Manual

CP 486

Order No.: HB73e
Rev. 00/14

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1. Introduction

1.1 General

This manual describes the handling with CP486 modules CP4-BG61, -BG62, -BG63, -BG64, and BG65 of VIPA GmbH started with revision level 1. The revision level 1 comprises the SYSTEMBIOS versions V18 and the VGA-BIOS V13. The CP486 modules are applicable to all automation systems (PLC-115U ...PLC-155U). The CPU486SLC has an internal cache of 1 KB. At the whole, the CP486 with 25Mhz runs faster by an factor 2.5-3 than the CP386 with 16Mhz. The CP486 module is compatible downwards to the CP386 module. The CP386 functions are further available. Addresses and parameters of the particular periphery elements has not been changed. The software for the link with the PLC runs without changes.

The manual is arranged as follows:
Introduction
The information in this introduction is intended for application fields of the CP486 module, structure and functioning of CP486, and moreover, specific components of the CP486 are described enhancing the conventional AT standard.

Hardware:
First, the different CP486 versions and each of their special features are described. The modules are differing in the number of interfaces, main memory capacity and mass storage, number of AT-bus slots and the mounting dimension. This overview is followed by the hardware configuration before installing in the PLC.

Plugs and Sockets:
All CP486 interfaces are described in this chapter including interconnection proposals and wiring instructions.

BIOS- and System Programming:
This section contains the description of the CP486 firmware, firmware presettings and the module programming on system oriented level. The standard user should attach importance thereof at most to the description of firmware presetting - the SYSTEM-SETUP.

MS-DOS Utilities:
This chapter is concerned with different drivers and programs especially created and compiled for CP486.

Linkage with PLC:
This chapter describes detailed how to proceed with the linkage between PLC and CP486, that is from the PLC point of view as well as from CP486 point of view.

1.2 Application Area

CP486 application within an automation system can be extended to many areas. Feasible application areas are visualisation, measured value processing, production data acquisition, network servicing up to the process control system and management computer. Hereto are added the most different scope of duties with trade-specific standard software. Only the following aspects are important for using the CP486:

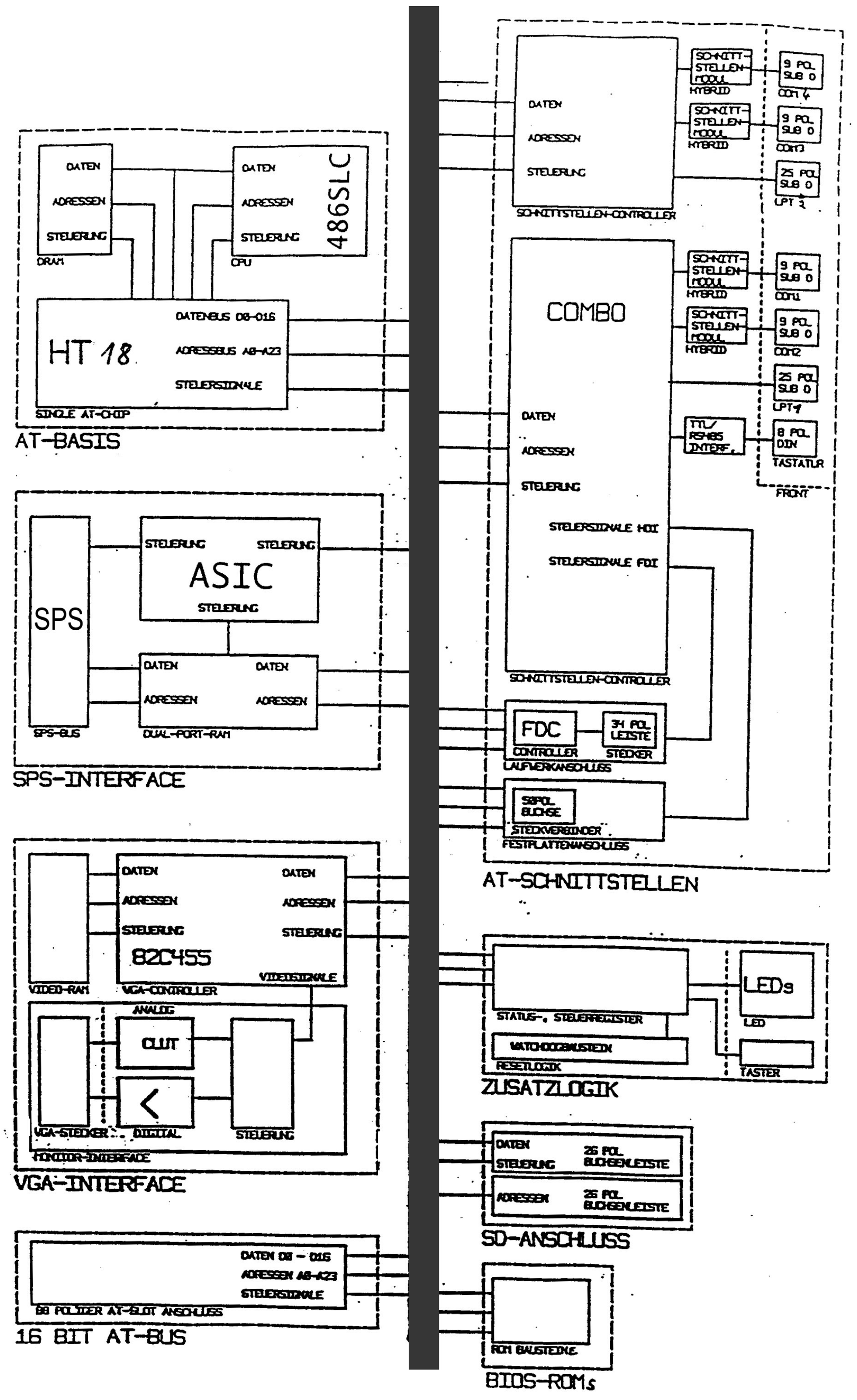
- direct hardware linkage to the back plane bus via a standard CP interface with eight banks enables a very fast communication with the PLC.
- linkage between PLC and CP486 is assisted by a system software supporting MS-DOS programmers without STEP5 experience as well as STEP5 programmers without MS-DOS experience (STEP5 from Siemens).
- CP486 is an PC-AT486 compatible computer.
- The enormous MS-DOS software world is made accessible for the PLC. Software packages are directly applicable.

1.3 Structure and Operation

- Dualport-RAM:
  The AT is directly interfaced to the back plane bus via a Dual Port RAM. This Dual Port RAM is available on the PLC as standard CP interface with 8 banks. Data can be interchanged via handling modules which also transfer synchronous to cycles the complete image of inputs, outputs, markers, timers and counters to the AT. For every cycle you can exchange 4x127 variables in different directions. Communication is realized by polling or interrupt controlled.

- **Communication Software**
  For communication between AT and PLC there are handling modules available providing the data interchange element-oriented. Thus, several data elements (bit, byte, word, doubleword, block) can be transferred per cycle at the same time. There is a continuously updated software reference list for the standard software whose driver is adapted and loadable to CP486.

1.4 Block Diagram of CP486



1.5 Special Components

Interface Modules

The four serial interfaces are configurable by plugin modules. As a standard, the following assignment is supplied: COM1 and COM3 as V24 interface, COM2 as 20mA interface and COM4 as RS422/485 interface.

Diagnostic Interface

All serial communications can be acquired by menas of the diagnostic terminal UPI-FOX via the diagnostic interface. This interface makes available sending and receiving signals of the individual interfaces as TTL signals.

Keyboard Extension

The module is equipped with special electronics enabling a keyboard cable extension up to 250m.

VGA Mode with Industrial RGB Monitors

The module includes in addition to the standard VGA signal an RGB signal for monitor connections up to a distance of 250m.

Battery Backup

CP486 data are buffered by means of the battery in the PC (programmable controller). It has a supplementary Lithium accumulator protecting the CP486 against overrun in removed mode approx. 1/2 year.

Silicon Disk

Silicon disk is a storage medium without flexible components. It is suitable to application in rough environment. Silicon disk is fixed installed and exchangeable only for servicing purposes. There are following silicon disk versions:

- **Chip Silicon Disk (IC3, IC4):**
  The module avails of two IC slots (IC3 and IC4) for the chip silicon disk. Different memory modules (EPROMs, SRAMs or PEROMs) can be inserted into these slots. This chip silicon disk has a capacity of 256KB or 1 MB respectively.
- **Memory Card Silicon Disk**
  There is a plugin slot for the memory card silicon disk. The memory card is contrary to the silicon disk an exchangeable medium based upon the cheque card memory. Memory cards have a capacity of 128KB, 512KB and 1MB. OTP-ROM and SRAM memory cards are available.

- **Silicon Disk Additional Board**
  The different additional boards are plugged into the slot for the PC bus and thus, have a capacity of up to 7MB. These silicon disk boards are available with FLASH-, SRAM- and EPROM assembly.

The different types **EPROM, SRAM, FLASH-PROM** and **OTP-ROM** of the silicon disks differ as follows:

- **OTPROM-Disk** is a read-only memory medium in the builtin mode comparable to a disk with write protection. The OTPROM disk has to be programmed with a specific programming device. The OTPROM card can be programmed only once and cannot be deleted again.

- **EPROM disk** is a read-only memory medium in the builtin mode comparable to a disk with write protection. EPROMs of this disk are generated with an additional program and programmed, before inserting into the base, with an EPROM program available on the market. EPROMs can be deleted by means of UV light.

- **FLASH-PROM-Disk** is a read-only and recordable memory medium in the builtin mode. The FLASH-PROM-DISK can be deleted and recorded agian in the builtin mode. The FLASH memory can only be completely deleted and recorded again (with 12V erase voltage). This memory can be recorded anew approximately 10000 times.

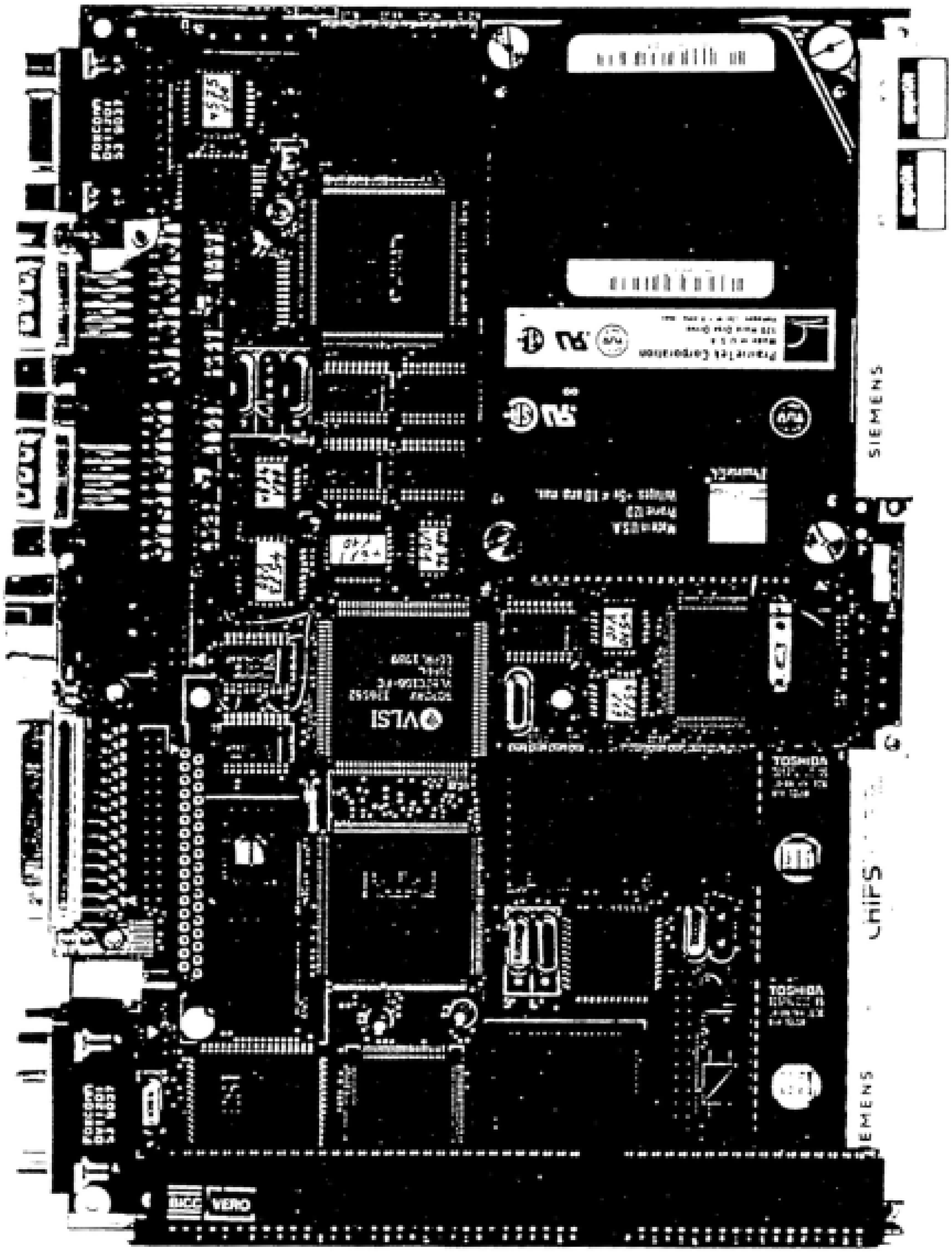
- **PEROM disk** is a read-only and recordable memory medium in the builtin mode. PEROM modules can be deleted and recorded again in the buitin mode. Note: the PEROM meory can only be completely deleted and recorded again (with 5V erase voltage). Only up to 1000 write cycles are permitted.

- **SRAM disk** is a read-only able and recordable memory medium in the buitin mode comparable to a recordable disk. But the read and write access is much more faster to the SRAM disk than to a normal disk. The data remain backed up. The chip silicon disk is backed up approx. 100 days by means of the accu of the CP486. The SRAM memory cards avail of an integrated, exchangeable battery for approx. 100 days. So they can also be used as transportable me-mories. The silicon disk additional boards have an own battery for nearly the same buffer time.

2. Hardware

2.1 Structure of Modules

2.1.1 Structure of the Base Module



Structure of the Base Module

The module contains a PC-AT486 with:

- CPU80486SLC and FPU80387SX base
- main memory up to 4MB
- keyboard interface connection
- VGA graphics
- slot for interfacing flat displays
- up to 4 slots for serial interface modules (COM1, COM2, COM3, COM4)
- up to 2 parallel interfaces (LPT1, LPT2)
- interface for floppy disk drive
- interface for hard disk
- base for silicon disk (2 memory chips)
- slot for silicon disk (memory card)
- removable 16bit AT bus
- 8K Dual Port RAM for PLC as CP interface

2.1.2 Structure of CP486S Module (VIPAOrder-No. CP4-BG61):

Controller for analog video signal

Monitor connection

COM1 (V24 interface)

COM2 (20mA interface)

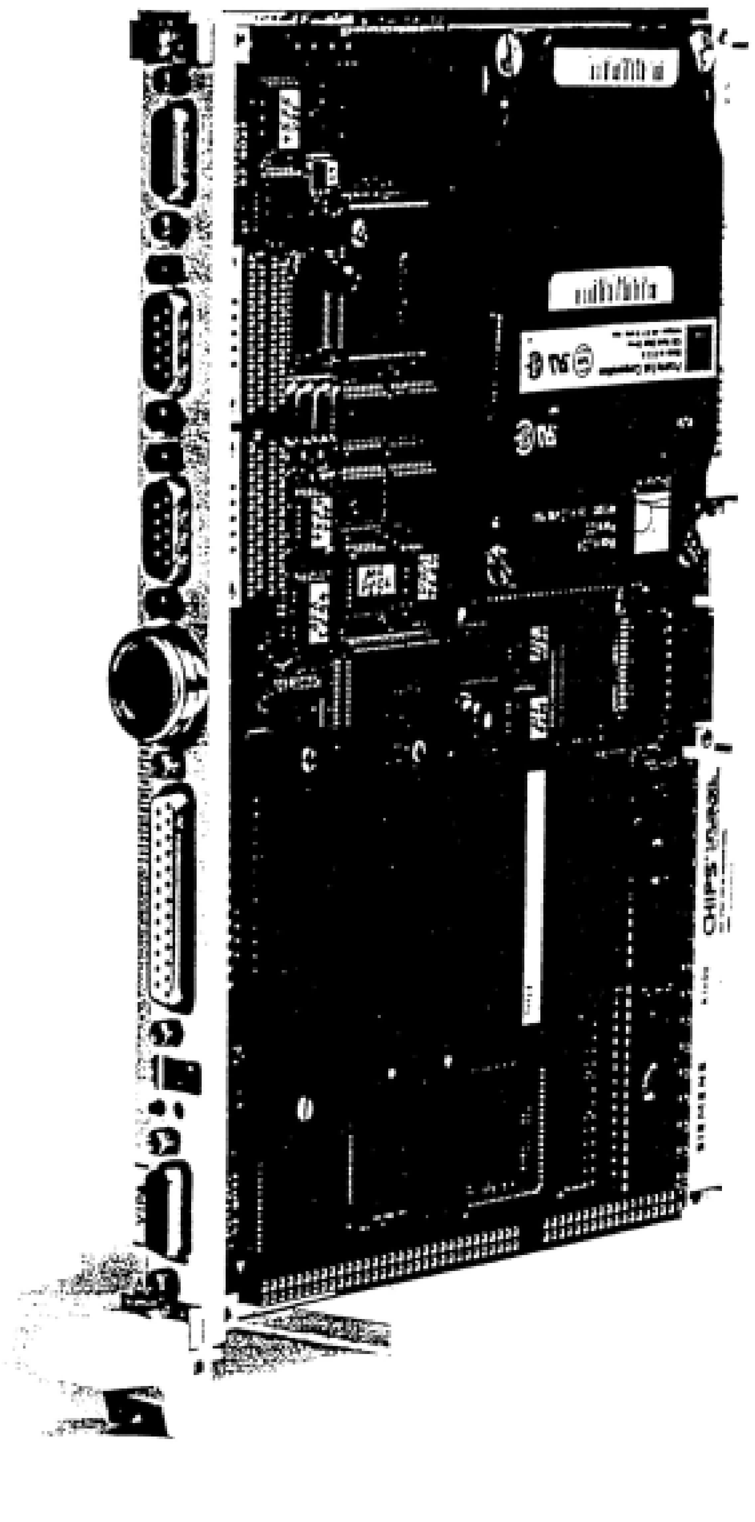
Keyboard connection

LPT1 (printer interface)

24V socket (ext. supply)

Reset key with watchdog-LED

VIPA diagnostic interface



Structure of CP486S (VIPA Order-No. CP4-BG61):

- CPU80486SLC and base for FPU80387SX
- main memory 4MB (CP4-BG61)
- keyboard interface connection
- VGA graphics
- 2 serial interfaces COM1 (V24), COM2 (20mA) (see also chapter 1.5)
- 1 parallel interface (LPT1)
- slot for hard disk
- base for silicon disk (2 memory chips)
- slot for silicon disk (memory card)
- 8K Dual Port RAM to PLC as CP interface

Operation and display elements on the front panel:

- one 15-pin HD Cannon socket for monitor connection
- two 9-pin Cannon sockets for COMl (V24), COM2 (20mA)
- one DIN socket for standard AT keyboard and sym. line driver up to 250m
- parallel interface LPT1, Centronics-compatible with 25-pin Cannon socket
- plug clamp for external 24V DC power supply for an EL display or using the keyboard extension
- LED display (red) for displaying an accumulated error (can be deleted by pressing a RESET key)
- RESET key
- one 15-pin HD Cannon socket for diagnostic interface

2.1.3 Structure of CP486M Module (VIPA Order-No. CP4-BG62):

Controller for analog
video signal

Monitor connection

COM1 (V24)
COM3 (V24)

COM2 (20mA)
COM4 (RS422/485)

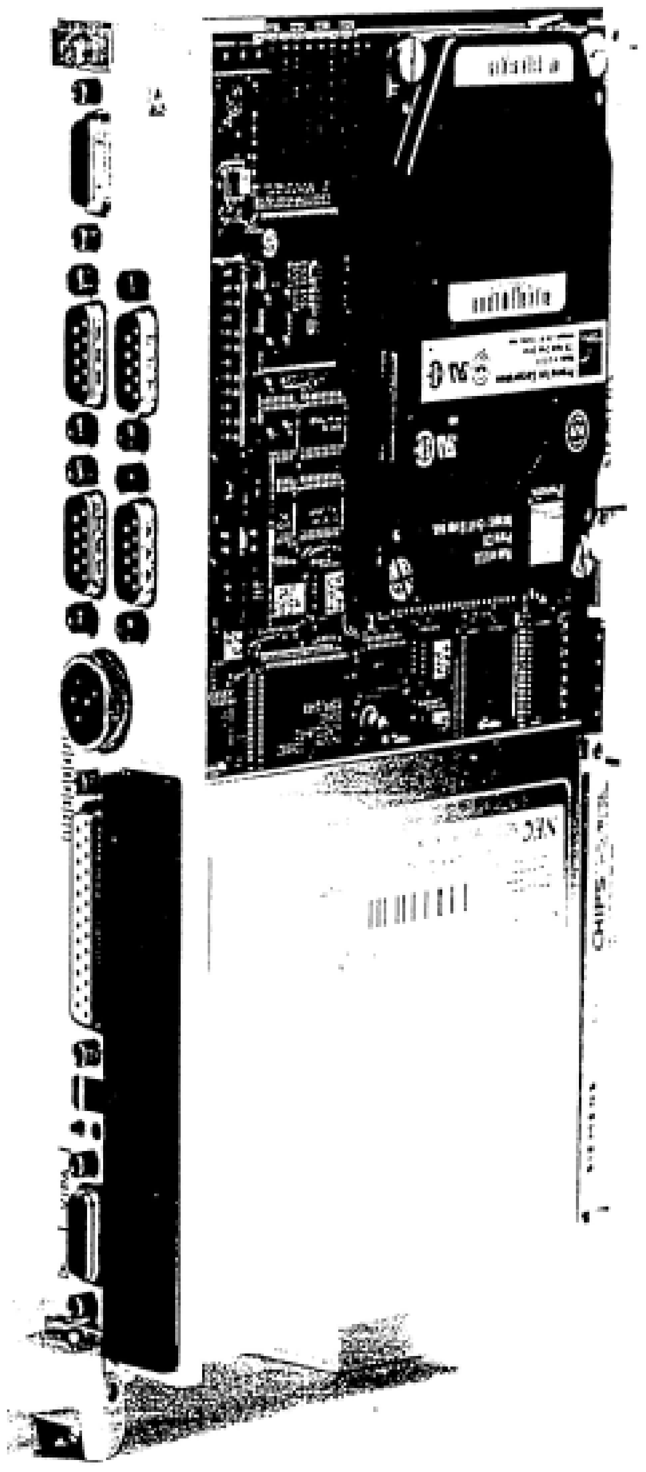
Keyboard connection

LPT1 (printer interface)

Floppy disk drive

24V socket (ext. supply)
Reset key with watchdog-LED

VIPA diagnostic interface



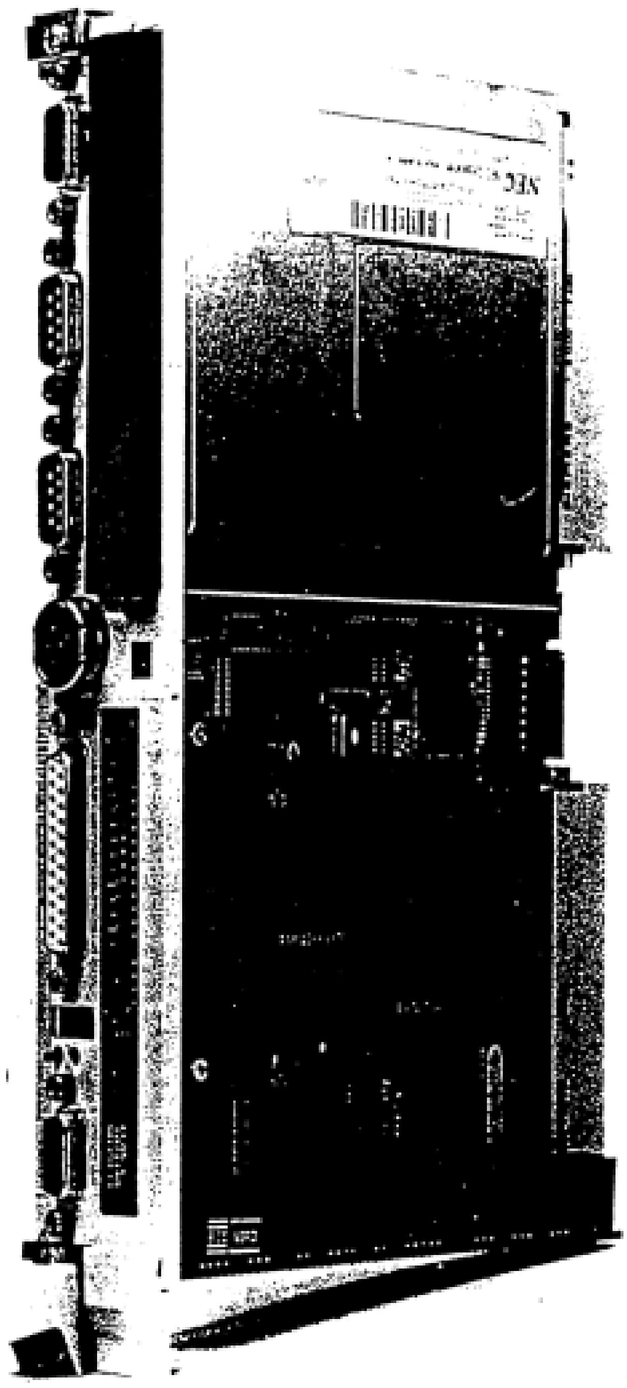
Structure of CP486M (VIPA Order-No. CP4-BG62):

- CPU80486SLC and base for FPU80387SX
- main memory 4MB (CP4-BG62)
- keyboard interface connection
- VGA graphics
- slot for interface to flat displays
- 4 serial interfaces COM1 (V24), COM2 (20mA), COM3 (V24), COM4(RS422/RS485) (see also chapter 1.5)
- 1 parallel interface (LPT1)
- slot for hard disk
- base for silicon disk (2 memory chips)
- slot for silicon disk (memory card)
- 3,5" floppy disk drive (720KB/1,44MB)
- 8K Dual-Port-RAM to PLC as CP interface

Operation and display elements on the front panel:

- one 15-pin HD Cannon socket for monitor connectionn
- four 9-pin Cannon sockets for COM1 (V24), COM2 (20mA), COM3 (V24) and COM4 (RS422/485)
- one DIN socket for standard AT keyboard and sym. line driver up to 250m
- parallel interface LPT1, Centronics-compatible with 25-pin Cannon socket
- plug clamp for external 24V DC power supply for an EL display or using the keyboard extension
- LED display (red) for displaying an accumulated error (can be deleted by pressing a RESET key)
- RESET key
- one 15-pin HD Cannon socket for diagnostic interface
- one 3,5" floppy disk drive

2.1.4 Structure of CP486ML Module (VIPA Order-No. CP4-BG63):



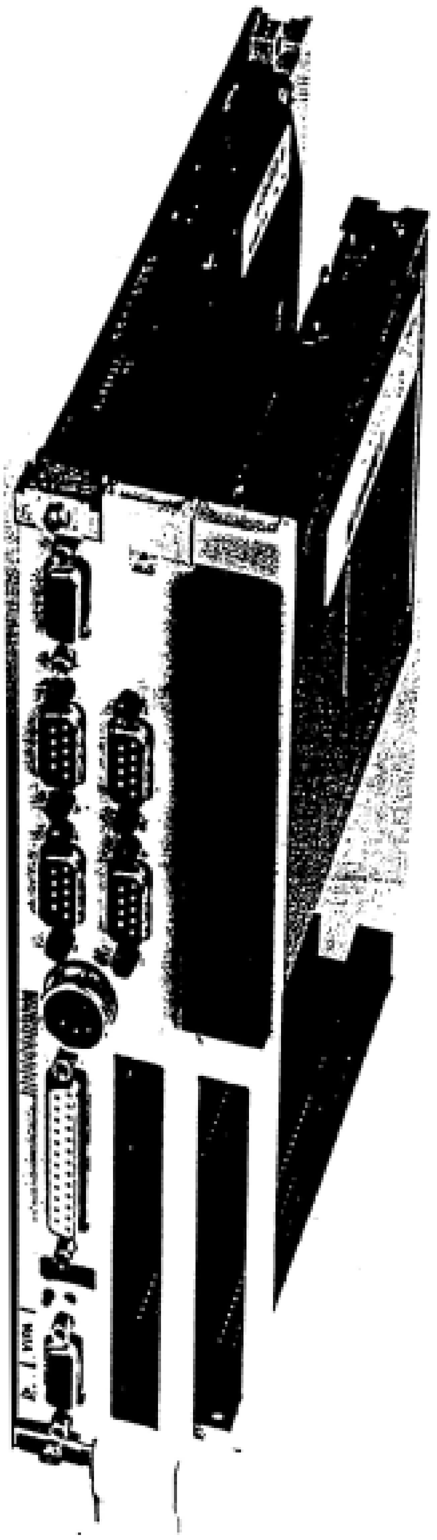
Structure of CP486ML (VIPA Order-No. CP4-BG63):

- CPU80486SLC and base for FPU80387SX
- main memory 4MB (CP4-BG63)
- keyboard interface connection
- VGA graphics
- slot for interface to flat displays
- 2 serial interfaces COM1 (V24), COM2 (20mA) (see also chapter 1.5)
- 3,5" floppy disk drive (720KB/1,44MB)
- 1 parallel interface (LPT1)
- slot for hard disk
- base for silicon disk (2 memory chips)
- slot for silicon disk (memory card)
- removable 16bit AT bus with 1 slot
- 8K Dual-Port-RAM to PLC as CP interface

Operation and display elements on the front panel:

- one 15-pin HD Cannon socket for monitor connectionn
- two 9-pin Cannon sockets for COM1 (V24), COM2 (20mA),
- one DIN socket for standard AT keyboard and sym. line driver up to 250m
- parallel interface LPT1, Centronics-compatible with 25-pin Cannon socket
- plug clamp for external 24V DC power supply for an EL display or using the keyboard extension
- LED display (red) for displaying an accumulated error (can be deleted by pressing a RESET key)
- RESET key
- one 15-pin HD Cannon socket for diagnostic interface
- one 3,5" floppy disk drive
- an opening for AT cards

