of your modules.

- Start at the outer left location with the installation of your header module like CPU, PC or bus coupler and install the peripheral modules to the right of this.
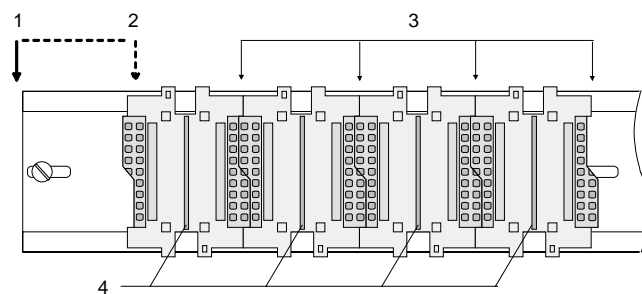
[1]	Header module like PC, CPU, bus coupler
[2]	Header module when this is a double width or a peripheral module
[3]	Peripheral module
[4]	Guide rails

- Insert the module that you are installing into the profile rail at an angle of 45 degrees from the top and rotate the module into place until it clicks into the profile rail with an audible click. The proper connection to the backplane bus can only be guaranteed when the module has properly clicked into place.

Clack

⚠ **Attention!**

Power must be turned off before modules are installed or removed!

**Removal
procedure**

The following sequence shows the steps required for the removal of modules in a side view.
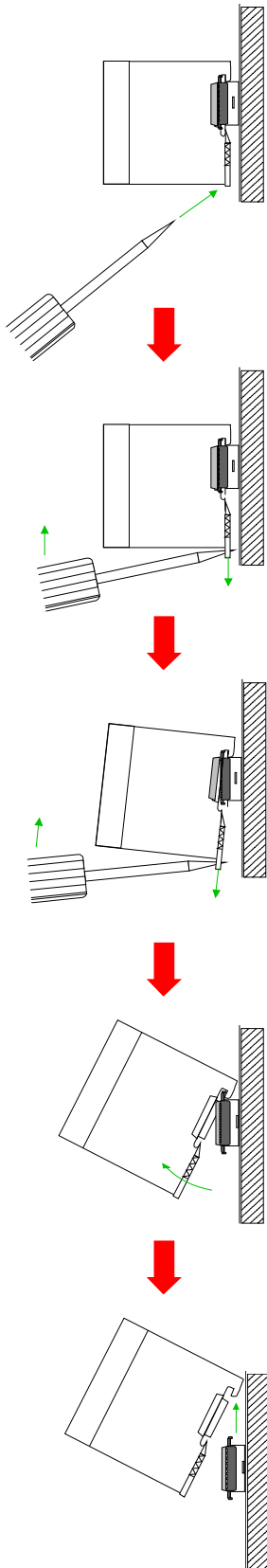
- The enclosure of the module has a spring-loaded clip at the bottom by which the module can be removed from the rail.
- Insert a screwdriver into the slot as shown

- The clip is unlocked by pressing the screwdriver in an upward direction.

- Withdraw the module with a slight rotation to the top.

Attention!

Power must be turned off before modules are installed or removed!

Please remember that the backplane bus is interrupted at the point where the module was removed!

Wiring

Outline

Most peripheral modules are equipped with a 10pole or an 18pole connector. This connector provides the electrical interface for the signaling and supply lines of the modules.

The modules carry spring-clip connectors for the interconnections and wiring.

The spring-clip connector technology simplifies the wiring requirements for signaling and power cables.

In contrast to screw terminal connections, spring-clip wiring is vibration proof. The assignment of the terminals is contained in the description of the respective modules.

You may connect conductors with a diameter from $0.08mm^2$ up to $2.5mm^2$ for 18pole connectors.

The following figure shows a module with a 10pole connector.

Folgende Abbildung zeigt ein Modul mit einem 10poligen Steckverbinder.

Pin no.

