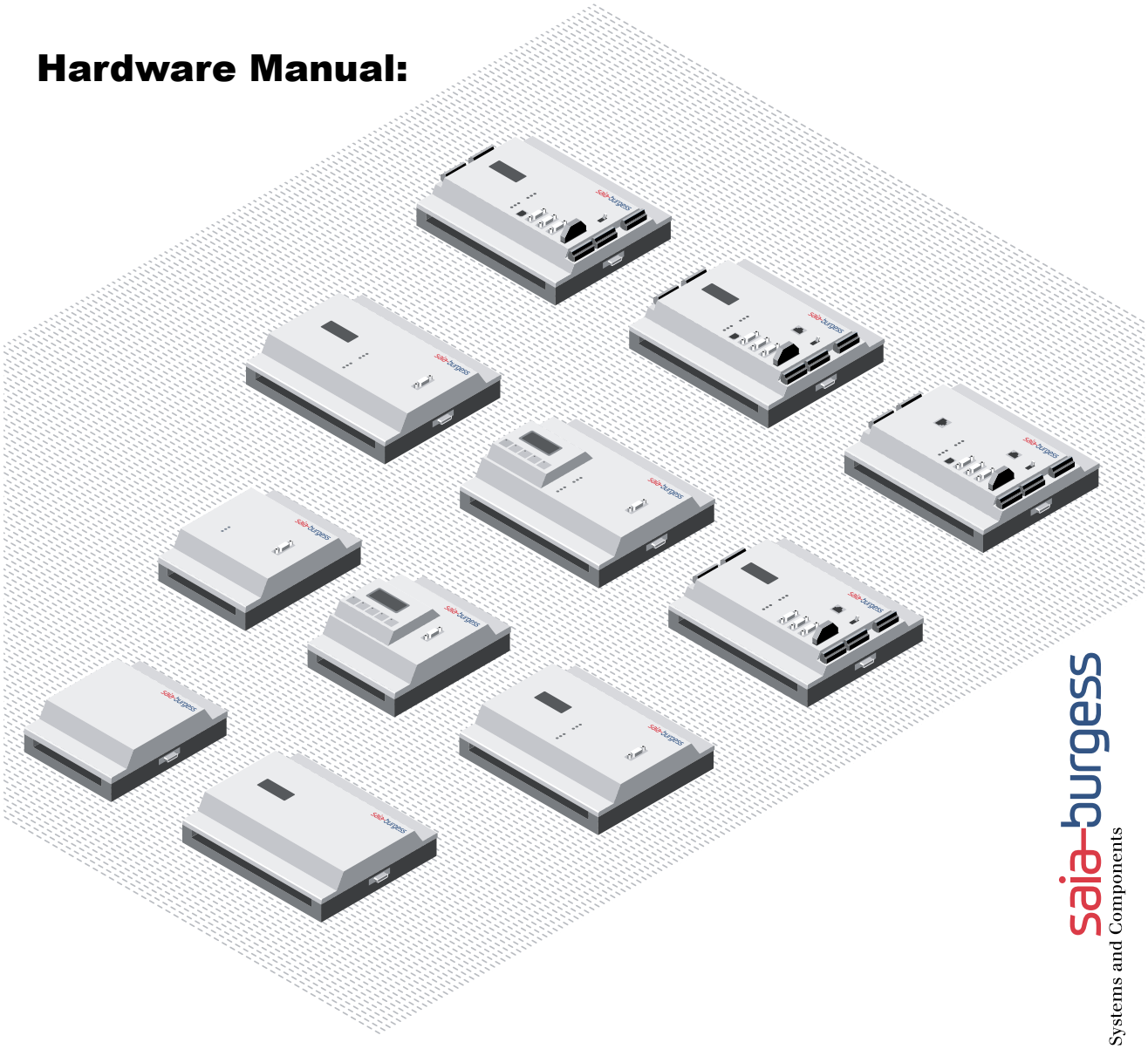
Hardware Manual:



saia-burgess

Control Systems and Components

PCD1/PCD2 Series

Controls Division

Document-No. 26/737; Edition EN 16; 2008-12-17

0

0

0.1 Document history

Published	Version	Changed	Remarks
24.12.2004	E11a	Whole Doc. Chapt. 4.8.1 Page 57	- translation from D11 - error in Profibus: 4.8.1 new - error in formulas: Page 57
01.02.2005	E12	Chapt. 0 Chapt. 1 Chapt. 3	- error in index (Acrobat) - error in graphical index M480 - watch-Dog IL-Example.: new
11.10.2005	E13	Chapt. 5	- corrected error in pin allocation PCD2.A465
2007-07-25	E14	Chapt. 3 Chapt. 4 Chapt. 5 Chapt. A	- inserted new controllers PCD1.M1x5 - added communications modules PCD7.F121 and PCD2.T500 - new order for the I/O-modules, according to the price list - maximal current of the I/O-modules instead of typical current. - added new I/O-Modules PCD2.E112, PCD2. E116, PCD2.E613, PCD2.E616 - PCD2.A465 pinout corrected - new TIP by PCD2.W2x0, wrong polarity on input - description of the Jumper positions for PCD2. K525 - calculation of the spark deletion in the appendix
2008-07-22	EN15	Chapt. 5 Chapt. 5	- Added new module PCD2.W525 - «Definition of input signals» revised
2008-12-17	EN16	Chapt. 3.4 Chapt. 5.7 Chapt. 5.12.1 Chapt. 6 Chapt. 7.1	- PCD2.M150 now with FW update - Wiring PCD2.W2x0 corrected -Digital / analog values PCD2.W2x0 corrected - New in its own handbook 26/792 - New indication for battery change

0.2 Trademarks

Saia® and Saia® PCD are registered trademarks of Saia-Burgess Controls AG.

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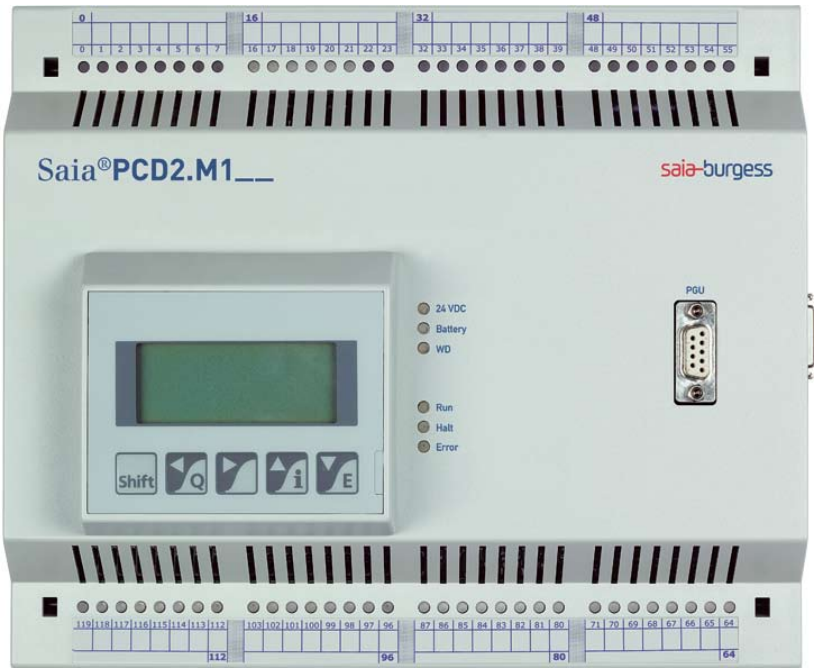
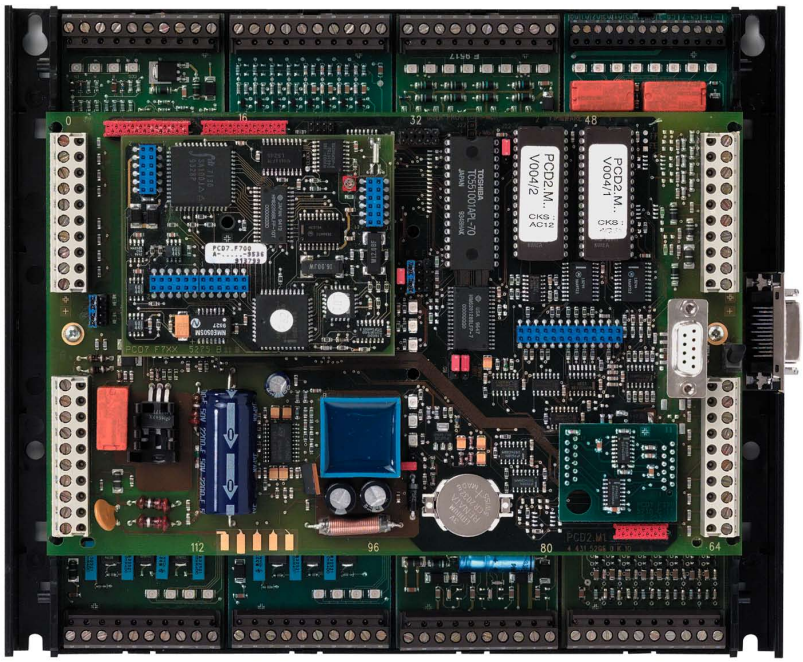
1 Graphical index

The graphical index singles out some highlights from the Hardware manual for the PCD1/PCD2 Series, and allows you to click on a component/connector to jump straight to the corresponding section. The facility to jump to any section from the table of contents is still to be completed.

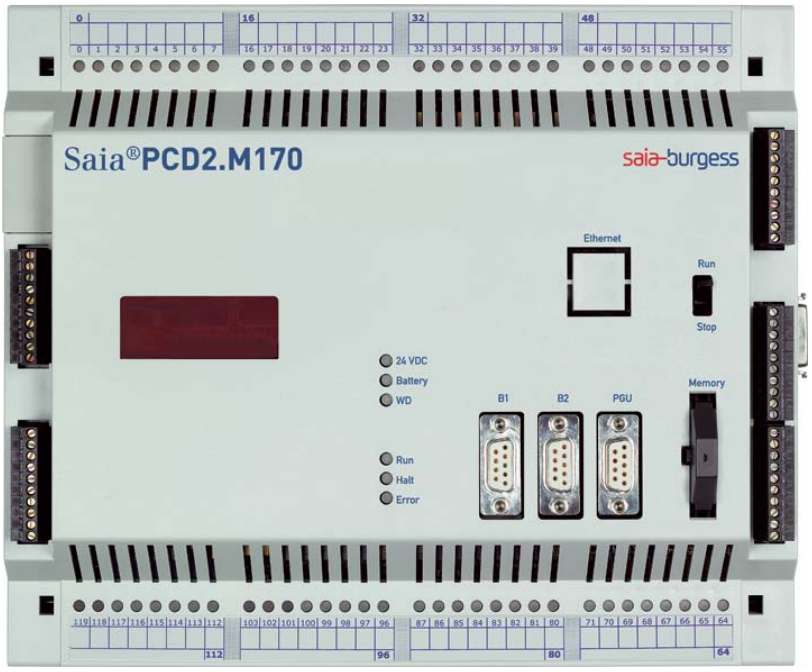
1.1 PCD1.M110/M120/M130/M125/M135

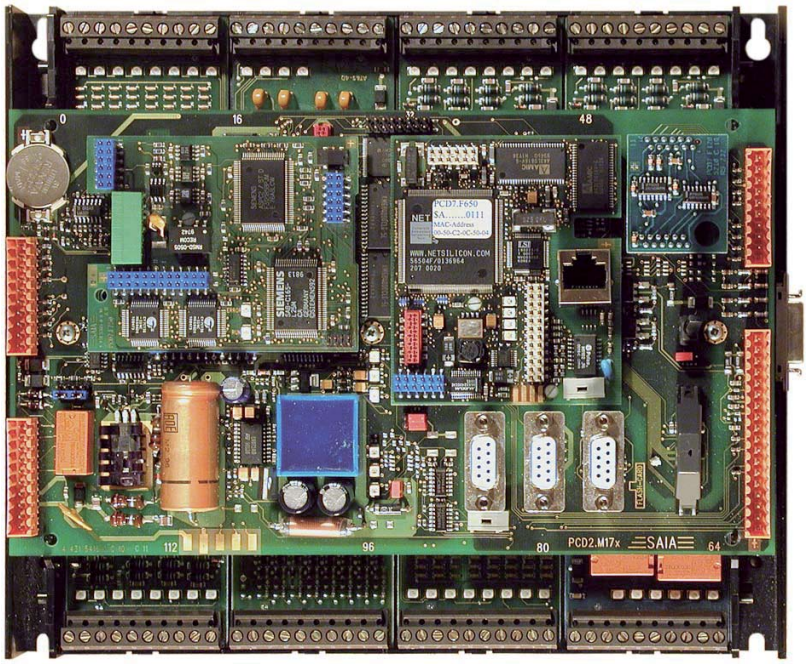
1.2 PCD2.M110/M120/M150



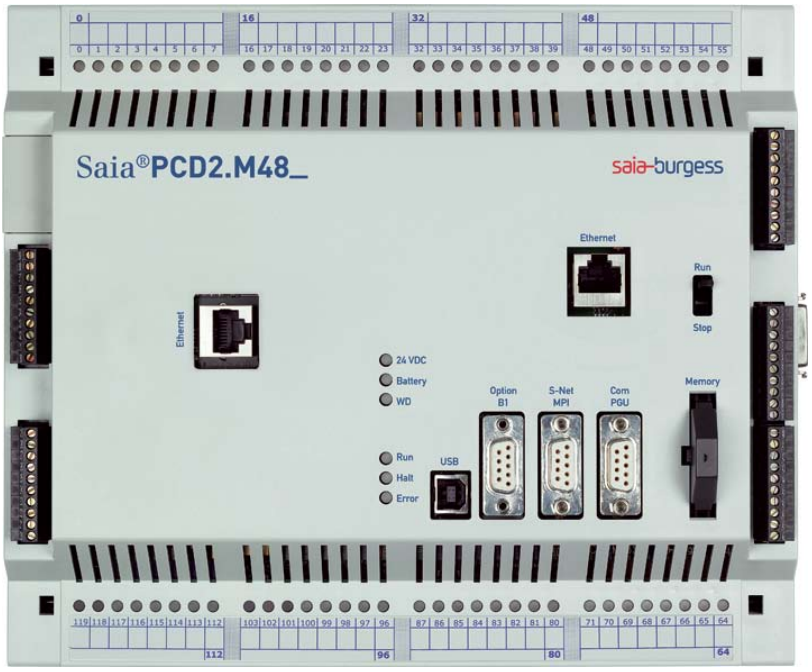


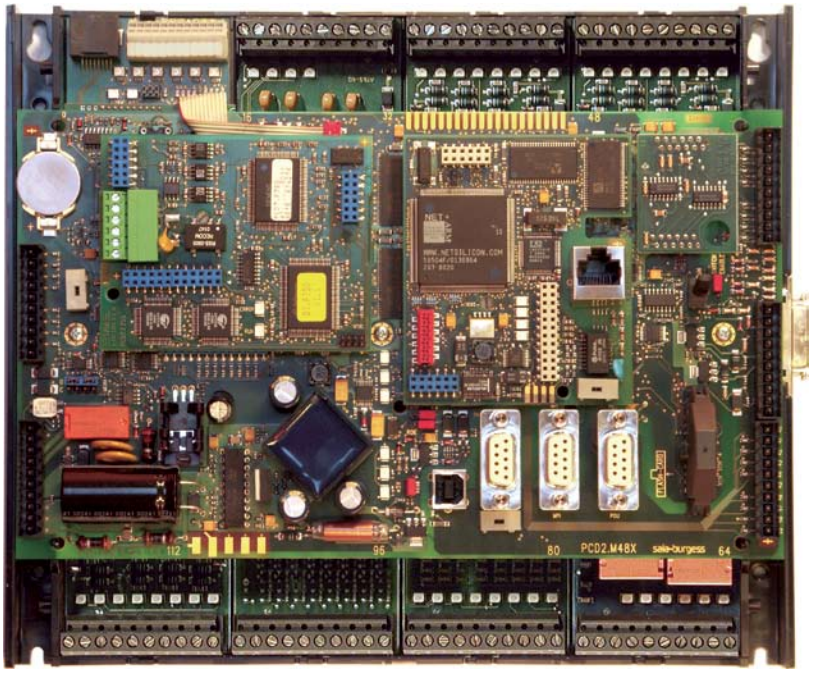
1.3 PCD2.M170


Saia®PCD2.M170
saia-burgess
Ethernet
Run
Stop
24 VDC
Battery
WD
B1
B2
PGU
Memory
Run
Halt
Error


PCD2.M17x
SAIA

1.4 PCD2.M480


Saia®PCD2.M48_
saia-burgess
Ethernet
Ethernet
Run
Stop
24 VDC
Battery
WD
Option
B1
S-Net
MPI
Com
PGU
Memory
Run
Halt
Error
USB


PCD2.M48X
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2 Guidance

2.1 Introduction

This manual covers the technical aspects of the PCD1 and PCD2 components. The following terms are used frequently:

- CPU — Central processing unit: the heart of the PCD
- RIOs — Remote I/Os: inputs and outputs connected to the CPU via a field bus such as Profibus
- LIOs — Local I/Os: these are connected to the CPU via the I/O bus or a RIO (i.e. with the shortest possible cables)
- Modules — Input/output elements, mounted in a housing, matched to the PCD1/2 system
- Module holders — CPUs, RIOs or LIOs, to which modules may be attached

The aim of the Overview section is to present the essentials of planning and installing control systems with PCD1/2 components. It covers the following topics:

- Planning an application
- Cabling

Details of hardware, software, configuration, maintenance and troubleshooting are described in separate sections.

2.2 Planning an application with PCD1/2/3 components

The following aspects should be considered when planning PCD1/2 applications:

- The internal load current taken by the I/O modules from the +5 V and V+ supply must not exceed the maximum supply current specified for the CPUs
- The CPU type determines the maximum number of modules
- The total length of the I/O bus is limited by technical factors; the shorter, the better

When planning an application, we recommend the following procedure:

❶ Select the I/O modules according to requirements.

❷ Check that the number of modules is allowed:

PCD Type	Max. number of I/O modules				Max. number[1]) of digital I/Os		
	PCD1/ PCD2 CPU	PCD2 expan-sion	PCD3 expan-sion	Total	PCD1/ PCD2 CPU	Expan-sion	Total
PCD1	4	–	–	4	64	–	64
PCD2.M120/150	8	8	8	16	128	128(-1)	256(-1)
PCD2.M170	8	8	24	32	128	384(-2)	512(-2)
PCD2.M480	8	8	56	64	128	896(-1)	1024(-1)

[1]) PCD2 modules and PCD3 modules with 16 I/Os each

The values in brackets have to be subtracted from the maximum number of digital I/Os because of the watchdog relay.

If you want to expand PCD2 CPUs with PCD3 LIOs/RIOs, please refer to the planning instructions in the PCD3 manual.

If the number of modules is allowed, continue from ❸; if not, select a different CPU

❸ If necessary, select the PCD2 expansion housing:

- PCD2.C100 with 8 module sockets
- PCD2.C150 with 4 module sockets
- PCD2.K100 26-core extension cable for connecting PCD2 base units mounted beneath each other.
- PCD2.K110 26-core extension cable for connecting PCD2 base units mounted side-by-side.
- PCD2.K120 26-core extension cable for specific applications (length 2 m).
- PCD2.K106 26-core extension cable for connecting PCD2 CPUs with PCD3 module holders.

❹ Where PCD2.Wxxx and PCD2.Hxxx modules are used, calculate the load current from the internal +5 V and V+ supply (use the worst-case / highest values)

❺ Check that the max. supply current for the CPU is sufficient; it generally should be. In extreme cases, switch to PCD3 expansion units.

❻ Estimate consumption from the 24 V supply. Use estimated values from the section on “Hardware”.
These estimated values can be found in section 3.8.5, “Power consumption of PCD2/PCD3 input/output modules”.

Note that in most applications the outputs place the heaviest load on the 24 V supply. For 16 outputs with a load current of 0.5 A each, the loading will be 8 A with all outputs connected.

2.3 Cabling

2.3.1 Cable routing

- 230 V supply lines and signal lines must be laid in separate cables at least 10 cm apart. Even within the switching cabinet, it is advisable to leave space between power and signal lines.
- Digital signal /bus lines and analogue signal /sensor lines should be laid in separate cables
- It is advisable to use shielded cables for analogue signal lines.
- The shield should be earthed at the entry or exit to the switching cabinet. The shields should be as short as possible and of the largest possible cross-section. The central earthing point should be > 10 mm² and connected to the PE ground wire by the shortest route
- The shield is generally connected to one side of the switching cabinet only, unless there is a potential equalization with significantly lower resistance than the shield resistance
- Inductivities installed in the same switching cabinet, e.g. contactor coils, should be provided with suitable suppressors (RC elements)
- Switching cabinet components with high field intensity, e.g. transformers or frequency inverters, should be shielded with separator plates with a good ground connection.

Surge protection for long distances or external lines

- Where lines are laid outside the building, or over longer distances, suitable surge protection measures should be applied. For bus lines in particular, these measures are essential.
- With lines laid outside, the shield must have adequate current-carrying capacity and be earthed at both ends.
- The surge conductors should be installed at the input to the switching cabinet.

3 PCD Classic CPUs and expansion housings

The CPUs in the xx7 Series are described in a separate manual, 26/757.

3.1 System overview

Saia® PCD Web-Server

The Saia® PCD controllers PCD1.M125, PCD1.M135, PCD2.M150, PCD2.M170, PCD2.M480 and PCD3.Mxxx0 come with an integrated web server as standard:

- Web browser as a tool for comissioning, support and visualization:
  Access to the Saia® Web server is via standard web browsers such as Internet Explorer or Netscape Navigator. This makes the web browser, which can be operated intuitively by anyone, the standard tool for comissioning, service, support and visualization of machines, units and installations. The user can retrieve pre-defined device and system-specific HTML pages, giving access to all data on controllers and RIOs. Graphical elements (images, diagrams etc.) as well as text documents (operating and repair manuals) can also be integrated into the HTML pages, to provide a personalized user interface
- General access to any desired interfaces and networks:
  Access to the web server is available not only via Ethernet TCP/IP, but also via cost-effective standard serial interfaces (RS 232, RS 485, modem etc.) and via Profibus networks, throughout the system and at different levels in the network. This makes it economical to use web technology to operate and monitor even the smallest applications.
- The Saia® PCD web server is integrated into all products:
  Having a web server integrated as standard eliminates the cost of run-time licenses or additional modules. In the Saia® PCD3 controllers enumerated above and the Saia® PCD3 RIOs, the web server is already included in the base units, at no extra cost.

3.2 General technical details

Supply (external and internal)	
Supply voltage (according EN / IEC 61131-2)	24 VDC -20 / +25% incl. 5% ripples
Power consumption[1)]	PCD1 and PCD2: typically 625 mA / 15 W for 64 I/Os PCD2: typically 833 mA / 20 W for 128 I/Os
Capacity of internal 5 V bus[2)]	PCD1: 750 mA PCD2.M110/M120 hardware version <H: 1100 mA PCD2.M110/M120 hardware version >=H: 1600 mA PCD2.M150: 1600 mA PCD2.M170: 1600 mA PCD2.M480: 2000 mA
Capacity of internal +V bus (16…24 V)[2)]	PCD1: 100 mA PCD2: 200 mA
Short voltage interruptions (according EN / IEC 61131-2)[)]	≤ 10 ms with interval ≥ 1 s

1) The loads on the outputs are generally more significant for sizing the supply than the internal power leakage within the controller

2) When planning PCD2 systems, it is essential to check that the two internal supplies are not overloaded. This check is especially important where analogue, counter and motion control modules are used, as these may consume a lot of power.

Atmospheric conditions	
Ambient temperature	Mounting on vertical surface with vertically aligned connection terminals: 0…+55 °C In all other mounting positions, a reduced temperature range of 0…+40 °C applies
Storage temperature	-20…+85 °C (DIN 40040, class HS)
Relative humidity	30…95% without condensation (DIN 40040, class F)

Vibration resistance	
Vibration	according to EN/IEC 61131-2: 5…13.2 Hz constant amplitude 1.42 mm 13.2…150 Hz, constant acceleration (simple gravitational acceleration)

Electrical safety	
Protection type	IP 20 according to EN 60529
Air/leakage paths	according to DIN EN 61131-2 and DIN EN 50178: between circuits and bodies and between electrically isolated circuits: surge category II, fouling level 2
Test voltage	350 V / 50Hz AC for nominal unit voltage 24 VDC

Electromagnetic compatibility		
Electrostatic discharge	according to EN 61000-4-2:	8 kV: air discharge 8 kV: contact discharge
Electromagnetic fields	according to EN 61000-4-3:	field intensity 10 V/m, 80…1000 MHz
Bursts	according to EN 61000-4-4:	4 kV on DC supply lines, 1/2 kV on I/O signal lines, 1 kV on interface lines
Noise emission PCD1, PCD2.M110/M120/M170	according to EN 50081-1:	Class B (residential areas)

Noise emission PCD2.M150/M480	according to EN 50 081-2: Class A (for industrial areas) Guidance on the correct use of these controls in residential areas can be found at www.sbc-support.ch (additional measures).
Noise immunity PCD1/ PCD2	according to EN 50 082-2

Mechanism and mounting	
Housing material	Base: Cover: Fibre optics: PC, crystal-clear
Mounting rail	Double top-hat rail as per EN 50022-35 (2 x 35 mm)

Connections	
Screw terminals	Unless specified otherwise: for wires of 1.5 mm^2 (AWG 16) or 2 x 0.5 mm^2 (2 x AWG 20)
Plug-in screw terminals	The terminal block may only be plugged onto 20 times. It must then be replaced, to guarantee a reliable contact

Standards / approvals	
EN/IEC	61 131-2
VDE (PCD1 and PCD2.M110/M120/M150 only)	0160
Shipbuilding	Germanischer Lloyd, Lloyd's Register of Shipping, Det Norske Veritas, Polski Rejestr Statków
UL-USA, UL-CDN	Please note the following conditions for UL-compliant use: Wiring: temperature: 60/75 °C, thermoplastic insulated Cu wires Terminal tightening torque: 0.5 Nm

3.3 System resources

3.3.1 Program blocks

Type	Number	Addresses	Remarks
Cyclic organization blocks (COB)	16	0…15	Main program elements
Exception/system-dependent organization blocks (XOB)	32	0…31	called from the system
Program blocks (PB)	300	0…299	Sub-programs
Function blocks (FB)	1000	0…999	Sub-programs with parameters
Sequential blocks (SB) PCD1, PCD2.M110/M120/M150: total 2000 steps and transitions each PCD2.M170, PCD2.M480: total 6000 steps and transitions each (with PG5 ≥ 1.2 and firmware version ≥ 010)	 32 96	 0…31 0…95	for Graftec programming of sequential processes

3.3.2 Computation ranges for count types

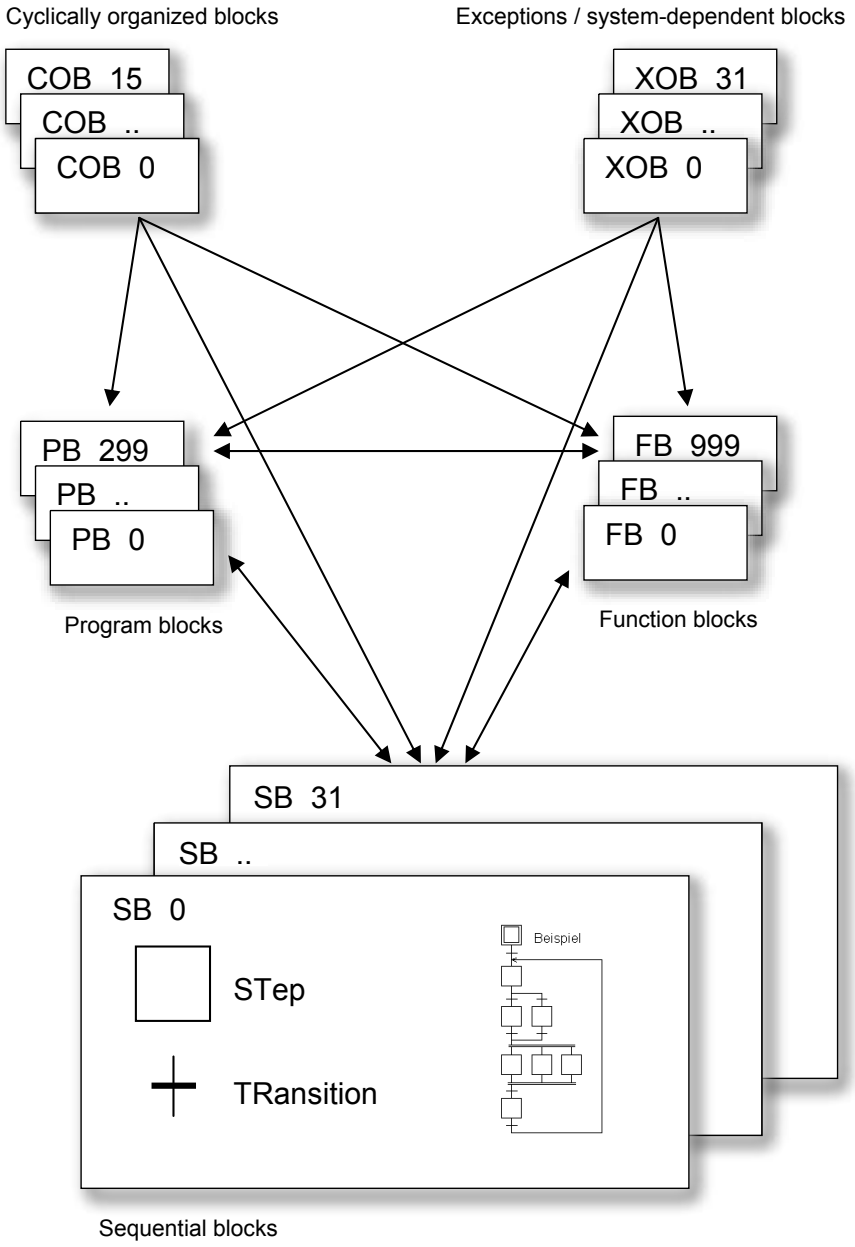
Type		Remarks
Integers	– 2,147,483,648 to + 2,147,483,647	Format: decimal, binary, BCD or hexadecimal
Floating point numbers	– 9.22337 x 10^{18} to – 5.42101 x 10^{-20} + 9.22337 x 10^{18} to + 5.42101 x 10^{-20}	Instructions are provided to convert values held in Saia format (Motorola Fast Floating Point, FFP) to IEEE 754 format and vice versa.

3.3.3 Media

Type	Number	Addresses	Remarks
Flags (1 bit)	8192	F 0…8191	By default, flags are not volatile, but a volatile range can be configured, beginning with address 0
Register (32 bit) PCD1 PCD2.M110/120/M150/M170 PCD2.M480	 4096 4096 16384	 R 0…4095 R 0…4095 R 0…16383	 For integer or floating point values
EEPROM register (32 bit) PCD1.M110/120/130 PCD1.M1x5 PCD2	 5 50 50		Allow values to be stored that are retained even when the battery or the buffer capacitor are empty. SYSRD/SYSWR instructions can be used to read and write these values. The mechanism is intended for configuration data that does not change often; the number of write cycles is restricted.
Text/data blocks with/out extended user memory PCD1 PCD2.M110/M120/M150 PCD2.M170 PCD2.M480	 4000/5000 4000/6000 8000 8191	X or DB 0…3999/4099 0…3999/5999 0…7999 0…8190	The texts 0..3999 are always written to the same memory area as the user program. Where the user memory has been extended, the base memory can be configured to hold RAM texts and DBs. The texts and DBs held in this way have addresses ≥ 4000
Timers/counters (31 bit)	1600[1)]	T/C 0…1599	The breakdown of timers and counters is configurable. Timers are periodically decremented by the operating system; the basic time unit can be set between 10 ms and 10 s
Constants with media code K	any number		Values 0..16383; may be used in instructions instead of registers
Constants with no media code	any number		Values - 2,147,483,648 to +2,147,483,647. Can only be loaded into a register with an LD command, and cannot be used in instructions instead of registers
Semaphores	100	0…99	Not relevant to PCD1/PCD2; used for locking resource accesses in multi-CPU systems like the PCD6

1) The number of timers configured should be only as many as required, to prevent unnecessary CPU loading

3.3.4 Program structure for the PCD Classic family

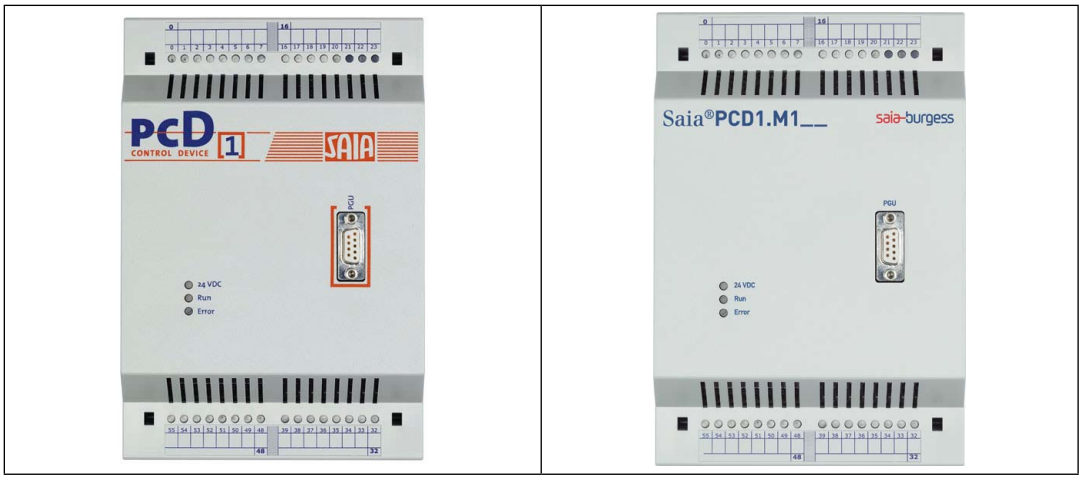


More information on this subject can be found in TIs 26/362 (PG5) and 26/354 (Operating system)

3

3.4 CPU overview

3.4.1 PCD1.M1xx



Differentiation of base units (general)	PCD1.M110	PCD1.M120	PCD1.M130	PCD1.M125	PCD1.M135
Number of inputs/outputs or I/O module sockets	64[1)] 4				
I/O modules	all PCD2 I/O modules except PCD2.Gxxx				
Processor	68340 @ 16 MHz				
Processing time Bit instruction Word instruction	z.B. ANH F 0 5 µs[2)] z.B. ADD R 0 20 µs[2)] R 1 R 2				
Firmware	1 PROM in socket; from first half of 2004 soldered PROMs			soldered Flash Memory modules[7)]	
Minimum PG5 version	1.0, for TCP/IP 1.1			1.3.120	1.3.120
User memory RAM basic set up Expansion with RAM, EPROM or Flash EPROM	17 Kbytes[3)] up to 128 Kbytes added up to 128 Kbytes added up to 112 Kbytes added			128 KByte 128 … 512 KBytes 128 KBytes 112 … 448 KBytes	
Clock (RTC)	no[4)]	yes, deviation < 30 ppm (80 secs/month)			
Data protection	30 days with Super Cap	7 days with Super Cap	1-3 years[5)] with CR 2032 lithium battery	7 days with Super Cap	1-3 years[5)] with CR 2032 lithium battery
Interrupt inputs Maximum input frequency	no -	2 1 kHz[6)]			

1) Using digital I/O modules PCD2.E16x or A46x with 16 I/Os each
2) Typical values; the processing time is dependent on the load on the communication ports
3) When extended memory is used, 13 Kbytes of the base memory can be used to store RAM texts and DBs (text/DB addresses ≥ 4000)
4) When the HeaVAC library is used: The absence of the clock is reported as an error when processing the HeaVAC initialization block, and the clock timers cannot be used
5) The period given is a buffer time; it is dependent on the ambient temperature (a higher temperature means a shorter buffer time)
6) The 1 kHz applies with a pulse/pause ratio of 1:1 and refers to the total frequencies of the two inputs
7) Updates of the firmware via PGU possible

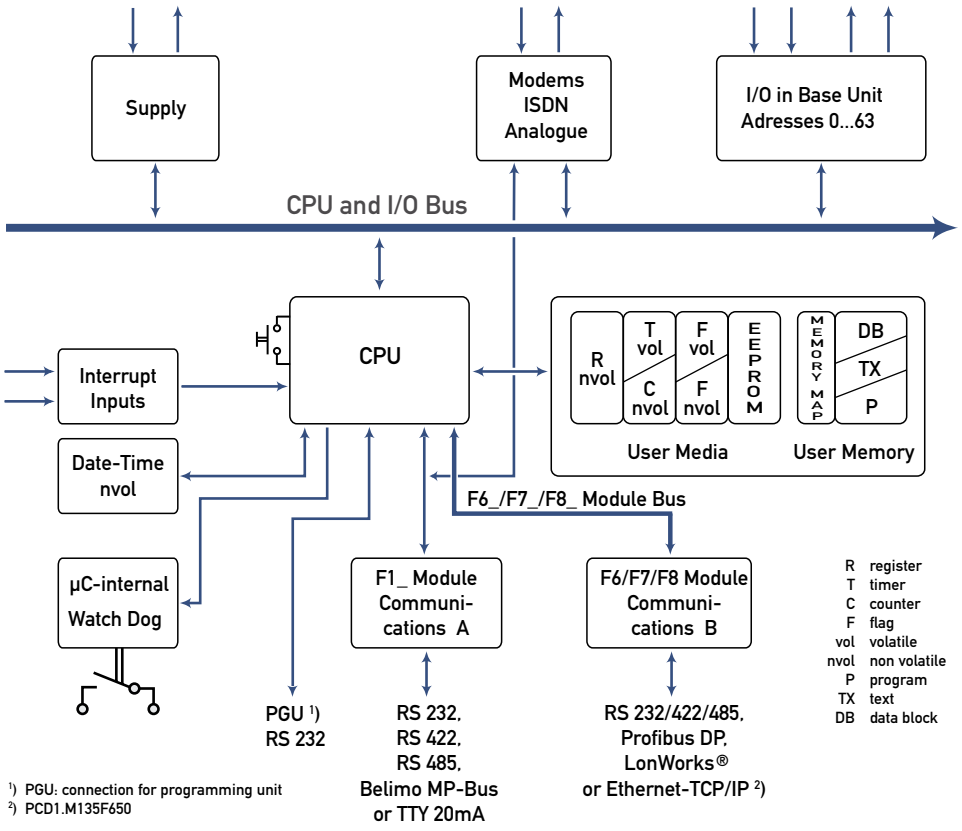
Differentiation of base units (ports)	**PCD1.M110**	**PCD1.M120**	**PCD1.M130**	**PCD1.M125**	**PCD1.M135**
Programming interface	PGU port D-Sub socket, 9-pole[1)] (for PCD8.K111 programming cable)				
Serial data port Socket A	1 RS 422, RS 485, built-in	1 RS 232, RS 422/485, MP bus or TTY current loop 20mA, plug-in (PCD7.F1xx modules)			
Field bus connections	Saia® S-Bus				
	-		Ethernet-TCP/IP (Ether-S-Bus)[2]	-	Ethernet-TCP/IP (Ether-S-Bus)[2)]
	-	Profibus DP LonWorks®			
Socket B for network and/or data port, LED display, small terminal	for PCD7.D162 terminal kit only[3)]	yes[3)]			

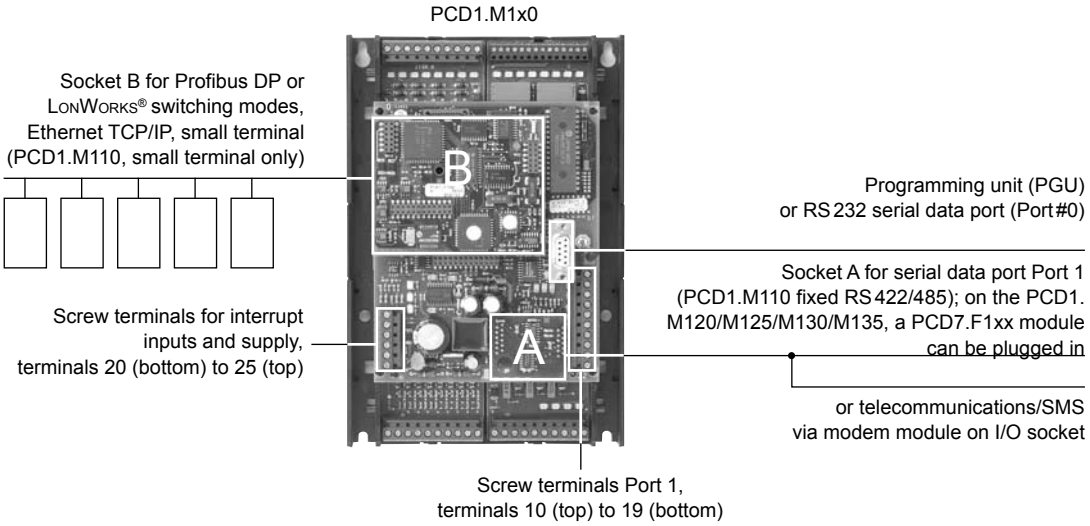
1) Can also be used as a serial data port, e.g. to connect a terminal; but this hampers troubleshooting with the debugger

2) Ethernet TCP/IP available as a configured system: PCD1.M130F655/PCD1.M135F655. If installed later, the cover must be replaced (item-no. 4 104 7409 0)

3) We recommend ordering the PCD2.D16x terminal kit mounted on the controller. If installed later, the cover must be replaced (item-no. 4 104 7338 0)

3.4.2 Block diagram : PCD1.M1xx





Removing the cover exposes components that are sensitive to electrostatic discharges.

Recommendations: Immediately before touching the electronic circuits, briefly touch the metal housing of the PGU connection. It is safer to use an anti-static wrist band, connected to the Minus of the system.

When the power is switched on, no operations (such as moving jumpers or (un)plugging I/O modules) should be attempted.

Removing the cover exposes components that are sensitive to electrostatic discharges.

3.4.3 Hardware and firmware versions for the PCD1

The firmware versions for the PCD1.M1xx are generally upwardly compatible in terms of hardware, so old CPUs can be fitted with new firmware, in order to take advantage of new functions. This feature is highly valued, and we will try to retain it for as long as possible; however, we cannot guarantee this.

At this point, the following known restrictions apply:

- The use of intelligent communication modules such as Profibus DP, LON and Ethernet requires the minimum hardware and firmware versions. Please refer to the manuals for the relevant communication modules

3.4.4 Firmware Upgrade for the PCD1.M110, PCD1.M120 and PCD1.M130

The firmware for the PCD1.M1x0 is stored in a PROM. These chips can only be programmed once. With blank chips (item-no. 4 502 7178 0) and an EPROM burner with adapter for PLCC44 chips (e.g. Galep-4 with adapter 210841), new firmware chips can be burnt at any time. The file with the latest firmware version can be downloaded from www.sbc-support.ch.

At this point, the following known restrictions apply:

- In the course of 2004, soldered firmware chips were adopted; for a firmware update, these controls have to be returned to the factory

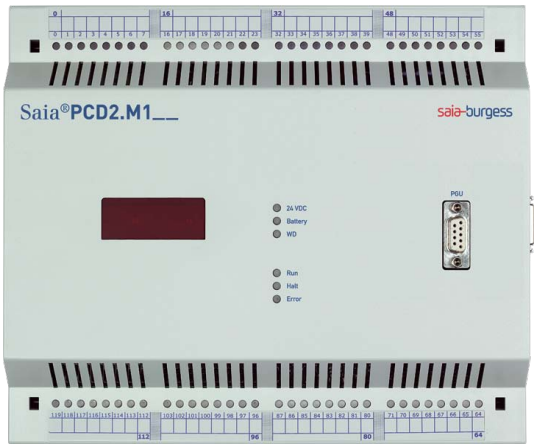
3.4.5 Firmware Upgrade for the PCD1.M125 and PCD1.M135

The Firmware is stored in a Flash EPROM, soldered to the motherboard. A firmware update can be applied by downloading a new version with the PG5. The procedure is as follows:

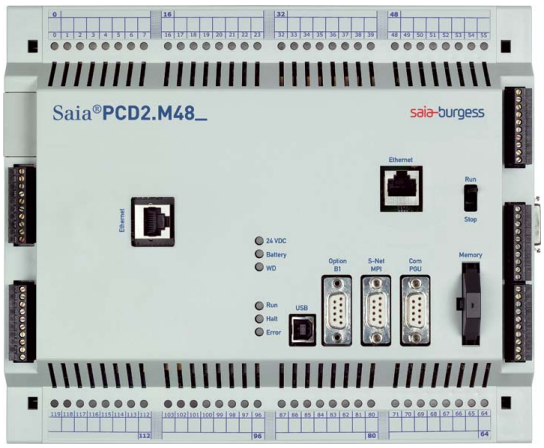
- Go to www.sbc-support.ch and download the latest firmware version.
- Establish a connection between PG5 and the CPU, as for a download of an application (depending on the facilities available, serially via PGU cable, modem[1)], USB, Ethernet).
- Open the Online Configurator and go offline.
- From the Tools menu, select “Update Firmware”, then use the Browse function to select a path to the file for the new firmware version. Ensure that only one file is selected for downloading.
- Start the download.
- After the download, the power supply to the PCD must not be interrupted for 3 minutes (CPLD programming sequence). Otherwise, the CPU may be blocked in such a way that it needs to be returned to the factory.

1) A modem connection is not always reliable. A modem may become blocked in such a way that remote access is no longer possible. In such cases, an on-site visit will be necessary. Other connection options are preferable.

3.4.6 PCD2.M1x0/M480 Hardware and Firmware



PCD2.M1x0



PCD2.M480

Differentiation of PCD2 base units (general, part 1)	**M110**	**M120**	**M150**	**M170**	**M480**
I/O bus connection for expansion units	No	Yes			
Number of inputs/outputs or I/O module sockets:					
When PCD2 components used exclusively	128[1)] 8	2551)[2)] 16			
When expanded with PCD3 components	-	255[2)] 16		510[2)] 32	1023[2)] 64
When expanded with PCD4 components	-	255[1)2)3)] 16			
Processor (Motorola)	68340 16 MHz		68340 25 MHz		CF 5407 162 MHz
Processing time Bit instr, e.g. ANH F 0 Word instr, e.g. ADD R 0 R 1 R 2	3.8 µs4) 20 µs[4)]		1.8 µs4) 10 µs[4)]		0.12 µs4) 0.4 µs[4)]
Firmware, firmware update	2 EPROMs on DIL socket, plug-in		2 Flash EPROM on DIL socket, plug-in	Firmware memory soldered on, download from PG5 environment	
Minimum PG5 version	1.0.xxx	1.0.xxx	1.0.xxx	1.1.xxx	1.2.xxx

1) Using digital I/O modules PCD2.E16x or A46x with 16 I/Os each

2) On all PCD2s, address 255 is reserved for the watchdog; on the M170, address 511 is also reserved for this purpose. The I/Os reserved for the watchdog cannot be used by the user, and no analogue or H modules may be attached to sockets with base address 240 (and on the M170, 496 also)

3) Not all PCD4 I/O modules are suitable for use with PCD2 CPUs; please refer to the section on “Expansion with PCD4 components”

4) Typical values; the processing time is dependent on the load on the communication ports

Differentiation of PCD2 base units (general, part 2)	**M110**	**M120**	**M150**	**M170**	**M480**
User memory RAM basic set up Expansion with RAM, EPROM or Flash EPROM	H/ware version >= J: 128 Kbytes[1] up to 512 Kbytes added H/ware version H: 32 Kbytes[1] up to 512 Kbytes added H/ware version H: 32 Kbytes[1] up to 128 Kbytes added		128 Kbytes[1] up to 512 Kbytes added	1 MByte RAM	
PCD7.R400 flash card as plug-in (backup of user program)	no			yes	
Clock (RTC)	yes, deviation < 15 ppm (40 secs/month)				
Data protection	CR 2032 lithium battery 1-3 years[2]				
Number of interrupt inputs Maximum input frequency	no -	2 1 kHz[3]		2 1 kHz[3]	4 1 kHz[4]

1) When extended memory is used, a large part of the base memory can be used to store RAM texts and DBs (text/DB addresses ≥ 4000)

2) The period given is a buffer time; it is dependent on the ambient temperature (a higher temperature means a shorter buffer time)

3) The 1 kHz applies with a pulse/pause ratio of 1:1 and refers to the total frequencies of the two inputs

4) The 1 kHz applies with a pulse/pause ratio of 1:1

Differentiation of PCD2 base units (ports)	**M110**	**M120**	**M150**	**M170**	**M480**
Programming interface	PGU port D-Sub socket, 9-pole[1)] (for PCD8.K111 programming cable) PCD2.M480, also USB port[2)]				
Serial data port Socket A	1 x RS 232, RS 422/485 or TTY loop circuit 20mA, plug-in (PCD7.F1xx modules)				
Port #0 (PGU) also available as RS 485 interface (either RS 232 or RS 485)	✓				×
Additional serial data port RS 485 (Port 6, up to 115 kbps)	×				✓
Profi-S-Net interface (up to 1.5 Mbps)	×				✓
Field bus connections:					
Serial-S-Bus (Saia® S-Bus)	✓				
Ether-S-Bus (Ethernet-TCP/IP)	×		✓[3)]	✓	
Profi-S-Bus	×				✓
Profibus FMS	×	✓			×[4)]
Profibus DP Master	×	✓			
Profibus DP Slave	×	✓			(✓)[4)]
LonWorks®	×	✓			×[4)]
Socket for network and/or data port, LED display, small terminal	(1 × B)[5)6)]	1 × B[6)]	1 × B[6)]	B1 and B2[6)7)8)]	

1) Can also be used as a serial data port, e.g. to connect a terminal; but this hampers comissioning and troubleshooting with the debugger

2) The USB port is type “USB 1.1 Slave Device 12 Mbps” and can only be used for programming and as an S-Bus Slave, together with certain software products (Webconnect, ViSi-PLUS with S-Driver)

3) Ethernet TCP/IP available as a configured system on the PCD2.M150: PCD2.M150F655. If installed later, the cover must be replaced (item-no. 4 104 7410 0)

4) Implementation of LonWorks and Profibus FMS is technically feasible, but not planned. Profibus DP Slave with Profi S-Net port up to 1.5 Mbps; a 12 Mbps solution with PCD7.F770 is not feasible

5) On the PCD2.M110, Socket B can only be used to attach the PCD7.D16x terminal kit and the PCD2.F510 LED display

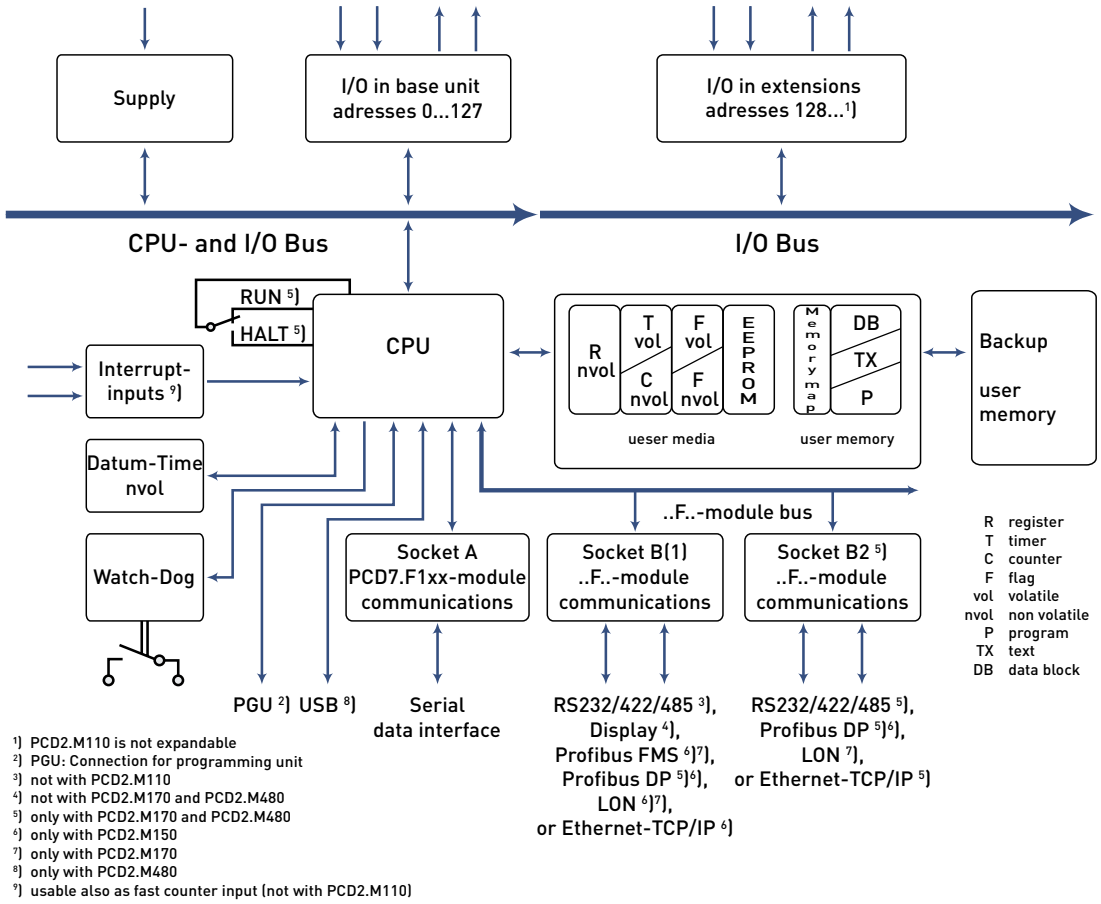
6) We recommend ordering the PCD7.D16x terminal kit mounted on the control. If installed later, the red viewing window must be removed, and four holes drilled for the terminal fixing screws (guide holes are provided on the inside of the cover)

7) Not all communication modules can be mounted on both sockets; please refer to the section on “Communication”

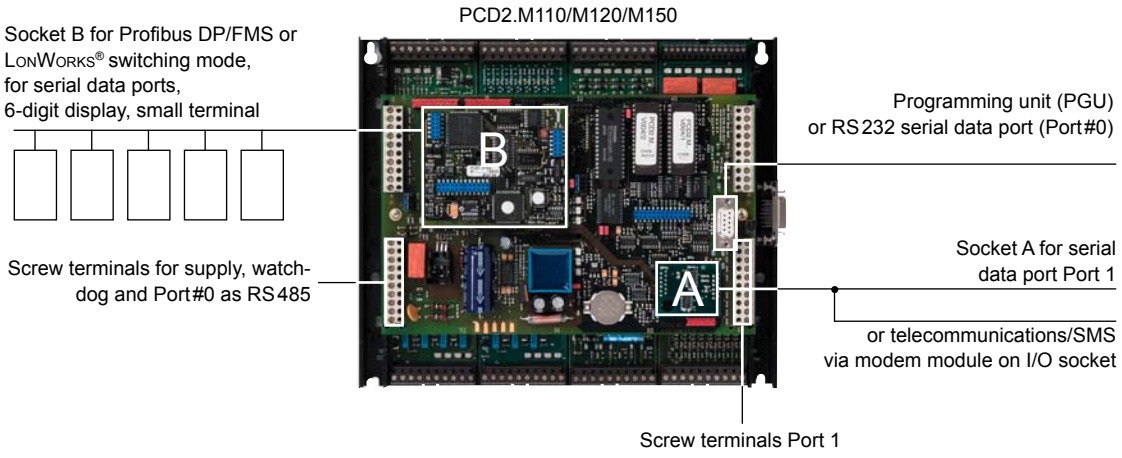
8) The PCD2.F510 and PCD2.F530 LED displays cannot be used with the PCD2.M170 and PCD2.M480

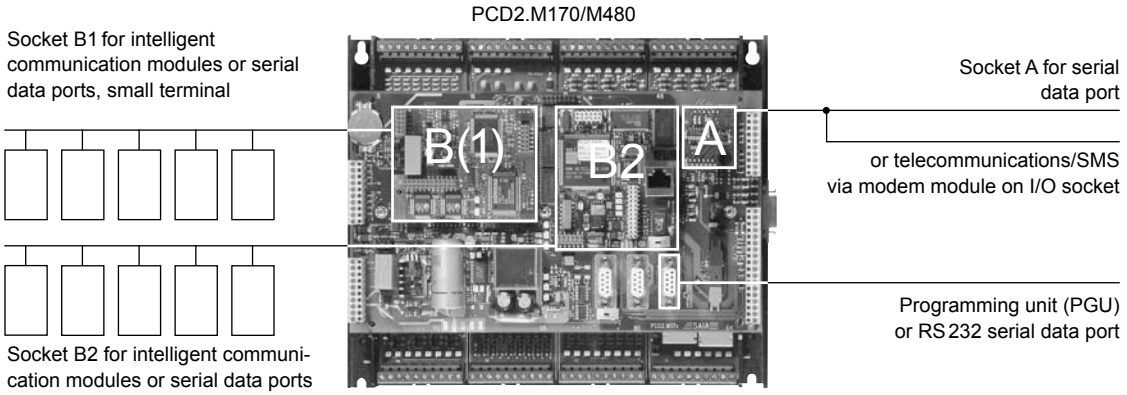
3

3.4.7 Block diagram : PCD2.Mxx0



[1]) PCD2.M110 is not expandable
[2]) PGU: Connection for programming unit
[3]) not with PCD2.M110
[4]) not with PCD2.M170 and PCD2.M480
[5]) only with PCD2.M170 and PCD2.M480
[6]) only with PCD2.M150
[7]) only with PCD2.M170
[8]) only with PCD2.M480
[9]) usable also as fast counter input (not with PCD2.M110)





Removing the cover exposes components that are sensitive to electrostatic discharges.

Recommendations: Immediately before touching the electronic circuits, briefly touch the metal housing of the PGU connection. It is safer to use an anti-static wrist band, connected to the Minus of the system.

When the power is switched on, no operations (such as moving jumpers or (un)plugging I/O modules) should be attempted.

Removing the cover exposes components that are sensitive to electrostatic discharges.

3.4.8 Hardware and firmware versions for the PCD2.M110/M120

The firmware versions for the PCD2.M110/M120 are generally upwardly compatible in terms of hardware, so old CPUs can be fitted with new firmware, in order to take advantage of new functions. This feature is highly valued, and we will try to retain it for as long as possible; however, we cannot guarantee this.

At this point, the following known restrictions apply:

- Hardware version D1 from July/August 1995 only works with firmware version $34; a firmware update is not possible with these controllers
- The use of intelligent communication modules such as Profibus DP, LON and Ethernet requires the minimum hardware and firmware versions. Please refer to the manuals for the communication modules

Hardware version H introduced significant changes:

- Hardware clock on the base circuit board (previously on the PCD2.Fxx0 communication modules)
- CR 2032 lithium buffer battery (older hardware versions can be easily recognized by the two round LR03 batteries)
- Internal 5 V supply now rated up to 1.6 A (previously 1.1 A)
- Option to extend memory with 4 MBit chips (giving 512 Kbytes)

From **hardware version J**, the default set up of the base memory is 128 Kbytes (previously 32 Kbytes).

The firmware for the PCD2.M110/M120 is stored in two EPROMs. **With an EPROM**

burner (e.g. Galep-4), new firmware chips can be burned at any time. The file with the latest firmware version can be downloaded from www.sbc-support.ch. Blank firmware chips can be obtained under item-no. 4 502 7126 0 (two chips per CPU need to be ordered).

3.4.9 Hardware and firmware versions for the PCD2.M150, FW < V0D0 (until early 2007)

The firmware versions for the PCD2.M150 are generally upwardly compatible in terms of hardware, so old CPUs can be fitted with new firmware, in order to take advantage of new functions. This feature is highly valued, and we will try to retain it for as long as possible; however, we cannot guarantee this.

The firmware for the PCD2.M150 is stored in two Flash EPROMs. **With an EPROM burner (e.g. Galep-4), new firmware chips can be burned at any time**; updating via download, as with the M170/M480 is not possible. The file with the latest firmware version can be downloaded from www.sbc-support.ch. Blank firmware chips can be obtained under item-no. 4 502 7341 0 (two chips per CPU need to be ordered).

3.4.10 Hardware and firmware versions for the PCD2.M150, FW ≥ V0D0 (since early 2007)

The Firmware is stored in a Flash EPROM, soldered to the motherboard. A firmware update can be applied by downloading a new version with the PG5. The procedure is as follows:

- Go to www.sbc-support.ch and download the latest firmware version.
- Establish a connection between PG5 and the CPU, as for a download of an application (depending on the facilities available, serially via PGU cable, modem[1)], USB, Ethernet).
- Open the Online Configurator and go offline.
- From the Tools menu, select “Update Firmware”, then use the Browse function to select a path to the file for the new firmware version. Ensure that only one file is selected for downloading.
- Start the download.
- After the download, the power supply to the PCD must not be interrupted for 3 minutes (CPLD programming sequence). Otherwise, the CPU may be blocked in such a way that it needs to be returned to the factory.

1) A modem connection is not always reliable. A modem may become blocked in such a way that remote access is no longer possible. In such cases, an on-site visit will be necessary. Other connection options are preferable.

3.4.10 Hardware and firmware versions for the PCD2.M170/M480

The firmware versions for the PCD2.M170/M480 are generally upwardly compatible in terms of hardware, so old CPUs can be fitted with new firmware, in order to take advantage of new functions. This feature is highly valued, and we will try to retain it for as long as possible; however, we cannot guarantee this.

The firmware for the PCD2.M170/M480 is stored in a Flash EPROM, soldered to the

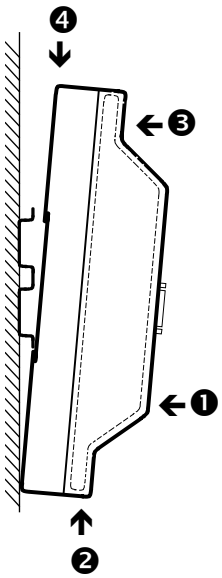
motherboard. A firmware update can be applied by downloading a new version with the PG5. The procedure is as follows:

- Go to www.sbc-support and download the latest firmware version.
- Establish a connection between PG5 and the CPU, as for a download of an application (depending on the facilities available, serially via PGU cable, modem[1)], USB, Ethernet).
- Open the Online Configurator and go offline.
- From the Tools menu, select “Update Firmware”, then use the Browse function to select a path to the file for the new firmware version. Ensure that only one file is selected for downloading.
- Start the download.
- After the download, the power supply to the PCD must not be interrupted for 3 minutes (CPLD programming sequence). Otherwise, the CPU may be blocked in such a way that it needs to be returned to the factory.

1) A modem connection is not always reliable. A modem may become blocked in such a way that remote access is no longer possible. In such cases, an on-site visit will be necessary. Other connection options are preferable.

3.5 Mounting

The PCD1 and PCD2 can be snapped onto two 35 mm top-hat rails (DIN 50 022). The PCD1/PCD2 can also be screwed to any other flat surface with 4 M4 screws; the grooves provided for this purpose can be accessed by lifting off the snap-on cover.



Mounting the PCD1/PCD2 on the top-hat rail

❶ Press bottom of housing onto the mounting surface
❷ Press upwards against the top-hat rail
❸ Press top of housing against the mounting surface and snap into place
❹ Push the housing down onto the top-hat rail to ensure that it is secure

Removal

To remove the housing, push upwards and pull out.

3.5.1 Mounting position and ambient temperature

A vertical surface is normally used to mount the module holder; the I/O connections to the modules then also run vertically. In this mounting position, the ambient temperature may be from 0 °C to 55 °C. In all other positions, air convection works less well, and an ambient temperature of 40 °C should not be exceeded.

3.6 Expansion housings and bus cables

The PCD2.M120/M150/M170/M480 can be expanded with PCD2, PCD3 or PCD4 components, and additional module sockets are provided:

Type	M120/M150	M170	M480
Maximum number of inputs/outputs or I/O module sockets for the system:			
When PCD2 components used exclusively	255[1)2)] 16		
When expanded with PCD3 components	255[1)2)] 16	510[1)2)] 32	1023[1)2)] 64
When expanded with PCD4 components	255[2)3)] 16		

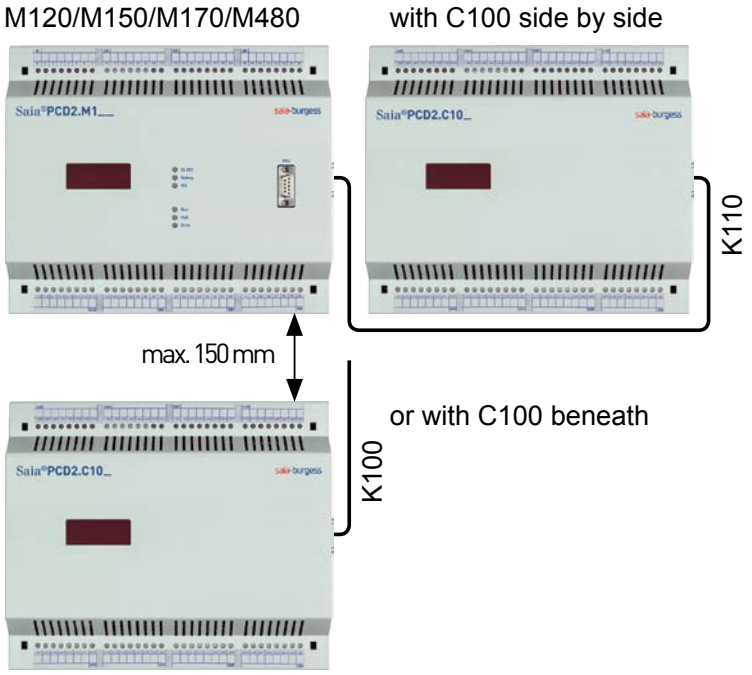
1) Using digital I/O modules PCD2/3.E16x or A46x with 16 I/Os each

2) On all PCD2s, address 256 is reserved for the watchdog; on the M170, address 511 is also reserved for this purpose. The I/Os reserved for the watchdog cannot be used by the user, and no analogue or H modules may be attached to sockets with base address 240 (and on the M170, 496 also)

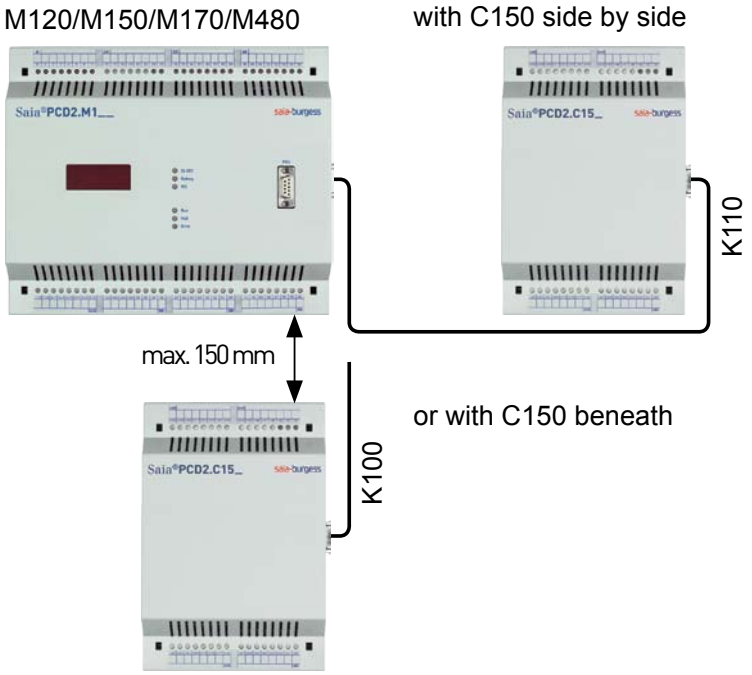
3) Not all PCD4 I/O modules are suitable for use with PCD2 CPUs; please refer to the section on "Expansion with PCD4 components"

3.6.1 Expansion with PCD2 components

The PCD2.C100 expansion housing provides space for 8 additional I/O modules. The dimensions of the housing match those of the PCD2.Mxx0 base unit.