2.1.5 Structure of CP486L Module (VIPA Order No. CP4-BG64):



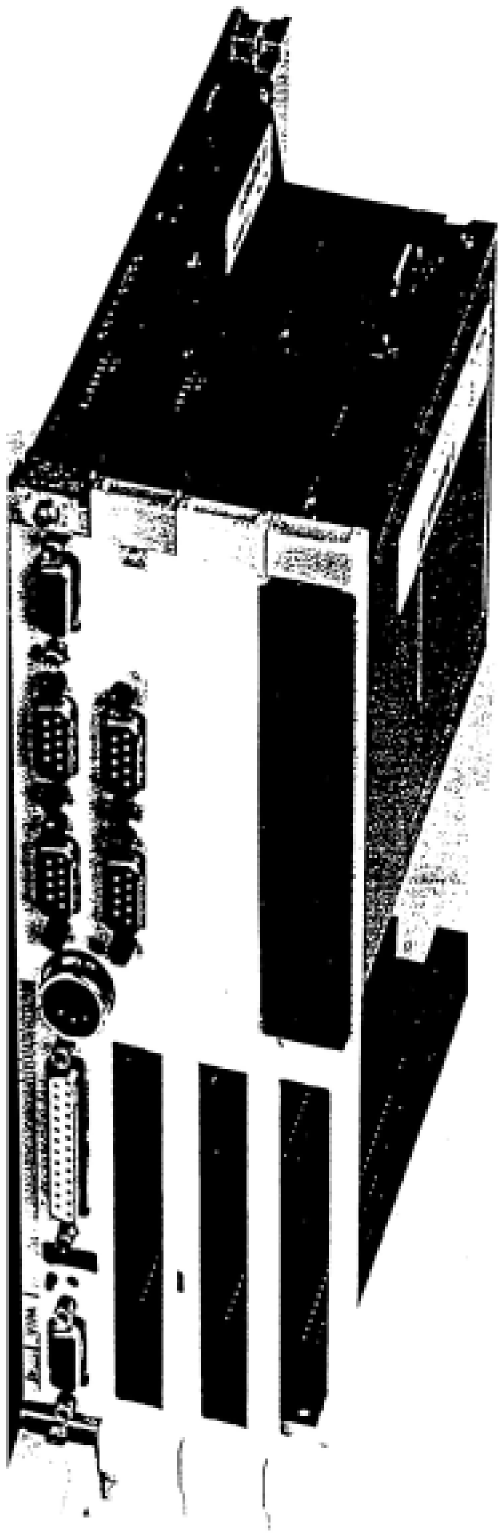
Structure of CP486L (VIPA Order No. CP4-BG64):

- CPU80486SLC and base for FPU80387SX
- main memory 4MB (CP4-BG64)
- keyboard interface connection
- VGA graphics
- slot for interface to flat displays
- 4 serial interfaces COM1 (V24), COM2 (20mA), COM3 (V24), COM4(RS422/RS485) (see also chapter 1.5)
- 1 parallel interface (LPT1)
- 3,5" floppy disk drive (720KB/1,44MB)
- slot for hard disk
- base for silicon disk (2 memory chips)
- slot for silicon disk (memory card)
- removable 16bit AT bus with 2 slots
- 8K Dual-Port-RAM to PLC as CP interface

Operation and display elements on the front panel:

- one 15-pin HD Cannon socket for monitor connectionn
- four 9-pin Cannon sockets for COM1 (V24), COM2 (20mA), COM3 (V24) and COM4 (RS422/485)
- one DIN socket for standard AT keyboard and sym. line driver up to 250m
- parallel interface LPT1, Centronics-compatible with 25-pin Cannon socket
- plug clamp for external 24V DC power supply for an EL display or using the keyboard extension
- LED display (red) for displaying an accumulated error (can be deleted by pressing a RESET key)
- RESET key
- a 15-pin HD Cannon socket for diagnostic interface
- a 3,5" floppy disk drive
- two openings for AT cards

2.1.6 Structure of CP486XL Module (VIPA Order No. CP4-BG65):



Structure of CP486XL (VIPA Order No. CP4-BG65):

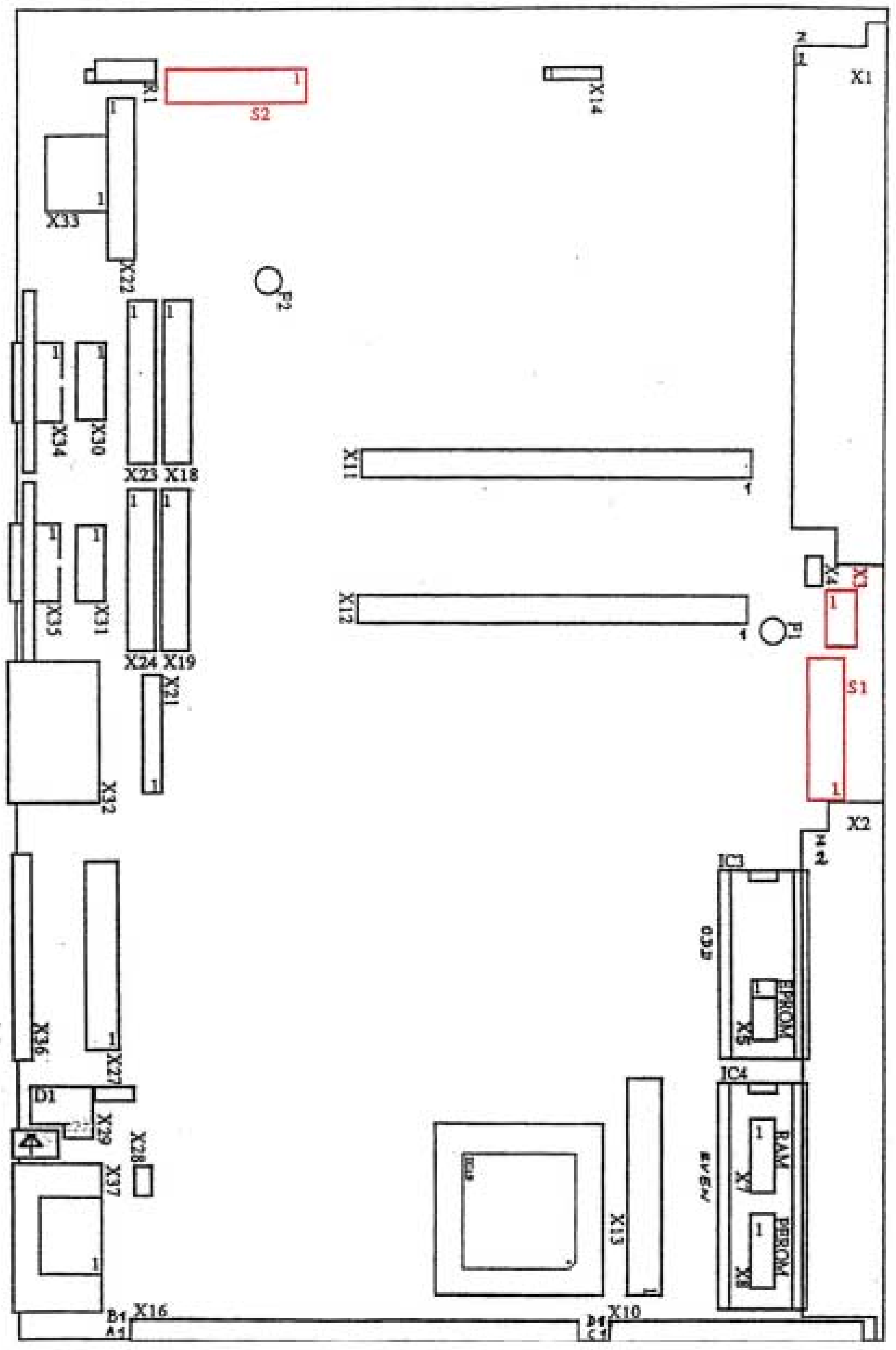
- CPU80486SLC and base for FPU80387SX
- main memory 4MB (CP4-BG65)
- keyboard interface connection
- VGA graphics
- slot for interface to flat displays
- 4 serial interfaces COM1 (V24), COM2 (20mA),
  COM3 (V24), COM4(RS422/RS485) (see also chapter 1.5)
- 1 parallel interface (LPT1)
- 3,5" floppy disk drive (720KB/1,44MB)
- slot for hard disk
- base for silicon disk (2 memory chips)
- slot for silicon disk (memory card)
- removable 16bit AT bus with 3 slots
- 8K Dual-Port-RAM to PLC as CP interface

Operation and display elements on the front panel:

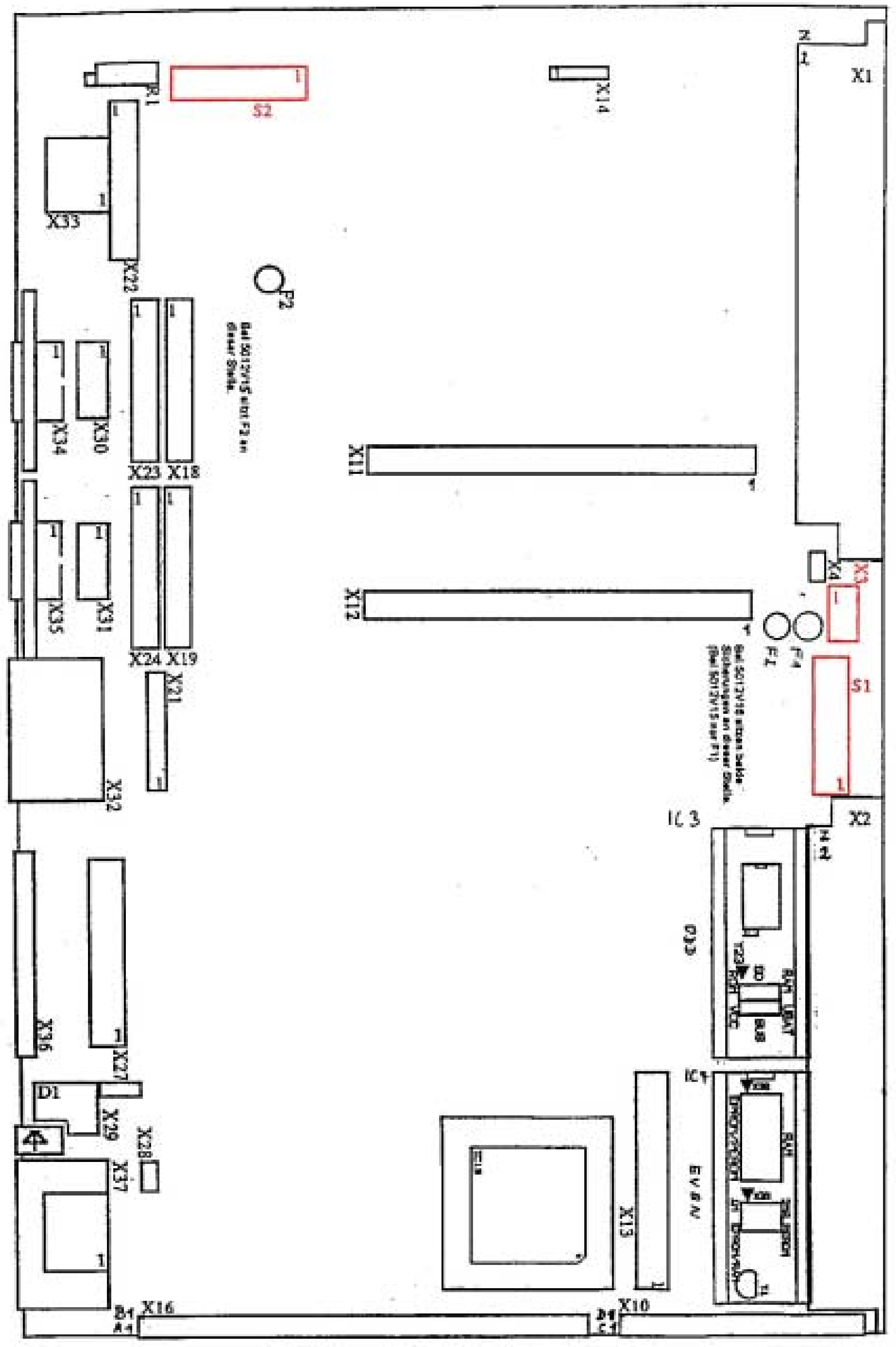
- one 15-pin HD Cannon socket for monitor connectionn
- four 9-pin Cannon sockets for COM1 (V24), COM2 (20mA),
  COM3 (V24) and COM4 (RS422/485)
- one DIN socket for standard AT keyboard and sym. line driver up to 250m
- parallel interface LPT1, Centronics-compatible with 25-pin Cannon socket
- plug clamp for external 24V DC power supply for an EL display or using the keyboard extension
- LED display (red) for displaying an accumulated error (can be deleted by pressing a RESET key)
- RESET key
- a 15-pin HD Cannon socket for diagnostic interface
- a 3,5" floppy disk drive
- three openings for AT cards

2.1.7 Diagram of DIP Switches, Jumpers and Plug Connectors

PCB 5012V14:



PCBs 5012V15, 5012V16 and 5012V17



2.2 Setting of DIP Switches

Setting of DIP Switch S1:

		OFF	ON
1	PC type selection	PLC-115 (NAU/BAU-Signal of X1)	PLC-135/PLC-155 (NAU/BAU-Signal of X2)
2	vacant		
3	PLC-signal BASP	will not be evaluated	triggers an interrupt on the CP486vacant
4	PLC-signal CPKL	will not be evaluated	triggers a RESET on the CP486
5	PLC-interrupt IRD	off	on
6	PLC-interrupt IRC	off	on
7	PLC-interrupt IRB	off	on
8	PLC-interrupt IRA	off	on

Delivery status: 1-2:ON, 3:ON, 8:OFF, 5-8:OFF

Remarks:

The DIP-switch S1/4 must be set to ON, if the module is used in the ZG188.

The DIP-switch S1/3 is not used on the boards (PCB-No.) 5012V14, 5012V15, 5012V16, 5012V17.

The described functions of this switch are available on the boards (PCB-No.) 5012V13, 5012V31....

Setting of DIP Switch S2:

DIP switches 1-3 determine the system configuration if the system SETUP has been lost. The system configuration is backed up by a Lithium accumulator approx. 6 months. If the module is stored more than 6 months, then the battery is empty and the filed configuration lost. In this case, a configuration can be set by means of switches 1-3 to ensure a module startup. The exact configuration can be loaded by software after the startup.
An empty battery is recharged after approx. 3 days operating time.

4	3	2	1	DIP-switch (default setting in the case of default system configuration) (battery failure):
		off	off	boot from silicon disk at address C00000 (hex)
		off	on	reserved
		on	off	boot from silicon disk at address 800000 (hex)
		on	on	boot from floppy disk drive A:
	off			no bank visible towards PLC
	on			active bank area: bank 32-39
off				reserved
on				reserved

8	7	6	5	DIP-switch (PCB no. 5012V15, 5012V16, 5012V17):
off	off	off	off	VGA monitor with separate Syncs
off	off	off	on	RGB monitor (up to VGA-BIOS V11 only graph mode)
off	off	on	off	RGB monitor (up to VGA-BIOS V11 only HSync positive)
off	off	on	on	RGB monitor (up to VGA-BIOS V11 only HSync negative)
off	on	off	off	Finlux-EL display (640*350)
off	on	off	on	Hercules, EGA monochrome
off	on	on	off	EGA monitor (640*350)
off	on	on	on	CGA monitor (80*25)
on	on	off	on	CGA monitor (40*25)
on	on	on	off	EGA monitor (640*200)
on	on	on	on	flat display via additional adapter

6	5	DIP-switch (PCB no. 5012V30, 5012V31, ...)
	off	VGA monitor with separate Syncs
	on	RGB monitor
off		color (default setup witchout monitor)
on		monochrome (default setup witchout monitor)

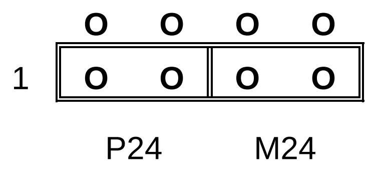
Delivery status: 1-3:ON, 4-8:OFF

2.3 Configuration of 24V Power Supply

CP486 must be supplied with 24 Volt DC in following cases:
- for running an active 20mA interface
- for using the optional keyboard extension
- when connecting a flat display

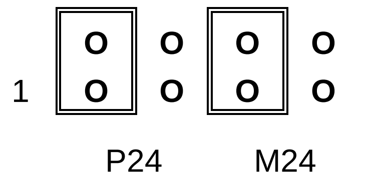
24 Volt power supply is set up via the jumper field X3:

Jumper X3:



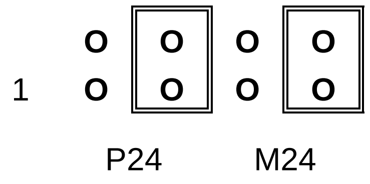
Supply via 24 Volt socket at the front and delivered connecting cable

Jumper X3:



Suppy from upper back plane bus plug

Jumper X3:



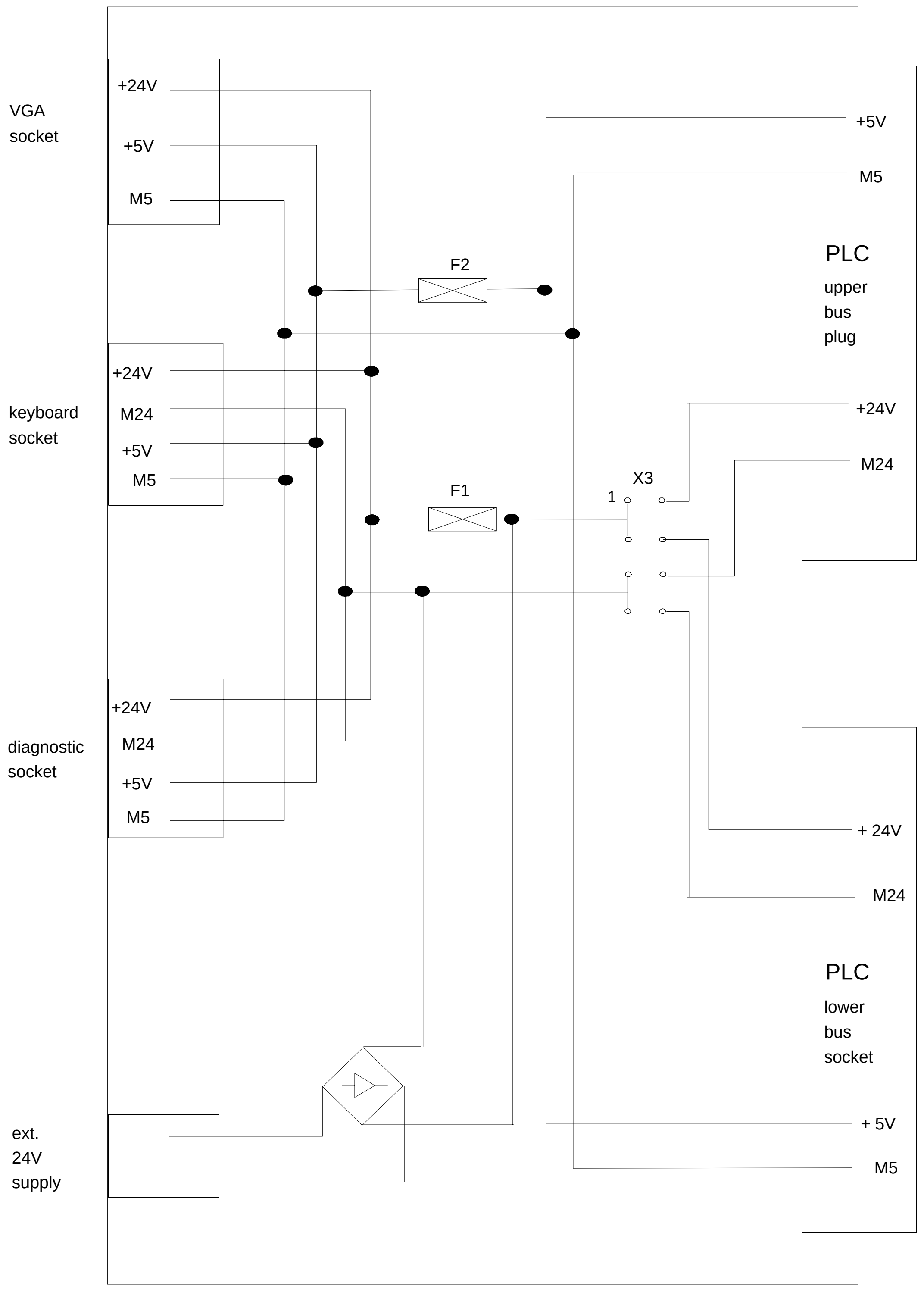
Supply from lower back plane bus plug

Attention:

Pay attention to limit data of the supply unit used!

When using the keyboard extension or flat display, a potential interface for 24 Volt and 5 Volt voltage source must be enabled in the case of external 24 Volt supply (supply via 24 Volt socket at module front), e.g. by connecting the 5 Volt mass with 24 Volt mass at the central mass point.

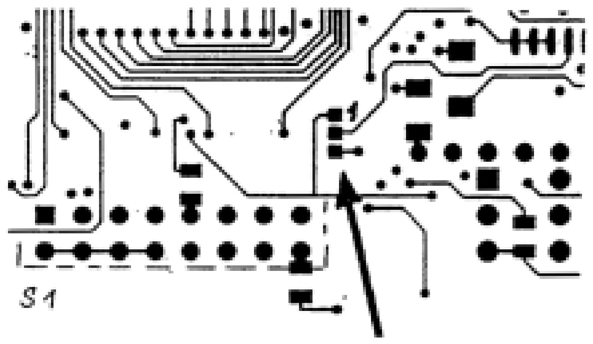
Overview of the Circuit Diagram of the 5V and 24V Power Supply:



2.4 Installation of Chip Silicon Disk

The module contains 2 bases (IC3 and IC4) for special memory chips. The bases for the silicon disk must be respectively assembled and the jumpers set up.
Jumper setup differs for the various base PCB (printed circuit board) versions.

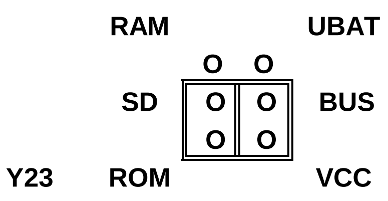
Battery Backup of the Chip Silicon Disk SRAM:
The silicon disk SRAM can be operated battery backed-up. The battery back-up is adjusted via a solder board (below DIP switch S1) for the modules 7458V24/7459V24 (PCB 5012V14):



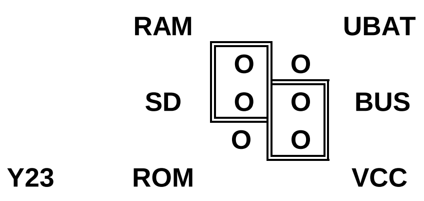
PCB 5012V14

Setting:	1-2 closed	2-3 open	Silicon disk is battery-backed (permitted only for silicon disk SRAM)
	1-2 open	2-3 closed	Silicon disk is not battery-backed (standard setting)

For the modules 7458V25/7459V25 (PCB 5012V15) , 7458V26/7459V26 (PCB 5012V16) and the modules 7458V27/7459V27 (PCB 5012V17) the battery back-up is set up via jumper Y23 (in the bases of the silicon disk chips IC3 and IC4):



Chip silicon disk is not battery backed-up

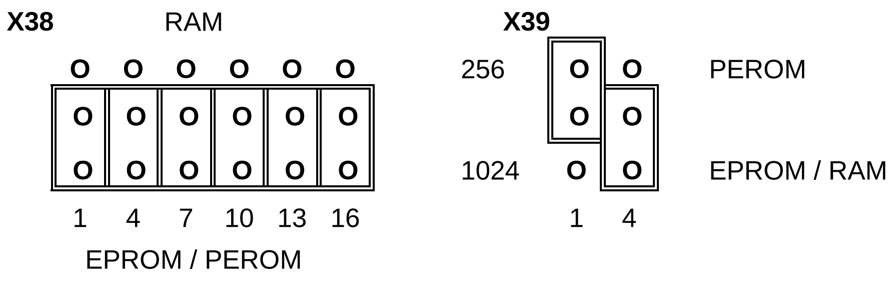


Chip silicon disk is battery backed-up

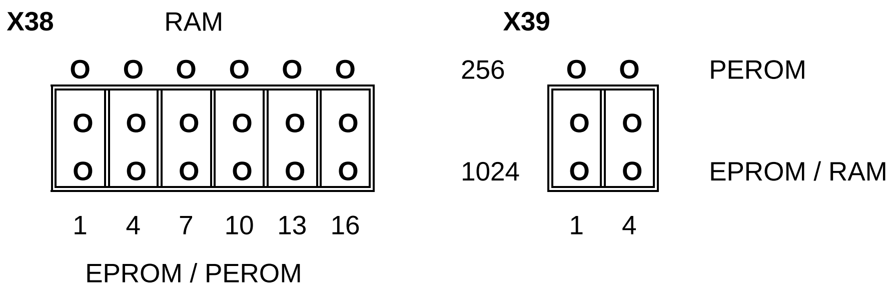
Started with the PCB 5012V17, the pin X16/B29 can be switched over from 5V power supply (in VCC position) to battery supply (in position UBAT) additionally via the jumper "BUS". Standard adjustment is in position VCC!. The position UBAT is required only to run special VIPA memory modules (e.g. 7MB silicon disk module).
Attention: A wrong configuration can cause malfunctions and defects.

Base board 7458V24/7459V24 (PCB 5012V14), base board 7458V25/7459V25 (PCB 5012V15), base board 7458V26/7459V26 (PCB 5012V16), base board 7458V27/7459V27 (PCB 5012V17):
Jumper fields X38 and X39 are placed onto sockets of silicon disk chips IC3/IC4.

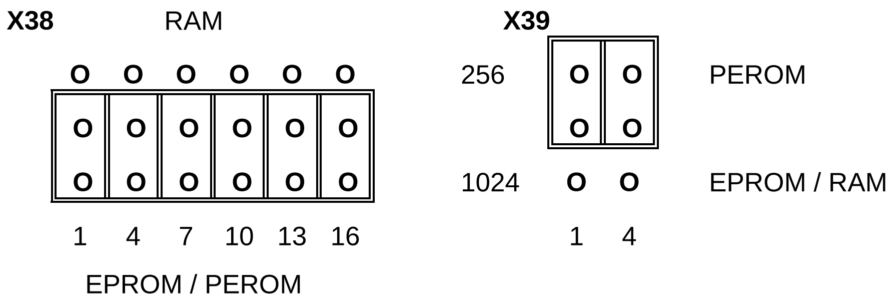
EPROM 256KB:



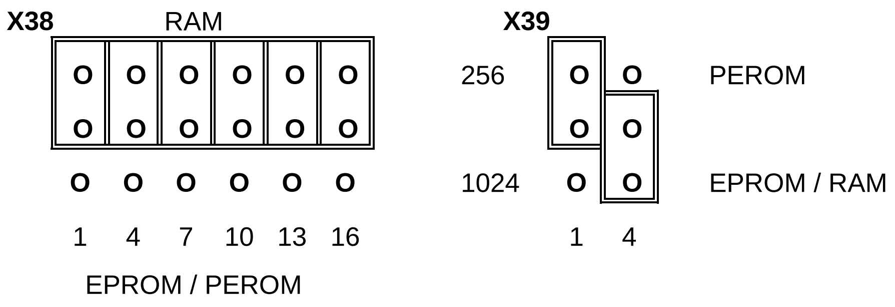
EPROM 1MB



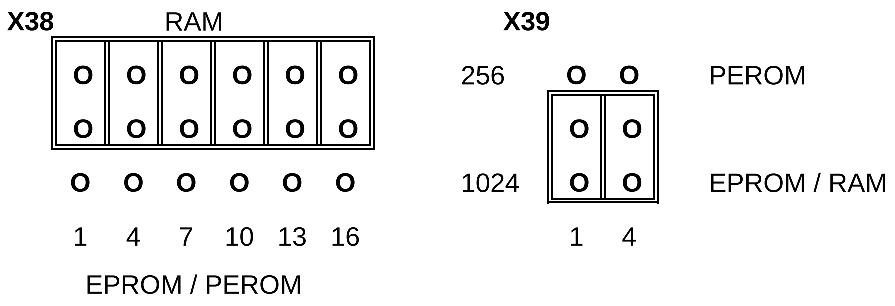
PEROM 256KB:



SRAM 256KB:



SRAM 1MB:



2.5 Installation of the Memory Card Silicon Disk

The memory card is installed by inserting the memory card into the provided plugin socket.The memory card silicon disk is always set up to address 800000.

2.6 Installation of an Additional Silicon Disk Board

Various additional silicon disk boards are available or in progress. These are provided essentially for the CP486S and CP486M. They are to be plugged into the PC/AT extension bus /X10, X16 - see page 20, 21).
The different additional boards can be set up according to the enclosed documentation.

2.7 Numeric Processor Installation (FPU)

The numeric processor is installed by inserting the module into the respective base (IC19) (Attention: consider module positioning when inserting). Installation should be realized by VIPA or skilled personnel.
(Note the instructions how to handle with electrostatic sensitive components).

At the system startup the numeric processor is automatically identified. Detailed information you get in the manual and from the disk (included in the scope of supply). The disk contains also the test software for the numeric processor.

Factual use of the numeric processor must be configured possibly in the applications software (see documentation for the applications software).

2.8. Interface Installation for VGA Flat Displays

A module (optional) can be plugged into the pin header X22 having a 15-pin SUBD socket at the module front. VGA flat display with 16 grey levels (EL display, 640*480 pixel) or a color TFT display (640*480 pixel, max. 64 colors) can be connected to this 15-pin SUBD socket.

2.9 Setting of AT Additional Boards

The extension bus corresponds to the IBM PC/AT extension bus with following restrictions:

- +12V,-12V and -5V can be loaded together with approx. 1 Watt
- EGA/VGA controller, FDD controller, HDD/TFI controller, COM1-4 and
- LPT1 are already integrated in the motherboard and can no more be plugged in.
- For reasons of space only a short 8/16Bit AT card can be plugged in. The cards are allowed to have a max. dimension of 108mm (incl. gold reed) * 158mm.

Before installing, remove the metal angle at the front of the AT card. After the card has been inserted, mount again the angle from outside.
Attention: please set up the card configuration (i.e. address assignment, interrupt assignment and DMA-assignment) before installing it, in such a way to avoid collision with the CP486. Dual assignments can damage and destroy the CP486 as well as the additional card.

2.10 Slots for CP486 in the PC

Following surveys show the possible installation places (signed by **x**) for the CP486 in the different PLC card cages.

Slots in PLC-115U

Slots	PS	CPU	0	1	2	3	4	5	6	IM
Power supply module	X									
Central module		X								
VIPA-CP486 (in CR 700-1)			X							
VIPA-CP486 (in CR 700-2)			X	X	X	X	X	X		
VIPA-CP486 (in CR 700-3)			X X	X X	X X	X	X	X		

CP486 has to be run in the adaptation case in PLC-115.