Round aperture for wires

Rectangular opening for screwdriver

Pin no.
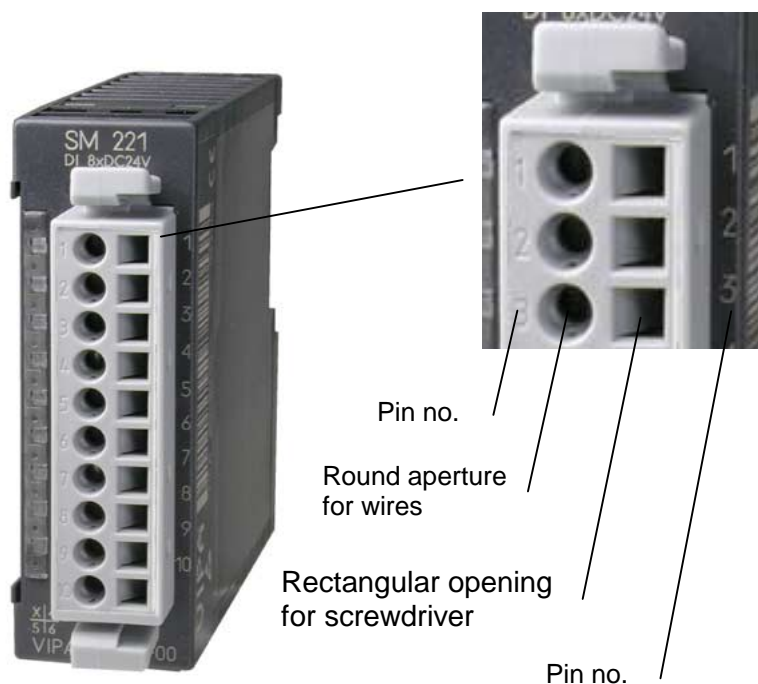
Note!

The spring-clip is destroyed if you insert the screwdriver into the opening for the hook-up wire!

Make sure that you only insert the screwdriver into the square hole of the connector!

Wiring procedure
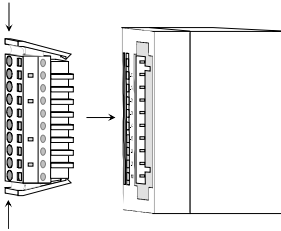
- Install the connector on the module until it locks with an audible click. For this purpose you press the two clips together as shown.

  The connector is now in a permanent position and can easily be wired.

The following section shows the wiring procedure from above.
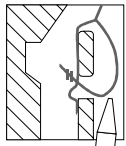
- Insert a screwdriver at an angel into the square opening as shown.
- Press and hold the screwdriver in the opposite direction to open the contact spring.
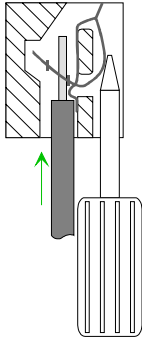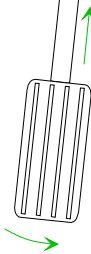
- Insert the stripped end of the hook-up wire into the round opening. You can use wires with a diameter of $0.08mm^2$ to $2.5mm^2$ ($1.5mm^2$ for 18pole connectors).
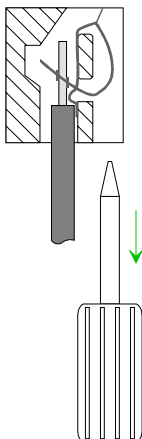
- When you remove the screwdriver, the wire is clipped securely.

Wire the power supply connections first
followed by the signal cables (inputs and outputs)

Installation dimensions

Here follow all the important dimensions of the System 200V.