The PCD2.C150 expansion housing provides space for 4 additional I/O modules. The dimensions of the housing match those of the PCD2.Mxx0 base unit.

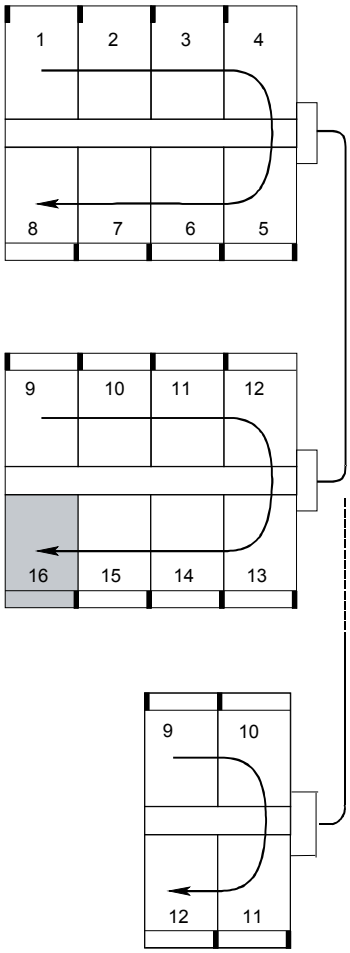


The connection to the base unit is via the 26-core extension cable

- PCD2.K100 for mounting beneath each other, or
- PCD2.K110 for mounting side-by-side
- PCD2.K120 for specific applications (length 2 m)

The PCD2.Mxx0 base units have 8 sockets for input/output modules. The sockets are numbered clockwise from the top left, from 1 to 8.

The controllers can also be expanded with PCD2.C150 (4-socket) and PCD2.C100 (8-socket) expansion housings to provide up to 16 sockets.



Base unit PCD2.Mxx0
Sockets numbered clockwise from 1 to 8.
All modules of types E, A, W and H can run in any socket.
The PCD2.T8xx modems cannot be used in all sockets; please refer to the manual 26/771 for these modules

PCD2.K100 or K110 bus extension cable

PCD2.C100 expansion housing
Sockets numbered clockwise from 9 to 16.

Socket 16 (shaded) cannot be used for modules of types W or H.

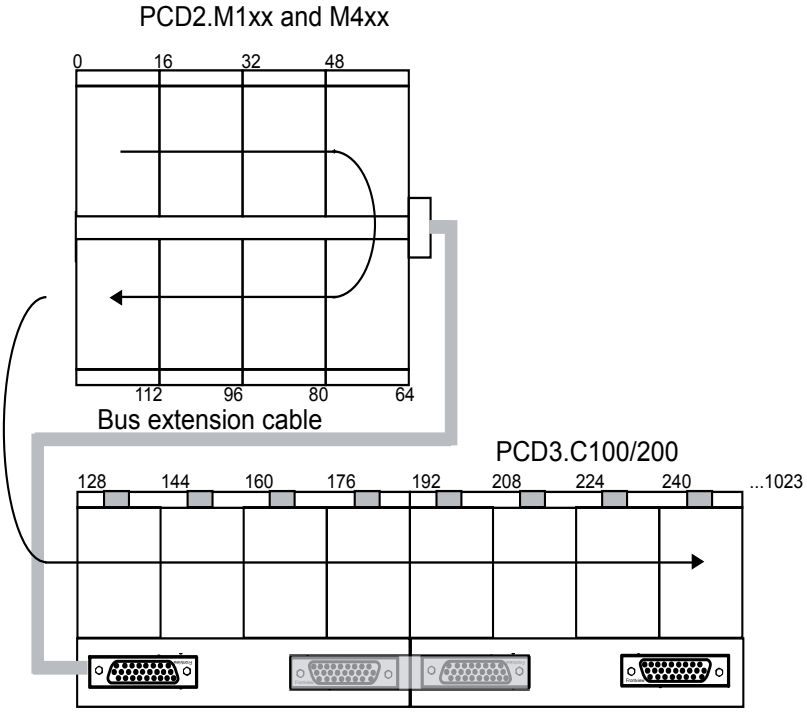
PCD2.C150 expansion housing

Sockets numbered clockwise from 9 to 12

3.6.2 Expansion with PCD3 components

For local expansion, the PCD3 LIO (Local I/O) modules can be used:

PCD3.C200 4 plug-in I/O modules, integrated 24 VDC / 5 VDC supply for modules and signal refresh.
PCD3.C100 4 plug-in I/O modules
PCD3.C110 2 plug-in I/O modules



For decentralized expansion, the PCD3 RIO (Remote I/O) modules can be used:

PCD3.T760 Integrated Profibus DP Slave / Profi S-Net Slave connection up to max. 1.5 MBit/s
4 plug-in I/O cassettes
Integrated web server for diagnostics, support and comissioning (Connection to PC via optional PCD3.K225 connector cable)

The maximum number of I/Os is dependent on the controller being used:

PCD type	Maximum number PCD3 I/Os	Maximum number I/Os per system
PCD2.M120/150	127	255
PCD2.M170	382	510
PCD2.M480	897	1023
PCD3.RIO nodes	256 per node	Determined by the maximum size of the I/O process map for DP Master

When selecting I/O cassettes, ensure that the internal 5 V and +V supply is not overloaded.

Detailed information on planning combined PCD2/PCD3 systems can be found in the PCD3 manual 26/789.

3.6.3 Expansion with PCD4 components

Starting from a PCD2.M120/M150/M170/M480, the PCD4.C225 coupling bus module makes it possible to run the following I/O modules and manual control modules from the PCD4 series:

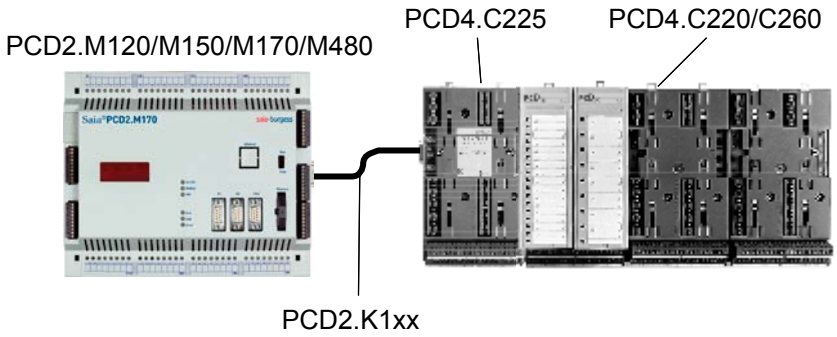
Digital input/output modules	Manual control modules
PCD4.E11x	PCD4.A810
PCD4.E60	PCD4.A820
PCD4.A200	
PCD4.A250	
PCD4.A350	
PCD4.A400	
PCD4.A410	
PCD4.B90x	

Any PCD4 I/O modules not listed are not supported.

As shown in the illustration below, the PCD4.C225 is connected to the PCD2 via a PCD2.K100/K110/K120 extension cable.

Using standard PCD4.C220 or PCD4.C260 bus modules, up to 6 additional module sockets can be attached to the right-hand side of the PCD4.C225 coupling bus module (making a total of 8 PCD4 sockets).

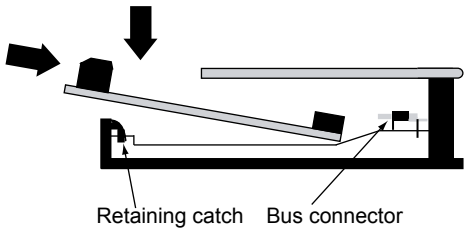
It is necessary to ensure that the internal 5 V and +V supply for the PCD2 is not overloaded. The power consumption for the PCD4 modules can be found in manual 26/734.



3.7 Installation and addressing of PCD2 I/O modules

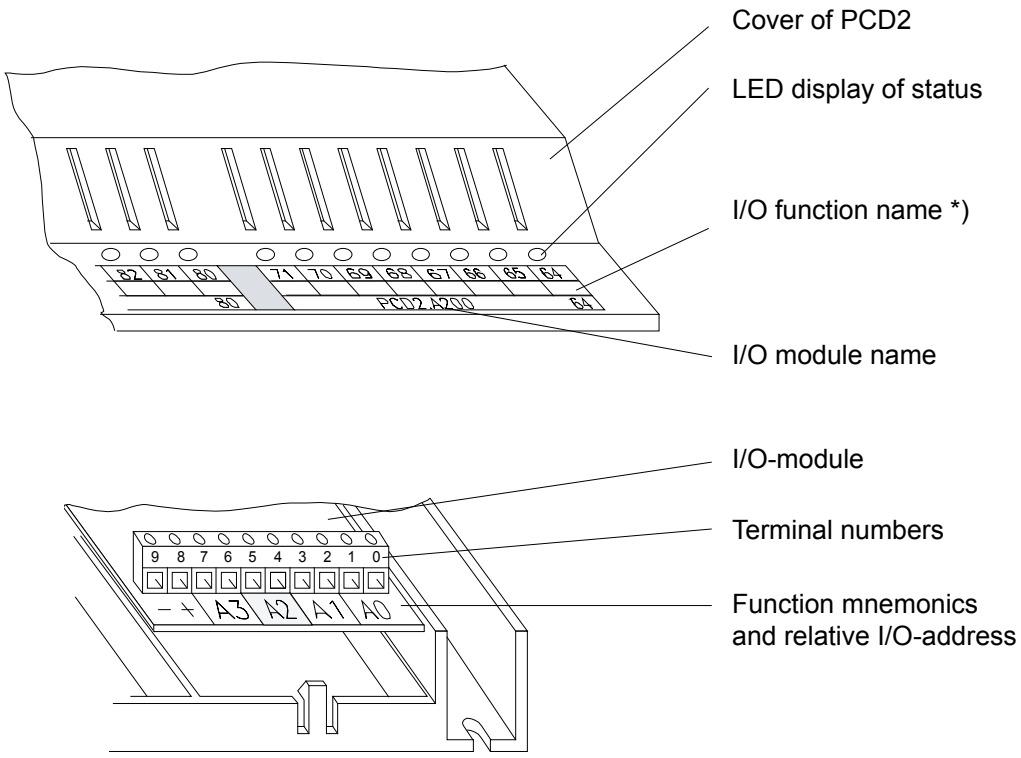
3.7.1 Insertion of I/O modules

The I/O module is inserted from the side, pushed towards the middle of the unit until it reaches the end stop, and snapped into the retaining catch.



When the power is switched on, no operations (such as moving jumpers or (un)plugging I/O modules) should be attempted.

3.7.2 Address and terminal designation

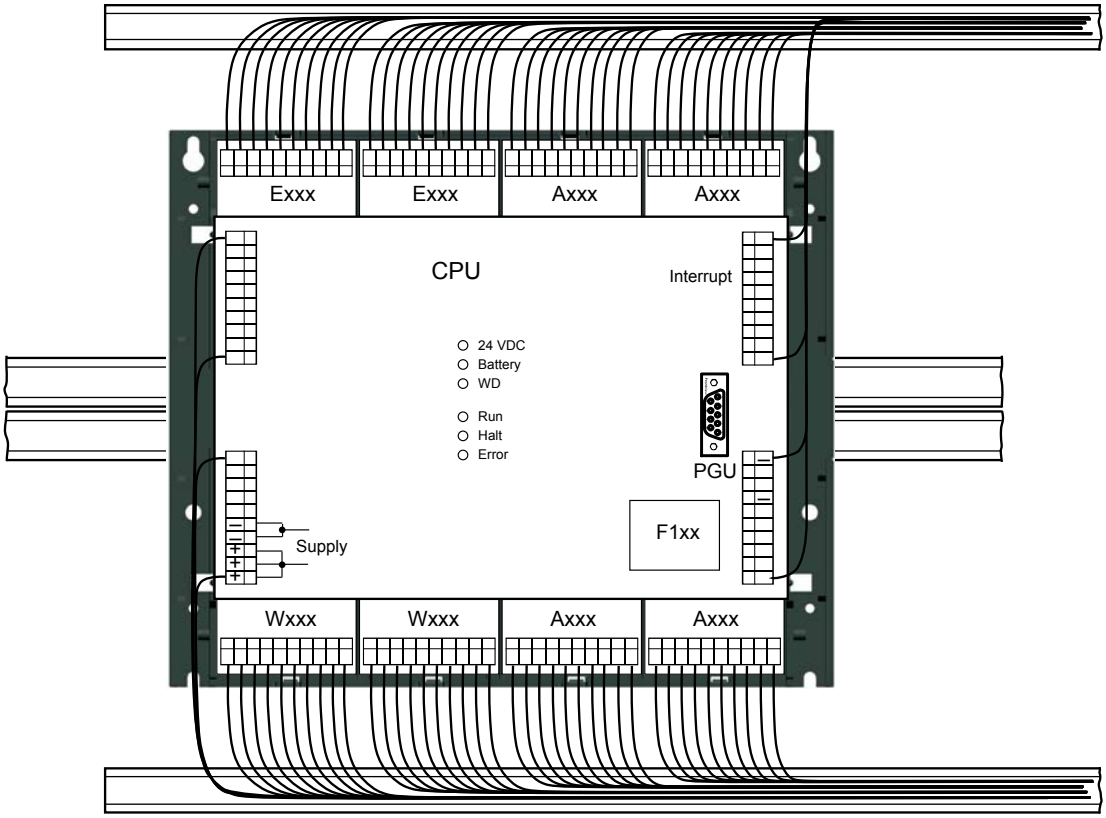


*) All PCD1/PCD2 units are suitably labelled

Removing the cover gives access to terminals, but also exposes components that are sensitive to electrostatic discharges.

3.7.3 Cable layout

Wiring to the I/O modules can be laid in the cable channels on both sides.



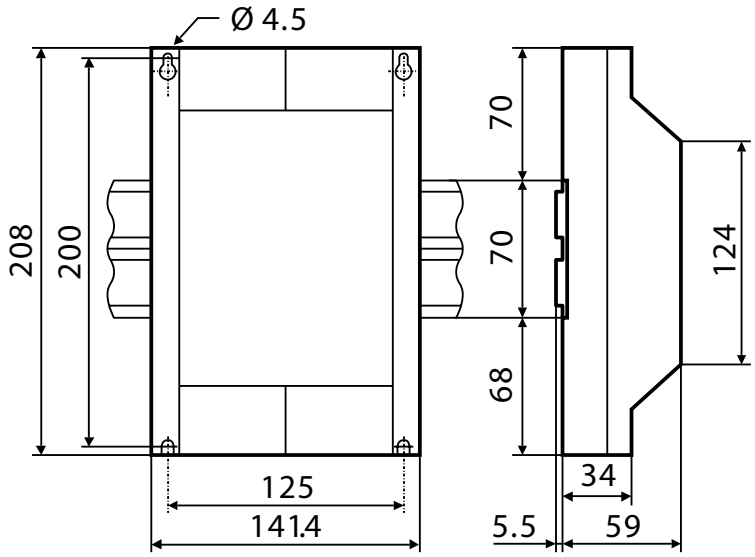
The cables to the terminals on the motherboard are run through the two side channels from the bottom or from the top.

On the PCD2.M170 and the PCD2.M480, the terminals on the motherboard are accessible without removing the cover.

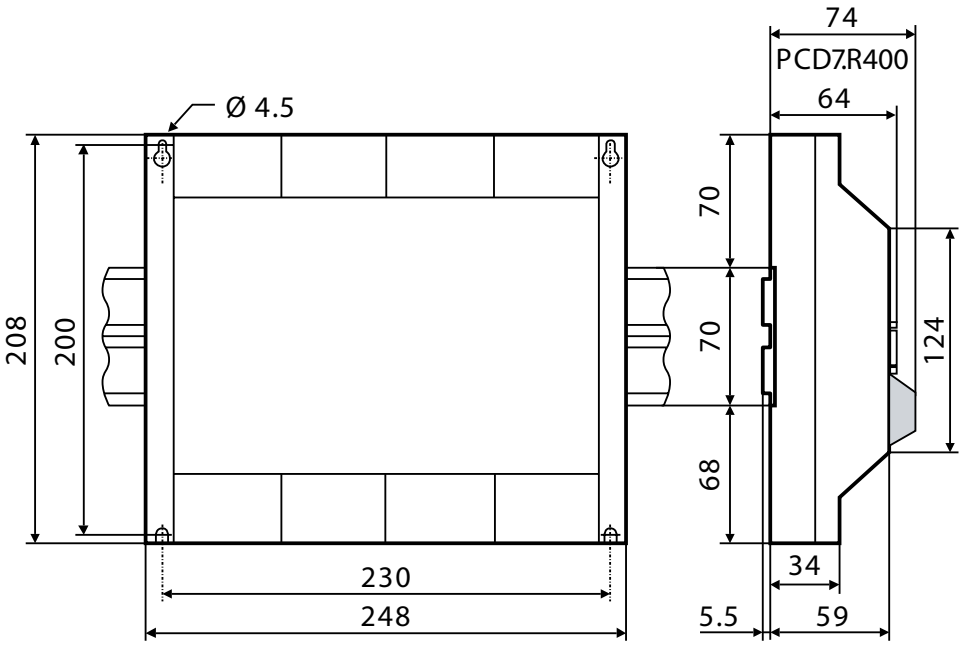
Following these rules will ensure that the LEDs are visible and the bus connections remain accessible.

3.8 Dimensions

PCD1.M1xx/PCD2.C150



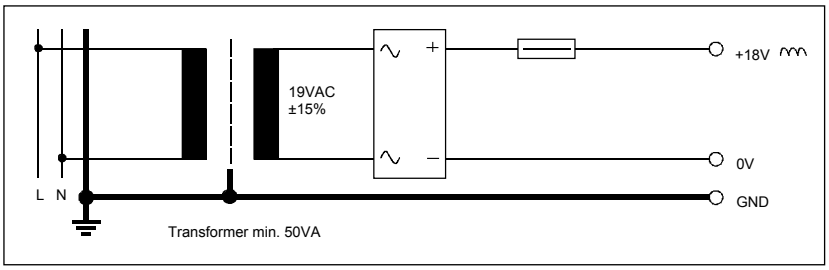
PCD2.Mxx0/PCD2.C100



3.9 Power supply and connection plan

3.9.1 External power supply

Simple, small installations

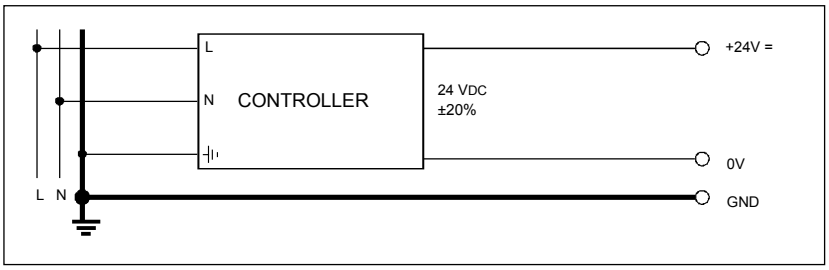


- Sensors: Electro-mechanical switches
- Actuators: Relays, lamps, small valves with < 0.5 A switching current

The transformer voltage of 19 VAC ±15% must be maintained. If not, the supply voltage at the input to the PCD may become too high and destroy it.

The PCD2. H1xx, H2xx, H3xx, PCD7.D1xx, D2xx and PCA2.D12/D14 modules must be connected to a smoothed 24 VDC supply

Small to medium installations

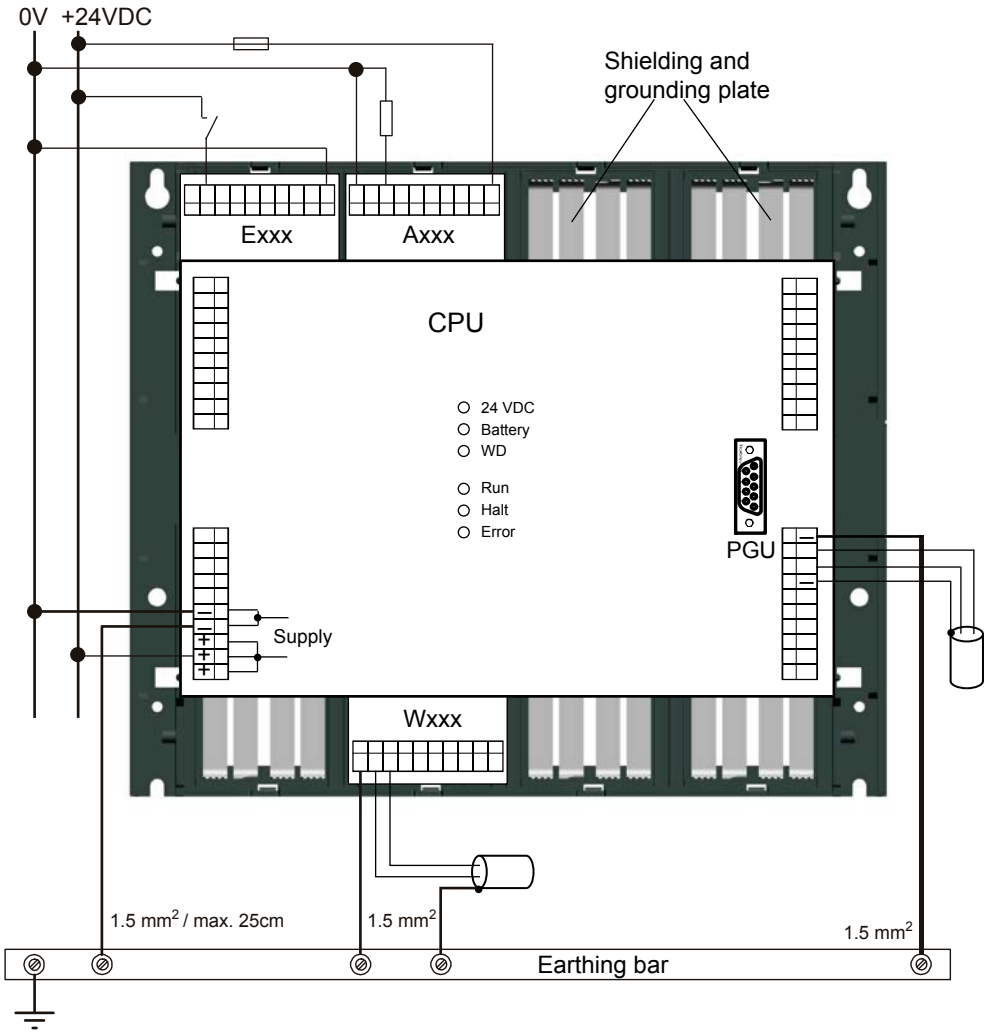


Controller: usual primary switched network component

- Sensors: Electro-mechanical and proximity switches, photoelectric barriers
- Actuators: Relays, lamps, displays, small valves with < 0.5 A switching current

3.9.2 Earthing and connection plan

Ground wire plan with earthing bar



In the bottom part of the PCD1/PCD2 housing there is a shielding and earthing plate. This constitutes the common, large-area ground for all I/O modules and for the external power supply.

When a module is plugged in at the I/O level, the blades on this plate ensure a reliable multi-point contact to the relevant module.

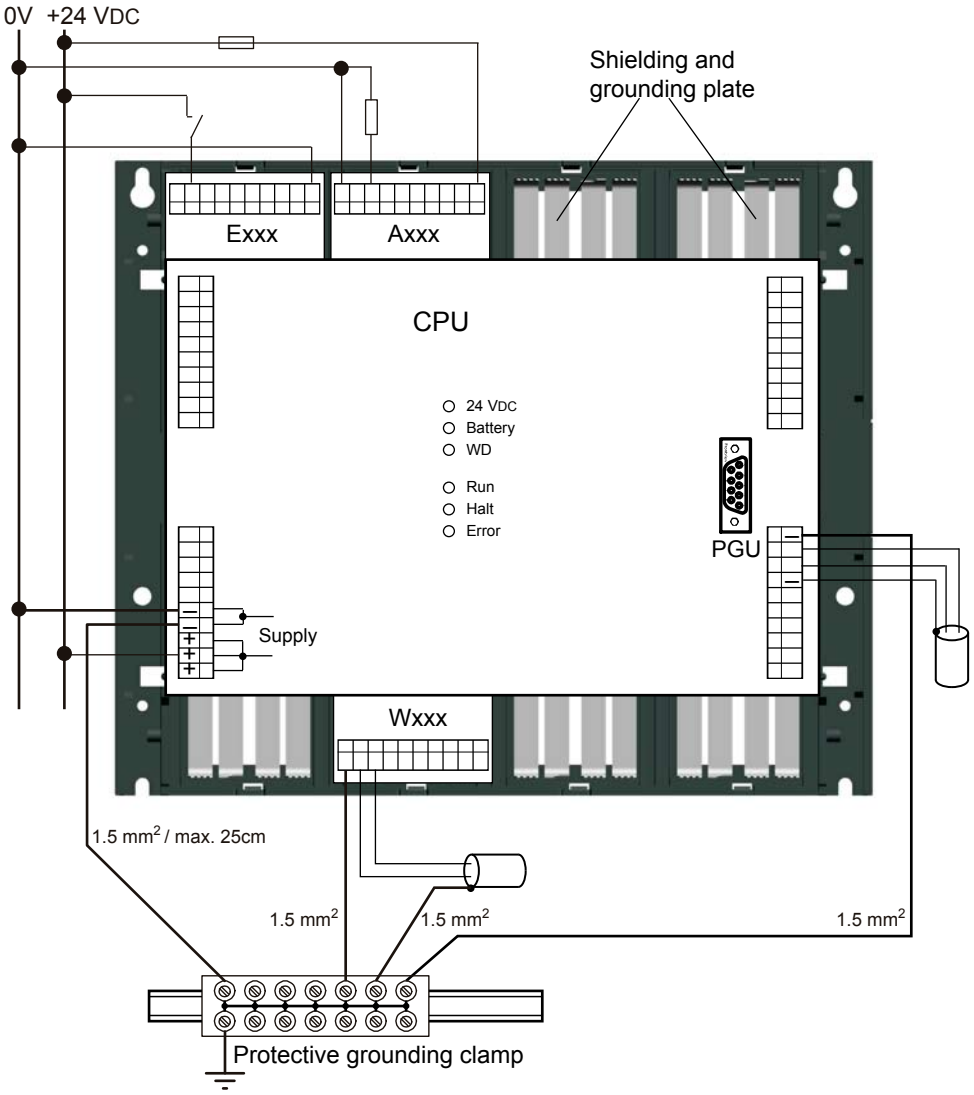
The zero-potential (Minus pole) of the 24 V supply is connected to the Minus terminal of the PCD1/PCD2 supply. This should be connected to the earthing bar with the shortest possible wire (< 25 cm) of 1.5 mm^2. The same applies to the Minus connection to the F1xx or the interrupt terminal.

Any shielding of analogue signals or communication cables should also be brought to the same earth potential, either via a Minus terminal or via the earthing bar.

All Minus connections are linked internally. For problem-free operation, these connections should be reinforced externally with short wires of 1.5 mm^2.

3

Star-shaped ground wire plan (alternative to earthing bar)



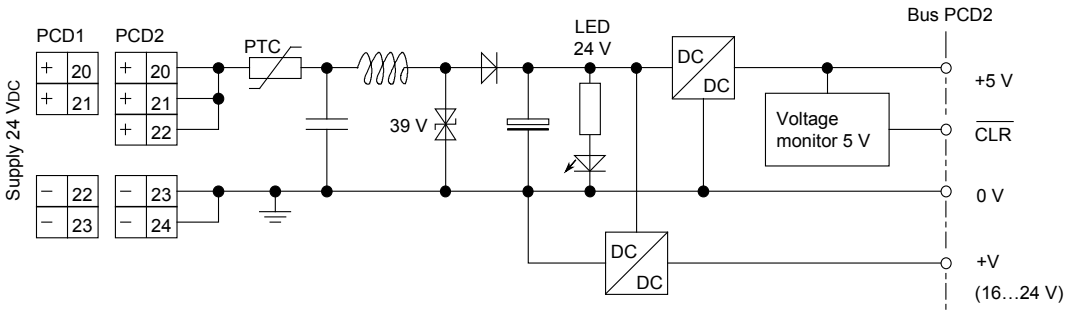
The star-shaped ground wire plan should only be used where there is no earthing bar.

Examples of ground wire terminals for 35 mm mounting rails[1)]

Manufac-turer	Connection type	Type	End plate	End bracket/ end clamp
Weidmüller	Screw connection	WPE4 101 010 0000		
Weidmüller	Screwless spring clip	ZPE4 163 208 0000	ZAP/TB4 163 209 0000	ZEW 954 000 0000
Wago	Screwless cage clamp	default: 281-107	grey: 281-301 orange: 281-302	6 mm: 249-117 10 mm: 249-116
Wieland	Screw connection	WKI4SL/35	AP2.5-4 grey	9708/2 S 35
Wieland	Spring clip	WKI4SL/35	APF2.5-4 GN	WEF 1/35

1) DIN46277, NFC, CENELC

3.9.3 Internal power supply



3.9.4 Capacity of internal power supply

Starting from the base units, the following currents are available for the plug-in modules:

+5 V:

PCD1:	:	750 mA
PCD2.M110/M120	:	1600 mA (before hardware version H: 1100 mA)
PCD2.M150/M170	:	1600 mA
PCD2.M480	:	2000 mA

+V (16…24 V) :

PCD1:	:	100 mA
PCD2:	:	200 mA

3.10 PCD1.M1x0 and PCD1.M1x5 operating states

The CPU can assume the following operating states:

START, RUN, CONDITIONAL RUN, STOP and HALT

The display uses 3 LEDs:	SUPPLY 24 VDC	LED yellow
	RUN	LED yellow
	ERROR	LED red

The "SUPPLY 24 VDC" LED shows that the electrical supply is working.
The RUN and ERROR LEDs together show the operating state of the CPU:

	START	RUN	COND. RUN	STOP	HALT	RESET
RUN	●/○	●	●/○	○	○	●
ERROR	●/○	1)	1)	1)	1)	●

1) An ERROR may be signalled by the LED in operating states RUN, CONDITIONAL RUN, STOP or HALT. In the event of an error, the LED only lights up if there is no XOB 13 programmed to deal with this error.

- ● LED on
- ●/○ LED flashing
- ○ LED off

START	Self-diagnosis for approx. 1s after switching on or after a Restart
RUN	Normal processing of the user program after START. Where a programming device is connected in PGU mode (e.g. PG5 in PGU mode), the CPU automatically goes into the STOP state and not the RUN state; this is for safety reasons
COND. RUN	Conditional RUN state A condition has been set in the debugger (RUN until..), which has not yet been met
STOP	The STOP state occurs in the following cases: • Programming device in PGU mode connected when CPU switched on • PGU stopped by programming device • Condition for a COND. RUN has been met
HALT	The HALT state occurs in the following cases: • HALT instruction processed • Serious error in user program • Hardware fault • No program loaded • No communication module on a S-Bus PGU or Gateway Master port
RESET	The RESET state has the following causes: • Supply voltage too low • Firmware not starting up

3.11 PCD2.M1x0/M480 operating states

The CPU can assume the following operating states: START, RUN, CONDITIONAL RUN, STOP, HALT and RESET

The display uses 3 LEDs: RUN LED yellow
HALT LED red
ERROR LED yellow

	START	RUN	COND. RUN	STOP	HALT	RESET
RUN	●/○	●	●/○	○	○	●
HALT	●/○	○	○	○	●	●
ERROR	●/○	[1]	[1]	[1]	[1]	●

[1] An ERROR may be signalled by the LED in operating states RUN, CONDITIONAL RUN, STOP or HALT. In the event of an error, the LED only lights up if there is no XOB 13 programmed to deal with this error.

- ● LED on
- ●/○ LED flashing
- ○ LED off

START	Self-diagnosis for approx. 1s after switching on or after a Restart
RUN	Normal processing of the user program after START. Where a programming device is connected via a PCD8.K11x in PGU mode (e.g. PG5 in PGU mode), the CPU automatically goes into the STOP state and not the RUN state; this is for safety reasons
COND. RUN	Conditional RUN state. A condition has been set in the debugger (RUN until...), which has not yet been met
STOP	The STOP state occurs in the following cases: • Programming device in PGU mode connected when the CPU was switched on • PGU stopped by programming device • Condition for a COND.RUN has been met
HALT	The HALT state occurs in the following cases: • HALT instruction processed • Serious error in user program • Hardware fault • No program loaded • No communication module on a S-Bus PGU or Gateway Master port
RESET	The RESET state has the following causes: • Supply voltage too low • Firmware not starting up

3.12 Expansion of user memory

3.12.1 Basics

The main reasons to expand the user memory for a PCD1/PCD2 are:

- The base memory is too small to store the user program and the texts
- The user program and the non-modifiable texts and data blocks are to be held in Flash EPROM as a failsafe measure (the base memory is always RAM)
- The benefits of data blocks with addresses ≥ 4000 are to be used:
  - up to 16,384 elements / DBs
  - much lower overhead per element: 4 bytes per 32-bit value rather than 8 bytes
  - much faster access

The **PCD2.M170** and **PCD2.M480** are equipped with 1 Mbyte of RAM as standard; this cannot be expanded. To minimize the risk of program loss, we recommend the use of the optional PCD7.R400 flash card, which allows the user program to be backed up.

The use of EPROMs to expand the user memory is obsolete and is no longer recommended. Working with Flash EPROMs is much more convenient (no EPROM programming device required, behaves like RAM for the programmer) and just as secure as EPROMs.

3.12.2 Memory location of the user program, the resources, texts and DBs

Depending on whether the user memory of a PCD1/PCD2 has been expanded or not, the memory location of various parts of the application will vary. When the user memory is expanded by plugging in a memory chip, the user program and the text strings/DBs with addresses < 4000 are stored in the additional plug-in chip.

The base memory provided on the CPU is then free, and can optionally be defined in the hardware configuration as “extension memory” and used to store texts and DBs with addresses ≥ 4000.

Memory location **Contents**	**No expansion of user memory**	**With expansion of user memory**
Resources (registers, flags, counters etc.)	The resources are held in a separate RAM memory on the CPU (always in the same location, buffered by the SuperCap or the battery)	
User program	in **base memory**	in additional chip in “**USER PROG**” socket[1)]
Texts and DBs with addresses < 4000	in **base memory**	in additional chip in “**USER PROG**” socket[1)]
Texts and DBs with addresses ≥ 4000	not available	in **extension memory**[2)]

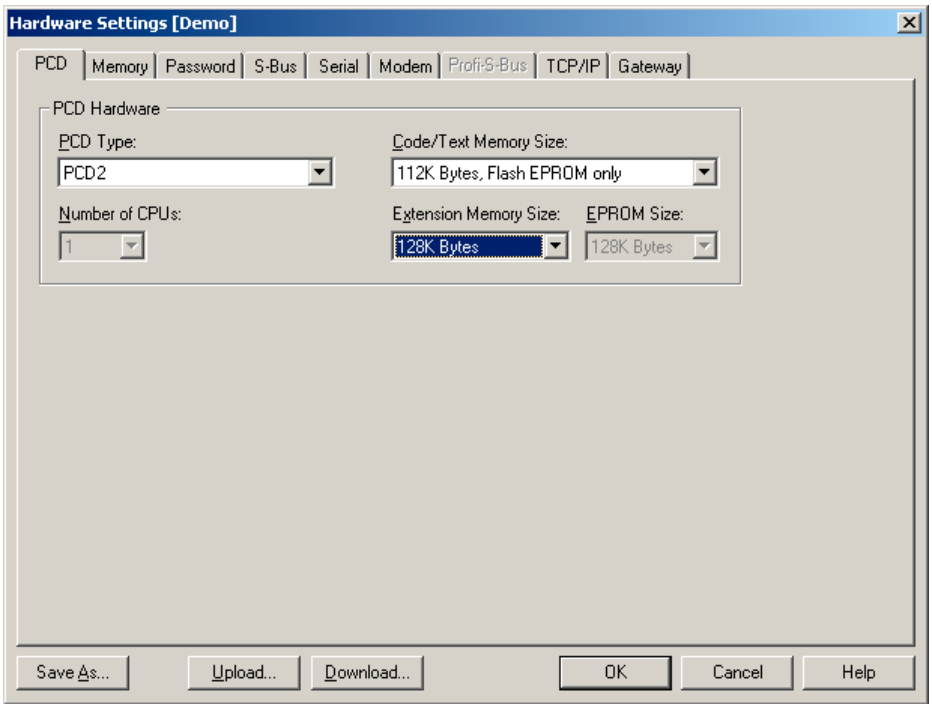
1) i.e. in RAM, EPROM or Flash EPROM depending on the chip used. The use of EPROM is no longer recommended; use Flash EPROM instead

2) Must be defined in the hardware configuration

3.12.3 Example of a memory configuration

The screenshots below show examples of the hardware configuration and associated software settings in PG5 for a PCD2.M120 (hardware version >= J) with a 1 Mbit Flash EPROM plug-in expansion unit (item-no. 4 502 7141 0).
Extension memory is configured and is used to hold RAM texts and RAM DBs.

Step 1: Hardware configuration



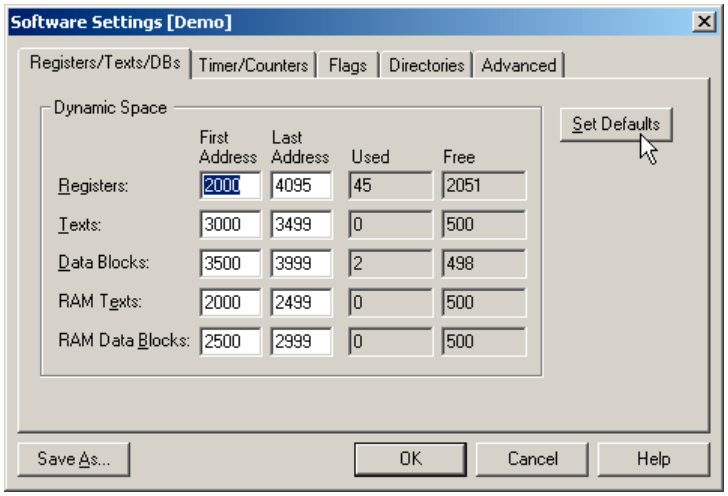
In this example, only 112 Kbytes of Flash EPROM are available as code/text memory (on the plug-in chip); one block of memory is lost to configuration data (header), because Flash EPROM can only be accessed in block mode.

For a PCD2.M110/M120 with hardware version < J, only 24 Kbytes of extension memory (onboard memory) can be configured; previously, less base memory was provided with these CPU types.

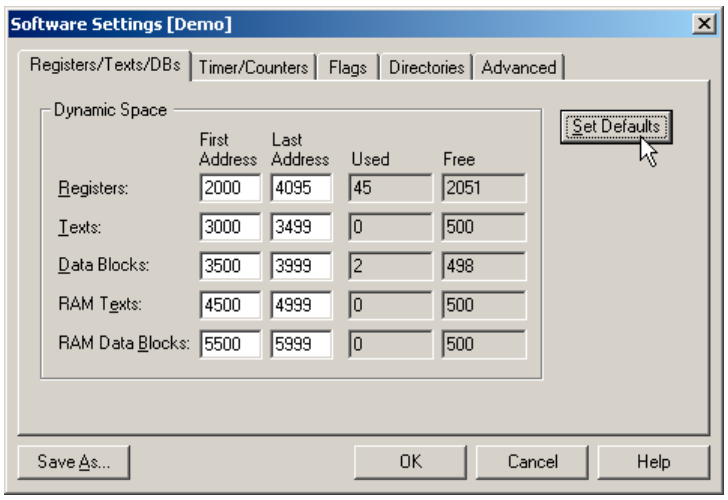
Step 2: Downloading the hardware configuration

Step 3: Modifying system settings

Software settings before modification:



After modification (“Set defaults” pressed):



The addresses of the RAM text strings and DBS have been changed.

The “Set Defaults” button is useful in many cases, as the addresses are automatically set according to the hardware configuration. However, the previous settings are lost.

The new software settings are picked up at the next build.

3.12.4 PCD1.M1x0

The user memory for PCD1 CPUs can be expanded with RAM, EPROM and, from firmware version 002, with Flash EPROM, **up to a maximum of 1 Mbit**.
The base memory thus released can be configured as extension memory and used to hold 13 Kbytes of texts and DBs.

As the price differences between the different memory chips are very small, we recommend the use of the following types:

Memory type	Item-no.	Typical codes	Size
RAM	4 502 7013 0[1)]	BS62LV1025 PC-70 LP621024D-70LL SRM20100LLC70 HY628100ALP-70 GM76C8128CLL-70 MEL M5M51008BP-70L	1 Mbit / 128 Kbytes
EPROM[2)]	4 502 7126 0	AM27C010-90 DC NM27C01Q-90 M27C1001-10F1	1 Mbit / 128 Kbytes
Flash EPROM[3)]	4 502 7141 0	AM29F010-70PC	1 Mbit / 112 Kbytes[4)]

1) Where RAM components not approved by Saia are used, there is a risk of losing data

2) The use of EPROMs is obsolete; use Flash EPROM instead

3) Flash EPROM is supported from firmware version 002 only

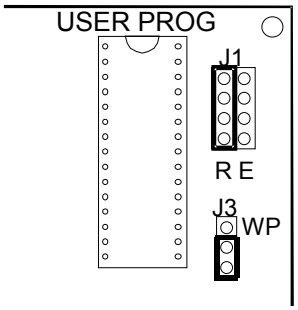
4) To hold the configuration, a portion of memory is lost, so for this chip,112 Kbytes rather than 128 are available to the user

The following chips will work, but are no longer recommended for new installations:

Memory type	Item-no.	Typical codes	Size
RAM	4 502 5414 0[1)]	SRM2B256LCX70 HY62256ALP-70 GM76C256CLL-70 MEL M5M5256DP-70LL TC55257DPL-70L	256 Kbits / 32 Kbytes
EPROM[2)]	4 502 3958 0	AM27C512-90 DC UPD27C512D-10 M27C512-10XF1 M27C512-10F1	512 Kbits / 64 Kbytes

Steps in the correct installation of extended user memory:

1) Switch off power supply and remove the cover of the PCD1
2) Plug the additional memory chip into the “USER PROG” socket.
   Ensure correct alignment (markings on the socket and the chip must match), and ensure that all pins on the chip are inserted into the socket
3) Set the jumper next to the socket correctly:



Jumper		**Position**
J1 (memory type)	**RAM** **EPROM** **Flash EPROM**	R[1)] E E
J3 (write-protection)	Write protection for extension memory **deactivated** Write protection for extension memory **activated** (only works with RAM and Flash EPROM)	beneath[1)] WP (up)

1) Jumper position on delivery: RAM, write protection deactivated

4) Modify the hardware configuration in PG5 accordingly, and download the new configuration

3.12.5 PCD1.M125 and PCD1.M135

The user memory for these CPUs can be expanded as follows :

CPU Typ	Expansion option	Available memory for extension memory[1)]
PCD1.M1x5	RAM: 512 KBit / 128 KByte	128 KByte
	EPROM: 128 KBit / 128 KByte	128 KByte
	Flash-EPROM: 448 KBit / 112 KByte	128 KByte

1) The base memory released by the extended memory can be configured as extension memory and used to store texts and DBs

As the price differences between the different memory chips are very small, we recommend the use of the following types:

Memory type	Item-no.	Typical codes	Size
RAM	4 502 7013 0[1)]	BS62LV1025 PC-70 LP621024D-70LL SRM20100LLC70 HY628100ALP-70 GM76C8128CLL-70 MEL M5M51008BP-70L	1 Mbit / 128 Kbytes
	4 502 7175 0[1)]	HM628512LP-5 KM684000BLP-SL K6T4008C1B-DB55	4 Mbits / 512 Kbytes
EPROM[2)]	4 502 7126 0	AM27C010-90 DC NM27C01Q-90 M27C1001-10F1	1 Mbit / 128 Kbytes
Flash EPROM[3)]	4 502 7141 0 4 502 7224 0	AM29F010-70PC SBE29F040 AM29F040B-90PC	1 Mbit / 112 Kbytes[3)] 4 Mbits / 448 Kbytes[3)]

1) Where RAM components not approved by Saia are used, there is a risk of losing data

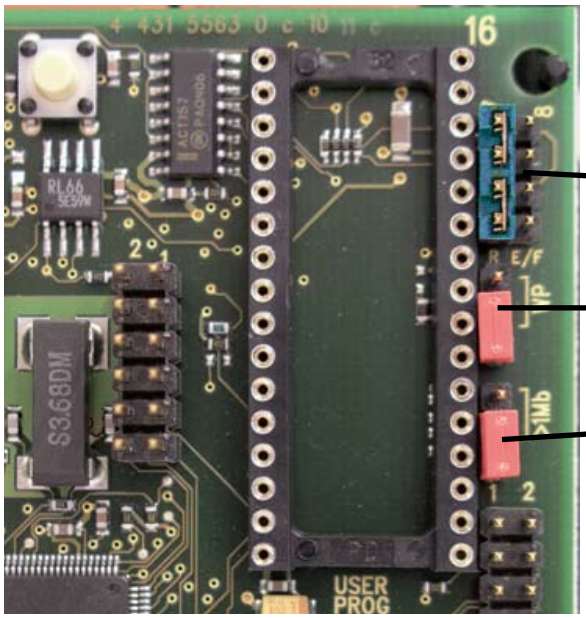
2) The use of EPROMs is obsolete; use Flash EPROM instead

3) To hold the configuration, a portion of memory is lost, so for this chip,112 Kbytes rather than 128 are available to the user

Steps in the correct installation of extended user memory:

1) Switch off power supply and remove the cover of the PCD2
2) Plug the additional memory chip into the “USER PROG” socket.
   Ensure correct alignment (markings on the socket and the chip must match), and ensure that all pins on the chip are inserted into the socket
3) Set the jumper next to the socket correctly:

PCD2.M125/M135



Jumper		**Position**
J1 (Memory type)	RAM EPROM Flash-EPROM	left; **R** 1) right; **E/F** right; **E/F** 2)
J2 (write-protection)	Write protection **activated**2) (only works for RAM and Flash-EPROM) Write protection **deactivated**2)	up; **WP** 1) down
J4 (memory size <= 1 MBit or > 1 MBit)	Memory size <= 1 MBit Memory size > 1 MBit	up1) down; **>1MB**

1) Jumper position on delivery: RAM, write-protection deactivated, memory size ≤ 1 Mbit

2) Write-protection only affects the chip in the USER PROG socket

4) Modify the hardware configuration in PG5 accordingly, and download the new configuration

3.12.6 PCD2.M110/M120/M150

The user memory for these CPUs can be expanded as follows:

CPU type	Expansion option	Available memory for extension memory[1)]
PCD2.M110/M120 with hardware version < H	RAM: 1 Mbit / 128 Kbytes EPROM: 1 Mbit / 128 Kbytes Flash EPROM: 1 Mbit / 112 Kbytes	24 Kbytes 24 Kbytes 24 Kbytes
PCD2.M110/M120 with hardware version >= H and firmware version > V006	RAM: 4 Mbit / 512 Kbytes EPROM: 4 Mbit / 512 Kbytes Flash EPROM: 4 Mbit / 448 Kbytes	128 Kbytes 128 Kbytes 128 Kbytes
PCD2.M150	RAM: 4 Mbit / 512 Kbytes EPROM: 4 Mbit / 512 Kbytes Flash EPROM: 4 Mbit / 448 Kbytes	128 Kbytes 128 Kbytes 128 Kbytes

1) The base memory released by the extended memory can be configured as extension memory and used to store texts and DBs

As the price differences between the different memory chips are very small, we recommend the use of the following types:

Memory type	Item-no.	Typical codes	Size
RAM	4 502 7013 0[1)]	BS62LV1025 PC-70 LP621024D-70LL SRM20100LLC70 HY628100ALP-70 GM76C8128CLL-70 MEL M5M51008BP-70L	1 Mbit / 128 Kbytes
	4 502 7175 0[1)]	HM628512LP-5 KM684000BLP-SL K6T4008C1B-DB55	4 Mbits / 512 Kbytes
EPROM[2)]	4 502 7126 0	AM27C010-90 DC NM27C01Q-90 M27C1001-10F1	1 Mbit / 128 Kbytes
	4 502 7223 0	AM27C040-100DC M27C4001-10F1	4 Mbits / 512 Kbytes
Flash EPROM[3)]	4 502 7141 0	AM29F010-70PC	1 Mbit / 112 Kbytes[4)]
	4 502 7224 0	SBE29F040 AM29F040B-90PC	4 Mbits / 448 Kbytes[4)]

1) Where RAM components not approved by Saia are used, there is a risk of losing data

2) The use of EPROMs is obsolete; use Flash EPROM instead

3) Flash EPROM is supported from firmware version 002 only

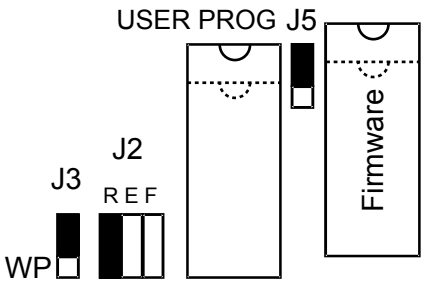
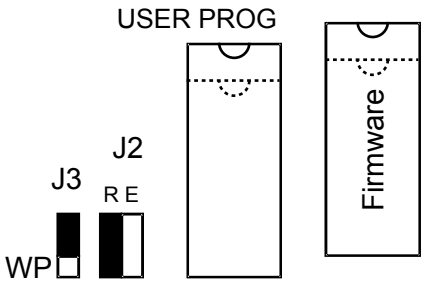
4) To hold the configuration, a portion of memory is lost, so for this chip,112 Kbytes rather than 128 are available to the user

The following chips will work, but are no longer recommended for new installations:

Memory type	Item-no.	Typical codes	Size
RAM	4 502 5414 0[1)]	SRM2B256LCX70 HY62256ALP-70 GM76C256CLL-70 MEL M5M5256DP-70LL TC55257DPL-70L	256 Kbits / 32 Kbytes
EPROM[2)]	4 502 3958 0	AM27C512-90 DC UPD27C512D-10 M27C512-10XF1 M27C512-10F1	512 Kbits / 64 Kbytes

Steps in the correct installation of extended user memory:

1) Switch off power supply and remove the cover of the PCD2
2) Plug the additional memory chip into the “USER PROG” socket.
   Ensure correct alignment (markings on the socket and the chip must match), and ensure that all pins on the chip are inserted into the socket
3) Set the jumper next to the socket correctly:

PCD2.M110/M120 hardware version ≥ H and PCD2.M150	**PCD2.M110/M120 hardware version < H**
	

Jumper		**Position**
J1 (memory type)	RAM EPROM Flash EPROM	R[1)] E F[2)]
J3 (write-protection)	Write protection **deactivated**[3)] Write protection **activated**[3)] (only works for RAM and Flash EPROM)	up[1)] WP (down)
J5 (memory size <= 1 Mbit or > 1 Mbit)[2)]	Memory size <= 1 Mbit Memory size > 1 Mbit	up[1)] down

1) Jumper position on delivery: RAM, write-protection deactivated, memory size ≤ 1 Mbit

2) On the PCD2.M110/M120 with hardware version < H, J5 and the J2 F jumper are not present. This means that where Flash EPROM is used with these controllers, J2 has to be attached to E and only chips up to 1 Mbit can be used for expansion

3) Write-protection only affects the chip in the USER PROG socket

4) Modify the hardware configuration in PG5 accordingly, and download the new configuration

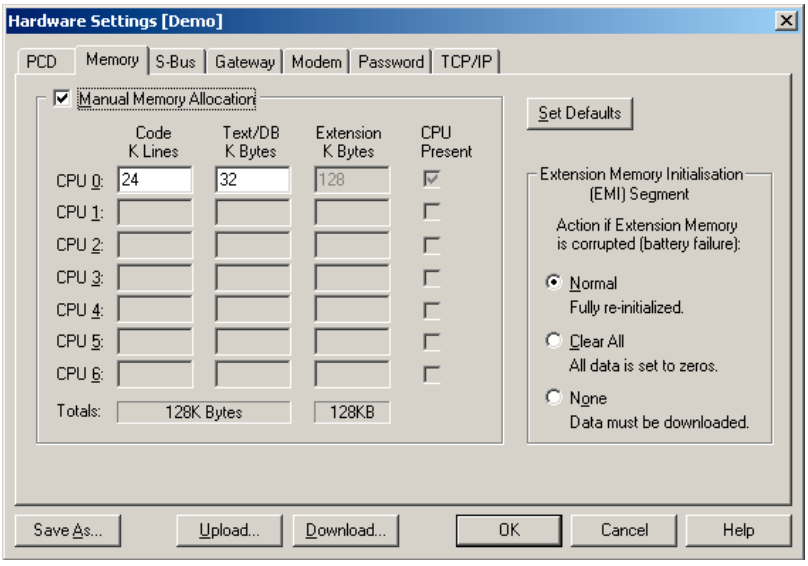
3.13 Partitioning options for user memory

In the PG5 hardware configuration, the user memory is partitioned by default into lines of code and texts/DBs, in a way that suits most applications.

In the case of a large program with few texts/DBs or a very small program with many texts/DBs, the user can partition the memory manually. In order to choose an appropriate breakdown, the following should be noted:

- the partitioning is into “Kbytes lines of code” and “Kbytes text/DBs”, where the “Kbytes lines of code” can only be changed in 4 Kbytes steps, as every line of code occupies 4 bytes
- the result of the formula (4 × “Kbytes lines of code”) + “Kbytes text/DBs” must equal the available user memory,
  e.g. 4 × 24 Kbytes + 32 Kbytes = 128 Kbytes
- each character of a text occupies 1 byte
- each 32-bit element of a DB occupies eight bytes in the address range 0..3999, and the header of the DB takes up a further three bytes
- PCD1, PCD2.M110/M120/M150:
  For applications with many DBs, we recommend fitting a memory expansion unit, so that extension memory can be configured. The DBs with addresses from 4000 that can be held there can hold more elements (16384 instead of 384), take up less space (only 4 bytes instead of 8 bytes per element, but NB, 8 bytes instead of 3 for the header) and the access time is substantially shorter. The extension memory is independent of the memory partitioning and is only configurable where an expansion unit is plugged in
- PCD2.M170/M480:
  We recommend that DBs with addresses ≥ 4000 should always be used. The addresses from 4000 that can be held there can hold more elements (16384 instead of 384), take up less space (only 4 bytes instead of 8 bytes per element, but NB, 8 bytes instead of 3 for the header) and the access time is substantially shorter.

Example of manual partitioning of a PCD2.M150:



3.14 Data storage in case of power outage

The resources (registers, flags, timers, counters etc), and possibly the user program and the text strings/DBs, are stored in RAM. To ensure that they are not lost and that the hardware clock (where present) continues to run when there is a power outage, the PCD1/PCD2 are equipped with a buffer capacitor (SuperCap) or a buffer battery.

CPU type	Buffer	Buffer time
PCD1.M110	Super Cap (soldered)	30 days[1) 2)]
PCD1.M120/M125	Super Cap (soldered)	7 days[2)]
PCD1.M130/M135	CR 2032 lithium battery	1-3 years[3)]
PCD2.M110/M120 hardware version < H	2 × alkaline batteries size LR03/AAA/AM4/Micro	1-5 years[3)]
PCD2.M110/M120 hardware version >= H	CR 2032 lithium battery	1-3 years[3)]
PCD2.M150/M170/M480	CR 2032 lithium battery	1-3 years[3)]

1) The PCD1.M110 has no hardware clock, so the buffer time is greater than it is for the PCD1.M120

2) The total load time of the PCD1.M110, PCD1.M120 and PCD1.M125 amounts to approx. 30 minutes

3) Depending on the ambient temperature; the higher the temperature, the shorter the buffer time

With new controllers, the batteries are packaged with the units, and have to be inserted on comissioning. Observe the polarity of the batteries:

- for alkaline batteries, the polarity can be seen on the socket
- insert CR 2032 coin cell in such a way that the Plus pole is visible

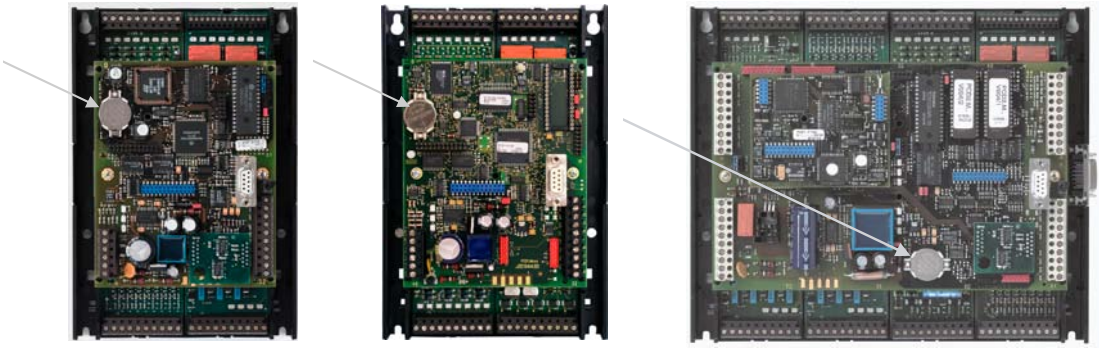
CPUs with alkaline or lithium batteries are not maintenance-free. The battery voltage is monitored by the CPU. The BATT LED lights up and XOB 2 is called if:

- the battery voltage is below 2.4 V or above 3.5 V
- the battery is flat or shows an interrupt
- the battery is missing

We recommend changing the batteries with the PCD attached to the power supply, to avoid any loss of data.

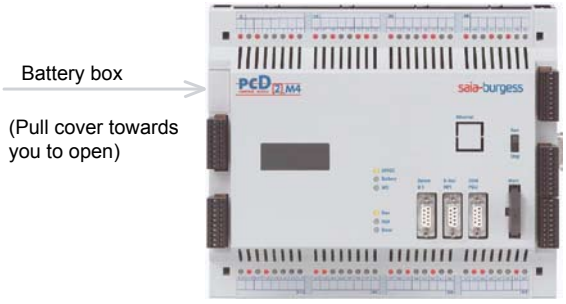
The batteries are easy to locate on all CPU types.

PCD1.M130: PCD1.M135: PCD2.M110/120/150:



On the PCD2.M170 and M480 the whole cover does not have to be removed; it is sufficient to open the battery compartment on the side to gain access to the battery.

PCD2.M170/480:



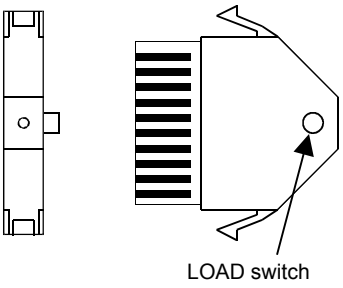
3.15 Backup of the user program (flash card for PCD2.M170/M480)

3.15.1 General

The PCD2.M170 and PCD2.M480 are equipped with 1 MByte of RAM as standard and can be fitted with an optional PCD7.R400 flash card. The flash card makes it possible to save a failsafe copy of the application after downloading (code, text/DBs and extension memory).

We recommend fitting all PCD2.M170 and M480 units with the flash card, to avoid any accidental loss of data.

Even with backup to the flash card, the source files for the project must be retained, as the application is only stored in the PCD as machine code.



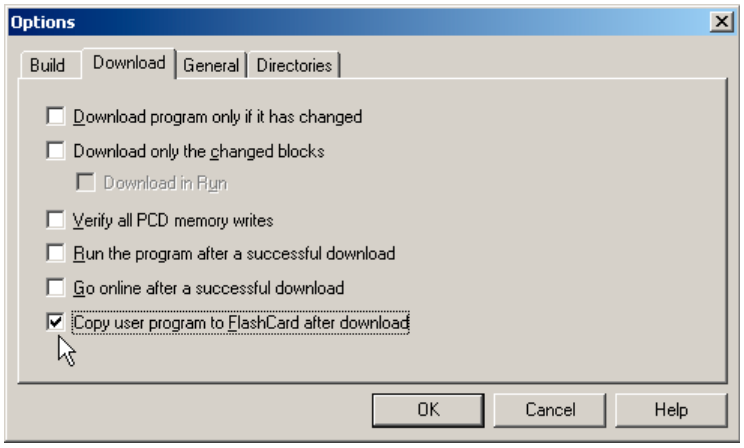
It is also possible to use the flash card to transfer applications from one controller to another, and to create a backup of RAM texts and DBs in extension memory (address ≥ 4000) while the controller is in operation.

The flash card must not be plugged in or removed while the unit is switched on.

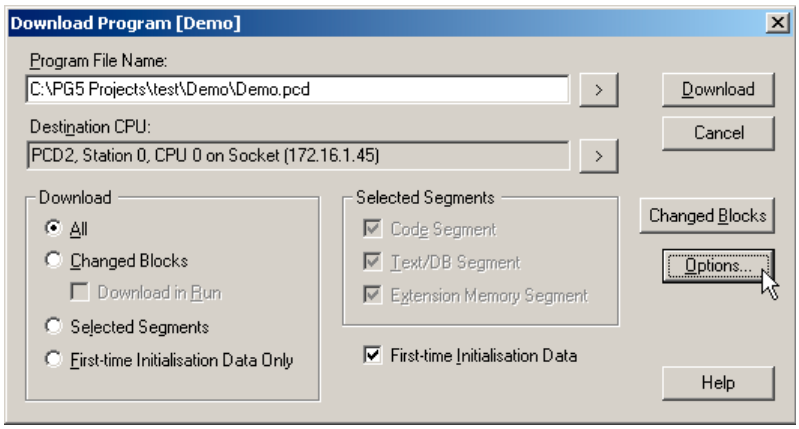
If it transpires when the PCD2.M170/M480 is started up that one of the RAM memories has been corrupted (e.g. after a power outage with a flat or missing battery), the application is automatically copied to the PCD.

3.15.2 Copying the application to the flash card (backup)

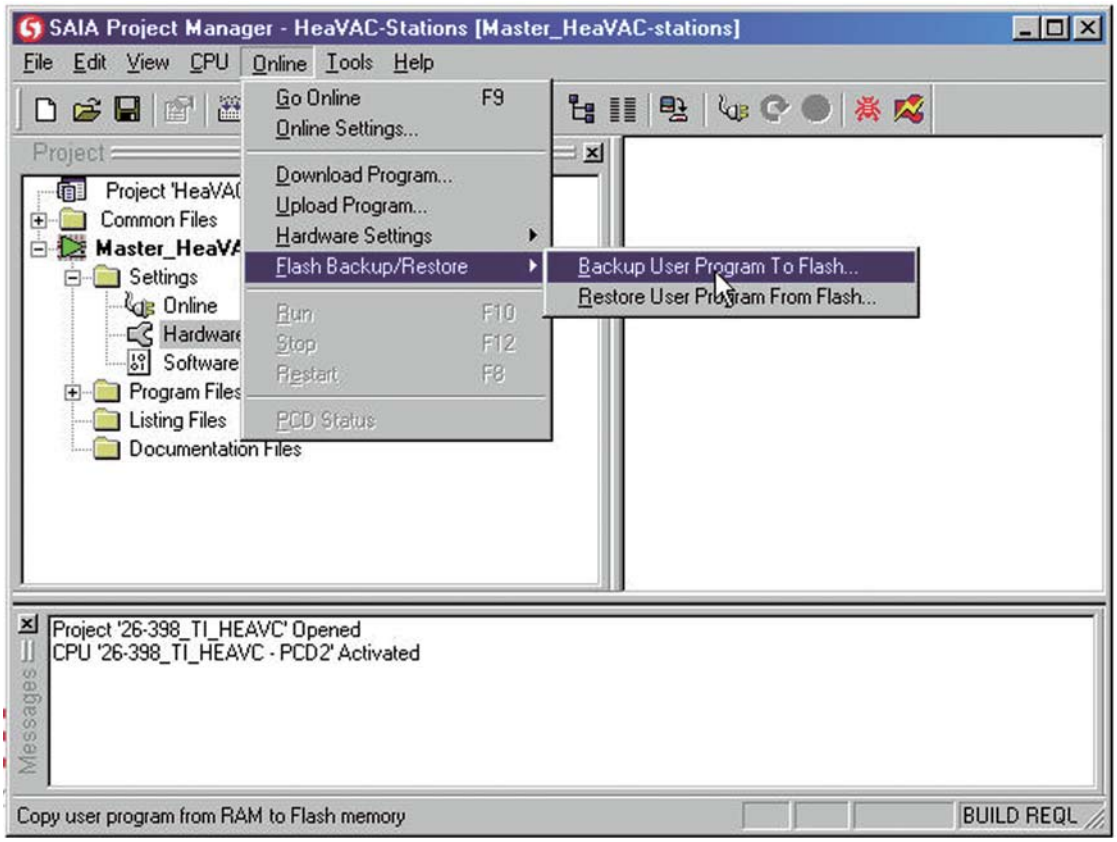
In PG5, an option can be set so that the complete user program (code, text strings/ DBs and extension memory) is copied to the flash card after every download. This can be found in the Project Manager, under Tools, Options, Download:



The same option window can be called up when downloading, as follows:



It is also possible to copy the application to the flash card independently of any download, or conversely, to copy the application from the flash card to the PCD. The relevant menu options can be found under Online, Flash Card:



Before copying, the controller must be moved into the STOP state; where applicable, an appropriate reminder will be displayed. The copying process may take up to 30 seconds.

3.15.3 Transferring an application

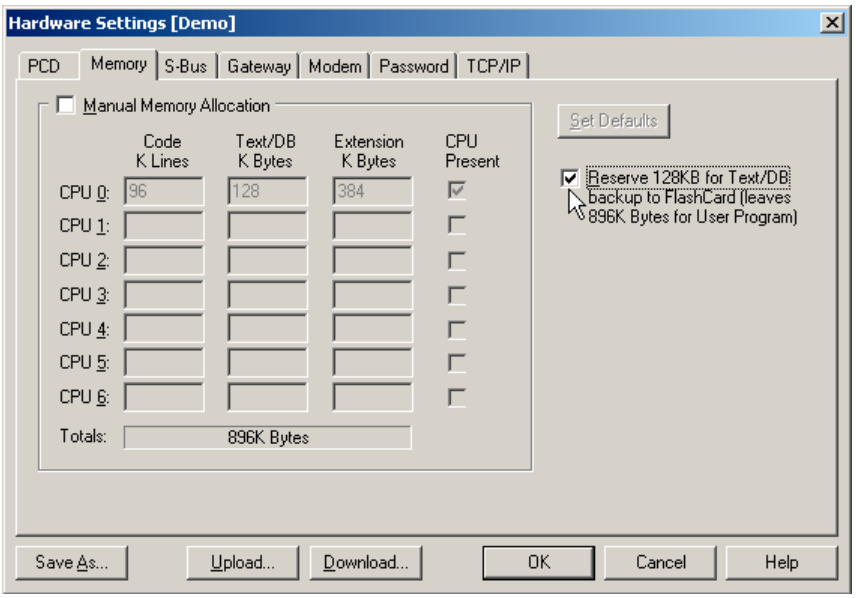
With the flash card, it is possible to transfer an application from a PCD2.M170/M480 to another controller of the same type:

- On the source controller,copy the application to the flash card as described in the preceding sections
- Remove the supply to the source controller, and unplug the flash card
- Send off the flash card where applicable
- Ensure that there is no supply voltage to the target controller, then plug in the flash card
- Switch on the supply to the target controller, then hold down the LOAD switch on the flash card for at least three seconds; this can be done at any time
- Wait until the controller has restarted

3.15.4 Backup/restore of RAM texts/DBs at run-time

As described above, the application can be copied to the flash card after downloading. In order to store process data gathered during operation, there is a facility to copy texts or DBs from extension memory (address >= 4000) to the flash card, or conversely, to copy the last state written to the flash card back in the text/DB in extension memory. A maximum of 64 Kbytes are available for this.