Slots in PLC-135U

Slots	3	11	19	27	35	43	51	59	67	75	83	91	99	107	115	123	131	139	147	155	163
Coordinator	X																				
R-, S-, M-processor		X	X	X	X																
Communication processors		X	X	X	X	X	X	X	X												
Interfaces 300-5, 301-5																					X
Interfaces 300-3, 301-3, 302																		X	X	X	X
VIPA-CP486			X	X	X	X	X	X	X												

Slots in PLC-150U

Slots	3	11	19	27	35	43	51	59	67	75	83	91	99	107	115	123	131	139	147	155	163
Central module					X	X	X	X													
Marshalling module 756				X																	
Main memory 340, 350										X	X	X	X	X	X						
Interfaces 300-5, 301-5																				X	X
Interfaces 300-3, 301-3																		X	X	X	X
PG-interface connections									X	X											
VIPA-CP486	X	X	X										X	X	X	X	X	X	X		

Slots 3, 11 and 19 are of use for the CP486 only if the marshalling module 756 or the VIPA economy memory are inserted to slot 27.

Slots in PLC-155U

Slots	3	11	19	27	35	43	51	59	67	75	83	91	99	107	115	123	131	139	147	155	163
Coordinator	X																				
Central modules		X	X	X																	
Communication processors					X	X	X	X	X	X	X	X	X	X	X	X	X				
Interfaces 300-5, 301-5																				X	X
Interf. 300-3, 301-3, 301-5, 308-3																		X	X	X	X
VIPA-CP486					X	X	X	X	X	X	X	X	X	X	X	X	X				

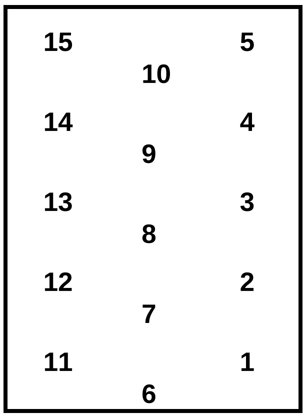
Slots in EG-185U

Slots	3	11	19	27	35	43	51	59	67	75	83	91	99	107	115	123	131	139	147	155	163
Interfaces 300																					X
Interfaces 314, 318	X																				
VIPA-CP486			X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X			

3. Assignment of Sockets and Plugs

The figures show plugs or sockets when regarding the module in the card cage. The top in the figure is also the top on the plug.

3.1 15-pin SubD-Socket for Connecting the Monitor



Socket assignment is specified by the DIP switch SW2 (5,6,7,8), (section 2.2).

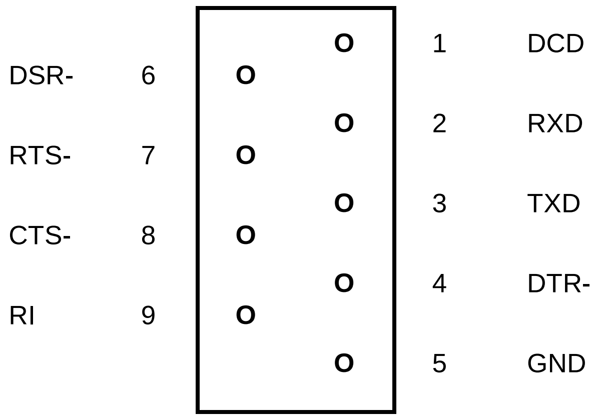
Mode	-------------------- analog modes ------------------------				------------- digital modes** ----------------		
	VGAcolor	VGAmono	RGB	BAS	EGA/CGA	EGA mono	EGA-EL
Cab.length	5-10m	5-10m	250m	250m	1.5m	1.5m	1.5m
PIN-NO.							
01	red	-	red	-	red	-	clock
02	green	video	green+sync	int.+sync	green	intensity	el-hsync
03	blue	-	blue	-	blue	video	intensity
04	------ not used--						
05	------ Gnd--						
06	------ Gnd red--						
07	------ Gnd green--						
08	------ Gnd blue--						
09	------ +24V supply voltage protected for external consumers (via micro fuse F1 (2A)--------------------------------						
10	------ Gnd sync--						
11	------- not used--						
11	------- not used--						
13	------ Hsync--						
14	------ Vsync--						
15	------ +5V supply voltage protected for external consumers (via micro fuse F2 (2A)*----------------------------------						

*: not connected on PCB 5012V17 and following
**: not available on PCB 5012V30 and following

Analog video voltage can be set between approx. 0.5V and 1.5V by means of the trimmer R1 (accessible from the front side of the module). Thus long cable dissipations can be compensated. As a standard 0.7V are set. **Attention:** voltages over 0.7V can damage the connected monitor!

The 15-pin high-density DSUB socket is used to connect the monitor. The socket is assigned similar to the socket of an original VGA monitor. All other monitors must be connected via special connection cables.

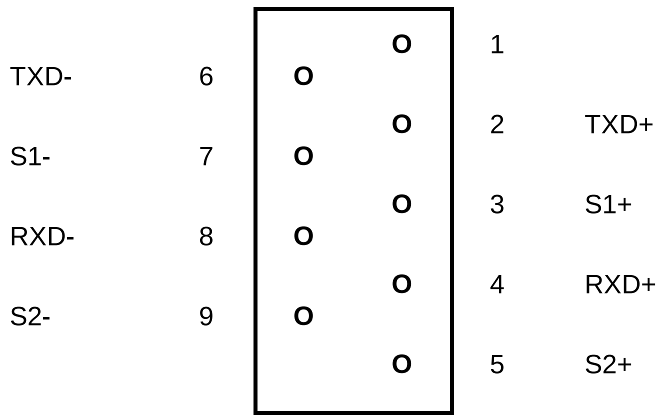
3.2 9-pin SubD-Plug with V24 Interface (COM1 and COM3)



The interface contains both types of handshake-signals (RTS/CTS and DSR/DTR). Which type of signals is to be used depends on wiring and programming of the interface.

3.3 9-pin SubD-Plug with 20mA Interface (COM2)

This interface can be operated as an active and passive 20mA-interface. The active operation requires a module supply of 24V. The 24V supply is configured by means of the jumper field X3 (cf. section 2.3)



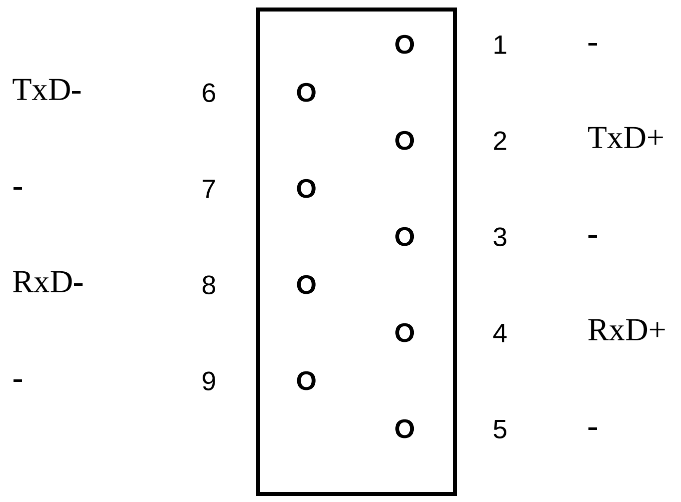
Passive 20mA-interface:
Passive interface operation uses 4 interface signals.

Active 20mA-interface:
The active operation avails of power sources at S-signals that are to be connected respectively to the data lines. In this case the module must be supplied with 24V.

3.4 9-pin SubD-Plug with RS422/485 Interface (COM4)

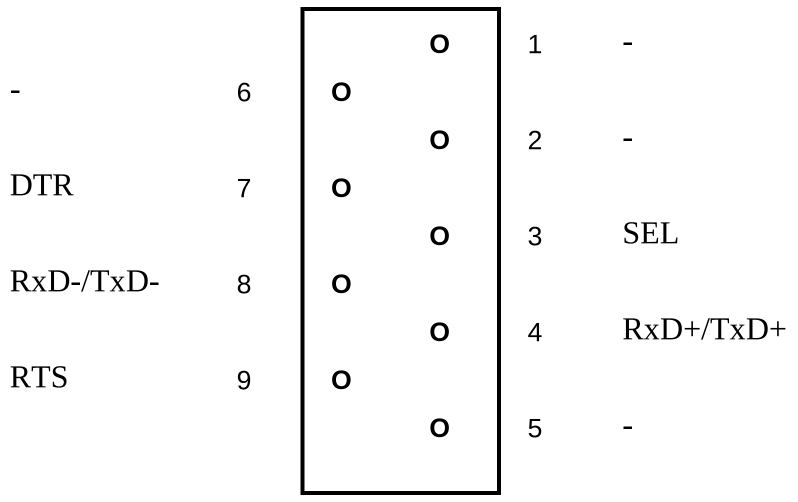
This interface can be operated as RS422-interface, i.e. for point-to-point circuit with separate send-receive lines, as well as RS485-interface for a bus system with send-receive function at the same line. For this purpose, the operating mode is switched over via a bus master by appropriate attending the SEL-signal.
TxD lines and RxD lines require for all cases each in pairs twisted and in pairs shielded lines.

3.4.1 Operation as RS422 Interface:



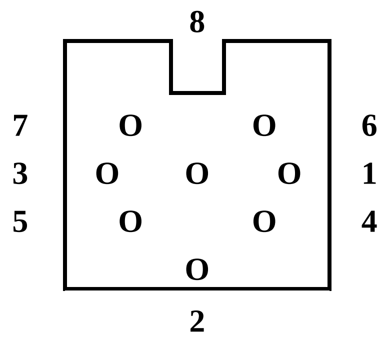
Pins signed with "-" are not used for the RS422 operation. They are not allowed to be connected!

3.4.2 Operation as RS485 Interface:



For RS485 operation only a two-wire line is terminated. The SEL-signal is used to switch over among send and receive. A logic 1 (5V) switches to transmission and a logic 0 (0V) to receive. SEL-signal can be controlled via DTR, via RTS or externally. This is selected via a jumper in the plug. Pins signed with "-" are not used for the RS485 operation. They are not allowed to be connected!

3.5 5/8-pin DIN Socket for Keyboard

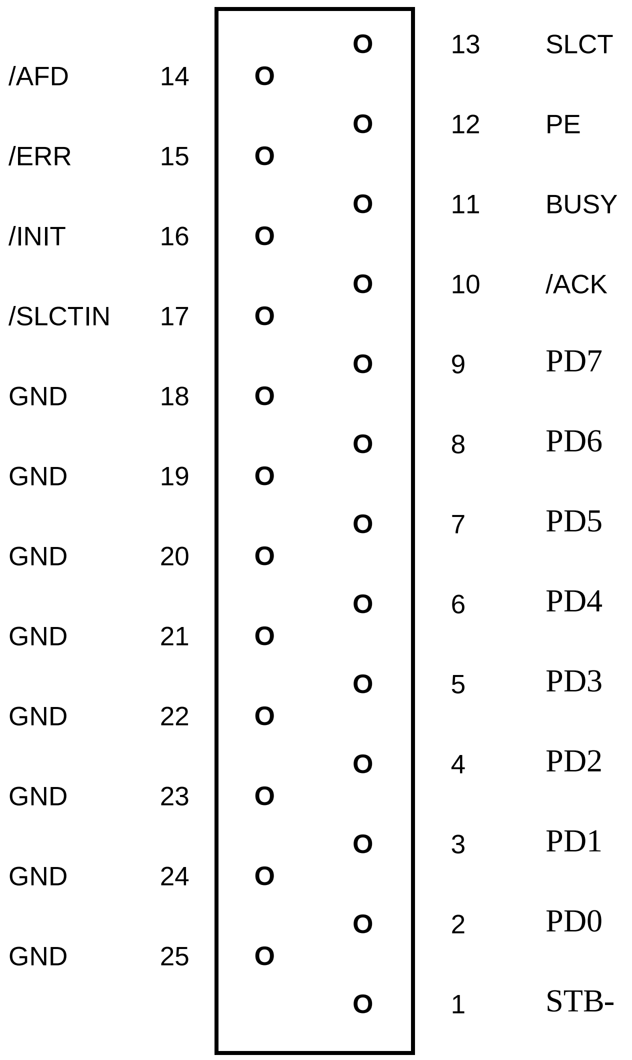


Pinno.	Signal	
1	KBCLK	
2	KBDATA	
3	GND (24V)	(for option keyboard extension)
4	GND (5V)	
5	+5V	current voltage for keyboard (protected by micro fuse F2 (2A))
6	-KBDATA	(for option keyboard extension)
7	-KBCLK	(for option keyboard extension)
8	+24V	(current voltage for option keyboard extension, protected by micro fuse F1 (2A))

The module has to be supplied with 24V for the operation of the optional keyboard extension. 24Volt power supply is configured via the jumper field X3. (cf. section 2.3)

Note:
AT-keyboards with automatical switchover between XT and AT mode are not supported by the CP486. Such keyboards are not identified and output a keyboard error. If possible, such keyboards should be set up to forced AT mode.

3.6 25-pin SubD-Socket with Centronics Interface (LPT1)



3.7 2-pin Plugin Socket for External 24V Supply

CP486 delivery includes a 1m long connecting cable with plug. M24 (mass of 24V) and P24 (+24V) is are supplied via the two pins. Both pins are optionally assigned. Polarity is of no importance.

Attention:
Concerning the 24V supply via this socket it must be ensured that the 24V supply of back plane bus is deactivated via the jumper field X3 (cf. section 2.3)!

3.8 15-pin SubD-Socket with VIPA Diagnostic Interface

15 TxD COM1		**5** GND
	10 RxD COM1	
14 TxD COM2		**4** +5V
	9 RxD COM2	
13 TxD COM3		**3** -
	8 RxD COM3	
12 TxD COM4		**2** -
	7 RxD COM4	
11 +24V		**1** screen
	6 M24	

VIPA diagnostic interface disposes of send and receive data lines (RxD and TxD) of the four present COM interfaces for listening as TTL-signals. Evaluation can be carried out by means of UPI-FOX of VIPA.

Supply voltages 5V and 24V are made available for external consumers.
5V supply is protected by the micro fuse F2 (2A).
24V supply is protected by the micro fuse F1 (2A).

3.9 Two-Part Clip Connector with AT Bus

B	A	
GND	SA0	31
OSC	SA1	30
+5V	SA2	29
BALE	SA3	28
T/C	SA4	27
DACK2-	SA5	26
IRQ3	SA6	25
IRQ4	SA7	24
IRQ5	SA8	23
IRQ6	SA9	22
IRQ7	SA10	21
CLK	SA11	20
RFSH	SA12	19
DRQ1	SA13	18
DACK1	SA14	17
DRQ3	SA15	16
DACK3	SA16	15
IOR-	SA17	14
IOW-	SA18	13
SMEMR-	SA19	12
SMEMW-	AEN	11
GND	IOCHRDY	10
+12V-	SD0	9
0WS	SD1	8
-12V	SD2	7
DRQ2	SD3	6
-5V	SD4	5
IRQ9	SD5	4
+5V	SD6	3
RESET	SD7	2
GND	IOCHK	1

D	C	
GND	SD15	18
MASTER-	SD14	17
+5V	SD13	16
DRQ7	SD12	15
DACK7-	SD11	14
DRQ6	SD10	13
DACK6-	SD9	12
DRQ5	SD8	11
DACK5-	MEMW-	10
DRQ0	MEMR-	9
DACK0-	LA17	8
IRQ14	LA18	7
IRQ15	LA19	6
IRQ12	LA20	5
IRQ11	LA21	4
IRQ10	LA22	3
IOCS16-	LA23	2
MEMCS16-	SBHE	1

3.10 PLC Base Plug (48-pin Male Connectors)

3.10.1 Base Plug X1

d	**b**	**z**	
nc	M	+5V	2
UBAT	PESP	nc	4
ADB12	ADB00	/CPKL	6
ADB13	ADB01	/MEMR	8
ADB14	ADB02	/MEMW	10
ADB15	ADB03	/RDY	12
IRA	ADB04	DBO	14
IRB	ADB05	DB1	16
IRC	ADB06	DB2	18
IRD	ADB07	DB3	20
/BAU115	ADB08	DB4	22
/NAU115	ADB09	DB5	24
nc	ADB10	DB6	26
DSI	ADB11	DB7	28
+24V	BASP	M24V	30
nc	M	nc	32

3.10.2 Base Plug X2

d	b	z	
nc	M	+5V	2
nc	nc	nc	4
nc	nc	nc	6
nc	nc	nc	8
nc	nc	nc	10
nc	nc	nc	12
nc	nc	/NAU	14
nc	nc	/BAU	16
nc	nc	nc	18
nc	nc	nc	20
/TxDSN	nc	nc	22
nc	nc	nc	24
nc	/RxDSN	nc	26
nc	nc	nc	28
nc	nc	M24V	30
nc	M	+24V	32

3.11 Memory Card Plug (Panasonic Memory Card)

1	+5V	A14	2
3	A12	WE-	4
5	A7	A13	6
7	A18	A19	8
9	A6	A8	10
11	A5	A9	12
13	A4	A11	14
15	A3	OE-	16
17	A2	A10	18
19	A1	CE-	20
21	A17	A15	22
23	A16	A0	24
25	D7	D0	26
27	D6	D1	28
29	D5	D2	30
31	D4	D3	32
33	-	GND	34

3.12 Slot for Interface Modules

DCD	1	2	+5V
SubD1	3	4	+24V
SubD6	5	6	DSR
SubD2	7	8	DTR
SubD7	9	10	RxD
SubD3	11	12	CTS-
SubD8	13	14	RTS-
SubD4	15	16	TxD
SubD9	17	18	M24
SubD5	19	20	GND
RI	21		

3.13 30/34-pin Pin Header for Floppy Disk Drive (X13)

34	+12V (input)	-12V (input)	33
30	Side Select 0	Signal GND	29
28	Read Data	Signal GND	27
26	Write Protect	Signal GND	25
24	Track 00	Signal GND	23
22	Write Gate	Signal GND	21
20	Write Data	Signal GND	19
18	Step	Signal GND	17
16	Direction	-	15
14	Motor On 0	-	13
12	Ready	VCC 5V	11
10	Disk Change	VCC 5V	9
8	Drive Select 0	VCC 5V	7
6	Index	VCC 5V	5
4	GND	GND	3
2	Drive Select 1	Motor On 1	1

The pins 33 and 34 are existing started with PCB 5012V16 and are used to supply +/-12Volt for the AT-bus.

3.14 50-pin Socket (X12) with TFI Interface for Hard Disk

2	-	-	1
4	-	-	3
6	-	-	5
8	GND	RESET-	7
10	D8	ID7	9
12	D9	D6	11
14	D10	D5	13
16	D11	D4	15
18	D12	D3	17
20	D13	D2	19
22	D14	D1	21
24	D15	D0	23
26	-	GND	25
28	GND	-	27
30	GND	IOW-	29
32	GND	IOR-	31
34	ALE	-	33
36	GND	-	35
38	IOCS16-	INT	37
40	-	A1	39
42	A2	A0	41
44	CS1-	CS0-	43
46	GND	LED-	45
48	+5V	+5V	47
50	-	-	49

3.15 50-pin Socket (X11) with AT Bus Signals for Special Use

2	IOCHRDY-	SA3	1
4	AEN	SA4	3
6	MEMR-	SA5	5
8	MEMW-	SA6	7
10	SBHE-	SA7	9
12	MASTER-	SA8	11
14	IOCS16-	SA9	13
16	MEMCS16-	SA10	15
18	BALE	SA11	17
20	T/C	SA12	19
22	-5V	SA13	21
24	REFRESH-	SA14	23
26	SMEMR-	SA15	25
28	SMEMW-	SA16	27
30	CSMCARD-	SA17	29
32	IDENH-	SA18	31
34	IDENL-	SA19	33
36	IRQ9	+12V	35
38	SYSCLK	LA17	37
40	IRQ11	LA18	39
42	IRQ10	LA19	41
44	DACK6-	LA20	43
46	DRQ6-	LA21-	45
48	-12V	LA22	47
50	OSC	LA23	49

Both plugin connectors X11 and X12 have a full 16Bit AT bus excepted some interrupt and DMA channels. Special adapters (of the H1 adapter) can be connected via this bus. In this case, the hard disk drive has to be removed from the motherboard and is to be installed onto the additional board.

3.16 26-pin Pin Header (X27) with Centronics Interface (LPT 2)

26	-	SLCT	25
24	GND	PE	23
22	GND	BUSY	21
20	GND	ACK-	19
18	GND	PD	17
16	GND	PD6	15
14	GND	PD5	13
12	GND	PD4	11
10	GND	PD3	9
8	SLCTIN-	PD2	7
6	INIT-	PD1	5
4	ERR-	PD0	3
2	AFD-	STB-	1

This interface can be made available at the module front via an optional connection cable with cover sheet. Then there is the LPT2:-Centronics interface on the 25-pin SubD socket having the following assignment:

		13	SLCT
/AFD	14		
		12	PE
/ERR	15		
		11	BUSY
/INIT	16		
		10	/ACK
/SLCTIN	17		
		9	PD7
GND	18		
		8	PD6
GND	19		
		7	PD5
GND	20		
		6	PD4
GND	21		
		5	PD3
GND	22		
		4	PD2
GND	23		
		3	PD1
GND	24		
		2	PD0
GND	25		
		1	STB-

3.17 20-pin Pin Header (X22) for Flat Display Connection

up to PCB 5012V15:

1	ACDCLK	GND	2
3	V7	V0	4
5	CLKX	V1	6
7	SCLK	V2	8
9	WGTCLK	GND	10
11	V6	V3	12
13	+5V VCC	V4	14
15	BLANK-	V5	16
17	HSYNC	GND	18
19	VSYNC	+24V	20

from PCB 5012V16 on:

1	ROT	BLANK	2
3	+24V VCC	VS	4
5	+5V VCC	HS	6
7	GND	PCLK	8
9	V7	V3	10
11	V6	V2	12
13	V5	V1	14
15	V4	V0	16
17	-	-	18
19	-	CLK-EXT	20

Supply voltages 5V and 24V are made available for external consumers.
5V supply is protected by the micro fuse F2 (2A).
24V supply is protected by the micro fuse F1 (2A).

3.18 16/24-pin Pin Header (X21) for Front Display and Keyboard

up to PCB 5012V15:

16	COM4 RxD	COM4 TxD	15
14	COM3 RxD	COM3 TxD	13
12	COM2 RxD	COM2 TxD	11
10	COM1 RxD	COM1 TxD	9
8	HDD-LED	Out D4	7
6	Turbo-LED	Out D5	5
4	GND	Out D6	3
2	+5V VCC	Out D7	1

from PCB 5012V16 on:

24	-KBCLK	COM4 RxD	COM4 TxD	22
21	GND (24V)	COM3 RxD	COM3 TxD	19
18	+5V	COM2 RxD	COM2 TxD	16
15	KBDATA	COM1 RxD	COM1 TxD	13
12	+24V	HDD-LED	Out D4	10
9	GND	UBAT	Out D5	7
6	KBCLK	GND	Out D6	4
3	-KBDATA	+5V VCC	Out D7	1

UBAT (PIN 8) is available started with PCB 5012V17.

3.19 2-pin Pin Header (X4) for Speaker Connection

Pinno.	Signal
1	5V VCC
2	VF (voice-frequency) signal

3.20 Fuses for External Current Consumers

F1	Fuse for 24V outputs (2A)
F2	Fuse for 5V outputs (2A)

These plugin fuses protect the 5V- and 24V connections for external consumers against overloading.

4. BIOS Description and System Programming

4.1 System Structure

CP486 has a firmware with basic functions for the present hardware - so called BIOS. The BIOS of the CP486 consists of several utilities:

QUADTEL-BIOS:	This part has usual functions for servicing of standard components of an AT-compatible computer.
VIPA-BIOS:	VIPA has supplemented some additional functions as initialization and servicing of the linkage hardware to the PLC, additional drivers for silicon disk and memory card including the boot functions and functions for a secure startup also after loss of system configuration.
C&T-VGA-BIOS:	This BIOS incorporates functions for operating the connected monitor.

Some BIOS utilities can be parameterized. For this purpose, the firmware contains a SETUP function. System Setup is set by VIPA appropriate to system configuration and remains stored in the module battery backed approx. 1500 hours in the OFF-mode. In the case of battery discharge a default setup is used to ensure the module start. Certain setups of the system configuration can be realized by the user via the SETUP.

4.2 BIOS-SETUP

At the system startup the active terminal displays the BIOS version. First BIOS runs a test with different system components and then a memory test. After test completion the system tries to boot from the disk drive A, if existent, and then from disk drive C, if existent.
The SETUP can be invoked only during the system startup by pressing the <F2> key. This input ensues as soon as the respective message is displayed on the screen. This is the case started with BIOS version V18. Up to the BIOS version V17, the SETUP is invoked by concurrently pressing "CTRL", "ALT" and "s" during system startup.

4.2.1 VIPA-BIOS-SETUP

First the VIPA-SETUP appears with the module series number (hexadecimal) and the fields password input, bank parameterization and silicon disk selection. This window shows moreover a system configuration (if battery is discharged) being lost. In the lower part of the screen are displayed information about the key assignment for operating the SETUP:

(The text in brackets is the translation of the displayed!)

```
                                (VIPA-Setup for bank interface and silicon disk V0.3)
                          VIPA-Setup für Kachelinterface und Silikondisk V0.3
----------------------------------------------------------------------------------------------------
                      (Serial number of the module:)
                      Seriennummer der Baugruppe:  0305

        (Change password:)
        Passwort ändern:
        (Current bank number:)
        Aktuelle Kachelnummer:    32-39
        (Disk drive A:)
        Laufwerk A:             FLOPPY-Disk



----------------------------------------------------------------------------------------------------
        ↑↓  Cursor bewegen     F5,F6  auswählen      F10 übernehmen      ESC Setup verlassen
              Move Cursor)              (Select)         (Take over)         (Leave setup)
```

A password (8 ASCII-characters) can be entered in the **password-field** of the SETUP. No password is specified, as long as the SETUP-field is displayed as a white block. In this case you select other SETUP options. A password is entered by an input of an ASCII-sequence up to 8 characters in the password field, which has to be finished by pressing the ENTER key. As soon as a password is entered the password field will not be displayed as a white but a black field. In this case the user can enter the SETUP in order to change the password or resp. the system setup only if the stored password is specified. If the ENTER key is pressed instead of entering an ASCII character in the password field, the password will be deleted.

In the **bank field** the base address of the PLC bank can be set from 0 ... 248 in steps of 8. The specified area is activated immediately at the start up of the CP486 and is available at the PLC side.

By means of the SETUP field "**disk drive A**" the user is able to specify further drive types (also a silicon disk) as boot drive for drive A. In order to take an effect, a floppy disk drive for A has to be selected in the second part of the SETUP.

Different silicon disks can be installed at the CP486, whereby the chip silicon disk and the memory card silicon disk are available directly on the module (optional):

- The chip silicon disk (IC3,IC4) is set hardware-specific to the address C00000 hex. It can be assembled with SRAMs, EPROMs or PEROMs.
- The memory card silicon disk (memory card plugin socket) is set hardware-specific to the address 800000 hex. Memory cards are available as SRAM cards and OTP cards.
- Further silicon disks are available as additional plugin boards. The addresses of these silicon disks can be specified on the additional boards.

One of these silicon disks can be used for booting the system. The user has to specify the address and the storage type - RAM or ROM - of the requested boot drive:

- ROM on base address 80 0000 hex	memory card silicon disk or add. silicon disk board
- RAM on base address 80 0000 hex	memory card silicon disk or add. silicon disk board
- ROM on base address C0 0000 hex	chip silicon disk or add. silicon disk board
- RAM on base address C0 0000 hex	chip silicon disk or add. silicon disk board

If in addition a floppy disk drive is to be used, it must be redirected to the second floppy disk drive. For this purpose, the jumper field A/B on the disk interface board must be set to B and the disk drive B in the BIOS-Setup.

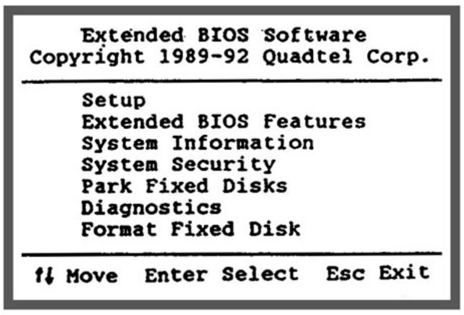
Examples:

VIPA-SETUP	Quadtel-SETUP	
Boot from 1.44MB disk:	Disk	1.44MB
Boot from EPROM chip silicon disk	ROM on C00000	1.44MB
Boot from SRAM memory card silicon disk	RAM on 800000	1.44MB

However, precondition for boot from silicon disk is the existence of a bootable silicon disk. When leaving this SETUP window with the <ESC> key, all settings will be stored (attention: the password will immediately be taken over and stored, if the ENTER key is pressed).

4.2.2 QUADTEL-BIOS Selection Menue

After leaving the VIPA-BIOS-Setup you select a menue:

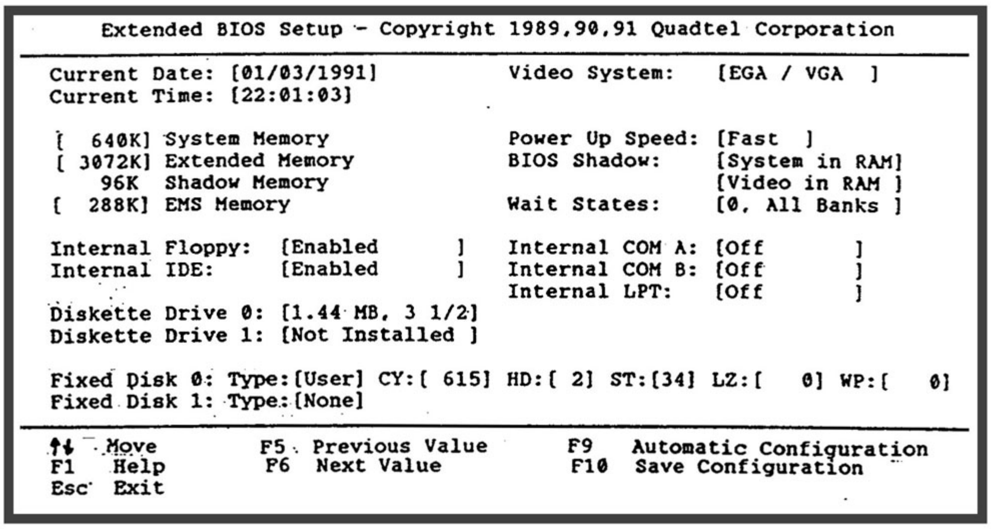


```
     Extended BIOS Software
Copyright 1989-92 Quadtel Corp.

     Setup
     Extended BIOS Features
     System Information
     System Security
     Park Fixed Disks
     Diagnostics
     Format Fixed Disk

↑↓ Move  Enter Select  Esc Exit
```

Modifications of the system setups in the different windows "Setup" and "Extended BIOS-Features" should be carried out only by experienced appliers. Normally, it is not necessary to modify any system setups. The menue item "System Information" informs about the applied QUADTEL-BIOS. In the menue item "System Security" a second password can be entered as a boot protection. If a password is specified at this item, the system does not boot before this password is entered. The menue item "Park Fixed Disks" is not required for the hard disks used. With the menue item "Diagnostics" particular system components can be tested. The menue item "Format Fixed Disk" offers the formatting of the hard disk, which is not allowed in the moment with the hard disks currently used.