Dimensions   1tier width (HxWxD) in mm: 76 x 25.4 x 76
Basic enclosure   2tier width (HxWxD) in mm: 76 x 50.8 x 76

**Installation
dimensions**
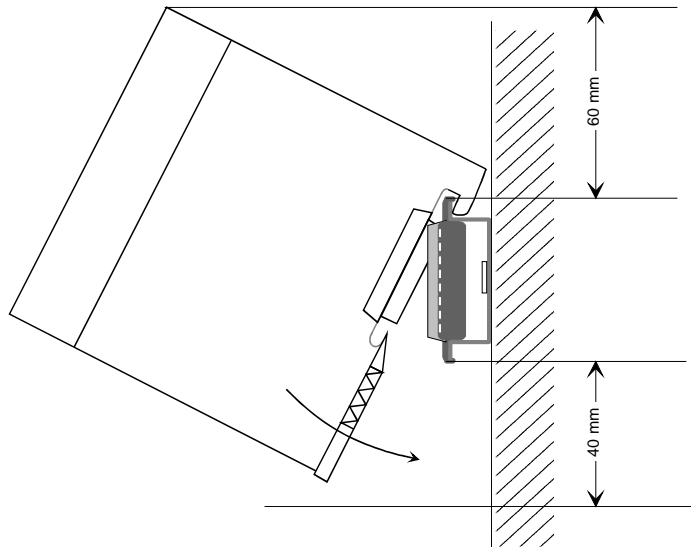
**Installed and
wired dimensions**
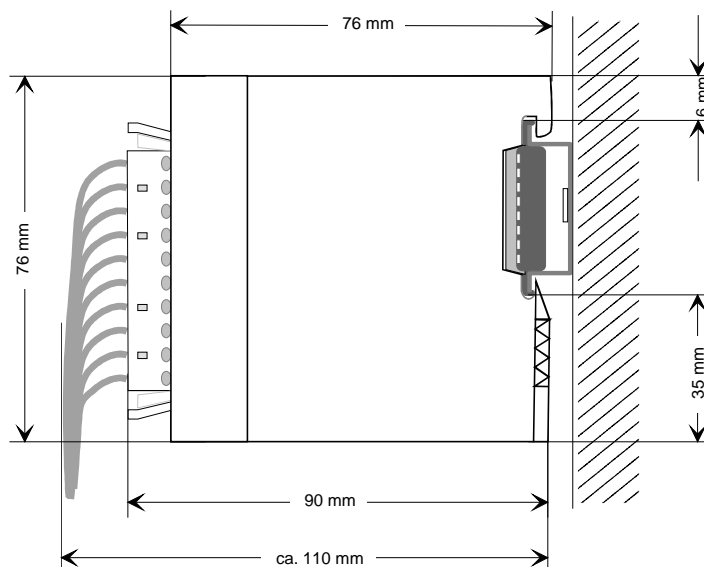
Automatic labeling

General   The System 200V peripheral modules have a label that can be used for automatic labeling.

Labeling by means of WinNCS   You may use the labeling components of WinNCS to print the required labels. WinNCS is the VIPA configuration tool that has a special label printing feature for the System 200V labels.

Labeling by means of WinLP   VIPA supplies the label printing package WinLP to create the labels for a Siemens S7 project. This generates labels for the System 200V from the Siemens S7-cfg file.

Order data

Type	Order number	Description
WinNCS	VIPA SW-WinNCS	Configuration and labeling software for the System 200V under Win9x/NT incl. WinLP
Demo Software	VIPA SW-Tool Demo	Demo versions of all VIPA tools incl. full labeling functions under WinNCS
Block of labels	VIPA 292-1XY00	10 label cards with covers
Sheets of labels	VIPA 292-1XY10	10 perforated sheets of labels 8 labels each

Installation guidelines

General
The installation guidelines contain information on the proper assembly of System 200V systems. Here we describe possible ways of interference that may disturb the controlling system and how you have to approach shielding and screening issues to ensure the electromagnetic compatibility (EMC).

What is EMC?
The term "electromagnetic compatibility" (EMC) refers to the ability of an electrical device to operate properly in an electromagnetic environment without interference from the environment or without the device causing illegal interference to the environment.

All System 200V components were developed for applications in harsh industrial environments and they comply with EMC requirements to a large degree. In spite of this you should implement an EMC strategy before installing any components which should include any possible source of interference.