In order to use this function, the option shown below must be activated in the hardware configuration and the configuration must be loaded into the controller.



This leaves only 896 Kbytes available for the whole application (code, texts/DBs and extension memory).

For storing texts/DBs on the flash card, restoring, deleting and running diagnostics, there are four SYSRD/SYSWR instructions provided, as described in detail below; these can be invoked at a suitable place in the user program. These instructions must be used with great care, to prevent any damage to the unit or the flash card.

Storing a text/DB on the flash card, SYSWR K 9000

Instruction:

SYSWR	**K 9000**[1)]	
	K number	; address of the texts/DBs as ; K constant or in a ; register, existing text/DB addresses in ; the range >= 4000 may be used

1) Alternatively, the value 9000 can be passed in a register. On the PCD3, the instruction SYSWR K 3000 is used for the same function. For reasons of compatibility, SYSWR K 3000 can also be used on the PCD1/2, but this alternative was only integrated into the firmware in the 2nd half of 2004

Accu status after execution:

low:	the text/DB has been saved, and the flash card is ready for new SYSWR instructions
high:	the last instruction was not processed to completion; before further SYSWR K 900x instructions, a SYSRD K 9000 must be executed to check the readiness of the flash card

When using the instruction SYSWR K 9000, note the following:

- The flash card can be written to a maximum of 100'000 times, so it is not permissible to invoke the instruction in a cyclical manner or at short intervals
- A SYSRD K 9000 must be executed before this instruction, to test whether the flash card is available and ready
- the processing time for the instruction may be up to 100 ms. At that point, there is no guarantee that all of the text/DB has been written (the process will continue in background). For this reason, the instruction must not be invoked in XOB 0 (XOB for a power outage) or during time-critical processes
- if errors occur during processing, e.g. because no flash card is plugged in, XOB 13 will be invoked (where present), or the Error LED will be set
- when starting the PCD after a loss of RAM memory, the state of the texts/DBs after the last download is restored, even where the SYSWR K 9000 instruction has been used to store newer versions.
- Within the maximum number of write cycles, a text/DB can be stored any number of times, without the flash card becoming over-full.

Restoring a text/DB, SYSWR K 9001

Instruction:

SYSWR	**K 9001**[1)]	
	K number	; address of the texts/DBs as ; K constant or in a ; register, existing text/DB addresses in ; the range >= 4000 mAy be used

1) Alternatively, the value 9001 can be passed in a register. On the PCD3, the instruction SYSWR K 3001 is used for the same function. For reasons of compatibility, SYSWR K 3001 can also be used on the PCD1/2, but this alternative was only integrated into the firmware in the 2nd half of 2004

Accu status after execution:

low:	the text/DB has been restored and the process is complete, so further SYSWR K 900x instructions can be executed immediately
high:	the last instruction has not yet processed to completion; before further SYSWR K 900x instructions, a SYSRD K 9000 must be executed to check the readiness of the flash card

When using the instruction SYSWR K 9001, note the following:

- A SYSRD K 9000 must be executed before this instruction, to test whether the flash card is available and ready
- If errors occur during processing, e.g. because no flash card is plugged in, XOB 13 will be invoked (where present), or the Error LED will be set

Deleting stored texts/DBs on the flash card, SYSWR K 9002

Instruction:

SYSWR	**K 9002**[1)]	
	K 0	; Dummy parameter, required to ; maintain the structure of the SYSWR ; instruction

1) Alternatively, the value 9002 can be passed in a register. On the PCD3, the instruction SYSWR K 3002 is used for the same function. For reasons of compatibility, SYSWR K 3002 can also be used on the PCD1/2, but this alternative was only integrated into the firmware in the 2nd half of 2004

Accu status after execution:

low:	The text strings/DBs have been deleted and the process is complete, so further SYSWR K 900x instructions can be executed immediately
high:	The last instruction has not yet processed to completion; before further SYSWR K 900x instructions, a SYSRD K 9000 must be executed to check the readiness of the flash card

When using the instruction SYSWR K 9002, note the following:

- The deletion only affects text/DBs previously stored with SYSWR K 9000. The contents of the extension memory stored after a download are retained
- A SYSRD K 9000 must be executed before this instruction, to test whether the flash card is available and ready
- The processing time for the instruction may be several 100 ms. For this reason, the instruction must not be invoked in XOB 0 (XOB for a power outage) or during time-critical processes
- If errors occur during processing, e.g. because no flash card is plugged in, XOB 13 will be invoked (where present), or the Error LED will be set

Diagnostics on the flash card, SYSRD K 9000

Instruction:

SYSRD	**K 9000**[1)]	
	R_Diag	; Diagnostics register

1) Alternatively, the value 9000 can be passed in a register. On the PCD3, the instruction SYSRD K 3000 is used for the same function. For reasons of compatibility, SYSRD K 3000 can also be used on the PCD1/2, but this alternative was only integrated into the firmware in the 2nd half of 2004

Accu status after execution:

low:	The flash card is ready, and SYSWR 900x instructions can be executed
high:	The Flash card is not available or not ready; the diagnostic register must be retrieved and the process retried later

When using the instruction SYSRD K 9000, note the following:

- If errors occur during processing, e.g. because no flash card is plugged in, XOB 13 will be invoked (where present), or the Error LED will be set

Specification of diagnostic register		
Bit	**Description (if high)**	**Cause**
0 (LSB)	No flash card	
1	Header not configured	No application on the flash card
2	No SYSWR access to flash card	The corresponding option has not been activated in the hardware configuration (reserved for text/DB etc.)
3	DB/text not present	In the last instruction, an incorrect DB/text number was used as a parameter
4	DB/text format invalid	The length of the DB or the text has been changed
5	Restored	Text/DB on the flash card has been restored, as an error occurred
6	Memory full	Too many texts/DBs, no more free memory space available
7	Already in progress	The last SYSWR 900x instruction had not yet been fully processed when the next was started
8…31	Spare	

3.16 Hardware clock (Real Time Clock)

Most PCD1/PCD2 CPUs are fitted with a hardware clock:

CPU type	Where is the hardware clock?
PCD1.M110	Not present, and cannot be fitted
PCD1.M120/M130	On the motherboard
PCD1.M125/M135	On the motherboard
PCD2.M110/M120 hardware version < H	On the optional PCD2.F5x0 Modules with hardware version A (while stocks last)
PCD2.M110/M120 hardware version >= H	On the motherboard. Old PCD2.W5x0 Modules can also be fitted with a hardware clock; in all cases, the clock on the motherboard is used
PCD2.M150/M170/M480	On the motherboard

The presence of a hardware clock is an absolute requirement where the HeaVAC library clock timers are used.

3.16.1 Clock module PCD2.F500 (obsolete, PCD2.M110/M120 only)

On the PCD2.M110/M120 with hardware version < H, a PCD2.F5x0 Module with hardware clock (hardware version A) could be fitted where necessary.

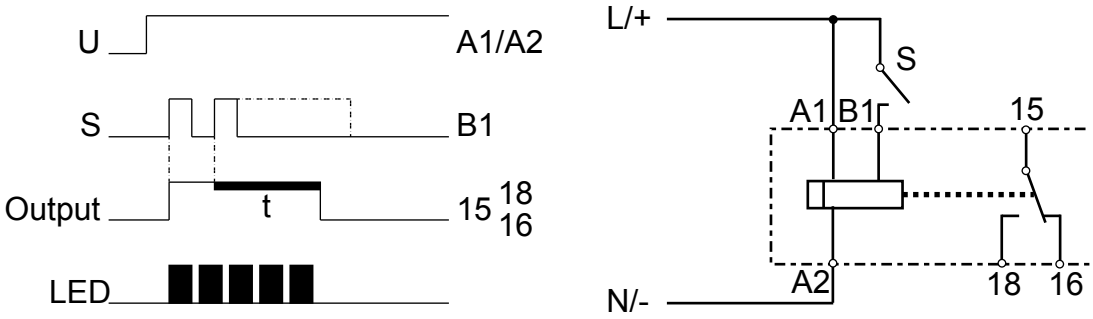
The PCD2.F500 is a clock module without serial ports for socket B and allows a hardware clock to be added to old controllers. It is no longer obtainable.

3.17 Monitoring the CPU (watchdog)

The watchdog monitoring unit can be used to monitor the correct processing of the user program with a high level of reliability; in the event of errors, effective safety measures can be triggered, e.g. to switch off parts of the installation.

3.17.1 PCD1 hardware watchdog

On the PCD1, this can be achieved with an external time relay (Saia KOP128j) with a timing range of 1 second. The time relay has a retriggerable drop-out delay; the B1 input to the time relay is connected to an output from the PCD1 (e.g. to an output from a PCD2.A400 card) .



In PCD user programs, the output is set to flashing.

Example:

```
COB   0          ; or 1…15
      0
ACC   H          ;Invert output 64
COM   O 64
:     :
:     :
ECOB
```

With the code shown in the example, the watchdog drops out in the case of loops caused by the programmer. With regard to the cycle time of the user program, please note:

- With very short cycle times, the time relay may not be able to detect the pulse reliably
- With very long cycle times, either the code sequence must be repeated several times in the user program, or the drop-out time for the time relay must be set to a longer interval, to prevent drop-out of the watchdog in normal operation.

3.17.2 PCD2 hardware watchdog

PCD2 CPUs are fitted with a hardware watchdog as standard. A relay at I/O address 255 can be triggered; this remains activated as long as the status of O 255 changes periodically at least every 200 ms. Within PG5, FBoxes are provided for this purpose.

If for any reason the program component with the watchdog FBox is no longer being processed at sufficiently short intervals, the watchdog relay will drop out and the yellow watchdog LED will go out. Please read online help for more details on these FBoxes.

The same function can also be implemented with IL (AWL) instructions. There are various ways of doing this:

Example:

```
COB   0           ; or 1…15
      0
STL   WD_Flag     ;Invert help flag
OUT   WD_Flag
OUT   O 255       ;Set output 255 to flashing
:     :
:     :
ECOB
```

With the code shown in example, the watchdog drops out in the case of loops caused by the programmer. With regard to the cycle time of the user program, please note:

- With cycle times of more than 200 ms, the code sequence must be repeated several times in the user program, to prevent a drop-out of the watchdog in normal operation.

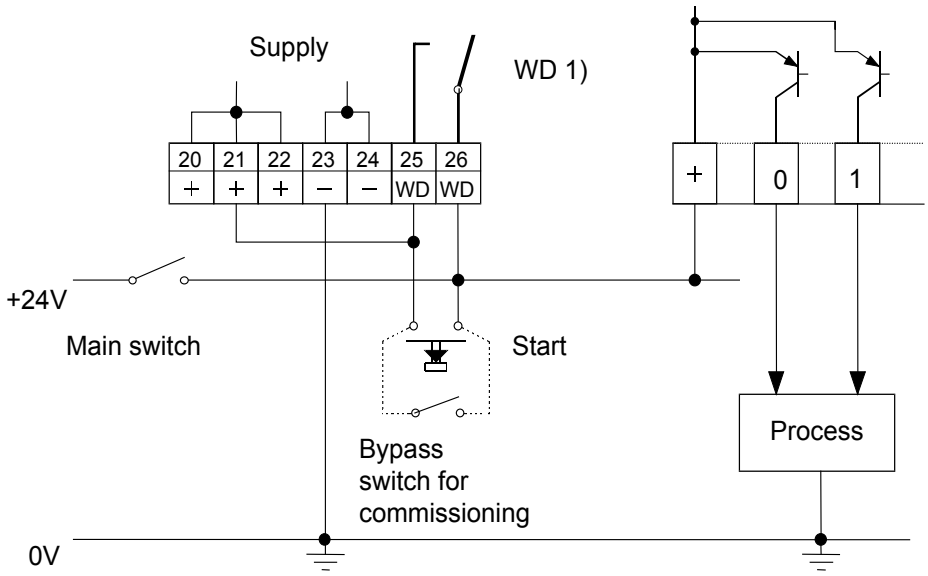
As address 255 is in the normal I/O range, there are restrictions on the permissible I/O modules in certain sockets:

CPU type	Restrictions
PCD2.M110	none
PCD2.M120/M150	1) No analogue, counter and motion control modules on the socket with base address 240 2) Output 255 cannot be used for digital I/O modules either
PCD2.M170	1) No analogue, counter and motion control modules on the sockets with base addresses 240 and 496 2) Outputs 255 and 511 cannot be used for digital I/O modules either
PCD2.M480	1) No analogue, counter and motion control modules on the socket with base address 240 2) Output 255 cannot be used for digital I/O modules either

The status of the watchdog is displayed by the yellow "WD" LED:

- LED lit up: Relay closed
- LED not lit up: Relay dropped out

Watchdog - connection diagram



1) Switching capacity of the watchdog contact: 1 A, 48 VAC/DC

3.17.3 Software watchdog for PCD1 and PCD2

The hardware watchdog provides maximum security. However, for non-critical applications, a software watchdog may be sufficient, whereby the processor monitors itself and the CPU is restarted in the event of a malfunction or a loop.

The core of the software watchdog is the instruction SYSWR K 1000. When this is first issued, the software watchdog function is activated. This instruction must then be issued at least every 200 ms, or the watchdog will trigger and restart the controller.

Instruction:

SYSWR	**K 1000**	; Software watchdog instruction	
	R/K x	; Parameters as per table below ; K constant or value in ; register	
x = 0	The software watchdog is deactivated		
x = 1	The software watchdog is activated; if the instruction is not repeated within 200 ms, there is a cold start		
x = 2	The software watchdog is activated; if the command is not repeated within 200 ms, XOB 0 will be called, followed by a cold start. XOB 0 calls are entered in the PCD history as follows:		
	“XOB 0 WDOG START”	where XOB 0 has been invoked by the software watchdog	
	“XOB 0 START EXEC”	where XOB 0 has been invoked because of a supply fault	

In order to use the software watchdog, the following minimum firmware versions are required:

CPU type	Minimum firmware version
PCD1.M1x0	001
PCD1.M1x5	001
PCD2.M110/120	080
PCD2.M150	0B0
PCD2.M170	010
PCD2.M480	010

PCD2.M480: The status of the watchdog relay can be read via I 8107

"1" = watchdog relay on

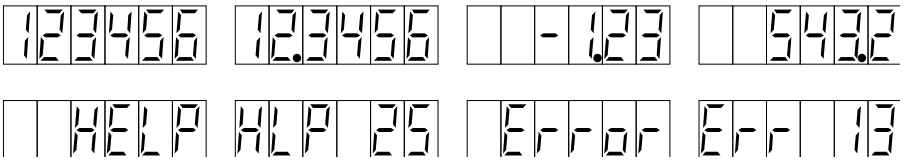
3.18 Internal LED displays and small terminals

Outputs / communication interfaces can be used to connect external displays and terminals to all PCD CPUs. On the PCD1 and PCD2, it is also possible to attach such a user interface directly to the CPU.

3.18.1 PCD2.F510 7-segment LED display (PCD2.M110/M120/M150 only)

The display consists of six 7-segment LED digits with decimal points, and is mounted on socket B. It is visible from outside through the window in the cover. The DSP instruction can be used to display the figures 0…9 and various other characters:

Examples:



This integrated display can be easily used to show process states, error numbers, step numbers, dates and times, update information etc. By alternating the display or setting switches on inputs, several pieces of information can be displayed.

In the Fupla standard library, two FBoxes are provided under "Display", allowing convenient access to the display.

The following programming rules apply for IL programming:

The display has three modes:

Mode	Properties
6-digit	The whole display is used to show a number (e.g. 123456) or one of the standard text strings (e.g. Error or HELP)
2-digit	The first four digits have been defined with a previous instruction (text, e.g. Err), and the last two digits can now be used to display a number
Free mode	Within the limitations of the 7-segment display, any character string can be displayed

The content of the display is managed with a DSP instruction. DSP instructions may be used with a constant (e.g. DSP K 0) or a register (e.g DSP R 0) as a parameter.

The effect of the DSP K x instructions is independent of the mode in which they are invoked, but many of them do affect the mode:

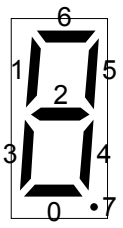
In-struc-tion		**Display**	**Mode after instruction**
DSP	K 0	The whole display is cleared and set to 6-digit mode	6-digit
DSP	K 1	Ξ S A I A Ξ	6-digit
DSP	K 2	Ξ P C D 2 Ξ	6-digit
DSP	K 3	H E L P	6-digit
DSP	K 4[1)]	H L P n n	2-digit
DSP	K 5	E r r o r	6-digit
DSP	K 6[1)]	E r r n n	2-digit
DSP	K 7[2)]	The display is cleared and leading zeros are displayed from the next DSP R x instruction	6-digit
DSP	K 8[2)]	The display is cleared and the output restricted to 2 digits	2-digit
DSP	K 10[2)]	Places the decimal point at digit no. 0 (far right, cleared with DSP K 0)	no change
DSP	K 11[2)]	Places the decimal point at digit no. 1 (cleared with DSP K 0)	no change
DSP	K 12[2)]	In 6-digit mode, places the decimal point at digit no. 2 (cleared with DSP K 0)	no change
DSP	K 13[2)]	In 6-digit mode, places the decimal point at digit no. 3 (cleared with DSP K 0)	no change
DSP	K 14[2)]	In 6-digit mode, places the decimal point at digit no. 4 (cleared with DSP K 0)	no change
DSP	K 15[2)]	In 6-digit mode, places the decimal point at digit no. 5 (far left, cleared with DSP K 0)	no change
DSP	K 20[3)]	Switch to free mode	Free mode
DSP	K 21[3)]	In free mode, all segments are moved one place to the left, a blank digit is inserted, and the previously leftmost digit is lost	Free mode
DSP	K 22[3)]	Switch to free mode in 2-digit mode	2-digit

1) These instructions must be followed by a second DSP instruction in the format: DSP R x ; x = 0.. 4095. The register value must be 0.. 99. If the value is outside this range, nothing will be displayed and the error flag will be set

2) On the PCD2.M110/M120, available from firmware version 002 only

3) On the PCD2.M110/M120, available from firmware version 003 only

The effect of the DSP R x instruction is dependent on the mode of the 7-segment display:

Mode	Content of R x	Effect of DSP R x instruction	
6-digit	- 99,999 to +999,999 outside this range	The value in the register is displayed right-justified. Only integer values in decimal format can be displayed no display; the error flag is set	
2-digit	0 to 99 outside this range	The value is displayed in the two rightmost digits. The four digits to the left of these are unchanged No display; the error flag is set	
Free mode	0 to 11111111 binary or 0 to 255 decimal	The segments of the rightmost digit are set according to the following layout: (Bit 0 = lowest value bit) Example: R x is binary 01110101; a 3 is displayed with no decimal point	

3.18.2 PCD2.F530 7-Segment LED display (PCD2.M120/M150 only)

This module combines the 7-segment display of a PCD2.F510 (please refer to the preceding section) and the two serial ports of a PCD2.F520 (details in section 3).

3.18.3 PCD7.D16x Small terminal kits

The PCD1 and PCD2 CPUs can be fitted with a small terminal, mounted in the cover:

There are 4 × 16 characters available, and the dialogue can be conveniently created in the HMI Editor. The HMI Editor is an integral part of the PG5 software.

The terminal communicates with the CPU via a communication module, which occupies socket B or B1. The following variants are available:

Kit	Communication module, additional interfaces	Suitable for
PCD7.D162	PCD2.F540[1)] **No additional interfaces**; the terminal occupies Port 2	PCD1.M1xx PCD2.Mxx0
PCD7.D163	PCD2.F550[1)] **One additional RS 485 / RS 422 interface** (occupies Port 3[2)]), the terminal occupies Port 2	PCD2.M120/M150/M170/M480
PCD7.D164	PCD7.F774[1)] **Profibus DP Slave**[3)] **and an additional RS 485 / RS 422 interface** (occupies Port 3[2)]); the terminal occupies Port 2	PCD1.M13x PCD2.M120/M150/M170
PCD7.D165	PCD7.F804[1)] **LON interface**[4)] **and an additional RS 485 / RS 422 interface** (occupies Port 3[2)]); the terminal occupies Port 2	PCD1.M13x PCD2.M120/M150/M170

1) Only obtainable as part of the PCD7.D16x kit
2) The connection is identical to Port 3 on a PCD2.F520; please refer to section 4 for more details
3) For Profibus DP, minimum hardware and firmware versions are required; please refer to the Profibus DP manual 26/765
4) For LON, minimum hardware and firmware versions are required; please refer to the LON manual 26/767

We recommend ordering the PCD7.D16x kits mounted on the CPUs. Mounting later is possible, but requires:

PCD1: replacing the cover, item-no. 4 104 7338 0

PCD2: removing the red viewing window and drilling 4 mounting holes; the position of the holes can be seen on the inside of the cover

3.19 Interrupt inputs

3.19.1 Basics

Because of the input filters and the effect of the cycle time, the digital input modules are not suitable for immediate reaction to events or for rapid counting processes. Some CPUs have interrupt inputs for this purpose.

When a positive edge is detected at the interrupt input, an associated XOB is called (e.g. XOB 20). The code in this XOB defines how the unit should react to the event, e.g. by incrementing a counter.

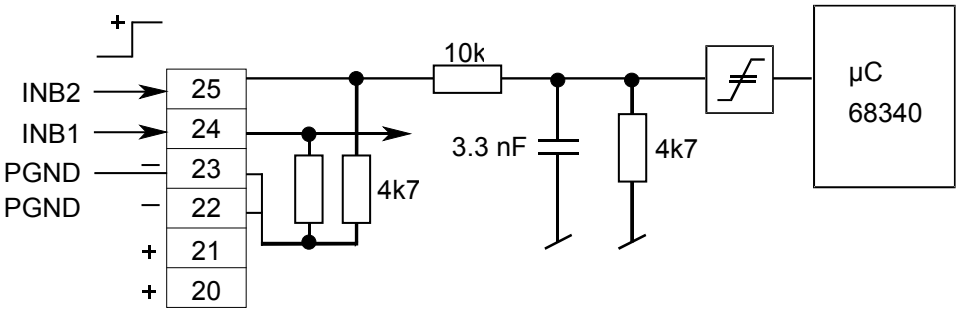
The code in XOBs called from interrupt inputs must be kept as brief as possible to allow enough time between the interrupts to process the rest of the user program.

Many FBoxes are intended for cyclic invocation and so not suitable for use in XOBs, or only in a limited way.
Exception: the FBoxes in the Graftec family (standard library) are well suited

3.19.2 PCD1.M120/M130 and PCD1.M125/M135

The two interrupt inputs are located on the motherboard and can be connected via the 6-pole, plug-in terminal block (terminals 20 to 25). Source operation is always used.

When a positive edge is detected at input **INB1, XOB 20** is called; a positive edge at input **INB2** causes **XOB 25** to be called. The reaction time up to the XOB 20/25 call is a maximum of 1 ms. The code in this XOB defines how the unit should react to the event, e.g. by incrementing a counter (input frequency max. 1 kHz where pulse/pause each 50%, total of the two frequencies max. 1 kHz). If the relevant XOB is not programmed, the ERROR LED is switched on or XOB 0 is called.



Input signals: (always source operation with PCD1.M12x and PCD1.M13x):

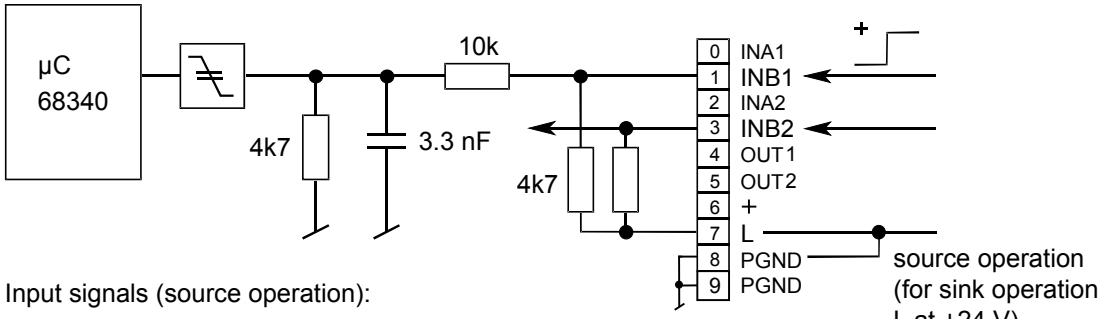
H = 15.. 30 V
L = -30..+5 V or no connected

3.19.3 PCD2.M120/M150/M170

The two interrupt inputs are located on the motherboard and can be connected via the 10-pole, plug-in terminal block (terminals 0 to 9). Either source or sink operation may be used.

Function in source and sink operation:

When a positive edge is detected at input **INB1, XOB 20** is called; a positive edge at input **INB2** causes **XOB 25** to be called. The reaction time up to the XOB 20/25 call is a maximum of 1 ms. The code in these XOBs defines how the unit should react to the event, e.g. by incrementing a counter (input frequency max. 1 kHz where pulse/pause each 50 %, total of the two frequencies max. 1 kHz).If the relevant XOB is not programmed, the ERROR LED is switched on or XOB 0 is called.



Input signals (source operation):
H = 15.. 30 V
L = -30.. + 5 V or no connected

Input signals (sink operation):
H = 15 .. 30 V or no connected
L = -30.. + 5 V

The INA1, INA2, OUT1, OUT2 and + connections are intended for future enhancements and must not be used.

3.19.4 PCD2.M480

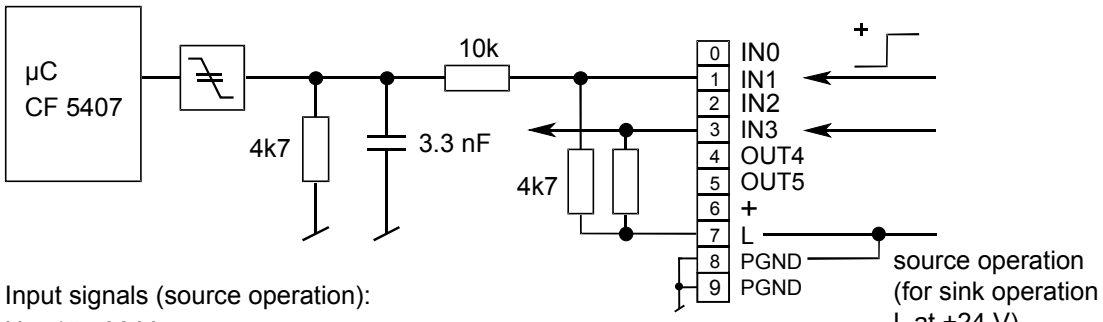
The four interrupt inputs are located on the motherboard and can be connected via the 10-pole, plug-in terminal block (terminals 0 to 9). Either source or sink operation may be used.

Function in source and sink operation:

Each interrupt input is mapped to an XOB that will be called when there is a positive edge at the input. The code in these XOBs defines how the unit should react to the event, e.g. by incrementing a counter (input frequency max.
1 kHz where pulse/pause each 50 %). The reaction time up to the XOB 20…23 call is a maximum of 1 ms.

If the relevant XOBs are not programmed, the interrupt inputs can be used in the user program like normal inputs from address 8100 upwards.

Interrupt input	XOB called in case of a positive edge	Input where the relevant XOB is not programmed
IN0	XOB 20	I 8100
IN1	XOB 21	I 8101
IN2	XOB 22	I 8102
IN3	XOB 23	I 8103



Input signals (source operation):
H = 15.. 30 V
L = -30.. + 5 V or no connected

Input signals (sink operation):
H = 15 .. 30 V or no connected
L = -30.. + 5 V

Outputs OUT4 and OUT5 can be used as “normal”, short-circuit-proof transistor outputs with addresses O 8104 and O 8105, and each loaded up to 0.5 A.

Where the OUT4/OUT5 outputs are used, the + connection (terminal 6) must have a +24 V supply.

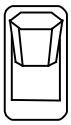
3.20 Run/Stop or Run/Halt switch (PCD2.M170/M480 only)

Traditionally, PCD controllers could only be reliably set to RUN or STOP mode from the PG3/4/5. With the PCD2.M170 and PCD2.M480 CPUs, it is also possible to influence the operating state with one of the switches accessible on the front.

On the PCD2.M170, the switch is labelled Run/Halt; on the PCD2.M480, it is labelled Run/Stop, in keeping with the practice for xx7 CPUs.

With both controllers, switching to STOP/HALT causes a change from RUN to HALT mode; switching to RUN causes a cold start to be executed.

As delivered from the factory, the Run/Stop or Run/Halt switch is deactivated; it can be activated with a jumper located right next to the switch:



Run

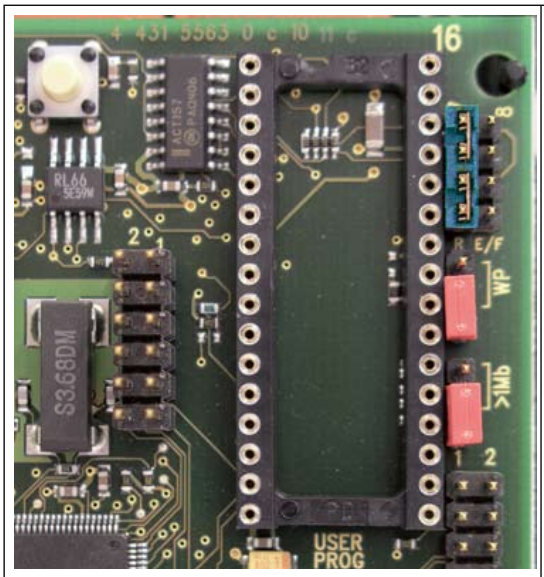
Stop/Halt

Switch
Enable

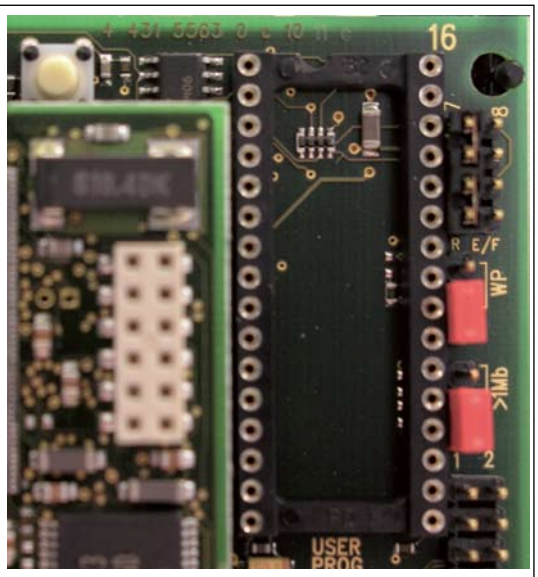
Only move jumpers with the supply switched off!

3.21 HALT switch on PCD1.M125 and PCD1.M135

Beside the IC socket for the user memory a switch is on the controllers PCD1.M125 and PCD1.M135. If this switch is pressed during starting the PCD controller, the controler goes not into the run mode, but remains in the HALT mode.



Localization without interface module on socket B



Localization with interface module on socket B

The PCD controller changes only after a cold start into the Run Mode. I.e. the supply of the control must be switched off/on for it, with not pressed switch.

3.21.1 HALT switch on PCD1.M125 and PCD1.M135 as input

The switch described above can be read in as entrance during normal operation. The cover of the PCD must removed and the switch must be read in over a SYSRD command for this manipulation. So, this switch is only to use for special functions (start-up, service…).

Instruction :

SYSRD	**K 8000**	
	R_Switch	; Diagnostic register

Description of the diagnostic register		
bit	**state**	**cause**
0 (LSB)	1 (high)	switch not pressed
	0 (low)	switch pressed

3.22 Storing data in EEPROM

On the PCD1/PCD2, an EEPROM is used to store configuration data. Part of this is available to the user to store 32-bit values (EEPROM register). These values are not lost even in the case of battery failure or an empty buffer capacitor.

On the PCD1 there are five EEPROM registers (addresses 2000 to 2004); on the PCD2 there are fifty (addresses 2000 to 2049). The EEPROM registers are independent of the "normal" registers with the same addresses.

The values are read with a SYSRD instruction and written with a SYSWR instruction:

Read:

SYSRD	**K x or R x** **R y**	; K x is the address of the EEPROM ; register in the range K 2000 to K 2004 ; for PCD1 CPUs, or K 2000 to K 2049 ; for PCD2 CPUs ; Alternatively, the address of a register ; can also be passed, containing the ; address of the EEPROM register (same ; ranges as for K constants)
		; R y is the target register

Write:

SYSWR	**K x or R x** **R y**	; K x is the address of the EEPROM ; register in the range K 2000 to K 2004 ; for PCD1 CPUs, or K 2000 to K 2049 ; for PCD2 CPUs ; Alternatively, the address of a register ; can also be passed, containing the ; address of the EEPROM register (same ; ranges as for K constants)
		; R y is the source register

When using the instruction SYSWR K 20xx, note the following:

- The EEPROM can be written to a maximum of 100,000 times, so it is not permissible to invoke the instruction in a cyclic manner or at short intervals
- The processing time for the instruction is approx. 20 ms. For this reason, the instruction must not be invoked in XOB 0 (XOB for a power outage) or during time-critical processes

In order to use the EEPROM register, the following minimum firmware versions are required:

CPU type	Minimum firmware version
PCD1.M1x0	001
PCD1.M1x5	001
PCD2.M110/120	004
PCD2.M150	0A0
PCD2.M170	010
PCD2.M480	010

3.23 Resetting the outputs on STOP or HALT (PCD2 only)

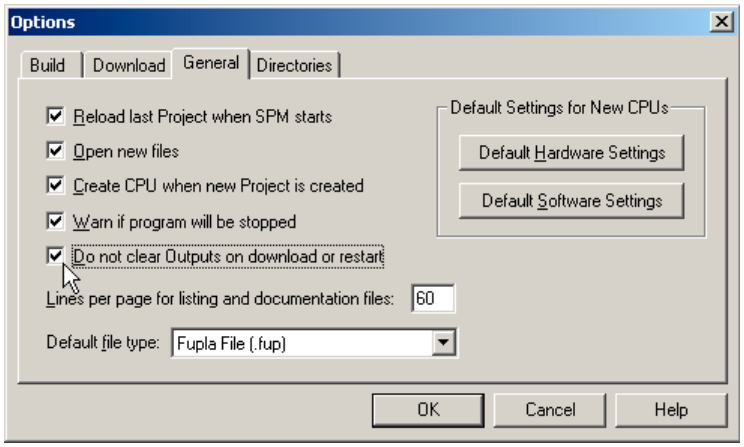
A jumper can be used to configure whether the outputs should all remain in their current state in a STOP or HALT state, or be reset.

The jumper in question is written to by RO or ROE (Reset Output Enable), and has two positions:

Position	Behaviour
RO/ROE	All outputs are reset in the STOP and HALT states
not RO/ ROE	The outputs remain unchanged in the STOP and HALT states (factory setting)

When the user program is downloaded with PG5, there is interaction between the PG5 options and those of the RO jumper:

The outputs are only retained if the jumper is in the “not RO” position **and** the “Do not clear Outputs on download or restart” option shown below is activated. In all other cases, the outputs are reset.



3.24 Presence/voltage monitoring for expansion unit (PCD2 only)

With all PCD2s except the PCD2.M110, it is possible to detect the presence of an expansion unit.

In conjunction with PCD3.C200 Modules it is also possible to recognize whether the closest C200 to the CPU is connected to the supply.

A jumper can be used to configure whether the monitoring is activated.

Position	Behaviour
XOB 1 ENABLE	Monitoring is switched on. In the following cases, XOB 1 is called: • no expansion unit is connected at start-up • at start-up, one of the PCD3.C200 units in the system is not on • during operation, the connection to the expansion unit(s) is lost • during operation, the supply to one of the PCD3.C200 units in the system fails
not XOB 1 ENABLE	Monitoring is switched off (factory setting)

The code in XOB 1 defines how the unit should react to the event. If it is called from the monitoring function, but has not been programmed, an entry will be written to history and the Error LED will be set.

4 PCD Classic communication interfaces

Saia® S-Net, the networking concept from Saia-Burgess Controls, is based on the RS 485, Profibus and Ethernet open standards. Ethernet covers layers 1 and 2 of the ISO layer model. Based on layer 2, a variety of different protocols and applications can be run in parallel on the same network.

For PCD2.M480 only:

Layer 2 (Field Data Link-FDL) from Profibus also allows parallel running of different application protocols such as DP, FMS and others. The use of this facility allows Profi S-Net to be used to create a “Private Control Network (PCN)”. This makes all Saia® units into active network components.

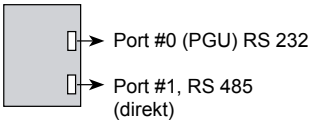
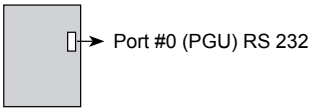
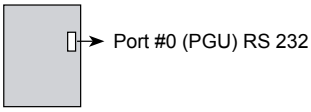
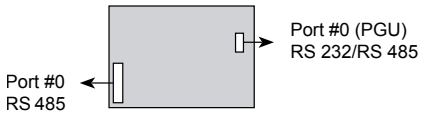
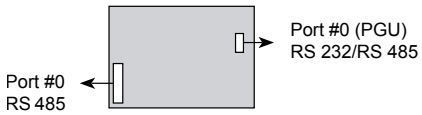
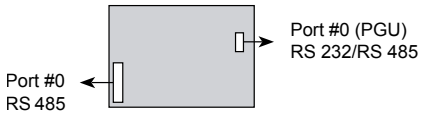
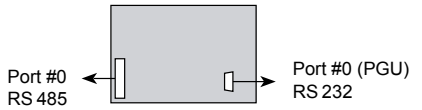
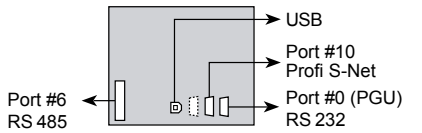
Profibus Layer 2 (FDL) is integrated into the operating system of the PCD2.M480 CPUs, giving these units a Profi S-Net connection with transmission speeds up to 1.5 Mbps.

These units support Profibus DP and S-Net on the same port. In this way, Profibus can be used to construct networks cheaply and flexibly (detailed notes can be found in TI 26/381).

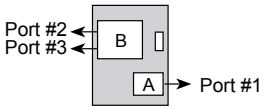
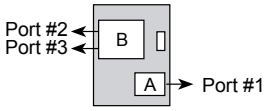
Transmission rates (Baud rates) of the PCD2.M480:

The controllers of the type PCD2.M480 have a new Saia® NT operating system. With the new operating system higher transmission rates (Saia® S-Bus up to 115 kBit/s) can be achieved, however low baud rates (300 and 600 Baud/sec.) are no more supported.

4.1 Summary of PCD1/PCD2 onboard interfaces

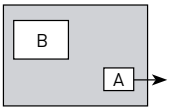
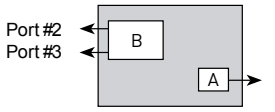
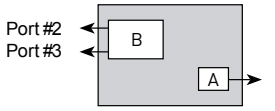
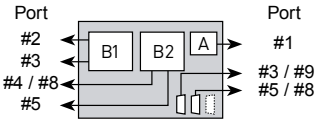
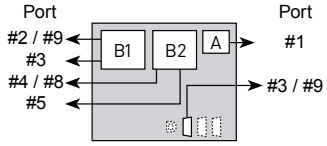
Base unit with onboard interfaces	Summary without plug-in communication modules					
	Port#	RS485	(PGU) RS232	(PGU) RS232/RS485	USB	Profi S-Net
PCD1.M110 	0	-	■	-	-	-
	1	■	-	-	-	-
PCD1.M120/M125 	0	-	■	-	-	-
PCD1.M130/M135 	0	-	■	-	-	-
PCD2.M110 	0	-	-	■	-	-
PCD2.M120 	0	-	-	■	-	-
PCD2.M150 	0	-	-	■	-	-
PCD2.M170 	0	-	-	■	-	-
PCD2.M480 	0	-	■	-	-	-
	6	■	-	-	-	-
	USB	-	-	-	■	-
	Profi S-Net	-	-	-	-	■

4.2 Summary of PCD1 plug-in interface modules

Base unit with sockets for plug-in communication modules	Summary of plug-in communication modules														
		Serial								Ethernet	Profibus				LON	
	Socket	PCD7.F110	PCD7.F120[1]	PCD7.F121[1]	PCD7.F130	PCD7.F150	PCD7.F180	PCD2.F520	PCD2.F522[1]	PCD7.F65x	PCD7.F700	PCD7.F750	PCD7.F770	PCD7.F772	PCD7.F800	PCD7.F802
PCD1.M110 	A	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	B	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
PCD1.M120/M125 	A	■	■	-	■	■	■	-	-	-	-	-	-	-	-	-
	B	-	-	-	-	-	-	-	-	-	-	■	■	-	■	-
PCD1.M130/M135 	A	■	■	-	■	■	■	-	-	-	-	-	-	-	-	-
	B	-	-	-	-	-	-	-	-	■[2]	-	■	■	-	■	-

1) Suitable for modem connection, as 6 control lines provided.
2) With special housing cover 4 104 7409 0 or as configured system with type-no. PCD1.M135F655

4.3 Summary of PCD2 plug-in interface modules

Base unit with sockets for plug-in communication modules	Summary of plug-in communication modules														
		Serial								Ethernet	Profibus				LON	
	Socket	PCD7.F110	PCD7.F120[1]	PCD7.F121[1]	PCD7.F130	PCD7.F150	PCD7.F180	PCD2.F520	PCD2.F522[1]	PCD7.F65x	PCD7.F700	PCD7.F750	PCD7.F770	PCD7.F772	PCD7.F800	PCD7.F802
PCD2.M110 	A	■	■	-	■	■	■	-	-	-	-	-	-	-	-	-
	B[5]	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
PCD2.M120 	A	■	■	-	■	■	■	-	-	-	-	-	-	-	-	-
	B	-	-	-	-	-	-	■	■	-	■	■	■	■	■	■
PCD2.M150 	A	■	■	-	■	■	■	-	-	-	-	-	-	-	-	-
	B	-	-	-	-	-	-	■	■	■[2]	■	■	■	■	■	■
PCD2.M170 	A	■	■	-	■	■	■	-	-	-	-	-	-	-	-	-
	B1	-	-	-	-	-	-	■	■	-	■	■[3]	■[3]	■[3]	■[3]	■[3]
	B2	-	-	-	-	-	-	■	■	■	-	■[3]	■[3]	■[3]	■[3]	■[3]
PCD2.M480 	A	■	■	■	■	■	■	-	-	-	-	-	-	-	-	-
	B1	-	-	-	-	-	-	■	■	■	-	■	-	-	-	-
	B2	-	-	-	-	-	-	■	■	■	-	■[4]	-	-	-	-

1) Suitable for modem connection, as 6 control lines provided
2) With special housing cover 4'104'7410'0 or as configured system with type-no. PCD2.M150F655
3) The following combinations are not possible: 2 x Profibus DP Slave/2 x LonWorks®
4) PCD7.F750 on PCD2.M480 socket B2 not recommended

4.4 Onboard interfaces

4.4.1 PGU connection (PORT#0, PCD1 and PCD2) (RS232) for connecting programming devices

The PGU interface (Port#0) is connected to a 9-pole D-Sub connector (female). The interface is used to connect the programming device when the unit is comissioned.

The interface is of type RS232c.

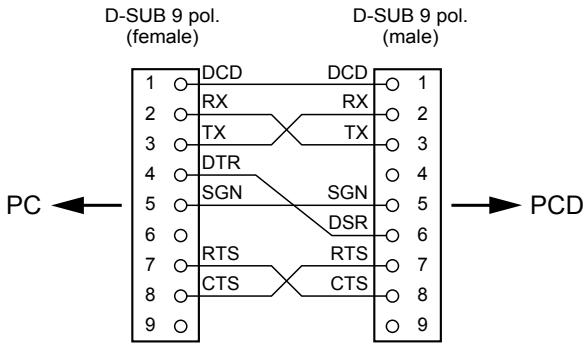
The pin configuration and associated signals are:

Pin	Designation	Meaning	
1	DCD	Data Carrier Detected	The equipment signals to the computer that it recognizes data on the line
2	RXD	Receive Data	Line for the receiving of data
3	TXD	Transmit Data	Line for outgoing (sent) data
4	n.c.	Not Connected	Not used
5	SGN	Signal Ground	Signal mass. Signal voltages are measured against this line
6	DSR	PGU Connected	Recognition PGU. Attached equipment signals to the computer that it is operational, if logical unity on this line lies close
7	RTS	Request To Send	Transmitters switch on. „send request“ (if this line on logically unity stands, would like to send the equipment data
8	CTS	Clear To Send	Ready-to-transmit-state. If this line stands on logically “high”, the equipment can receive data
9	+5 V	Supply P100	Supply for the programming unit P100

The PGU protocol is provided for operation with a programming device. The use of the PCD8.P800 service unit is supported from firmware version $301 for all PCD1/PCD2 controllers.

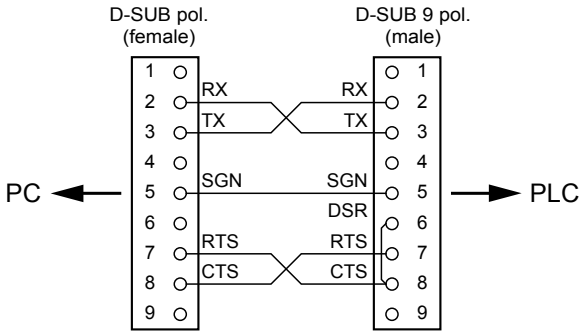
PCD8.K111 connecting cable

(P8 and S-Bus protocol, suitable for all PCD1/PCD2 units)



PCD8.K110 connection cable (obsolete)

(P8 protocol, suitable for PCD1.M110/120 and PCD2.M110/120 only)



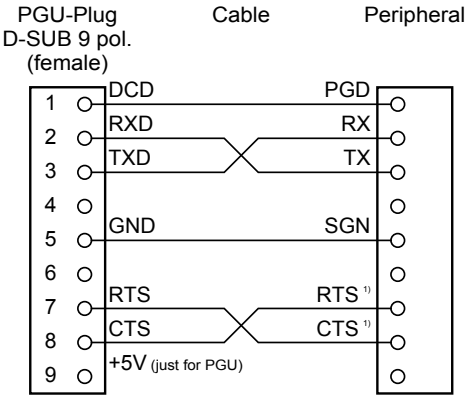
4.4.2 PGU connection (PORT#0, PCD1 and PCD2) (RS232) as communication interface

When comissioning/programming are complete, the port can be used for other purposes.

Option 1: Configuration with desired protocol
(S-Bus PGU configuration)

Option 2: Assignment (SASI) in the user program
(the port must not be configured as an S-Bus PGU port)

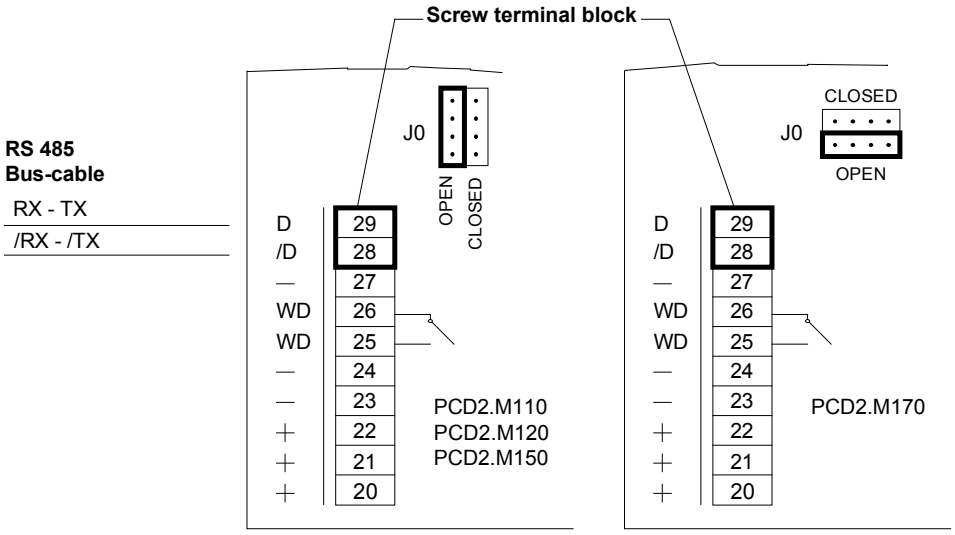
- If another programming device is connected during operation instead of the peripheral device, the unit will switch over automatically to PGU mode (pin 6 logical “1” (DSR); in PGU mode: DSR PING = “1”).
- Before using the port to connect another peripheral device, Port#0 must be reconfigured by means of an SASI instruction.



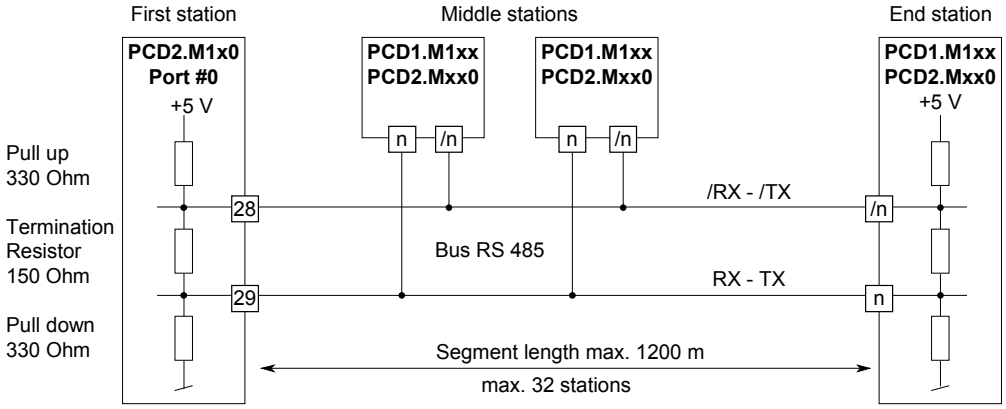
1) When communicating with terminals, check whether some connections are provided with bridges or need to be set to “H” or “L” with the “SOCL” instruction. It is generally recommended to use a handshake (RTS/CTS)

4.4.3 PGU connection (PORT#0, only on PCD2.M1x0) (RS485) as communication interface

If Port#0 is not used via the PGU connection (with the programming device or as an RS232 interface), it can be used via terminals 28 and 29 for an S-Bus or MC4 connection.



Choice of line termination resistors

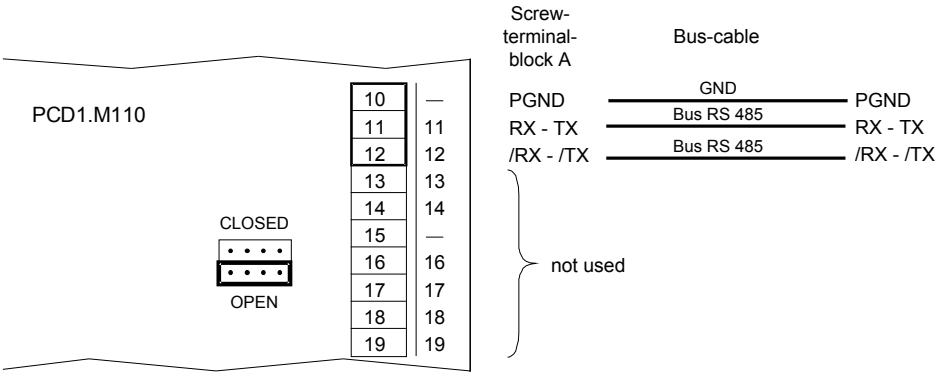


At the first and last stations, jumper J0 must be set to the “CLOSED“ position.

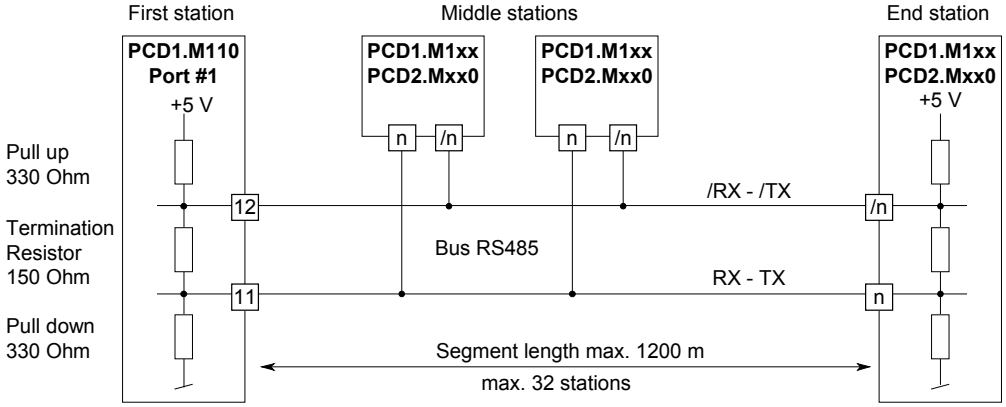
At all other stations, jumper J0 must be set to “OPEN” (factory setting).

4.4.4 RS485 communication interface PORT#1, only on PCD1.M110

On the PCD1.M110, on Port#1, is a built-in RS485 interface.



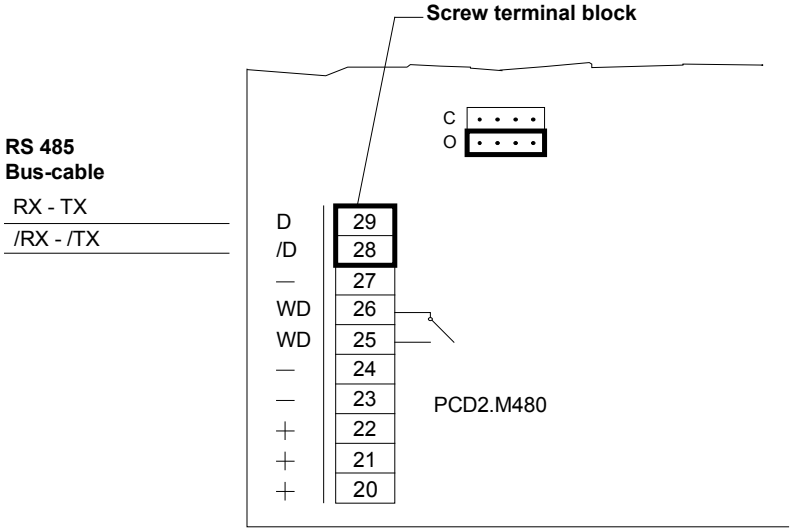
Choice of the termination resistors



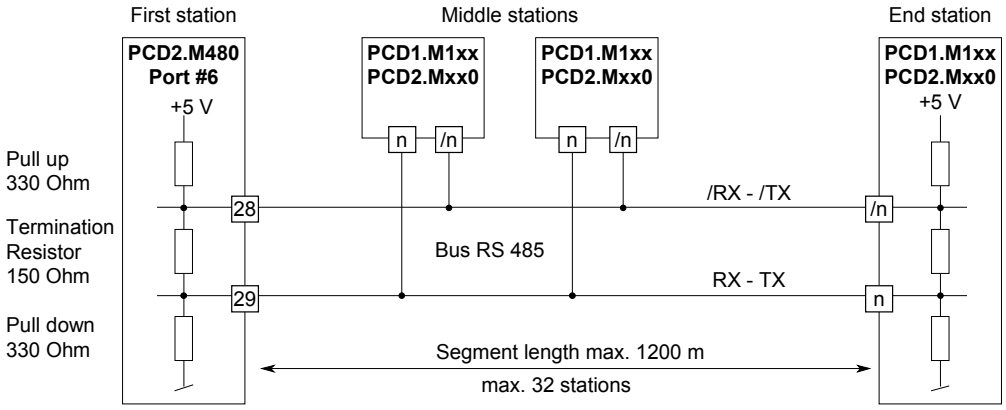
At the first and last stations, the jumper must be set to the “CLOSED“ position.
At all other stations, the jumper must be set to “OPEN” (factory setting).

4.4.5 RS485 communiaction interface PORT#6, only on PCD2.M480

On the PCD2.M480, on Port#6, is a built-in RS485 interface.



Choice of the termination resistors



At the first and last stations, the jumper must be set to the “C“ (closed) position.
At all other stations, the jumper must be set to “O” (open) position (factory setting).

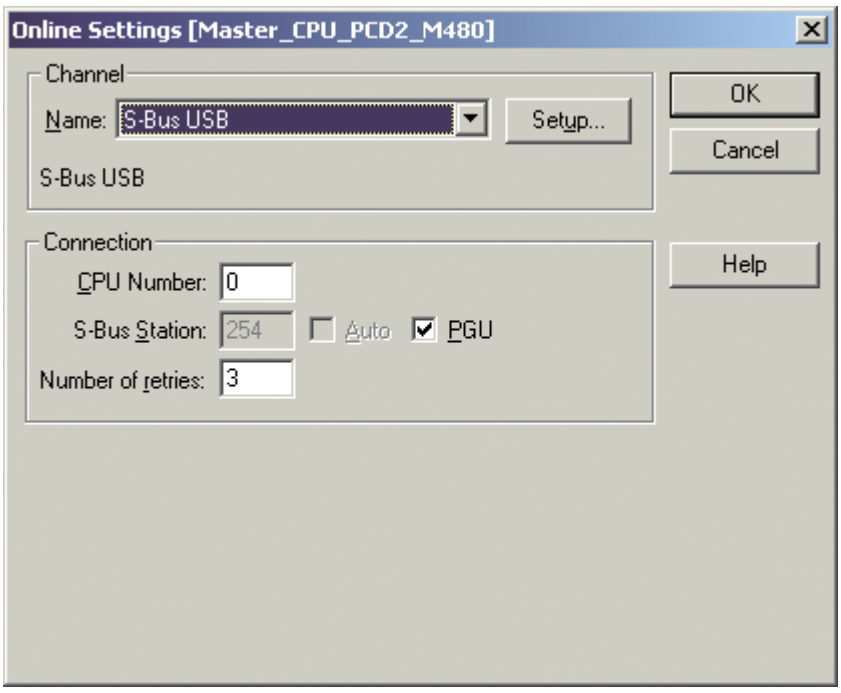
4.4.6 USB interface as PGU interface. on PCD2.M480

The USB interface can be used exclusively as PGU interface. Thus the PGU plug becomes free for other communication connections (RS 232).

In order to use the USB interface on the PCD2.M480, PG5 version 1.3.100 or later must be installed.

When the PCD2.M480 is first connected to a PC via the USB interface, the PC operating system automatically installs the appropriate USB driver.

To establish a connection with a PCD via USB, the following settings must be entered in the online settings for the PG5 project:



Activating the PGU option ensures that the PCD2.M480 connected directly to the PC can be reached, regardless of the S-Bus address that has been configured.

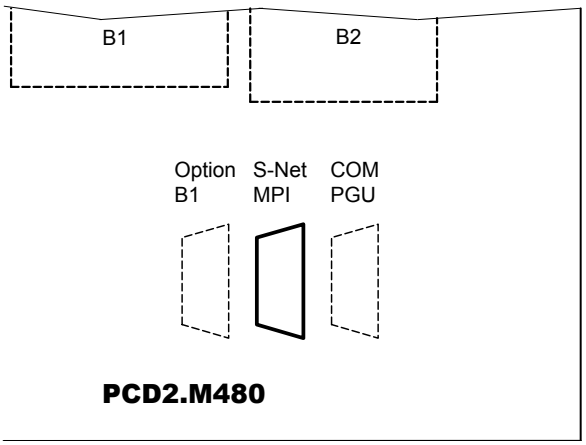
4.4.7 Profi S-Net on PCD2.M480

The PCD2.M480 is equipped with a Profi S-Net interface as standard. This can be used both for programming and for communication with other CPUs (that support Profi S-Bus) and/or Saia RIOs.

Technical details:

Transmission rates	up to 1.5 MBit/s
Number of stations	up to 124 stations in segments of 32 stations each
Protocols	Profi S-Bus, Profi S-IO, DP Slave, HTTP in preparation (multi-protocol operation on the same interface)

Connection diagram



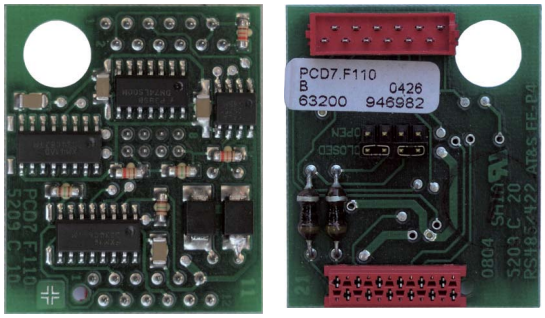
Port#10	D-Sub Pin	Profibus DP Master
S-Net	1	-
	2	-
	3	RxD/TxD-P
	4	RTS/CNTR-P
	5	GND
	6	+5 V
	7	-
	8	RxD/TxD-N
	9	-

For details of the configuration and programming of Profi S-Net functions, please consult the specialised manuals.

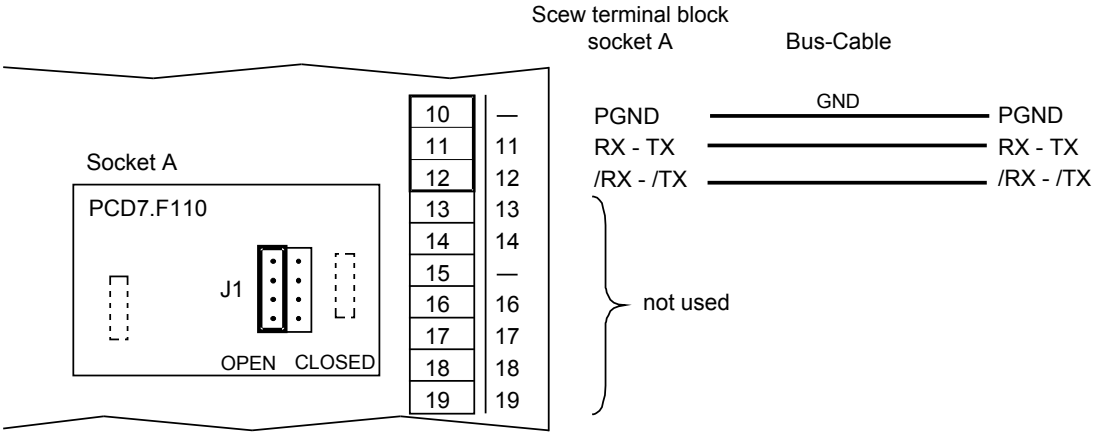
4.5 Plug-in interfaces modules: Socket A

4.5.1 RS485/422 with PCD7.F110, Port#1 (with PCD1.M110 hard-wired)

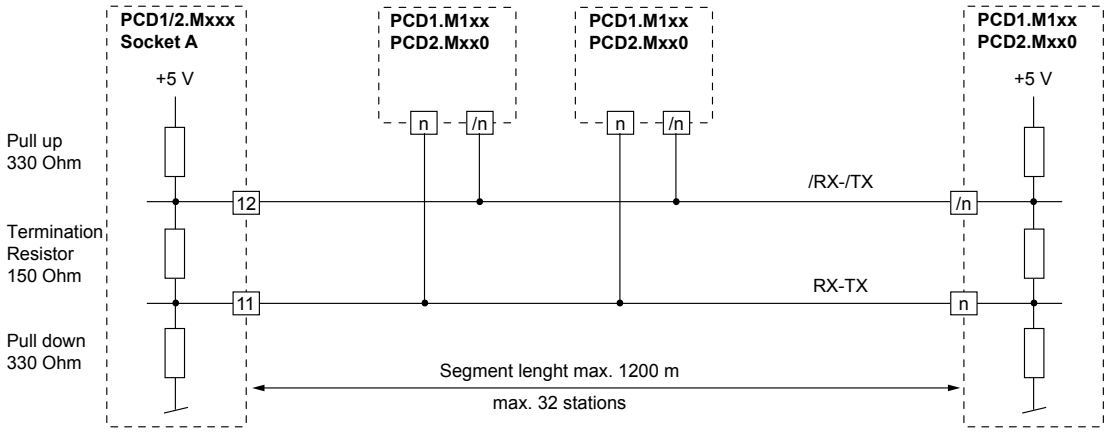
Connection for RS485



PCD7.F110:
RS422 with RTS/CTS or RS485 electrically connected, with line termination resistors capable of activation, for socket A



Choice of line termination resistors

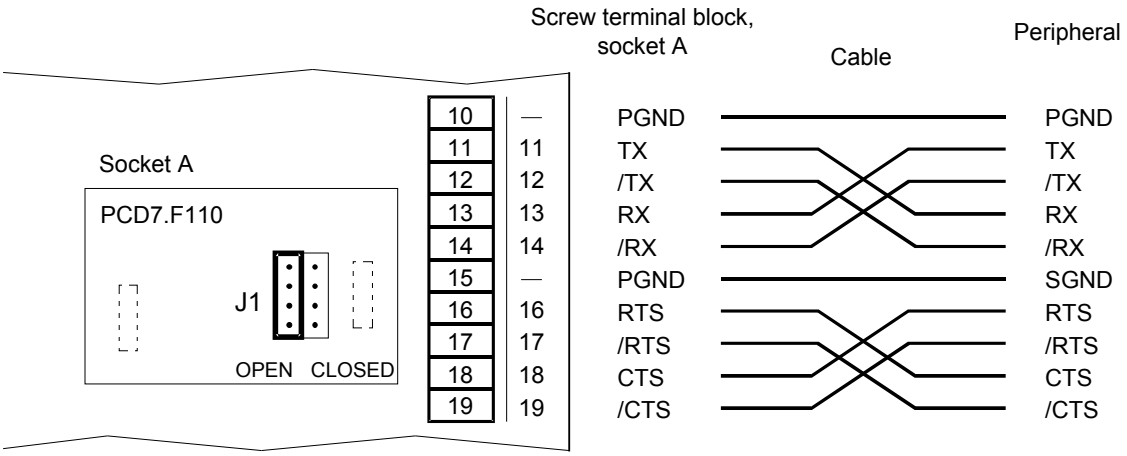


Not all manufacturers use the same connection configuration, so the data lines sometimes need to be crossed.

At the first and last stations, jumper J1 must be set to the “CLOSED” position.
At all other stations, jumper J1 must be set to “OPEN” (factory setting). The jumper is on the connection side of the module.

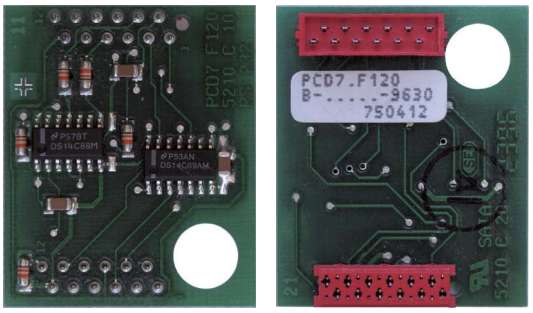
For details, see manual 26/740 :
“Installation components for RS485 networks”

Connection for RS 422

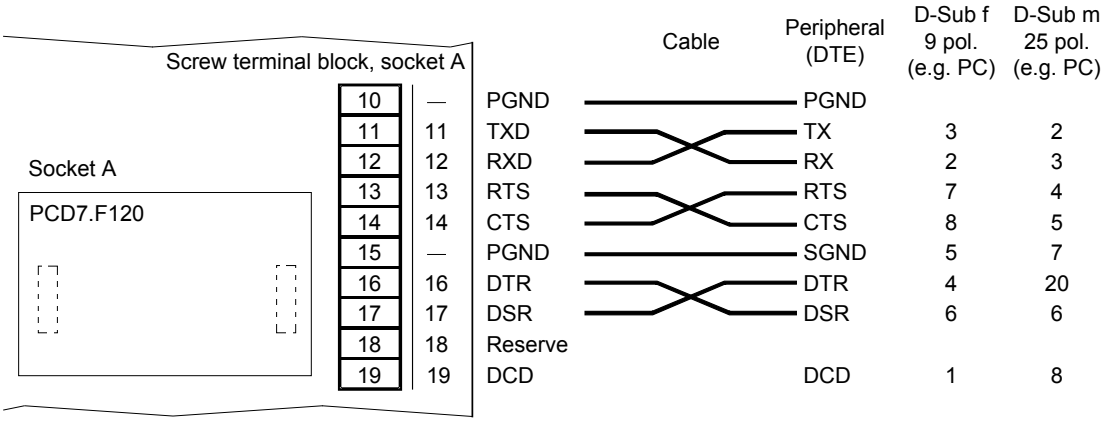


For RS 422, each pair of receive lines is terminated with a 150 Ω line termination resistor. Jumper J1 must be left in the “OPEN” position (factory setting). The jumper is on the connection side of the module.