4.2.3 QUADTEL-BIOS-Setup

The **BIOS Setup** has the following setup possibilities (shown are the default setups):



```
     Extended BIOS Setup - Copyright 1989,90,91 Quadtel Corporation

 Current Date: [01/03/1991]         Video System:   [EGA / VGA  ]
 Current Time: [22:01:03]

 [  640K] System Memory             Power Up Speed: [Fast  ]
 [ 3072K] Extended Memory           BIOS Shadow:    [System in RAM]
     96K  Shadow Memory                             [Video in RAM ]
 [  288K] EMS Memory                Wait States:    [0, All Banks ]

 Internal Floppy:  [Enabled      ]  Internal COM A: [Off       ]
 Internal IDE:     [Enabled      ]  Internal COM B: [Off       ]
                                    Internal LPT:   [Off       ]
 Diskette Drive 0: [1.44 MB, 3 1/2]
 Diskette Drive 1: [Not Installed ]

 Fixed Disk 0: Type:[User] CY:[ 615] HD:[ 2] ST:[34] LZ:[   0] WP:[   0]
 Fixed Disk 1: Type:[None]

 ↑↓   Move        F5  Previous Value       F9   Automatic Configuration
 F1   Help        F6  Next Value           F10  Save Configuration
 Esc  Exit
```

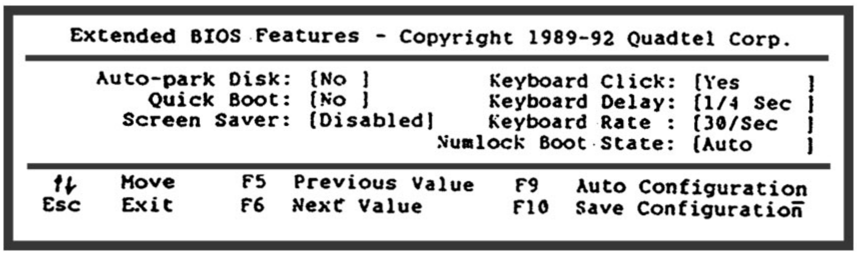
In the BIOS-Setup the following system parameters can be set up:

- date
- time
- password for system startup
- type of floppy disk drive 1 (360KB, 720KB, 1.2MB, 1.44MB)
- type of floppy disk drive 2 (360KB, 720KB, 1.2MB, 1.44MB)
- type of the hard disk 1 (1 .. 47)
- type of the hard disk 2 (1 .. 47)
- type of the video interface
- size, type and system memory segmentation
- shadow-RAM for system-BIOS
- shadow-RAM for VGA-BIOS

The setup should be modified only by experienced users. Normally, it is not necessary to intervene in the system setup.
The control keys for the **SETUP** are displayed in the lower part of the screen. By pressing the <F1> key you get help information. The displayed configuration is stored with the <F10> key, you return from the BIOS Setup to the menue with the <ESC> key.

4.2.4 Extended BIOS-Features

The **Extended BIOS** has the following additional features (shown are the default setups):

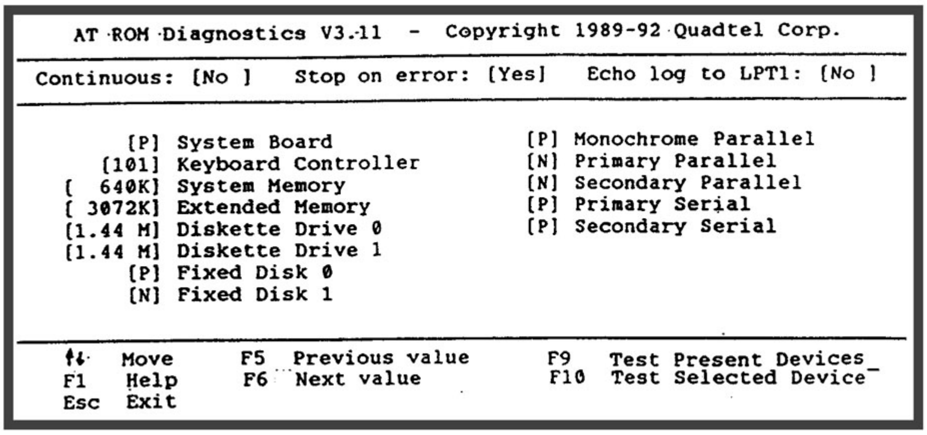


```
        Extended BIOS Features - Copyright 1989-92 Quadtel Corp.

     Auto-park Disk: [No ]          Keyboard Click: [Yes      ]
         Quick Boot: [No ]          Keyboard Delay: [1/4 Sec  ]
       Screen Saver: [Disabled]     Keyboard Rate : [30/Sec   ]
                               Numlock Boot State: [Auto     ]

 ↑↓    Move      F5   Previous Value    F9   Auto Configuration
 Esc   Exit      F6   Next Value        F10  Save Configuration
```

Further system parameter can be set up in the window Extended BIOS Features. The setup should be modified only by experienced users. Normally, it is not necessary to intervene.
The control keys are displayed in the lower part of the screen. By pressing the <F1> key you get help information. The displayed configuration is stored with the <F10> key, you return to the menue with the <ESC> key.

4.2.5 AT ROM Diagnostics

Almost all system components can be tested via the integrated **AT ROM Diagnostics**:



```
   AT ROM Diagnostics V3.11  -  Copyright 1989-92 Quadtel Corp.
 ---------------------------------------------------------------
 Continuous: [No ]   Stop on error: [Yes]   Echo log to LPT1: [No ]
 ---------------------------------------------------------------

          [P] System Board               [P] Monochrome Parallel
        [101] Keyboard Controller        [N] Primary Parallel
    [  640K] System Memory               [N] Secondary Parallel
    [ 3072K] Extended Memory             [P] Primary Serial
    [1.44 M] Diskette Drive 0            [P] Secondary Serial
    [1.44 M] Diskette Drive 1
          [P] Fixed Disk 0
          [N] Fixed Disk 1

 ---------------------------------------------------------------
   ↑↓   Move      F5  Previous value      F9   Test Present Devices
   F1   Help      F6  Next value          F10  Test Selected Device
   Esc  Exit
```

The individual system components can be tested in the menue item "Diagnostics". The control keys are displayed in the lower part of the screen. By pressing the <F1> key you get help information. You leave the diagnostics window and return to the menue with the <ESC> key.

4.3 System Register

4.3.1 CP-Status Register (I/O-Address 280 hex - read only)

			status
Bit 0	/PLC bank interrupt	0	INT 12 was triggered via PLC-access to element 1023 in the current bank
		1	no access to bank element 1023 via PLC
Bit 1	/WD reset	0	error: watchdog has announced
		1	no error
Bit 2	/PFO (accu supervision)	0	CP accu voltage under 2.5V (accu empty or defective)
		1	CP accu voltage over 2.5V (accu ok)
Bit 3	reserved		reserved

Bits 4 - 7 indicate settings of DIP switch S2 (boot defaults at accu failure) :

Bit 4	DIP switch S2 position 1	0	no boot from floppy disk drive
		1	boot from floppy disk drive A
Bit 5	DIP switch S2 position 2	0	boot from silicon disk as disk drive A
		1	boot from memory card as disk drive A
Bit 6	DIP switch S2 position 3	0	bank on PLC side not visible
		1	8 banks on PLC side (32-39) visible
Bit 7	DIP switch S2 position 4		reserved

4.3.2 PLC-Status Register (I/O-Address 281 hex - read only)

Bit 0	CPKL	0	PLC has started
		1	PLC in RESET mode (approx. 1.6sec)
Bit 1	BASP	0	outputs are conducted
		1	outputs are deactivated
Bit 2	BAU	0	PLC battery is ok
		1	PLC battery has failed
Bit 3	NAU	0	power supply connected to PLC
		1	power supply for PLC is off
Bit 4	PC type (of DIP-SW)	0	PLC-135/PLC-155 set up
		1	PLC-115 set up
Bit 5	reserved		
Bit 6	reserved		
Bit 7	reserved		

4.3.3 Control Register (I/O-Address 282 hex - write only)

The bit 0 and bit 1 control the system reset:

bit 1	bit 0	reset by watchdog	reset by RES key
0	0	on	off
0	1	off	on
1	0	off	off
1	1	on*	on*

* The mode bit1 = 1 and bit0 = 1 can be used with the CP486 modules with level 2 or higher (PCB board 5012V30 or higher)

		Status	
Bit 2	interrupt to PLC		connected to interrupt line on back plane bus
Bit 3	bank reset off	0	bank reset at system reset
	(from PCB 5012V17 on)	1	bank reset off (bank can be responded by the PLC)
Bit 4	LED 1	0	LED off
		1	LED on
Bit 5	LED 2	0	LED off
		1	LED on
Bit 6	LED 3	0	LED off
		1	LED on
Bit 7	LED 4	0	LED off
		1	LED on

4.3.4 Watchdog (I/O-Address Area 270-277)

The watchdog is deactivated after system startup and after reset, and can be set on and off by means of software.
The watchdog must be triggered every 1.6 seconds after enabling. This triggering is realized by programming a flank. If it is not re-triggered within these 1.6 seconds, the watchdog calls a system reset (depending on CONTROL register bit 0). The watchdog mode can be inquired by software at any time in the CP-STATUS register.

The watchdog register is responded by I/O address 270H with following values:

watchdog on :	load 40H to address 270H
watchdog off :	load 50H to address 270H
trigger watchdog:	load 60H to address 270H and finally
	load 70H to address 270H

4.3.5 Interrupt-Management

Interrupt Initiation in the CP

The hardware interrupt IRQ12 (software interrupt 74) on the CP486 can be initiated by

- PLC access to element 1023 of respectively active bank
- BASP activation on back plane bus

The appertaining interrupt vector is filed to address 1D0 - 1D3 (hex). The initiated interrupt must be reset by accessing the interrupt reset register (address: C000:9F8E) in the interrupt service routine.

Example: Pascal Program for Evaluation of Interrupt 12

```
PROGRAM INT_74_TEST;

USES CRT, DOS;

CONST EOI         : BYTE   = $20;         { End of Interrupt acknowledgement }
      PIC_1       : BYTE   = $20;         { Address of first Int-Controller  }
      PIC_2       : BYTE   = $A0;         { Address of second Int-Controller }

TYPE  BITARRAY    = ARRAY[0..7] OF BYTE;

VAR   OLD_VEC                             : POINTER;
      I                                   : INTEGER;
      STATUS,S5_STATUS,CP_STATUS          : BYTE;
      S5_STATUSBIT,CP_STATUSBIT           : BITARRAY;
      INT_AKTIVBIT                        : BOOLEAN;

{$F+}
PROCEDURE INT_74; INTERRUPT;              { ***** INTERRUPT - Routine ************}
{$F-}

BEGIN
i:=i+1;                                   { Increase interrupt counter    }
INT_AKTIVBIT:=TRUE;                       { Set flag for the processing   }
                                          { in the main program           }

S5_STATUS:=PORT[$281];                    { Buffer S5- and CP-register }
CP_STATUS:=PORT[$280];

PORT[PIC_1]:=EOI;                         { Interrupt acknowledgement to  }
PORT[PIC_2]:=EOI;                         { both interrupt controllers    }
END;


PROCEDURE HEX2BIN(STATUS:BYTE;VAR STATUSBIT:BITARRAY); { Conversion HEX --> BIN }

 VAR      I    : INTEGER;
          H1   : BYTE;
  BEGIN
   FOR I:=0 TO 7 DO
    BEGIN
    H1:=STATUS MOD 2;
     IF H1<>0 THEN
      STATUSBIT[I]:=1
     ELSE
      STATUSBIT[I]:=0;
    STATUS:=STATUS DIV 2
    END;
  END;


PROCEDURE FEHLER;
```

```
 BEGIN
  GOTOXY(1,10);
  WRITE('INTERRUPT 12 was not initiated by PLC                      ')
 END;


PROCEDURE BASP_INT;
 BEGIN
  GOTOXY(1,10);
  WRITE('INTERRUPT 12 was not initiated by BASP                   ')
 END;


PROCEDURE KACHEL_INT;
 BEGIN
  MEM[$C000:$9F8E]:=0;                    { Reset interrupt by accessing }
                                          { the interrupt reset register }
  GOTOXY(1,10);
  WRITE('INTERRUPT 12 was initiated by PLC via bank access   ')
 END;

PROCEDURE INT_ANZAHL;
 BEGIN
 GOTOXY(1,1);
  WRITE('Number of initiated INTERRUPTs :',I);
 END;


PROCEDURE INT_AKTIV;
 BEGIN
  INT_AKTIVBIT:=FALSE;
  HEX2BIN(S5_STATUS,S5_STATUSBIT);        { HEX --> BIN - conversion }
  HEX2BIN(CP_STATUS,CP_STATUSBIT);

  IF (S5_STATUSBIT[1]<>0) THEN
   BASP_INT                               { INT via BASP signal }
  ELSE BEGIN
   IF (CP_STATUSBIT[0]=0) THEN            { INT via S5-bank access }
    KACHEL_INT
   ELSE                                   { another hardware interrupt }
    FEHLER;
  END;
 END;


BEGIN                                     {*********** MAIN *****************}

  CLRSCR;
  I:=0;                                   { Preset counter }
  INT_AKTIVBIT:=FALSE;
  PORT[PIC_2+1]:=PORT[PIC_2+1] and $EF;   { Enable interrupt 12 }
  GETINTVEC($74,OLD_VEC);                 { Save old IRQ 12-vector, }
  SETINTVEC($74,@INT_74);                 { and refer to own Int-routine }
  gotoxy(1,24);
  write('           Interruption with optional key ');

  REPEAT
   INT_ANZAHL;                            { Output current Int-number }
   IF INT_AKTIVBIT THEN INT_AKTIV         { Is there an Interrupt ?   }
  UNTIL KEYPRESSED;

  SETINTVEC($74,OLD_VEC);                 { Recover old Int-vector }
  PORT[PIC_2+1]:=PORT[PIC_2+1] or $10;    { Disable interrupt 12   }

END.
```

4.3.6 CMOS-RAM Statusbyte (CMOS-RAM Address 4E)

CMOS-RAM used contains additional memory areas from 40 to 4F. These memory areas are used by VIPA for BIOS-extensions and for the VIPA-SETUP, and are protected by a checksum. The user is not allowed to make any changes in this RAM area.

Byte 4E - the VIPA-CMOS status byte - is excepted herefrom. It is assigned as follows:

Bit 0	0	system date and system time are ok
	1	system date and system time are lost
Bit 1	0	system configuration is ok
	1	system configuration lost, default table was loaded
Bit 2-6		vacant
Bit 7	0	must be set to 0

Procedure:
CP486 always boots also in the case of lost system configuration (discharged battery) because of the extensions in the VIPA-BIOS. The exact system configuration can be reloaded by DOS, excepted date and time. These two parameters must be input by the operator in any case if the configuration is lost. For this purpose, bit 0 in the VIPA-CMOS status register is used. This bit can be inquired and set by the operator also on standard language level.
The operator is allowed to access to bit 0 and to set this bit to 1 if he has corrected date and time. This byte is not supervised by the checksum control.

4.3.7 ROM-SETUP

VIPA-BIOS enables an ROM-SETUP. In this case, CMOS-RAM is only used to buffer date and time. The proper system SETUP is filed in the system EPROM.

Table for ROM-SETUP is stored in the BIOS-EPROM in the addresses F000:7800 to F000:784E (hex). This table contains as a standard the SETUP table in case of battery failure.
Address F000:784F (hex) includes a control flag having following functions:

FF	For system startup, SETUP from CMOS-RAM is used. Only in the case of a battery failure the SETUP in ROM is used together with the settings of the DIP-switch S2
00	ROM-SETUP is always used to start up the system. A SETUP change is possible then only by exchanging the BIOS-EPROM.

(For customer's specific SETUPs please ask VIPA)

4.3.8 Bank Interface

4.3.8.1 Operating Modes of Bank Interface

The bank interface on the CP486 consists of a 8 KByte RAM memory, which can be written or read from the PLC as well as from the CP side. Memory access and memory size are adjusted via registers on the CP486 side. Following operating modes are available:

Operating Banks via Bank Selection Register:
In this mode of operation the individual banks are selected via the bank select register on the PLC side. The bank select register (address 0FEFF(hex)), has a width of 8 bytes and this way supports 256 bank numbers. In this mode the interrupt to the CP3/4 is released, as soon as a write access to the highest bank byte from the SPS ensues. (Annotation: This mode can only be utilized in address area 0Fxxx(hex) on the PLC side.)

Operating Banks via the Highest Bank Address:
In this mode of operation the individual banks are selected each via the highest bank byte of the current bank on the PLC side. So the highest byte of each bank has two functions in this mode of operation: If the data bit 7 equals 0 during writing, a bank 0..127 (corresponding to the data bits 0..6) will be selected. If bit 7 is set to 1, the bank will not be switched but the value will be stored in the highest bank byte and an interrupt on the CP486 will be released. When the highest bank byte is read, always the contents will be returned (annotation: in this mode of operation only 128 bank numbers are available).

Linear Operation
In linear mode of operation a bank is available to th PLC. A selection of banks is not possible. In this mode of operation the ident register must have a value of 0 and the number of banks has to be set to 1. In this mode of operation an interrupt will also be initiated during write access of the PLC to the highest bank address.

During starting up of the system the BIOS adjusts the default bank operating. In this adjustment 8 banks with a size of 1KByte each are available on the PLC side. The 8 banks are located directly one after another and will be selected from the PLC via the bank select register. The bank numbers can be adjusted in the SETUP of the CP486. These 8 banks are available as large continuous 8 KByte memory area on the CP486 side.

For different configurations the registers have to be reparameterized on the CP486 side correspondingly. These registers are set up the following way:

4.3.8.2 Bank Interface Registers

The registers must be written in the following order:

Ident register	(C800:1F80)
Bank initial register 1	(C800:1F84)
Bank initial register 2	(C800:1F86)
Configuration register	(C800:1F82)
Interrupt reset register	(C800:1F8E)

Ident Register (Address 0C9F80H):

By means of this register the bank numbers are set up to which the bank interface on PLC side is responding. If using more than a bank, the entered value must correspond to the each highest bank number. During the linear operation the value 0 must be transferred.
The register has a width of 8 Bit.

Example 1:	eight banks	07 (hex)	programming on bank 00 .. 07 (hex)
		27 (hex)	programming on bank 20 .. 27 (hex)
Example 2:	two banks	01 (hex)	programming on bank 00 .. 01 (hex)
		85 (hex)	programming on bank 84 .. 85 (hex)

Bank Initial Register 1 / 2 (Address 0C9F84H / 0C9F86H)

The start address of the bank on the SPS side is set via the bank start register. The bank start address must be a multiple of the bank size. Moreover it has to be checked, whether the address area is available resp. free at the back plane bus. For the PLC-135 only addresses in the area Fxxx(hex) are possible. For operation of the banks with the bank select register FEFF(hex) the start address must be located in the area of F000(hex)-FFFF(hex). The start address is adjusted via the bank start register 1 and 2 in the following way:

Bank initial address register 1:

```
Bit                     7     6     5     4     3     2     1     0
Comparing address bit   A11   A10   A9    A8    A7    A6    A5    A4
```

Bank initial address register 2:

```
Bit                     7     6     5     4     3     2     1     0
Comparing address bit   0     0     0     0    /A15  /A14  /A13  A12
```

Attention: A15, A14, A13 must be input inverted (/Axx).

Example: For the bank initial address F400(hex) following values are required:
- bank initial register 1: value = 40(hex)
- bank initial register 2: value = 01(hex)

Configuration Register (Address 0C9F82H)

The configuration register is used to configure the number of banks, bank size and mode of the bank operation. Programming of this register approves the bank inerface for implementation towards PLC side.

Assignment:

Bit	7	6	5	4	3	2	1	0	
	L2	L1	L0	CP	Lin	K2	K1	K0	
									bank length
	0	0	0						64 KByte
	0	0	1						16 Byte
	0	1	0						32 Byte
	0	1	1						64 Byte
	1	0	0						128 Byte
	1	0	1						256 Byte
	1	1	0						1 KByte
	1	1	1						8 KByte
									bank-operated
				0	0				linear, no bank addressing
				0	1				bank-operated via upper bank address
				1	0				CP bank-operated via address D7DFEH
				1	1				not allowed
									number of banks
						0	0	0	1 bank
						0	0	1	2 banks
						0	1	1	4 banks
						1	1	1	8 banks

Annotation: The maximal RAM-size on the CP486 amounts to 8KByte.
For linear operation the number of banks must be set to 1.

Reset Interrupt Register (Address 0C9F8EH)

An PLC access to the last bank byte (in the case of 1KByte bank size at element 1023) triggers the hardware interrupt 12 (software interrupt 74) at the CP486. The appropriate vector is filed in the addresses 1D0-1D3. Concerning the operating mode bank operation via highest bank address it has to be noted that bit 7 of the written date must have the value 1in order to address the bank byte (see also section 4.3.8.1)
The interrupt has to be reset in the corresponding interrupt service routine by a write access to the interrupt reset register (address C800:1F8E (hex)). The interrupt is automatically reset in the case of a hardware reset.

4.3.8.3 Configuration Example: Standard CP BankOperation (8 Banks with each 1KByte)

Configuration:

Number of banks:	8
Bank capacity:	1024 Byte
PLC initial address of the bank:	F400(hex) (Note: the initial address must be in the Fxxx(hex) range)
Specified bank numbers:	8 .. 15 (Note: first number must be a multiple of the number of banks.)
Bank selection in the PLC:	Bank select register FEFF(hex)

Register parameterization:

Ident register	(C800:1F80):	0Fhex
Bank initial register 1	(C800:1F84):	40hex
Bank initial register 2	(C800:1F86):	01hex
Configuration register	(C800:1F82):	D7hex
Interrupt reset register	(C800:1F8E):	00hex

Interrupt in the CP486:

In the CP486 an interrupt is initiated by an PLC write access to the highest bank element at address F7FF(hex).

Address assignment:

```
Bank      PLC address         CP486 address
  8       F400 - F7FF         C800:3C00 - C800:3FFF
  9       F400 - F7FF         C800:3800 - C800:3BFF
 10       F400 - F7FF         C800:3400 - C800:37FF
 11       F400 - F7FF         C800:3000 - C800:33FF
 12       F400 - F7FF         C800:2C00 - C800:2FFF
 13       F400 - F7FF         C800:2800 - C800:2BFF
 14       F400 - F7FF         C800:2400 - C800:27FF
 15       F400 - F7FF         C800:2000 - C800:23FF
```

4.3.8.4 Configuration Example: Bank Operation (4 Banks with each 64 Byte)

Configuration:

Number of banks:	4
Bank capacity:	64 Byte
PLC initial address of the bank:	F500(hex) (Note: the initial address must be in the Fxxx(hex) range)
Specified bank numbers:	16..19 (Note: the first number must be multiple of the number of banks.)
Bank selection in the PLC:	Bank select register FEFF(hex)

Register parameterization:

Ident register	(C800:1F80):	13(hex) (corresponds to the highest bank number)
Bank initial register 1	(C800:1F84):	50(hex)
Bank initial register 2	(C800:1F86):	01(hex)
Configuration register	(C800:1F82):	73(hex)
Interrupt reset register	(C800:1F8E):	00(hex)

Interrupt in the CP486:

In the CP486 an interrupt is initiated by an PLC write access to the highest bank element at address F53F(hex).

Address assignment:

Bank	PLC address	CP486 address
16	F500 - F53F	C800:3C00 - C800:383F
17	F500 - F53F	C800:3800 - C800:383F
18	F500 - F53F	C800:3400 - C800:343F
19	F500 - F53F	C800:3000 - C800:303F

4.3.8.5 Configuration Example: Bank Operation via Highest Bank Address

Configuration:

Number of banks:	8
Bank capacity:	256 Byte
PLC initial address of the bank:	0000(hex)
Specified bank numbers:	80 .. 87 (Note: the first number must be a multiple of the number of banks.)
Bank selection in the PLC:	highest bank byte 00FF(hex) with data bit 7 to 0 (If data bit 7is set to 1, the bank element itself is responded)

Register parameterization:

Ident register	(C800:1F80):	57(hex) (corresponds to the highest bank number)
Bank initial register 1	(C800:1F84):	00(hex)
Bank initial register 2	(C800:1F86):	0E(hex)
Configuration register	(C800:1F82):	AF(hex)
Interrupt reset register	(C800:1F8E):	00(hex)

Interrupt in the CP486:

In the CP486 an interrupt is initiated by an PLC write access to the highest bank element at address 00FF(hex).

Address assignment:

```
Bank      PLC address        CP486 address
 80       0000 - 00FF        C800:3C00 - C800:3CFF
 81       0000 - 00FF        C800:3800 - C800:38FF
 82       0000 - 00FF        C800:3400 - C800:34FF
 83       0000 - 00FF        C800:3000 - C800:30FF
 84       0000 - 00FF        C800:2C00 - C800:2CFF
 85       0000 - 00FF        C800:2800 - C800:28FF
 86       0000 - 00FF        C800:2400 - C800:24FF
 87       0000 - 00FF        C800:2000 - C800:20FF
```

4.3.8.6 Configuration Example: Linear Operation

Configuration:

Number of banks:	1 (In the linear operation only 1 bank is possible)
Bank capacity:	8 KByte
PLC initial address of the bank:	8000(hex)
Specified bank numbers:	0 (Note: for linear operation the bank number must be 0)
Bank selection in the PLC:	not possible

Registerinhalte:

Ident register	(C800:1F80):	00(hex) (corresponds to the highest bank number)
Bank initial register 1	(C800:1F84):	00(hex)
Bank initial register 2	(C800:1F86):	06(hex)
Configuration register	(C800:1F82):	E0(hex)
Interrupt reset register	(C800:1F8E):	00(hex)

Interrupt in the CP486:

In the CP486 an interrupt is initiated by an PLC write access to the highest
bank element at address 9FFF(hex).

Address assignment:

```
Bank     PLC address         CP486 address
 0       8000 - 9FFF         C800:2000 - C800:3FFF
```

4.4 Address Assignment, Interrupts and DMA Channels

4.4.1 Memory Address Assignment

000000 -	09FFFF	640KB	DRAM main memory	
0A0000 -	0BFFFF	128KB	screen memory	
0C0000 -	0C7FFF	32KB	VGA-BIOS	
0C8000 -	0C9FFF	8KB	bank interface register area	
			ident register:	C9F80
			conf. register:	C9F82
			bank register 1:	C9F84
			bank register 2:	C9F86
			reset int-register:	0C9F8E
0CA000 -	0CBFFF	8KB	bank interface data area	
0CC000 -	0CFFFF	16KB	reserved	
0D0000 -	0D7FFF	64KB	usable for	
			- EMS	
			- AT-bus additional modules	
			- special functions	
0E0000 -	0FFFFF	128KB	diagnostic, SETUP, AT-BIOS, Vipa-Utilities, driver	
100000 -	15FFFF		expanded memory	for 1Megabyte modules
	45FFFF			for 4Megabyte modules
.. -	7FFFFF		usable for	
			- additional silicon disk board	
			- AT-bus additional modules	
800000 -	BFFFFF	4MB	memory card silicon disk (optional up to 4MB)	
C00000 -	DFFFFF	2MB	chip silicon disk (optional up to 2MB)	
FE0000 -	FFFFFF	128KB	diagnostic, SETUP, AT-BIOS, Vipa-Utilities, driver	

4.4.2 I/O Address Assignment

000-01F	DMA controller 1
020-03F	interrupt controller 1
040-05F	timer 8254
060	keyboard controller
061	port B register, PPI, 8255
062-06F	keyboard controller
070-07F	real time clock and CMOS-RAM, NMI mask
080-08F	DMA page register
090-091	DMA map register
092	alternate gate A20 and hot reset
093-09F	DMA map register
0A0-0BF	interrupt controller 2
0C0-0DF	DMA controller 2
0F0	clear math coprocessor busy
0F1	reset math coprocessor
0F8-0FF	math coprocessor
102-104	VGA controller
1EC-1EF	HT21 EMS- and control register
1F0-1F8	hard disk
270-277	backup logic and watchdog
278-27F	LPT2
280	VIPA CP status register
281	VIPA-PLC status register
282	VIPA control register
283-28F	reserved for VIPA register
2E8-2EF	COM4
2F8-2FF	COM2
378-37B	LPT1 (applicable after corresp. conf. of Combo)
3B0-3BB	VGA controller
3BC-3BF	LPT1
3C0-3DF	VGA controller
3E8-3EF	COM3
3F0-3F7	FD controller
3F8-3FF	COM1
46E8	VGA controller

4.4.3 Interrupt Assignment

IRQ0	timer output 0
IRQ1	keyboard (output buffer full)
IRQ2	interrupt of interrupt controller 2 (IRQ8-IRQ15)
IRQ3	COM2
IRQ4	COM1
IRQ5	COM3
IRQ6	FD controller
IRQ7	LPT1
IRQ8	real time clock
IRQ9	VGA / VIPA additional board
IRQ10	reserved for VIPA additional board
IRQ11	reserved for VIPA additional board
IRQ12	interrupt from PLC (bank interrupt and BASP interrupt)
IRQ13	coprocessor
IRQ14	hard disk
IRQ15	COM4

4.4.4 Assignment of DMA Channels

CH0	-
CH1	-
CH2	FD controller
CH3	-
CH4	cascading for controller 1
CH5	-
CH6	reserved for VIPA additional board
CH7	-

5. Utility Software for MS-DOS

It is recommended to use MS-DOS 4.01 or MS-DOS 5.0 as operating system. Setting up and further description for this operating system is described in the accompanying manuals of Microsoft resp. in supplementary documentation of the publishing house MARKT UND TECHNIK and DATA BECKER. Informations concerning internal system functions can be
found in the book PC INTERN of the publishing house DATA BECKER.

Concerning the operation systems MS-DOS 3.3, MS-DOS 4.01 and MS-DOS 5.0 VIPA developped utilities and tools for the operation of the CP486. Software described in chapters 5.1 up to 5.4 is included on VIPA disk CP3-SW593. The QUADTEL software (chap. 5.5 and 5.6) is part of disk CP3-SW583.

5.1 MS DOS Utilities for Silicon Disk Operation

5.1.1 Silicon Disk Driver

The BIOS contains driver functions for operating and usage of standard hardware components. Additional or modified hardware has also to be operated by drivers. For fear that every small system change requires to set up a new BIOS, MS-DOS offers the possibility to couple additional drivers to the BIOS. This happens by means of an entry in the file CONFIG.SYS.

For the CP486 there are several silicon disks available:

- chip silicon disk (IC3, IC4):
  The chip silicon disk has a capacity of 256KB resp. 1MB. The chip silicon disk can be assembled with SRAM, EPROM and PEROM.
- memory card silicon disk
  memory cards have a capacity of 128KB, 512KB and 1MB. There are OTP-ROM- and SRAM memory cards available.
- silicon disk addtional board
  The different additional boards have a capacity up to 7MB and are available with the component parts FLASH-, SRAM- and EPROM.