Possible sources for disturbances
Electromagnetic interference can enter your system in many different ways:

- Fields
- I/O signal lines
- Bus system
- Power supply
- Protective conductor

Interference is coupled into your system in different ways, depending in the propagation medium (conducted or not) and the distance to the source of the interference.
We differentiate between:

- galvanic coupling
- capacitive coupling
- inductive coupling
- radiated power coupling

The most important rules for ensuring EMC

In many cases, adherence to a set of very elementary rules is sufficient to ensure EMC. For this reason we wish to advise you to heed the following rules when you are installing your controllers.

- During the installation of your components you have to ensure that any inactive metal components are grounded via a proper large-surface earth.
  - Install a central connection between the chassis ground and the earthing/protection system.
  - Interconnect any inactive metal components via low-impedance conductors with a large cross-sectional area.
  - Avoid aluminum components. Aluminum oxidizes easily and is therefore not suitable for grounding purposes.
- Ensure that wiring is routed properly during installation.
  - Divide the cabling into different types of cable. (Heavy current, power supply, signal and data lines).
  - Install heavy current lines and signal or data lines in separate channeling or cabling trusses.
  - Install signaling and data lines as close as possible to any metallic ground surfaces (e.g. frames, metal rails, sheet metal).
- Ensure that the screening of lines is grounded properly.
  - Data lines must be screened.
  - Analog lines must be screened. Where low-amplitude signals are transferred, it may be advisable to connect the screen on one side of the cable only.
  - Attach the screening of cables to the ground rail by means of large surface connectors located as close as possible to the point of entry. Clamp cables mechanically by means of cable clamps.
  - Ensure that the ground rail has a low-impedance connection to the cabinet/cubicle.
  - Use only metallic or metallized covers for the plugs of screened data lines.
- In critical cases you should implement special EMC measures.
  - Connect snubber networks to all inductive loads that are controlled by System 200V modules.
  - Use incandescent lamps for illumination purposes inside cabinets or cubicles, do not use fluorescent lamps.
- Create a single reference potential and ensure that all electrical equipment is grounded wherever possible.
  - Ensure that earthing measures are implemented effectively. The controllers are earthed to provide protection and for functional reasons.
  - Provide a star-shaped connection between the plant, cabinets/cubicles of the System 200V and the earthing/protection system. In this way you avoid ground loops.
  - Where potential differences exist you must install sufficiently large equipotential bonding conductors between the different parts of the plant.

Screening of cables

The screening of cables reduces the influence of electrical, magnetic or electromagnetic fields; we talk of attenuation.

The earthing rail that is connected conductively to the cabinet diverts interfering currents from screen conductors to ground. It is essential that the connection to the protective conductor is of low-impedance as the interfering currents could otherwise become a source of trouble in themselves.

The following should be noted when cables are screened:

- Use cables with braided screens wherever possible.
- The coverage of the screen should exceed 80%.
- Screens should always be grounded at both ends of cables. High frequency interference can only be suppressed by grounding cables on both ends.

  Grounding at one end may become necessary under exceptional circumstances. However, this only provides attenuation to low frequency interference. One-sided earthing may be of advantage where:
  - it is not possible to install equipotential bonding conductors
  - analog signals (in the mV or µA range) are transferred
  - foil-type shields (static shields) are used.
- Always use metallic or metallized covers for the plugs on data lines for serial links. Connect the screen of the data line to the cover. Do **not** connect the screen to PIN 1 of the plug!
- In a stationary environment it is recommended that the insulation is stripped from the screened cable interruption-free and to attach the screen to the screening/protective ground rail.
- Connect screening braids by means of metallic cable clamps. These clamps need a good electrical and large surface contact with the screen.
- Attach the screen of a cable to the grounding rail directly where the cable enters the cabinet/cubicle. Continue the screen right up to the System 200V module but do **not** connect the screen to ground at this point!

Please heed the following when you assemble the system!

Where potential differences exist between earthing connections it is possible that an equalizing current could be established where the screen of a cable is connected at both ends.

Remedy: install equipotential bonding conductors

Appendix

A Index

M.Stich