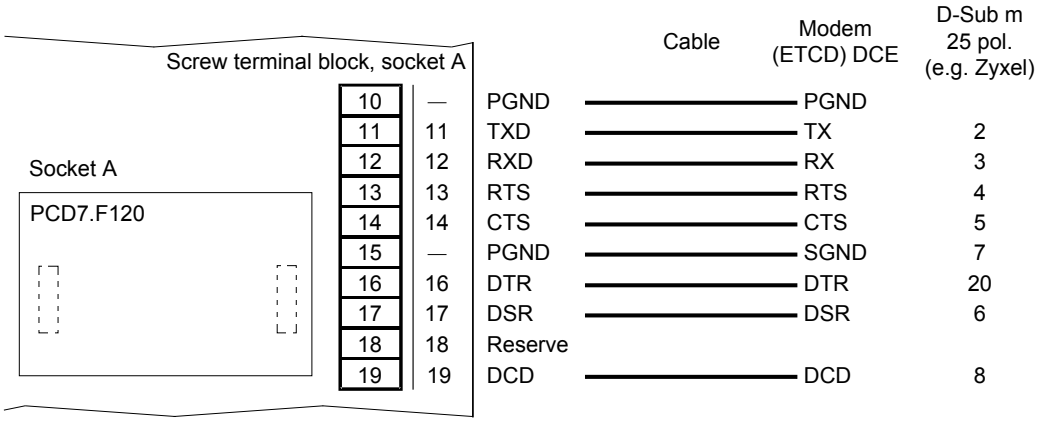
4.5.2 RS232 with PCD7.F120 (suitable for modem), Port#1 (without PCD1.M110)



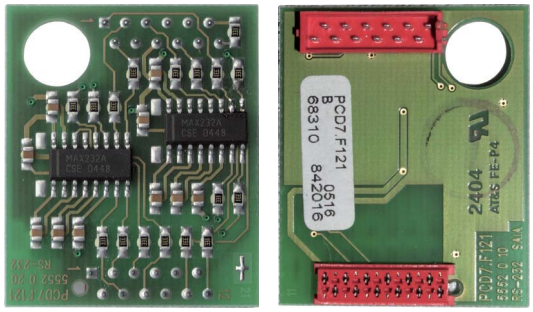
PCD7.F120:
RS232 with RTS/CTS, DTR/DSR, DCD, suitable for modem connection, for socket A



RS232 interface, Port#1 for external modem (DCE), socket A

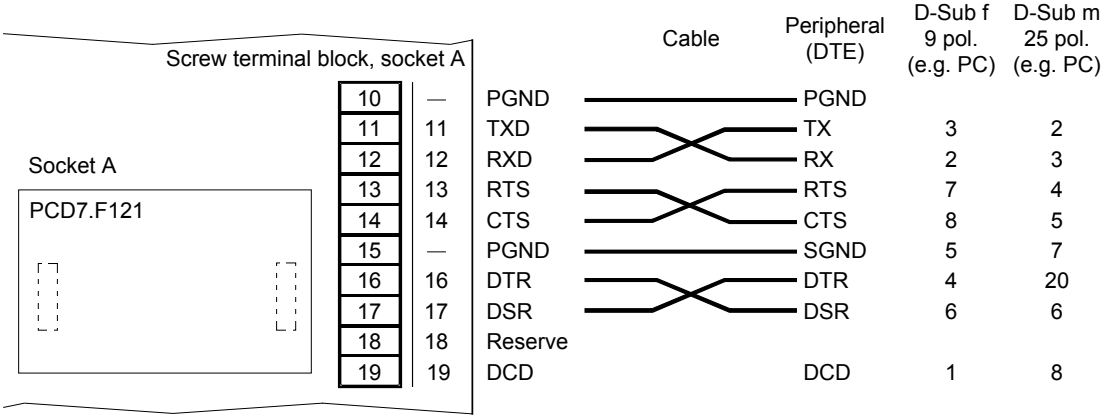


4.5.3 RS232 with PCD7.F121 (only for PCD2.M480), Port#1

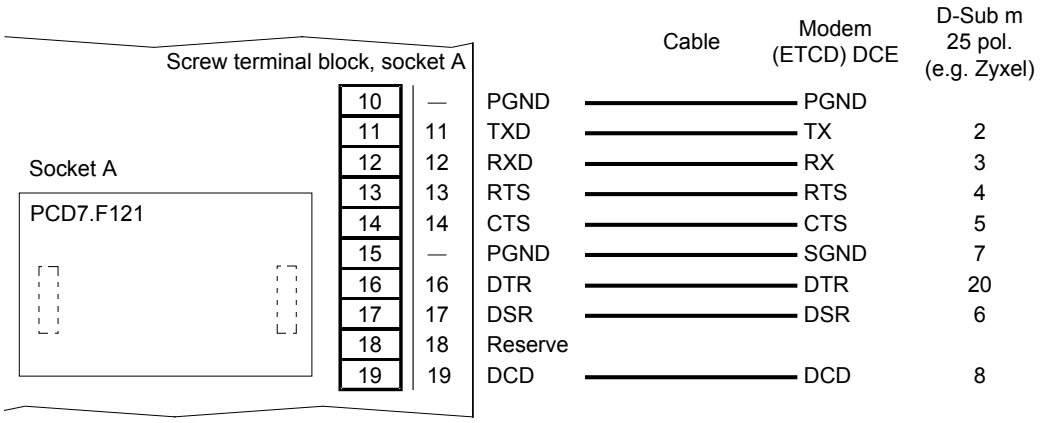


PCD7.F121:
RS232 with RTS/CTS, DTR/DSR, DCD, suitable for modem connection, for Socket A.

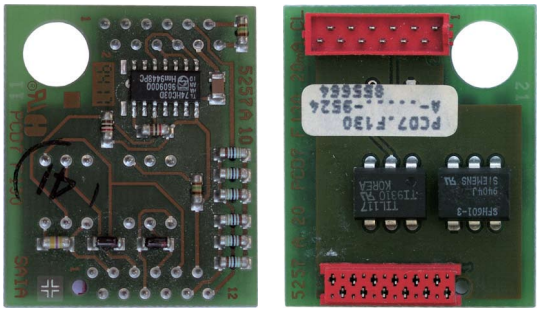
This module can be used up to 115200 Baud



RS232 interface, Port#1 for external modem (DCE), socket A



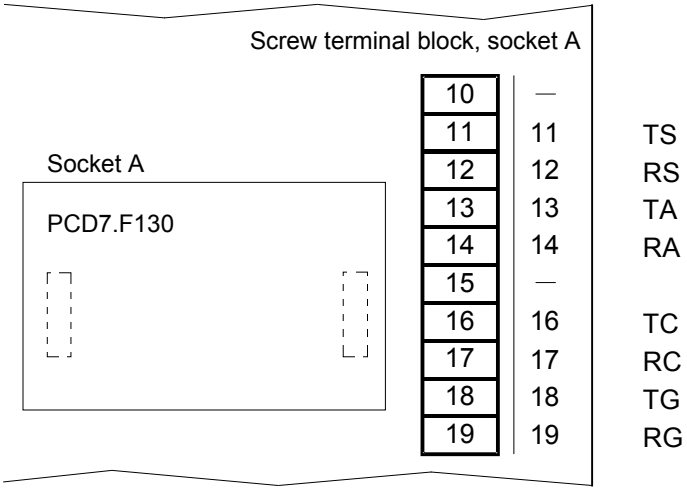
4.5.4 Current loop with PCD7.F130, Port#1 (without PCD1.M110)



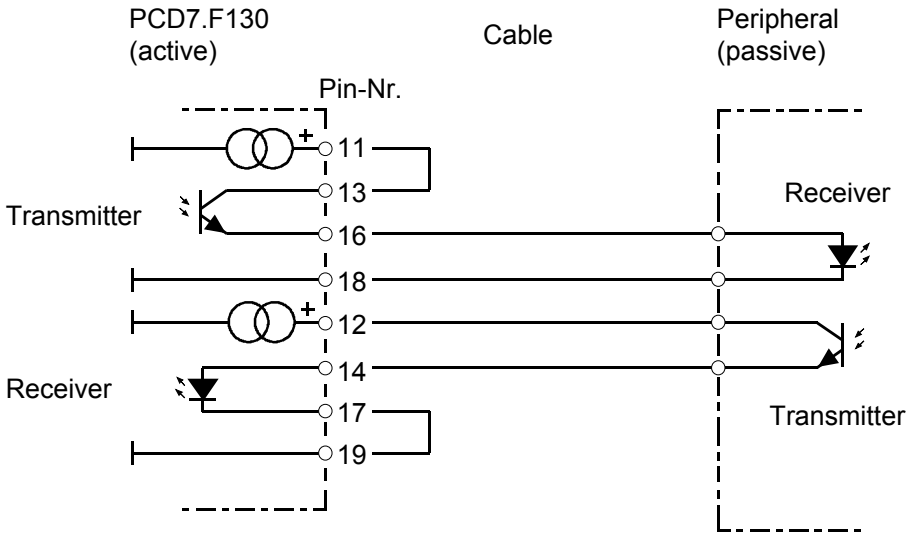
PCD7.F130:
TTY/current loop 20 mA (active or passive),
for socket A

4

Connections

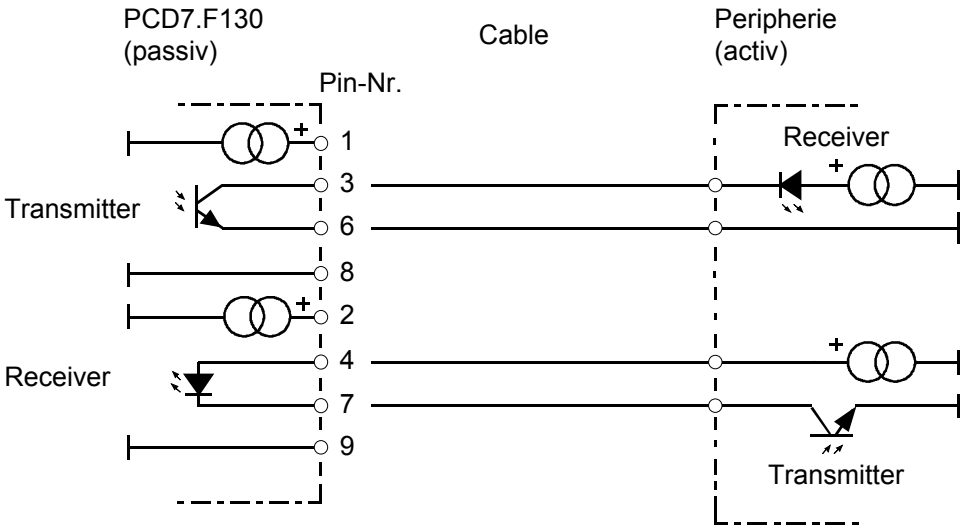


PCD active

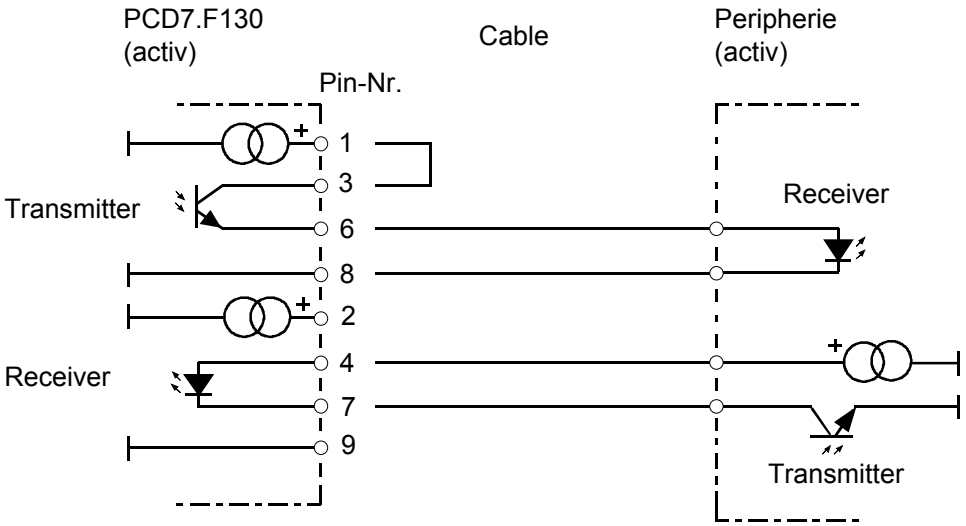


4

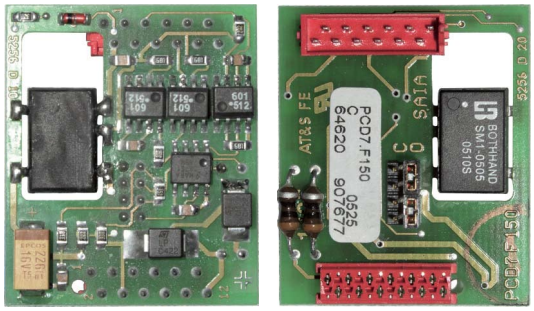
PCD passive



PCD and peripheral transmitters active

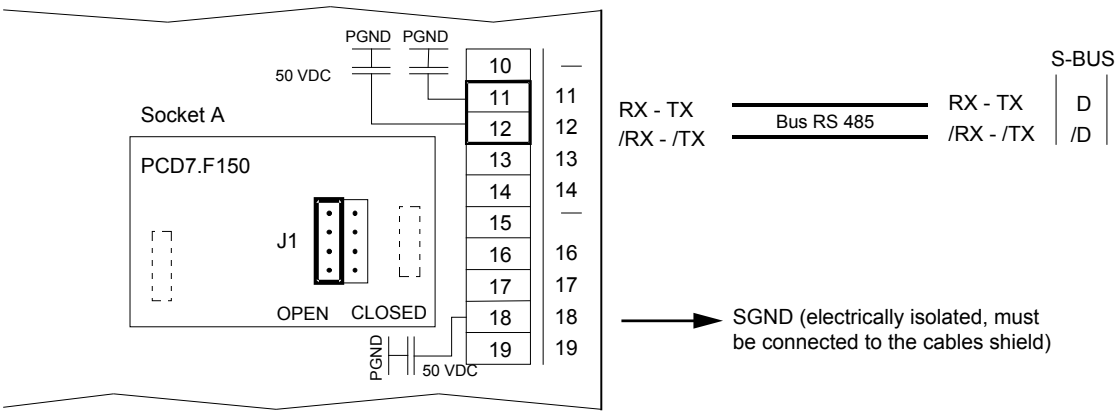


4.5.5 RS485 with PCD7.F150, Port#1 (without PCD1.M110)

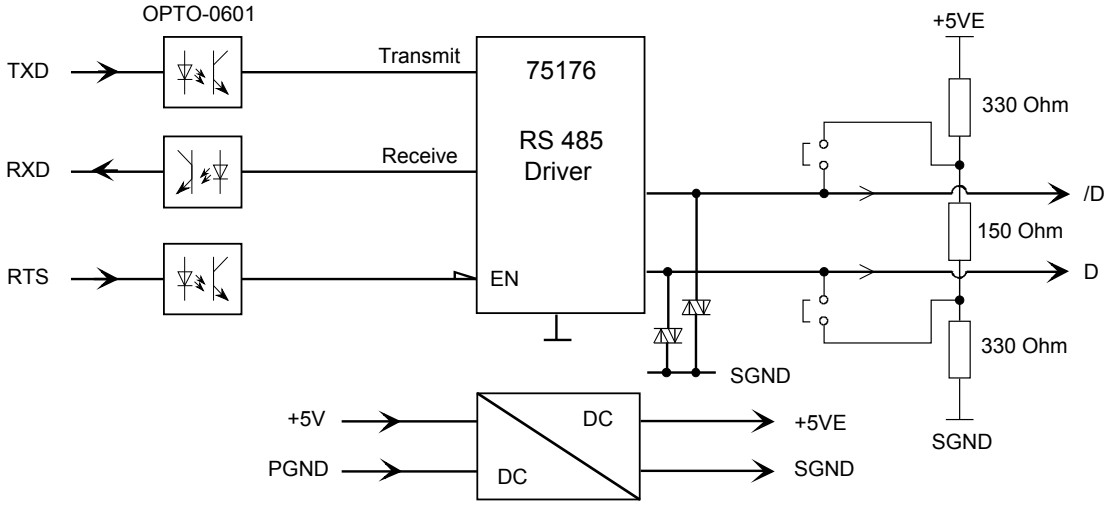


PCD7.F150:
RS485 electrically isolated, with line termination resistors capable of activation, for socket A

The electrical isolation is achieved with 3 optocouplers and a DC/DC transducer. The data signals are protected against surges by a suppressor diode (10 V). The line termination resistors can be connected/disconnected with a jumper.



Block diagram:

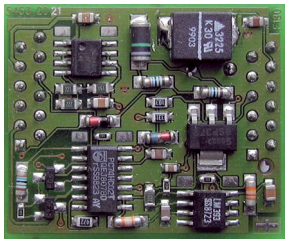


Not all manufacturers use the same connection configuration, so the data lines may need to be crossed.

The potential difference between PGND and the data lines Rx-Tx, Rx-/Tx (and SGND) is limited to 50 V by a suppressor capacitor.

For installation details, see manual 26/740 :
“Installation components for RS485 networks”.

4.5.6 MP-Bus with PCD7.F180, Port#1 (without PCD1.M110)

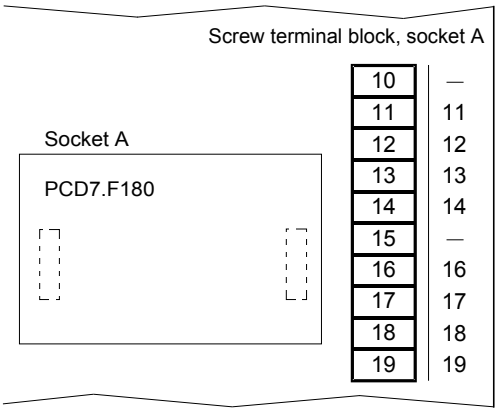


PCD7.F180:
Connecting module for MP-Bus, for socket A

The user has a facility to connect an MP-Bus line with 8 drives and sensors.

4

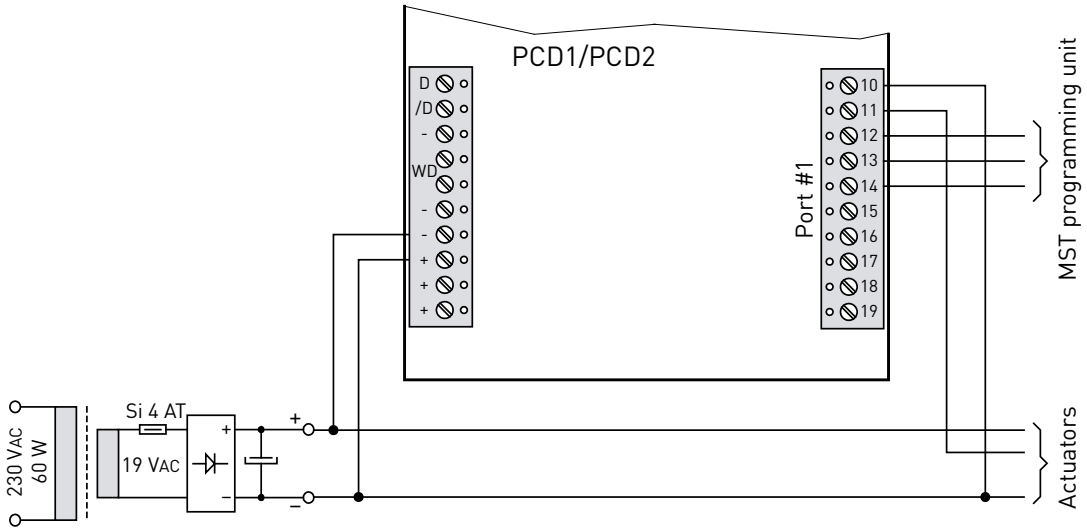
Connections



-	GND (Branch A–)
A COM	MP-Bus signal line (18 V in/out)
‚MST'	MST programming unit (MP-Bus internal)
‚IN'	MST programming unit detection (input 10 kΩ, Z5V1)
GND	Earth connection, MST programming unit
-	GND

Supply option

Common supply for control and drive



When using the PCD7.F180 connection module, the supply voltage to the PC control unit must be at least 24 VDC, ±5 % (not the default tolerance of ±20 %).

With a separate DC or AC supply to the drives, it is especially important to ensure that the PCD control unit is connected to the earth (Minus pole) of the drive supply. The earth serves as a common base for communication.

For details, see Technical Information P+P26/342
“MP-Bus interface for BELIMO actuating drives”

4.5.7 Modem communication

Modem module for I/O module socket

PCD2.T814:
33.6 kbps analogue modem
(RS 232 and TTL interface)

PCD2.T851:
ISDN-TA digital modem
(RS 232 and TTL interface)

Recommended sockets for connection with ribbon cable:
PCD1.M130 - socket 3
PCD2.M120 - socket 5
PCD2.M130 - socket 5
PCD2.M150 - socket 5
PCD2.M170 - socket 2
PCD2.M480 - socket 2

If a different socket is chosen for the internal modem, it can no longer be connected via the ribbon cable. The modem may be connected by a spring clip to the PCD7.F120 (Port 1) or PCD2.F522 (Port 2) interface modules.

External modems can also be connected to the PCD7.F120 or PCD2.F522 modules.

For mechanical reasons PCD2.T8xx modems cannot be inserted at the colored marked socket locations:

PCD1.Mxxx / PCD2.C150

#1	#2
#4	#3

PCD2.Mxxx / PCD2.C100

#1	#2	#3	#4
#8	#7	#6	#5

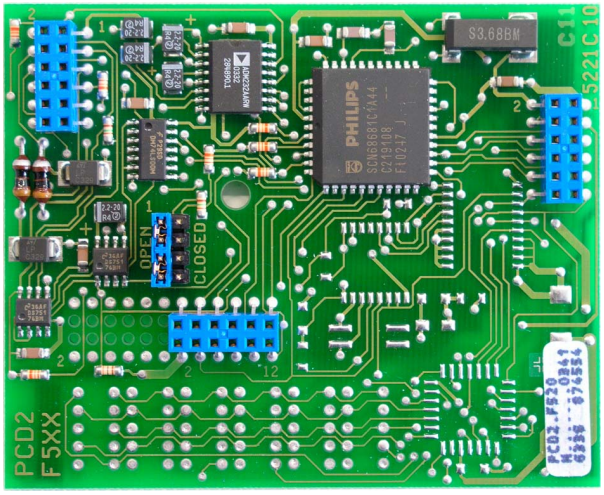
Not permitted socket location

Two modem modules cannot be mounted side-by-side.

For installation details, see manual 26/771
“PCD2.T8xx modem module”

4.6 Serial interfaces: socket B(1) or B2

4.6.1 RS 485 with PCD2.F520 (PCD2 only)



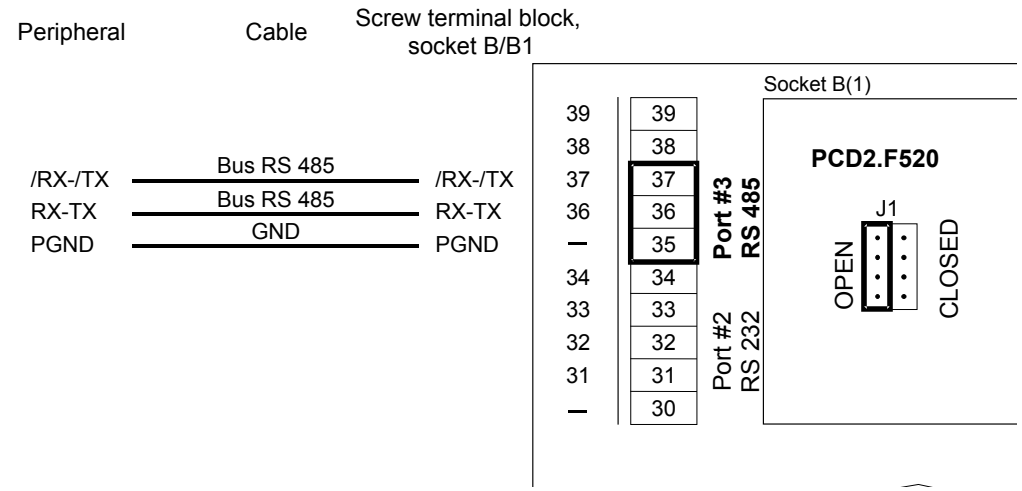
PCD2.F520:
1 × RS 232 with RTS/CTS and
1 × RS 485 electrically connected

or

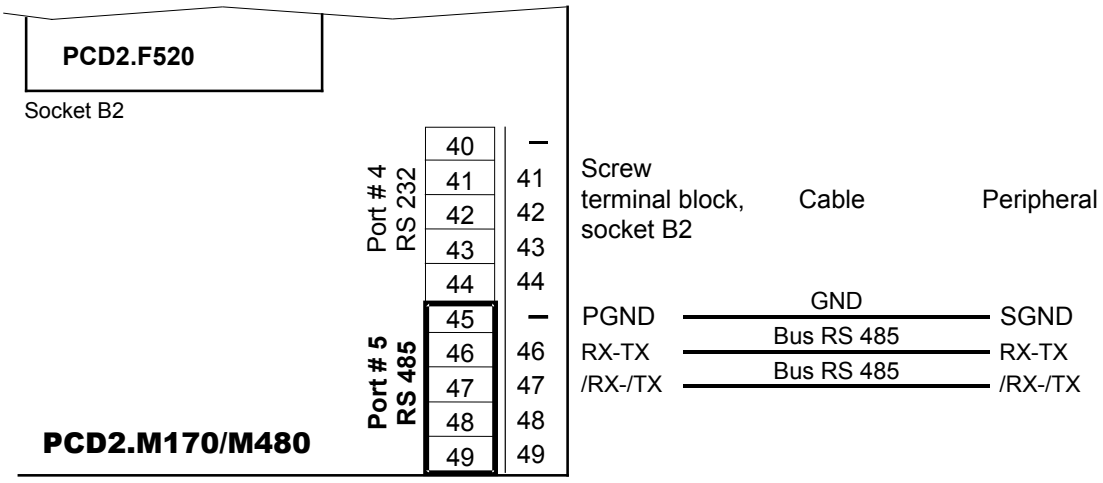
1 × RS 232 with RTS/CTS and
1 × RS 422 without RTS/CTS

for socket B(1) or B2

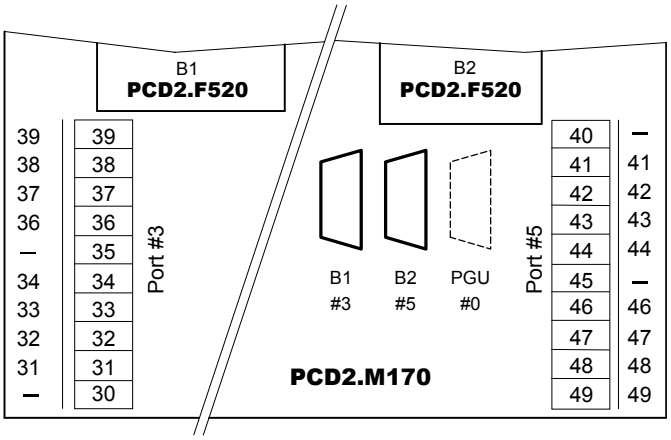
RS 485: socket B(1), Port #3



RS 485: socket B2, Port #5 (M170/M480 only)

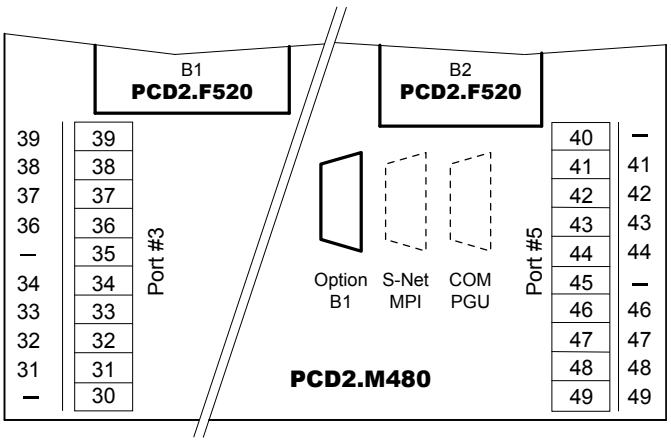


RS 485 to D-Sub connector with PCD2.M170



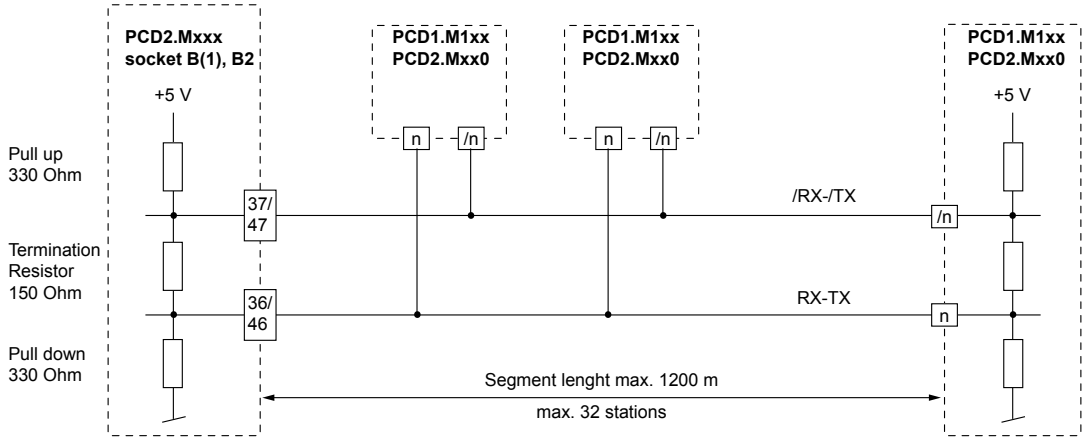
Assignement RS 485	Socket B1 Port#3 D-Sub Pin	Socket B2 Port#5 D-Sub Pin
PGND	1	1
-	2	2
/Rx-/Tx	3	3
-	4	4
-	5	5
-	6	6
-	7	7
Rx-Tx	8	8
-	9	9

RS 485 to D-Sub connector with PCD2.M480



Assignement RS 485	Socket B1 Port#3 D-Sub Pin
PGND	1
-	2
/Rx-/Tx	3
-	4
-	5
-	6
-	7
Rx-Tx	8
-	9

Connection diagram for RS 485 line termination resistors



At the first and last stations, jumper J1 must be set to the “CLOSED“ position. At all other stations, jumper J1 must be set to “OPEN” (factory setting)

For installation details, see manual 26/740 “Installation components for RS 485 networks”

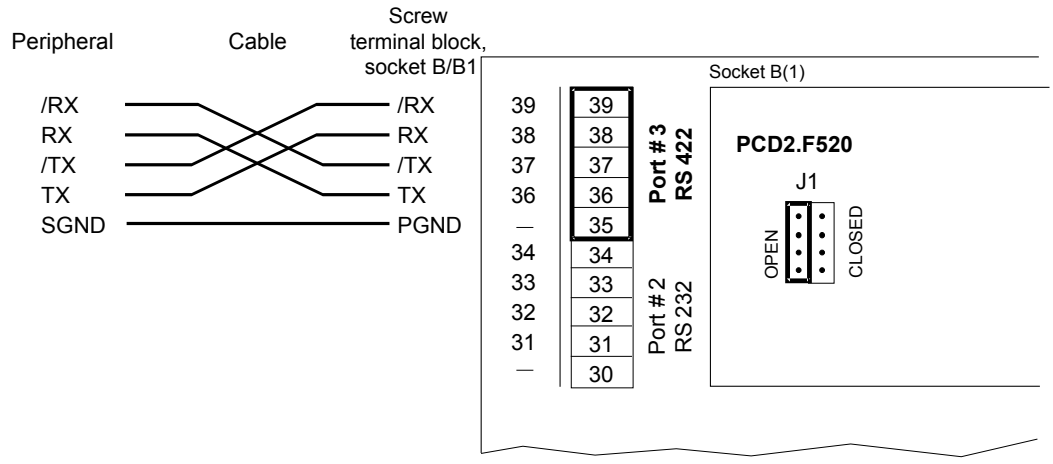
The PCD7.F772 Profibus module (details in 4.8.3) and the PCD7.F802 LON module (details in 4.9) also have an RS 485 interface.

However, these modules are not supported by all PCD1/PCD2 units.

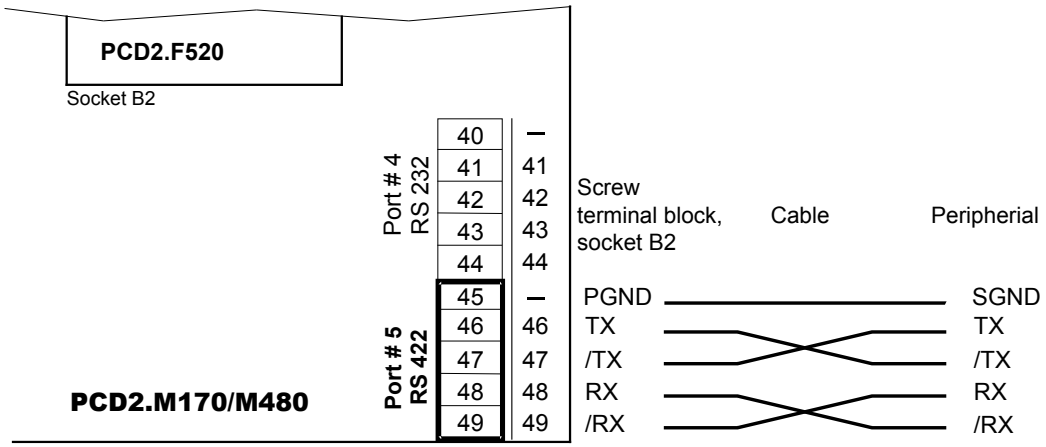
The wiring is identical to the RS 485 wiring for the PCD2.F520 Modules.

4.6.2 RS 422 with PCD2.F520

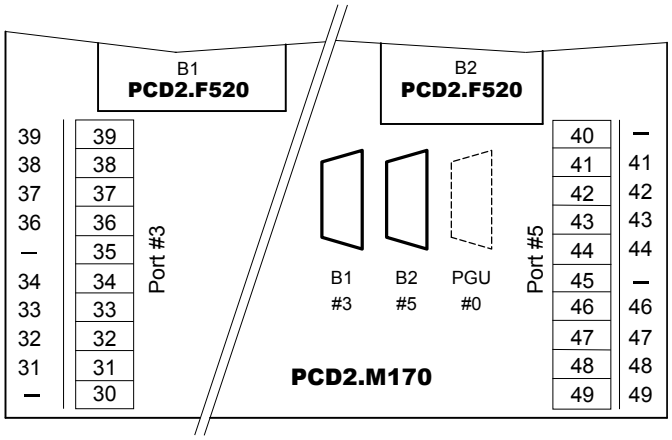
RS 422: socket B(1) Port #3



RS 422: socket B2, Port #5 (M170/M480 only), for peripheral device

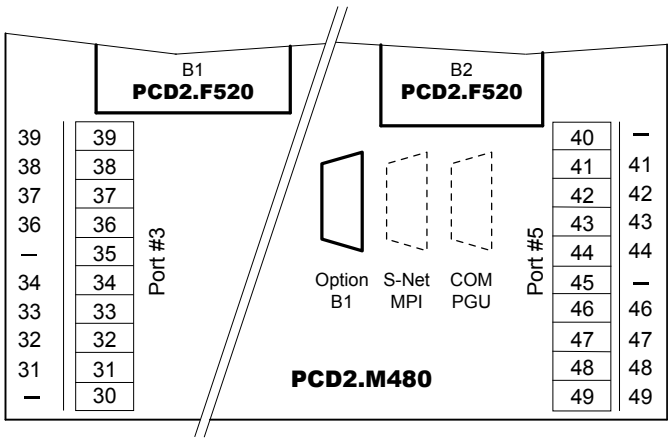


RS 422 to D-Sub connector with PCD2.M170



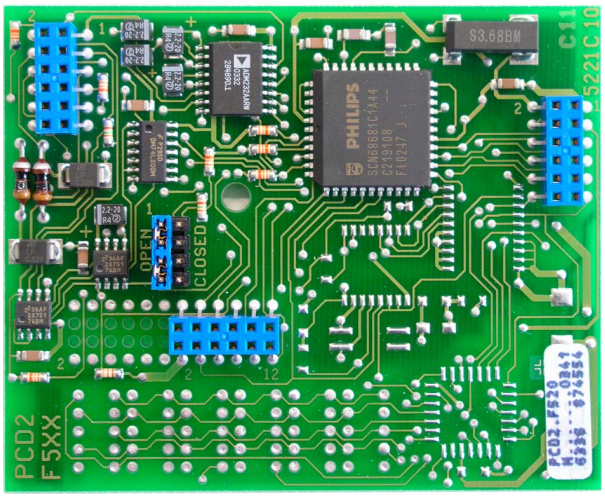
Assignement RS 422	Socket B1 Port #3 D-Sub Pin	Socket B2 Port #5 D-Sub Pin
PGND	1	1
-	2	2
/Tx	3	3
-	4	4
/Rx	5	5
Rx	6	6
-	7	7
Tx	8	8
-	9	9

RS 422 to D-Sub connector with PCD2.M480



Assignement RS 422	Socket B1 Port #3 D-Sub Pin
PGND	1
-	2
/Tx	3
-	4
/Rx	5
Rx	6
-	7
Tx	8
-	9

4.6.3 RS 232 with PCD2.F520/F522



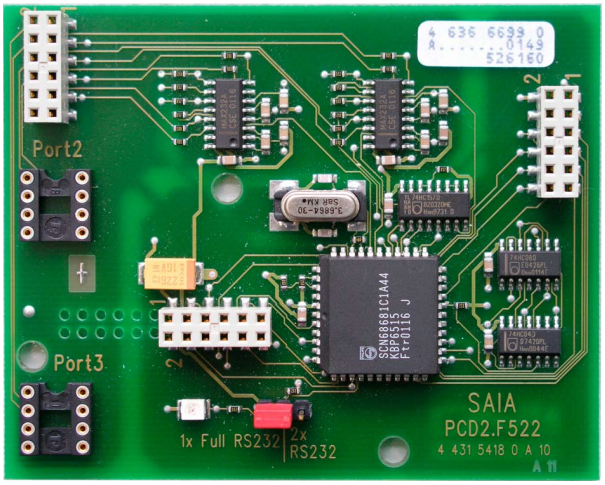
PCD2.F520:
1 x RS 232 with RTS/CTS and
1 x RS 485 electrically connected

or

1 x RS 232 with RTS/CTS and
1 x RS 422 without RTS/CTS

for socket B / B1/B2

not suitable for modem



PCD2.F522:
choice between
2 × RS 232 with RTS/CTS

or

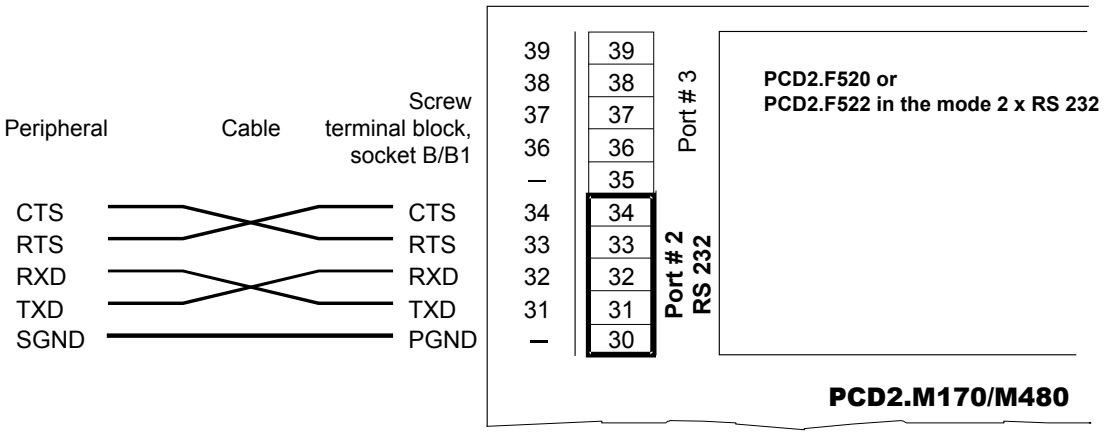
1 × RS 232 full with RTS/CTS,
DTR/DSR, DCD

Jumper for
2 x RS 232 or
1 x RS 232 full

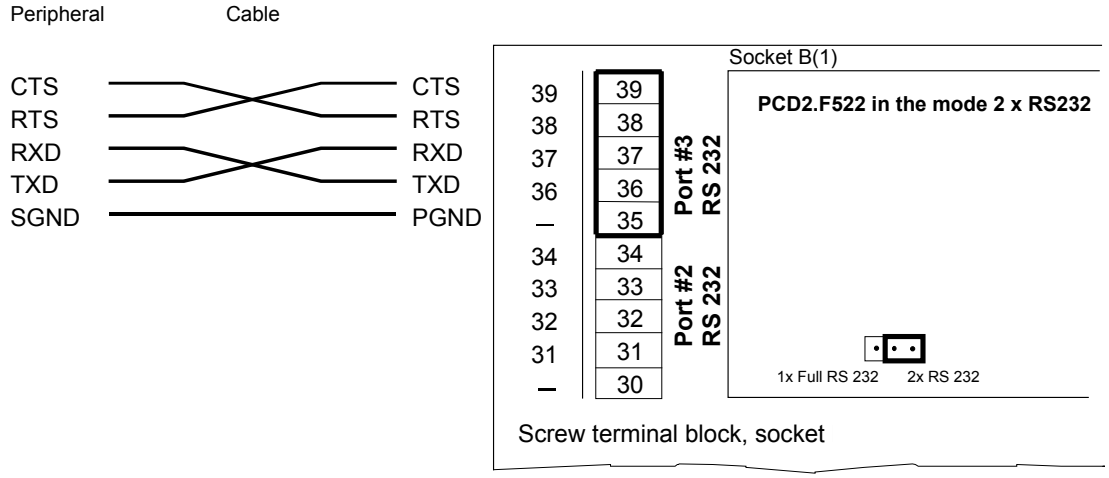
suitable for modem connection for
socket B / B1/B

The PCD2.F520 and PCD2.F522 modules are only supported by PCD2.M120/M150/M170/M480 controllers.

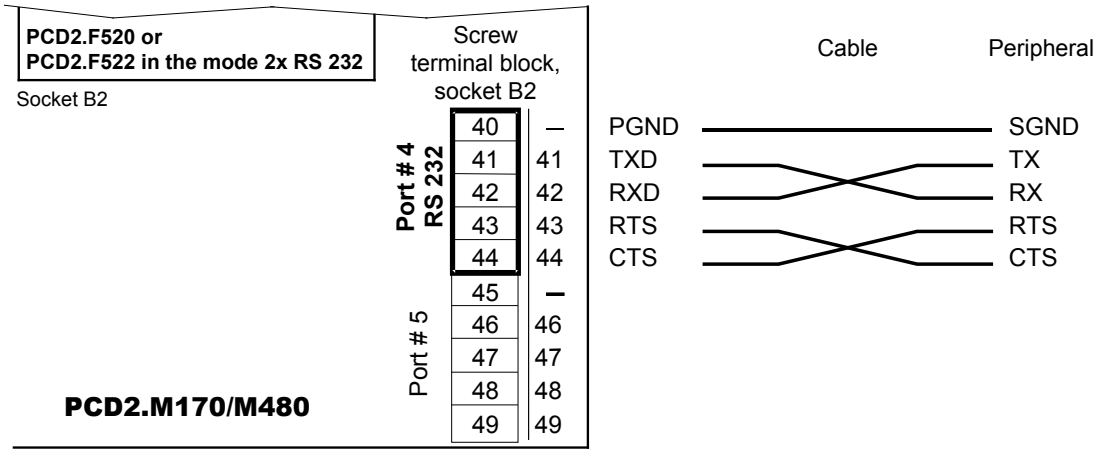
RS 232: socket B(1), Port #2, for peripheral device



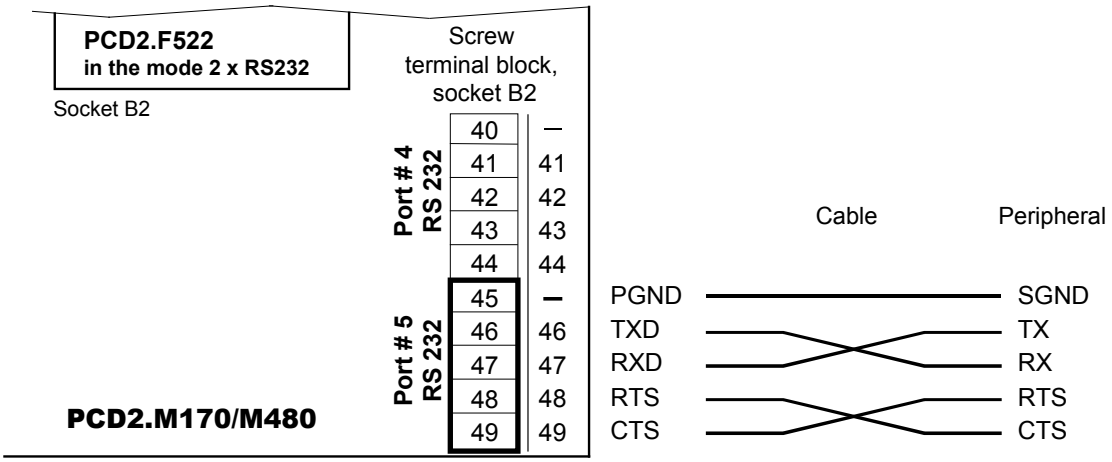
RS 232: socket B(1), Port #3, for peripheral device



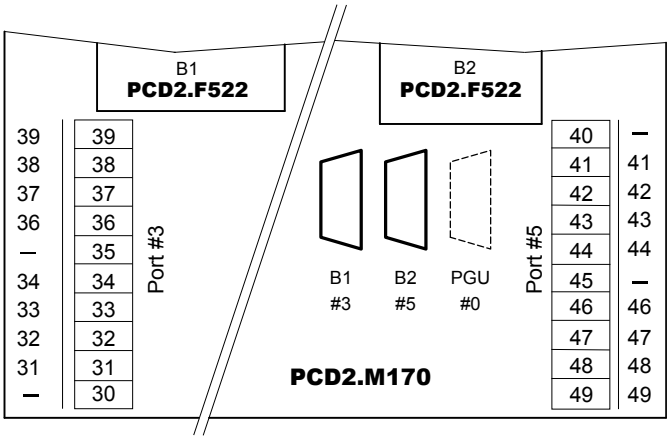
RS 232: socket B2, Port #4 (M170/M480 only), for peripheral device



RS 232: socket B2, Port #5 (M170/M480 only), for peripheral device

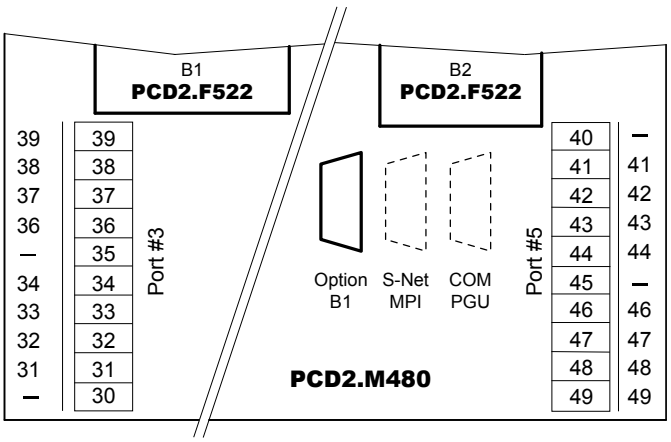


RS 232 to D-Sub connector with PCD2.M170



Assignement RS 232	B1 Port#3 D-Sub Pin	B2 Port#5 D-Sub Pin
PGND	1	1
-	2	2
RxD	3	3
-	4	4
CTS	5	5
RTS	6	6
-	7	7
TxD	8	8
-	9	9

RS 232 to D-Sub connector with PCD2.M170

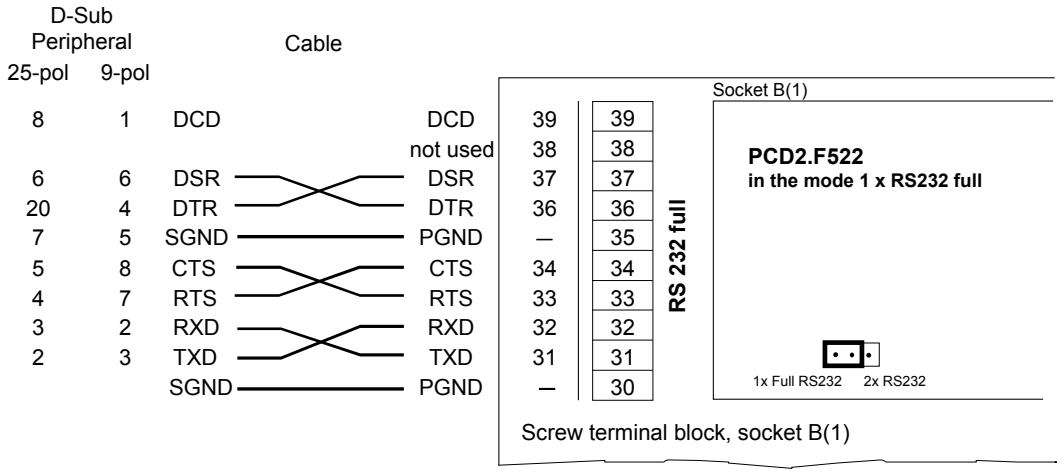


Assignement RS 422	B1 Port#3 D-Sub Pin
PGND	1
-	2
RxD	3
-	4
CTS	5
RTS	6
-	7
TxD	8
-	9

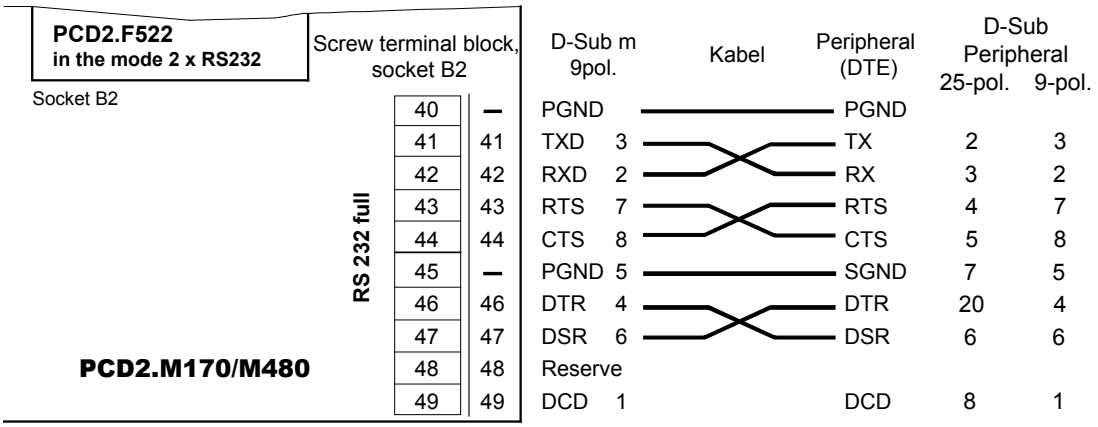
The DTR/DSR and DCD control lines are not present on these interfaces. If they are needed, e.g. to connect a modem, it is advisable to use the PCD7.F120 Module on socket A (Port# 1) or PCD2.F522 (in RS 232 full mode) on socket B1/B2.

4.6.4 RS 232 full with PCD2.F522 (suitable for modem)

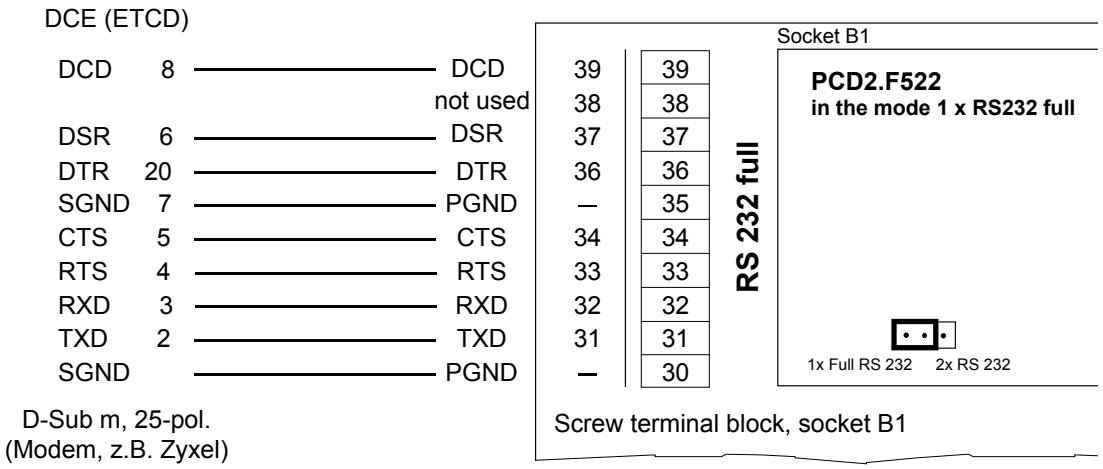
RS 232 full on socket B / B1, Port #2, for peripheral device



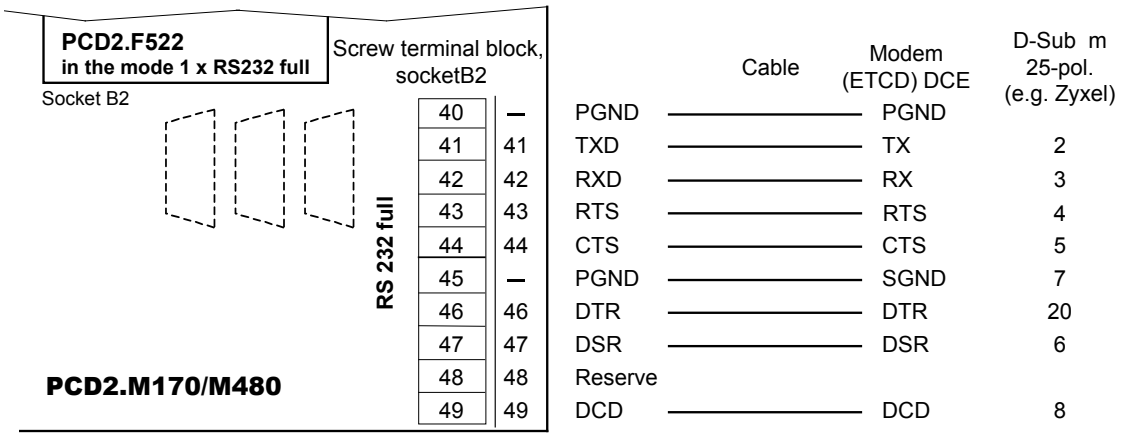
RS 232 full on socket B2, Port #4 (M170/M480 only), for peripheral device



RS 232 full on socket B1, Port #2, for external modem (DCE)

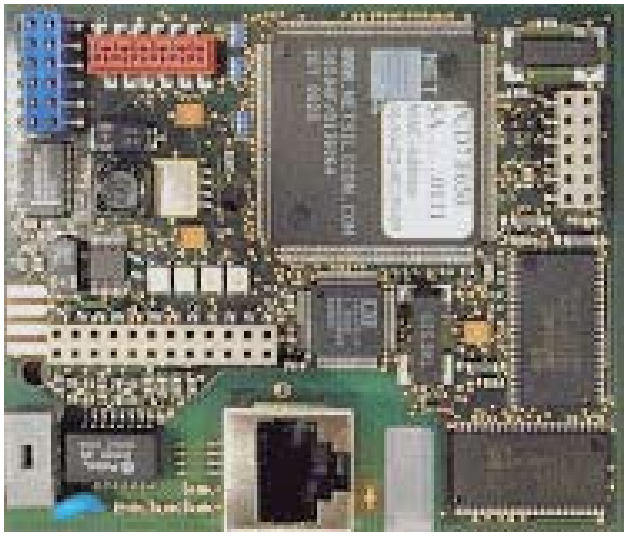


RS 232 full on socket B2, Port #4 (M170/M480 only) for external modem (DCE)



The jumper on the module must be in position 1x full RS 232.

4.7 Ethernet TCP/IP



PCD7.F655 *
Intelligent interface module for connection to Ethernet TCP/IP

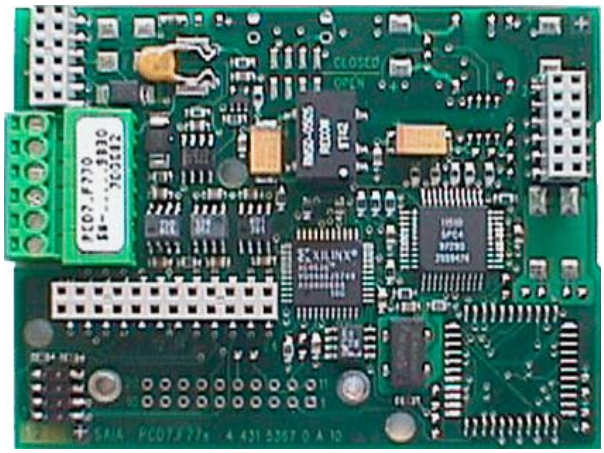
* The Ethernet module PCD7.F650 is not no more sold

The Ethernet module is not supported on the PCD1.M110/M120 and PCD2.M110/M120. On the PCD2.M170, the module can only be operated on socket B2. On the PCD2.M480, 2 x Ethernet is supported.

Details can be found in manual 26/776 “Ethernet TCP/IP”.

4.8 Profibus

PCD7.F770



PCD7.F700
for connection as Profibus FMS client/server
PCD7.F750
for connection as Profibus DP Master
PCD7.F770
for connection as Profibus DP Slave
PCD7.F772
for connection as Profibus DP Slave, with electrically isolated RS 485 interface

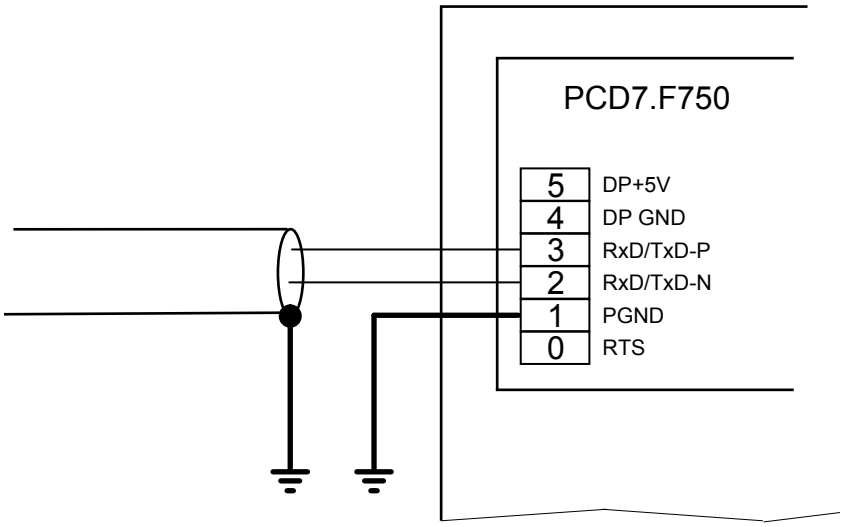
Not all modules are supported by every PCD. The possible combinations are set out in tables
“4.2 Summary of PCD1 plug-in interface modules” and
“4.3 Summary of PCD2 plug-in interface modules”.

To avoid reflections, each segment must be terminated at the line ends. According to the Profibus standard, this must not be on the unit itself. For the termination boxes, either PCD7.T160s or normal 9-pole Profibus DP D-type connectors are suitable (on the M170/M480 only).

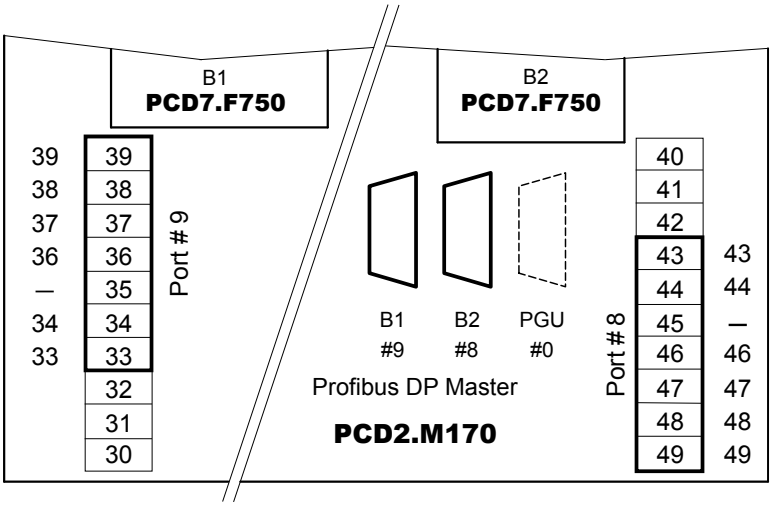
Details can be found in manual 26/765 “Profibus DP” or 26/742 “Profibus FMS”.

4.8.1 Profibus DP Master, module PCD7.F750

PCD1.M120/M130 and PCD2.M120/M150
The bus should be connected directly to the PCD7.F750 Module.

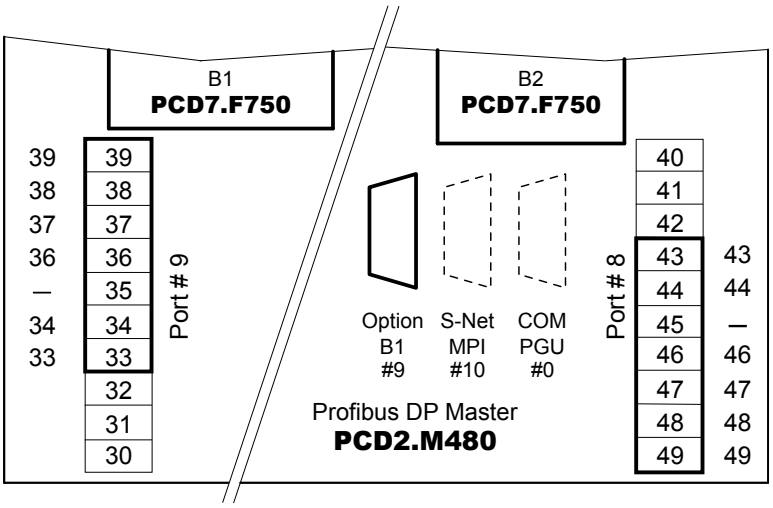


PCD2.M170
The bus should be connected to the D-Sub connector. The pin configuration is as per the Profibus standard. Alternatively the Profibus can be attached to the screw terminal block.



Socket	**B1 Port#9**		**B2 Port#8**	
Kind of connection	D-Sub	Screw terminal block	D-Sub	Screw terminal block
	9 pole	10 pole	9 pole	10 pole
Signal	Pin number	Terminal number	Pin number	Terminal number
RTS/CNTR-P	4	33	4	43
PGND	1	35	1	45
RxD/TxD-N	8	36	8	46
RxD/TxD-P	3	37	3	47
DP GND	5	38	5	48
DP +5 V	6	39	6	49

PCD2.M480

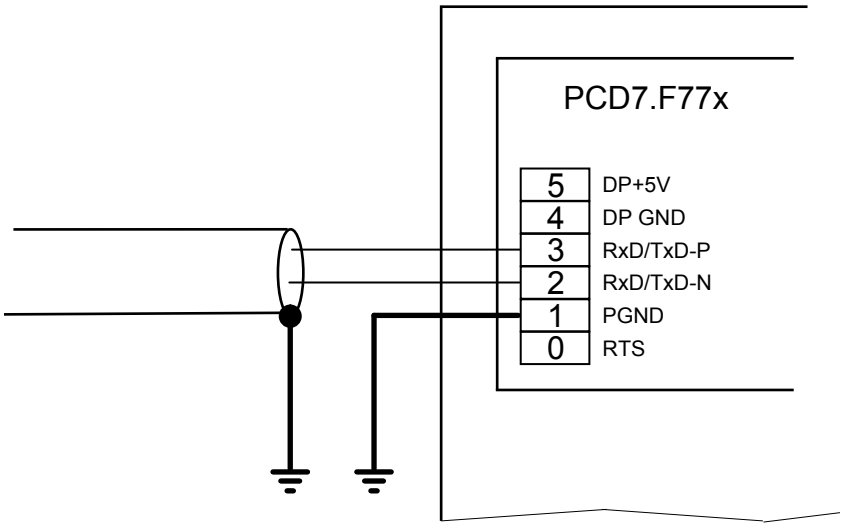


Socket	**B1 Port#9**		**B2 Port#8**
Kind of connection	D-Sub 9 pole	Screw terminal block 10 pole	Screw terminal block 10 pole
Signal	Pin number	Terminal number	Terminal number
RTS/CNTR-P	4	33	43
PGND	1	35	45
RxD/TxD-N	8	36	46
RxD/TxD-P	3	37	47
DP GND	5	38	48
DP +5 V	6	39	49

4.8.2 Profibus DP Slave, module PCD7.F77x

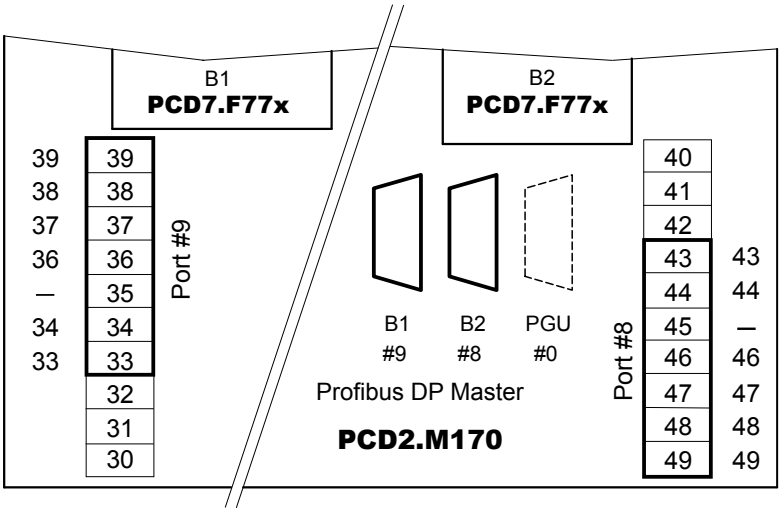
PCD1.M120/M130 and PCD2.M120/M150

The bus should be connected directly to the module PCD7.F770 or PCD7.F772.