In order to respond to the silicon disks as drives, the corresponding driver has to be entered in the system configuration file CONFIG.SYS.
Several drivers are available:

SDRAM.SYS	driver for SRAM silicon disk The driver enables to read or write silicon disks.
SDROM.SYS	driver for EPROM-, FLASH-PROM- and OTP-ROM silicon disks This driver enables nothing but read.
SDPEROM.SYS	driver for silicon disks with EEPROM modules (This silicon disk can be read and written. However the durability of EEPROMs depends strongly on the number of write cycles (1000 up to 10000 according to type). Therefore it is recommended to install this driver just short-term to fill the EEPROMs with data, or modify data. Following the driver SDROM.SYS should be used to prevent write accesses.

The corresponding driver is installed in the file CONFIG.SYS by the following command:

```
device=[d:][path]SDxxx.SYS [remark][/bb][remark][/llll][remark][/pp]
```

The particular parameters have the following function:

[c:][path]	drive and path specification with driver SDxxx.SYS, whereby xxx indicates the memory type being used for the silicon disk. The three described drivers SDRAM, SDROM and SDPEROM are available.
[remark]	optional text excluded the slash "/" and entry key
/bb	base address of the silicon disk (step ratio = 64 kByte) (e.g. /C0 corresponds to the physical start address C00000hex)
/llll	capacity of the silicon disk (step ratio = 1 KByte) (e.g. /256 corresponds to a disk capacity of 256 KByte = 262144 Byte)
/pp	parameter for SDPEROM.SYS: block size of PEROMS 64 for AT29MC010 module 128 for AT29C010 and for AT29MC040 module 256 for AT29MC040 module

Examples:

Chip Silicon Disk with 1MB EPROM:
DEVICE = \DEVICE\sdrom.sys base address=/c0 size=/1024

Explanation: The driver is in the subdirectory "DEVICE" on the boot drive. The silicon disk consists of a read-only memory. Therefore, the driver SDROM.SYS is taken. The base address of the silicon disk lies at C00000H. The silicon disk has a capacity of 256 KByte.

Chip Silicon Disk with 256KB SRAM:
DEVICE = \DEVICE\sdram.sys base address=/c0 size=/256

Explanation: The driver is in the subdirectory "DEVICE" on the boot drive. The silicon disk consists of a write-only memory. Therfore, the driver SDRAM.SYS is taken. The base address of the silicon disk lies at C00000H. The silicon disk has a capacity of 1024 KByte = 1 MByte

Memory Card Silicon Disk with 1MB ROM:

```
DEVICE = \DEVICE\sdrom.sys base address=/80 size=/1024
```

Explanation: The driver is in the subdirectory "DEVICE" on the boot drive. The silicon disk consists of a read-only memory. Therefore, the driver SDROM.SYS is taken. The base address of the memory card slot is 800000H. The silicon disk has a capacity of 1024 KByte = 1MB.

Memory Card Silicon Disk with 128KB SRAM:

```
DEVICE = \DEVICE\sdram.sys base address=/80 size=/128
```

Explanation: The driver is in the subdirectory "DEVICE" on the boot drive. The silicon disk consists of a write-only memory. Therefore, the driver SDRAM.SYS is taken. The base address of the memory card slot is 800000H. The silicon disk has a capacity of 128 KByte.

Annotation:

If the silicon disk has already been activated in the VIPA-SETUP, an entry in the CONFIG.SYS file is not necessary! In this case, the disk has already been assigned the drive identification A:. An additional entry in the CONFIG.SYS file would assign a second disk drive identification.

Several silicon disks can be installed by repeating the statement in the file CONFIG.SYS with the corresponding changes of the parameters. In this manner a physically coherent address area can be seperated in several logical silicon disk drives.

The operating system installs all drivers in the file CONFIG.SYS. On this occasion a drive specification is assigned to every storage media (e.g. D: oder E: and so on). This drive specification will be displayed on the screen during start up as a message.

Every virtual drive will expand the resident part of DOS at about 600 bytes for the driver.

SRAM silicon disks have to be intitialized by the program FORMATSD. If the RAM disk is battery or accumulator buffered, this has to take place just once, otherwise after every start of the system. On buffered RAM disks data will be maintained even after switching off the system for a certain period (see specification).

Buffered RAM disks are bootable, if an operating system is installed on the disk.

5.1.2 Formatting Program for SRAM Silicon Disk

Similar to a disk SRAM silicon disks have to be formatted before they are usable as storage media under DOS. The program FORMATSD.EXE serves to format the silicon disk. Under MS-DOS the program is called as follows:

```
[c:][path]FORMATSD d:[/D:xx][/S]
```

The particular parameters have the following function:

[c:][path]	specification of drive and path with the FORMATSD-command file
d:	specification of the silicon disk drive, which is to be formatted
/D:xx	this parameter specifies, how much space is to be reserved for directory entries. xx can take values between 1 and 99. If this parameter is missing, space for 64 directory entries will be reserved.
/S	by means of this parameter the operating system files of the MS-DOS boot drive will be copied to the new silicon disk. This is necessary, if the new silicon disk should be bootable.

Attention:

This program deletes all data on the specific drive!

The program FORMATSD has to be executed before other programs or system commands (e.g. DIR) access the silicon disk drive to be formatted. If this is disregarded, it might happen that the silicon disk drive will not be formatted with the desired size.

5.1.3 Silicon Disk Generator

With the program SDGEN binary files for the EPROMs, FLASH-PROMS and PEROMS of the program storage are generated. The program is called in the following way:

```
[c:][path] SDGEN
```

The program requires the following parameters:

EPROM size in bit	(0,512,1M,2M,4M,8M): The size of the EPROMs is to be specified (e.g. 1M for EPROM 27C010). Files of the appropriate size will be generated for a EPROM programming device. If a value of 0 is entered, one single file will be created, in the way SDLOAD needs.
split (Y/N)	Split files are required for 16 bit silicon disks. The silicon disk of the CP486 has a width of 16 bit, the memory card has a width of 8Bit. In the silicon disk with a width of 16 bit 2 EPROMS (odd and even byte) are always parallel.
source drive	created mother drive for the silicon disk
target file name	file name for the binary files for EPROM programming

Corresponding to the EPROM size several binary files are generated with the specified target file name. The extension of single files is provided with a subsequent number (target file name.xxx). In the case of splitted files, ODD- and EVEN files are marked by an O or an E in the first character of the extension (target file name.Oxx or target file name.Exx).

Attention:
If a bootable silicon disk is to be generated by means of MS-DOS-Ramdisk RAMDRIVE.SYS, first the label must be removed from this RAM-disk by means of the system program LABEL. Accordingly, the operating system files (IO.SYS, MSDOS.SYS and COMMAND.COM) must be copied to the empty RAM-disk before the other files of the user. Then SDGEN must be applied. If the data are to be transmitted via SDLOAD, a large file has to be generated with SDGEN which is loaded then with SDLOAD. Direct transfer of the MS-DOS-Ramdisk with SDLOAD does not function in this case. The temporary file is always required!

5.1.4 Silicon Disk Loader

The program SDLOAD.EXE is used to load the silicon disk with the prepared data records. This loader must be applied for FLASH-PROMs and for PEROMs. FLASH-PROMs can only be deleted complete and are also completely written again with this program. For PEROMs the number of write cycles is very restricted. When transferring files with a standard DOS copy program, certain sectors, especially in the directory area, would be very often re-written, through which the durability of the components would be reduced very. Also in this case a complete data transfer, where every sector is written only once, is efficient.

The program SDLOAD is called in MS-DOS as follows:

```
[c:][path]SDLOAD
```

whereby in [c:][path] are included the drive and the path of the SDLOAD program.

After the program call, the following list of components is displayed on the screen.

```
Following FLASH-PROMs or EEPROMs/PEROMs can be programmed:
     1  Am28F010-150,P28F010-150
     2  Am28F020-150,P28F020-150
     3  Am28F040-150,P28F040-150
     4  AT28C010-150
     5  AT28C040-150
     6  AT29C010-150
     7  AT29C040-150
     8  AT29MC010-150
     9  AT29MC040-150
Please give the number of the ROM type used by you:
```

The inserted components must be selected by entering the number and pressing the enter key. Following, the number of components involved is inquired:

```
Please enter the number of modules shown above (2, 4, 6 or 8):
```

The corresponding number of pieces must be input and the enter key actuated.

Then the base address is inquired where the silicon disk board is to be applied. This address is entered as hexadecimal address:

Possible input values are:	800000
	840000
	880000
	...
	FC0000

Either the file contents generated with SDGEN or the contents of of a logical drive can be transferred now to the silicon disk. If the contents of a file has to be transferred, the file name must be entered. If the contents of a drive has to be transferred, only the drive label is specified.

File names are specified in the following format: [d:][path]file name
Drive labels are entered in the following format: d:

When specifying a file, this must have been generated with SDGEN in such a manner that the complete drive contents is stored to only one file. The file is named then e.g.: SDISK.000

The drive to be programmed must have the same or larger capacity than the source file or the source drive.

Attention:

SDLOAD copies the drive or the specified file without any changes. A drive being not bootable is also non-bootable after it has been copied with SDLOAD. Concerning one case, a file must first be created with SDGEN.

5.1.5 Examples for Applying the Silicon Disk

5.1.5.1 Example for Generating a SRAM-Disk:

Goal: On the base address C0 0000hex, an SRAM silicon disk with a capacity of 256KB (consisting of two 128KByte SRAMs (1MBit SRAMs)) should be generated.

The base board is to be assembled with 2 SRAMs each of 128KByte-chips and the jumpers set up adequate (see HW-description of the base board).

The system is booted from hard disk (drive C:). The programs SDRAM.SYS, FORMATSD.EXE (in the subdirectory C:\SD) and a text editor are required for the generation.

The following lines are input at the end into the file C:\CONFIG.SYS via the text editor:

```
DEVICE = C:\SD\SDRAM.SYS  base=/C0 size=/256
```

The system is re-started by pressing at the same time the keys <CTRL>, <ALT> and <DEL>.
At the runup, the system outputs i.a. the following messages:

```
SILICON DISK installed as drive D: .  Vx.x  date
RAMDISK STARTED WITH ADDRESS C0 0000H
```

Thus, the drive is present and has to be formatted by means of the following call:

```
C:\SD\FORMATSD D:  /D:32  /S
```

The program FORMATSD.EXE sets up now a DOS-structure at the drive D: (SRAM-disk). In doing so, space for 32 main directory entries is reserved. If the program has formatted the data memory without error messages, this can be responded as MS-DOS drive. The system files are transferred to the SRAM-disk by means of the parameter /S. Thus the SRAM-disk can be used as boot drive.

5.1.5.2 Example for Generating a FLASH-PROM Silicon Disk

Goal: On the base address C0 0000hex, an FLASH-PROM silicon disk with a capacity of 1MByte (consisting of four 256KByte FLASH-PROMs (2MBit FLASH-PROMs)) should be generated.

A silicon disk board with four 256KByte FLASH-PROMs (2MBit FLASH-PROMs) and two 512KByte SRAMs (4MBit SRAMs) is used. The base address of the FLASH-PROM disk is set to C0 0000 hex and to a length of 1MB. The base address of the SRAM-disk is set to 80 0000 hex and also to a length of 1 MB.

The system is booted from hard disk (drive C:). The programs SDROM.SYS, SDRAM.SYS, FORMATSD.EXE and SDLOAD.EXE (in the subdirectory C:\SD) and a text editor are required for the generation.
The following lines are input at the end into the file C:\CONFIG.SYS via the text editor:

```
DEVICE = C:\SD\SDRAM.SYS base=/80 size=/1024
DEVICE = C:\SD\SDROM.SYS base=/C0 size=/1024
```

The system is re-started by pressing at the same time the keys <CTRL>, <ALT> and <DEL>.
At the runup, the system outputs i.a. the following messages:

```
SILICON DISK installed as drive D: .  Vx.y  date
RAMDISK STARTED WITH ADDRESS 80 0000H

SILICON DISK installed as drive E: .  Vx.y  date
ROMDISK STARTED WITH ADDRESS C0 0000H
```

In drive D: (SRAM disk) a master for the program memory is generated. For this purpose, the SRAM-disk must first be formatted by means of the following command:

```
SD\FORMATSD D: /D:32 /S
```

Following all the files required on the FLASH-PROM disk are copied to this drive D:. Thus, the master for the FLASH-PROM disk generated and can also be tested. For this, the silicon disk must be selected on base address 80 0000H in the Setup.

For transferring purposes of this master to the FLASH-PROM disk, the program SDLOAD is called and the following parameters are entered:

```
C:\SD\SDLOAD

Following FLASH-PROMs or EEPROMs/PEROMs resp. can be programmed:
        1  Am28F010-150,P28F010-150
        2  Am28F020-150,P28F020-150
        3  Am28F040-150,P28F040-150
        4  AT28C010-150
        5  AT28C040-150
        6  AT29C010-150
        7  AT29C040-150
        8  AT29MC010-150
        9  AT29MC040-150
Please enter the number of the ROM type used by you: 2

Please enter the number of modules specified above
(2,4,6,8): 4

Please enter which base address you have set up on the silicon disk board.
Entry as hexadecimal value: C00000

Either the contents of a file generated with SDGEN or the contents of a
logic drive can be transferred to the silicon disk.
Please enter the file name or the drive label:
D:
```

The contents of drive D: is transferred now to the FLASH-PROMs. If the program has finished without errors, the FLASH-PROM disk can be responded as drive E:. The contents of drive D: and E: is the same. But the drive E: is write-protected. If the silicon disk is set to address C0 0000hex as drive A: in the BIOS-Setup, then this silicon disk can also be used for booting.

5.1.5.3 Example for Generating a Program Memory with EPROMs:

Goal: An EPROM silicon disk is to be generated using two 512KByte EPROMs.

For this purpose, an SRAM disk with two 512KByte SRAMs (4MBit SRAMs) is installed on the base board. The base board is to be assembled correspondingly and the jumpers set up accordingly (see HW-description of the base board). C0 0000hex is set up as base address.

The system is booted from hard disk (drive C:). The programs SDROM.SYS, SDRAM.SYS, FORMATSD.EXE (in the subdirectory C:\SD) and a text editor are required for the generation. The following lines are input at the end into the file C:\CONFIG.SYS via the text editor:

```
DEVICE = SD\SDRAM.SYS  base=/C0 size=/1024
```

The system is re-started by pressing at the same time the keys <CTRL>, <ALT> and <DEL>.
At the runup, the system outputs i.a. the following messages:

```
SILICON DISK installed as drive D:.  Vx.y  date
RAMDISK STARTED WITH ADDRESS C00000H
```

In drive D: (SRAM disk) a master for the program memory is generated. For this purpose, the SRAM-disk must first be formatted by means of the following command:

```
SD\FORMATSD D: /D:32 /S
```

Following all the files required on the EPROM disk are copied to this drive D:. Thus, the master for the EPROM disk is generated and can also be tested. For this, the silicon disk ROM must be selected on address C00000 in the Setup and the line

```
DEVICE = SD\SDRAM.SYS base=/C0 size=/1024
```

must be deleted in the file CONFIG.SYS.

From this master now files for the two EPROMs must be generated. Therfor the program SDGEN is called up and the following parameters are entered:

```
C:\SDGEN

  EPROM-SIZE in Bit (0,512,1M,2M,4M,8M): 4M

  SPLITTED IN ODD-EVEN          (Y/N): Y

  SOURCE DRIVE (A: .... F:)          : D:

  TARGET-FILE NAME (max. 8 char.)      : EPROM
```

The program generates the files EPROM.O00 and EPROM.E00. Hereby it refers to binary files for the EPROM programming device. Every file belongs to an EPROM. These EPROMs are to be programmed. Accordingly the SRAMs are removed from the silicon disk bases, and the programmed EPROMs installed into the silicon disk bases as follows:

EPROM.E00 in IC4 (even)
EPROM.O00 in IC3 (odd)

After the restart and boot, the storage media generated in the moment is available as drive E:.

If the silicon disk ROM is set to address C0 0000hex as drive A: in the BIOS-Setup, then this program memory can also be used for booting.

5.1.5.4 Example for Generating a ROM-Silicon Disk with FLASH-PROMs by Means of the MS-DOS-RAM-Disk:

Goal: On the silicon disk board, an FLASH-PROM silicon disk with a capacity of 2MByte (consisting of eight 256KByte FLASH-PROMs (2MBit FLASH-PROMs) should be generated started with the base address C0 0000hex.

A silicon disk board with eight 256KByte FLASH-PROMs (2MBit FLASH-PROMs) is used. The base address is set to C0 0000 hex and to a length of 2MB.

The system is booted from hard disk (drive C:). The programs SDROM.SYS, SDGEN.EXE and SDLOAD.EXE (in the subdirectory C:\SD) and a text editor are required for the generation.

The following lines are input at the end into the file C:\CONFIG.SYS via the text editor:

```
DEVICE = C:\DOS\RAMDRIVE.SYS 2024 512 64 /E
DEVICE = C:\SD\SDROM.SYS base=/C0 size=/2048
```

The system is re-started by pressing at the same time the keys <CTRL>, <ALT> and <DEL>. At the runup, the system outputs i.a. the following messages:

```
Microsoft RAMDrive Version x.y - virtual drive D:
        disk size: 2042K
        sector size: 512 Byte
        block size: 1 sector
        directory entries: 64
ROM SILICON DISK installed as drive E:.  Vx.y  date
```

The drive D: is used as master for the ROM silicon disk. For this purpose, first the label must be removed as this occupies a space required by the operating system. The respective command is:

```
LABEL D:
```

Then the following message is displayed:

```
data medium in drive D is MS-RAMDRIVE
data medium label (11 characters, ENTRY KEY for none)?
```

No data medium label is entered but only the enter key is actuated. Then the question appears:

Delete current data medium label (Y/N)?

This question is acknowledged with "Y" and the enter key.

After this the program LABEL is finished (MS-DOS-Prompt). Next, all required files are copied to the drive D: (adhere following order if the drive should be bootable):

1. Io.sys
2. Msdos.sys
3. command.com
4. remaining files and directories in optional order

Attention: The files Io.sys and Msdos.sys are hidden files and thus, cannot be transferred via the DOS-command COPY. It is possible to transfer them e.g. by mean of DOSSHELL or the Norton Commander. Thus the master for the program memory is generated, and the program SDGEN is called up next with following parameters:

```
C:\SD\SDGEN

  EPROM-SIZE in Bit (0,512,1M,2M,4M,8M): 0

  SPLITTED IN ODD-EVEN         (Y/N): N

  SOURCE DRIVE (A: .... F:)          : D:

  TARGET FILE NAME (max. 8 char.)    : EPROM
```

The program generates the file EPROM.000. (Note for insider: During generation of this file the boot sector and the double FAT will be created. With it the silicon disk will be bootable). Subsequently, this file can be transferred with the program SDLOAD to the program memory . The program SDLOAD is called with the following parameters:

```
C:\SD\SDLOAD

  FLASH-PROMs resp. EEPROMs/PEROMs can be programmed:
        1  Am28F010-150,P28F010-150
        2  Am28F020-150,P28F020-150
        3  Am28F040-150,P28F040-150
        4  AT28C010-150
        5  AT28C040-150
        6  AT29C010-150
        7  AT29C040-150
        8  AT29MC010-150
        9  AT29MC040-150
  Please indicate the number of the ROM-type you used: 2

  Please indicate the number of modules specified above
  (2,4,6,8): 8

  Please indicate the base address, you specified on the silicon disk board.
  Input as Hex value: C00000

  The contents of a file generated by SDGEN or the contents of a logical drive can be trasferred in
  the silicon disk. Indicate the file name or the drive specification:
  C:\EPROM.000
```

The contents of the file C:\EPROM.000 will now be transferred to the FLASH-PROMs. If the program terminates without error, the FLASH-PROM disk is to be accessed as drive E:. The contents of drive D: and drive E: are the same. However drive E: is write-protected. If the silicon disk is specified as drive A: at address C00000hex in the BIOS-Setup, this program memory can be used for booting as well.

5.2 VGA-Configuration Program

in preparation

5.3 Program CPLINK for Computer Link

With this program files can be loaded to the CP486 or read from the CP486 via the serial interface. This way CP486 modules without floppy disk drive or without alternate memory
cards can be supplied with data and programs or recorded data can be read out.

5.4 Program for Visualizing the PLC Process Image

The program S5KOP serves in the current version to visualize the process image in the processor of the automation system.
The MS-DOS program S5KOP.EXE in the version 1.0 from 4-19-1991 has a capacity of 75645 bytes. VIPA handling modules for the CP486 must be included in the PLC.

Calling from MS-DOS is realized via the command "S5KOP<Return>". A title screen is displayed which is cleared after pressing an optional key. Now you are in the main menu.
The menu "process image"is activated by pressing <F1>. There you can select via function keys what is to be cyclically displayed:

<F1>	Display of inputs
<F2>	Display of outputs
<F3>	Display of markers 0..127
<F4>	Display of markers 128..255
<F5>	Display of timers
<F6>	Display of counters
<F8>	Display of bank

The cyclic display can be interrupted by pressing the pause key <F7> until the next key press.

After pressing a selection key F1 .. F6 or F8, the respective process image is cyclically displayed until you choose alternative.
By pressing the <F7> key ("pause") the current status is frozen until the next key press.

By pressing <ESC> you exit the menu process image and return back to the main menu and from there again with <ESC> back to the DOS command prompt.

5.5 EMS Driver

Driver for the EMS memory on CP486 is contained on the optionally available disk with original QUADTEL software (software package CP4-SW583 (MS-DOS diskette, 3.5", 720KB) included the manual CP4-HB72). This software is only sold as simplex capability, i.e. every system where this driver is utilized requires a licence.

This package contains inter alia the following programs and drivers (cf. also section 5.8):

- Expanded Memory Manager (EMS)
- high memory loader
- printer spooler
- disk cache driver
- Ramdisk driver (for virtual disk in DRAM memory)

Installation is supported by the program INSTALL on the disk.

5.6 System Test Program

This system test program is contained on the optionally available disk with original QUADTEL software (software package CP4-SW583 (MS-DOS diskette, 3.5", 720KB) included the manual CP4-HB72). This software is only sold as simplex capability, i.e. every system where this driver is utilized requires a licence.

This package contains inter alia a diagnostic program for the CP486 (cf. also section 5.5). The diagnostic program can be loaded under MS-DOS and offers a list of tests of all important system components. These tests can be run single or also as package.

6. Linkage with PLC

6.1 General Description

Data transfer between CP486 and PLC is supported by handling modules on PLC side and by software interrupts on CP side. Following routines are available:

		Operation on PLC side	Operation on CP side
Bank 0	PLC job: read data from CP **(PLC active)**	Handling module (FB3)	Interrupt service routine
Bank 1	PLC job: send data to CP **(PLC active)**	Handling module (FB3)	Interrupt service routine
Bank 2	CP job: read data from PLC **(CP486 active)**	Cyclically called handling module (FB1)	Software interrupt
Bank 3	CP job: send data to PLC **(CP486 active)**	Cyclically called handling module (FB1)	Software interrupt
Bank 4	reserved		
Bank 5	reserved		
Bank 6	reserved for standard CP operation (Send, Receive, Control, ..)		
Bank 7	Transfer process image to CP	Cyclically called handling module (FB1)	Software interrupt or direct access to bank

Following data structures in the PLC can be accessed on CP side:

- single elements in format byte, words and doublewords
  DB, DX, markers, inputs, outputs, timer, counter, flag word
- data blocks
  DB, DX, FB, FX, OB, PB, SB, BA, BB, BT, BS

Following PLC accesses to CP are possible:

the linkage supports all types of MS-DOS device-oriented accesses.
all jobs issued by the PLC are based on MS-DOS device functions.

Functions described below are available upward for CP386COM version 1.00 (Software CP4-SW593 version 2.00) and handling module version 2.00 (CP4-SW977 and CP4-SW978 version 2.00). The program CP386COM is named in the following description as COM-driver.

6.2 Installation of Bank Software for Linking PLC and CP486

6.2.1 PLC Side: Handling Modules

handling modules FB1 and FB2 have to be loaded in the PLC to enable communication with the CP486. Handling module FB1 is called up in OB1 and handling module FB2 in the restart modules (OB21 and OB22).

Example for calling up FB1 in OB1:

```
        Module#OB1
        BIB
0000            ;SPA FB 1
        NAME    #CP-L/S
        ANSS    =KY 2,32
        PAA     =KF +1
        PAFE    =MB 99
0005            ;BE
```

Transfer parameters:

ANSS:	KY	AN	Number of jobs to be at most processed on the bank when calling up a handling module
		SS	Number of basic bank
PAA:	KF		Update ident of process images on the bank when calling up the handling module >< 0 Process images are updated = 0 Process images are **not** updated
PAFE:	MB		Error acknowledgement message of handling module = 0 no error occurred >< 0 error occurred. Error number is sent in PAFE-byte Error number: 1 Number of jobs to be at most processed when calling up a handling module is 0. 2 Number of jobs to be at most processed when calling up a handling module is higher than 127. 3 Basic bank number is not divisible by 8 5 Bank is not synchronized yet by CP. 6 For a block job being the first call, no further job is allowed to be in the bank. 7 A further block job is only allowed to be the first job in the bank.

Scratch markers used: MB200-MB255

Example for calling up FB2 in OB21:

```
        Module#OB21
        BIB
0000            ;SPA FB 2
        NAME    #SYNCHRON
        SSNR    =KY +32
        WART    =KF +0
        PAFE    =MB 98
0005            ;BE
```

Transfer parameters:

SSNR:	KF	Number of basic bank	
WART:		= 0	FB-SYNCHRON does not wait until every single bank is synchronized by CP
		>< 0	FB-SYNCHRON waits at every single bank until the CP has synchronized this bank
PAFE:	BY	Error acknowledgement message of handling module	
		= 0	no error occurred
		>< 0	error occurred:
		3	basic bank number is not divisible by 8.

Scratch markers used: MB200-MB255

6.2.2 CP486: MS-DOS Driver Program

For communication via banks between PC and CP a specific communication driver must be loaded in the CP486. This driver is specific for the communication with the VIPA handling modules. The driver supplies functions which are easy to handle. The user needs no detailed information concerning structure and operation of the banks. The driver contains software to control all banks. At the moment it currently supports: banks 0 and 1 (PC active, CP passive). banks 2 und 3 (PC passive, CP active) and bank 7 (process image). The driver automatically supports all functions for all banks, no further configuration is necessary for particular banks.

Driver Installation:
It is recommended to load the driver at the best during the start of the CP486, that means already in AUTOEXEC.BAT. As well a later call is possible. Notice, that as a rule , the handling modules for synchronization are called during the restart. They just wait for a fixed time for a reaction of the CP. Therefore PC and CP remain unsynchronized if the driver is not started within this time and no communication is possible.

Call: `CP386com.exe [/ini] [/txx] [/ixx] [/notsr] [/?] [/h]`

The driver is a resident program (TSR-Utility) and allocates about 26 KByte of main memory (program and data). The driver can be loaded only once at a time. Any further call causes a message, that the driver has already been installed. A removal of the driver from main memory (de-installation) is not pssible, thereto the CP has to be rebooted.

Driver options (Revision 2.6 and following):

/INI or /ini
With this option-switch the communication bank is initialized, pending jobs are stopped and the whole bank is cleared. The driver is not installed. This initialization can be as often as necessary.

/Txx or /txx
This option specifies the timeout in seconds for the driver. The default timeout value is 10seconds. Possible values for the timeout time are 1sec .. xx 30sec

/Ixx or /ixx
This option specifies the number of the software-interrupt for the communication via bank 2 and 3 (CP active mode). The default value is 78h. Possible values are 78h, 7Ah .. 7Fh.

/NOTSR or /notsr
Using this option when calling the driver in the command line causes the program to be installed nonresident. The program will not be finished, no further DOS-commands can be entered or

programs can be started subsequently. This option is only meaningful, if communication ensues exclusively via banks 0 and 1 (CP passive). By pressing the F10-key and subsequent confirmation with "j" the driver will be removed again.

/?, /H or /hxx
This option shows a list of all possible options of the driver.

Attention:
The COM-driver is designed to work with CP486-modules of the VIPA GmbH exclusively and can be installed on these systems solely. Loading the driver on different AT-systems, even on i386 or i486 processor, causes an immediate system-hang-up.

Reserved interrupts:
The driver uses several software interrupts for operation and communication with the applications software of theCP-module:

- INT 1Ch Timer-Interrupt and INT 28 DOS-Idle-Interrupt

The so called ticker-interrupt with number 1Ch, as well as the so called DOS-idle interrupt are used for routine and cyclical check of the bank. By this, it is regularly checked, whether the PC tries to synchronize the banks recently. After executing the CP-specific functions, the initial interrupt service routine is called.

- INT 74h (IRQ 12):

The CP486 uses the hardware-IRQ 12, which occupies software-interrupt 74h. This interrupt will be triggered, if BASP is active in PC, or if the highest memory location of every bank (byte1023) is written by the PC. The usage of the interrupt permits fast reaction of the CP to a request by the PLC. After processing the CP-specific functions the initial interrupt service routine is called. In this manner, different devices can use IRQ 12.

- INT 78h Service-Interrupt:

This interrupt is to be used by applications software in the CP to call functions of the driver, for example data exchange with the PC via banks 2 and 3. Different functions can be triggered by corresponding assigment of the processor registers. If INT 78 is called with register values, which are invalid for the CP486 communication, the initial interrupt service routine is called.

6.2.3 Different Data Representation in Memory:

For the transfer of data between CP and PC, the different representation of words and doublewords (extended words) on AT and PC (programmable controllers) has to be taken into account.
Unlike AT´s the PLC stores the datatype word in a different form in memory, High-Byte and Low-Byte are stored reverse. In doublewords all 4 bytes are stored in exact reverse order. If data of type word, doubleword is exchanged between PC and CP, it´s quite natural that an interchange has to be undertaken, otherwise data is wrong after transmission. As far this is possible in a meaningful way the COM-driver processes this adaptation automatically.
For data exchange via banks 0/1 the user has to execute the interchange on its own, either on the CP or on the PC. The driver processes the interchange automatically for the banks 2/3 and bank 7 in all cases.

Operation:
During transmission of bytes no interchange takes place.
During transmission of words High- Byte and Low-Byte are interchanged.
During transmission of extended words all 4 bytes are reversed according to their order.

Data representation in PC (programmable controller):

Address n	Byte	Representation Byte
Address n	High-Byte	
Address n+1	Low-Byte	Representation Word
Address n	High-Byte High-Word	
Address n+1	Low-Byte High-Word	
Address n+2	High-Byte Low-Word	Repres. Doubleword
Address n+3	Low-Byte Low-Word	

Data representation in AT

Address n	Byte	Representation Byte
Address n	Low-Byte	
Address n+1	High-Byte	Representation Word
Address n	Low-Byte Low-Word	
Address n+1	High-Byte Low-Word	
Address n+2	Low-Byte High-Word	Repres. Doubleword
Address n+3	HighByte High-Word	

6.3 PLC-Jobs for CP486 (Functions for Bank 0 and 1)

6.3.1 Overview

All PLC-jobs are transacted via banks 0 and 1. In this way the CPU can use series of MS-DOS-functions.
Die PLC-instructions are processed in background via interrupts, as soon as this driver is being installed. In this way no additional software for the CP486 is necessary to operate the PLC-jobs.

The driver permits to call several MS-DOS system functions from the PC. Hereby all parameters and information are exchanged transparent between PC and MS-DOS. The AT-driver software is solely useful, to record the passed parameters correctly in the processor-register and to transfer the returned values in a suitable form to the PC. The only fundamental restriction is, that only one part of the MS-DOS system functions can be called by the PC. It´s not recommendable to call all functions by the PC, because a great number of functions cannot be used meaningful by the PLC at all. For further reasons a breakdown of the operating system can occur if a series of functions is used in a non-adequate way. Therefore the driver software only supports such functions, which can be used meaningful by the PLC. As function numbers for calling, exactly these function numbers of the MS-DOS system function are to be specified.

Bank no.	**Function no.** **hex**	**dec**	**Function**
1	$0D	13	reset all disk drives
1	$0E	14	select disk drive
0	$19	25	determine current disk drive
1	$39	57	set up directory
1	$3A	58	delete directory
1	$3B	59	change directory
0	$47	71	determine current directory
1	$3C	60	create file
1	$5A	90	create file without overwriting
1	$3D	61	open file
1	$68	104	write file physically to disk (without close)
1	$3E	62	close file
1	$41	65	delete file
1	$56	86	rename file
1	$42	66	set file pointer
0	$C2	194	read file pointer (no MS-DOS system function) !!
0	$3F	63	read from file or device
1	$40	64	write to file or device
0	$2A	42	read date
0	$2C	44	read time
1	$4B	75	execute program
0	$30	48	determine MS-DOS version
0	$59	89	read detailed error information
1	$FF	255	optional interrupt

Interface concept for banks 0 and 1

These two banks serve for reading and writing of data from or to the CP486 respectively. If the PLC tries to read data from the CP or write data, it has to call the suitable handling module (SEND or FETCH and RECEIVE). As a result these handling modules provide a job unit in bank 0 or bank 1. A maximum of one job can be entered in the banks 0 und 1 at a time. The size of the data to be transferred ranges from one word up to 504 words. The structure of the job unit inside bank 0 and bank 1 is absolutely identical. The distinction reading or writing is only due to the bank number.

On the CP486-side, there is a job catalog deposit. As soon as the CP registers a job in bank 0 or in bank 1, it takes the job number from the job unit and searches for the respective parameter block on its side of the job catalog. In this catalog it is deposit, what should happen with the data, which e.g. will be transferred from the PLC to the CP. The same happens for reading correspondingly, that means, the CP searches in the bank by means of the job number, whether a catalog is filed on its side. If yes, it makes the requested data available corresponding to its catalog.

Processing a Write Job:

The applications software calls the handling module SEND. At this point the programmer sets the parameter for the job number, the transmission length in words, as well as the source of data in the PC. The handling module checks these specifications. If the specifications are correct, it verifies, whether the bank is unassigned. Unassigned means, whether the bank reports a running job. In this case the send job would be rejected. If the bank is available the handling module creates a job unit and stores the data to be written subsequent to the job unit in the bank and sets the job status to 'job is running'. This is the identification for the CP, that a new job to be executed is waiting in the bank. Accordingly, if the job is executable, the CP resets after executing the job, the identification 'job is running' and sets instead of one of the identifications 'job finished with error' or 'job finished without error'. If an error occurred, The CP reports a corresponding error code. With the handling module CONTROL the user gets information about the status of the running job or the last job.

Processing a Read Job:

With the handling module FETCH the applications software passes a read job to the CP. This handling module verifies as well as the handling module SEND the specified parameters, creates a job unit in bank 0 and sets the status to 'job is running'. By this the CP detects the existence of a new job and executes this job, as already described under 'Write'. If the CP is able to supply these data, it stores the data subsequent to the job unit in bank 0 and sets the status to 'finished without error'. Additionally it sets the identification to 'data for receive available'. With the handling module CONTROL the applications software allows reading the status instantly. If the data is prepared by the CP, it can be transmitted to the PC via handling module RECEIVE. If this was successful, the handling module RECEIVE resets the identification 'data for receive available'. From this time a new receive job can be entered by the software.

In the case, that the applications software tries to access a new write or read job, while a write or read job is still running, the applications software receives the identification 'interface busy". This identifications are placed only by handling modules, they are of no account for the communication with the CP.

Multiprocessor Operation:

The interface (data structured in banks) is not suitable in the current version for multiprocessor operation in PC. Only one and the same CPU is allowed to access at any time to a CP implemented in the PC !!

,6.3.2 Parameterization of Handling Modules:

The handling modules SEND (FB3), CONTROL (FB4), FETCH (FB5) and RECEIVE (FB6) are parameterized as follows:

6.3.2.1 Handling Module SEND (FB3, Relative Bank Number: 1):

This handling module transfers a data block of up to 504 words from a DB to the CP486. For identification purposes a job number is also sent to the CP486. The handling module supplies the result by means of a display word in a marker word to the application program. Parameterization errors are signalled via a marker byte. The handling module is directly and indirectly parameterizable:

```
Module#FB3
BSTNAME #SEND
BIB
BEZ     #INSS           D:KY
BEZ     #A-NR      D:KY
BEZ     #DOSP      D:KY
BEZ     #ANZW      D:KY
BEZ     #QT/N      D:KY
BEZ     #QANF      D:KF
BEZ     #QLAE      D:KF
BEZ     #PAFE      A:BY
```

Transfer parameters:

```
INSS:   D       KY    IN    Code if direct or indirect parameterization
                            = 0    direct parameterization via formal operands
                            >< 0   indirect parameterization - transfer parameters are filed
                                   in opened DB
                      SS    number of basic bank (must be divisible by 8)

A-NR:   D       KY          If direct parameterization left byte has the job number
                            (1..127) and right byte the function number for CP-driver.
                            If indirect parameterization, A-NR has the DW-no, from which
                            on the parameters are in the open DB. Thereby the content
                            of the parameter is evaluated as word.

DOSP:   D       KY          DOS-parameter which is also transferred at certain functions.
                            It can be a handle, an access or a drive-number.

ANZW:   D       KY          left byte:          reserve
                            right byte:         contains the MW-no. where the display word is
                            to be stored (permitted are MW0..MW198)
                            Display word can have following information at SEND status:
                            Bit    .0 =0
                                   .1 job runs (job transferred without errors)
                                   .2 =0
                                   .3 job finished with error
                                   4 F-Nr.      2 raised to 0
                                                2 raised to 1
                                                2 raised to 2
                                                2 raised to 3
```

Error numbers are dual encoded.

Error number	1 interface occupied by PLC (job runs)
	6 interface occupied by CP

QT/N:	D	KY	left byte: reserve right byte: source module no. (2...255), DB-no. of the module with data to be transferred is specified
QANF:	D	KF	Initial address in DB (0...32761), the DW-no. is specified from which on the data to be transferred are filed in the DB.
QLAE:	D	KF	Number of data words to be transferred (1...504)
PAFE:	A	BY	Markerbyte, in which the PAFE-message is transferred to PLC program (permitted 0...255) Error acknowledge message of handling module:

= 0	no error occurred
><0	error occurred, error number in PAFE-Byte:
3	basic bank number is not divisible by 8
5	bank is not synchronized yet by the CP
10	invalid job number (out of 1...127)
12	no DB open for indirect parameterization
13	source module is not existent
14	source module too short
15	QLAE is invalid (out of 1...504)
16	DB for indirect parameterization too short
18	invalid source module no. (out of 2...255)
19	invalid source initial address (out of 0...32761)
20	invalid marker word no. for ANZW (out of 0...198)

Attention: If the bank number of the CP does not coincide with the number parameterized in this module, the CPU goes in stop with QVZ!

Parameter storage in a DB if parameterization is indirect:

A-NR points to the beginning

DL	DR
INSS	
A-NR	F-NR
DOSP	
ANZW	
QT/N	
QANF	
QLAE	

PAFE is not parameterizable indirectly

0 can be parameterized at all other formal operands (SS, DOSP, ANZW, QT/N, QANF, QLAE) because these are not evaluated at indirect parameterization.

Scratch markers used: MB200-255

6.3.2.2 Handling Module CONTROL (FB4, Relative Bank Number: 0/1):

This handling module outputs the status of a write or read job. For identification purposes a job number is also sent to the CP486. The handling module supplies the result by means of a display word in a marker word to the application program. Parameterization errors are signalled via a marker byte. The handling module is directly and indirectly parameterizable:

```
Module#FB4
BSTNAME #CONTROL
BIB
BEZ     #INSS           D:KY
BEZ     #A-NR      D:KF
BEZ     #DOSP      D:KY
BEZ     #RWAW      D:KY
BEZ     #PAFE      A:BY
```

Transfer parameters:

INSS:	D	KY	IN	Code if direct or indirect parameterization
				= 0 direct parameterization via formal operands
				>< 0 indirect parameterization - transfer parameters are filed in opened DB
			SS	number of basic bank (must be divisible by 8)
A-NR:	D	KF		If direct parameterization right byte has the job number (0..127)
				If indirect parameterization, A-NR has the DW-No, from which on the parameters are in the open DB. Thereby the content of the parameter is evaluated as word.
				For job number 1...127, the status of the suitable job is read.
				For job number 0, the status of the actually running or finally executed job is read.
DOSP:	D	KY		left byte: reserve
				right byte: contains MW-no., where DOS-parameter is to be stored.
RWAW:	D	KY	RW	= Control for read job in bank 0
				= Control for write job in bank 1
			AW	contains the MW-no. where the display word is to be stored (permitted are MW0..MW198)
				Display word can have following information:
				Bit .0 receive meaningful
				.1 job runs (job transferred without errors)
				.2 finished without error
				.3 job finished with error
				4 F-Nr. 2 raised to 0
				2 raised to 1
				2 raised to 2
				2 raised to 3
				Error number is dual encoded.
				Error number 4 not defined job status on the CP
				5 no job under this job number
				6 interface occupied by CP
				Bits 8-15 contain a probable error number of the CP486
PAFE:	A	BY		Markerbyte, in which the PAFE-message is transferred to

PLC program (permitted 0...255)
Error acknowledge message of handling module:

= 0	no error occurred
><0	error occurred, error number in PAFE-Byte:
3	basic bank number is not divisible by 8
4	bank is not existent (acknowledgement delay at bank access)
5	bank is not synchronized yet by the CP
10	invalid job number (out of 1...127)
12	no DB open for indirect parameterization
16	DB for indirect parameterization too short
20	invalid marker word no. for ANZW (out of 0...198)
21	invalid marker word no. for DOSP (out of 0...198)

Parameter storage in a DB if parameterization is indirect:

A-NR points to the beginning

DL DR
INSS
A-NR
DOSP
RWAW

PAFE is not parameterizable indirectly
0 can be parameterized at all other formal operands (SS, RWAW) because these are not evaluated at indirect parameterization.

Scratch markers used: MB200-255

6.3.2.3 Handling Module FETCH (FB5, Relative Bank Number: 0):

This handling module transfers the read job to the CP486. For identification purposes a job number is also sent to the CP486. The handling module supplies the result by means of a display word in a marker word to the application program. Parameterization errors are signalled via a marker byte. The handling module is directly and indirectly parameterizable:

```
Module#FB5
BSTNAME #FETCH
BIB
BEZ     #INSS            D:KY
BEZ     #A-NR       D:KY
BEZ     #DOSP       D:KY
BEZ     #LAE             D:KF
BEZ     #ANZW       D:KY
BEZ     #PAFE       A:BY
```

Transfer parameters:

INSS:	D	KY	IN	Code if direct or indirect parameterization = 0 direct parameterization via formal operands >< 0 indirect parameterization - transfer parameters are filed in opened DB
			SS	Number of basic bank (must be divisible by 8)
A-NR:	D	KY		If direct parameterization left byte has the job number (1..127) and right byte the function number for CP-driver. If indirect parameterization, A-NR has the DW-No, from which on the parameters are in the open DB. Thereby the content of the parameter is evaluated as word.
DOSP:	D	KY		DOS-parameter which is also transferred at certain functions. It can be a handle, an access or a drive-number.
LAE:	D	KF		Number of data words to be read (corresponding to the passed function no. for the DOS-driver, e.g. number of data which are to be read from a file
ANZW:	D	KY		left byte: reserve right byte: contains the MW-no. where the display word is to be stored (permitted are MW0..MW198) Display word can have following information at FETCH status: Bit .0 =0 .1 job runs (job transferred without errors) .2 =0 .3 job finished with error (job was not transferred) 4 F-Nr. 2 raised to 0 2 raised to 1 2 raised to 2 2 raised to 3 Error numbers are dual encoded. Error number 1 interface occupied by PLC (job runs) 6 interface occupied by CP
PAFE:	A	BY		Markerbyte, in which the PAFE-message is transferred to PLC program (permitted 0...255)

Error acknowledge message of handling module:

= 0	no error occurred
><0	error occurred, error number in PAFE-Byte:
3	basic bank number is not divisible by 8
5	bank is not synchronized yet by the CP
10	invalid job number (out of 1...127)
12	no DB open for indirect parameterization
16	DB for indirect parameterization too short
20	invalid marker word no. for ANZW (out of 0...198)

Attenttion:
If the bank number of the CP does not coincide with the number parameterized in this module, the CPU goes in stop with QVZ!

Parameter storage in a DB if parameterization is indirect:

A-NR points to the beginning

DL	DR
INSS	
A-NR	F-NR
DOSP	
LAE	
ANZW	

PAFE is not parameterizable indirectly
0 can be parameterized at all other formal operands (SS, DOSP, LAE, ANZW) because these are not evaluated at indirect parameterization.

Scratch markers used: MB200-255

6.3.2.4 Handling Module RECEIVE (FB6, Relative Bank Number: 0):

This handling module transfers a data block of up to 504 words from the CP486 to a DB. Before calling the RECEIVE module, the CP486 must be informed by means of the FETCH handling module about data which it requires. For identification purposes a job number is also sent to the CP486. This job number is returned together with the data.
The handling module supplies the result by means of a display word in a marker word to the application program. Parameterization errors are signalled via a marker byte. The handling module is directly and indirectly parameterizable:

```
Module#FB6
BSTNAME #RECEIVE
BIB
BEZ     #INSS           D:KY
BEZ     #A-NR      D:KF
BEZ     #ANZW      D:KY
BEZ     #ZT/N      D:KY
BEZ     #ZANF      D:KF
BEZ     #ZLAE      D:KF
BEZ     #PAFE      A:BY
```

Transfer parameters:

INSS:	D	KY	IN	Code if direct or indirect parameterization = 0 direct parameterization via formal operands >< 0 indirect parameterization - transfer parameters are filed in opened DB
			SS	number of basic bank (must be divisible by 8)
A-NR:	D	KF		If direct parameterization, A-NR has the job number (0..127). For a number 1...127 it is checked whether data being prepared by the CP, have the same job number. Data are taken over only if they have the same job number. In case of job number 0, data are taken over by the CP in any case. If indirect parameterization, A-NR has the DW-No, from which on the parameters are in the open DB. Thereby the content of the parameter is evaluated as word.
ANZW:	D	KY		left byte: reserve right byte: contains the MW-no. where the display word is to be stored (permitted are MW0..MW198) Display word can have following information at SEND status: Bit .0 =0 .1 job runs (still no data received from the CP) .2 job finished without error (data are in DB) .3 job finished with error (error no. in Bit 4...7) 4 F-Nr. 2 raised to 0 2 raised to 1 2 raised to 2 2 raised to 3 Error numbers are dual encoded. Error number 2 no data existent 3 no data present for this job 4 not defined job status on the CP 6 interface occupied by the CP

ZT/N:	D	KY	left byte: reserve right byte: target module no. (2...255), DB-no. of the module with data to be transferred is specified
ZANF:	D	KF	Initial address in DB (0...32761), the DW-no. is specified from which on the data to be transferred are filed in the DB.
ZLAE:	D	KF	Number of data words (1...504) at least to be transferred, CP passes only so many data words as it also supplies.
PAFE:	A	BY	Markerbyte, in which the PAFE-message is transferred to PLC program (permitted 0...255) Error acknowledge message of handling module: = 0 no error occurred ><0 error occurred, error number in PAFE-Byte: 3 basic bank number is not divisible by 8 4 bank not existent (acknowl. delay at access) 5 bank is not synchronized yet by the CP 10 invalid job number (out of 1...127) 12 no DB open for indirect parameterization 13 source module is not existent 14 source module too short 15 ZLAE is invalid (out of 1...504) 16 DB for indirect parameterization too short 18 invalid target module no. (out of 2...255) 19 invalid target initial address (out of 0...32761) 20 invalid marker word no. for ANZW (out of 0...198)

Attention: error number 4 in PAFE is dedicated for future improvements. In the moment, it is generally not possible to recognize QVZ via software in the CPUs for the PLC-115. In this version, the CPU goes in QVZ in stop, if the bank number of the CP does not coincide with the number being parameterized in this module.

Parameter storage in a DB if parameterization is indirect:

A-NR points to the beginning

DL DR
INSS
A-NR
ANZW
ZT/N
ZANF
ZLAE

PAFE is not parameterizable indirectly

0 can be parameterized at all other formal operands (SS,, ANZW, ZT/N, ZANF, ZLAE) because these are not evaluated at indirect parameterization.

Data storage in a DB:

ZANF points to the beginning

DL	DR
A-Nr	F-Nr
No. of word being read	
Data being read by the CP are filed from here on	

Scratch markers used: MB200-255

6.3.2.5 Parameterization of File Accesses via Handles

The COM-driver allows full access to all drives of the CP and supports access to directories. For every file access a drive and/or directory name can be specified and the same rules are valid, as known from MS-DOS.
To access files under MS-DOS numbers, the so called handles are used. The amount of available handles and herewith the maximum number of open files at the same time is specified by the entry FILES = n in the CONFIG.SYS. We recommend to set the FILES-parameter at a minimum of 20, better however to 25 or 30.
By means of handles not only files on a mass storage, like hard disk, RAM disk or disk can be accessed. MS-DOS offers the opportunity to access via handles so called devices as well, like printer and serial interfaces. For a series of devices standard handles have already been defined. These devices need not to be opened before they are accessed. By direct read or write functions data can be read or output. Thus the PC can in easy way directly access printer, screen and keyboard of the CP486.

Predefined Standard-Handles

Handle	Device	access mode
00	standard-input (keyboard),	read only
01	standard-output (screen),	write only
02	standard-error (screen too),	write only
03	standard-auxiliary (V24-interface),	read and write
04	standard-printer (auxiliary),	write only

6.3.2.6 File Names

Like already mentioned, file names can be specified as well with drive and/or path specification. The CP486 software does not affect this. Directories are to be assigned, as usual, with a backslash (ASCII-Code 92, 5C hex). The character can also be entered correctly with the PG. The maximum length of a path specification is up to 64 characters. A file specification can consist of a maximum of 2 characters for the disk drive specification, up to 64 characters for the path specification as well as 8 characters for the file name and 3 characters for the extension, at the whole up to 78 characters.

Ist also possible to use a fixed form for a file name, consisting of 8 characters, a point, and 3 characters for the extension. If the file name is shorter than 8 characters or the extension shorter than 3 characters, it is possible to preset the positions not used with blanks (ASCII-Code 32, 20 hex).

For MS-DOS system functions, which need a file name as parameter, the file name must be closed up with the character ASCII zero (ASCII-code 0). For this reason the file name should be terminated with character ASCII-zero when a file name is passed from the PC to the CP486. If the file name is odd-numbered, this is unconditionally required. As the handling modules can enter only a block of words into a bank, it is necessary to fill up the file name with ASCII zero to an even-numbered length to achieve a block of words. If a file name is specified without terminating ASCII zero, the CP software completes the missing zero.

6.3.3 Function Description

6.3.3.1 Reset All Disk Drives (Disk Reset)

This functon enables to store all modified and non-saved file buffers physically to the drives.

Parameterization of FB3:	F-Nr	13 ($0D hex)

6.3.3.2 Select Disk

Parameterization of FB3:	F-Nr	14 ($0E hex)
	DOSP	Number of requested disk drive

Drive number	0	A:
	1	B:
	2	C:

Attention:
For this function drive number 0 corresponds to drive A:, composite to other functions like "get current directory".

6.3.3.3 Get Disk

The function outputs the number of the current (default) disk drive. The corresponding disk drive character "A", "C", ... is filed to byte 6.

Parameterization of FB5:	F-Nr	25 ($19 hex)	
Parameterization of FB6:	ZT/N	no. of DB for disk drive data	
	ZANF	position of data word in DB	
	ZLAE	length of drive data in the DB in words (1)	
Content of DB:	DW1	A-NR	F-Nr
	DW2	number of words being read	
	DW3	drive character	drive number

Parameter Disk drive no.:	0	A:
	1	B:
	..	..

Attention:

For this function drive number 0 corresponds to drive A:, composite to other functions like "get current directory".

6.3.3.4 Create Directory

Parameterization of FB3:	F-Nr	57 ($39 hex)
	QT/N	no. of DB with directory name
	QANF	position of directory name in the DB
	QLAE	length of directory name in the DB in words

Content of DB:	DW1	directory name
	DW2	...
	DW3	...
	...	

Note:
The directory name must be terminated with 0-byte, if it is of odd-numbered length (is not necessary for even-numbered length).

6.3.3.5 Delete Directory

Parameterization of FB3:	F-Nr	58 ($3A hex)
	QT/N	no. of the DB with directory name
	QANF	position of directory name in DB
	QLAE	length of directory name in the DB in words

Content of DB:	DW1	directory name
	DW2	...
	DW3	...
	...	

Note:
The directory name must be terminated with 0-byte, if it is of odd-numbered length (is not necessary for even-numbered length).
Specifying a disk drive in the directory name allows to delete a directory also in a not logged-on drive.
This function is finished with an error if the specified directory is the current directory or if the specified directory contains files.

6.3.3.6 Set Current Directory

Parameterization of FB3:	F-Nr	59 ($3B hex)
	QT/N	no. of DB with the directory name
	QANF	position of directory name in DB
	QLAE	length of directory name in the DB in words

Content of DB:	DW1	directory name
	DW2	...
	DW3	...
	...	

Note:
The directory name must be terminated with 0-byte, if it has an odd-numbered length (is not necessary for even-numbered length).
Regard that the current drive cannot be changed by means of this function. The directory can be, of course, affixed with a drive specification, but the current directory remains adjusted on the previous value on the drive logged-on. Only when the directed drive is accessed e.g. by the function "Select Disk", then the required drive is set.

6.3.3.7 Get Current Directory

Parameterization of FB5:	F-Nr	71 ($47 hex)
	DOSP	disk drive number
Parameterization of FB6:	ZT/N	no. of DB with the directory name
	ZANF	position of directory name in DB
	ZLAE	length of directory name in the DB in words
Content of DB:	DW1	A-NR F-Nr
	DW2	number of words being read
	DW3	directory name
	DW4	...
	...	

6.3.3.8 Create File/Rewrite Existing File

Parameterization of FB3:	F-Nr	60 ($3C hex)
	DOSP	attribute of new file
	QT/N	no. of DB with the file name
	QANF	position of file name in DB
	QLAE	length of file name in the DB in words

Content of DB:	DW1	file name
	DW2	...
	DW3	...
	...	

Parameter:

Attribute:	00	normal
	01	read-only
	02	hidden
	04	system

File attributes can be added up:
e.g. attribute 03 => file is read-only and hidden.

Return of FB3:	DOSP	Handle of the new file

Note:
Does a file with the specified name already exist, then it is cut to zero length, i.e. all present data are deleted.

6.3.3.9 Create New File

Parameterization of FB3:	F-Nr	90 ($5A hex)
	DOSP	attribute of the new file
	QT/N	no. of DB with the file name
	QANF	position of file name in DB
	QLAE	length of file name in the DB in words

Content of DB:	DW1	file name
	DW2	...
	DW3	...
	...	

Parameter:

Attribute:	00	normal
	01	read-only
	02	hidden
	04	system

File attributes can be added up:
e.g. attribute 03 => file is read-only and hidden.

Return of FB3:	DOSP	Handle of the new file

Note:

Does a file with the specified name already exist, then it is cut to zero length, i.e. all present data are deleted.

6.3.3.10 Open File

Parameterization of FB3:	F-Nr	61 ($3D hex)
	DOSP	access mode
	QT/N	no. of DB with file name
	QANF	position of file name in DB
	QLAE	length of file name in DB in words

Content of DB:	DW1	file name
	DW2	...
	DW3	...
	...	

Parameter:

Access mode:	00	open file for reading
	01	open file for writing
	02	open file for reading and writing

Return of FB3:	DOSP	handle of the new file

Note:
After opening the file, the access mode can no more be changed, just after closing and renewed opening it is possible to apply another access mode. Net accesses are possible for this function but are not taken into account.
(SHARE.EXE must be loaded)

6.3.3.11 Write Physically a File to Disk (Commit File)

This function ensures a physical transfer of all modified internal data buffers of a CP486 file to the drive and updating of date and time of the last modification in the directory and updating of the file size. This function is equivalent to file closing and renewed opening.

Parameterization of FB3:	F-Nr	104 ($68 hex)
	DOSP	handle number of file to be written

This function does not transfer any data from the PC to the CP486.

6.3.3.12 Close File

Parameterization of FB3:	F-Nr	62 ($3E hex)
	DOSP	handle number of file to be closed

This function does not transfer any data from the PC to the CP486.

6.3.3.13 Delete File

This function deletes a file on a CP486 drive. The file needs not to be open before deletion. It is even possible to delete a file without error message which is open somewhere else and is still processed. The user has to take care that no files being in the moment accessed are deleted. This task is realized for networks by the network management software.

Parameterization of FB3:	F-Nr	65 ($41 hex)
	QT/N	no. of DB with file name
	QANF	position of file name in DB
	QLAE	length of file name in the DB in words

Content of DB:	DW1	file name
	DW2	...
	DW3	...
	...	

6.3.3.14 Rename File

Parameterization of FB3:	F-Nr	86 ($56 hex)
	QT/N	no. of DB with file name
	QANF	position of file names in DB
	QLAE	length of file names in the DB in words
Content of DB:	DW1	original file name, zero character, new
	DW2	file name
	DW3	...
	...	

The file must not be opened before renaming.

As data both file names are to be transferred connected, first the original file name and then the new file name. Both names must be separated by at least an ASCII-zero character. As data length must be defined the length of both file names including all zero characters.

This function can be used to move a file into another directory (move file). Therefore, only the name of the required target directory must be specified in the new file name. Regard that moving a file is possible only within a disk drive.

6.3.3.15 Set File Pointer

Parameterization of FB3:	F-Nr	66 ($42 hex)
	DOSP	POS (high-order byte), handle (low-order byte)
	QT/N	no. of DB with file pointer
	QANF	position of file pointer in DB
	QLAE	length of data record (2 words)
Content of DB:	DW1	high-order word of file pointer
	DW2	low-order word of file pointer

Parameter:

POS:	0	abs. position of file start
	1	rel. position from current position (signed)
	2	rel. position from file end (signed)

Note:
Note that the value of the file pointer is always to be regarded as the specification of a byte-position.
Length of a file can be detected by means of this function if 02 is entered as function code and 0 as new relative position of file end. Finally, the position being at the same time the number of data can be achieved via "get file pointer".

6.3.3.16 Get File Pointer

Parameterization of FB5:	F-Nr	194 ($C2 hex)
	DOSP	handle
Parameterization of FB6:	ZT/N	no. of DB for required data
	ZANF	target position in DB
	ZLAE	2
Content of DB:	DW1	A-NR F-Nr
	DW2	number of words being read
	DW3	high-order word of file pointer
	DW4	low-order word of file pointer

The file pointer is returned again as a doubleword. Thus, the digit 2 is also to be specified as number of data. Note that the value of the file pointer is always to be regarded as the specification of a byte-position.

6.3.3.17 Read File or Device

Parameterization of FB5:	F-Nr	63 ($3F hex)
	DOSP	handle of the file
Parameterization of FB6:	ZT/N	no. of DB for data to be read
	ZANF	target position in DB
	ZLAE	number of data words to be read (2)
Content of DB:	DW1	A-NR F-Nr
	DW2	number of words being read
	DW3	data word 1
	DW4	data word 2
	...	

The number of words to be read from the file is not allowed to be higher than 504, otherwise the function is aborted with errors.

An exchange of bytes in a data word or doubleword is not provided in this function. All data are transferred unchanged from the CP486 to the PC. In most of the cases it is delt with ASCII-files where an exchange is proved anyway to be not necessary. If required, the exchange must be done on the AT or PLC side, depending on the demands.

6.3.3.18 Write File or Device

Parameterization of FB3:	F-Nr	64 ($40 hex)
	DOSP	handle of file
	QT/N	no. of DB with data to be written
	QANF	position of data in DB
	QLAE	length of data record to be written in words

The number of words to read from the file is not allowed to be higher than 504, otherwise the function is aborted with errors.

An exchange of bytes in a data word or doubleword is not provided in this function. All data are transferred unchanged from the PC to the CP486. In most of the cases it is delt with ASCII-files where an exchange is proved anyway to be not necessary. If required, the exchange must be done on the AT or PLC side, depending on the demands.

If the function was terminated without errors but the written number is lower than the required, then a partial write error has probably occurred during the execution, or the character ^Z ASCII-code 26, 1A hex has been written to a character device (standard output).

6.3.3.19 Get Date

Parameterization of FB5:	F-Nr	42 ($2A hex)	
Parameterization of FB6:	ZT/N	no. of DB for the date to be read	
	ZANF	target position in DB	
	ZLAE	number of data words to be read (3)	
Content of DB:	DW1	A-NR	F-Nr
	DW2	number of words	being read
	DW3	year	
	DW4	month	day
	DW4	week-day	-----

Parameter:

Year	1980 ... 2099
Month	1 ... 12
Day	1 ... 31
Week-day	0 ... 6, (0=Sunday, 1= Monday, ...)

6.3.3.20 Get Time

Parameterization of FB5:	F-Nr	44 ($2C hex)	
Parameterization of FB6:	ZT/N	no. of DB for the time to be read	
	ZANF	target position in DB	
	ZLAE	number of data words to be read (2)	
Content of DB:	DW1	A-NR	F-Nr
	DW2	number of words	being read
	DW3	hour	minutes
	DW4	seconds	hundredth seconds

Parameter:

Hour	0 ... 23
Minute	0 ... 59
Second	0 ... 59
Hundredth second	0 ... 99

The function returns after an error-free termination two words as number of data.
All values are to be interpreted as bytes.

6.3.3.21 Program Execute

Direct commands can be passed to the CP486 via this function.

Parameterization of FB3:	F-Nr	75 ($4B hex)
	QT/N	no. of DB with the MS-DOS-command line
	QANF	position of command line in DB
	QLAE	length of command line in DB in words

MS-DOS is no Multi-Tasking operating system enabling concurrent execution of several programs. As a rule, the main memory of a personal computer is too much limited as to load a series of resident programs with extensive data areas. This function can be called in the moment only if no other program is running on the CP486 apart from the COM-driver and other resident utilities. The COM-driver CP386COM.EXE must be started hereto in non-resident operation (option /NOTSR when calling CP386COM.EXE).

This function is finished when the called program is terminated with or without errors. Consequently, the bank stays disabled for other jobs during the program run. This must be considered when calling another function!