PCD7.F770 with PCD2.M170

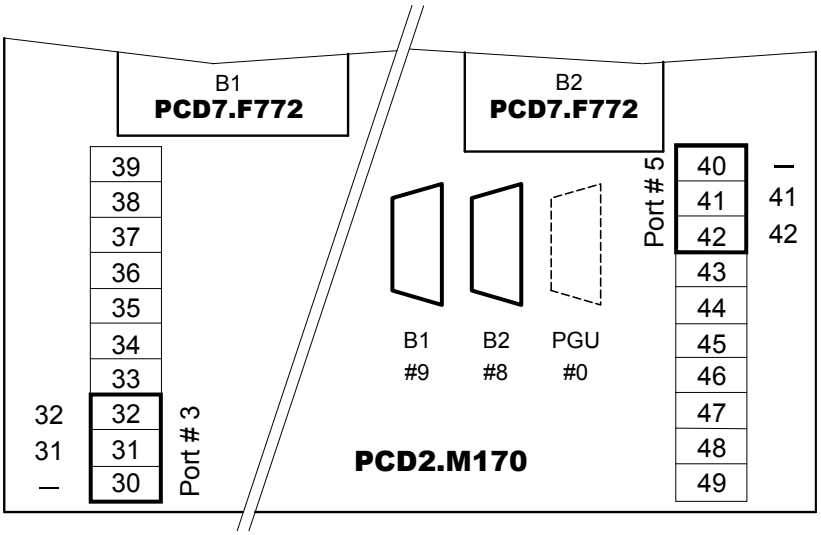
The bus should be connected to the D-Sub connector. The pin configuration is as per the Profibus standard. Alternatively the Profibus can be attached to the screw terminal block.



Socket	B1 Port#9		B2 Port#8	
Kind of connection	D-Sub	Screw terminal block	D-Sub	Screw terminal block
	9 pole	10 pole	9 pole	10 pole
Signal	Pin number	Terminal number	Pin number	Terminal number
RTS/CNTR-P	4	33	4	43
PGND	1	35	1	45
RxD/TxD-N	8	36	8	46
RxD/TxD-P	3	37	3	47
DP GND	5	38	5	48
DP +5 V	6	39	6	49

PCD7.F772 with PCD2.M170

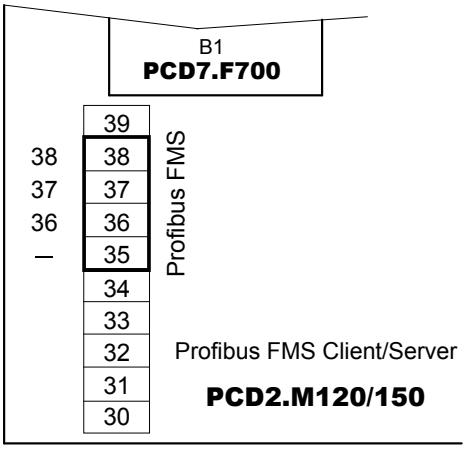
Like PCD7.F770 however per module a serial interface RS 485 additionally.



Socket	B1 Port#3	B2 Port#5
Kind of connection	Screw terminal block	Screw terminal block
Signal	Terminal number	Terminal number
/RX-/TX	32	42
RX-TX	31	41
PGND	30	40

4.8.4 Profibus FMS, module PCD7.F700

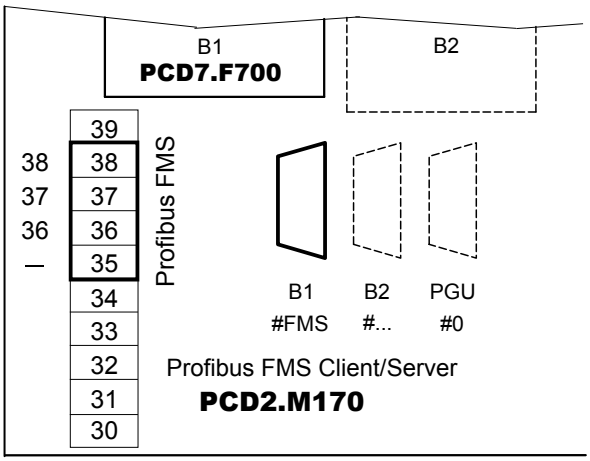
PCD7.F700 with PCD2.M120/150
The bus should be connected to the PCD2.



Socket	B1 FMS Client/Server
Kind of connection	Screw terminal block 10 pole
Signal	Terminal number
DP GND	38
RxD/TxD-P	37
RxD/TxD-N	36
PGND	35

PCD7.F700 with PCD2.M170

The bus should be connected to the D-Sub connector. The pin configuration is as per the Profibus standard. Alternatively the Profibus can be attached to the screw terminal block.

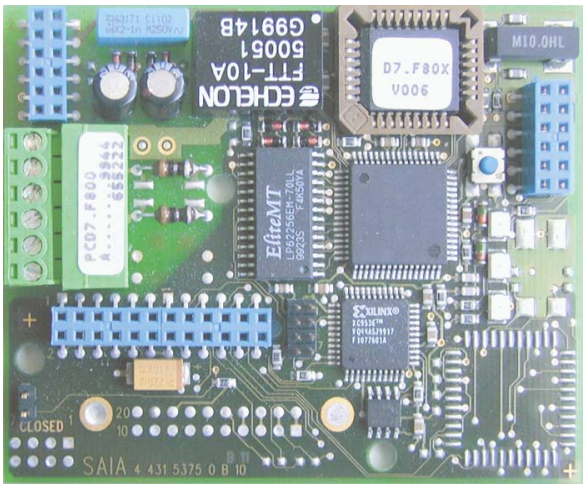


Socket	**B1 FMS Client/Server**	
Kind of connection	D-Sub	Screw terminal block
	9 pole	10 pole
Signal	Pin number	Terminal number
RxD/TxD-P	3	37
RxD/TxD-N	8	36
PGND	1	35
DP GND	5	38

There are no line termination resistors on this module. It is advisable to use an external termination box (e.g. PCD7.T160).

4.9 LonWorks® (freely configurable LON nodes)

PCD7.F800/F802



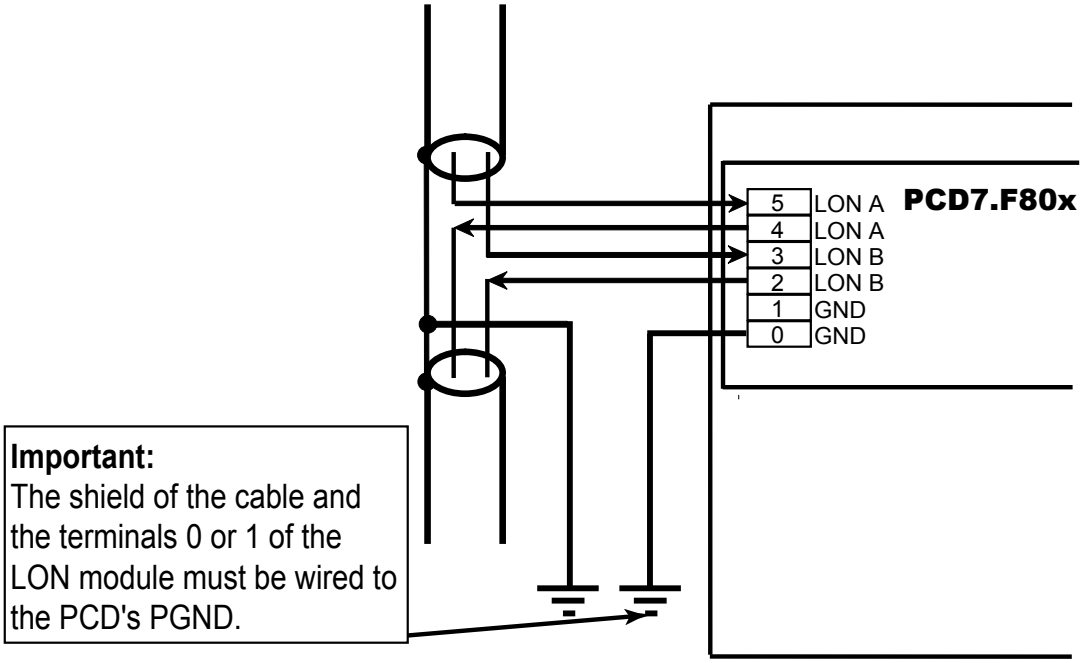
PCD7.F800
for connecting to the LonWorks® network (free topology FTT-10)

PCD7.F802
for connecting to the LonWorks® network (free topology FTT-10), with additional RS 485 serial port, electrically connected

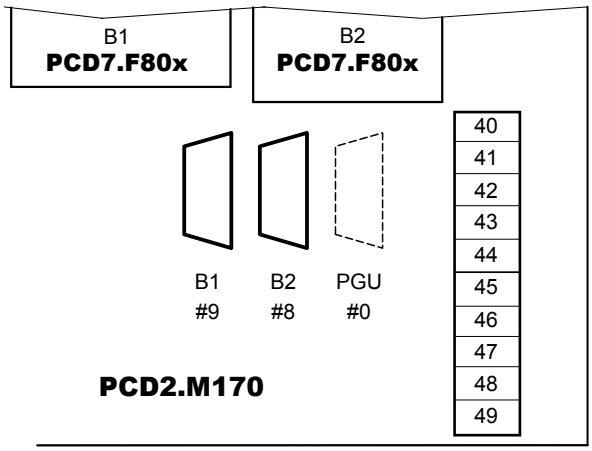
Not all LON modules are supported by every PCD. The possible combinations are set out in tables 3.1 “Summary of PCD1 communication options” and 3.2 “Summary of PCD2 communication options”.

Details can be found in manual 26/767 “LON”.

PCD1.M120/M130 and PCD2.M120/M150 LonWorks® PCD7.F80x on socket B / B1

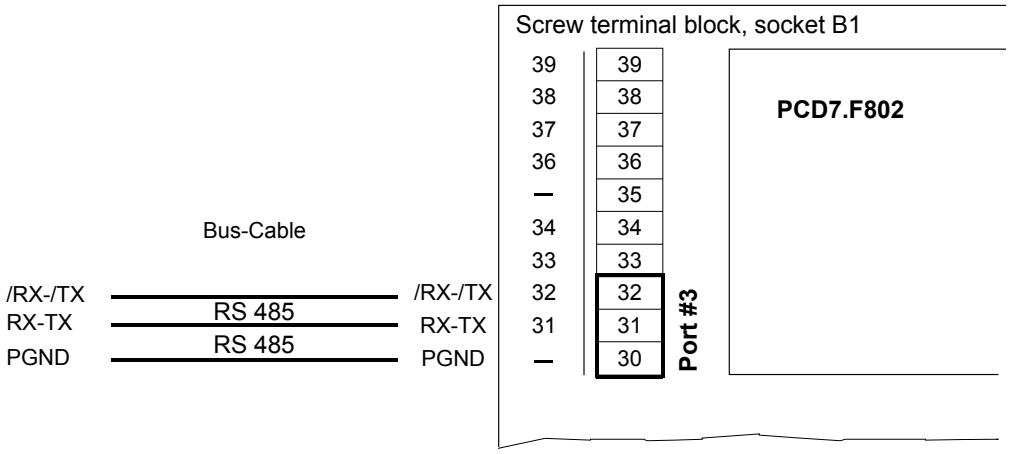


LonWorks® PCD7.F80x on PCD2.M170

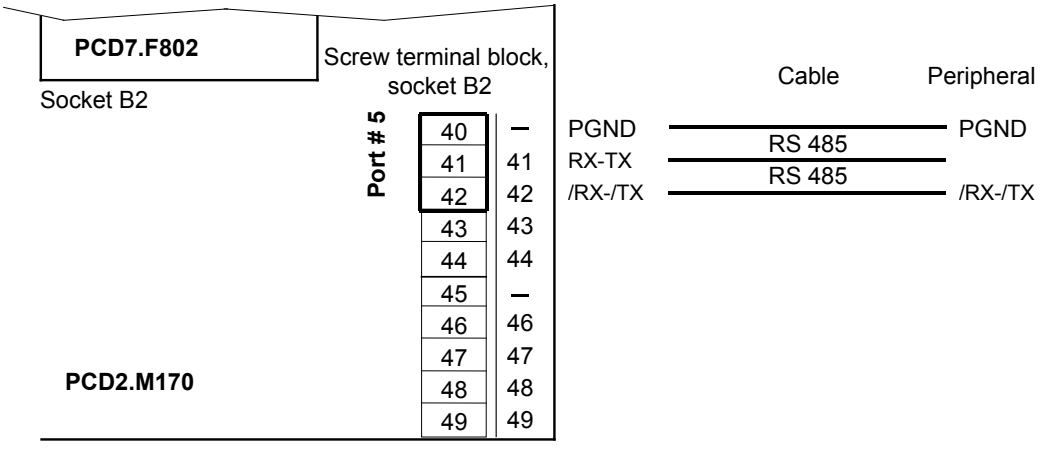


D-Sub	Pin	LonWorks®
B1 oder B2	1	-
	2	-
	3	LON A
	4	-
	5	LON GND
	6	-
	7	-
	8	LON B
	9	-

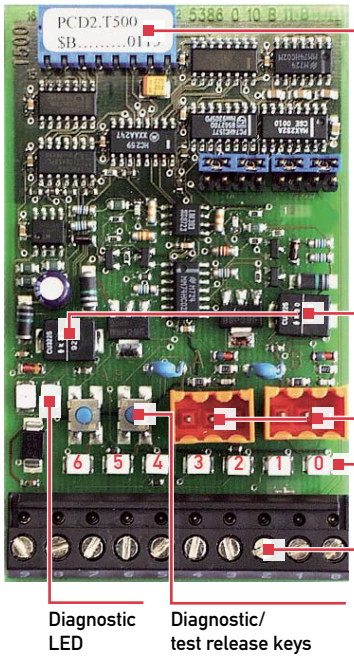
RS 485 serial interface on PCD7.F802 on socket B1



RS 485 serial interface on PCD7.F802 on socket B2



4.10 Connection module for MP-Bus PCD2.T500



- Connection module for PCD1/PCD2 automation systems
- Can be plugged onto an I/O module socket
- 2 RS 232 or TTL communications channels
- 2 actuator connection channels, each for 8 MFT/MFT2 actuators and sensors
- Connection of very wide variety of sensors: passive and active sensors, 2-point sensor on actuator
- Integral monitoring of actuator function
- Extremely easy service check

4

4.10.1 Communications signals

The PCD2.T500 Module serves as an interface between the automation system (DDC-PLUS) and the MFT/MFT2 damper actuators from BELIMO Automation AG. The module can actuator up to two branches (bus connections) each having eight connected actuators. Each branch can be run asynchronously, independently of each other. To run both branches independently, the automation system will also require two logical communications channels (RS 232/TTL). However, if required, both branches can also be run on only one logical communications channel.

Data exchange is asynchronous and runs at 1200 pulses/second. The automation system leads the network as the “master”. The actuators have been designed as “slaves” and only communicate when instructed to do so by the master.

4.10.2 Controls on PCD2.T500

Tip-jacks for MFT parameter setting unit from BELIMO®

When the cover is removed from the controller, branches A and B can be provided with tip-jacks that allow connection of an MFT parameter setting unit from BELIMO®. As soon as the device is plugged in, the communications connection will automatically switch over from the connection module to the parameter setting unit. The controller is simultaneously informed of this fact, to avoid the appearance of a break in communications.

Diagnostic and test release keys

For each branch a control key has been provided that triggers the start of a test for fault-free communications with all connected actuators.

Diagnostic LED

To the left of these keys are two LEDs (branch A on the left, branch B on the right) which, in association with the keys, indicate the result of a completed diagnosis. If a connected, addressed actuator does not communicate correctly with the PCD master

station, the LED flashes. The number of flash signals matches the bus address of the actuator. They are repeated 5 times, with interruption.

Function LED

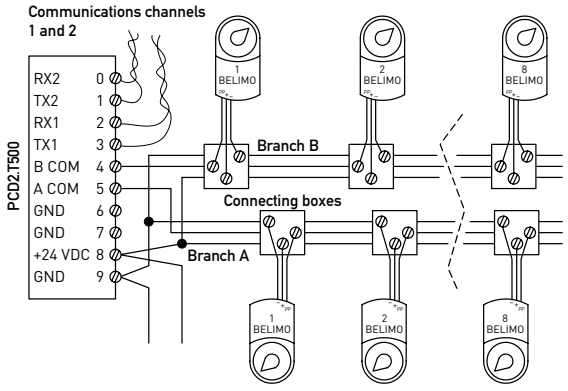
These LEDs are visible even when the cover is closed and indicate the following states:

LED	off	on
0	Channel 1 = Branch A Channel 2 = Branch B	Channel 1 = Branch B
1	Branch A is switched on	Branch A is switched off
2		Transmit signals at branch A
3		Transmit or receive signals at branch A
4	Branch B is switched on	Branch B is switched off
5		Transmit signals at branch B
6		Transmit or receive signals at branch B

Base address

The PCD2.T500 Module can be slotted into any I/O module socket on the PCD1/PCD2. The base address of the socket is required for software linking in the function boxes. For ease of wiring, it is recommended to choose a socket near to the communications ports.

4.10.3 Connection and wiring



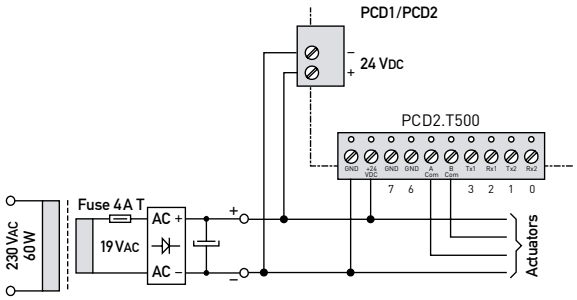
Terminal	Designation	Description	
0	Rx2	Receive line	Communications channel 2
1	Tx2	Transmit line	Communications channel 2
2	Rx1	Receive line	Communications channel 1
3	TX1	Transmit line	Communications channel 1
4	B Com	Communication branch B	
5	A Com	Communication branch A	
6	-	Earth connection for actuators, branches A and B	
7	-	Earth connection for actuators, actuators branches A and B	
8	+24 VDC	Module supply +	
9	GND	Module supply - and earth connection	

The supply voltage of the PCD1/PCD2 automation system is generally used to supply the PCD2.T500 Module. However, if preferred an external power source can also be used to supply the module and/or actuators. The following demands are placed on the supply voltage:

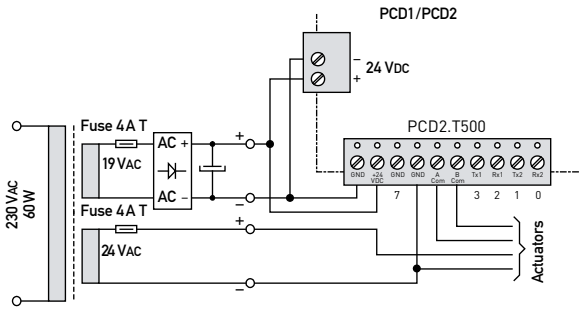
- 24 VDC ±20 % smoothed or
- 19 VAC ±15 % with full-wave rectifier and smoothing capacitor 10 000 µF/40 V

4.10.4 Supply possibilities

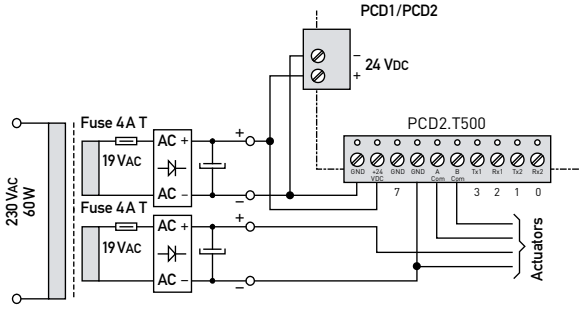
Common supply for controller and actuators



Separate supply of actuators with 24 VAC

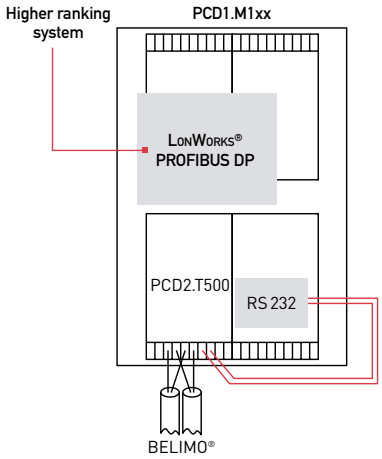


Individual DC supply for controller and actuators



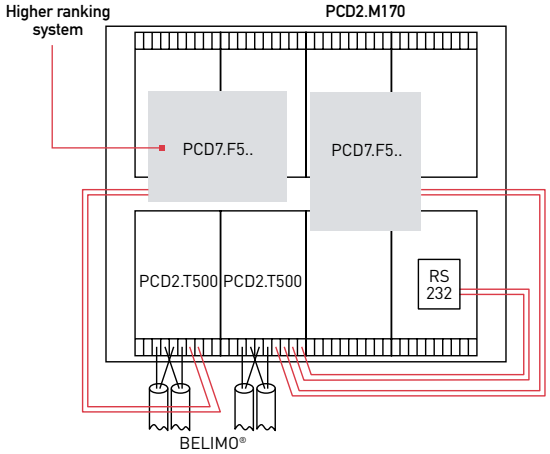
4.10.5 Configuration examples

Configuration example 1 with PCD1.M1xx



- PCD1.M1xx base unit
- Connection module assigned 1 × RS 232 communications interface (PCD7.F120 at space A) and 2 MP-Bus branches
- Gateway to other, higher ranking networks

Configuration example 2 with PCD2.M170



- PCD2.M170 base unit
- Connection module A assigned 1 × RS 232 communications interface and 2 MP-Bus branches
- Connection module B assigned 2 × RS 232 communications interfaces and 2 MP-Bus branches
- Gateway to other, higher ranking networks

Data exchange with DDC-PLUS systems

Every connection module (PCD2.T500 or PCD7.F180) needs an RS 232 serial port for communication with the master station! On the PCD2.T500 connection module, this port must be wired manually from the chosen PCD communications interface.

The PCD2.T500 connection module has two actuator branches (channel A and channel B) that can run both on one or two RS 232 transmission interfaces. The RS 232 interface connection at port 1 (terminals 2 and 3) will be for the first actuator branch and the RS 232 interface at port 2 (terminals 0 and 1) will be for the second actuator branch.

In projects that only have one RS 232 transmission interface within the PCD, both actuator branches (max. 16 actuators) can run on it. This involves a multiplexing process that switches between the two actuator branches. The fundamental rule applies that the more actuators are operated on one RS 232 serial transmission interface, the greater the load per branch.

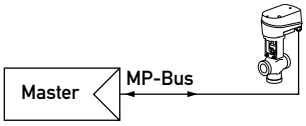
In multiplex operation the communications times of all actuators on both branches must be added together to obtain the overall cycle time. See also the examples below.

4.10.6 Communications times for MP-Bus

For each instruction transmitted via the bus, an average communications time of approx. 150 milliseconds is required (a command always consists of an instruction and an answer). The following values are identical for both damper and valve actuators.

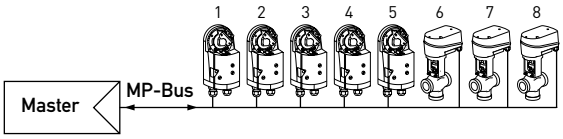
1. Example with one MFT(2) actuator
- The master sends a setpoint to the MFT(2) actuator (1st command).
- The master reads the actual value from the MFT(2) actuator (2nd command).

The entire communications process therefore comprises 2 commands of 150 ms = approx. 300 ms.



2. Example with two MFT(2) actuators
- The master sends one setpoint each to MFT(2) actuators 1…8 (total commands: 8).
- The master reads actual values from the MFT(2) actuators (total commands: 8).

The entire communications process therefore comprises 16 commands of 150 ms = approx. 2.4 s



4.10.7 Calculation of line length

Connection of MP-Bus
- The network consists of a 3-wire connection (MP communication and 24 V supply).
- Special cable or line termination resistors are not required.

- Line lengths are limited
  - by the total power rating for all connected MFT/MFT2 actuators,
  - by the type of supply (24 VAC or 24 VDC via the bus)
  - and by the conductor cross-section.

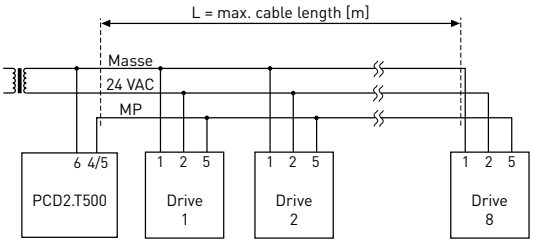
Distance table for the MP-Bus	Supply	maximum line lengths with 1.5 mm² cable							
Total power consumption [Watt]		5	10	15	20	25	30	35	40
max. line length*	24 VDC	300	150	100	85	60	50	42	38
	24 VAC	200	120	80	55	45	38	32	28

* all distance data are approximately and can deviate from the local condition

- By bigger cross sections of the cable, the distances can be increased.
- The maximum length of 800 meters can be reached, when the drives are supplied locally via a separate transformer with 24 VAC

Further data concerning distances and connection types are offered by BELIMO Automation AG

4.10.8 Maximum line length for 24 VAC supply



Important: For the NVF24-MFT2, dimensional output must be multiplied by a factor of 2.

4

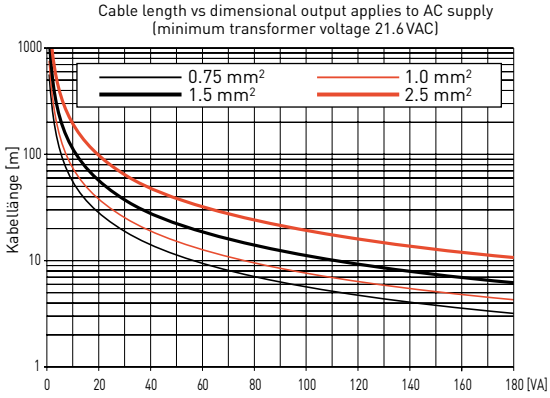
Determining maximum line lengths

The dimensional outputs [VA] of all MFT (2) actuators used must be added together and the corresponding line lengths read from the diagram.

Example: 1 × NM.., 1 × AM.., 1 × AF.. and 1 × NV.. are connected to the MP-Bus.

Total dimensional output: 3 VA + 5 VA + 10 VA + 5 VA = 23 VA

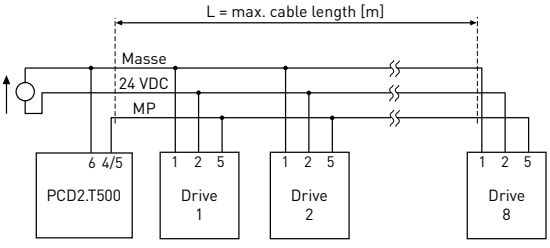
Total power consumption of MFT2 actuators [W]



The following can be read from the family of curves:

– Cable with conductor Ø 0.75 mm² gives: **Cable length 25 m**
– Cable with conductor Ø 1.0 mm² gives: **Cable length 33 m**
– Cable with conductor Ø 1.5 mm² gives: **Cable length 50 m**
– Cable with conductor Ø 2.5 mm² gives: **Cable length 85 m**

4.10.9 Maximum line length for 24 VDC supply



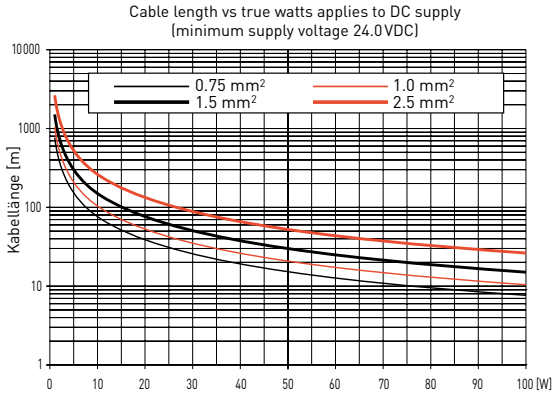
Determining maximum line lengths

Determining maximum line lengths The power consumption values [W] of all MFT/MFT2 actuators used must be added together and the corresponding line lengths read from the diagram.

Example: 1 × NM.., 1 × AM.., 1 × AF.. and 1 × NV.. are connected to the MP-Bus.

Total power consumption: 1.3 W + 2.5 W + 6.0 W + 3.0 W = 12.8 W

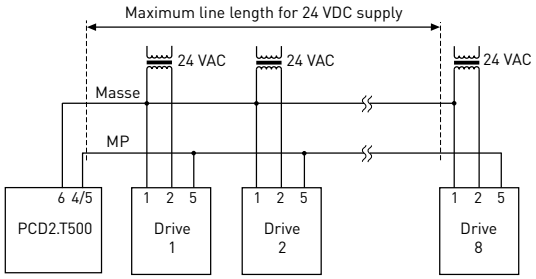
Total power consumption of MFT2 actuators [W]



The following can be read from the family of curves:

– Cable with conductor 0.75 mm² gives: **Cable length 60 m**
– Cable with conductor 1.0 mm² gives: **Cable length 80 m**
– Cable with conductor 1.5 mm² gives: **Cable length 115 m**
– Cable with conductor 2.5 mm² gives: **Cable length 200 m**

4.10.10 Maximum line length for 24 VAC supply (in situ)



If the actuators are supplied locally with 24 VAC via a separate transformer, line lengths can be much increased. Regardless of the power ratings for the actuators connected, the line lengths will be according to the following table.

Conductor Ø	L = max. line length
0.75 mm²	800 m
1.0 mm²	800 m
1.5 mm²	800 m
2.5 mm²	800 m

5 Input/output (I/O) modules

The summary below shows the available digital and analogue I/O modules, counters etc. for the PCD2 series:

Type	Des-igna-tion	No. I/Os or mod	Description	Input/output signal range	Page
PCD2 digital input modules					
PCD2.E110	8 I	8	8 inputs 8 ms	24 VDC	5-7
PCD2.E111	8 I	8	8 inputs 0.2 ms	24 VDC	5-7
PCD2.E112	8 I	8	8 inputs 9 ms	12 VDC	5-7
PCD2.E116	8 I	8	8 inputs 0.2 ms	5 VDC	5-7
PCD2.E160	16 I	16	16 inputs 8 ms, connection via 34-pole ribbon connector	24 VDC	5-9
PCD2.E161	16 I	16	16 inputs 0.2 ms, connection via 34-pole ribbon connector	24 VDC	5-9
PCD2.E165	16 I	16	16 inputs 8 ms, spring terminal connection	24 VDC	5-12
PCD2.E166	16 I	16	16 inputs 0.2 ms, spring terminal connection	24 VDC	5-12
PCD2 digital input modules, electrically isolated [1])					
PCD2.E500	6 I	6	6 inputs	100…240 VAC	5-15
PCD2.E610	8 I	8	8 inputs 10 ms, electrically isolated	24 VDC	5-17
PCD2.E611	8 I	8	8 inputs 0.2 ms, electrically isolated	24 VDC	5-17
PCD2.E613	8 I	8	8 inputs 9 ms, electrically isolated	48 VDC	5-17
PCD2.E616	8 I	8	8 inputs 0.2 ms, electrically isolated	5 VDC	5-17
PCD2 digital output modules					
PCD2.A300	6 O	6	6 outputs 2 A	10…32 VDC	5-20
PCD2.A400	8 O	8	8 outputs 0.5 A	5…32 VDC	5-22
PCD2.A460	8 O	8	8 outputs 0.5 A, electrically isolated	10…32 VDC	5-24
PCD2.A465	16 O	16	16 outputs 0.5 A, spring terminal connection	10…32 VDC	5-27
PCD2 digital output modules, electrically isolated					
PCD2.A200	4 O	4	4 make contacts 2 A	250 VAC 50 VDC	5-30
PCD2.A210	4 O	4	4 break contacts 2 A	250 VAC 50 VDC	5-32
PCD2.A220	6 O	6	6 make contacts 2 A	250 VAC 50 VDC	5-34
PCD2.A250	8 O	8	8 make contacts 2 A	48 VAC 50 VDC	5-36
PCD2.A410	8 O	8	8 outputs 0.5 A, electrically isolated [1])	5…32 VDC	5-38
PCD2 digital, combined I/O modules					
PCD2.B100	2I + 2O + 4I/O	8	2 inputs, 2 outputs, 4 selectable as inputs or outputs	24 VDC 5…32 VDC 24 VDC	5-41

1) galvanic separation of outputs to PCD, the channels themselves are not separated against each other

Type	Des-igna-tion	No. I/Os or mod	Description	Input/output signal range	Page

PCD2 multi-functional I/O modules

PCD2.G400			10 digital inputs 2 analogue inputs 10 bit 6 analogue inputs 10 bit 8 digital outputs 6 analogue outputs 8 bit	24 VDC 0…10 V Pt/Ni 1000 24 VDC 0…10 VDC	5-45
PCD2.G410			16 digital inputs 4 analogue inputs 10 bit 4 relay outputs 4 analogue outputs 8 bit	24 VDC I/U/T 250 VAC U/I	5-46

PCD2 analogue input modules

PCD2.W100	4 I	4	Analogue inputs 12 bit	0…10 V, -10…+10 V	5-49
PCD2.W105	4 I	4	Analogue inputs 12 bit	0…+20 mA -20…0 mA -20…+20 mA	5-49
PCD2.W110	4 I	4	Analogue inputs 12 bit	Pt 100	5-52
PCD2.W111	4 I	4	Analogue inputs 12 bit	Ni 100	5-52
PCD2.W112	4 I	4	Analogue inputs 12 bit	Pt 1000	5-52
PCD2.W113	4 I	4	Analogue inputs 12 bit	Ni 1000	5-52
PCD2.W114	4 I	4	Analogue inputs 12 bit	Pt 100	5-52
PCD2.W200	8 I	8	8 analogue inputs 10 bit	0…10 V	5-57
PCD2.W210	8 I	8	8 analogue inputs 10 bit	0…20 mA	5-57
PCD2.W220	8 I	8	8 analogue inputs 10 bit	Pt/Ni 1000	5-57
PCD2.W220Z02	8 I	8	8 analogue inputs 10 bit	NTC 10	5-57
PCD2.W220Z12	8 I	8	8 analogue inputs 10 bit	4×0…10 V 4×Pt/Ni 1000	5-57
PCD2.W300	8 I	8	8 analogue inputs 12 bit	0…10 V	5-62
PCD2.W310	8 I	8	8 analogue inputs 12 bit	0…20 mA	5-62
PCD2.W340	8 I	8	8 analogue inputs 12 bit, jumper selectable	0…10 V, 0…2,5 V 0…20 mA, Pt/Ni 1000	5-62
PCD2.W350	8 I	8	8 analogue inputs 12 bit	Pt/Ni 100	5-62
PCD2.W360	8 I	8	8 analogue inputs 12 bit, resolution ‹ 0.1 °C	Pt 1000	5-62

PCD2 analogue input modules, electrically isolated [1])

PCD2.W305	7 I	7	7 analogue inputs 12 bit	0…10 V	5-68
PCD2.W315	7 I	7	7 analogue inputs 12 bit	0…20 mA	5-68
PCD2.W325	7 I	7	7 analogue inputs 12 bit	-10…+10 V	5-68

1) galvanic separation of outputs to PCD, the channels themselves are not separated against each other

Type	Des-igna-tion	No. I/Os or mod	Description	Input/output signal range	Page

PCD2 analogue combined input/output modules

PCD2.W500	2I + 2O	4	2 analogue inputs 12 bit + 2 analogue outputs 12 bit	0…10 V, -10…+10 V	5-74
PCD2.W510	2I + 2O	4	2 analogue inputs 12 bit + 2 analogue outputs 12 bit	0…+20 mA -20…+20 mA	5-74

PCD2 analogue combined input/output modules, electrically isolated [1])

PCD2.W525	4 E + 2 A	4	4 analogue inputs 14 bit + 2 analogue outputs 12 bit	0…10 V, 0(4)…20 mA Pt 500 / 1000, Ni 1000 0…10 V, 0(4)…20 mA	5-79

PCD2 analogue output modules

PCD2.W400	4 O	4	4 analogue outputs 8 bit	0…10 V	5-85
PCD2.W410	4 O	4	4 analogue outputs 8 bit, jumper selectable	0…10 V, 0…20 mA, 4…20 mA	5-85
PCD2.W600	4 O	4	4 analogue outputs 12 bit	0…10 V	5-89
PCD2.W610	4 O	4	4 analogue outputs 12 bit, jumper selectable	0…10 V, -10 V..+10 V 0…20 mA, 4…20 mA, Pt 1000	5-89

PCD2 analogue output modules, electrically isolated [1])

PCD2.W605	6 O	6	6 analogue outputs 10 bit	0…10 V	5-94
PCD2.W615	4 O	4	4 analogue outputs 10 bit	0…20 mA	5-94
PCD2.W615	6 O	6	6 analogue outputs 10 bit	-10…+10 V	5-94

PCD2 weighing modules

PCD2.W710	1 I	1	1-channel weighing module for 4/6-wire weighing cells		5-98
PCD2.W720	2 I	2	2-channel weighing module for 4/6-wire weighing cells		5-98

PCD2 thermocouple modules

PCD2.W745	4 I	4	Thermocouple module for J, K… thermo-elements		5-99

1) Only one weighing cell connected to each channel

Type	Des-igna-tion	No. I/Os or mod	Description	Input/output signal range	Page
PCCD2 fast counting I/O modules					
PCD2.H100			Counting module up to 20 kHz		5-101
PCD2.H110			General purpose module up to 100 kHz		5-106
PCD2 SSI encoder modules					
PCD2.H150			SSI interface module		5-108
PCD2 Positioning modules for stepping motors					
PCD2.H210			Motion control module for stepper motors		5-112
Positioning modules for servo-drives					
PCD2.H310			Motion control module for servo-motors 1-axis encoder 24 VDC		5-117
PCD2.H311			Same as H310, but 1-axis encoder 5 VDC		5-117
PCD2.H320			Motion control module for servo-drives 2-axis with encoder 24 VDC		5-121
PCD2.H322			Same as H320, but 1-axis (slave operation)		5-121
PCD2.H325			Motion control module for servo-drives, 2-axis with 5 V and SSI absolute value encoder		5-121
PCD2.H327			Same as H325, but 1-axis (slave operation)		5-121

5

5.0.1 Power consumption of PCD2 input/output modules

Type PCD2....	Maximal internal current consumption I from +5 V [mA]	Maximal internal current consumption I from +V [mA]	Maximal external current consumption at 24 V, I [mA]
E11x	24	--	8 inputs, 6 mA/input
E16x	72	--	16 inputs, 4 mA/input
E500	1	--	6 inputs, 10…12 mA/input
E61x	24	--	8 inputs, 5 mA/input
A200	15	--	32 mA[1)]
A220	20	--	48 mA[1)]
A251	25	--	64 mA[1)]
A300	20	--	Load current
A400	25	--	Load current
A410	24	--	Load current
A46x	74	--	Load current
B100	25	--	Load current
W200/210	8	5	--
W220	8	16	--
W300/310	8	5	--
W3x5	60	0	--
W340/360	8	20	--
W350	8	30	--
W4x0	1	30	W410 100 mA[2)]
W5x0	200	--	--
W525	40	--	Load current
W600	4	20	--
W605/625	110	--	--
W610	110	--	100 mA[2)]
W615	55	--	90 mA
W720	60	100	--
W745	200	--	--
H100/H110	90	--	CCO output: load current
H150	25	--	Load current
H210	85	--	Load current
H310/H311	140	--	max. 15 mA
H320/H322	230	20	Load current
H325/H327	250	20	Load current

1) Coil resistance of the relay 3 kOhm

2) Basic consumption 20 mA, plus 0..20 mA per output

5.0.2 Maximal current consumption from base units

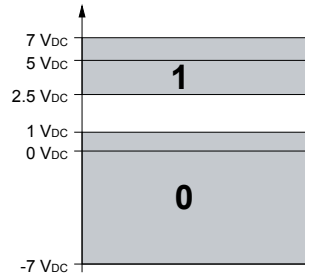
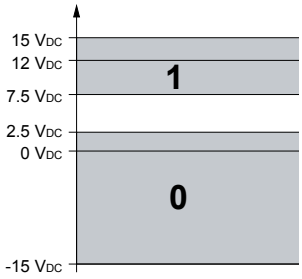
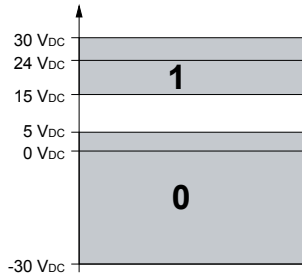
Base unit	internal 5 V-Bus	internal +V-Bus
PCD1	750 mA	100 mA
PCD2.M110/M120 (before hardware version H)	1100 mA	200 mA
PCD2.M110/M120	1600 mA	200 mA
PCD2.M150/M170	1600 mA	200 mA
PCD2.M480	2000 mA	200 mA

5.1 Digital input modules

PCD2.E110	**8 inputs, 24 VDC, 8 ms**
PCD2.E111	**8 inputs, 24 VDC, 0.2 ms**
PCD2.E112	**8 inputs, 12 VDC, 9 ms**
PCD2.E116	**8 inputs, 5 VDC, 0.2 ms**
PCD2.E160	**16 inputs, 24 VDC, 8 ms, connection via 34-pole ribbon connector**
PCD2.E161	**16 inputs, 24 VDC, 0.2 ms, connection via 34-pole ribbon connector**
PCD2.E165	**16 inputs, 24 VDC, 8 ms, spring terminal connection**
PCD2.E166	**16 inputs, 24 VDC, 0.2 ms, spring terminal connection**

5

Definition of input signals

for 5 VDC	for 12 VDC	for 24 VDC
PCD2.E116	PCD2.E112	PCD2.E110, PCD2.E111, PCD2.E160…E166
		

I/O modules and I/O terminal blocks may only be plugged in and removed when the PCD is disconnected from the power supply.

5.1.1 PCD2.E11x, 8 digital inputs

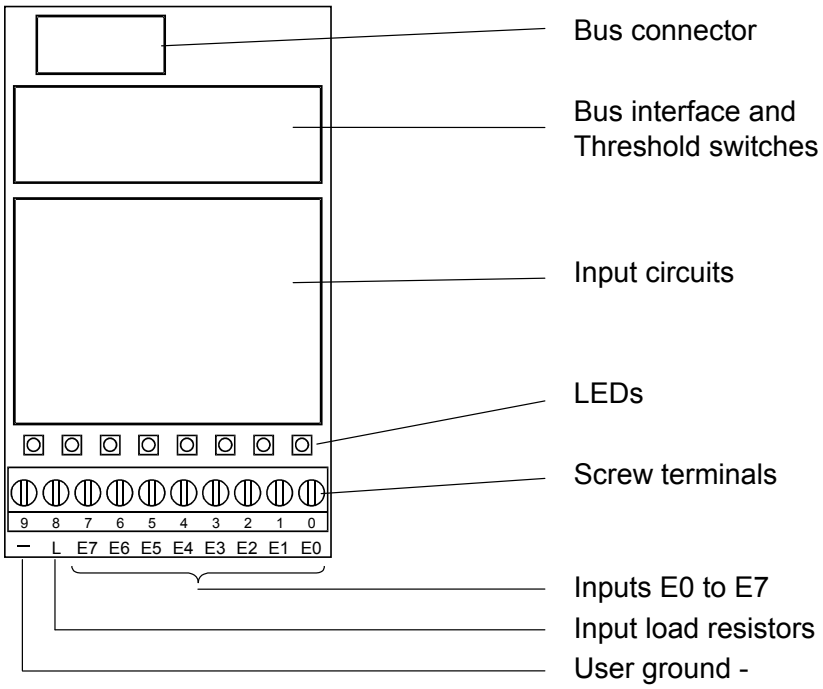
Application

Low-cost input module for source or sink operation with 8 inputs, electrically connected. Suitable for most electronic and electromechanical switching elements at 24 VDC. The PCD2.E111 differs from the PCD2.E110 in its shorter input delay, typically 0.2 ms.

Technical data

Number of inputs:		8 electrically connected, source or sink operation
Input voltage	E110 :	24 VDC (15…30 VDC) smoothed or pulsed
	E111 :	24 VDC (15…30 VDC) smoothed, max. 10 % residual ripple
	E113 :	12 VDC (7.5…15 VDC) smoothed, max. 10 % residual ripple
	E116 :	5 VDC (1…7 VDC) smoothed, max. 10 % residual ripple
	Special :	other values on request
Input current:		6 mA at 24 VDC
Input delay	E110 :	typically 8 ms
	E111 :	typically 0.2 ms
	E113 :	typically 9 ms
	E116:	typically 0.2 ms
Resistance to interference: acc. to IEC 801-4		2 kV under capacitive coupling (whole trunk group)
Internal current consumption: (from +5 V bus)		1…24 mA typically 12 mA
Internal current consumption: (from V+ bus)		0 mA
External current consumption:		max. 48 mA (all inputs=1) at 24 VDC
Terminals:		Pluggable 10-pole screw terminal block (4 405 4847 0), for wires up to 1.5 mm²

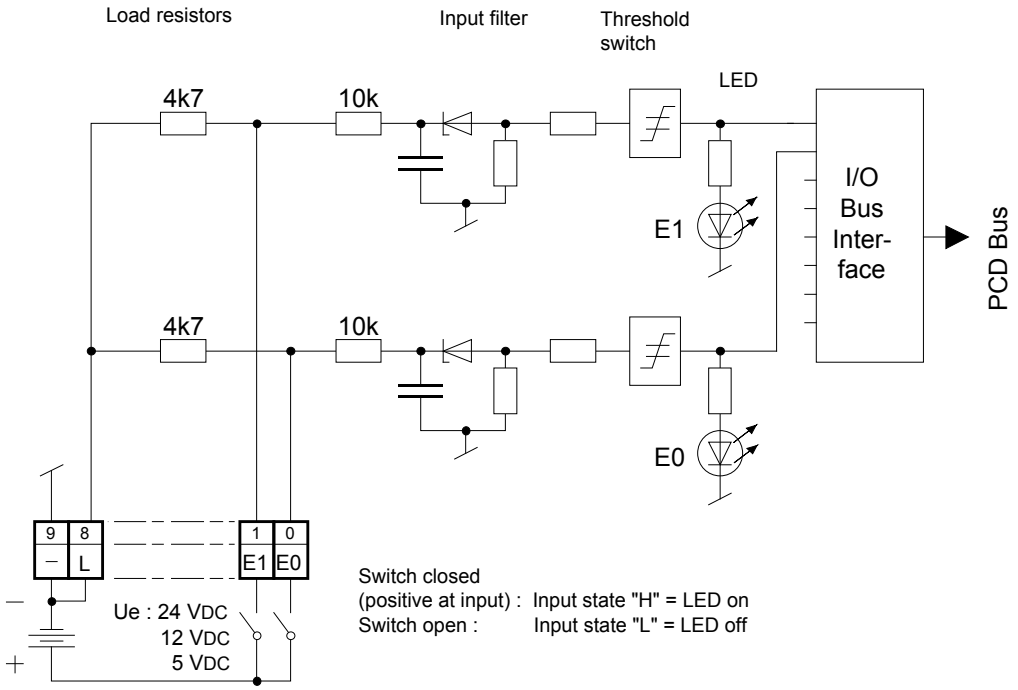
LEDs and connection terminals



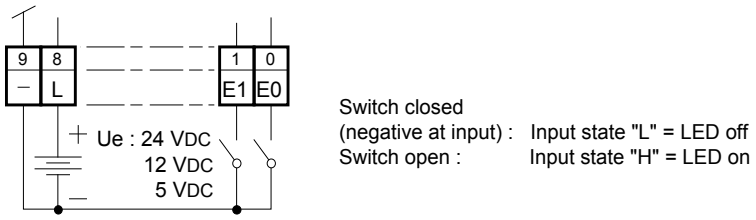
Input circuits and terminal designation

Depending on external wiring, this module may be used for source or sink operation.

Source operation (positive logic):



Sink operation (negative logic):



Watchdog: This module can be used on all base addresses; there is no interaction with the watchdog on the CPUs. For details, please refer to the "Watchdog" section, which describes the correct use of the watchdog in conjunction with PCD2 components.

5.1.2 PCD2.E160/161, 16 digital inputs, ribbon cable connector

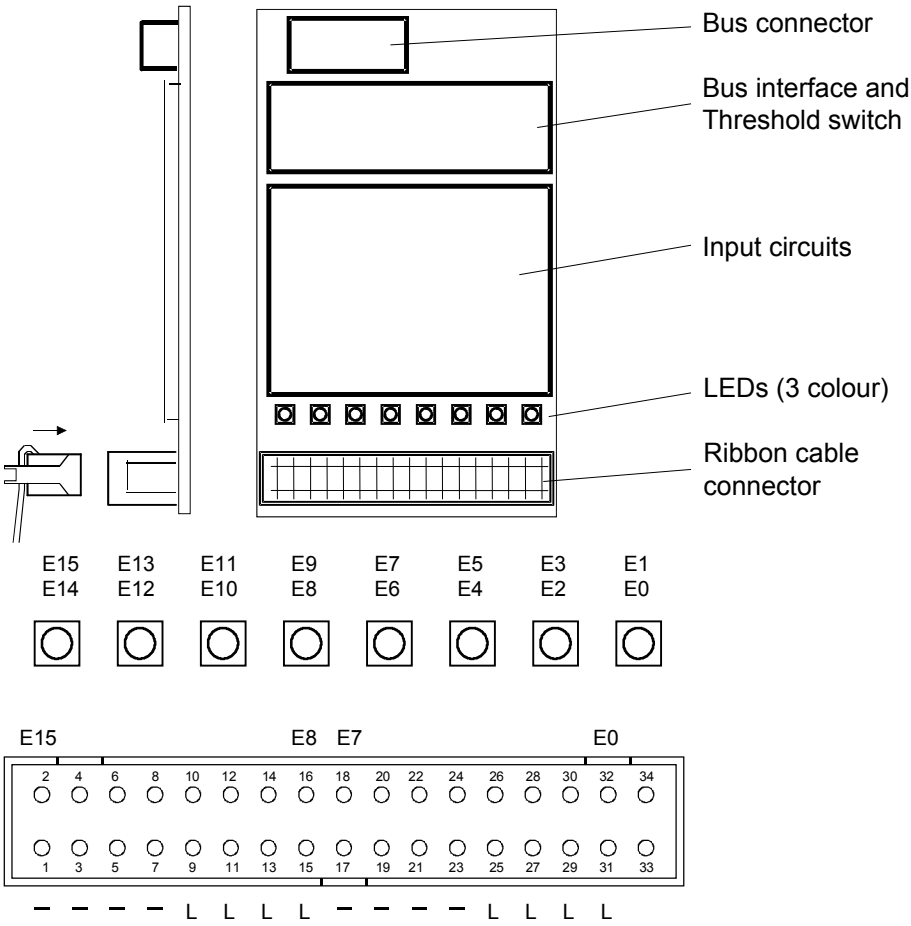
Application

Low-cost input module for source or sink operation with 16 inputs, electrically connected. Suitable for most electronic and electromechanical switching elements at 24 VDC. The PCD2.E161 differs from the PCD2.E160 in its shorter input delay, typically 0.2 ms.

Technical data

Number of inputs:	16 electrically connected, source or sink operation
Input voltage E160: E161:	24 VDC (15…30 VDC) smoothed or pulsed 24 VDC (15…30 VDC) smoothed max. 10 % residual ripple
Input current:	4 mA per input at 24 VDC
Input delay E160: E161:	typically 8 ms typically 0.2 ms
Resistance to interference: acc. to IEC 1000-4-4	2 kV under capacitive coupling (whole trunk group)
Internal current consumption: (from +5 V bus)	1…72 mA typically 36 mA
Internal current consumption: (from V+ bus)	0 mA
External current consumption	max. 64 mA (all inputs=”1”) at 24 VDC
Terminals:	34-pole ribbon connector

LEDs and connection terminals



For every 2 inputs, a 3-colour LED is fitted:

LED																
	E0	**E1**	**E2**	**E3**	**E4**	**E5**	**E6**	**E7**	**E8**	**E9**	**E10**	**E11**	**E12**	**E13**	**E14**	**E15**
off	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
red	1	0	1	0	1	0	1	0	1	0	1	0	1	0	1	0
green	0	1	0	1	0	1	0	1	0	1	0	1	0	1	0	1
yellow	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1

Saia-Burgess Controls provides a wide range of pre-configured cables with a 34-pole ribbon connector at one or both ends.

5

These connection cables can be plugged at one end into the PCD2.E160 I/O module and at the other end into an I/O terminal adapter.
The following adapters are obtainable from Saia-Burgess Controls: terminal adapters for connecting 3-wire sensors to individual terminals for Signal, Plus and Minus; terminal adapters for connecting 16 I/Os with and without LED and relay interface; and terminal adapters with changeover contacts for signal conversion for digital output modules.

For further details, please refer to TI 26/326.

The following materials can be ordered from ‘3M’:

- Socket connector 34-pole — Type 3414-6600
- (Metal strain relief) *) — Type 3448-2034
- (Handle for socket connector 34-pole) *) — Type 3490-3

Matching cables can be ordered in reels from ‘3M’:

- Ribbon cable 34-pole, grey with pin 1 identification — Type 3770/34 or 3801/34
- Round cable 34-pole, grey with pin 1 identification — Type 3759/34

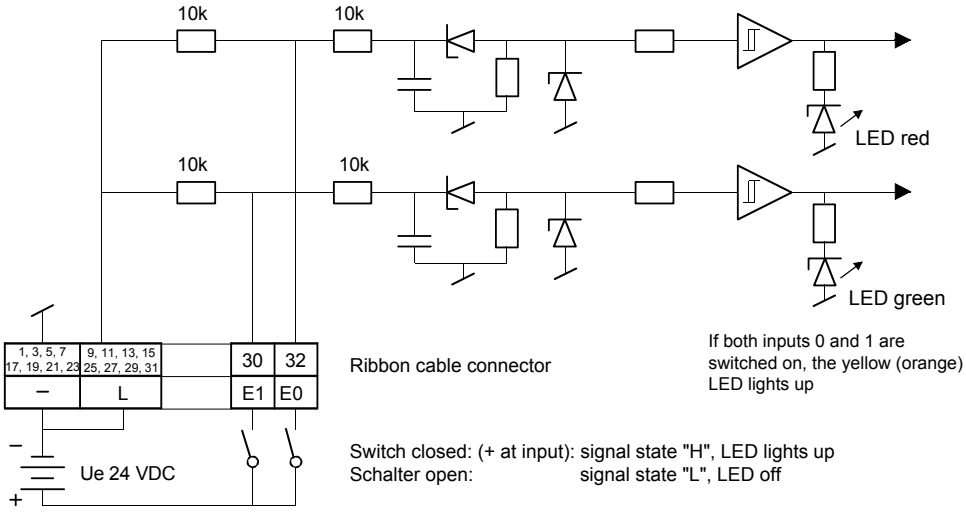
*) optional

5

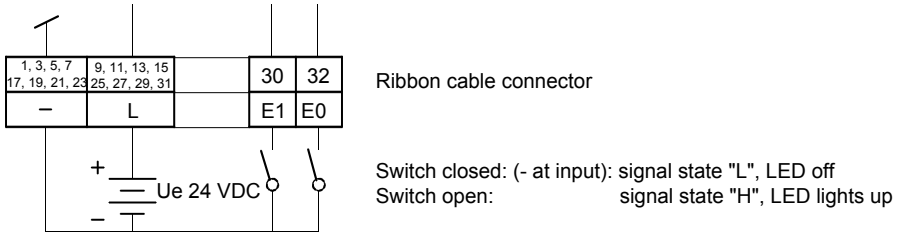
Input circuits and terminal designation

Depending on external wiring, this module may be used for source or sink operation.

Source operation (positive logic):



Sink operation (negative logic):



Watchdog: This module can interact with the watchdog; if it is used on base address 240 (or 496 for the PCD2.M17x), the last input with address 255 (or 511 for the PCD2.M17x) cannot be used.

For details, please refer to the “Watchdog” section, which describes the correct use of the watchdog in conjunction with PCD2 components.

5.1.3 PCD2.E165/166, 16 digital inputs, spring terminal connectors

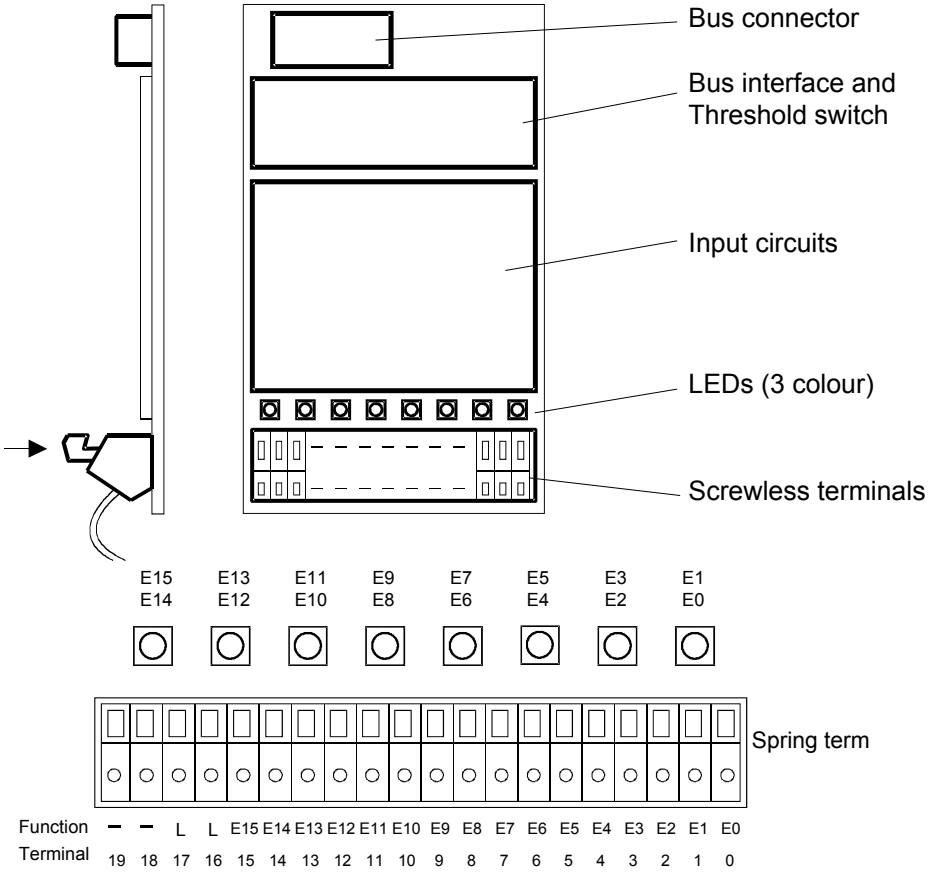
Application

Low-cost input module for source or sink operation with 16 inputs, electrically connected. Suitable for most electronic and electromechanical switching elements at 24 VDC. The PCD2.E166 differs from the PCD2.E165 in its shorter input delay, typically 0.2 ms.

Technical data

Number of inputs:	16 electrically connected, source or sink operation
Input voltage E165: E166:	24 VDC (15…30 VDC) smoothed or pulsed 24 VDC (15…30 VDC) smoothed max. 10 % residual ripple
Input current:	4 mA per input at 24 VDC
Input delay E165: E166:	typically 8 ms typically 0.2 ms
Resistance to interference: acc. to IEC 1000-4-4	2 kV under capacitive coupling (whole trunk group)
Internal current consumption: (from +5 V bus)	1…72 mA typically 36 mA
Internal current consumption: (from V+ bus)	0 mA
External current consumption	max. 64 mA (all inputs=1) at 24 VDC
Terminals:	Spring terminal connection (not pluggable), for wires up to max. 0.5 mm² (1 × AWG 20)

LEDs and connection terminals



For every 2 inputs, a 3-colour LED is fitted:

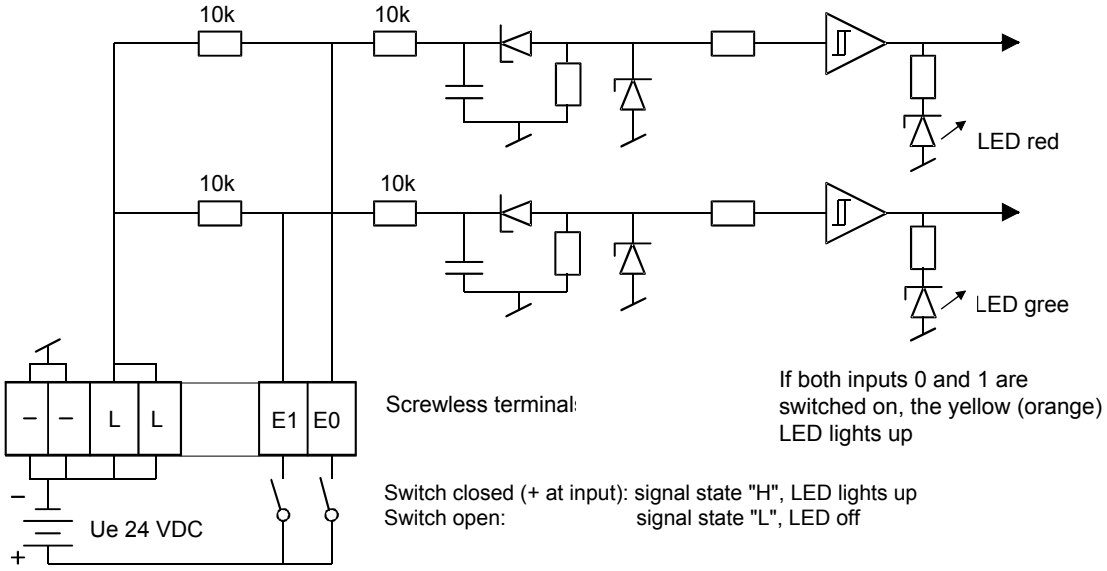
LED																
	E0	E1	E2	E3	E4	E5	E6	E7	E8	E9	E10	E11	E12	E13	E14	E15
off	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
red	1	0	1	0	1	0	1	0	1	0	1	0	1	0	1	0
green	0	1	0	1	0	1	0	1	0	1	0	1	0	1	0	1
yellow	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1

Input circuits and terminal designation

Depending on external wiring, this module may be used for source or sink operation.

5

Source operation (positive logic):

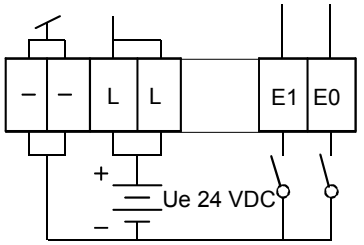


Screwless terminal

If both inputs 0 and 1 are switched on, the yellow (orange) LED lights up

Switch closed (+ at input): signal state "H", LED lights up
Switch open: signal state "L", LED off

Sink operation (negative logic):



Screwless terminal

Switch closed (- at input): signal state "L", LED off
Switch open: signal state "H", LED lights up

Watchdog: This module can interact with the watchdog; if it is used on base address 240 (or 496 for the PCD2.M17x), the last input with address 255 (or 511 for the PCD2.M17x) cannot be used.

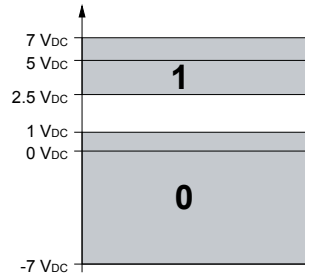
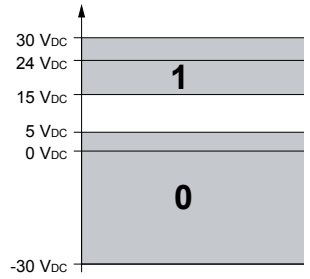
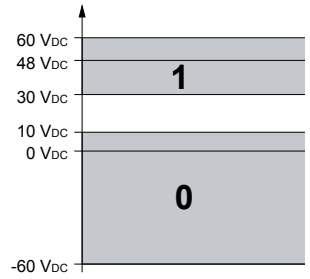
For details, please refer to the "Watchdog" section, which describes the correct use of the watchdog in conjunction with PCD2 components.

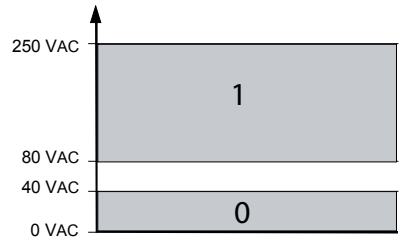
5.2 Digital input modules, electrically isolated

PCD2.E500	**6 inputs for 115 - 230 VAC**
PCD2.E610	**8 inputs 24 VDC, 10 ms**
PCD2.E611	**8 inputs 24 VDC, 0.2 ms**
PCD2.E613	**8 inputs 48 VDC, 9 ms**
PCD2.E616	**8 inputs 5 VDC, 0.2 ms,**

Galvanic separation of outputs to PCD.
The channels themselves not are separated.

Definition of input signals

for 5 VDC	for 24 VDC	for 48 VDC
PCD2.E616	PCD2.E610, PCD2E611	PCD2.E613
		

for 115 – 230 VAC
PCD2.E500


Installation instructions

For reasons of safety it is not permissible to connect low voltages (up to 50 V) and higher voltages (50…250 V) to the same module.

If a PCD module is connected to a higher voltage (50…250 V), approved components for this voltage must be used for all elements that are electrically connected to the system.

Using higher voltage (50…250 V), all connections to the relay contacts must be connected on the same circuit, i.e. in such a way that they are all protected against one AC phase by one common fuse. Each load circuit may also be protected individually.

I/O modules and I/O terminal blocks may only be plugged in and removed when the PCD is disconnected from the power supply.

5.2.1 PCD2.E500, 6 digital inputs for 115 - 230 VAC

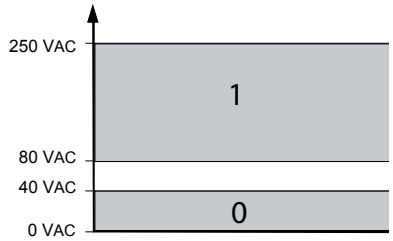
Application

Module with 6 electrically isolated inputs for alternating current. The inputs are set up for source operation and **have one common "COM" terminal**. Only the positive half-wave of the alternating current is used.

Technical data

Number of inputs	6 electrically isolated from the CPU, Source operation, all inputs to the module in the same phase
Input voltage	115/230 V 50/60 Hz, sinusoidal (80 to 250 VAC)
Input current	115 VAC: 5…6 mA (wattless current) 230 VAC: 10…12 mA (wattless current)
Input delay switch-on: switch-off:	 typically 10 ms; max. 20 ms typically 20 ms; max. 30 ms
LED	supplied directly from input current
Resistance to interference acc. to IEC 801-4	4 kV under direct coupling 2 kV under capacitive coupling (whole trunk group)
Electrical isolation voltage	2000 VAC, 1 min
Electrical isolation resistance	100 MOhm / 500 VDC
Optocoupler isolation voltage	2.5 kV Galvanic separation of outputs to PCD. The channels themselves not are separated.
Internal current consumption: (from +5 V bus)	< 1 mA
Internal current consumption: (from V+ bus)	0 mA
External current consumption:	
Terminals:	Pluggable 10-pole screw terminal block (4 405 4847 0), for wires up to 1.5 mm²

Switch on/off level:



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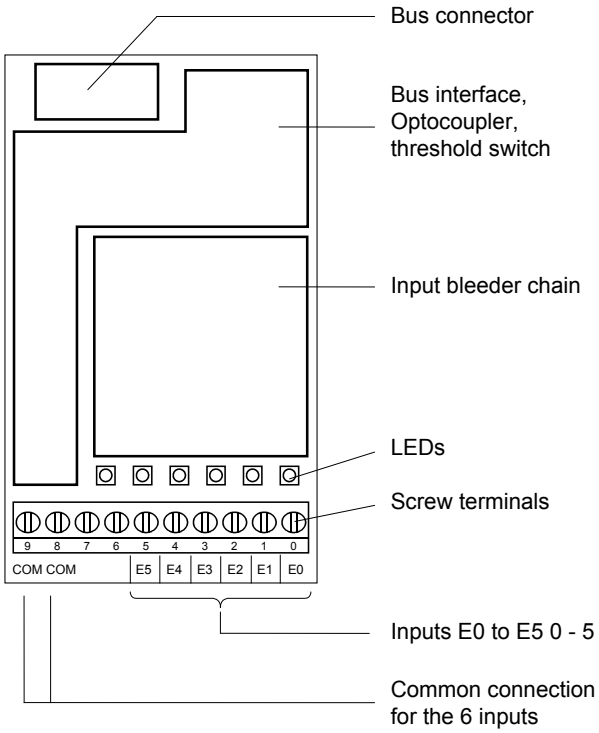
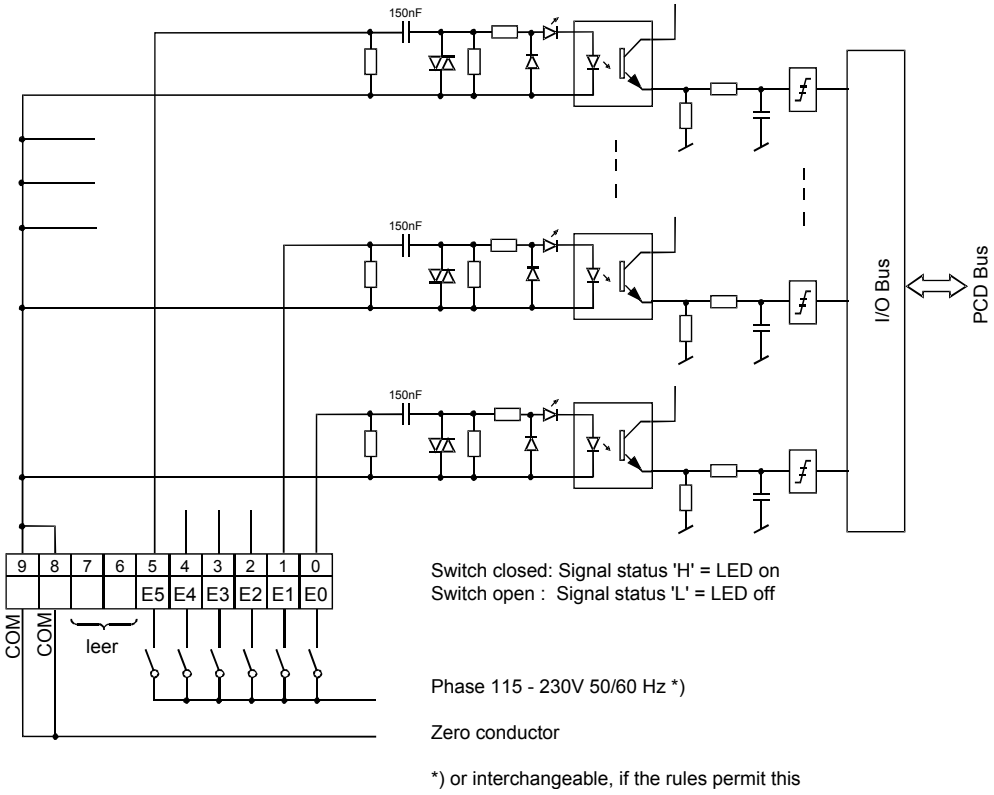
LEDs and connection terminals



Input circuits and terminal designation



Watchdog: This module can be used on all base addresses; there is no interaction with the watchdog on the CPUs. For details, please refer to the "Watchdog" section, which describes the correct use of the watchdog in conjunction with PCD2 components.

5.2.2 PCD2.E61x, 8 digital inputs, electrically isolated

Application

Input module for source or sink operation with 8 inputs, electrically isolated by optocoupler. Suitable for most electronic and electromechanical switching elements at 24 VDC. The PCD2.E611 differs from the PCD2.E610 in its shorter input delay, typically 0.2 ms.

Technical data

Number of inputs:	8 electrically isolated by optocoupler, source or sink operation, all inputs to the module in the same phase				
Input voltage	E610:	24 VDC (15…30 VDC) smoothed or pulsed			
	E611:	24 VDC (15…30 VDC) smoothed max. 10 % residual ripple			
	E613:	48 VDC (30…60 VDC) smoothed max. 10 % residual ripple			
	E616:	5 VDC (7.5…15 VDC) smoothed max. 10 % residual ripple			
Supply voltage:		E610:	E611:	E613:	E616:
for source operation:	min.	15 V	15 V	30 V	3 V
for sink operation:	min.	18 V	18 V	36 V	3.6 V
Input current:		E610:	E611:	E613:	E616:
(at input voltage)		(24 VDC)	(24 VDC)	(48 VDC)	(5 VDC)
for source operation:		5 mA	5 mA	2 mA	8.4 mA
for sink operation:		3.7 mA	3.7 mA	1.5 mA	6.2mA
Input delay (0-1/1-0):		E610:	E611:	E613:	E616:
	on.	10 ms	0.2 ms	9 ms	0.2 ms
	off.	10 ms	1.0 ms	9 ms	1.0 ms
Resistance to interference: acc. to IEC 801-4	4 kV under direct coupling 2 kV under capacitive coupling (whole trunk group)				
Electrical isolation voltage: Optocoupler isolation voltage:	1000 VAC, 1 min. 2.5 kV Galvanic separation of outputs to PCD. The channels themselves not are separated.				
Internal current consumption: (from +5 V bus)	1…24 mA typ. 12 mA				
Internal current consumption: (from V+ bus)	0 mA				
External current consumption:	max. 40 mA (all inputs=1) at 24 VDC, (source operation), max. 18 mA (sink operation)				
Terminals:	Pluggable 10-pole spring terminal block (4 405 4847 0), for wires up to 1.5 mm²				

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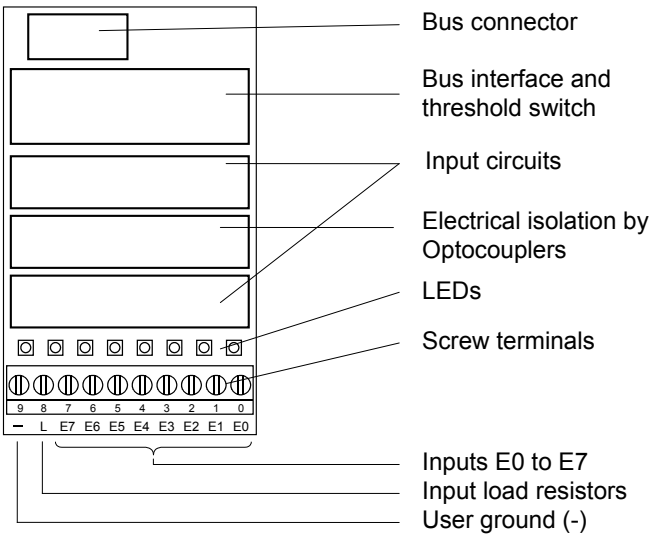
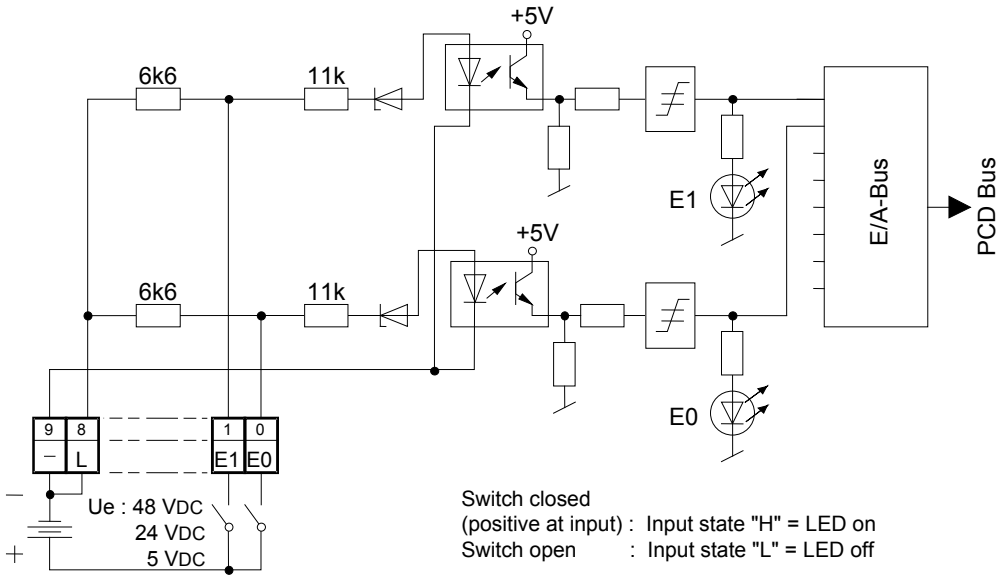
LEDs and connection terminals



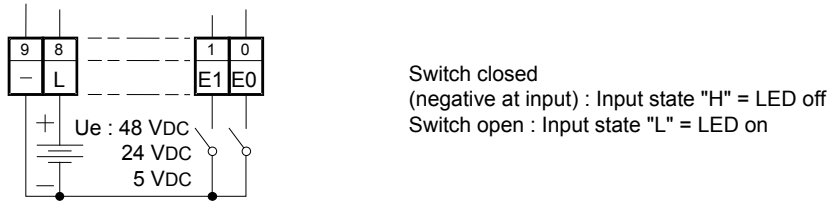
Input circuits and terminal designation

Depending on external wiring, this module may be used for source or sink operation.

Source operation (positive logic):



Sink operation (negative logic):



Watchdog: This module can be used on all base addresses; there is no interaction with the watchdog on the CPUs. For details, please refer to the "Watchdog" section, which describes the correct use of the watchdog in conjunction with PCD2 components.

5.3 Digital output modules

PCD2.A300	**6 outputs 2 A, 10…32 VDC**
PCD2.A400	**8 outputs 0.5 A, 10…32 VDC**
PCD2.A460	**16 outputs 0.5 A, 10…32 VDC**
PCD2.A465	**16 outputs 0.5 A, 10..32 VDC**

I/O modules and I/O terminal blocks may only be plugged in and removed when the PCD is disconnected from the power supply.

5.3.1 PCD2.A300, 6 digital outputs for 2 A each

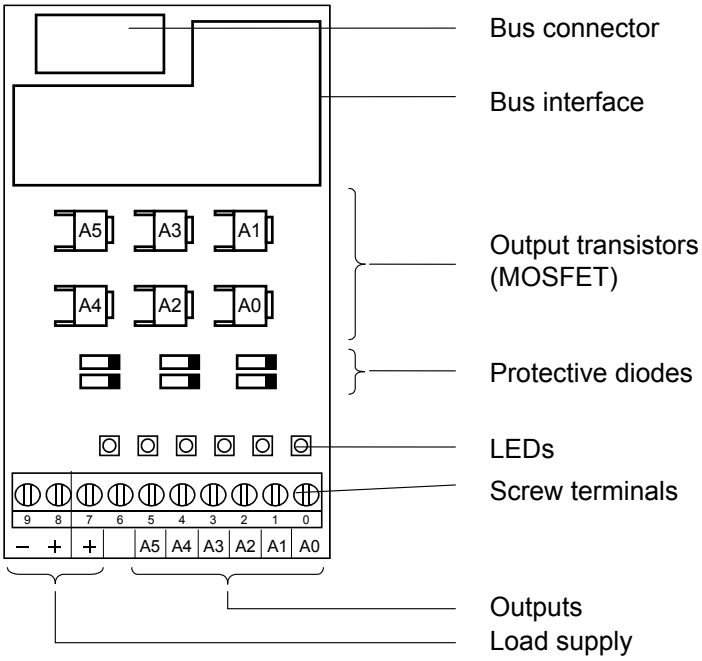
Application

Low cost output module with 6 transistor outputs 5 mA…2 A, without short-circuit protection. The individual circuits are electrically connected; the voltage range is 10…32 VDC.

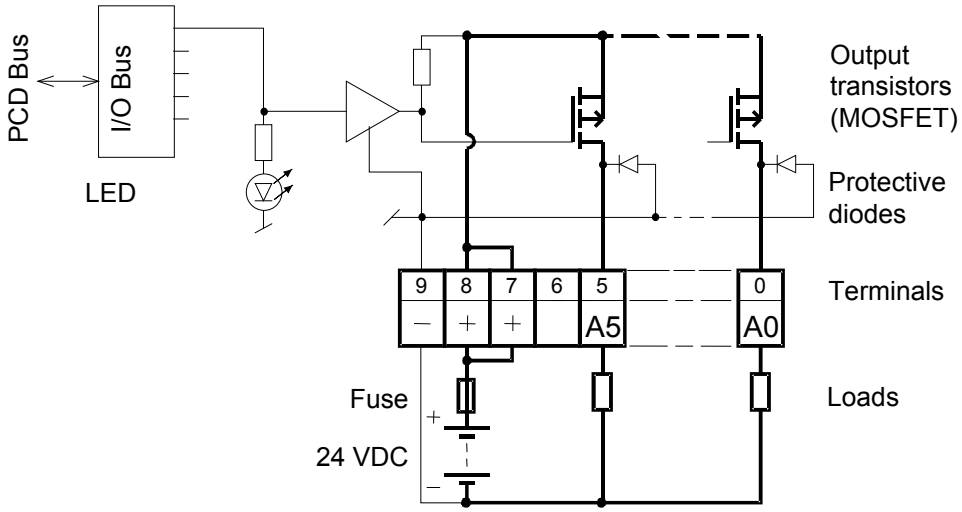
Technical data

Number of outputs:	6, electrically connected
Output current:	5 mA…2 A (leakage current max. 0.1 mA)
Total current per module:	6 × 2 A = 12 A (on 100 % duty cycle)
Operating mode:	Source operation (positive switching)
Voltage range:	10…32 VDC, smoothed 10…25 VDC, pulsed
Voltage drop:	0.2 V at 2 A
Output delay:	Switch-on delay <1 µs Switch-off delay <200 µs with inductive loads the delay is longer, because of the protective diode.
Isolation voltage:	1000 VAC, 1 min
Resistance to interference: acc. to IEC 801-4	4 kV under direct coupling 2 kV under capacitive coupling (whole trunk group)
Internal current consumption: (from +5 V bus)	1…20 mA typically 12 mA
Internal current consumption: (from V+ bus)	0 mA
External current consumption:	Load current
Terminals:	Pluggable 10-pole screw terminal block (4 405 4847 0), for wires up to 1.5 mm²

LEDs and connection terminals



Output circuits and terminal designation



Output conducting (set): LED on
Output disconnected (reset): LED off

Fuse: It is recommended that each module should be separately protected with a fast-blow (S) fuse of max. 12.5 A.

Watchdog: This module can be used on all base addresses; there is no interaction with the watchdog on the CPUs. For details, please refer to the "Watchdog" section, which describes the correct use of the watchdog in conjunction with PCD2 components.

5.3.2 PCD2.A400, 8 digital outputs for 0.5 A each

Application

Low cost output module with 8 transistor outputs 5…500 mA, without short circuit protection. For non-isolated circuits in the voltage range 5…32 VDC.

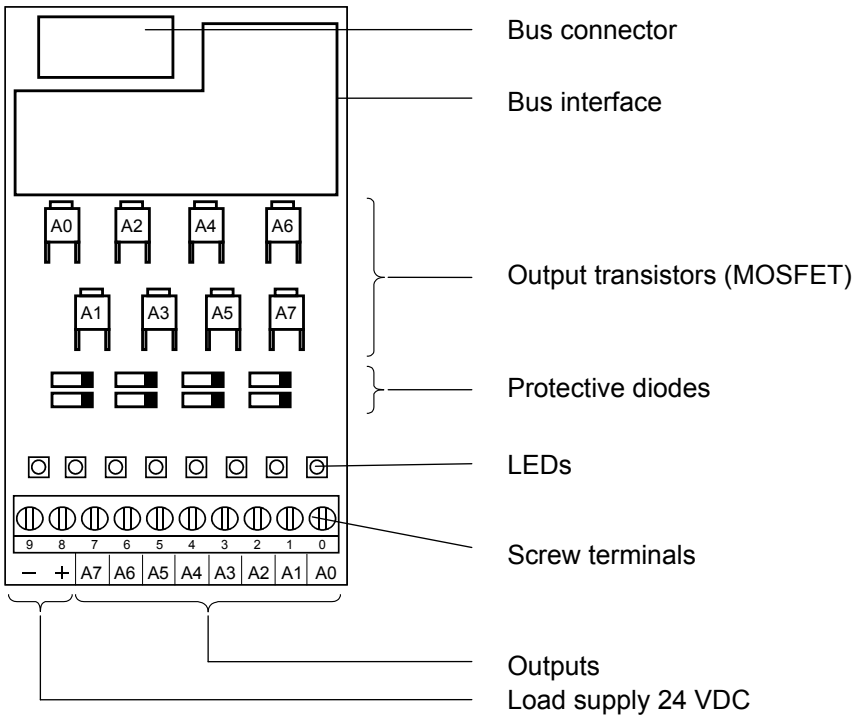
Technical data (for version “B”)*

Number of outputs:	8, electrically connected
Output current:	5…500 mA (leakage current max. 0,1 mA) Within the voltage range 5…24 VDC, the load resistance should be at least 48 Ω
Total current per module:	4 A on 100 % duty cycle
Operating mode:	Source operation (positive switching)
Voltage range:	5…32 VDC, smoothed 10…25 VDC, pulsed
Voltage drop:	≤ 0.4 V at 0.5 A
Output delay:	Switch-on delay typically 10 µs Switch-off delay typically 50 µs (ohmic load 5…500 mA), longer with inductive load, because of the protective diode.
Resistance to interference: acc. to IEC 801-4	4 kV under direct coupling 2 kV under capacitive coupling (whole trunk group)
Internal current consumption: (from +5 V bus)	1…25 mA typically 15 mA
Internal current consumption: (from V+ bus)	0 mA
External current consumption:	Load current
Terminals:	Pluggable 10-pole screw terminal block (4 405 4847 0), for wires up to 1.5 mm²

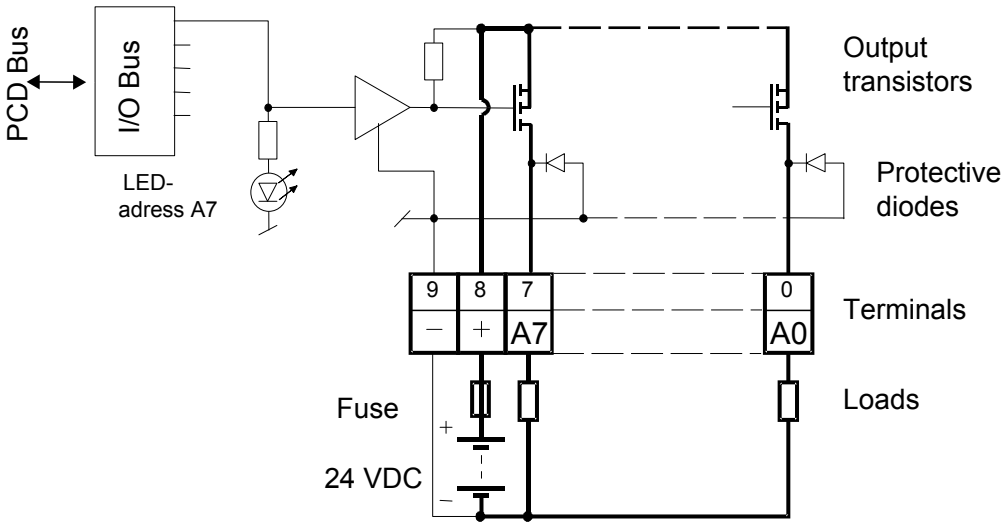
* Version “B” available since February 1995

(Version “A” was fitted with bipolar transistors. These had a shorter recovery time, but also a higher residual voltage, resulting in a restriction on 100 % loading)

LEDs and connection terminals



Output circuits and terminal designation



Output conducting (set): LED on
Output disconnected (reset): LED off

Fuse: It is recommended that each module should be separately protected with a fast-blow (S) 4 A fuse

Watchdog: This module can be used on all base addresses; there is no interaction with the watchdog on the CPUs. For details, please refer to the "Watchdog" section, which describes the correct use of the watchdog in conjunction with PCD2 components.

5.3.3 PCD2.A460, 16 digital outputs for 0.5 A each, with ribbon connector

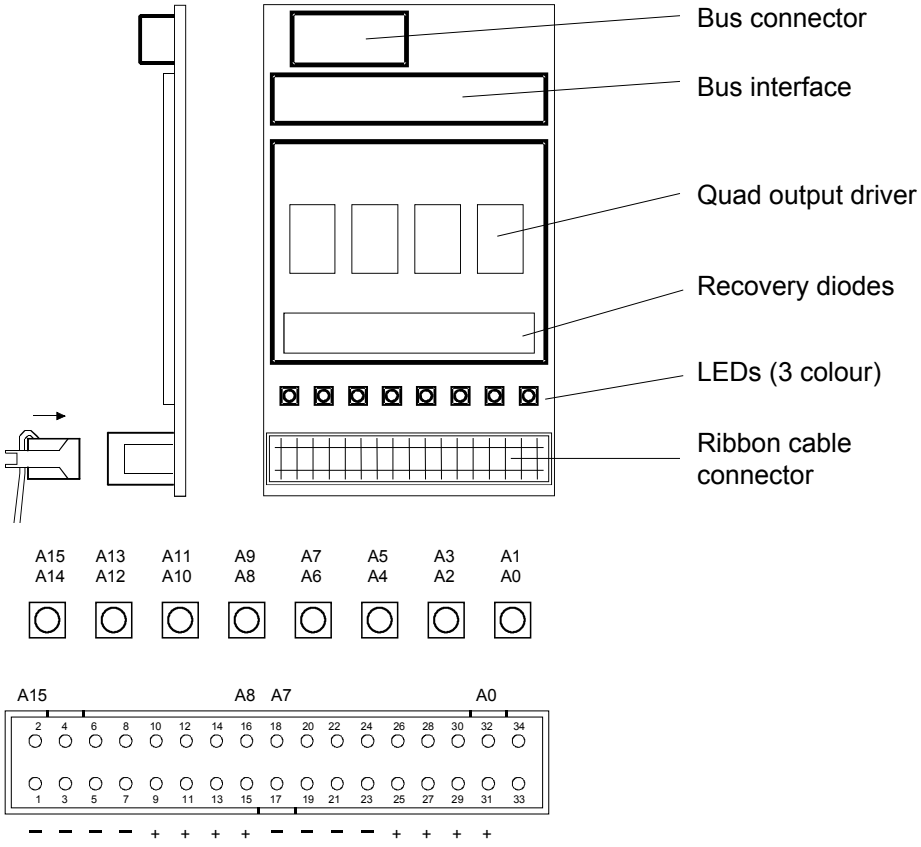
Application

Low cost output module with 16 transistor outputs 5…500 mA, with short-circuit protection. The individual circuits are electrically connected; the voltage range is 10…32 VDC.

Technical data

Number of outputs:	16, electrically connected
Output current:	5…500 mA (leakage current max. 0,1 mA) Within the voltage range 5…24 VDC, the load resistance should be at least 48 Ω
Short circuit protection	yes
Total current per module:	8 A on 100 % duty cycle
Operating mode:	Source operation (positive switching)
Voltage range:	10…32 VDC, smoothed, max. 10 % residual ripple
Voltage drop:	max. 0.3 V at 0.5 A
Output delay:	typically 50 µs, max. 100 µs for resistive load
Resistance to interference: acc. to IEC 801-4	4 kV under direct coupling 2 kV under capacitive coupling (whole trunk group)
Internal current consumption: (from +5 V bus)	max 74 mA (all outputs = “1”) typically 40 mA
Internal current consumption: (from V+ bus)	0 mA
External current consumption:	Load current
Terminals:	34-pole ribbon cable connector

LEDs and connection terminals



For every 2 inputs, a 3-colour LED is fitted:

LED																
	A0	**A1**	**A2**	**A3**	**A4**	**A5**	**A6**	**A7**	**A8**	**A9**	**A10**	**A11**	**A12**	**A13**	**A14**	**A15**
off	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
red	1	0	1	0	1	0	1	0	1	0	1	0	1	0	1	0
green	0	1	0	1	0	1	0	1	0	1	0	1	0	1	0	1
yellow	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1

Saia-Burgess Controls provides a wide range of pre-configured cables with a 34-pole ribbon connector at one or both ends.

These connection cables can be plugged at one end into the PCD2.E460 I/O module and at the other end into an I/O terminal adapter.
The following adapters are obtainable from Saia-Burgess Controls: terminal adapters for connecting 3-wire sensors to individual terminals for Signal, Plus and Minus; terminal adapters for connecting 16 I/Os with and without LED and relay interface; and terminal adapters with changeover contacts for signal conversion for digital output modules.

For further details, please refer to TI P+P26/326.

The following materials can be ordered from ‘3M’:

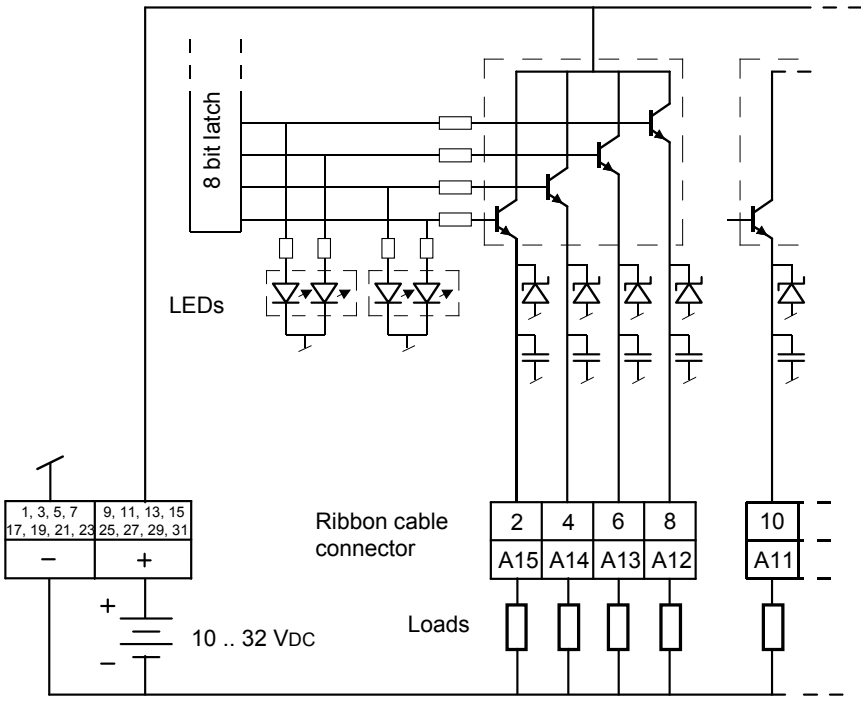
- Socket connector 34-pole Type 3414-6600
- (Metal strain relief) *) Type 3448-2034
- (Handle for socket connector 34-pole) *) Type 3490-3

Matching cables can be ordered in reels from ‘3M’:

- Ribbon cable 34-pole,
  grey with pin 1 identification Type 3770/34 or 3801/34
- Round cable 34-pole,
  grey with pin 1 identification Type 3759/34

*) optional

Output circuits and terminal designation



Watchdog: This module can interact with the watchdog; if it is used on base address 240 (or 496 for the PCD2.M17x), the last input with address 255 (or 511 for the PCD2.M17x) cannot be used.

For details, please refer to the "Watchdog" section, which describes the correct use of the watchdog in conjunction with PCD2 components.

5.3.4 PCD2.A465, 16 digital outputs, for 0.5 A each

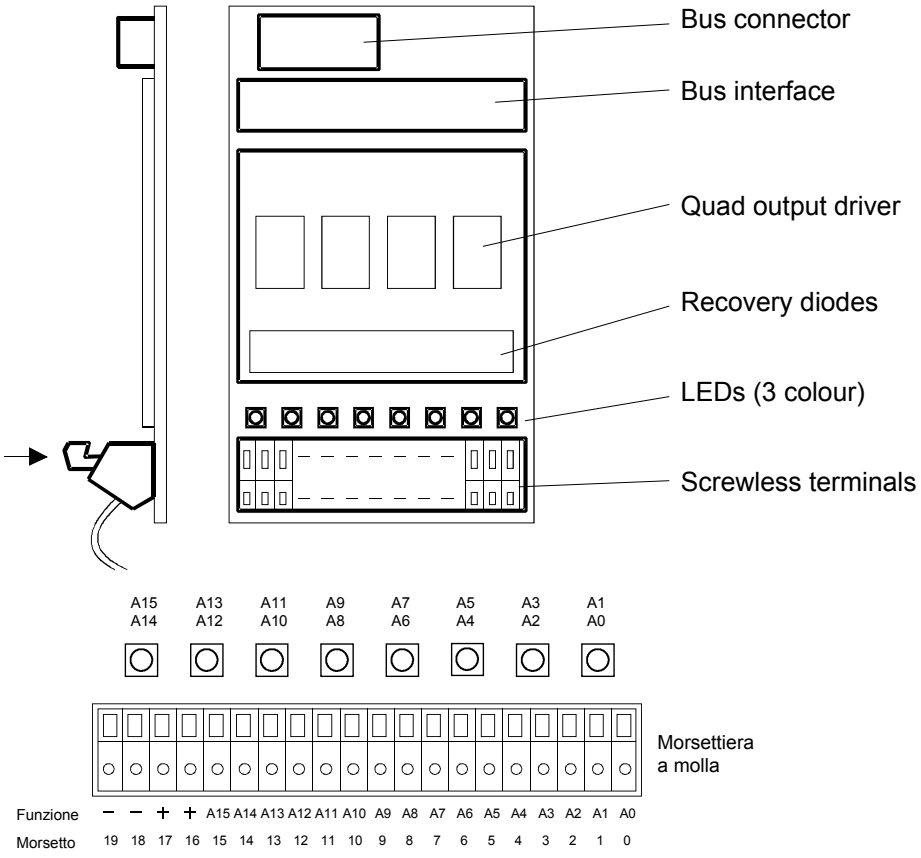
Application

Low cost output module with 16 transistor outputs 5…500 mA, with short-circuit protection. The individual circuits are electrically connected; the voltage range is 10…32 VDC.

Technical data

Number of outputs:	16, electrically connected
Output current:	5…500 mA (leakage current max. 0,1 mA) Within the voltage range 10…24 VDC, the load resistance should be at least 48 Ω
Short circuit protection	yes
Total current per module:	8 A on 100 % duty cycle
Operating mode:	Source operation (positive switching)
Voltage range:	10…32 VDC, smoothed, max. 10 % residual ripple
Voltage drop:	max. 0.3 V at 0.5 A
Output delay:	typically 50 µs, max. 100 µs for resistive load
Resistance to interference: acc. to IEC 801-4	4 kV under direct coupling 2 kV under capacitive coupling (whole trunk group)
Internal current consumption: (from +5 V bus)	max 74 mA (all outputs = “1”) typically 40 mA
Internal current consumption: (from V+ bus)	0 mA
External current consumption:	Load current
Terminals:	Spring terminal connection (not pluggable), for wires up to max. 0.5 mm² (1 × AWG 20)

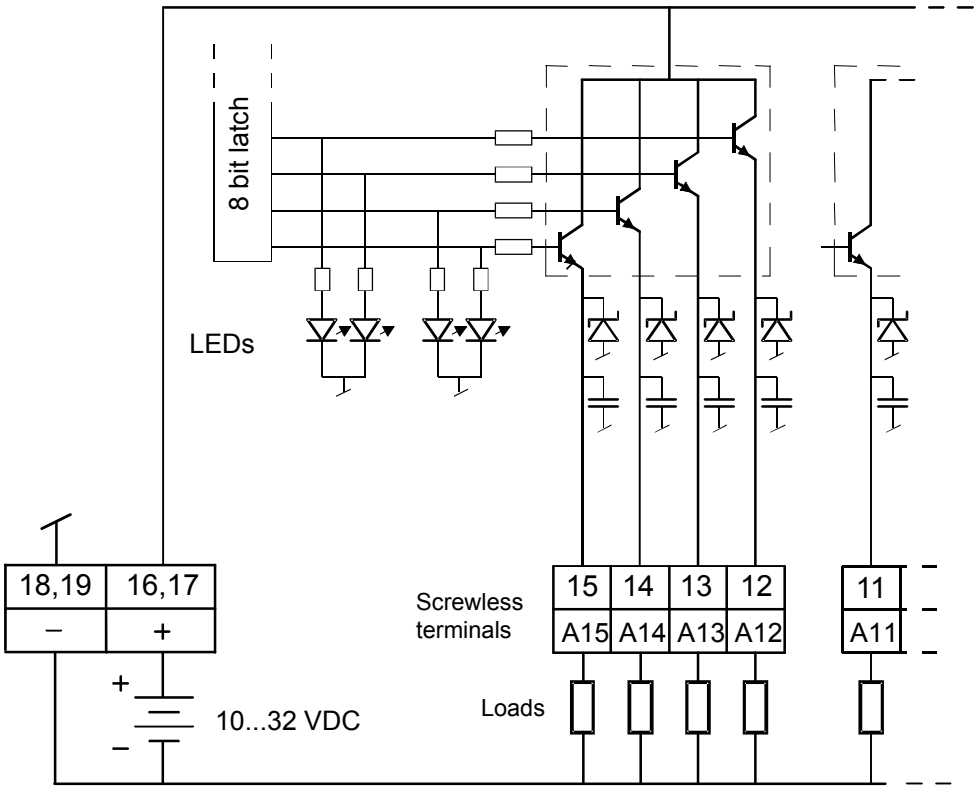
LEDs and connection terminals



For every 2 outputs, a 3-colour LED is fitted:

LED	○		○		○		○		○		○		○		○	
	A0	**A1**	**A2**	**A3**	**A4**	**A5**	**A6**	**A7**	**A8**	**A9**	**A10**	**A11**	**A12**	**A13**	**A14**	**A15**
off	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
red	1	0	1	0	1	0	1	0	1	0	1	0	1	0	1	0
green	0	1	0	1	0	1	0	1	0	1	0	1	0	1	0	1
yellow	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1

Output circuits and terminal designation



Watchdog: This module can interact with the watchdog; if it is used on base address 240 (or 496 for the PCD2.M17x), the last input with address 255 (or 511 for the PCD2.M17x) cannot be used.

For details, please refer to the "Watchdog" section, which describes the correct use of the watchdog in conjunction with PCD2 components.

5.4 Digital output modules, electrically isolated

PCD2.A200	**4 make contacts 2 A, 250 VAC | 50 VDC**
PCD2.A210	**4 break contacts 2 A, 250 VAC | 50 VDC**
PCD2.A220	**6 make contacts 2 A, 250 VAC | 50 VDC**
PCD2.A250	**8 make contacts 2 A, 48 VAC | 50 VDC pluggable 14-pole screw terminal block**
PCD2.A410	**8 digital outputs 0.5 A each, 5…32 VDC, electrically isolated against PCD2 bus**

Installation instructions

For reasons of safety it is not permissible to connect low voltages (up to 50 V) and higher voltages (50…250 V) to the same module.

If a PCD module is connected to a higher voltage (50…250 V), approved components for this voltage must be used for all elements that are electrically connected to the system.

Using higher voltage (50…250 V), all connections to the relay contacts must be connected on the same circuit, i.e. in such a way that they are all protected against one AC phase by one common fuse. Each load circuit may also be protected individually.

I/O modules and I/O terminal blocks may only be plugged in and removed when the PCD is disconnected from the power supply.

In the appendix, Chapter A.4 relay contacts, are calculation data and wiring suggestions for the relay contacts. These data should be absolutely considered for safe switching and a long life span of the relays.

5.4.1 PCD2.A200, 4 relays with make contacts, with contact protection

Application

The module contains 4 relays with normally-open contacts for direct or alternating current up to 2 A, 250 VAC. The contacts are protected by a varistor and an RC element. The module is especially suited wherever perfectly isolated AC switching circuits with infrequent switching have to be controlled.

Technical data

Number of outputs:	4, electrically isolated make contacts
Type of relay (typical):	RE 030024, SCHRACK
Switching capacity: (contact lifetime)	2 A, 250 VAC AC1 0.7 × 10^6 operations 1 A, 250 VAC AC11 1.0 × 10^6 operations 2 A, 50 VDC DC1 0.3 × 10^6 operations [3)] 1 A, 24 VDC DC11 0.1 × 10^6 operations [1)3)]
Relay coil supply: [2)]	nominal 24 VDC smoothed or pulsed, 8 mA per relay coil
Voltage tolerance, dependent on ambient temperature:	20 °C: 17.0…35 VDC 30 °C: 19.5…35 VDC 40 °C: 20.5…32 VDC 50 °C: 21.5…30 VDC
Output delay:	typically 5 ms bei 24 VDC
Resistance to interference: acc. to IEC 801-4	4 kV under direct coupling 2 kV under capacitive coupling (whole trunk group)
Internal current consumption: (from +5 V bus)	1…15 mA typically 10 mA
Internal current consumption: (from V+ bus)	0 mA
External current consumption:	max. 32 mA
Terminals:	Pluggable 10-pole screw terminal block (4 405 4847 0), for wires up to 1.5 mm²
[1)] With external protective diode [2)] With reverse voltage protection [3)] These ratings are not UL-listed	

In the appendix, Chapter A.4 relay contacts, are calculation data and wiring suggestions for the relay contacts. These data should be absolutely considered for safe switching and a long life span of the relays.

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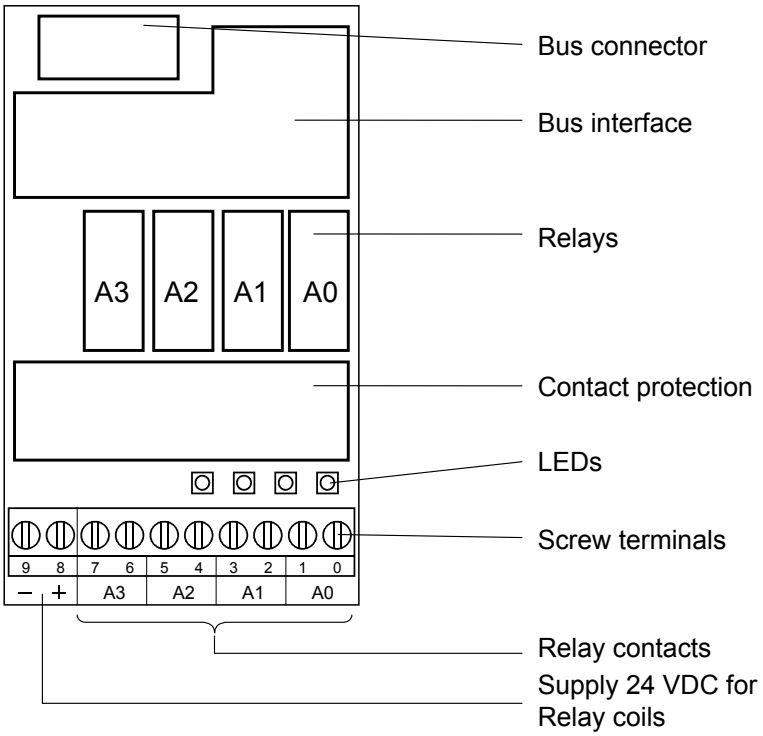
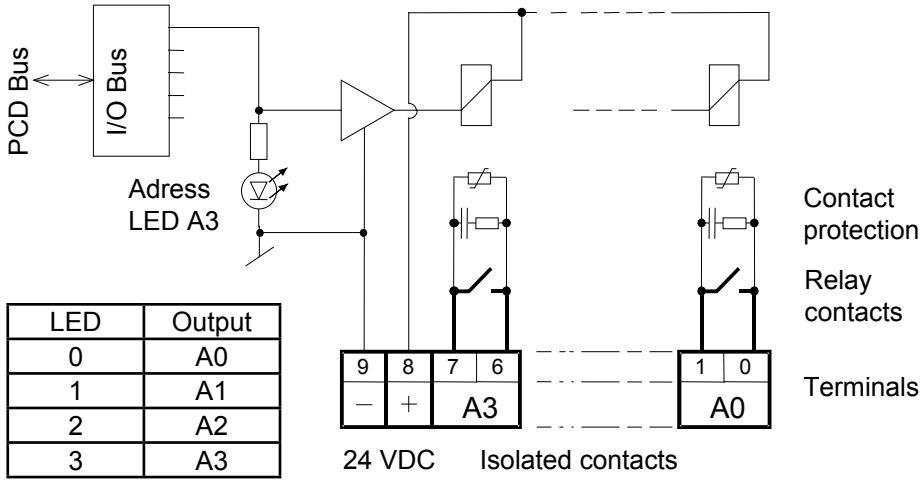
LEDs and connection terminals



Output circuits and terminal designation



LED	Output
0	A0
1	A1
2	A2
3	A3

Relay energized (contact closed): LED on
Relay reset (contact open): LED off
24 VDC must be connected to the +/- terminals.

With an open relay contact, the current leakage through the contact protection is **0.7 mA** (at 230 V / 50 Hz). This should be taken into account for smaller AC loads. If this is too high, it is recommended to use a PCD2.A220 Module (without contact protection).

Watchdog: This module can be used on all base addresses; there is no interaction with the watchdog on the CPUs. For details, please refer to the "Watchdog" section, which describes the correct use of the watchdog in conjunction with PCD2 components.

5.4.2 PCD2.A210, 4 relays with break contacts, with contact protection

Application

The module contains 4 relays with normally-closed contacts for direct or alternating current up to 2 A, 250 VAC. The contacts are protected by a varistor. The module is especially suited wherever perfectly isolated AC switching circuits with infrequent switching have to be controlled.

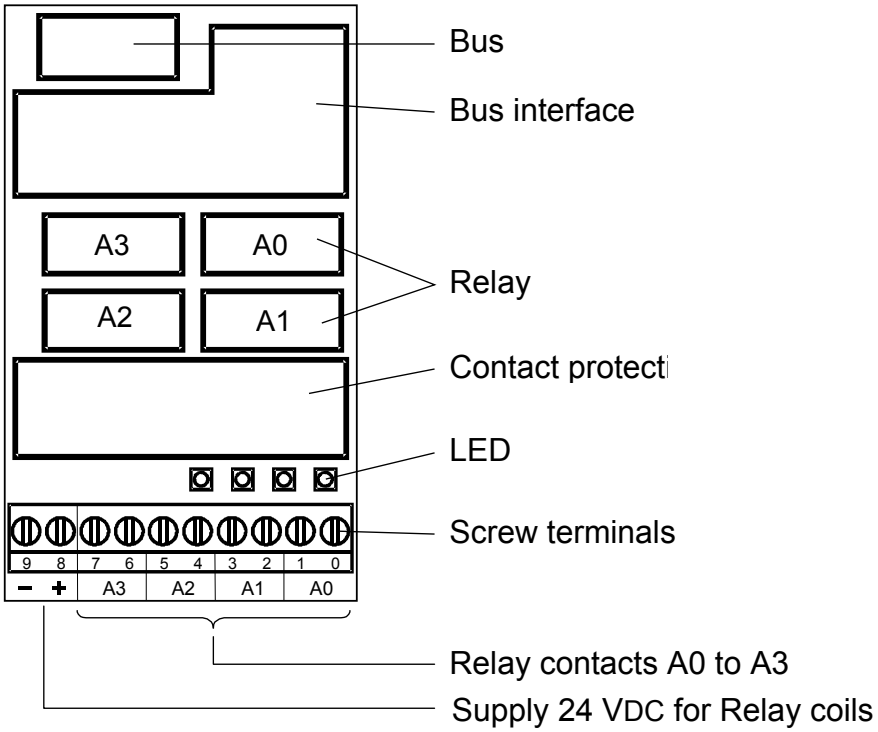
Technical data

Number of outputs:	4, electrically isolated break contacts
Type of relay (typical):	RE 014024, SCHRACK
Switching capacity: (contact lifetime)	2 A, 250 VAC AC1 0.7 × 10^6 operations 1 A, 250 VAC AC11 1.0 × 10^6 operations 2 A, 50 VDC DC11 0.3 × 10^6 operations [3)] 1 A, 24 VDC DC11 0.1 × 10^6 operations [1)3)]
Relay coil supply: [2)]	nominal 24 VDC smoothed or pulsed, 9 mA per relay coil
Voltage tolerance, dependent on ambient temperature:	20 °C: 17.0…35 VDC 30 °C: 19.5…35 VDC 40 °C: 20.5…32 VDC 50 °C: 21.5…30 VDC
Output delay:	typically 5 ms at 24 VDC
Resistance to interference: acc. to IEC 801-4	4 kV under direct coupling 2 kV under capacitive coupling (whole trunk group)
Internal current consumption: (from +5 V bus)	1…15 mA typically 10 mA
Internal current consumption: (from V+ bus)	0 mA
External current consumption:	max. 32 mA
Terminals:	Pluggable 10-pole screw terminal block (4 405 4847 0), for wires up to 1.5 mm²
[1)] With external protective diode [2)] With reverse voltage protection [3)] These ratings are not UL-listed	

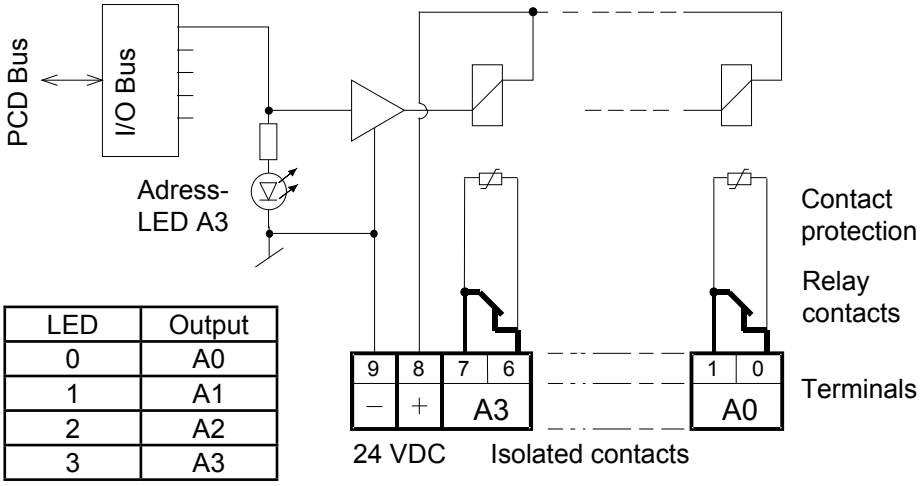
In the appendix, Chapter A.4 relay contacts, are calculation data and wiring suggestions for the relay contacts. These data should be absolutely considered for safe switching and a long life span of the relays.

5

LEDs and connection terminals



Output circuits and terminal designation



LED	Output
0	A0
1	A1
2	A2
3	A3

Relay energized (contact open): LED on
Relay reset (contact closed): LED off
24 VDC must be connected to the +/- terminals.

Watchdog: This module can be used on all base addresses; there is no interaction with the watchdog on the CPUs. For details, please refer to the "Watchdog" section, which describes the correct use of the watchdog in conjunction with PCD2 components.

5.4.3 PCD2.A220, 6 relays with make contacts, without contact protection

Application

The module contains 6 relays with normally-open contacts for direct or alternating current up to 2 A, 250 VAC. The module is especially suited wherever AC switching circuits with infrequent switching have to be controlled. For space reasons, there is no integrated contact protection. Each group of 3 relays has a common connection.

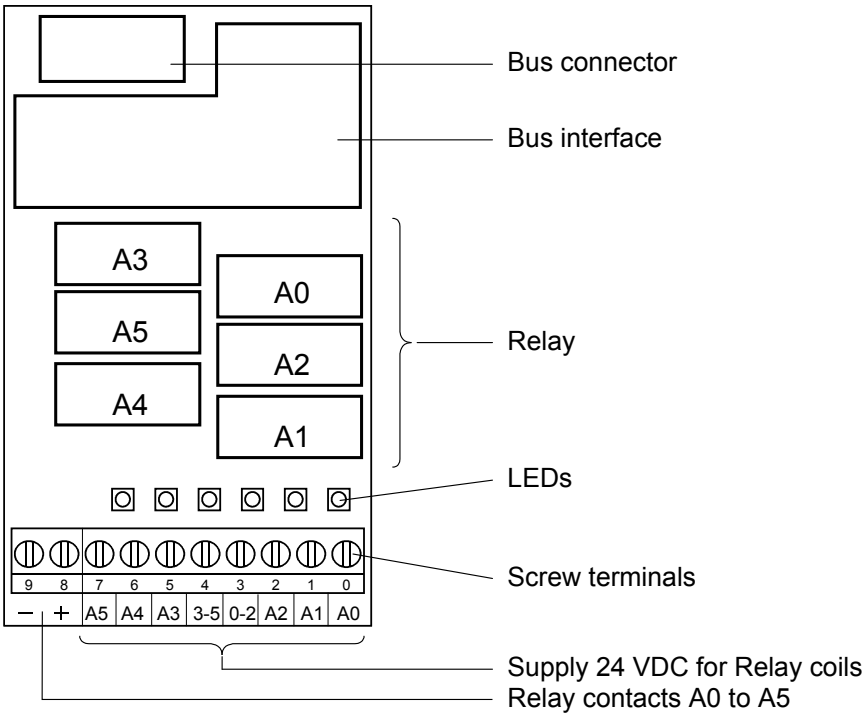
Technical data

Number of outputs:	3 + 3 make contacts with common terminal
Type of relay (typical):	RE 030024, SCHRACK
Switching capacity: (contact lifetime)	2 A, 250 VAC AC1 0.7 × 10^6 operations 1 A, 250 VAC AC11 1.0 × 10^6 operations 2 A, 50 VDC DC11 0.3 × 10^6 operations [3)] 1 A, 24 VDC DC11 0.1 × 10^6 operations [1)3)]
Relay coil supply: [2)]	nominal 24 VDC smoothed or pulsed, 8 mA per relay coil
Voltage tolerance, dependent on ambient temperature:	20 °C: 17.0…35 VDC 30 °C: 19.5…35 VDC 40 °C: 20.5…32 VDC 50 °C: 21.5…30 VDC
Output delay:	typically 5 ms at 24 VDC
Resistance to interference: acc. to IEC 801-4	4 kV under direct coupling 2 kV under capacitive coupling (whole trunk group)
Internal current consumption: (from +5 V bus)	1…20 mA typically 10 mA
Internal current consumption: (from V+ bus)	0 mA
External current consumption:	max. 48 mA
Terminals:	Pluggable 10-pole screw terminal block (4 405 4847 0), for wires up to 1.5 mm²
[1)] With external protective diode [2)] With reverse voltage protection [3)] These ratings are not UL-listed	

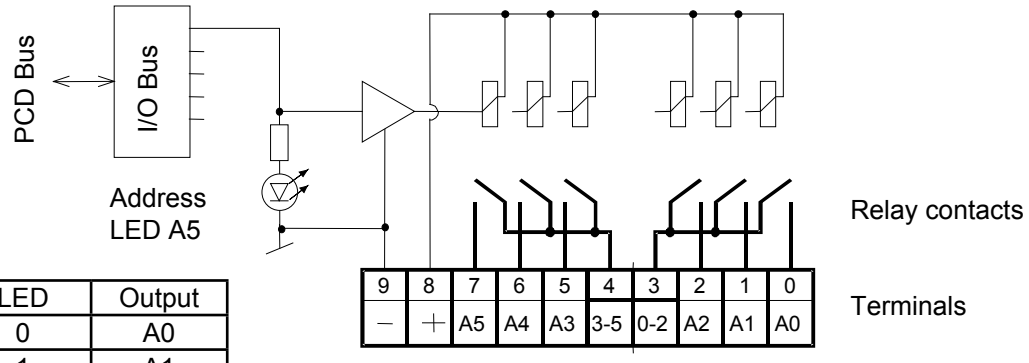
In the appendix, Chapter A.4 relay contacts, are calculation data and wiring suggestions for the relay contacts. These data should be absolutely considered for safe switching and a long life span of the relays.

5

LEDs and connection terminals



Output circuits and terminal designation



LED	Output
0	A0
1	A1
2	A2
3	A3
4	A4
5	A5

Relay energized (contact closed): LED on
Relay reset (contact open): LED off
24 VDC must be connected to the +/- terminals.

Watchdog: This module can be used on all base addresses; there is no interaction with the watchdog on the CPUs. For details, please refer to the "Watchdog" section, which describes the correct use of the watchdog in conjunction with PCD2 components.

5.4.4 PCD2.A250, 8 relays with make contacts, without contact protection

Application

The module contains 8 relays with normally-open contacts for direct or alternating current up to 2 A, 48 VAC. The module is especially suited wherever AC switching circuits with infrequent switching have to be controlled. For space reasons, there is no integrated contact protection.

Technical data

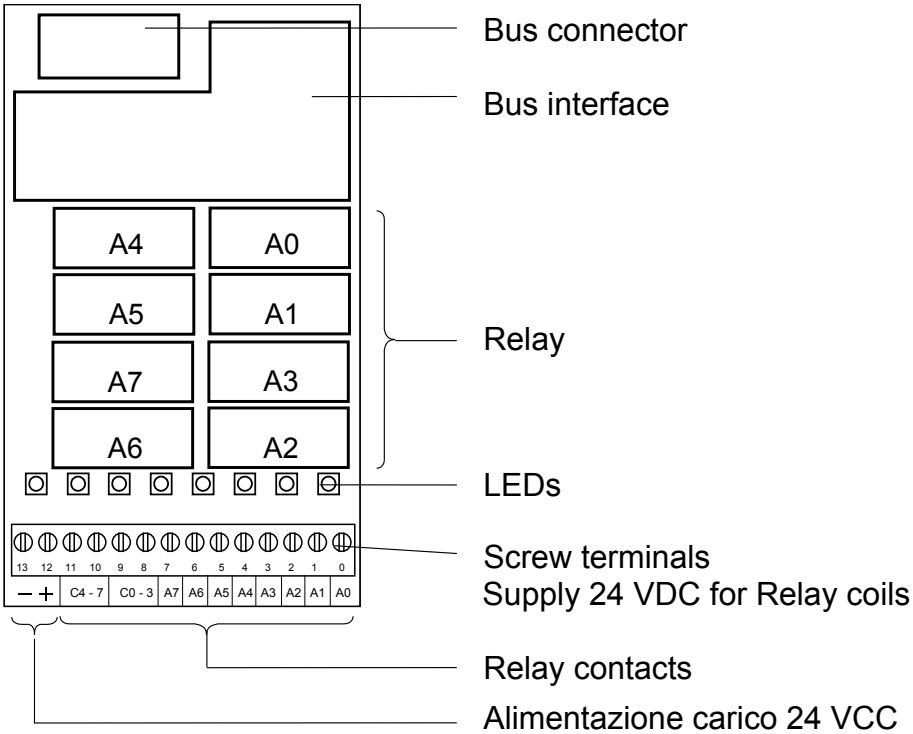
Number of outputs:	4 + 4 make contacts with common terminal
Type of relay (typical):	RE 030024, SCHRACK
Operating mode:	> 12 V, > 100 mA
Switching capacity: *) (contact lifetime)	2 A, 48 VAC AC1 0.7 × 10^6 operations 1 A, 48 VAC AC11 1.0 × 10^6 operations 2 A, 50 VDC DC11 0.3 × 10^6 operations [3)] 1 A, 24 VDC DC11 0.1 × 10^6 operations [1)3)]
Relay coil supply: [2)]	nominal 24 VDC smoothed or pulsed, 8 mA per relay coil
Voltage tolerance, dependent on ambient temperature:	20 °C: 17.0…35 VDC 30 °C: 19.5…35 VDC 40 °C: 20.5…32 VDC 50 °C: 21.5…30 VDC
Output delay:	typically 5 ms at 24 VDC
Resistance to interference: acc. to IEC 801-4	4 kV under direct coupling 2 kV under capacitive coupling (whole trunk group)
Internal current consumption: (from +5 V bus)	1…25 mA typically 15 mA
Internal current consumption: (from V+ bus)	0 mA
External current consumption:	max. 64 mA
Terminals:	Pluggable 14-pole screw terminal block (4 405 4869 0), for wires up to 0.6 mm²
[1)] With external protective diode [2)] With reverse voltage protection [3)] These ratings are not UL-listed	

***)** Higher voltages are not allowed for this module because safety standards for clearance and creepage distances do not apply.

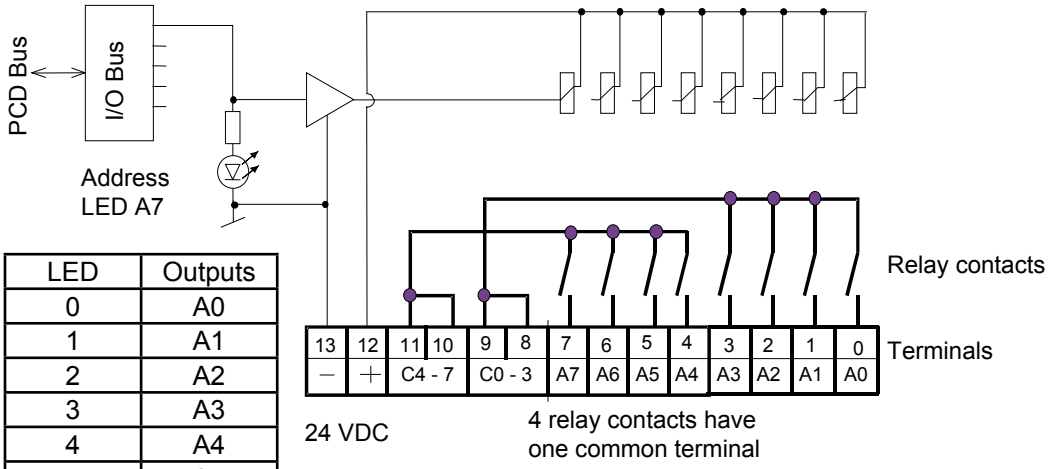
In the appendix, Chapter A.4 relay contacts, are calculation data and wiring suggestions for the relay contacts. These data should be absolutely considered for safe switching and a long life span of the relays.

5

LEDs and connection terminals



Output circuits and terminal designation



LED	Outputs
0	A0
1	A1
2	A2
3	A3
4	A4
5	A5
6	A6
7	A7

Relay energized (contact closed): LED on
Relay reset (contact open): LED off
24 VDC must be connected to the +/- terminals.

Watchdog: This module can be used on all base addresses; there is no interaction with the watchdog on the CPUs. For details, please refer to the "Watchdog" section, which describes the correct use of the watchdog in conjunction with PCD2 components.

5.4.5 PCD2.A410, 8 digital outputs for 0.5 A each, electrically isolated

Application

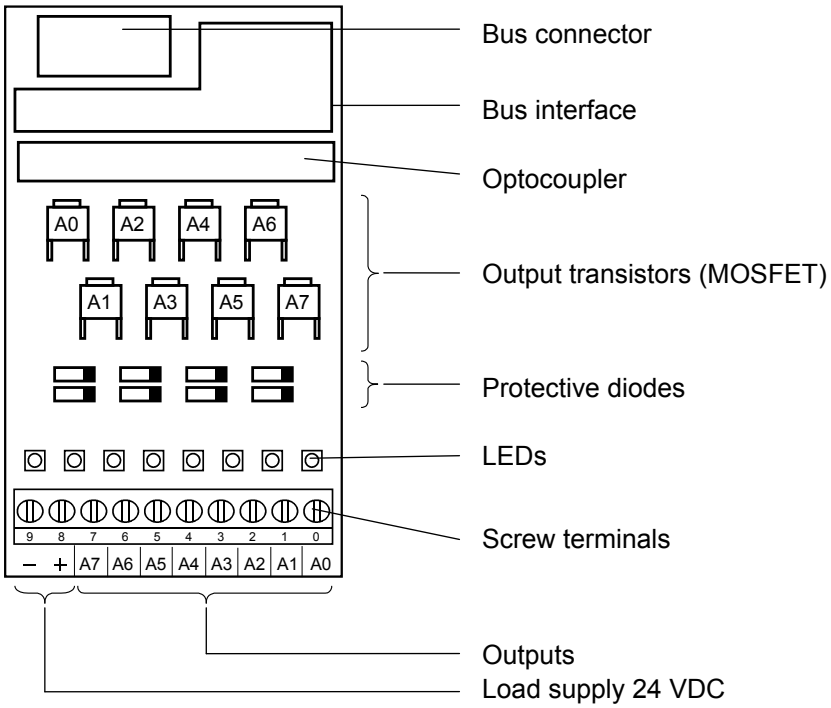
Output module, electrically isolated from the CPU, with 8 MOSFET transistor outputs, without short-circuit protection. Voltage range 5…32 VDC.

This module is not suitable for triggering the PCA2.D12/D14 display modules.

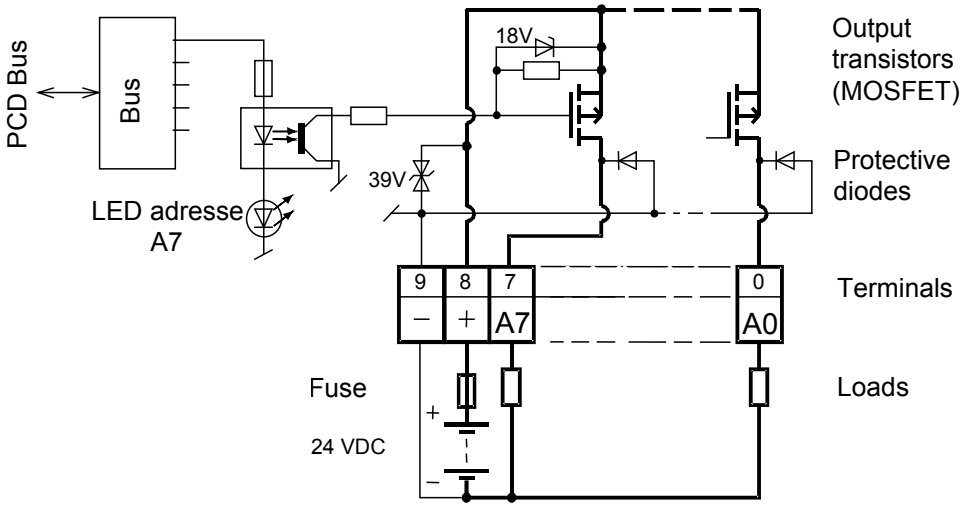
Technical data

Number of outputs:	8, electrically isolated
Output current:	1…500 mA (leakage current max. 0,1 mA) Within the voltage range 5…24 VDC, the load resistance should be at least 48 Ω.
Total current per module:	4 A on 100 % duty cycle
Operating mode:	Source operation (positive switching)
Voltage range:	5…32 VDC, smoothed 10…25 VDC, pulsed
Voltage drop:	≤ 0,4 V at 0,5 A
Output delay:	Switch-on delay typically 10 µs Switch-off delay typically 50 µs (ohmic load 5…500 mA), longer with inductive load, because of the protective diode.
Isolation voltage:	1000 VAC, 1 min
Resistance to interference: acc. to IEC 801-4	4 kV under direct coupling 2 kV under capacitive coupling (whole trunk group)
Internal current consumption: (from +5 V bus)	1…24 mA typically 15 mA
Internal current consumption: (from V+ bus)	0 mA
External current consumption:	Load current
Terminals:	Pluggable 10-pole screw terminal block (4 405 4847 0), for wires up to 1.5 mm²

LEDs and connection terminals



Output circuits and terminal designation



Output conducting (set): LED on
Output disconnected (reset): LED off

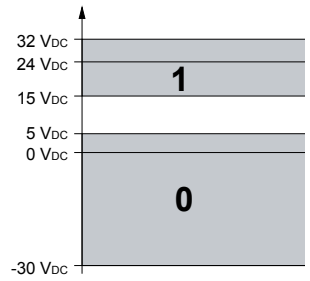
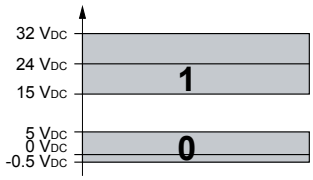
Fuse: It is recommended that each module should be separately protected with a fast-blow (S) 4 A fuse

Watchdog: This module can be used on all base addresses; there is no interaction with the watchdog on the CPUs. For details, please refer to the "Watchdog" section, which describes the correct use of the watchdog in conjunction with PCD2 components.

5.5 Digital combined input and output modules

PCD2.B100	2 inputs, 2 outputs, 4 selectable as inputs or outputs

Definition of input signals

for 24 VDC	for 24 VDC
PCD2.B100; E0 and E1	PCD2.B100; E2 to E5
	

I/O modules and I/O terminal blocks may only be plugged in and removed when the PCD is disconnected from the power supply.

5.5.1 PCD2.B100, 2 inputs + 2 outputs + 4 digital inputs/outputs (selectable)

Application

Economical combined input/output module with:

- 2 inputs 24 VDC/8 ms for source operation, electrically connected
- 2 transistor outputs 0.5 A/5…32 VDC, electrically connected, not short circuit protected, and
- 4 combined inputs/outputs 24 VDC/8 ms or 0.5 A/5…32 VDC on common I/O terminals.

Technical data on inputs

Number of inputs:	6 (2 + 4), electrically connected, source operation
Input voltage:	24 VDC smoothed or pulsed
2 inputs E0 and E1 low-range: high-range:	 -30…+5 V +15…+32 V
4 inputs E/A2…E/A5 low-range: high-range:	 -0.5…+5 V *) +15…+32 V
All 6 inputs: low-high switching threshold: high-low switching threshold: hysteresis: input current (24 VDC): switching delay 0-1 (24 VDC): switching delay 1-0 (24 VDC):	13 V typically 6 V typically 7 V typically 7 mA typically 8 ms typically 8 ms typically
*) Negative voltage is restricted by the protective diode (I_{max} = 0.5 A)	

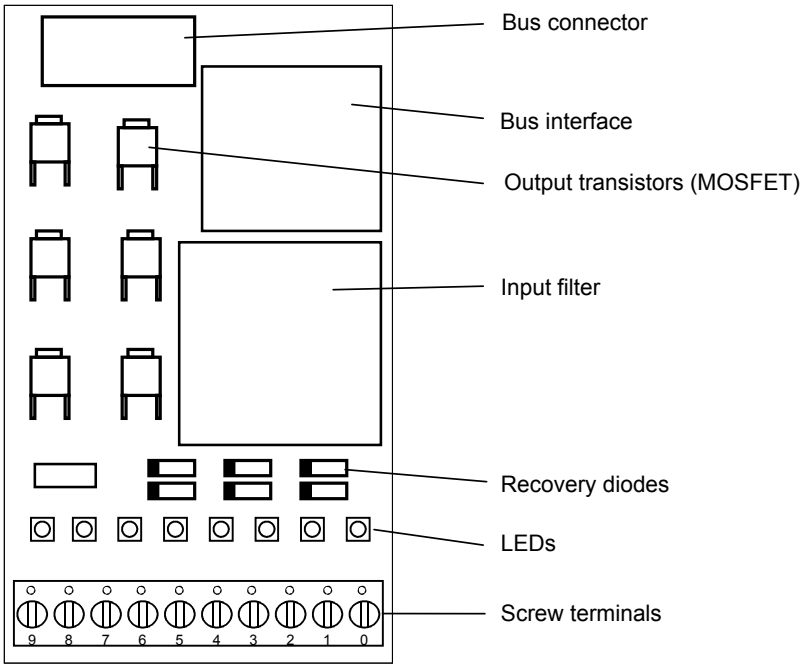
Technical data on outputs

Number of outputs:	6 (2 + 4) electrically connected, source operation not short circuit protected
Current:	5…500 mA steady load
Voltage range:	5…32 VDC *)
Voltage drop:	< 0.3 V at 500 mA for A6 and A7 < 0.7 V at 500 mA for E/A2…E/A5
Total current per module:	3 A steady load
Switch-on delay:	10 µs typically
Switch-off delay:	50 µs typically (100 µs max.), (ohmic load 5…500 mA), longer for inductive load because of protective diode.
*) If it is intended to read the status of a combined output, the external voltage must be at least 17 VDC, as both the status and the LED are displayed via the input.	

General technical data on inputs and outputs

Isolation voltage	1000 VAC, 1 min
Resistance to interference: acc. to IEC 801-4	4 kV under direct coupling 2 kV under capacitive coupling (whole trunk group)
Internal current consumption: (from +5 V bus)	1…25 mA typically 15 mA
Internal current consumption: (from V+ bus)	0 mA
External current consumption:	Load current
Terminals:	Pluggable 10-pole screw terminal block (4 405 4847 0), for wires up to 1.5 mm²

LEDs and connection terminals



The module contains 8 LEDs:

- 2 LEDs are directly triggered by the pure inputs.
- 2 LEDs are directly triggered by the pure outputs.
- 4 LEDs are triggered by the inputs of the combined inputs/outputs and therefore always indicate voltage status at the I/O terminal.