6.3.3.22 Get MS-DOS Version

Parameterization of FB5:	F-Nr	48 ($30 hex)	
Parameterization of FB6:	ZT/N	no. of DB for data to be read	
	ZANF	target position in DB	
	ZLAE	number of data words to be read (3)	
Content of DB:	DW1	A-NR	F-Nr
	DW2	number of words being read	
	DW3	main number	subnumber
	DW4	OEM-number	user number
	DW5	serial number	

The function returns 3 words as data number after an error-free completion. The version main number is entered to data byte 0, version subnumber to data byte 1 and the OEM identification is entered to data byte 2. The bytes 3 and 5 return a 24 bit application serial number. Thereof the highest-order byte is filed to byte 3 and the low-order bytes to byte 4 and 5.

6.3.3.23 Get Detailed Error Information

Parameterization of FB5:	F-Nr	89 ($59 hex)	
Parameterization of FB6:	ZT/N	no. of the DB for data to be read	
	ZANF	target position in DB	
	ZLAE	number of data words to be read (3)	
Content of DB:	DW1	A-NR	F-Nr
	DW2	number of words being read	
	DW3	error code	
	DW4	error class remedy	
	DW5	error location	------

The function outputs MS-DOS error codes in the data record after an error-free completion. Error code (see table) is entered in data byte 0 and 1, in data byte 2 the error class (see table), in data byte 3 the remedy and in data byte 4 the error position (see table).

Table with error codes:

01	invalid function number
02	file not found
03	path (directory) not found
04	too many open files, remedy: increase number of files in CONFIG.SYS
05	access refused attempt to modify a write-protected file
06	invalid handle, there is no opened file for the specified handle
07	memory control blocks destroyed MS-DOS inoperable, system must be rebooted
08	no memory existent
09	invalid memory control block
10 (0A)	invalid environment
11 (0B)	invalid program format program is incorrect structured or file has no program
12 (0C)	invalid access code, wrong access mode input when opening file
13 (0D)	invalid data
14 (0E)	invalid unit
15 (0F)	invalid disk drive, a non-existing disk drive has been responded
16 (10)	invalid command
17 (11)	not the same device
18 (12)	no more files can be created, directory is full
19 (13)	disk is write protected
20 (14)	unknown device
21 (15)	disk drive not ready. No disk inserted
22 (16)	unknwn command
23 (17)	data error (CRC-error) checksum of disk/hard disk sector wrong; sector probably defect
24 (18)	length of request structure wrong
25 (19)	seek error, positioning error, file pointer was positioned beyond end of file
26 (1A)	unknown media type, (disk is not in MS-DOS format)
27 (1B)	sector not found
28 (1C)	printer reports paper out
29 (1D)	write error
30 (1E)	read error
31 (1F)	general error
32 (20)	file sharing violation
33 (21)	file locking violation
34 (22)	invalid disk change
35 (23)	FCB not available
36 (24)	file sharing buffer overflow
80 (50)	file already exists
82 (52)	directory cannot be created
83 (53)	Int 24 error (handling of critical errors)

Attention: for special error conditions the CP486 reports two specific error codes, which are not defined under MS-DOS.

112 (70)	size error, invalid number of data (e.g. trial to read or write more than 504 words)
113 (71)	time exceeded during communication. For about 10 sec the CP was unable to access the bank.

Code table for error classes:

01	no resources available (memory or handles)
02	no error, but actual status (disabled region in a file), which is expected to disappear.
03	authorisation problem
04	internal error in system software
05	hardware error
06	system software error, no error of active process (as missing configuration files)
07	application program error
08	file or element not found
09	file or element has a faulty type or format
0A	file or element access disabled
0B	wrong disk in disk drive, faulty data sectors or error of storage medium
0C	other error

Code table for recommended measures

01	function repeat several times.Then ask user whether to abort or to ignore the error.
02	function repeat several times time-delayed between single attempts. Then ask the user whether to abort or to ignore the error.
03	correct information by user input (usually caused by invalid file name or disk drive specification).
04	abort application correctly (close opened files, disable file locking)
05	stop application immediately without 'ordering'.
06	ignore error
07	repeat after the user is prompted to correct the error.

Code table for error locations

01	unknown
02	block device or disk drive emulation (RAM disk)
03	network
04	serial device
05	memory

6.3.3.24 General Interrupt

The function enables to call general interrupts of the AT, e.g. VGA-BIOS-interrupts, keyboard interrupt, mouse interrupt etc. Because of various parameterization opportunities it is not possible to supply all registers with parameters. Four data words are passed to this function which are loaded correspondingly in registers AX, BX, CD and DX. The interrupt number is to be stored to the DOSP-parameter. All interrupt numbers are permitted.

After the function is executed, the value returned to register AX is entered in DOSP-parameter.

Parameterization of FB3:	F-Nr	255 ($FF hex)
	DOSP	interrupt number
	QT/N	no. of DB with data to be written
	QANF	data position in DB
	QLAE	length of data record to be written in words
DB content:	DW1	data word for register AX
	DW2	data word for register BX
	DW3	data word for register CX
	DW4	data word for register DX
Return of FB3:	DOSP	data word from register AX

Attention:

This call should only be used by experienced DOS-programmers because this call enables arbitrary DOS-accesses.

6.3.4 Demo Program: Get Time of CP486 from PLC

6.4 CP486 Jobs for PLC (Functions for Bank 2, 3 and 7)

6.4.1 Overview

The driver program CP386COM serves jobs initiated by the PLC, as well as jobs initiated by the CP386. The driver supplies a series of functions for the banks 2, 3 and 7. With these functions data can be read from the PC or written to the PC respectively from a running application on the CP486. All functions are called by means of software interrupt 78h.
Tranfer and return of parameters is realized exclusively in the processor registers when calling the interrupt. Register assignment is included in the description of functions. Interfaces are implemented for Turbo-Pascal, Turbo-C and C++, as well as Microsoft-C. Also functions for reading and writing of data to the PC, status call and abort functions are realized. Functios are differed by exchanging single elements and data blocks when data are transmitted. Functios are handled as "jobs". When calling a function, a job number is returned which is used to call the processing status. Up to 127 jobs can processed at the same time in each of banks 2 and 3.

Following functions are available:

Bank used	**Function number**	**Function**
none	$00	status call
2	$21	read a single element from the PC
2	$21	read a block from the PC
2	$20	status call of read job
2	$28	abort all read jobs
3	$31	write a single element into the PC
3	$31	write a block into the PC
3	$30	status call of write job
3	$38	abort all write jobs
7	$70	status call for process image
7	$71	read a process image area

6.4.2 Driver Functions via Software Interrupt

6.4.2.1 CP-Status Call

This function outputs various arbitrary status information via the CP486. Moreover, it can be used by the applications software to check whether the CP486 software driver is loaded. Further information returned is the output status of hard and software, CPU identification etc.

Register	IN	OUT high	OUT low
AX	$00	$C386	
BX		VGA-Bios	Bios
CX		CP	CPU
DX		CP-Status	PC-Status

AX	C386 hex code for CP software is loaded
BH	output status of CP486 VGA-BIOS
BL	output status of CP486-BIOS
CH	output status of driver software (CP)
CL	code of CPU in PC (valid if banks are synchronised)
DH	CP status register (IO-address 280h)
DL	PC status register (IO-address 281h)

Codes of the output statuses (version numbers) for BIOS, VGA and driver are BCD-coded in one byte. That is, the value 10 (hex) is equivalent to version 1.0; 15 (hex) is equivalent to version number 1.5 and 1A (hex) is equivalent to version 1.10.
This function does not execute any initializations in the banks.

6.4.2.2 Read a Single Element from the PC

With this function a single data type (bit, byte, word,...) can be read from the PC. The function is just starting the job and does not wait for the PC to execute it, but returns immediately, to where it was called. Therefore the data can be read not before the function 'status call' was executed (see there).

Register	high	**In** low		**Out**
AX	$21	typ		status
BX	size	bst		
CX	adr			
DX	-	bit		

typ	element area (type) of data for single element in PC (DB, MB, ...)	
size	code of data size (bit, byte, ...)	
bst	module number, is to be set only for data area (type) DB or DX if data area (type) is absolute, the higher order bits of adr are here.	
adr	initial address in area	
bit	Bit-number if element size is bit or semaphore.	
status	< 0	error code because of an error error numbers of PC are summed up with FFF0h
	1..127	job number to call status

Note:
This function does not return data! If the job status is 'finished without error', the data can be passed by calling the function status call.

To ensure, that a finished reading job will not be overwritten with a new job before data are passed, the job is blocked. After starting a job, its status is to be checked as long as the job is finished with or without error. If the status of the job is 'finished without error', data will be copied to the AT with the address specified. If no status call is executed, the job remains blocked, and possibly no further read jobs can be started, even if all jobs in the bank are finished.

6.4.2.3 Read a Block from the PC

With this function a whole block of data can be read from the PC. The function is just starting the job, and does not wait until the PC is executing it, but returns immediately to where it was called. Therefore the data can be read not before the function 'status call' was executed (see there).

Register	high	**In**	low	**Out**
AX	$21		typ	status
BX	size		bst	
CX	adr			
DX	len			

typ	element area (type) of data for single element in the PC (DB, MB, ...)		
size	data size of block data (ident. whether single bytes are to be exchanged)		
	0F(hex)	data block of bytes (no exchange)	
	1F(hex)	data block of words	(exchange of high- and low-byte)
	2F(hex)	data block of doublewords	(exchange of all 4 bytes)
bst	module number, is to be set for element areas (type) DB, DX , FX ...		
	if element area (type) is absolute, then here are high-order bits of adr.		
adr	initial address in the area		
len	number of data in words !! (also if size is byte or doubleword)		

status	< 0	error number because of error
	= 0	job number to call status

Note:
For reasons of executing an automatical adjustment of data during the transmission, the type of the data in a block (bytes, words, doublewords) has to be specified. One block can only contain data of the same type. Concernig words and doublewords for every single data an exchange of the bytes is executed correspondingly.

This function does not return data! If the job status is 'finished without error', the data can be passed by calling the function status call.

A block read job can only be started, if bank 2 is empty, that means, no variable read jobs and no block read job may be in processing status.

To enable, that a finished reading job will not be overwritten with a new job before data are passed, the job is blocked. After starting a job, its status is to be checked as long as the job is finished with or without error. If the status of the job is 'finished without error', data will be copied to the AT with the address specified. If no status call is executed, the job remains blocked, and possibly no further read jobs can be started.

6.4.2.4 Write a Variable to the PC

This function enables to write single data (bit, byte, word,...) to the memory of the PC. When calling, the address of a variable to be written must be specified. The function transmits its value to the bank and does not wait for the PC to read the data, but returns immediately to where it was called.

Register	In high	In low	Out
AX	$31	typ	status
BX	size	bst	
CX	adr	adr	
DX	-	bit	
SI	offset	offset	
DS	segment	segment	

typ	element area (type) of data for single element in PC (DB, MB, ...)
size	code of data size (Bit, Byte, ...)
bst	module number, is to be set only for element area (type) DB or DX if element area (type) is absolute, here are the high-order bits of adr.
adr	initial address in area
bit	bit number if data size is bit or semaphor.
offset	offset of variable address (in AT)
segment	segment of variable address (in AT)

status	< 0	error number because of error
	129-255	job number to call status

Note:
Different to read jobs, a write job is not being blocked, nevertheless the job status as well should be as long called as the job is finished with or without error.

Depending on the element size, the pointer to the data in the AT is to interpreted differently:
- bit or semaphore:
  pointer is the address of a byte, the bit is read by bit number 0.
- Byte, left byte, right byte: the pointer is the address of a byte. The byte is read from the memory cell.
- Word:
  the pointer is the address of a word. High- and low-byte are exchanged at the transmission.
- Doubleword/extended word:
  the pointer is the address of a extended word, the extended word is read and the order of all 4 bytes is reverse.

6.4.2.5 Write a Block to the PC

With this functions a whole data block can be transmitted to the PC. When calling, a pointer to the data block is to be specified. The function writes the data to the bank and returns immediately to where it was called. There is no delay for the PC to read the data. Subsequently the data block is competely available in the CP and could be overwritten for example.

Register	In high	In low	Out
AX	$31	typ	status
BX	size	bst	
CX	adr		
DX	len		
SI	offset		
DS	segment		

typ	data type of data for block element in PC (DB, MB, ...)	
size	data size of block data	
	0F(hex)	data block of bytes
	1F(hex)	data block of words
	2F(hex)	data block of doublewords
bst	module number where DB, DX, FB is relevant, contains at typ = absolute the high-bits of adr	
adr	initial address in the area	
len	number of data in words !!	
offset	offset of block address (in AT)	
segment	segment of block address (in AT)	
status	< 0	error number because of error
	128	job number to call status

Note:
For reasons of executing an automatical adjustment of data during the transmission, the type of the data in a block (bytes, words, doublewords) has to be specified. One block can only contain data of the same type. Concernig words and doublewords for every single data, an exchange of the bytes is executed correspondingly.

A block write job can only be started, if bank 3 is empty, that means, no variable write jobs and no block write job may be in processing status.

A block write job is blocking the bank. After starting a job, its status is to be checked as long as the job is finished with or without error. If the status of the job is 'finished without error', data will be copied to the PC with the address specified. If no status call is executed, the job remains blocked, and possibly no further read jobs can be started.

6.4.2.6 Read Job Status

With this function, the status of an earlier started job can be called. For read jobs, variable and block read jobs, this function copies data to a specified address to the CP, if the job status is 'finished without error'.

Register	high	**In**	low	**Out**
AX	$20/$30		a_nr	status
SI		offset		
DS		segment		

fn	function number for status call $20 for read jobs $30 for write jobs
a_nr	job number
offset	offset of data address (in AT) to be specified only for read jobs (variables and block).
segment	segment of data address (in AT) to be specified only for read jobs (variables and block).

status	< 0	job finished with error error messages of PC are added with FF00h.
	1	job still in process
	2	job status not defined
	3	job finished without error

The following procedure is advisable for the status call:

- If the job is still "in processing", the status function has to be called as long as the status changes.

- Concerning write jobs (bank 3): if the job was "finished without error", then the data were written to the PC. For block elements, the bank has been released.

- Concerning read jobs (bank 2): If the job is 'finished without error', and a pointer was specified for the data, the data will be copied to the specified address in the AT. Depending on the specified data size, an exchange of bytes will be executed, if neccessary. The job block will be released, in order to enable the execution of new jobs. If the address NULL (0:0) is specified as a pointer, no data will be copied, but the job will be released as well.

- If the job status is 'not defined' the job was already finished earlier, but was not overwritten by a new job. If this job was a read job and a pointer unequal to NULL was specified, the data will be copied to the specified destination address.

- If the job is "finished with error", then the job block was enabled if a read job or a block job is concerned.

- For a read job for single variables, the pointer is to be interpreted differently, depending on the element size:
  - Bit or semaphore:
    The pointer is the address of a byte, the bit will be written to bit number 0, the whole byte will be overwritten.
  - Byte, left byte, right byte:
    The pointer is the address of a byte. The byte will be written to the storage cell.
  - Word:
    The pointer is the address of a word. High and low-byte will be interchanged during transmission.
  - Doubleword/extended word:
    The pointer is the address of a exetended word, the order of all 4 bytes will be interchanged and be written to the extended word.

- For a read job for a data block, the pointer is to be interpreted differently, depending on the element size:
  - Byte:
    The pointer is the address of a block of bytes, the individual bytes will be transmitted unchanged from the PC.
  - Word:
    The pointer is the address of a block of words. High and low byte will be interchanged for every individual word during transmission.
  - Doubleword/extended word:
    The pointer is the address of a block of exetended words. All 4 bytes of every individual exetended word will be interchanged during transmission.

6.4.2.7 Abort All Jobs of a Bank

Register	In		Out
	high	low	
AX	fn		status

fn	function number for status call $28 abort all read jobs $38 abort all write jobs

status	< 0	error number because error occurred
	0	all jobs were aborted.

All not yet finished write or read jobs can be aborted by means of this function. It must not be differed between variable and block jobs. Also if there were no jobs active in the bank, the function answers with the return value 0.

6.4.2.8 Read Status of Process Image

Register	high	**In** low		**Out**
AX	$70	-		status

status	0	no process image available
	1..255	current process image counter

The current value of the process image counter (bank 7 address 3FEh) can be read by means of this function. If the value is 0 then no process image is available.

6.4.2.9 Read Area of Process Image

Register	In high	In low	Out
AX	$71	typr	status
BX	adr		
CX	len		
SI	offset		
DS	segment		

typ	data type of process image (EB, MB)
adr	initial address in area
len	number of data in bytes or words (depending on TYPE)!!
offset	offset of data address (in AT)
segment	segment of data address (in AT)

status	< 0	error number because of error
	= 0	process image not available
	> 0	counter for process image (as for status function)

This function is used to read an area of the current process image. When accessing single areas, then the length of the area is supervised, e.g. cannot be read from EB126 with the length of 4 bytes because only 128 byte EB are available.

The length is input in words for timer and counter access, and in bytes for all other types. For timer and counter the high- and low byte of every word is exchanged also at the transfer, so that the data in the AT can be correctly processed as words.

By setting the type ABSOLUT, an optional process image sector can be read, also affecting other areas. The length is given in bytes, also if it is read from timer or counter range. If a range of timer or counter is read, then high- and low byte is changed again, too !!

Tab. Data types for process image:

06	counter (length in words)
07	timer (length in words)
08	marker (length in bytes)
09	EB (length in bytes)
0A	AB (length in bytes)
0F	absolute access to process image (length in bytes)

6.4.2.10 Error Numbers of CP for Banks 2, 3 and 7:

hex	**dec.**	**description**
FFFF	-1	invalid data type
FFFE	-2	length error (e.g. address too big, bit number too high)
FFFD	-3	invalid data size (wrong value at single or block job)
FFFC	-4	data type for this CPU not possible
FFFB	-5	bank full, 127 single jobs in the bank, or at least 1 single element- and a block job are to be started.
FFFA	-6	bank access disabled for 10 sec (PC stop probably)
FFF9	-7	job/bank is still blocked (job status was not checked in order to de-block the job).
FFF8	-8	wrong job number for status function (e.g. job no > 255)
FFF7	-9	faulty source data pointer (address NULL was entered in write job)
FFF6	-10	job not in process (not used !!!!)
FF	255	invalid function call
EE	238	job stopped during initialization

6.4.3 Interface for Turbo-Pascal (from Version 4.0)

To facilitate calling functions of COM-driver from Pascal programs, a Turbo-Pascal-Unit has been created which makes available all functions of the service interrupt INT 78 to be easy called. For every driver function an adequate Pascal-procedure is defined which supplies registers, calls interrupts and returns values. Thus, also users being not familiar with system-oriented programming on AT, are able to utilize fully all driver feasibilities.

All required functions, data types and constants are included in the Unit CP386LIB. This has to be entered with "USES CP386Lib" into the application program if it should be used in a Pascal-program. It must be ensured that the compiled Unit CP386LIB.TPU is contained in the directory where Turbo-Pascal traces for units. Setting occurs via the menu items "Options| Directories| EXE & TPU-directory" (cf. Manual or Help-Functions for Turbo-Pascal).

Following sections show only a survey of the individual functions. For a detailed description including all important information see function descriptions of the previously described sections.

6.4.3.1 Function CP-Status Call

FUNCTION CP_Info(VAR inforec : CP386InfoRec) : INTEGER;

Data structures:

```
TYPE CP386InfoRec =
        RECORD
          CP_id : WORD;                     (* identification: CP386 value= $C386 *)
          VGA_ver, BIOS_ver : BYTE;         (* version numbers: VGA-BIOS and BIOS *)
          DRV_ver: BYTE;                    (* identification: software version *)
          CPU_AG : BYTE;                    (* identification CPU in PC *)
          CP_reg, S5_reg : BYTE;            (* CP- and PLC-status register *)
        END;
```

Data structure for the general status info function and the components are defined corresponding to CP486 values.

This function calls the driver function "general status information", but previously it is checked whether the driver is installed. If not, the function returns the value -1. If the COM-driver is installed, value 0 is returned and the components of info-structure inforec are set adequate. The component CP_id is always identified with the value $C386.

6.4.3.2 Read a Single Element from the PC

FUNCTION CP_read_AG(size, typ, bst : BYTE; adr : longint; bit : BYTE) : INTEGER;

size:	data size of single elements (see Tab. 1)
typ:	data type for single elements (see Tab. 2)
bst:	module number
adr:	address in the module or absolute address
bit:	bit number

Return: job number or negative number if there is an error

This function calls the driver function "read a single element from the PC". The registers are preset according to the transferred parameters when calling up. Meaning of the parameters is described in the section of driver function. If the driver has detected an error during the execution, then the respective error message (negative number) is returned as function value. If the function can be executed without errors, the job number is returned as function value.

Recommended calling method

To process correctly driver functions, the following scheme should be adhered when executing functions. Otherwise the bank, for example, can be blocked (cf. sections about driver functions).

```
VAR   a_nr,                                 (* job number for read job *)
      stat : INTEGER;                       (* momentaneous job status *)
      wert : BYTE;                          (* value read from the PC *)
BEGIN

(* start job *)
   a_nr := CP_read_AG(LBYTE_ELM, DB_SNG, 10, 1, 0);

   IF a_nr < 0                                  (* error occurred *)
   THEN WriteLn('job finished with error: ', a_nr);

   ELSE  BEGIN                                  (* a_nr contains job number *)
      REPEAT
            stat := CP_stat_AG(a_nr, Addr(value)); (* job status/fetch data *)
      UNTIL stat <> REQ_WRKN;   (* as long as job is ready with or without errors *)

      CASE stat  OF
        REQ_NO_ERR:  WriteLn('date: ', value, ' has been read');
        REQ_UNDEF:   WriteLn('job status nondefined,date: ',value, ' read');
        ELSE          WriteLn('job is ready with error: ', stat);
      END;

   END;
```

6.4.3.3 Read a Block from the PC

FUNCTION CP_readn_AG(size, typ, bst:BYTE; adr:longint; len:WORD):integer;

size:	data size of block elements (see Tab.4)
typ:	data type of block elements (see Tab. 3)
bst:	module number
adr:	address in module or absolute address
len:	number of data in words

Return:	job number or negative number if there is an error

This function calls the driver function "read a block from the PC". The registers are preset according to the transferred parameters when calling up. Meaning of the parameters is described in the section of driver function. If the driver has detected an error during the execution, then the respective error message (negative number) is returned as function value. If the function can be executed without errors, the job number 0 is returned as function value.

Recommended calling method

To process correctly driver functions, the following scheme should be adhered when executing functions. Otherwise the bank, for example, can be blocked (cf. sections about driver functions).

```
VAR   a_nr,                                      (* job number for read job*)
      stat : INTEGER;                            (* momentaneous job status *)
      buff : ARRAY[1..50 ] OF INTEGER            (* data read from the PC *)
BEGIN

(* start job *)
   a_nr := CP_readn_AG(W_BLOCK, DB_BLK, 5, 10, 100);

   IF a_nr < 0                                   (* error occurred *)
   THEN WriteLn('job finished with error: ', a_nr);

   ELSE  BEGIN                                   (* a_nr contains job number *)
      REPEAT
            stat := CP_stat_AG(a_nr, Addr(buf)); (* job status/fetch data *)
      UNTIL stat <> REQ_WRKN;  (* as long as job is ready with or without errors *)

      CASE stat  OF
          REQ_NO_ERR:      WriteLn(buffer was read');
          REQ_UNDEF:       WriteLn('job status nondefined, buffer was read');
          ELSE              WriteLn('job is ready with error: ', stat);
      END;

   END;
```

6.4.3.4 Write a Single Element to the PC

FUNCTION CP_write_AG(size, typ, bst : BYTE; adr: longint; bit: BYTE; p: POINTER)
: integer;

size:	data size (see Tab. 1)	
typ:	data type single elements (see Tab. 2)	
bst:	module number	
adr:	address in module or absolute address	
bit:	bit number	
p:	pointer to date to be written	
	for data type bit, semaphore or byte:	pointer to a byte
	for data type word:	pointer to a word
	for data type doubleword:	pointer to a doubleword
Return:	job number or negative number if there is an error	

This function calls the driver function "write a single element into the PC". The registers are preset according to the transferred parameters when calling up. Meaning of the parameters is described in the section of driver function. If the driver has detected an error during the execution, then the respective error message (negative number) is returned as function value. If the function can be executed without errors, the job number is returned as function value.

Recommended calling method

```
VAR   a_nr,                                (* job number for read job*)
      stat : INTEGER;                      (* momentaneous job status *)
      wert : BYTE;                         (* value to be written *)
BEGIN
 ...
(* start job *)
   wert := $7E;
   a_nr := CP_write_AG(BYTE_ELM, DB_SNG, 10, 1, 0, Addr(value));

   IF a_nr < 0                             (* error occurred *)
   THEN WriteLn('job finished with error: ', a_nr);

   ELSE  BEGIN                             (* a_nr contains job number *)
      REPEAT
            stat := CP_stat_AG(a_nr, NIL);     (* read job status *)
      UNTIL stat <> REQ_WRKN;  (* as long as job is ready with or without errors *)

      CASE stat OF
          REQ_NO_ERR:       WriteLn('date: ', value, ' was written');
          REQ_UNDEF:  WriteLn('job status nondefined.');
          ELSE              WriteLn('job is ready with error: ', stat);
      END;
   END;
```

6.4.3.5 Write a Block into the PC

FUNCTION CP_writen_AG(size, typ, bst : BYTE; adr : longint; len : word;
p : POINTER) : integer;

size:	data size of block elements (see Tab.4)
typ:	data type block elements (see Tab. 3)
bst:	module number
adr:	address in module or absolute address
len:	number or data in words
p:	pointer to the data block to be written

Return: job number or negative number if there was an error

This function calls the driver function "write a block into the PC". The registers are preset according to the transferred parameters when calling up. Meaning of the parameters is described in the section of driver function. If the driver has detected an error during the execution, then the respective error message (negative number) is returned as function value. If the function can be executed without errors, the job number $80 (hex) is returned as function value.

Recommended calling method

```
VAR   a_nr,                                     (* job number for read job*)
      stat : INTEGER;                           (* momentaneous job status *)
      i : INTEGER;
      buff : ARRAY[1..100 ] OF BYTE;            (* data to be written *)
BEGIN
 ...
   FOR i := 1 TO 100 DO
          buff[i] := i;                         (* preset data buffer *)
(* start job *)
   a_nr := CP_writen_AG(B_BLOCK, DB_BLK, 5, 10, 100, Addr(buff));

   IF a_nr < 0                                  (* error occurred *)
   THEN WriteLn('job finished with error: ', a_nr);

   ELSE  BEGIN                                  (* a_nr contains job number *)
      REPEAT
            stat := CP_stat_AG(a_nr, NIL);      (* read job status *)
      UNTIL stat <> REQ_WRKN;  (* as long as job is ready with or without errors *)

      CASE stat OF
          REQ_NO_ERR:             WriteLn('buffer was written');
          REQ_UNDEF:       WriteLn('job status nondefined.');
          ELSE                    WriteLn('job is ready with error: ', stat);
      END;
   END;
```

6.4.3.6 Read Job Status

FUNCTION CP_stat_AG(a_nr : INTEGER; p: POINTER): INTEGER;

a_nr:	job number of the job to be tested
p:	pointer to date or data block in AT-memory (to be preset only for read jobs with single and block element) for data type bit, semaphore or byte pointer to a byte for data type word, pointer to a word for data type doubleword, pointer to a doubleword for data type block, pointer to buffer for data block
Return:	job status or negative number if there is an error

This function calls the driver function "read job status". The registers are preset according to the transferred parameters when calling up. Meaning of the parameters is described in the section of driver function. If there was an error during the job execution, then the respective error message (negative number) is returned as function value. If the function can be executed without errors, the job status (see tab. 5) is returned.

6.4.3.7 Abort all Jobs of a Bank

FUNCTION CP_cncl_AG(a_nr : BYTE): INTEGER;

a_nr:	identification for bank 2 or 3 $00 abort all still active jobs of bank 2 $80 abort all still active jobs of bank 3
Return:	0 or negative number if there is an error

This function calls the driver function "abort all jobs of a bank". The registers are preset according to the transferred parameters when calling up. Meaning of the parameters is described in the section of driver function. If there was an error during the job execution, then the respective error message (negative number) is returned as function value. If the function can be executed without errors, i.e. all jobs have been aborted, then 0 is returned.

6.4.3.8 Read Status of Process Image

FUNCTION CP_stat_PA : BYTE;

Return: process image counter

This function calls the driver function "status call process image". This function returns the process image counter.

6.4.3.9 Read Area of Process Image

FUNCTION CP_read_PA(typ : BYTE; adr, len : WORD; p : POINTER) : INTEGER;

typ:	data type process image (see Tab. 6)
adr:	address in the area or absolute address
len:	number of data (bytes or words) depending on the type
p:	pointer to a data buffer in the storage

Return: process image counter

This function calls the driver function "read a process image area". The registers are preset according to the transferred parameters when calling up. Meaning of the parameters is described in the section of driver function. If the driver has detected an error during the execution, then the respective error message (negative number) is returned as function value. If the function can be executed without errors, the current value of the process image counter is returned.

6.4.3.10 Constants

Following constants are already predefined. It is recommended to use these constants also in the program text for reasons of clearness and better readability. Moreover, adaptations attended to possible later changes of the COM-driver can be easier carried out.

Tab. 1 predefined constants for data sizes:

```
CONST
          BIT_ELM          = $00;          (* bit *)
          SEMA_ELM         = $01;          (* bit as semaphore *)
          BYTE_ELM         = $02;          (* byte *)
          LBYTE_ELM        = $02;          (* left byte of a word *)
          RBYTE_ELM        = $03;          (* right byte of a word *)
          WORD_ELM         = $04;          (* word *)
          DWORD_ELM        = $05;          (* doubleword *)
          BLOCK_ELM        = $07;          (* block *)
```

Tab. 2 predefined constants for data types for single elements

```
CONST
          DB_SNG           = $00;          (* DB *)
          DX_SNG           = $01;          (* DB in external memory *)
          BA_SNG           = $02;          (* BA *)
          BB_SNG           = $03;          (* BB *)
          BS_SNG           = $04;          (* BS *)
          BT_SNG           = $05;          (* BT *)
          Z_SNG            = $06;          (* counter*)
          T_SNG            = $07;          (* timer *)
          MB_SNG           = $08;          (* marker *)
          EB_SNG           = $09;          (* input area *)
          AB_SNG           = $0A;          (* output area *)
          PB_SNG           = $0B;          (* P-periphery *)
          QB_SNG           = $0C;          (* Q-periphery *)
          ABS_SNG          = $0F;          (* absolute memory *)
```

Tab. 3 predefined constants for data types for block elements

```
CONST
        DB_BLK          = $00;          (* data module *)
        DX_BLK          = $01;          (* DB in external memory *)
        BA_BLK          = $02;          (* BA *)
        BB_BLK          = $03;          (* BB *)
        BS_BLK          = $04;          (* BS *)
        BT_BLK          = $05;          (* BT *)
        FB_BLK          = $06;          (* FB *)
        FX_BLK          = $07;          (* FB in external memory *)
        OB_BLK          = $08;          (* OB *)
        PB_BLK          = $09;          (* PB *)
        SB_BLK          = $0A;          (* SB *)
        MB_BLK          = $0B;          (* MB *)
        ABS_BLK         = $0F;          (* absolute memory *)
```

Tab. 4 predefined constants for the data type for block elements:

```
CONST
        B_BLOCK         = $0F;          (* type: block of bytes  *)
        W_BLOCK         = $1F;          (* type: block of words  *)
        D_BLOCK         = $2F;          (* type: block of doublewords)
```

Tab. 5 identifications for job status

```
CONST
        REQ_WRKN        = $01;          (* job in process *)
        REQ_UNDEF       = $02;          (* job status undefined *)
        REQ_NO_ERR      = $03;          (* job ready without error *)
```

Tab. 6 predefined constants for data types for process image

```
CONST
        Z_PA            = $06;          (* counter  *)
        T_PA            = $07;          (* timer  *)
        MB_PA           = $08;          (* marker  *)
        EB_PA           = $09;          (* input area  *)
        AB_PA           = $0A;          (* output area  *)
        ABS_PA          = $0F;          (* absolute block in PA (process image) *)
```

Tab. 7 predefined constants for error messages: bank 2, 3 and 7

CONST		
ERR_S5_TYP	= $01;	(* invalid element type *) With a single-element access with the element type DX_SNG, BA_SNG, BB_SNG, BT_SNG or QB_SNG or with a block element access with element type DX_BLK, BA_BLK, BB_BLK, BT_BLK or FX_BLK the programme tried to access data in a programmable controller of the type 115U. However, these element types do not exist in this programmable controller type. *Correction:* To correct the parameter „typ“ in the function call of the PC user software.
ERR_S5_BST	= $02;	(* module not available *) With a single-element access with element type DB_SNG or with a block element type DB_BLK the programme tried to access a not existing module. *Correction:* To create data block in the programmable controller or to correct parameter „bst“ in the function call of the PC-user software.
ERR_S5_ELM	= $03;	(* element not available *) With a single-element access with element type DB_SNG or with a block element access with element type DB_BLK the programme tried to access data in a data block which are not available. *Correction:* To extend the data block in the programmable controller correspondingly or to correct the parameter „adr“ or „len“ in the function call of the PC user software. With a single-element access with element type Z_SNG or T_SNG the programme tried to access timer or counter with a number > 127. *Correction:* To correct the parameter „adr“ in the function call of the PC user software. With a single-element access with element type MB_SNG the programme tried to access flags with a number > 199 with the size of element Byte, with number > 198 with the size of element word or with number > 196 with the size of ement douple word. *Correction:* To check the parameter „adr“ in the function call of the PC user software for valence. With a single-element access with element type EB_ - or AB_SNG the programme tried to access the process image of the I/O range with number > 127 with the element size Byte, with number > 126 with element size word or with number > 124 with element size douple word. *Correction:* To check the parameter „adr“ in the function call of the PC user software for valence. With a single-element access with element type PB_SNG the programme tried to access elements of the P-peripherals with number > 255 with element size Byte, with number > 254 with element size word or with number > 252 with element size douple word.

		Correction: To check the parameter „adr“ in the function call of the PC user software for valence.
ERR_S5_SIZE	= $04;	(* invalid element size *)
		With a single-element access with element type Z_SNG or T_SNG the programme tried to access timer or counter, whereas the parameter element size was not set to word access (WORD_ELM).
		Correction: To correct the parameter „size“ in the function call of the PC user software.
		With a single-element access with element type MB_SNG or ABS_SNG the programme tried to access flags or absolute addresses with the parameter element size RBYTE_ELM.
		Correction: To correct the parameter „size“ in the function call of the PC user software.
		With a single-element access with element type EB_SNG or AB_SNG the programme tried to access inputs or outputs in the process image with the parameter element size SEMA_ELM or RBYTE_ELM.
		Correction: To correct the parameter „typ“ in the function call of the PC user software.
		With a single-element access with element type PB_SNG the programme tried to access the P-peripherals with the parameter element size BIT_ELM, SEMA_ELM or RBYTE_ELM.
		Correction: To correct the parameter „typ“ in the function call of the PC user software.
		With a reading single-element access with element type ABS_SNG the programme tried to read absolute addresses with element size SEMA_ELM. This type of access is only possible in writing under absolute addressing! When single bits are to be read then the element size BIT_ELM has to be used.
		Correction: To correct the parameter „typ“ in the function call of the PC user software.
ERR_S5_BIT	= $05;	(* Bit-number too high *)
		With a single-element access with element type MB_SNG or ABS_SNG and the element size BIT_ELM or SEMA_ELM the programme tried to access a flag bit or an absolute address bit with a bit number > 7 (15).
		Correction: To correct the parameter „bit“ in the function call of the PC user software.
		With a single-element access with element type EB_SNG or AB_SNG the programme tried to access an I/O-BIT with a bit number > 7.
		Correction: To correct the parameter „bit“ in the function call of the PC user software.
ERR_S5_STRT	= $06;	(* invalid starting address *)
		With a block element access with element type „module“_BLK the programme tried to transfer blocks via modules whereas the relative starting address in the block is> 32767.

Correction: To correct the parameter „adr“ in the function call of the PC user software.

ERR_S5_LEN = $07; (* invalide block length *)

With a block element access under all element types the programme tried to transfer blocks with a length > 504.

Correction: To correct the parameter „len“ in the function call of the PC user software.

ERR_S5_ADR = $08; (* Address too big *)

With a single- or block element access with element type ABS_SNG the programme tried to addess an address
> FFFFh in a programmable controller of the typee 115U. However, the CPUs (up to CPU 944) have an address range of only 64 KB.

Correction: To correct the parameter „adr“ in the function call of the PC user software.

ERR_S5_QVZ = $09; (* QVZ/ADF in the programmable controller with reading/writing *)

The programme tried to access an address range which is physically not available.
The programmable controllers of the type 135 and 155 make this error message available. A programmable controller of the type 115U would be set to STOP in this case.

Correction: To correct the parameters „typ“ or „adr“ in the function call of the PC user software.

ERR_S5_944 = $0A; (* CPU 944: module in prog.bank *)

With a block element access with element type „module“_BLK the programme tried to access a module which is not in the data block. (This only concerns the CPU 944 form the programmable controller type 115U)

Correction: To create a module in the programmable controller in the data block bank (via BIB-Nr. 19285) or to correct the function call in the PC user software.

6.4.4 Interface to Turbo-C (2.0 and C++ from 1.0), Microsoft-C 6.0

To facilitate calling functions of COM-driver from C-programs, a library file has been created which makes available all functions of the service interrupt INT 78 to be easy called. For every driver function a respective C-function is defined which supplies registers, calls interrupts and returns values. Thus, also users being not familiar with system-oriented programming on AT, are able to utilize fully all driver feasibilities.

Data types and constants for element sizes, element types and error numbers as well as function prototypes of of functions in ANSI-C-style described in the following are defined in the Include File "CP386DEF.H". The Include-File must be quoted in the application program.

All required functions are implemented in the CP386LIB.C file. The CP386LIB.O file is also to be implemented if it is to be used in a program. Depending on the programming environment and version, the file is to be packed into the project file (Turbo-C) or Depencie List (Microsoft-C) or into the Make-File. For detailed information see the respective manuals.

Reference: in "CP386LIB.H" is
byte defined as unsigned char
word defined as unsigned short.

6.4.4.1 Function CP Status Call

Data structures:

```
typedef struct {
            word CP_id;                  /* identification: CP386 value = $C386  */
            byte VGA_ver, BIOS_ver;      /* version numbers: VGA-BIOS and BIOS  */
            byte DRV_ver;                /* identification: software version  */
            byte CPU_AG;                 /* identification CPU in PC  */
            byte CP_reg, S5_reg;         /* CP- and PLC-status registers  */
            } CP386_InfoBlk;             /* info-block   */
```

Data structure for the general status info function, the components are preset according to values of the CP486.

6.4.4.2 Read a Single Element from the PC

int CP_read_AG(byte size, byte typ, byte bst, unsigned long adr, byte bit);

size:	data size (see Tab. 1)
typ:	data type single elements (see Tab. 2)
bst:	module number
adr:	address in module or absolute address
bit:	bit number

Return: job number or negative number if there is an error

This function calls the driver function "read a single element from the PC". The registers are preset according to the transferred parameters when calling up. Meaning of the parameters is described in the section of driver function. If the driver has detected an error during the execution, then the respective error message (negative number) is returned as function value. If the function can be executed without errors, the job number is returned as function value.

Recommended calling method

To process correctly driver functions, the following scheme should be adhered when executing functions. Otherwise the bank, for example, can be blocked (cf. sections about driver functions).

```
          int a_nr;                            /* job number for read job*/
          int stat;                            /* momentaneous job status */
          int time_count=4000;                 /* timeout counter (4 seconds) */
          byte wert ;                          /* value read from the PC */

/* start job */
   a_nr = CP_read_AG(LBYTE_ELM, DB_SNG, 10, 1, 0);

   if(a_nr < 0)                                /* error occurred */
     printf("job finished with error: %d\n", a_nr);

   else {                                      /* a_nr contains job number */
      do {
         stat = CP_stat_AG(a_nr, &wert);       /* job status/fetch data */
      } while((time_count > 0)&&(stat == REQ_WRKN));
                                         /* as long as job is ready with or without errors*/

      switch(stat)  {
       case REQ_NO_ERR:     printf("date: %d was read\n", wert);
                            break;
       case REQ_UNDEF:      printf("job status nondefined, date: %d read\n", wert);
                            break;
       default:             printf("job is ready with error: %d\n", stat);
      }

   }
```

6.4.4.3 Read a Block from the PC

int CP_readn_AG(byte size, byte typ, byte bst, unsigned long adr, word len);

size:	data size of block elements (see Tab.4)
typ:	data type block elements (see Tab. 3)
bst:	module number
adr:	address in module or absolute address
len:	number of data in words

Return: job number 0 or negative number if there is an error

This function calls the driver function "read a block from the PC". The registers are preset according to the transferred parameters when calling up. Meaning of the parameters is described in the section of driver function. If the driver has detected an error during the execution, then the respective error message (negative number) is returned as function value. If the function can be executed without errors, the job number 0 is returned as function value.

Recommended calling method

To process correctly driver functions, the following scheme should be adhered when executing functions. Otherwise the bank, for example, can be blocked (cf. sections about driver functions).

```
        int a_nr;                             /* job number for read job*/
        int stat;                      /* momentaneous job status */
        int time_count=4000;                  /* timeout counter (4 seconds) */
        int buff[100] ;                       /* value read from the PC */

/* start job */
   a_nr = CP_readn_AG(W_BLOCK, DB_BLK, 5, 10, 100);

   if(a_nr < 0)                               /* error occurred */
     printf("job finished with error: %d\n", a_nr);

   else {                                     /* a_nr contains job number */
       do {
          stat = CP_stat_AG(a_nr, &buff);     /* job status/fetch data */
       } while((time_count > 0)&&(stat == REQ_WRKN));
                                        /* as long as job is ready with or without errors */

      switch(stat)  {
        case REQ_NO_ERR:   printf("Data have been readed\n", value);
                           break;
        case REQ_UNDEF:    printf("job status nondefined\n");
                           break;
        default:           printf("job is ready with error: %d\n", stat);
      }

   }
```

6.4.4.4 Write a Single Element into the PC

int CP_write_AG(byte size, byte type, byte bst, unsigned long adr, byte bit, void far *p);

size:	data size (see Tab. 1)
typ:	data type single elements (see Tab. 2)
bst:	module number
adr:	address in module or absolute address
bit:	bit number
p:	pointer to the date to be written in the AT-memory
	for data type bit, semaphore or byte pointer to a byte
	for data type word pointer to a word
	for data type doubleword pointer to a doubleword
Return	job number or negative number is there is an error

This function calls the driver function "write a single element into a PC". The registers are preset according to the transferred parameters when calling up. Meaning of the parameters is described in the section of driver function. If the driver has detected an error during the execution, then the respective error message (negative number) is returned as function value. If the function can be executed without errors, the job number is returned as function value.

Recommended calling method

To process correctly driver functions, the following scheme should be adhered when executing functions. Otherwise the bank, for example, can be blocked (cf. sections about driver functions).

```
       int a_nr;                      /* job number for read job*/
       int stat;                      /* momentaneous job status */
        int time_count=4000;                 /* timeout counter (4 seconds) */
       byte wert = 0x5A;              /* value read from the PC */


   /* start job */
   a_nr = CP_write_AG(LBYTE_ELM, DB_SNG, 10, 1, 0, &wert);

   if(a_nr < 0)                              /* error occurred */
     printf("job finished with error: %d\n", a_nr);

   else {                                    /* a_nr contains job number */
     do {
        stat = CP_stat_AG(a_nr, NULL);       /* read job status */
     } while((time_count > 0)&&(stat == REQ_WRKN));
                                        /* as long as job is ready with or without errors */

     switch(stat)  {
          case REQ_NO_ERR:  printf("date: %d was written\n", value);
                                   break;
          case REQ_UNDEF:   printf("job status nondefined\n");
                                   break;
          default:          printf("job is ready with error: %d\n", stat);
      }
   }
```

6.4.4.5 Write a Block into the PC

int CP_writen_AG(byte size, byte typ, byte bst, unsigned long adr, word len, void far *p);

size:	data size of block elements (see Tab.4)
typ:	data type block elements (see Tab. 3)
bst:	module number
adr:	address in module or absolute address
len:	number of data in words
p:	pointer to the data block to be written in the AT-memory

Return:	job number $80 or negative number if there is an error

This function calls the driver function "write a block into a PC". The registers are preset according to the transferred parameters when calling up. Meaning of the parameters is described in the section of driver function. If the driver has detected an error during the execution, then the respective error message (negative number) is returned as function value. If the function can be executed without errors, the job number $80 (hex) is returned as function value.

Recommended calling method

To process correctly driver functions, the following scheme should be adhered when executing functions. Otherwise the bank, for example, can be blocked (cf. sections about driver functions).

```
        int a_nr;                            /* job number for read job*/
        int stat;                            /* momentaneous job status */
        int time_count=4000;                 /* timeout counter (4 seconds) */
        int i;
        byte buff[100];                      /* data to be written */


   for(i = 0; i< 100; i++)
        buff[i] = (byte)i;                  /* preset data buffer */

/* start job */
   a_nr = CP_writen_AG(B_BLOCK, DB_BLK, 5, 10, 100, &buff);


   if(a_nr < 0)                             /* error occurred */
     printf("job finished with error: %d\n", a_nr);
   else {                                   /* a_nr contains job number */
      do {
         stat = CP_stat_AG(a_nr, NULL);     /* read job status */
      } while(stat == REQ_WRKN); /* as long as job is ready with or without errors */

      switch(stat)  {
          case REQ_NO_ERR:  printf("data have been written\n", value);
                                   break;
          case REQ_UNDEF:   printf("job status nondefined\n");
                                   break;
          default:          printf("job is ready with error: %d\n", stat);
      }
   }
```

6.4.4.6 Read Job Status

int CP_stat_AG(int r, void far *p);

a_nr:	job number of the job to be tested
p:	pointer to date or data block in AT-memory (only for read jobs with single and block element pointer to a byte for data variables bit, semaphore or byte pointer to a word for data type word pointer to a doubleword for data type doubleword pointer to buffer for data block for data type block
Return:	job status or negative number if error

This function calls the driver function "status call for job". The registers are preset according to the transferred parameters when calling up. Meaning of the parameters is described in the section of driver function. If there was an error during the job execution, then the respective error message (negative number) is returned as function value. If the function can be executed without errors, the job status (see tab. 5) is returned.

6.4.4.7 Abort All Jobs of a Bank

int CP_cncl_AG(int a_nr);

a_nr:	code for bank 2 or 3 $00 abort all still active jobs of bank 2 $80 abort all still active jobs of bank 3

This function calls the driver function "abort all jobs of a bank". The registers are preset according to the transferred parameters when calling up. Meaning of the parameters is described in the section of driver function. If there was an error during the job execution, then the respective error message (negative number) is returned as function value. If the function can be executed without errors, i.e. all jobs have been aborted, then 0 is returned.

6.4.4.8 Read Status of Process Image

byte CP_stat_PA();

Return:	process image counter

This function calls the driver function "status call process image". The function returns the process image counter.

6.4.4.9 Read Area of Process Image

int CP_read_PA(byte typ, word adr, word len, void far *p);

typ:	data type single elements (see Tab. 5)
bst:	module number
adr:	address in module or absolute address
len:	number of data (bytes or words) depending on the type
p:	pointer to data buffer in AT-memory

Return:	process image counter

This function calls the driver function "read an area of process image". The registers are preset according to the transferred parameters when calling up. Meaning of the parameters is described in the section of driver function. If there was an error during the job execution, then the respective error message (negative number) is returned as function value. If the function can be executed without errors, the current value of the process image counter is returned.

6.4.4.10 Constants

Following constants are already predefined. It is recommended to use these constants also in the program text for reasons of clearness and better readability. Moreover, adaptations attended to possible later changes of the COM-driver can be carried out easier.

Tab. 1 predefined constants for data sizes

```
#define BIT_ELM   0x00              /* bit */
#define SEMA_ELM  0x01              /* bit as semaphore */
#define BYTE_ELM  0x02              /* byte */
#define LBYTE_ELM 0x02              /* left byte of a word */
#define RBYTE_ELM 0x03              /* right byte of a word */
#define WORD_ELM  0x04              /* word */
#define DWORD_ELM 0x05              /* doubleword */
#define BLOCK_ELM 0x07              /* block */
```

Tab. 2 predefined constants for data types for single elements

```
#define DB_SNG 0x00                 /* DB */
#define DX_SNG 0x01                 /* DB in external memory */
#define BA_SNG 0x02                 /* BA */
#define BB_SNG 0x03                 /* BB */
#define BS_SNG 0x04                 /* BS */
#define BT_SNG 0x05                 /* BT */
#define Z_SNG  0x06                 /* counter */
#define T_SNG  0x07                 /* timer */
#define MB_SNG 0x08                 /* marker */
#define EB_SNG 0x09                 /* input area */
#define AB_SNG 0x0A                 /* output area */
#define PB_SNG 0x0B                 /* P-peripherals */
#define QB_SNG 0x0C                 /* Q-peripherals */
#define ABS_SNG0x0F                 /* absolute memory */
```

Tab. 3 predefined constants for data types for block elements

```
#define DB_BLK  0x00                /* data module */
#define DX_BLK  0x01                /* DB in external memory */
#define BA_BLK  0x02                /* BA */
#define BB_BLK  0x03                /* BB */
#define BS_BLK  0x04                /* BS */
#define BT_BLK  0x05                /* BT */
#define FB_BLK  0x06                /* FB */
#define FX_BLK  0x07                /* FB in external memory */
#define OB_BLK  0x08                /* OB */
#define PB_BLK  0x09                /* PB */
#define SB_BLK  0x0A                /* SB */
#define MB_BLK  0x0B                /* MB */
#define ABS_BLK 0x0F                /* absolute memory */
```

Tab. 4 predefined constants for data type for block elements

```
#define B_BLOCK  0x0F               /* type: block with bytes  */
#define W_BLOCK  0x1F/* type: block with words  */
#define D_BLOCK  0x2F               /* type: block with extended words */
```

Tab. 5 identifications for job status

```
#define REQ_WRKN 0x01               /* job in processing */
#define REQ_UNDEF  0x02             /* job status not defined */
#define REQ_NO_ERR  0x03            /* job ready without errors */
```

Tab. 6 predefined constants for data types for process image

```
#define Z_PA  0x06                  /* counter*/
#define T_PA  0x07                  /* timer */
#define MB_PA 0x08                  /* marker */
#define EB_PA 0x09                  /* input area */
#define AB_PA 0x0A                  /* output area */
#define ABS_PA0x0F                  /* absolute block in PA */
```

Tab. 7 predefined constants for error messages: bank 2, 3 and 7

CONST

ERR_S5_TYP = $01; (* invalid element type *)

With a single-element access with the element type DX_SNG, BA_SNG, BB_SNG, BT_SNG or QB_SNG or with a block element access with element type DX_BLK, BA_BLK, BB_BLK, BT_BLK or FX_BLK the programme tried to access data in a programmable controller of the type 115U. However, these element types do not exist in this programmable controller type.

Correction: To correct the parameter „typ“ in the function call of the PC user software.

ERR_S5_BST = $02; (* module not available *)

With a single-element access with element type DB_SNG or with a block element type DB_BLK the programme tried to access a not existing module.

Correction: To create data block in the programmable controller or to correct parameter „bst“ in the function call of the PC-user software.

ERR_S5_ELM = $03; (* element not available *)

With a single-element access with element type DB_SNG or with a block element access with element type DB_BLK the programme tried to access data in a data block which are not available.

Correction: To extend the data block in the programmable controller correspondingly or to correct the parameter „adr“ or „len“ in the function call of the PC user software.

With a single-element access with element type Z_SNG or T_SNG the programme tried to access timer or counter with a number > 127.

Correction: To correct the parameter „adr“ in the function call of the PC user software.

With a single-element access with element type MB_SNG the programme tried to access flags with a number > 199 with the size of element Byte, with number > 198 with the size of element word or with number > 196 with the size of ement douple word.

Correction: To check the parameter „adr“ in the function call of the PC user software for valence.

With a single-element access with element type EB_ - or AB_SNG the programme tried to access the process image of the I/O range with number > 127 with the element size Byte, with number > 126 with element size word or with number > 124 with element size douple word.

Correction: To check the parameter „adr“ in the function call of the PC user software for valence.

With a single-element access with element type PB_SNG the programme tried to access elements of the P-peripherals with number > 255 with element size Byte, with number > 254 with element size word or with number > 252 with element size douple word.

		Correction: To check the parameter „adr" in the function call of the PC user software for valence.
ERR_S5_SIZE	= $04;	(* invalid element size *) With a single-element access with element type Z_SNG or T_SNG the programme tried to access timer or counter, whereas the parameter element size was not set to word access (WORD_ELM). *Correction:* To correct the parameter „size" in the function call of the PC user software. With a single-element access with element type MB_SNG or ABS_SNG the programme tried to access flags or absolute addresses with the parameter element size RBYTE_ELM. Correction: To correct the parameter „size" in the function call of the PC user software. With a single-element access with element type EB_SNG or AB_SNG the programme tried to access inputs or outputs in the process image with the parameter element size SEMA_ELM or RBYTE_ELM. *Correction:* To correct the parameter „typ" in the function call of the PC user software. With a single-element access with element type PB_SNG the programme tried to access the P-peripherals with the parameter element size BIT_ELM, SEMA_ELM or RBYTE_ELM. *Correction:* To correct the parameter „typ" in the function call of the PC user software. With a reading single-element access with element type ABS_SNG the programme tried to read absolute addresses with element size SEMA_ELM. This type of access is only possible in writing under absolute addressing! When single bits are to be read then the element size BIT_ELM has to be used. *Correction:* To correct the parameter „typ" in the function call of the PC user software.
ERR_S5_BIT	= $05;	(* Bit-number too high *) With a single-element access with element type MB_SNG or ABS_SNG and the element size BIT_ELM or SEMA_ELM the programme tried to access a flag bit or an absolute address bit with a bit number > 7 (15). *Correction:* To correct the parameter „bit" in the function call of the PC user software. With a single-element access with element type EB_SNG or AB_SNG the programme tried to access an I/O-BIT with a bit number > 7. *Correction:* To correct the parameter „bit" in the function call of the PC user software.
ERR_S5_STRT	= $06;	(* invalid starting address *) With a block element access with element type „module"_BLK the programme tried to transfer blocks via modules whereas the relative starting address in the block is> 32767.

Correction: To correct the parameter „adr“ in the function call of the PC user software.

ERR_S5_LEN = $07; (* invalide block length *)

With a block element access under all element types the programme tried to transfer blocks with a length > 504.

Correction: To correct the parameter „len“ in the function call of the PC user software.

ERR_S5_ADR = $08; (* Address too big *)

With a single- or block element access with element type ABS_SNG the programme tried to addess an address
> FFFFh in a programmable controller of the typee 115U. However, the CPUs (up to CPU 944) have an address range of only 64 KB.

Correction: To correct the parameter „adr“ in the function call of the PC user software.

ERR_S5_QVZ = $09; (* QVZ/ADF in the programmable controller with reading/writing *)

The programme tried to access an address range which is physically not available.
The programmable controllers of the type 135 and 155 make this error message available. A programmable controller of the type 115U would be set to STOP in this case.

Correction: To correct the parameters „typ“ or „adr“ in the function call of the PC user software.

ERR_S5_944 = $0A; (* CPU 944: module in prog.bank *)

With a block element access with element type „module“_BLK the programme tried to access a module which is not in the data block. (This only concerns the CPU 944 form the programmable controller type 115U)

Correction: To create a module in the programmable controller in the data block bank (via BIB-Nr. 19285) or to correct the function call in the PC user software.

6.4.5 Storage of Process Images to Bank 7

The process image can also be directly read out by the user. Following survey shows how bank 7 is structured. Direct access is very fast:

```
Address in the
bank (hex)

Byte   0 process image EB 0          -+
       .                              ¦
       .                              ¦ 128 byte PAE 0-127
       .                              ¦
Byte 127 process image EB 127        -+
Byte 128 process image AB 0          -+
       .                              ¦
       .                              ¦ 128 byte PAA 0-127
       .                              ¦
Byte 255 process image AB 127        -+
Byte 256 marker Byte 0               -+
       .                              ¦
       .                              ¦ 256 byte marker 0-255
       .                              ¦
Byte 511 marker Byte 255             -+
Byte 512/513 Timer 0   (high/low)    -+
       .                              ¦
       .                              ¦ 128 words timer 0-127
       .                              ¦
Byte 766/767 timer 127 (high/low)    -+
Byte 768/769 counter  0 (high/low)   -+
       .                              ¦
       .                              ¦ 127 words counter 0-126
       .                              ¦
Byte 1020/1021 counter 126 (high/low)-+
Byte 1022 count byte 1)                      +    count byte
Byte 1023 trigger interrupt on CP
```

Annotation:
All values of this bank are refreshed when the handling module CP L/S is called up (if this is enabled on the formal operand of the handling module). After every data refreshing in the bank 7 the handling module increments the count byte by 1. CP recognizes by this count byte whether data are valid and how often they have been refreshed since the last reading. Data are then valid when the count byte content is involved in the range dual 1...255. iegt. In the case of overflow the count byte starts again with 1.
The handling module Synchron sets the current counter, address 3FE in bank 7 to 0. By that the CP recognizes that the data in bank 7 are not valid in the moment.
This bank needs not to be deleted by the CP if 0 is contained in the count byte (address 3FE of bank).
This bank can only be write accessed by the handling module.
The handling module for refreshing data of bank 7 does not trigger any interrupt.

6.5 Access on the CP386COM from WINDOWS

From the tool disk version 2.2 onwards a programme library for MS-WINDOWS 3.1 with the following data is available:

The header file CP386WIN.H and the OBJ-file CP386WIN.OBJ.

The file CP386WIN.H contains the necessary definitions for an operation on WINDOWS.

The file CP386WIN.OBJ contains the communication functions on WINDOWS. The functions have to be called as described in chapter 6.4 for DOS (**exception:** CP_stat_AG)

Changes in the function call:

CP_stat_AG:	CP_stat_AG(byte r) with r = Order number.

New functions:

CP_init(void):	Creates a data area for the communication on Dual Port RAM and returns a pointer on this area.
CP_exit(void):	Sets free the data area. This command has to be called at the end of the programme.

Note: In the SYSTEM.INI under the section [386Enh] the Dual Port RAM area has to be excluded with the command *EMMExclude* = ... from the WINDOWS memory management in addition to the entry in the CONFIG.SYS!
(This is valid for all cases where the CP486 runs on WINDOWS 3.1 because WINDOWS does not exclude the Dual Port RAM independently!)

Tool disk 2.2 contains an example for the operation under Windows.

7. Technical Data

7.1 Base Module

Power supply	+5V +/-5%
Power assumption (without options)	1.4 A (CP486S)
	1.6 A (CP486M, CP486ML, CP486L, CP486XL)
Loading voltage for options	24V DC +/-10%
Processor	CPU80486SLC
Clock frequency	25MHz/33MHz
Main memory	1 MB / 4 MB with parity
Video-interface	VGA, 16Bit, 256KB, max. 800*600 pixel resolution
	connection to TTL-, EGA-, VGA-, BAS-, RGB-monitor (cable length for BAS and RGB: 250m)
	connection for EL display (EGA, mono, 640*350 pixel)
Option: EL-display	VGA 640*480 pixel, 16 grey levels
	(only CP486M, CP486L and CP486XL)
Option: TFT-display	VGA 640*480 pixel, 16 or 64 colors
	(only CP486M, CP486L and CP486XL)
Keyboard	Standard-AT (symmetrically up to 250 m)
Serial interfaces	COM 1/3: V.24
	COM2: TTY
	COM4: RS422/485
Diagnostic interface	Send and receive data with TTL level
Parallel interfaces	LPT1 (Centronics)
	LPT2 (Centronics via pin header)
Floppy disk drive	3.5" (720KB / 1.44MB)
Hard disk interface	IDE standard
Chip silicon disk	Slot for 2 DIP-ICs, 32-pin
Memory card silicon disk	Panasonic interface
CP-interface	8 banks each of 1K*8
Watchdog	triggerable, LED display, reset key
Write protection	Serial number and write protection logic
AT-bus	ISA-96-Bus, 16Bit, short card
	+/-12V/200mA, -5V/50mA
System-Bios	QUADTEL acc. to VIPA specification
VGA-Bios	C&T acc. to VIPA specification

Dimensions

Height	233.4mm
Depth	160,0mm
Memory requirements	1 slot (CP486S) 2 slots (CP486M, CP486ML) 3 slots (CP486L) 4 slots (CP486XL)

Environmental conditions (without options)

	Operation	Storage/Transport
Temperature	0°C to 55°C	-20°C to 70°C
Temperature variation	20°C/h	20°C/h
Air humidity	95% at 25°C	95% at 25°C
Altitude above sea level	-300m to 3300m	-300m to 13000m

7.2 Option Hard Disk

Environmental Conditions:

	Operation	Storage/Transport
Temperature	5°C to 50°C	-40°C to 70°C
Temperature variation	20°C/h	20°C/h
Air humidity	10% to 90%	10% to 90%
Altitude above sea level	-300m to 3300m	-300m to 13000m
Shock		
1/2 Sine, 11ms	5G	100G
Vibration		
1 Octave/Min., 10-400Hz	1G	5G

7.3 Option Floppy Disk Drive

Environmental conditions :

	Operation	Storage/Transport
Temperature	4°C to 46°C	-20°C to 60°C
Temperature variation	20°C/h	30°C/h
Air humidity	20% to 80%	10% to 90%
Altitude above sea level	-300m to 3300m	-300m to 13000m
Shock		
1/2 Sine, 10ms	5G	15G
Vibration		
1 Octave/Min., 10-100Hz	0.5G	2G