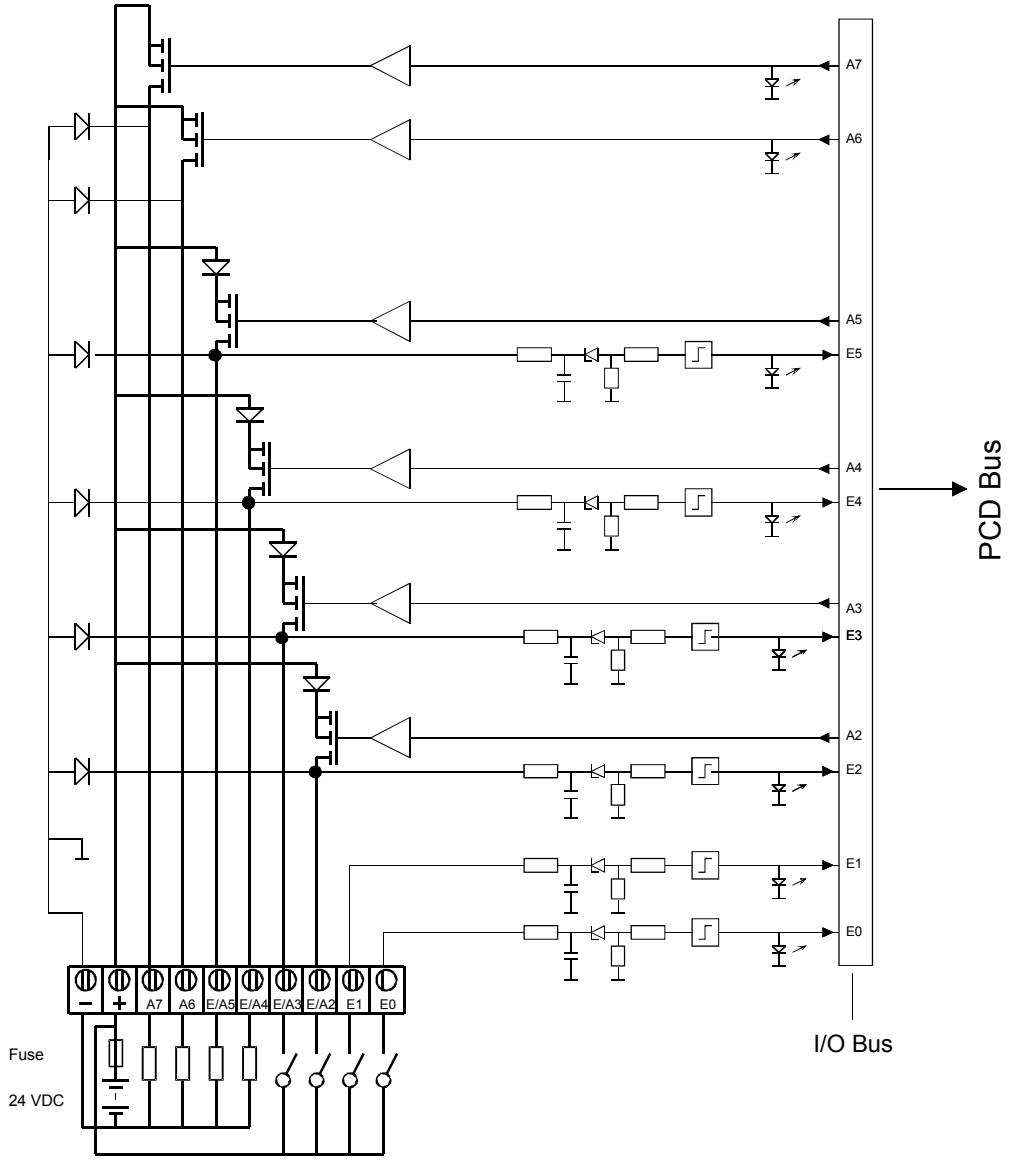
If the combined I/Os are used as outputs, the following should be noted:
The LEDs of combined outputs E/A2…E/A5 only light up when the output is high and a supply voltage of 24 V is connected.

Mixing the combined inputs/outputs

If combined I/Os are used as inputs in source operation, i.e. with sending devices which either apply +24 V to the input or are open, the low status of an open input can be overwritten as high if the corresponding output at the same address is set in error. However, if the input is shifted to 0 V with a changeover contact and the corresponding output is set in error, the MOS-FET can be destroyed, as it is not short circuit protected. For this reason, only positive-switching contacts should be used.

5

Input/output circuits and terminal designation



The example shows E/A2 and E/A3 used as inputs and
E/A4 and E/A5 used as outputs

The following applies for the inputs:
Switch closed (input positive): Signal state = “1” = LED on
Switch open: Signal state = “0” = LED off

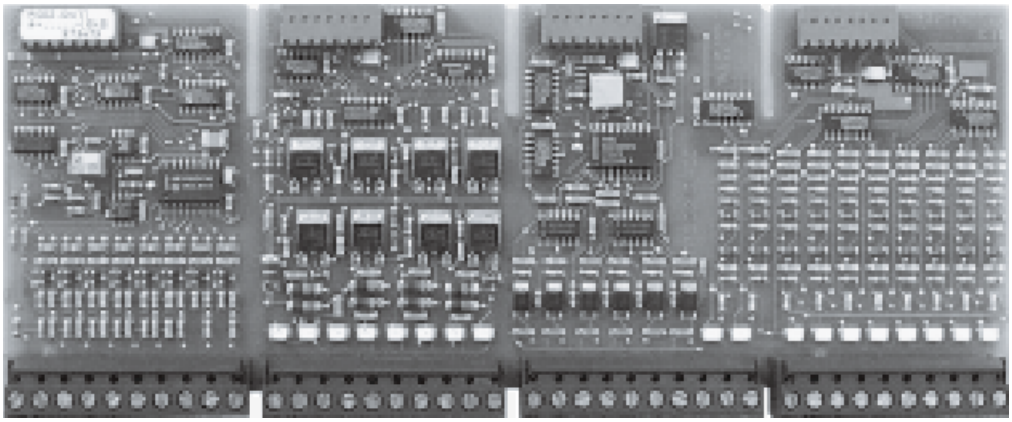
Fuse: It is recommended that each module should be separately protected with a fast-blow 3.15 A fuse.

Watchdog: This module can be used on all base addresses; there is no interaction with the watchdog on the CPUs. For details, please refer to the “Watchdog” section, which describes the correct use of the watchdog in conjunction with PCD2 components.

5.6 Multi-functional input/output modules

PCD2.G400	**Multi-functional input/output module**
PCD2.G410	**Multi-functional input/output module**

The two modules PCD2.G400 and PCD2.G410 are examples of the development and production of customer-specific versions.



The wide range of digital and analogue I/O modules provides optimum adaptability.

- Economic: The modular structure means that it is only necessary to include (and pay for) those functions that are actually required for a specific application.
- Flexible: All modules at the I/O level can be plugged onto any preferred point on the bus and are easy to exchange.
- Functional security: Guaranteed by their robust design and excellent reliability (average field failure rate FFR > 106 hours).
- Time saved in electrical wiring: Due to plug-in screw terminals, spring terminals or ready-made cables and ribbon cable adapters.

I/O modules and I/O terminal blocks may only be plugged in and removed when the PCD is disconnected from the power supply.

5.6.1 PCD2.G400, multi-functional input/output module

Application

Combined module with digital and analogue inputs and outputs. This module is designed to extend the range of uses for the PCD. The functions and the technical specification are based on the existing PCD2 modules.

This module cannot be installed in the PCD1.

The technical details should be taken from the descriptions of these modules.

Number and type of inputs/outputs

10 digital inputs, E0…E9 (addresses 0…9)

Technical data as for PCD2.E110, but without the option of sink operation, i.e. no “L” connection.

6 analogue outputs, A16…A21 (base address 16, channels 0…5)

0…10 VDC / 8 bit; remaining tech. data as for PCD2.W400.

8 digital outputs, A32…A39 (addresses 32…39)

24 VDC / 0.5 A; remaining tech. data as for PCD2.A400.

2 analogue inputs, E48 and E49 (base address 48, channels 0…1)

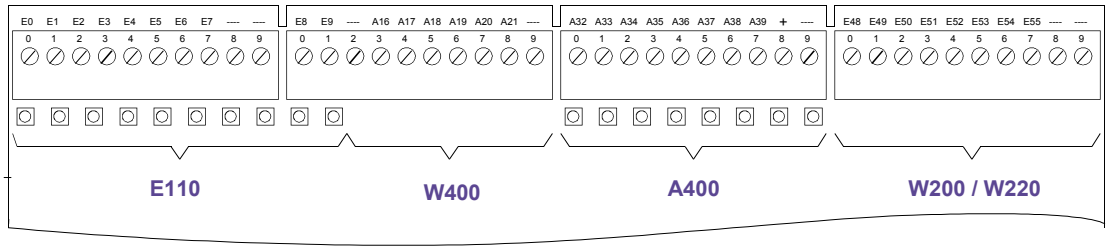
0…10 VDC / 10 bit; remaining tech. data as for PCD2.W200.

6 analogue inputs, E50…E55 (base address 48, channels 2…7)

Pt/Ni 1000 / 10 bit with data as for PCD2.W220.

Internal current consumption from	+5 V bus:	10…65 mA
	V+ bus:	35 mA

LEDs and connection terminals



The module can be installed on sockets 1…4 (top) on the PCD2.

5.6.2 PCD2.G410, multi-functional I/O module with elect. isolated digital I/O

Application

Combined module with digital and analogue inputs and outputs. This module is designed to extend the range of uses for the PCD. The functions and the technical specification are based on the existing PCD2 modules.

This module cannot be installed in the PCD1.

The technical details should be taken from the descriptions of these modules.

Number and type of inputs/outputs

16 digital inputs, electrically isolated, E0…E15, (addresses 0…15).

Tech. data as for PCD2.E610,
Source or sink operation selectable via “Q/S” jumper.

4 relay outputs, A16…A19 (addresses 16…19),

Each with a changeover contact protected with 2 varistors.
Tech. data as for PCD2.A200.
The 24 V supply to the relay coils is via the screwless terminals “U_{ext}”, located next to the 4 relays.

4 analogue outputs, with 8 bit resolution, A32…A35
(base address 32 *, channels 0…3)

Each channel selectable with “U/I” jumper for voltage 0…10 V or current 0…20 mA.
Tech. data as for PCD2.W410.

4 analogue inputs, with 10 bit resolution, E48…E51
(base address 48 *, channels 0…3)

Each channel can be configured separately with the jumper combinations shown for voltage 0…10 V (“U”), current 0…20 mA (“I”) or for resistive temperature sensors Pt/Ni 1000 (“T”) for a temperature range from -20…+100 °C.
Tech. data as for PCD2.W2xx.

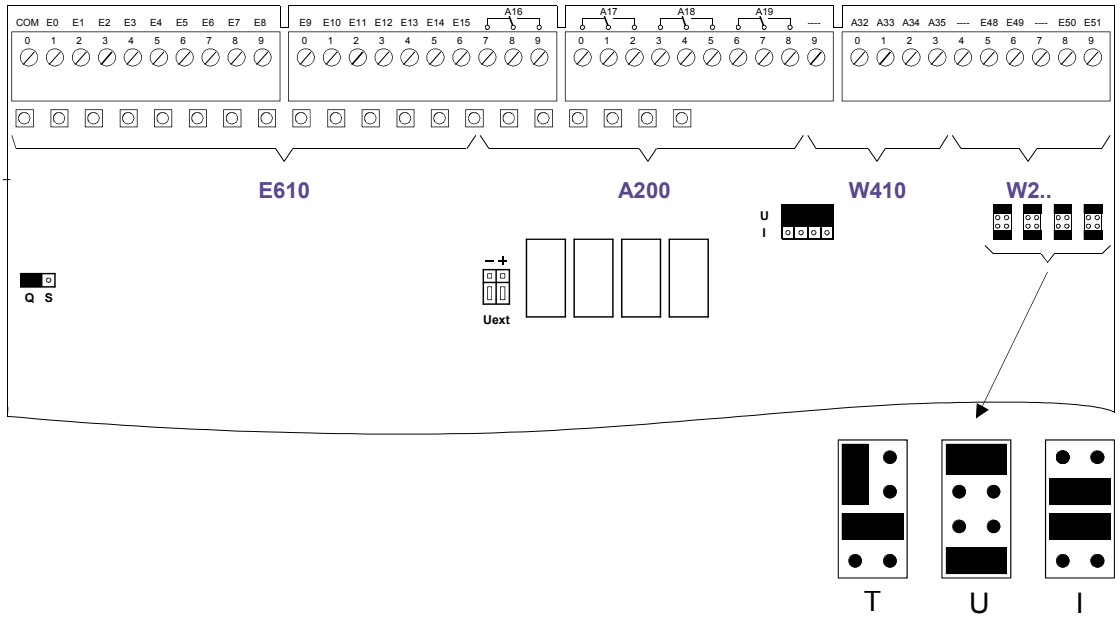
Internal current consumption from	+5 V bus	10…50 mA
	V+ bus	10…40 mA

24 V connection (U_{ext}):	This is located next to the 4 relays as screwless terminal “U_{ext}”. The 24 V supply is common to the relay coils and the external supply to the analogue outputs.
Current consumption:	9 mA per relay 20 mA per analogue output

* (when the module is installed on sockets 1…4 on the PCD2).

LEDs and connection terminals

The terminal numbering refers to the use of the module on sockets 1…4 (top) on the PCD2. If the module is installed on sockets 5…8 (bottom), the value 64 must be added to the addresses given. When using the module in the PCD2.C100 expansion housing, the same logic applies, with the value 128 to be added to the ‘top’ and 192 to the ‘bottom’.



Jumper Config.

Factory settings:	E0…E15	Source operation:	Q
	A32…A35	Voltage:	0…10 V “U”
	E48…E51	Voltage:	0…10 V “U”

5.7 Analogue input modules

PCD2.W100	**4 analogue inputs 12 bit, 0…10 V, -10 V…+10 V *)**
PCD2.W105	**4 analogue inputs 12 bit, 0…+20 mA, -20…0 mA, -20 mA…+20 mA *)**
PCD2.W110	**4 analogue inputs 12 bit, Pt 100**
PCD2.W111	**4 analogue inputs 12 bit, Ni 100**
PCD2.W112	**4 analogue inputs 12 bit, Pt 1000**
PCD2.W113	**4 analogue inputs 12 bit, Ni 1000**
PCD2.W114	**4 analogue inputs 12 bit, Pt 100, 0 °C…+350 °C**
PCD2.W200	**8 analogue inputs 10 bit, 0…10 V**
PCD2.W210	**8 analogue inputs 10 bit, 0..20 mA**
PCD2.W220	**8 analogue inputs 10 bit, Pt/Ni 1000**
PCD2.W300	**8 analogue inputs 12 bit, 0…10 V**
PCD2.W310	**8 analogue inputs 12 bit, 0…20 mA**
PCD2.W340	**8 analogue inputs 12 bit, 0…10 V, 0…20 mA, Pt/Ni 1000 *)**
PCD2.W350	**8 analogue inputs 12 bit, Pt/Ni 100**
PCD2.W360	**8 analogue inputs 12 bit, resolution ‹ 0.1 °C, Pt 1000**

*) jumper selectable

I/O modules and I/O terminal blocks may only be plugged in and removed when the PCD is disconnected from the power supply.

5.7.1 PCD2.W10x, analogue inputs, 4 channels, 12 bit resolution

High-speed module for general use for recording analogue signals with a conversion time of ≤ 30 µs and a resolution of 12 bits.

Module overview

PCD2.W100 4 channels for signals 0…10 V
Unipolar*): 0 V…+10 V or -10 V…0 V
Bipolar*): -10 V…+10 V
Input resistance: >10 MΩ

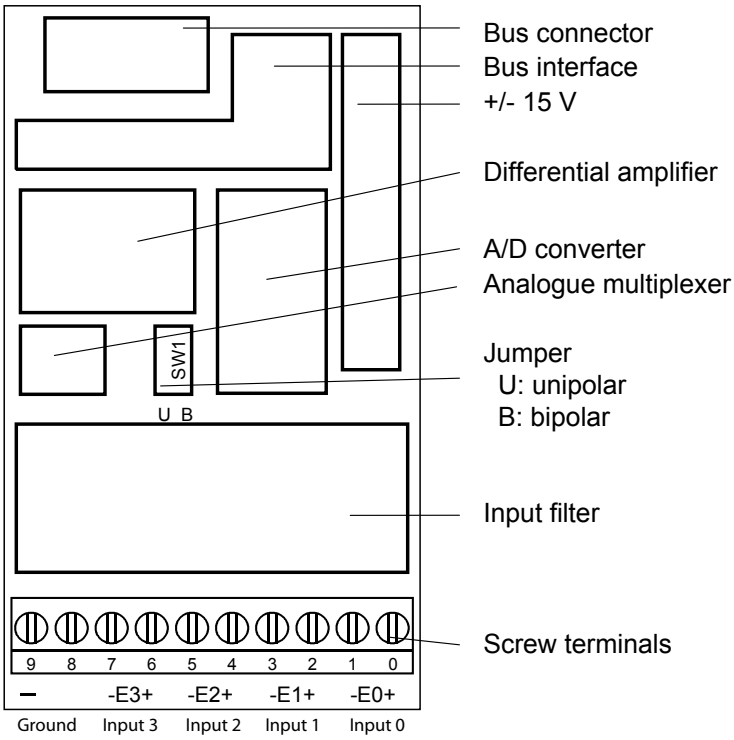
PCD2.W105 4 channels for signals 0…20 mA
Unipolar*): 0…+20 mA or -20…0 mA
Bipolar *): -20 mA…+20 mA
Circuit resistance (Rshunt): 100 Ω/0.1 %

*) Unipolar - bipolar, switchable with jumper

Technical data

Signal ranges	see module overview	
Galvanic separation	no	
Resolution (digital representation)	12 bits (0…4095)	
Measuring principle	differential	
Conversion time	≤ 30 µs	
Input resistance	W100: >10 MΩ	W105: 100 Ω/0.1 %
Accuracy at 25 °C (of measured value)	W100: ± 0.1 % W100: ± 0.05 % W105: ± 0.2 %	+ ± 1 LSB bipolar + ± 1 LSB unipolar + ± 1 LSB unip/bip.
Repeating accuracy	± 1 LSB	
Common mode range (CMR)	W100: ± 11 V	W105: ± 8 V
Common mode rejection (CMRR)	> 70 dB	
Temperature error (0…+55 °C)	W100: ± 0.2 % + ± 2 LSB W105: ± 0.3 % + ± 2 LSB	
Overvoltage protection (W100)	± 60 VDC (permanent)	
Overcurrent protection (W105)	± 50 mA (permanent)	
Burst protection capacitive coupling (IEC 801-4)	± 1 kV, with unshielded cables ± 2 kV, with shielded cables	
Time constant of input filter	3 ms	
Internal current consumption: (from +5 V bus)	45 mA typ. 20 mA	
Internal current consumption: (from V+ bus)	15 mA	
External current consumption:	0 mA	
Terminals:	Pluggable 10-pole screw terminal block (4 405 4847 0), for wires up to 1.5 mm²	

Terminals



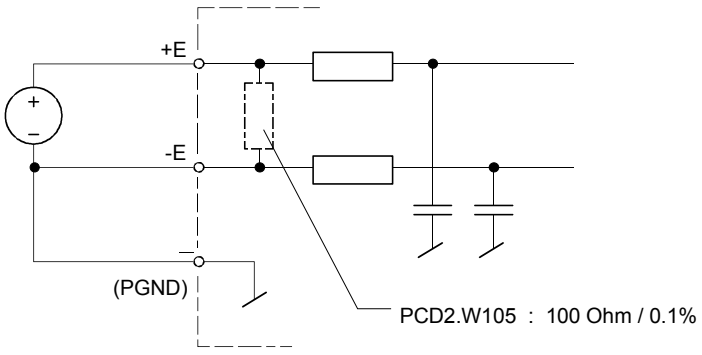
Moving the jumpers

On this circuit board there are components that are sensitive to electrostatic discharges. For further information, refer to Appendix B, “Icons”.

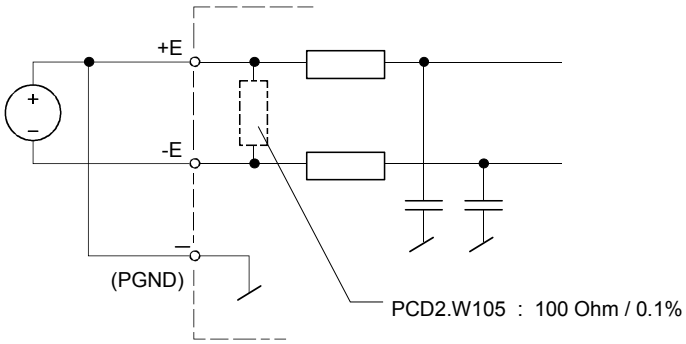
Analogue/digital values

PCD2.W100 (voltage range 0…10 V)		
Unipolar positive	**Unipolar negative**	**Bipolar**
0 V → 0 +5 V → 2047 +10 V → 4095	0 V→ 0 -5 V → 2047 -10 V → 4095	-10 V→ 0 0 V → 2047 +10 V → 4095
PCD2.W105 (current range 0…20 mA)		
Unipolar positive	**Unipolar negative**	**Bipolar**
0 mA→ 0 +10 mA → 2047 +20 mA → 4095	0 mA→ 0 -10 mA → 2047 -20 mA → 4095	-20 mA→ 0 0 mA → 2047 +20 mA → 4095

Wiring for positive unipolar or bipolar analogue inputs

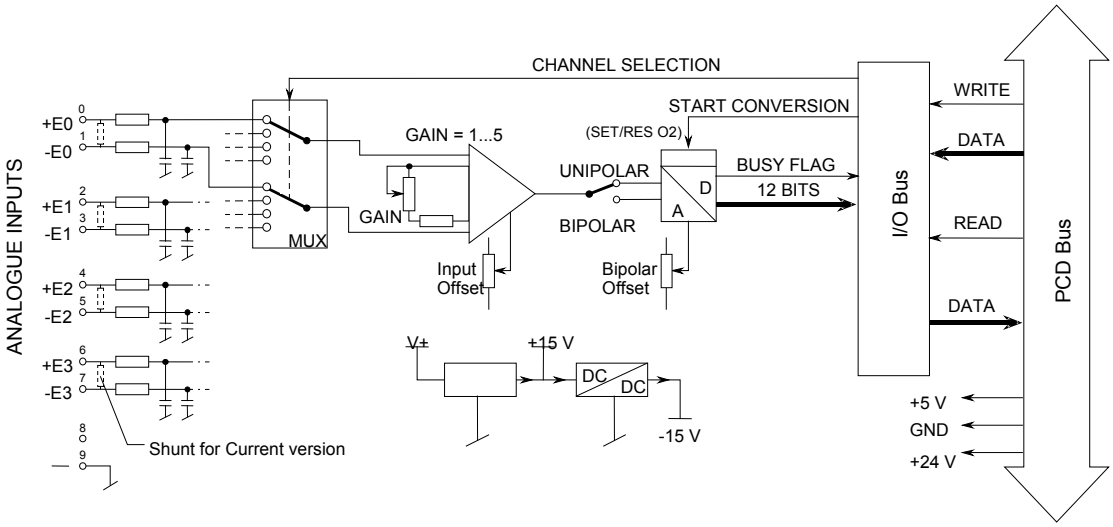


Wiring for negative unipolar analogue inputs



All unused inputs must be earthed.

Output circuits and terminal designation



Programming

Classic: Programming examples for the PCD2.W10x can be found in a separate manual and on the TCS Support site (www.sbc-support.ch + getting started).
xx7: the firmware reads in the values according to the configuration (I/O Builder)

Watchdog: This module cannot be used on the base address 240 (or 496 for the PCD2.M17x), because it would interact with the watchdog, and would cause a malfunction.

For details, please refer to the "Watchdog" section, which describes the correct use of the watchdog in conjunction with PCD2 components.

5.7.2 PCD2.W11x, analogue inputs, 4 channels, 12 bit resolution

for resistive temperature sensors Pt/Ni 100, 1000

High-speed, convenient module for recording absolute temperatures in the range -50…+150 °C or +350 °C (W114) using a resistive temperature sensor. (2-wire connection with zero adjustment) The temperature curves are linearized in the module itself. The resolution is 12 bits.

Module overview

PCD2.W110	4 analogue inputs for temperature measurement with Pt 100 probes (IEC 751)
PCD2.W111	4 analogue inputs for temperature measurement with Ni 100 probes (DIN 43 760)
PCD2.W112	4 analogue inputs for temperature measurement with Pt 1000 probes (IEC 751)
PCD2.W113	4 analogue inputs for temperature measurement with Ni 1000 probes (DIN 43 760)
PCD2.W114	4 analogue inputs for temperature measurement with Pt 100 probes (IEC 751)

Technical data

Number of channels	4
Galvanic separation	no
Resolution (digital representation)	12 bits (0…4095)
Measuring principle	differential
Conversion time	< 30 µs
Time between 2 measurements	≥ 1 ms
Temperature error:	+10…+30 °C max. ± 0.4 °C 0…+55 °C max. ± 1 °C
Repeating accuracy (multiple measurements with the same module under the same conditions)	± 2 LSB
Probe type	2-wire
Linearization	integrated
Current sources	1 per channel
Offset setting (allows zero value to be adjusted according to length of cable)	separate for each channel
Sensitivity	20.475 LSB/° C (4095…200) or 0.0488 °C/LSB (200…4095)
Internal current consumption: (from +5 V bus)	45 mA typ. 20 mA
Internal current consumption: (from V+ bus)	30 mA (W110/W111) 20 mA (W112/W113/W114)
External current consumption:	0 mA
Terminals:	Pluggable 10-pole screw terminal block (4 405 4847 0), for wires up to 1.5 mm²

Technical data for add-on modules (variant modules)

PCD2.W110	4 inputs for Pt 100 probes
Current sources	2 mA
Measuring range	-50 °C…+150 °C
Accuracy of measurement	better than 0.2 °C
PCD2.W111	4 inputs for Ni 100 probes
Current sources	2 mA
Measuring range	-50 °C…+150 °C
Accuracy of measurement	better than 0.4 °C
PCD2.W112	4 inputs for Pt 1000 probes
Current sources	0.2 mA
Measuring range	-50 °C…+150 °C
Accuracy of measurement	better than 0.2 °C
PCD2.W113	4 inputs for Ni 1000 probes
Current sources	0.2 mA
Measuring range -	-50 °C…+150 °C
Accuracy of measurement	better than 0.4 °C
PCD2.W114	4 inputs for Pt 100 probes
Current sources	0.2 mA
Measuring range	0 °C…+350 °C
Accuracy of measurement	better than 0.4 °C

Accuracy of measurements

The curves below show the maximum measurement error (measurement and repeating accuracy).

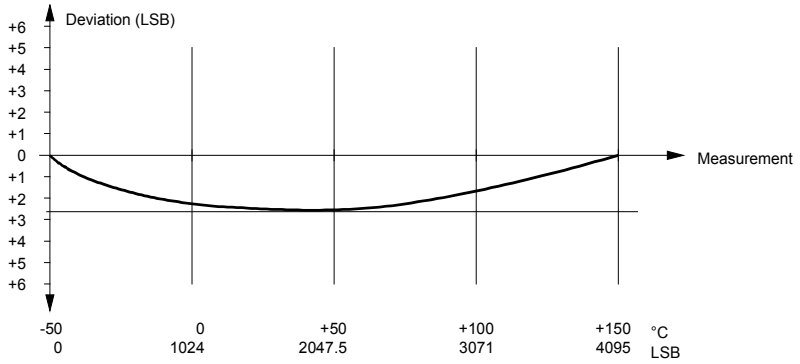
Total error = linearization error + repeating error

Each channel is calibrated to the minimum and maximum values:

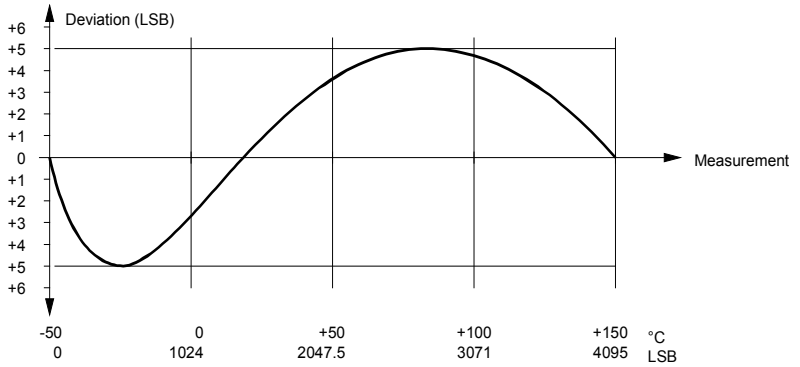
-50 °C	→	0	+ 2 LSB
+150 °C	→	4095	- 2 LSB

For these two values, the measurement error = 0.

Typical linearity error for W110/112/114 (Pt 100/Pt 1000)



Typical linearity error for W111/113 (Ni 100/Ni 1000)



On cable break	→	Measurement	4095
On short circuit	→	Measurement	0

Base and variant modules

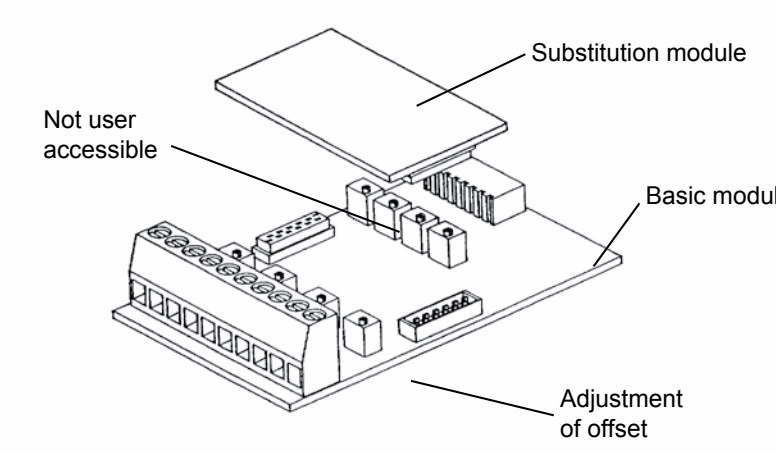
Each module comprises 2 individual modules.

- Base module with input filters, A/D converter, I/O port. Same module with same fittings for all 4 variants.
- Plug-on variant modules with switching circuit to generate -15 V, power sources and linearization. Each of the four variants has a module of its own, i.e. a module with different equipment.

The user has access to the 4 potentiometers to set the offset for each individual channel. This can be useful for adjusting the zero value (at -50 °C) for long measurement cables.

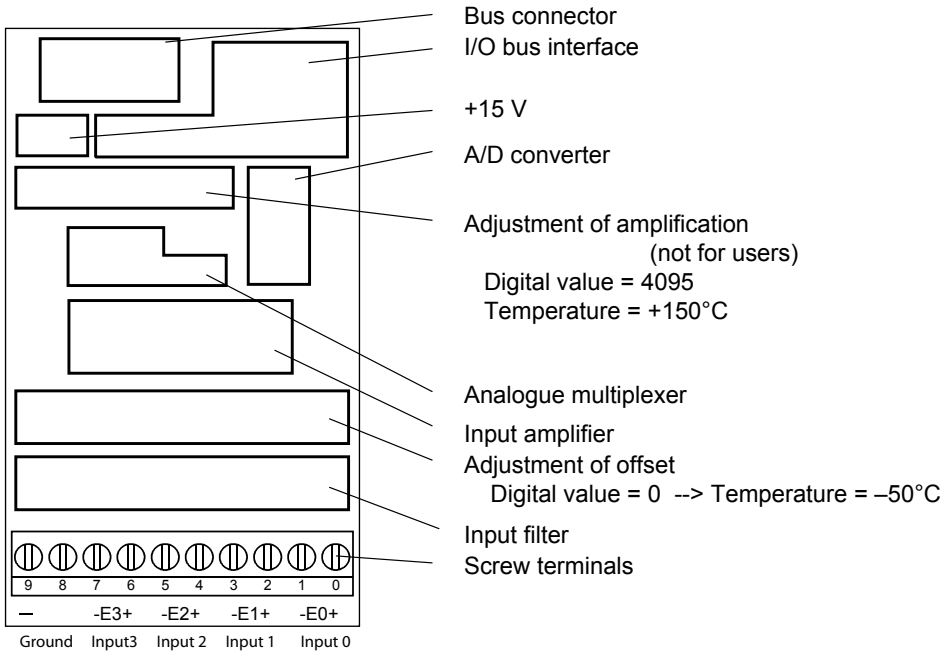
All modules are set up in pairs (base and variant module) at the factory. The variant modules must **not** be exchanged.

The 4 built-in potentiometers for setting the amplification are not accessible to the user and must **not** be adjusted.

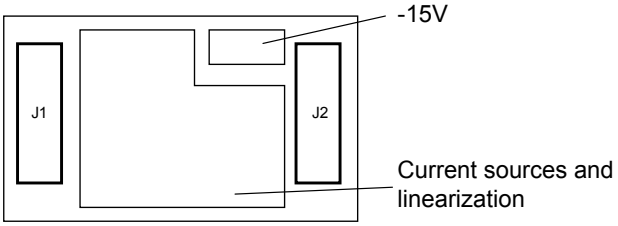


Terminals

Basic module



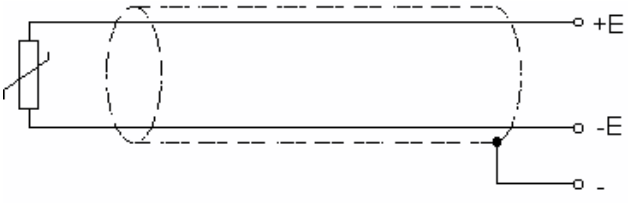
Substitution module



The negative terminals for each input are connected to the ground.

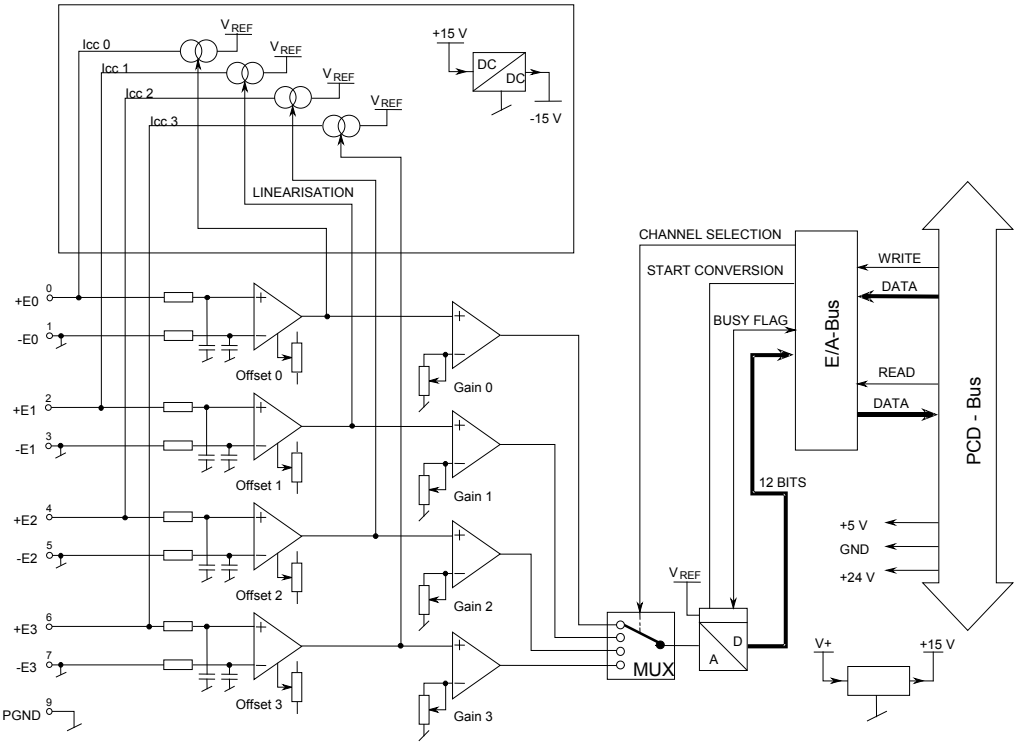
On this circuit board there are components that are sensitive to electrostatic discharges. For further information, refer to Appendix B, “Icons”.

Wiring



All unused inputs must be short-circuited: +I to -I in each case

Output circuits and terminal designation



Programming

Classic: Programming examples for the PCD2.W11x can be found in a separate manual and on the TCS Support site (www.sbc-support.ch + getting started).
xx7: the firmware reads in the values according to the configuration (I/O Builder)

Watchdog: This module can be used on all base addresses; there is no interaction with the watchdog on the CPUs. For details, please refer to the "Watchdog" section, which describes the correct use of the watchdog in conjunction with PCD2 components.

5.7.3 PCD2.W2x0, analogue inputs, 8 channels, 10 bit resolution

Application

With its short conversion time of <50 µs, this module is universally suitable for recording analogue signals. The only limitations are with weak signals, as with Pt 100 resistive temperature sensors, or with thermocouples.

Module overview

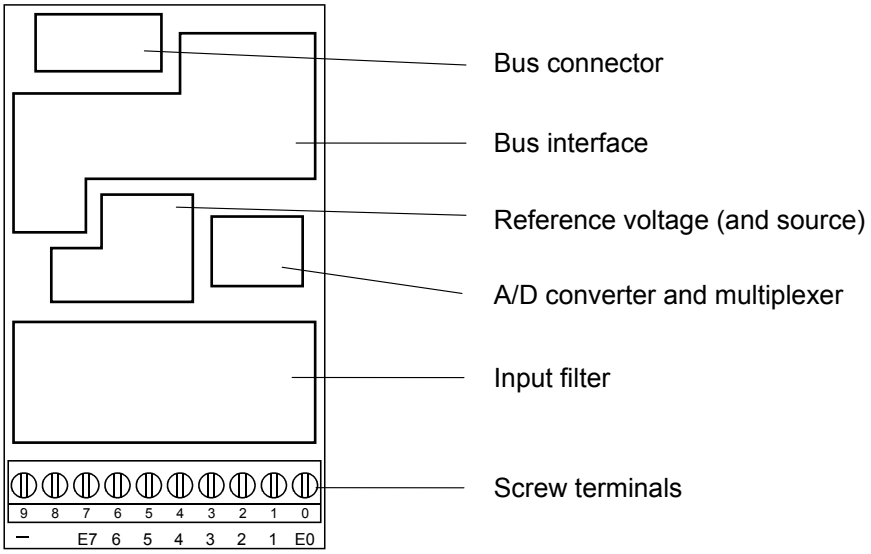
PCD2.W200	8 channels for signals 0…10 V
PCD2.W210	8 channels for signals 0…20 mA
PCD2.W220	8 channels for resistive temperature sensors Pt/Ni 1000

Technical data

Signal ranges:	see module overview
Galvanic separation:	no
Resolution (digital representation):	10 bits (0…1023)
Measuring principle:	non-differential, single-ended
Input resistance:	0…10 V: 200 kΩ / 0.15 % 0…20 mA: 125 Ω / 0,1 % Pt/Ni 1000: 7,5 kΩ / 0,1 %
Maximum signal current for the resistance measurement with W220:	1.5 mA
Accuracy: (of measured value)	± 3 LSB
Repeating accuracy: (under same conditions)	within 1 LSB
Temperature error:	± 0.3 % (± 3 LSB), (over temperature range from 0°…+55 °C)
Conversion time A/D:	<50 µs
Overvoltage protection:	W200/220: ± 50 VDC
Overcurrent protection:	W210: ± 40 mA
Burst protection: (IEC 1000-4-4)	± 1 kV, with unshielded cables ± 2 kV, with shielded cables
Time constant of input filter:	W200: typically 5 ms W210: typically 1 ms W220 : typically 10 ms
Internal current consumption: (from +5 V bus)	8 mA (W200/210/220)
Internal current consumption: (from V+ bus)	5 mA (W200/210) 16 mA (W220)
External current consumption:	0 mA
Terminals:	Pluggable 10-pole screw terminal block (4 405 4847 0), for wires up to 1.5 mm²

A signal with wrong polarity at an input, may cause that the measuring results at the other channels are significantly falsified.

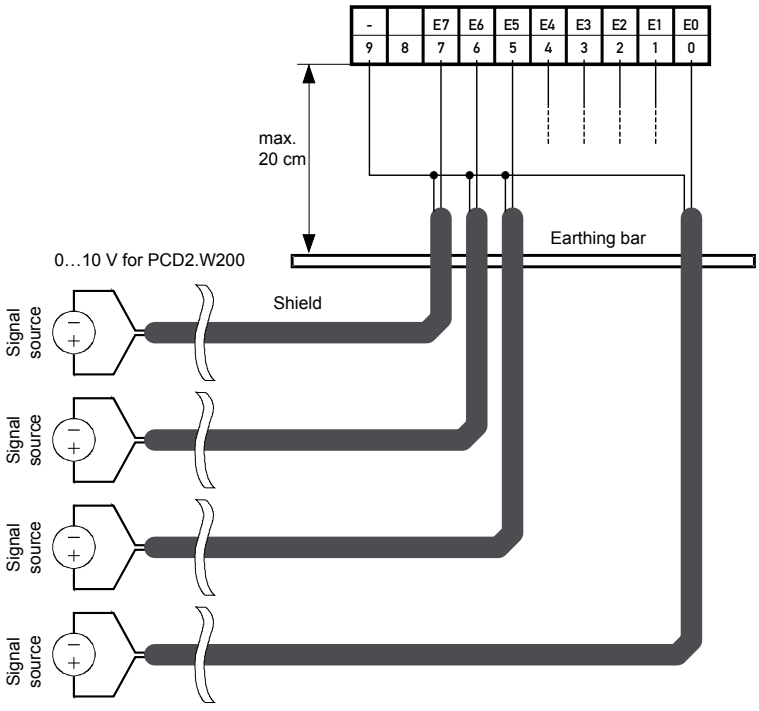
Terminals



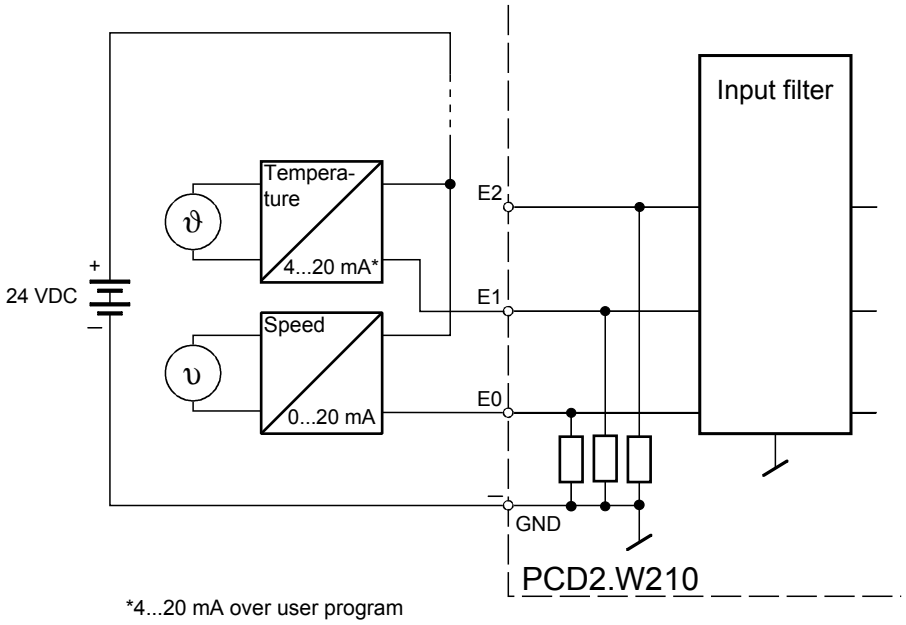
Digital/analogue values

Input signals and type			Digital values		
PCD2.W200	**PCD2.W210**	**PCD2.W220**	**Classic**	**xx7**	**Simatic**
+ 10.0 V	+ 20 mA	Calculate the appropriate values with the formulae at the end of this section	1023	1023	27648
+ 5.0 V	+ 10 mA		512	512	13824
	+ 4 mA		205	205	5530
0 V	0 mA		0	0	0
– 10.0 V	– 20 mA		0	0	0

Connection concept PCD2.W200



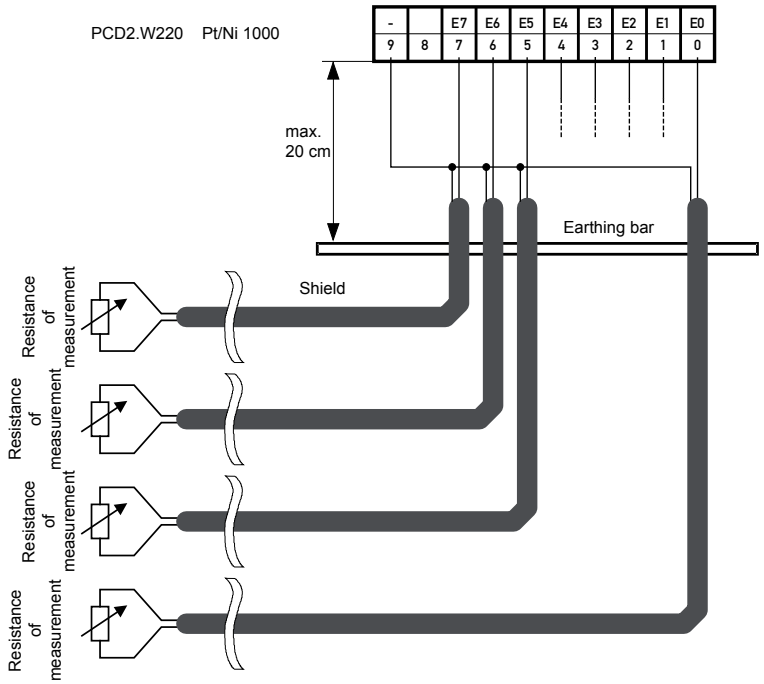
Connection concept PCD2.W210 for two-wire transducers



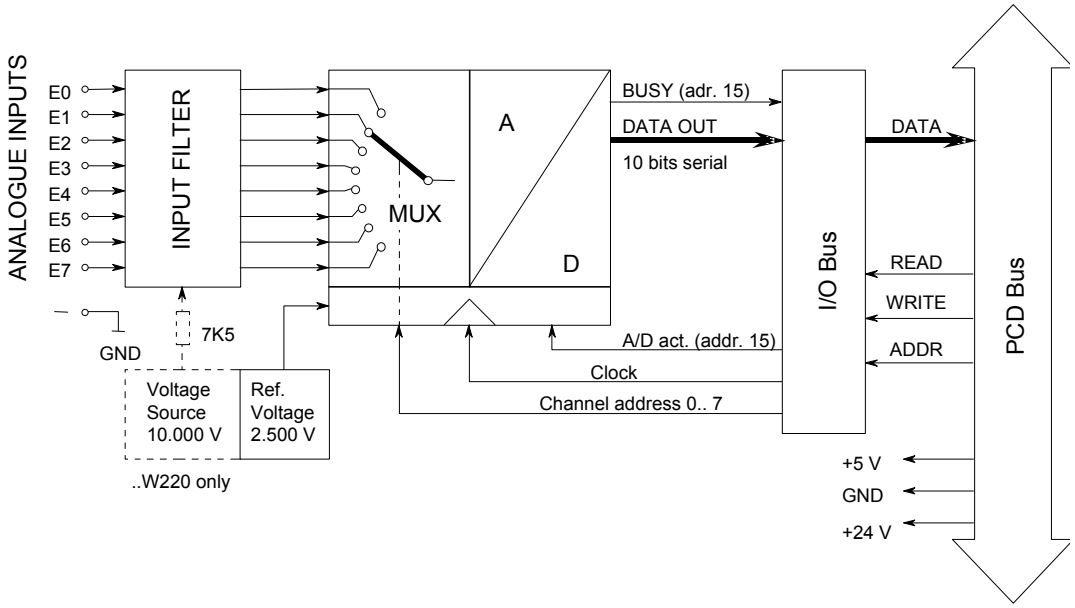
*4...20 mA over user program

Two-wire transducers (0..20 mA and 4…20 mA transmitters) need a 24 VDC supply in the measuring trunk.

Connection concept PCD2.W220



Block diagram



Watchdog: This module cannot be used on the base address 240 (or 496 for the PCD2.M170), because it would interact with the watchdog, and would cause a malfunction.

For details, please refer to the "Watchdog" section, which describes the correct use of the watchdog in conjunction with PCD2 components.

5

Temperature measurement with Pt 1000

In the temperature range – 50 °C to + 200 °C, the following formulae can be used for working to an accuracy of ± 1 % (± 1.5 °C). Repeating accuracy is significantly higher.

$$T[^\circ C] = \frac{DV}{2.08 - (0.509 \cdot 10^{-3} \cdot DV)} - 261{,}8$$

T=temperature in °C DV=digital value (0…1023)

Example 1: digital value DV=562
temperature T in °C ?

$$T[^\circ C] = \frac{562}{2.08 - (0.509 \cdot 10^{-3} \cdot 562)} - 261{,}8 = \underline{51.5\,^\circ C}$$

$$DV = \frac{2.08 \cdot (261.8 + T)}{1 + (0.509 \cdot 10^{-3} \cdot (261.8 + T))}$$

DV=digital value (0…1023) T=temperature in °C

Example 2: preset temperature T = –10 °C
corresponding digital value DV ?

$$DV = \frac{2.08 \cdot (261.8 - 10)}{1 + (0.509 \cdot 10^{-3} \cdot (261.8 - 10))} = \underline{464}$$

Resistance measurement up to 2.5 kΩ

Special temperature sensors or any other resistances up to 2.5 kΩ can be connected to the PCD2.W220. The digital value can be calculated as follows:

$$DV = \frac{4092 \cdot R}{(7500 + R)}$$

where 0 ≤ DV ≤ 1023 and R=the resistance to be measured in Ω.

5.7.4 PCD2.W3x0, analogue inputs, 8 channels, 12 bit resolution

Application

High-speed input module for general use with 8 channels, each with 12 bit resolution. Different variants for voltage 0…10 V, current 0…20 mA and the use of different resistance thermometers are available.

Module overview **resolution *)**

PCD2.W300:	Voltage 0…10 V		2.442 mV
PCD2.W310:	Current 0…20 mA		4.884 µA
PCD2.W340:	General purpose module		
	0…10 V		2.442 mV
	0…20 mA		4.884 µA
	Pt/Ni 1000 (default)		
	Pt 1000:	-50…+400 °C	0.14…0.24 °C
	Ni 1000:	-50…+200 °C	0.09…0.12 °C
PCD2.W350:	Temperature sensor		
	Pt/Ni 100		
	Pt 100:	-50…+600 °C	0.14…0.20 °C
	Ni 100:	-50…+250 °C	0.06…0.12 °C
PCD2.W360:	Temperature sensor		
	Pt 1000	-50…+150 °C	0.07…0.09 °C (resolution < 0.1 °C)
Method of linearization for temperature inputs: by software			

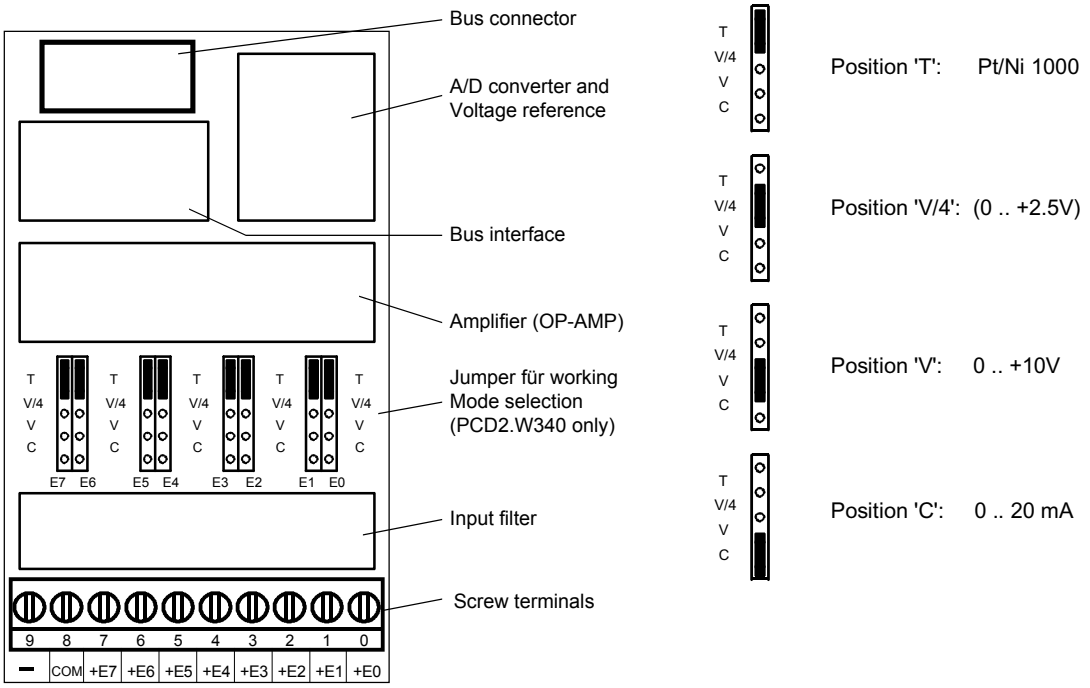
*) Resolution = value of least significant bit (LSB)

Technical data

Input ranges:	see module overview	
Galvanic separation:	no	
Resolution (digital representation):	12 bits (0…4095)	
Measuring principle:	non-differential, single-ended	
Input resistance:	W300: W310: W340: W350: W360:	20 kΩ / 0.15 % 125 Ω / 0.1 % U: 200 kΩ / I: 125 Ω not relevant not relevant
Maximum signal current for the resistance thermometers:	2.0 mA	
Accuracy at 25 °C	W300, 310: W340, 350, 360:	± 0.5 % ± 0.3 %
Repeating accuracy:	± 0.05 %	
Temperature error (0…+55 °C)	± 0.2 %	
Conversion time A/D:	< 10 µs	
Overvoltage protection:	W340: W300 *):	± 50 VDC (permanent) + 50 VDC (permanent)
Overcurrent protection:	W340: W310 *):	± 40 mA (permanent) + 40 mA (permanent)
EMC protection:	yes	

Time constant of input filter:	W300: typically 10.5 ms W310: typically 12.4 ms W340 V: typically 7.8 ms C: typically 24.2 ms T: typically 24.2 ms W350: typically 16.9 ms W360: typically 16.9 ms
Internal current consumption: (from +5 V bus)	< 8 mA for all module types
Internalcurrent consumption: (from V+ bus)	W300, 310 < 5 mA W340, 360 < 20 mA W350 < 30 mA
External current consumption:	0 mA
Terminals:	Pluggable 10-pole screw terminal block (4 405 4847 0), for wires up to 1.5 mm²
*) No negative input voltage should be applied on these modules.	

Terminals



Jumper positions for selecting working mode

PCD2.W340 only; on the other module types the working modes are fixed

All inputs set for temperature (position T) must be wired. All unused inputs (with the W340) must be adjusted to current range ‘C’ or voltage range ‘V’.

Changing the jumpers
On this circuit board there are components that are sensitive to electrostatic discharges. For further information, refer to Appendix B, “Icons”.

Digital/analogue values

Input signals and type			Digital values		
PCD2.W300/W340	**PCD2.W310/W340**	**PCD2.W340/50/60**	**Classic**	**xx7**	**Simatic**
+ 10.0 V	+ 20 mA	Calculate the appropriate values with the formulae at the end of this section	4095	4095	27684
+ 5.0 V	+ 10 mA		2047	2047	13824
0 V	0 mA		0	0	0

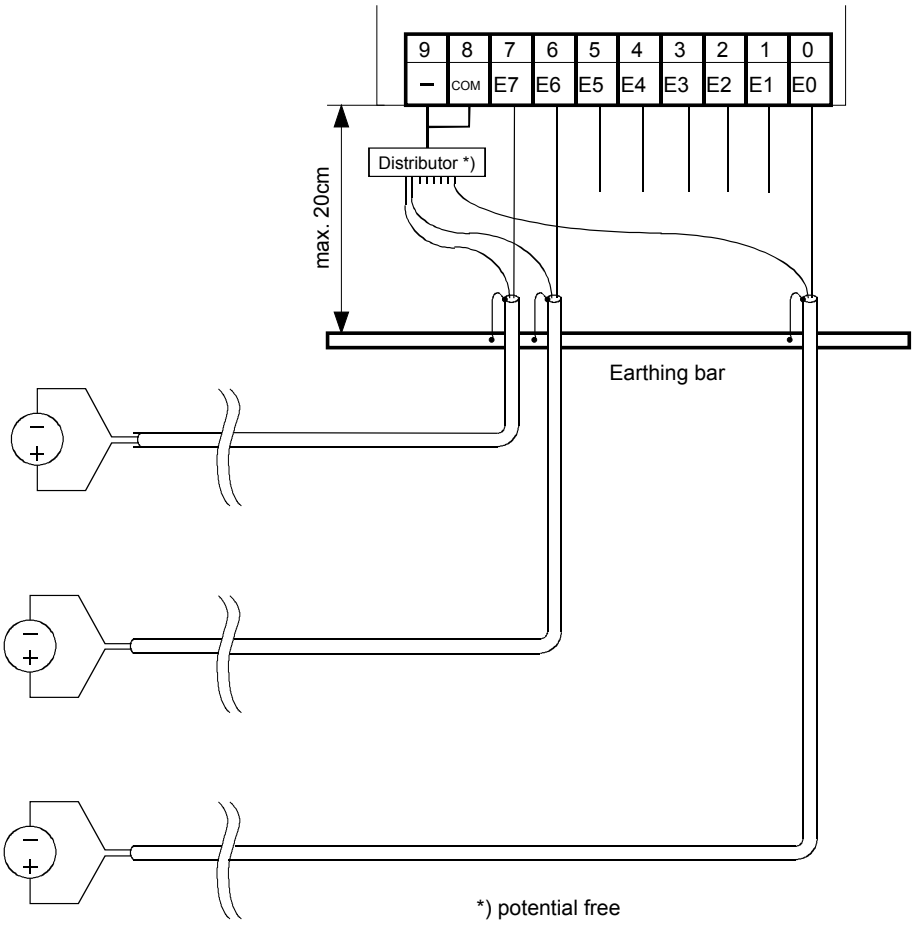
Connection concept for voltage and current inputs

The voltage and current input signals are connected directly to the 10-pole terminal block (E0…E7). To minimize the amount of interference coupled into the module via the transmission lines, connection should be made according to the principle explained below.

5

The following connection diagram shows a typical wiring layout for:

- voltage inputs with the PCD2.W300 and …W340 Modules or
- current inputs with the PCD2.W310 and …W340 Modules

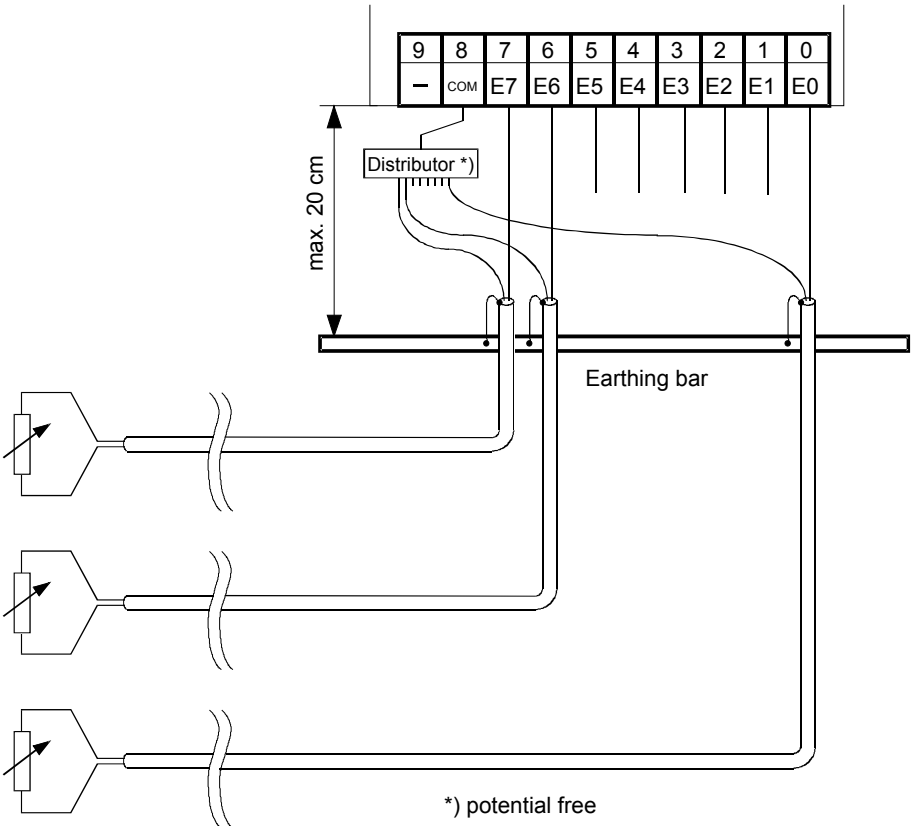


- The reference potentials of signal sources should be wired to a common GND connection (“–” and “COM” terminals). To obtain optimum measurement results, any connection to an earthing bar should be avoided
- If shielded cables are used, the shield should be continued to an external earthing bar.

Connection concept for temperature sensors

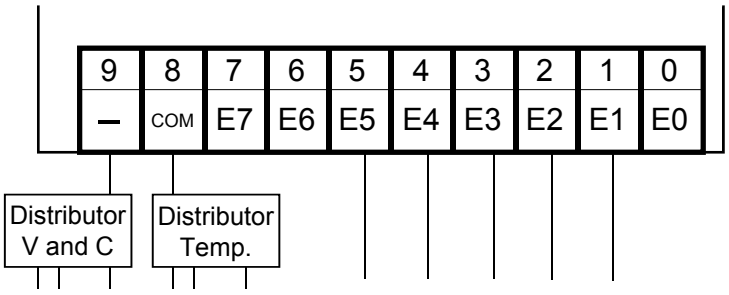
The input signals for the temperature sensors are connected directly to the 10-pole terminal block (E0…E7).

The following connection diagram shows a typical layout for temperature sensors with the PCD2.W340, …W350 and …W360 Modules.

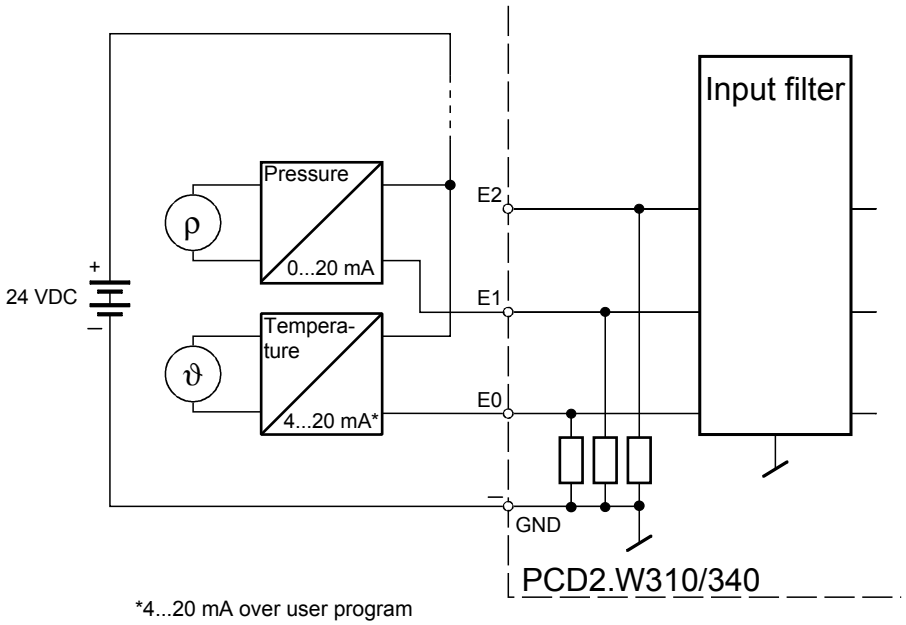


- The reference potential for temperature measurements is the “COM” terminal, which should not have any external earth or GND connection.
- If screened cables are used, screening should be continued to an external earthing bar.
- Unused temperature inputs are to be connected to the logical ground.

Mixed operation



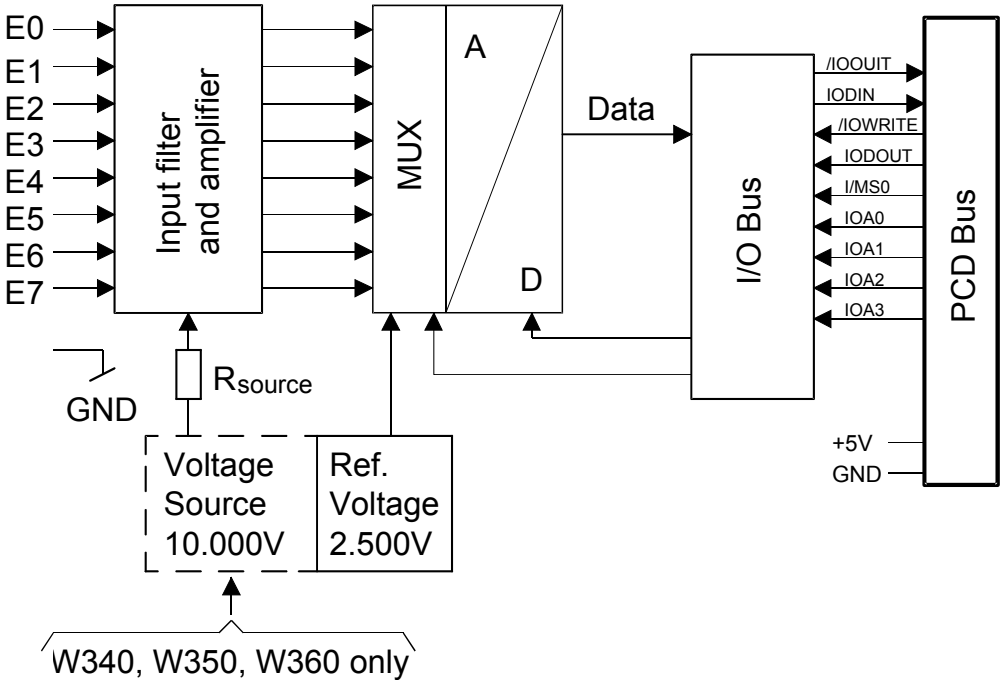
Connection concept for two-wire transducers



*4...20 mA over user program

Two-wire transducers need a 24 VDC-supply in the measuring trunk.

Block diagram



Programming

Classic: Programming examples for the PCD2.W3x0 can be found in a separate manual and on the TCS Support site (www.sbc-support.ch + getting started).

xx7: the firmware reads in the values according to the configuration (I/O Builder)

Watchdog: This module cannot be used on the base address 240 (or 496 for the PCD2.M17x), because it would interact with the watchdog, and would cause a malfunction.

For details, please refer to the "Watchdog" section, which describes the correct use of the watchdog in conjunction with PCD2 components.

Formulae for temperature measurement

For Ni 1000 (PCD2.W340)

Validity: Temperature range - 50…+ 210 °C

Computational error: ± 0.5 °C

$$T = -188.5 + \frac{260 \cdot DV}{2616} - 4.676 \cdot 10^{-6} \cdot (DV - 2784)^2$$

For Pt 1000 (PCD2.W340)

Validity: Temperature range - 50…+400 °C

Computational error: ± 1.5 °C

$$T = -366.5 + \frac{450 \cdot DV}{2474} + 18.291 \cdot 10^{-6} \cdot (DV - 2821)^2$$

Resistance measurement up to 2.5 kΩ (PCD2.W340)

Special temperature sensors or any other resistances up to 2.5 kΩ can be connected to the PCD2.W340. The digital value can be calculated as follows:

$$DV = \frac{16\,380 \cdot R}{(7\,500 + R)}$$

where 0 ≤ DV ≤ 4095 and R=the resistance to be measured in Ω.

For Ni 100 (PCD2.W350)

Validity: Temperature range - 50…+250 °C

Computational error: ± 1.65 °C

$$T = -28.7 + \frac{300 \cdot DV}{3628} - 7.294 \cdot 10^{-6} \cdot (DV - 1850)^2$$

For Pt 100 (PCD2.W350)

Validity: Temperature range - 50…+600 °C

Computational error: ± 1 °C

$$T = -99.9 + \frac{650 \cdot DV}{3910} + 6.625 \cdot 10^{-6} \cdot (DV - 2114)^2$$

For Pt 1000 (PCD2.W360)

Validity: Temperature range - 50…+150 °C

Computational error: ± 0.25 °C

$$T = -178.1 + \frac{200 \cdot DV}{2509} + 3.873 \cdot 10^{-6} \cdot (DV - 2786)^2$$

T = temperature

DV = digital value

5.8 Analogue input modules with electricaly isolation

PCD2.W305	**7 analogue inputs 12 bit resolution, 0…10 V**
PCD2.W315	**7 analogue inputs 12 bit resolution, 0…20 mA**
PCD2.W325	**7 analogue inputs 12 bit resolution, -10 V…+10 V**

Galvanic separation of outputs to PCD, channels themselves not separated

I/O modules and I/O terminal blocks may only be plugged in and removed when the PCD is disconnected from the power supply.

5.8.1 PCD2.W3x5, analogue inputs, 7 channels, 12 bit resolution, elect. isol.

Application

High-speed input module with galvanic separation of outputs to PCD bus, for general use with 7 channels, each with 12 bit resolution. Different variants for voltage 0…10 V, -10 V…+10 V and current 0…20 mA are available.

Module overview **resolution *)**

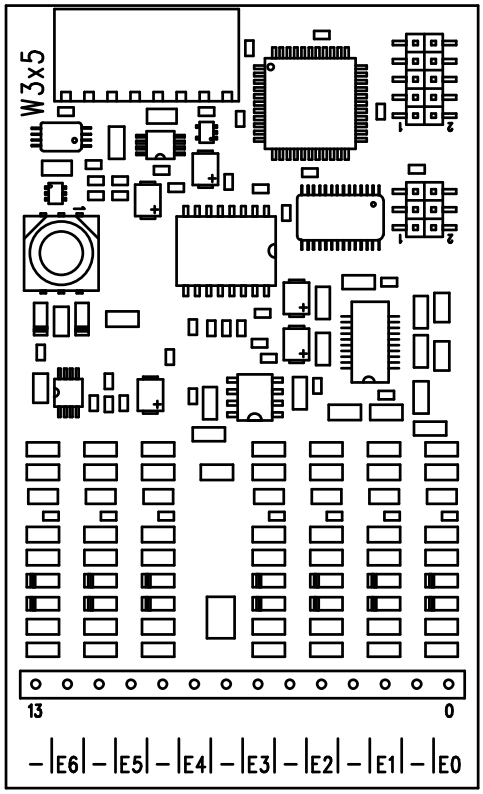
PCD2.W305:	Voltage 0…10 V	2.5 mV
PCD2.W315:	Current 0…20 mA	5 µA
PCD2.W325:	Voltage -10…+10 V	5 mV

*) Resolution = value of least significant bit (LSB)

Technical data

Input ranges:	see module overview
Galvanic separation:	500 V, galvanic separation of outputs to PCD, channels themselves not separated
Resolution (digital representation):	12 bits (0…4095)
Measuring principle:	non-differential, single-ended
Input resistance:	W305: 13.5 kΩ / 0.1 % W315: 120 Ω / 0.1 % W325: 13.7 kΩ / 0.1 %
Accuracy at 25 °C	± 0.15 %
Repeating accuracy:	± 0.05 %
Temperature error (0…+55 °C)	± 0.25 %
Conversion time A/D:	≤ 2 ms
Overvoltage protection:	W305: ± 40 VDC (permanent) W325: ± 40 VDC (permanent)
Overcurrent protection:	W315: ± 35 mA (permanent)
EMC protection:	yes
Time constant of input filter:	Typically 2.4 ms
Internal current consumption: (from +5 V bus)	< 60 mA
Internal current consumption: (from V+ bus)	0 mA
External current consumption:	0 mA
Terminals:	Pluggable 14-pole cage spring terminal block (4 405 5002 0), for wires up to 1.5 mm²

Terminals



Digital/analogue values

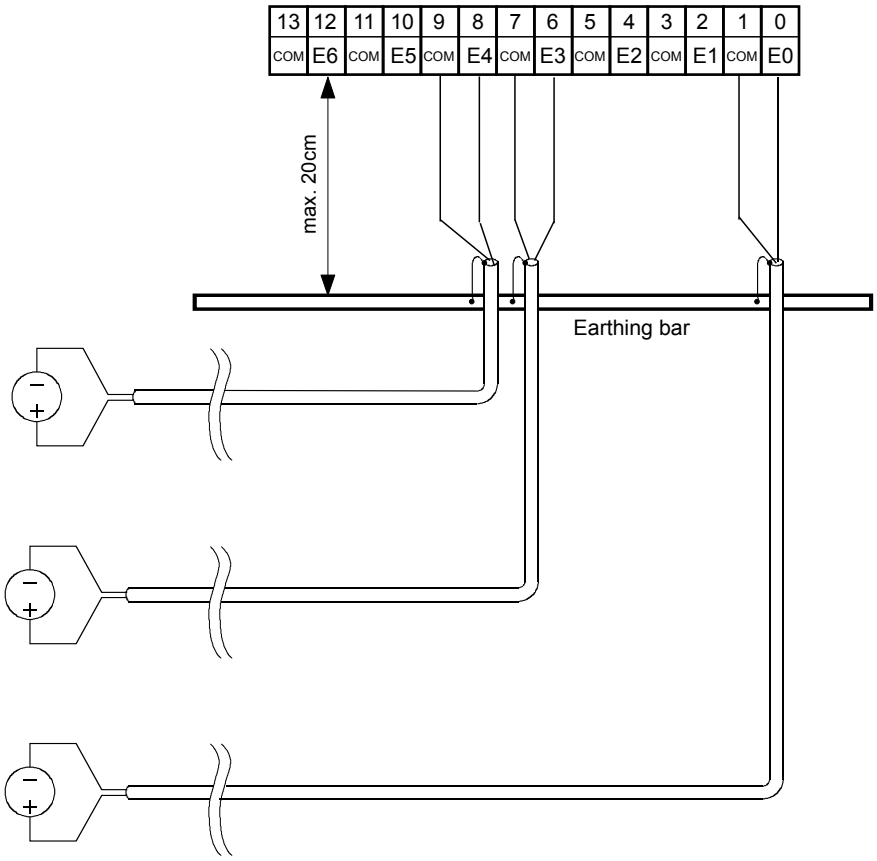
Input signals and type			Digital values		
PCD2.W305	**PCD2.W315**	**PCD2.W325**	**Classic**	**xx7**	**Simatic**
+ 10.0 V	+ 20 mA	+10 V	4095	4095	27684
+ 5.0 V	+ 10 mA	0 V	2047	2047	13842
0 V	0 mA	-10 V	0	0	0

Connection concept for voltage and current inputs

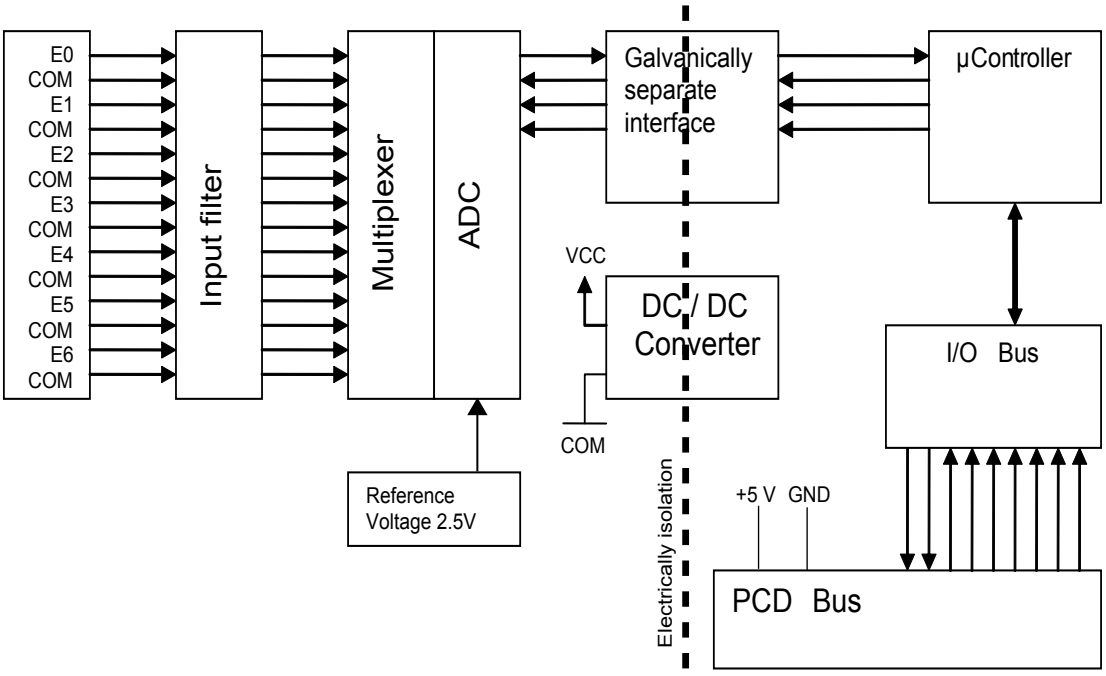
The voltage and current input signals are connected directly to the 14-pole terminal block (E0…E6 and COM). To minimize the amount of interference coupled into the module via the transmission lines, connection should be made according to the principle explained below.

The following connection diagram shows a typical wiring layout for:

- Voltage inputs with the PCD2.W305 and .W325 modules or
- Current inputs for the PCD2.W315 module
- If shielded cables are used, the shield should be continued to an external earthing bar.



Block diagram



Programming

Classic:	For programming the modules, an FBox is available.
xx7 and RIOs:	the firmware reads in the values according to the configuration (I/O Builder or network configurator)

Watchdog: This module can be used on all base addresses; there is no interaction with the watchdog on the CPUs. For details, please refer to the “Watchdog” section, which describes the correct use of the watchdog in conjunction with PCD2 components.

5.9 Analogue input and output modules

PCD2.W500	**2 analogue inputs 12 bit + 2 analogue outputs 12 bit, 0…10 V, -10 V…+10 V *)**
PCD2.W510	**2 analogue inputs 12 bit + 2 analogue outputs 12 bit, 0…+20 mA, -20…+20 mA *)**

*) jumper selectable

I/O modules and I/O terminal blocks may only be plugged in and removed when the PCD is disconnected from the power supply.

5.9.1 PCD2.W5x0, analogue inputs/outputs, 2 + 2 channels, 12 bit resolution

Application

Combined high speed analogue input/output module with 2 voltage inputs and 2 voltage outputs 0…+10 V (unipolar) or -10…+10 V (bipolar), jumper selectable, all with 12 bit resolution. The module is suitable for precise, high-speed applications.

Module overview

PCD2.W500: Combined high-speed analogue input/output module with 2 voltage inputs and 2 voltage outputs 0…+10 V (unipolar) or -10…+10 V (bipolar), jumper selectable (standard module).

PCD2.W510: Module with 2 current inputs and 2 voltage outputs (special version)

Technical data

Inputs		
Number of input channels:		2
Signal ranges	W500:	0…+10 V } jumper selectable -10…+10 V } together
	W510:	0…+20 mA } jumper selectable -20…+20 mA } together
Galvanic separation:		no
Measuring principle:		differential
Conversion timeA/D:		< 30 µs
Resolution (digital representation):		12 bits (0…4095)
Input resistance:		0…+10 V :1 MΩ 0…+20 mA: 100 Ω
Accuracy (of measured value):		unipolar: ± 2 LSB bipolar: ± 10 LSB
Repeating accuracy (under same conditions):		± 2 LSB
Common mode range:		CMR ± 10 V
Common mode rejection:		CMRR ≥ 75 dB
Overvoltage protection:		± 40 VCC (permanent)
Time constant of input filter:		3 ms
Outputs		
Number of output channels:		2, short circuit protected
Signal ranges:		0…+10 V } jumper selectable -10…+10 V } individually
Galvanic separation:		no
Conversion time D/A:		< 20 µs
Resolution (digital representation):		12 bits (0…4095)
Load impedance:		> 3 kΩ
Accuracy (of output value):		0.3 % ± 20 mV

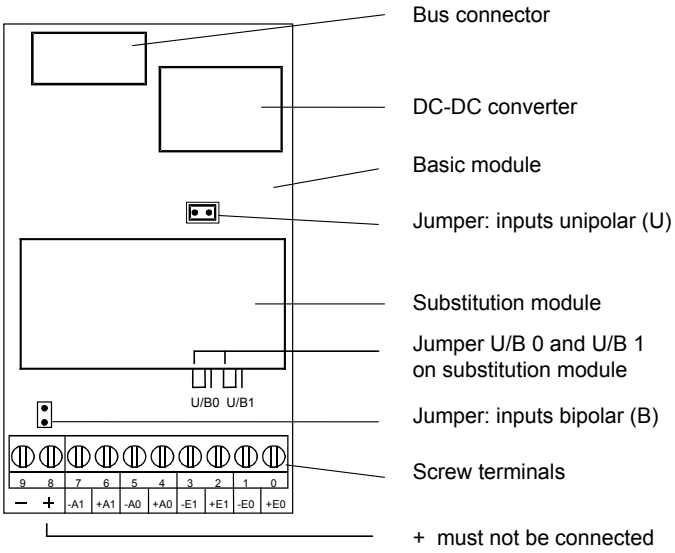
Technical data common to the whole module

Burst protection: (IEC 801-4)	± 1 kV, with unshielded cables ± 2 kV, with shielded cables
Temperature error	0.3 % (across temperature range 0…+55 °C)
Internal current consumption:(from +5 V bus)	max. 200 mA

Internal current consumption: (from V+ bus)	0 mA
External current consumption:	0 mA
Terminals:	Pluggable 10-pole screw terminal block (4 405 4847 0), for wires up to 1.5 mm²

As the current consumption of this module is considerable, when using a number of them in the same system, the total load for all modules must be taken into consideration..

Terminals



The negative terminals "–" of outputs are connected internally to the ground, each via a 100 Ω resistor.

Analogue/digital values

Inputs

Input signals	Digital values					
	Classic		xx7		Simatic	
	unipolar	bipolar	unipolar	bipolar	unipolar	bipolar
+10 V	4095	4095	4095	4095	27648	27648
+5 V	2047	3071	2047	3071	13824	13824
0 V	0	2047	0	2047	0	0
-5 V	0	1023	0	1023	0	-13824
-10 V	0	0	0	0	0	-27648

Outputs

Digital values			Output signals	
Classic	xx7	Simatic	unipolar	bipolar
4095	4095	27648	+10.0 V	+10.0 V
3071	3071	20736	+7.5 V	+ 5.0 V
2047	2047	13824	+5.0 V	0 V
1023	1023	6912	+2.5 V	-5.0 V
0	0	0	0 V	-10.0 V

PCD2.W500 Module, fully equipped
(with additional module plugged on)

Apart from the bus connector, DC-DC converter and terminals, the base module carries the two input channels with the 2-pole jumper for unipolar or bipolar operation and a number of preset potentiometers, which cannot be adjusted by the user.

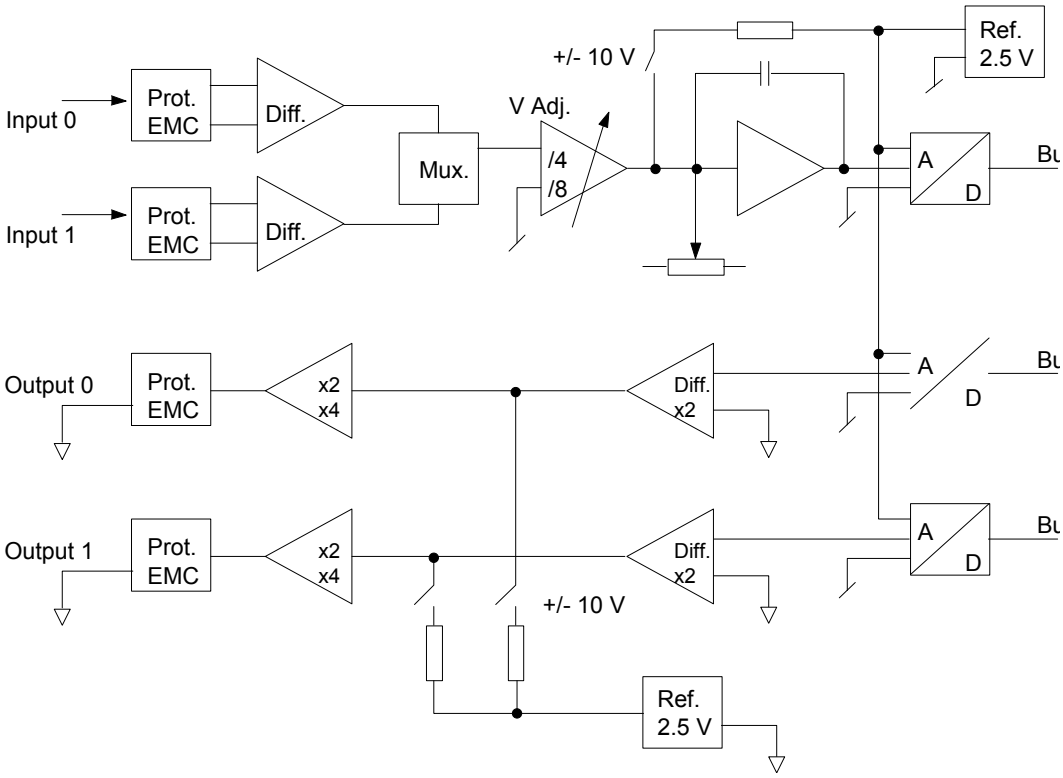
The plug-on module contains the two analogue outputs with the two 3-pole jumpers for the individual unipolar or bipolar operation of each output.

The module also works without the plug-on module.

Changing the jumpers

On this circuit board there are components that are sensitive to electrostatic discharges. For further information, refer to Appendix B, “Icons”.

Block diagram



Programming

Reset

When the module or CPU powers up, both analogue outputs of the PCD2.W500 Module are set at the maximum value of +10 V (or a random value between 0 and +10 V). If this should cause problems, XOB 16 (the cold-start routine) should be used to initialize both these outputs to zero or any desired cold-start value.

If the debugger is connected or the P100 handheld service device is plugged in, there is no cold-start when the CPU supply switches on. Both analogue outputs of the PCD2.W500 are then set to the maximum value of +10 V, despite the reset routine.

Classic: Programming examples for the PCD2.W500 can be found in a separate manual and on the TCS Support site (www.sbc-support.ch + getting started).
xx7: the firmware reads and writes the values according to the configuration (I/O Builder)

Watchdog: This module cannot be used on the base address 240 (or 496 for the PCD2.M17x), because it would interact with the watchdog, and would cause a malfunction. For details, please refer to the "Watchdog" section, which describes the correct use of the watchdog in conjunction with PCD2 components

.

5.10 Combined analogue input/output modules with galvanic isolation

PCD2.W525	**4 inputs,** **14 bits, 0…10 V, 0(4)…20 mA, Pt 1000, Pt 500 or Ni 1000** **(selectable by DIP switch)** **and** **2 outputs, 12 bits, 0…10 V or 0(4)…20 mA** **(selectable by software (FBox, FB)**

Galvanic separation of outputs to PCD, channels themselves not separated

I/O modules and I/O terminal blocks may only be plugged in and removed when the PCD is disconnected from the power supply.

5.10.1 PCD2.W525 Combined analogue input/output modules with galvanic isolation

General Information

PCD2.W525 is an analogue multipurpose module with four inputs and two outputs. Each input and each output can be individually configured as one of the standard industrial interface type like 0…10 V, 0…20 mA and 4…20 mA. In addition, the inputs can be configured to support Pt/Ni1000 or Pt500 temperature sensors. Furthermore, the module offers high flexibility in selecting filter types and scaling ranges.

Inputs-14 Bit

- 4 Inputs. Every channel has four modes of operation (configurable by DIP-Switches):
  - ***Differential Voltage Inputs***
    0…10 V, resolution: 0.61 mV per LSB (14 Bit)
  - ***Differential Current Inputs***-measured in differential mode
    0…20 mA, resolution: 1.2 µA per LSB (14 Bit)
    4…20 mA, resolution: 1.2 µA per LSB (13.7 Bit)
  - ***Temperature***
    Pt1000, -50…400 °C, resolution: 0.1 °C
    Pt500, -50…400 °C, resolution: 0.2 °C
    Ni1000, -60…200 °C, resolution 0.1 °C
  - ***Resistance***
    0…2500 Ω, resolution 0.2 Ω
- Each channel can be configured to have a software based 50 Hz / 60 Hz filter

Outputs-12 Bit

- 2 Outputs. Every channel has three modes of operation (configurable by software):
  - ***Voltage***
    0…10 V, resolution: 2.44 mV per LSB (12 Bit)
  - ***Current***
    0…20 mA, resolution: 4.88 µA per LSB (12 Bit)
    4…20 mA, resolution 4.88 µA per LSB (11.7 Bit)
  - ***High impedance***

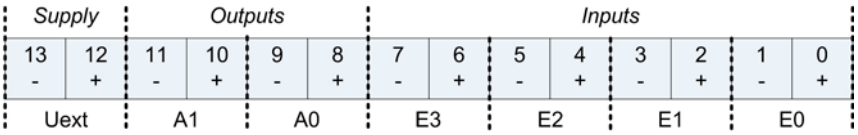
Miscellaneous

- All I/O-Channels are galvanically isolated to the PCD and external power supply. (But all channels are galvanically connected to each other.)
- Every channel has two connection terminals.

Configuration

Module connections/LED

The connections of the module terminal are the following:



Description of the LED:

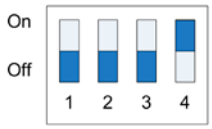
- Off: Module is not powered. U_{ext} (24 V) is missing.
- On: Module is running without errors
- Blinking slow: Channel error (Over range/under range/short circuit/open load)
- Blinking fast: U_{ext} is lower than specified (< 19 V)

How to configure the inputs

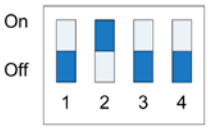
Each input channel is configured by a DIP-Switch with four switches. The function of each switch is the following:

Switch nr.	*Off*	*On*
1	Differential Mode	Single Ended Mode
2		Current Shunt On
3		Supply for external Resistors On
4	Gain=1	Gain=0.25

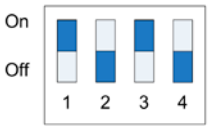
According to this table, the configuration for the different modes of operation is as follows:



Voltage mode
0...10 V



Current mode
0...20 mA
4...20 mA



Temperature mode
Pt1000 (-50...400 ˚C)
Pt500 (-50...400 ˚C)
Ni1000 (-60...200 ˚C)
Resistor mode
0...2500 Ω

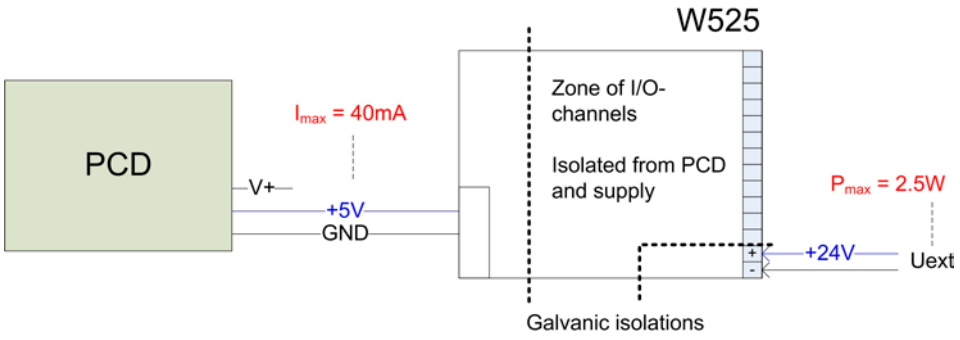
How to configure the outputs

Since the outputs are configured by software (with the corresponding FBox or FB), there is no need to configure the mode of operation of the outputs with any kind of jumpers or DIP-Switches.

Function

Power Supply

PCD2.W525 has to be supplied externally! This power supply is galvanically isolated to both, the PCD and the I/Os of W525. Furthermore, the design allows using the same power supply for the PCD and for W525 without loosing the galvanic isolation. These schematics show the different zones of isolation:



Timing

- **Inputs**
  - Internally, W525 finishes acquiring every 2 ms a new value for every input channel
  - This value is always ready to be read by the PCD.
  - Dependent on the PCD speed, the transmission time of a single 16-Bit scaled value (of a single input channel) takes typically 100 µs (on a PCD2.M480) or 600µs (on a PCD2.M170)
- **Outputs**
  - Internally, W525 outputs the last received output value from PCD with a maximum delay of 2 ms.
  - Dependent on the PCD speed, the transmission time of a single 16-Bit scaled output value takes typically 100 µs (on a PCD2.M480) or 600 µs (on a PCD2.M170).

Filter

- **Inputs**

  There are two factors, which have filtering effects to the acquired values:
  - The base hardware filter with a time constant of 2 ms. This filter attenuates the input signal by 6 dB/decade at a cut-off frequency of 80 Hz.
  - The second influence is caused by software and results in a delay of the acquired value for 2 ms with a notch filter characteristics at 500 Hz if no software based 50 Hz / 60 Hz filter is selected.

  In case of use of a 50 Hz (60 Hz) filter, the notch filter frequency is 50 Hz (60 Hz); the delay remains the mentioned 2ms.
- **Outputs**

  There is only the hardware based filter with a time constant of 1 ms, which is active

Technical Data

Inputs	
General:	
Resolution:	14 Bit
Kind of Measurement:	differential
Number of channels:	4
Galvanic isolated to PCD:	yes
Galvanic isolated to external supply:	yes
Galvanic isolated between other channels:	no
Kind of connections:	two wires per channel
How to configure mode of operation:	by DIP-Switches
Accuracy at 25 °C:	± 0.2% max.
Accuracy repetitive:	± 0.05% max.
Temperature drift (0...55 °C) max.:	± 70 ppm/°C
Over voltage protection:	± 50 V min.
Over current protection:	± 35 mA min.
Common mode voltage max:	± 50 V min.
Common mode rejection ratio:	70 dB min.
Filter:	
Time constant of hardware filter:	2 ms
Attenuation of software based 50 Hz Filter:	40 dB min. between 49.5 and 50.5 Hz
Attenuation of software based 60 Hz Filter:	40 dB min. between 59.5 and 60.5 Hz
Voltage mode:	
Resolution range 0…10 V mode:	14 Bit; 0.61 mV per LSB
Current mode:	
Current shunt:	125 Ω
Resolution range 0…20 mA:	14 Bit; 1.22 µA per LSB
Resolution range 4…20 mA:	13.7 Bit; 1.22 µA per LSB
Temperature / Resistance mode:	
Resolution for Pt1000; Range -50…400 °C	0.1 °C
Resolution for Pt500; Range -50…400 °C	0.2 °C
Resolution for Ni1000; Range -60…200 °C	0.1 °C
Resolution for Resistor; Range 0…2500 Ω	0.2 Ω
Power dissipation in temp. sensor / resistor:	2.5 mW max
Outputs	
General:	
Resolution:	12 Bit
Number of channels:	2
Galvanic isolated to PCD:	yes
Galvanic isolated to external supply:	yes
Galvanic isolated between other channels:	no
Kind of connections:	two wires per channel
How to configure mode of operation:	by software (FBOX, FB)
Accuracy at 25 °C:	± 0.5% max.
Accuracy repetitive:	± 0.1% max.
Temperature drift (0...55 °C) max.:	± 70 ppm/°C.
Over current protection:	short circuit protected
Time constant of filter:	1 ms
Voltage mode:	
Max. load to guarantee specified accuracy:	> 700 Ω
Resolution range 0…10 V:	12 Bit; 2.44 mV per LSB

Current mode:		
Working resistance:		< 600 Ω
Resolution range 0…20 mA:		12 Bit; 4.88 µA per LSB
Resolution range 4…20 mA:		11.7 Bit; 4.88 µA per LSB
General Data		
Power consumption at I/O-Bus +5V:		max. 40 mA
Power consumption at I/O-Bus V+:		unloaded
Temperature range:		0...55 °C
External power supply		
(It is possible and allowed to use the same power supply as the PCD itself is supplied with – without losing the galvanic isolation of the I/Os!)		
Operation voltage:		24 V ±4 V smoothed
Power consumption:		max. 2.5 W (depends on output load)
Terminal:	PCD2	Pluggable 14-pole screw terminal (PCD2.W525; O no. 4 405 5002 0, will be delivered with the module), both for wires up to 1,5 mm²

5.11 Analogue output modules

PCD2.W400	**4 analogue outputs 8 bit, 0…10 V**
PCD2.W410	**4 analogue outputs 8 bit, 0…10 V, 0…20 mA, 4…20 mA *)**
PCD2.W600	**4 analogue outputs 12 bit, 0…10 V**
PCD2.W610	**4 analogue outputs 12 bit, 0…10 V, 0…20 mA, 4…20 mA, Pt/Ni 1000 *)**

*) jumper selectable

I/O modules and I/O terminal blocks may only be plugged in and removed when the PCD is disconnected from the power supply.

5.11.1 PCD2.W4x0, analogue outputs, 4 channels, 8 bit resolution

Application

High-speed output module with 4 output channels of 8 bits each. Different output signals can be chosen with the aid of jumpers. Suitable for processes in which a large number of actuators have to be controlled, such as in the chemical industry and building automation.

Module overview

PCD2.W400: Simple module with 4 output channels of 8 bits each. 0…10 V

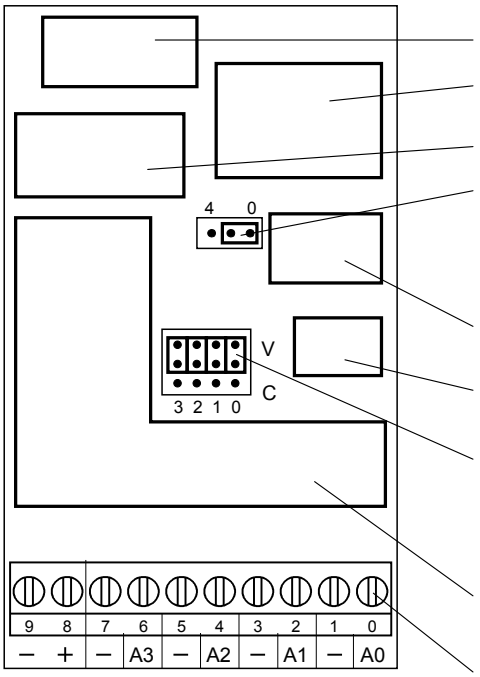
PCD2.W410: General purpose module with 4 output channels of 8 bits each. Signals can be selected from 0…10 V, 0…20 mA or 4…20 mA.

5

Technical data

Number of output channels:	4, short circuit protected
Signal ranges:	W400 0…10 V W410 0…10 V*) } selectable 0…20 mA } with jumpers 4…20 mA *) Factory setting
Resolution (digital representation):	8 bits (0…255)
Conversion time D/A:	< 5 µs
Load impedance:	for 0…10 V: ≥ 3 kΩ for 0…20 mA: 0…500 Ω for 4…20 mA: 0…500 Ω
Accuracy (of output value):	for 0…10 V: 1 % ± 50 mV for 0…20 mA: 1 % ± 0.2 mA for 4…20 mA: 1 % ± 0.2 mA
Residual ripple:	for 0…10 V: < 15 mVpp for 0…20 mA: < 50 µApp for 4…20 mA: < 50 µApp
Temperature error:	typically 0.2 %, (across temperature range 0…+55 °C)
Burst protection: (IEC 801-4)	± 1 kV, with unshielded cables ± 2 kV, with shielded cables
Internal current consumption: (from +5 V bus)	1 mA
Internal current consumption: (from V+ bus)	30 mA
External current consumption:	max. 0.1 A (type PCD2.W410 only, for current outputs)
Terminals:	Pluggable 10-pole screw terminal block (4 405 4847 0), for wires up to 1.5 mm²

Terminals



Bus connector
Reference voltage
Bus interface
Offset-Jumper J1 (type PCD2.W410 only)
Position "0" : 0.to. 10 Vor 0.to. 20 mA
Position "4" : 2.to. 10 Vor 4.to. 20 mA
D/A converter
Output amplifier 0.to. 10 V
Jumper J2 for voltage/current
(type PCD2.W410 only)
Position "V" : Voltage output
Position "C" : Current output
External supply to V/C converter
(type PCD2.W410 only)
Screw terminals

5

Analogue/digital values and jumper positions

Jumper "V/C"			V	C	C
Jumper "0/4"			0	0	4
Signal range			0…10 V	0…20 mA	4…20 mA
Digital values					
Classic	**xx7**	**Simatic**			
255	**255**	**27648**	10.0 V	20 mA	20 mA
128	**128**	**13824**	5.0 V*)	10 mA*)	12 mA*)
0	**0**	**0**	0	0	4 mA

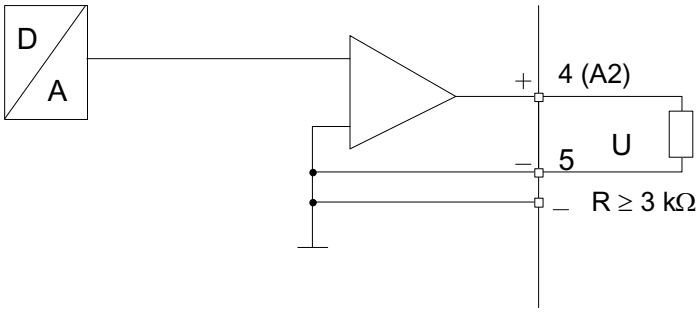
*) The exact values are 1/255 higher

Changing the jumpers

On this circuit board there are components that are sensitive to electrostatic discharges. For further information, refer to Appendix B, "Icons".

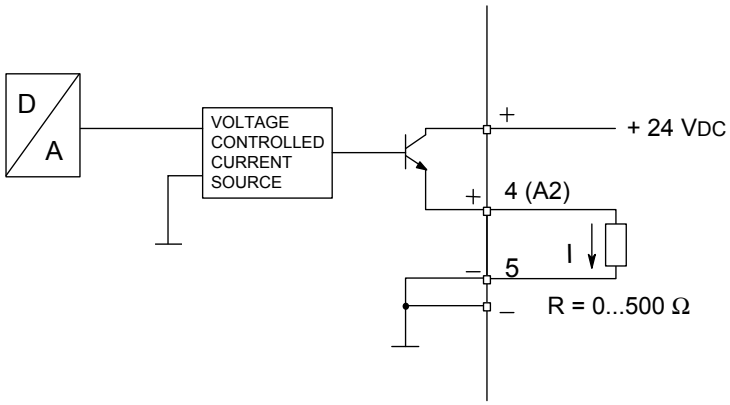
Connection concept

Connection for 0…10 V



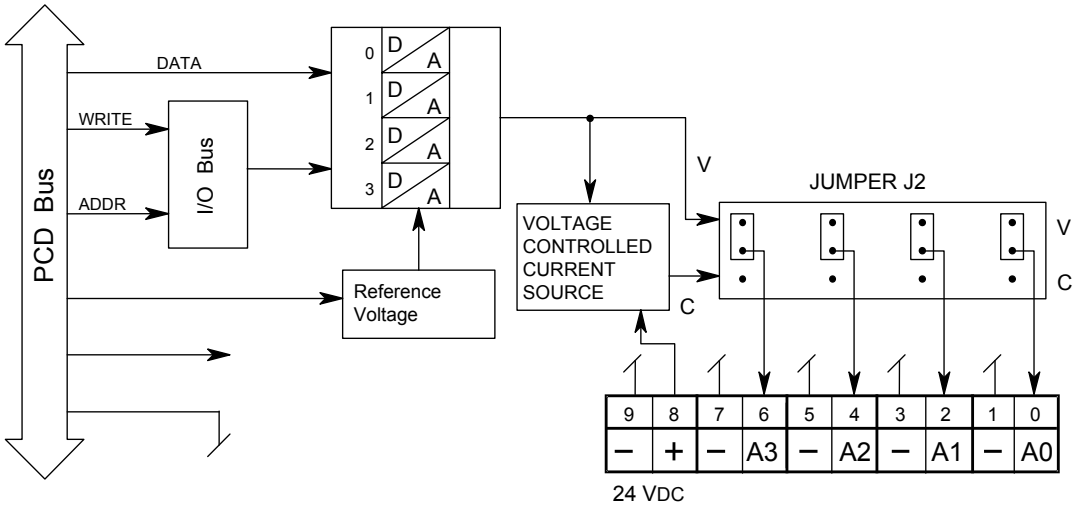
Connection for 0…20 mA or 4…20 mA

(selectable with jumpers on type PCD2.W410)



An external 24 VDC supply is required for current outputs

Block diagram



Programming

Classic: Programming examples for the PCD2.W4x0 can be found in a separate manual and on the TCS Support site (www.sbc-support.ch + getting started).

xx7: the firmware writes the values according to the configuration (I/O Builder)

Watchdog: This module cannot be used on the base address 240 (or 496 for the PCD2.M17x), because it would interact with the watchdog, and would cause a malfunction.

For details, please refer to the "Watchdog" section, which describes the correct use of the watchdog in conjunction with PCD2 components.

5.11.2 PCD2.W6x0, analogue outputs, 4 channels, 12 bit resolution

Application

High-speed output module for general use with 4 channels, each with 12 bit resolution. Different variants for voltage 0…10 V, -10…+10 V and current 0…20 mA are available.

Module overview

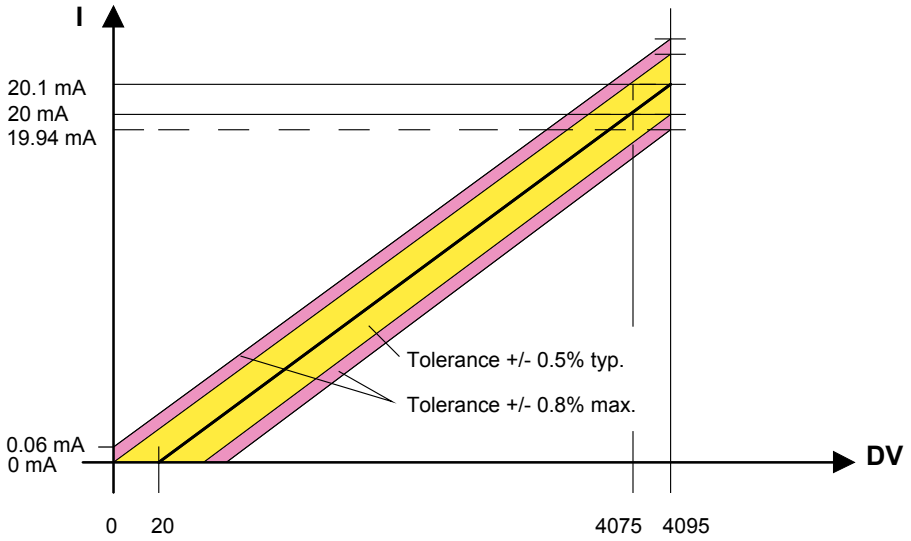
PCD2.W600:	Unipolar voltage outputs	0…10 V
PCD2.W610:	Bipolar voltage outputs to unipolar voltage	-10 V…+10 V, switchable 0…10 V / current 0…20 mA

Technical data

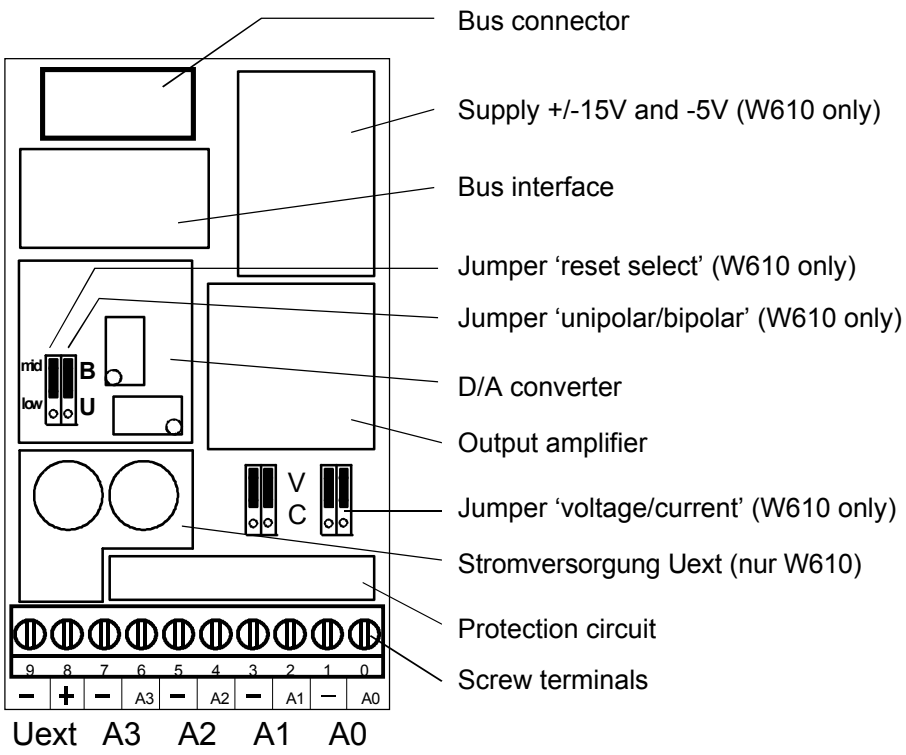
	resolution		
Number of output channels:	4, short circuit protected		
Signal range:	W600: 0…+10 V	2.442 mV	
	W610: -10 V…+10 V	4.884 mV	selectable with jumper
	0…+10 V	2.442 mV	
	0…20 mA	4.884 µA	
Galvanic separation:	no		
Resolution (digital representation):	12 bits (0…4095)		
Conversion time D/A:	typ. 10 µs		
Load impedance	Voltage:	> 3 kΩ	
	Current:	< 500 Ω	
Accuracy at 25 °C (of output value)	Voltage:	± 0.5 %	
	Current:	± 0.8 % *)	
Temperature error:	Voltage:	± 0.1 %	(across temperature range
	Current:	± 0.2 %	0…+55 °C)
Internal current consumption: (from +5 V bus)	W600:	max. 4 mA	
	W610:	max. 110 mA	
Internal current consumption: (from V+ bus)	W600:	max. 20 mA	
	W610:	0 mA	
External current consumption:	max. 100 mA	(type PCD2.W610 only, for current outputs)	
Terminals:	Pluggable 10-pole screw terminal block (4 405 4847 0), for wires up to 1.5 mm²		

*) Note on current outputs:
Since for some applications it is important to be able to reach the outside limit values of the range (0 mA, 20 mA), current outputs have been laid out according to the following characteristic line:

During the start, a voltage of 5 V will be at all outputs of the module PCD2.W600. The starting phase lasts 40 ms, afterwards 0 V will be put to the outputs.



Terminals



Digital/analogue values

Digital values			Output signals
Classic	**xx7**	**Simatic**	
4095	4095	27648	+20.1 mA
4075	4075	27513	+20 mA
2048	2048	13824	+10 mA
20	20	135	0 mA
0	0	0	0 mA

Changing the jumpers

There are components on this circuit board, that are sensitive to electrostatic discharges. For further information, refer to Appendix B, “Icons”.

Range selection (PCD2.W610)

Jumpers, factory settings:	A0…A3:	“V”	(voltage)
	U/B:	“B”	(bipolar)
	Reset select:	“mid“	(reset to mid-scale, i.e. 0 V in bipolar mode)

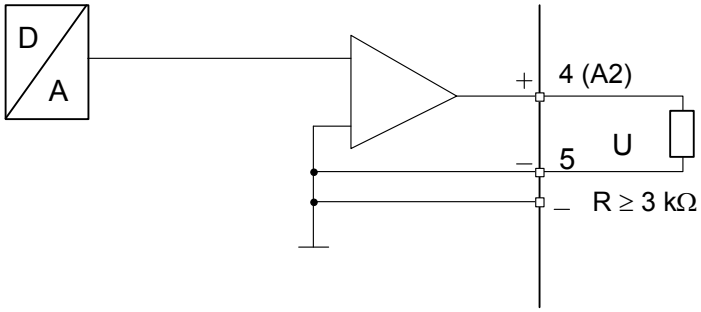
Ranges depending on application:

Per module: U/B:			**U**nipolar or **B**ipolar operation
	Reset select:		**Reset to low-** or **mid**-scale
	Rec. setting:		**Unipolar →low-scale**
			Bipolar → mid-scale
Per channel:		“V”	Voltage output: 0…+10 V or -10 V…+10 V
		“C”:	Current output: 0…20 mA

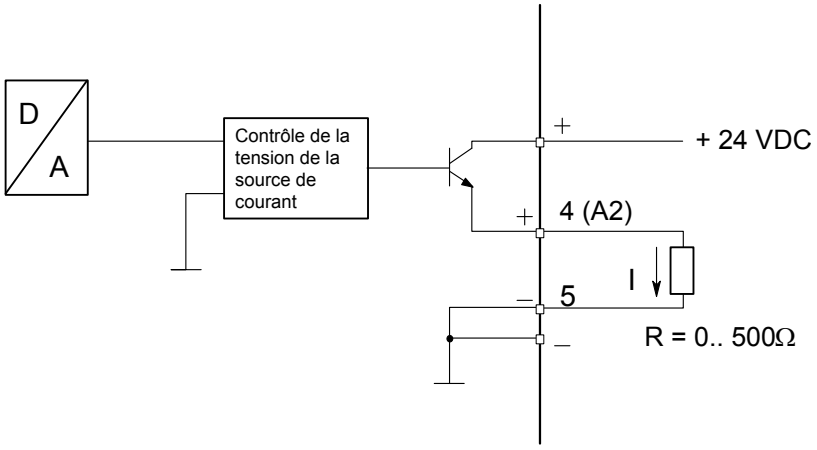
Current outputs have been laid out for unipolar mode. Bipolar mode is possible, but for the negative half of this operation the output is 0 mA.

Connection concept

Connection for 0…10 V or -10 V…+10 V: (selectable on the PCD2.W610)

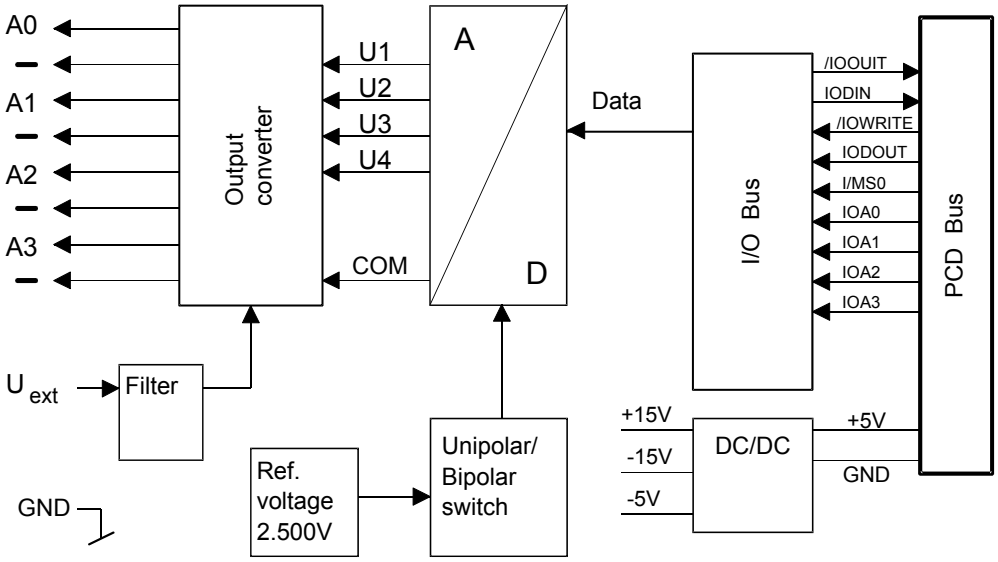


Connection for 0…20 mA: (PCD2.W610 only)



An external 24 VDC supply is required for current outputs.

Block diagram



Programming

Classic: Programming examples for the PCD2.W6x0 can be found in a separate manual and on the TCS Support site (www.sbc-support.ch + getting started).
xx7: the firmware writes the values according to the configuration (I/O Builder)

Watchdog: This module cannot be used on the base address 240 (or 496 for the PCD2.M17x), because it would interact with the watchdog, and would cause a malfunction.

For details, please refer to the "Watchdog" section, which describes the correct use of the watchdog in conjunction with PCD2 components.

5.12 Analogue output modules with electrically isolation

PCD2.W605	**6 analogue inputs 10 bit resolution, 0…10 V**
PCD2.W615	**4 analogue inputs 10 bit resolution, 0…20 mA**
PCD2.W625	**6 analogue inputs 10 bit resolution, -10 V…+10 V**

To ensure maximum resistance to interference, all analogue input/output modules must pass the strictest interference tests in accordance with IEC 801-4:

- Noise emission: CE mark according to EN 61 000-6-3
- Noise immunity: CE mark according to EN 61 000-6-2

I/O modules and I/O terminal blocks may only be plugged in and removed when the PCD is disconnected from the power supply.

5.12.1 PCD2.W6x5, analogue outputs, 6 (4) channels, 10 bit resolution, el. isol.

Application

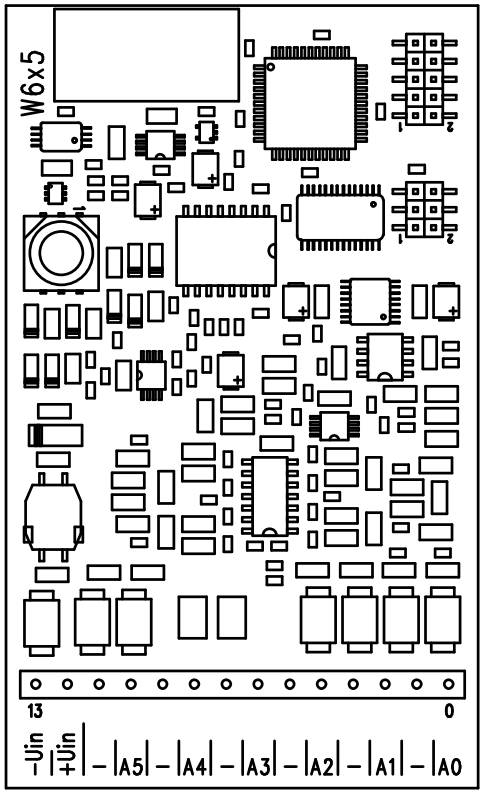
High-speed output module with galvanic separation of outputs to PCD bus, for general use with 6 (4) channels, each with 10 bit resolution. Different variants for voltage 0…10 V, -10 V…+10 V and current 0…20 mA are available.

Module overview		Channels	Resolution
PCD2.W605:	Voltage 0…10 V	6 (A0…A5)	10 mV
PCD2.W615:	Current 0…20 mA	4 (A0…A3)	20 µA
PCD2.W625:	Voltage -10…+10 V	6 (A0…A5)	20 mV

Technical data

Output ranges:	see module overview
Galvanic separation:	500 V, galvanic separation of outputs to PCD, channels themselves not separated
Resolution (digital representation):	10 bits (0…1023)
Loadresistance:	W605: >3 kΩ W615: <500 Ω* W625: >3 kΩ
Accuracy at 25 °C	W605: ± 0.4 % W615: ± 0.7 % W625: ± 0.4 %
Temperature error (0…+55 °C)	± 0.25 %, 100 ppm/K or 0.01 %/K
Short circuitprotection:	yes (permanent)
EMC protection:	acc. to standards ENV 50141, EN 55022, EN 61 000-4-2, EN 61 000-4-4, EN 61 000-4-5
Time constant of output filter:	W605: typically 1 ms W615: typically 0.3 ms W625: typically 1 ms
Internal current consumption: (from +5 V bus)	W605: 110 mA (typ. 80 mA) W615: 55 mA (typically 45 mA) W625: 110 mA (typically 80 mA)
Internal current consumption: (from V+ bus)	W605/W625: 0 mA W615: 90 mA
External current consumption:	max. 90 mA, smoothed Voltage range: RL•20 mA + 10…20 V *E.g. RL=500 Ω → Ue = 20…30 V RL=0 Ω → Ue=10…20 V
Terminals:	Pluggable 14-pole spring terminal block (4 405 4998 0), for wires up to 1.5 mm²

Terminals



Digital/analogue values

Output signals and type			Digital values		
PCD2.W605	**PCD2.W615**	**PCD2.W625**	**Classic**	**xx7**	**Simatic**
+ 10.0 V	+ 20 mA	+10 V	1023	1023	27684
+ 5.0 V	+ 10 mA	0 V	512	512	13842
	+ 4 mA		205	205	5530
0 V	0 mA	-10 V	0	0	0

Notes on the output range

Balancing the offset and the amplification is done for the PCD2.W6x5 digitally by the µC. As there is no potentiometer, the output range has been slightly enlarged to cover maximum values even in the worst case.

Typical output range (without component tolerances):
W605: - 0.26 V…+ 10.36 V (instead of 0…+ 10 V)
W615: 0 mA …21.4 mA (instead of 0…20 mA)
W625: - 10.62 V…10.36 V (instead of - 10…+10 V)

This range is broken down on a 10 bit scale (1024 steps), as before. The result is the following LSB resolution:
W605: 1 LSB = 10.38 µV
W615: 1 LSB = 21.7 µA
W625: 1 LSB = 20.75 µV

With this balance the nominal range (0…10 V) is now scaled 0…1023, making it possible for the output value not to change on an increase of 1 LSB.

In the FBs the output values are not limited to 0…1023, so the whole range of the module can be used.

For voltages > 10 V or currents > 20 mA, values >1023 may be output, and for voltages < 0 V or

< -10 V, negative values may be output. (With the W615 it is not possible to output negative currents).

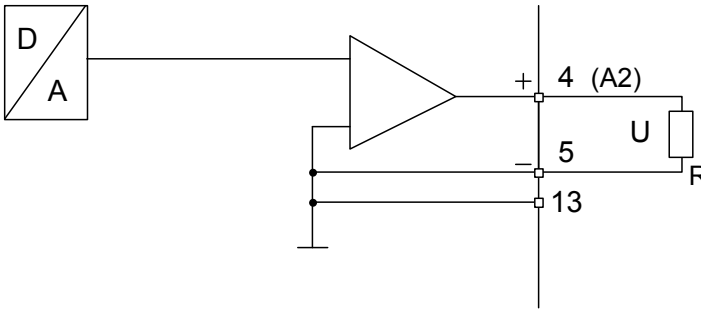
This extended range does depend on the tolerances of the components, and cannot be guaranteed.

Connection concept for voltage and current outputs

The voltage and current output signals are connected directly to the 14-pole terminal block (A0…A5 / A3 and -).

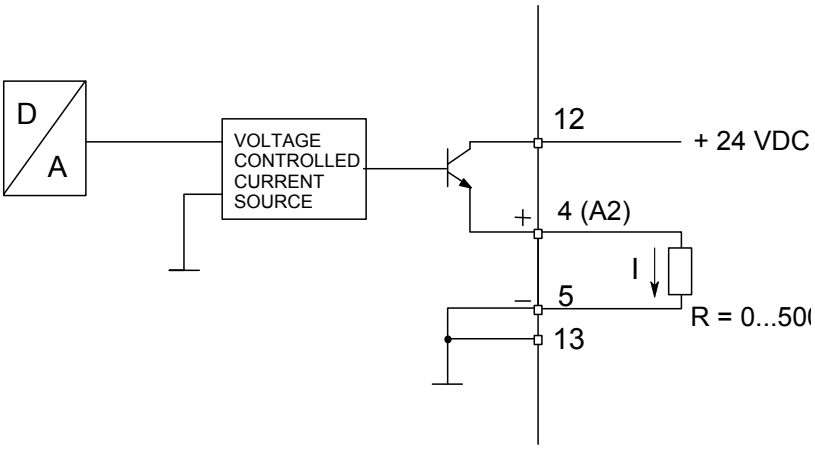
The following connection diagram shows a typical wiring layout for:
- voltage outputs with the PCD2.W605 and .W625 modules or
- current outputs for the PCD2.W615 module

Connection for 0…10 V (W605) or -10 V…+10 V (W625):



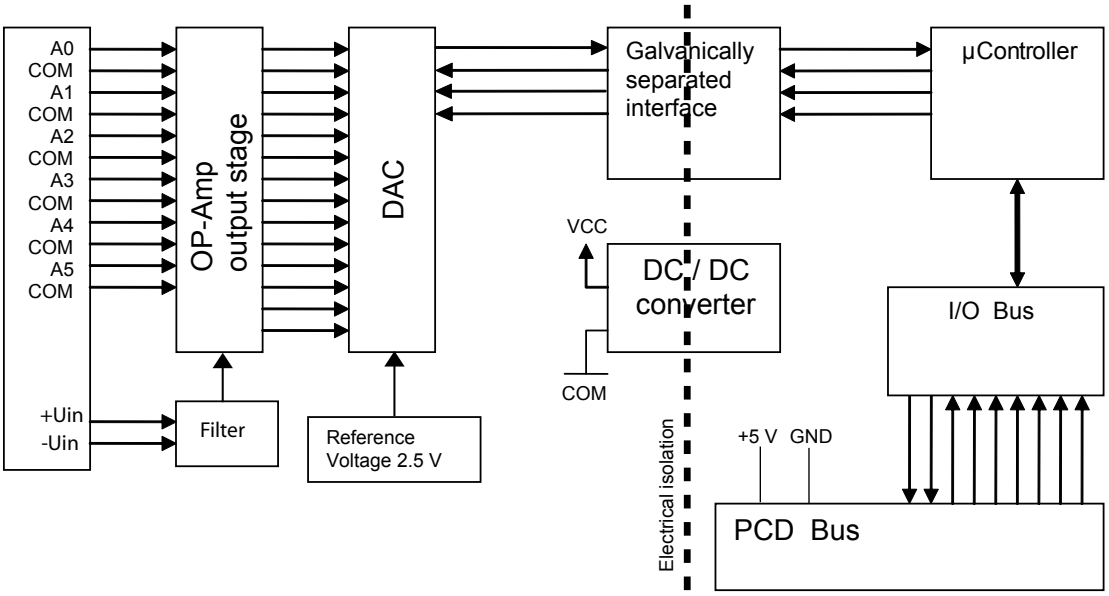
For voltage outputs no external supply is needed.

Connection for 0…20 mA (W615)



An external 24 VDC supply is required for current outputs.

Block diagram



Programming

Classic: For programming the modules, an FBox is available.
xx7 and RIOs: the firmware reads in the values according to the configuration (I/O Builder or network configurator)

Watchdog: This module can be used on all base addresses; there is no interaction with the watchdog on the CPUs. For details, please refer to the "Watchdog" section, which describes the correct use of the watchdog in conjunction with PCD2 components.

5.13 Analogue weighing modules

PCD2.W710	**1-channel weighing module for 4/6-wire elements**
PCD2.W720	**2-channel weighing module for 4/6-wire elements**

To ensure maximum resistance to interference, all analogue input/output modules must pass the strictest interference tests in accordance with IEC 801-4:

- Noise emission: CE mark according to EN 61 000-6-3
- Noise immunity: CE mark according to EN 61 000-6-2

I/O modules and I/O terminal blocks may only be plugged in and removed when the PCD is disconnected from the power supply.

5.13.1 PCD2.W710 and PCD2.W720

The modules PCD2.W710 and PCD2.W720 are described in the manual 26/833.

5.14 Analogue thermocouple modules

PCD2.W745	4-channel thermocouple modules for J, K… thermoelemets

Supported temperature sensors are:

- Thermocouples – TC type J, K
  Thermocouples – TC type R, S, T, E and N on request
- Resistive temperature detectors – RTD's type Pt 100, Pt 1000, Ni 100, Ni 1000

To ensure maximum resistance to interference, all analogue input/output modules must pass the strictest interference tests in accordance with IEC 801-4:

- Noise emission: CE mark according to EN 61 000-6-3
- Noise immunity: CE mark according to EN 61 000-6-2

I/O modules and I/O terminal blocks may only be plugged in and removed when the PCD is disconnected from the power supply.

5.14.1 PCD2.W745

The module PCD2.W745 is described in the manual 26/796.

5.15 Fast counting modules

PCD2.H100	**Counting module up to 20 kHz**
PCD2.H110	**General purpose counting and measuring module up to 100 kHz**

I/O modules and I/O terminal blocks may only be plugged in and removed when the PCD is disconnected from the power supply.

5.15.1 PCD2.H100, counting module up to 20 kHz

Application

Simple counting module, comprising two inputs “A” and “B” plus one direct control output marked “CCO”; allows counting of the number of revolutions or the calculation of distances (pulses) and the measurement by counting of pulses within a logical AND gate (second input).

Typical areas of application:

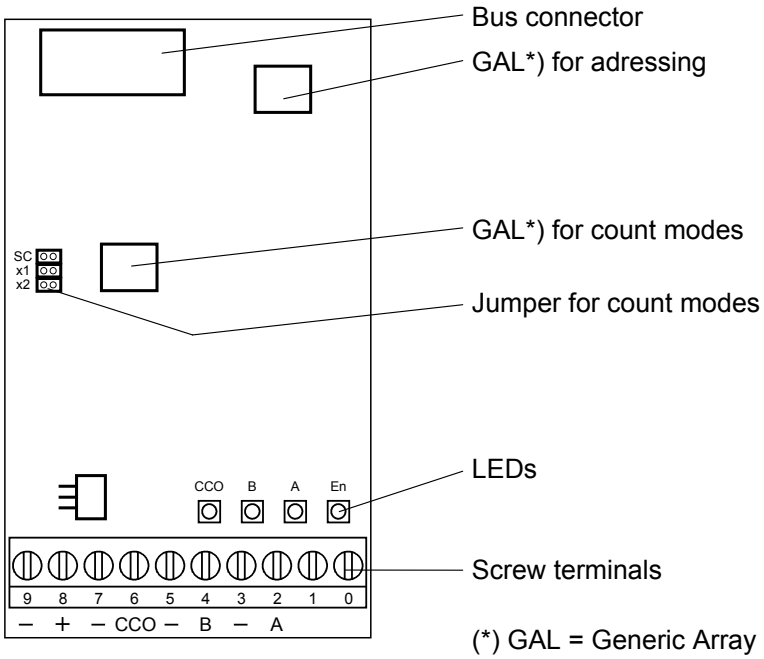
- Counting revolutions or distances (impulses)
- Presetting a count value and switching off output CCO when Counter = 0
- Measurement by counting: measuring signals counted only when particular conditions are met, e.g. photoelectric barrier covered
- Counting with recognition of count direction for incremental shaft encoders providing simple motion control

Technical data

Number of systems:	1	
Counting range:	0…65,535 (16 bit) (can be extended with CPU counters)	
Counting frequency:	max. 20 kHz (at pulse/pause ratio 50 %)	
Data protection:	All data in this module are volatile (non-volatile PCD registers are available).	
Digital inputs		
“IN-A” and “IN-B” signal voltages:	nominal voltage: “low” range: “high” range:	24 VDC -30…+5 V +15…30 V for source operation
Input current:	typically 7.5 mA	
Input filer:	25 kHz	
Process output		
Counter controlled output CCO:	counter output (switches when count is 0 or 65,535)	
Current range:	5…500 mA	(max. current leakage 1 mA) (min. load resistance 48 Ω in voltage range 5…24 V).
Voltage range:	5…32 V smoothed, residual ripple max. 10 %	
Circuit type:	Electrically coupled, not short circuit protected, positive switching	
Voltage drop:	typically 2V at 500 mA	
Output delay:	< 10 µs,	(longer for inductive load due to protective diode).
Power supply		
External supply	5…32 VDC, (for supply of CCO output only)	
Internal current consumption: (from +5 V bus)	max. 90 mA	
Internal current consumption: (from V+ bus)	0 mA	
External current consumption:	CCO output load current	
Operational conditions		
Ambient temperature	operation: storage:	0…+55 °C without forced ventilation, -20…+85 °C
Noise immunity:	EC mark according to EN 61000-6-3 and EN 61000-6-2	

Programming:	Based on PCD user program and pre-programmed function blocks (FB).
Count modes:	Selectable with jumper
Terminals:	Pluggable 10-pole screw terminal block (4 405 4847 0), for wires up to 1.5 mm²

LEDs and connection terminals



(*) GAL = Generic Array Logic)

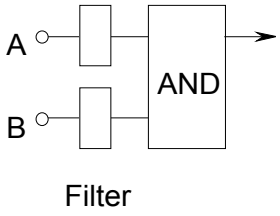
“A”	Input “A”	1
“B”	Input “B”	2
“En” (Enable)	Counter active	0
“CCO”	Output “CCO”	3

Changing the jumpers

On this circuit board there are components that are sensitive to electrostatic discharges. For further information, refer to Appendix B, “Icons”.

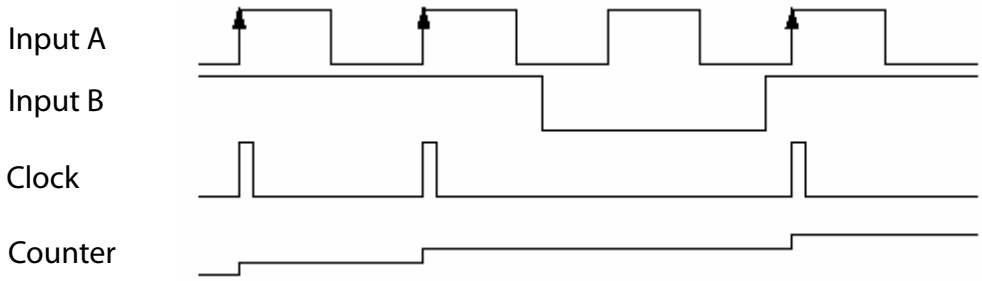
Count modes

SC (Single Count):



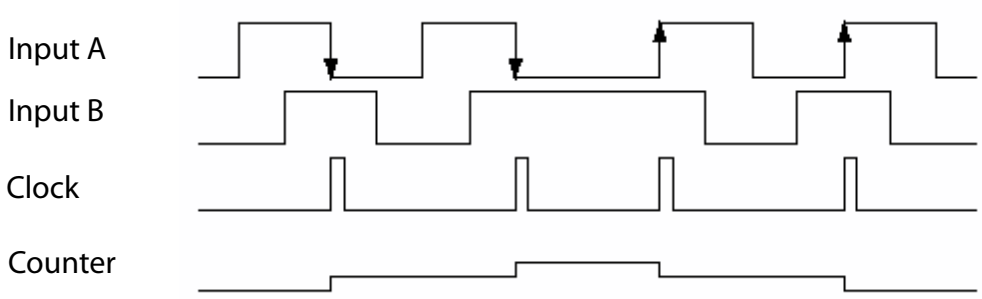
Counting signals at input A.
Up and down counting selectable by user program.

To enable signals at input A to be counted, input B must be connected to 24 V (AND gate).

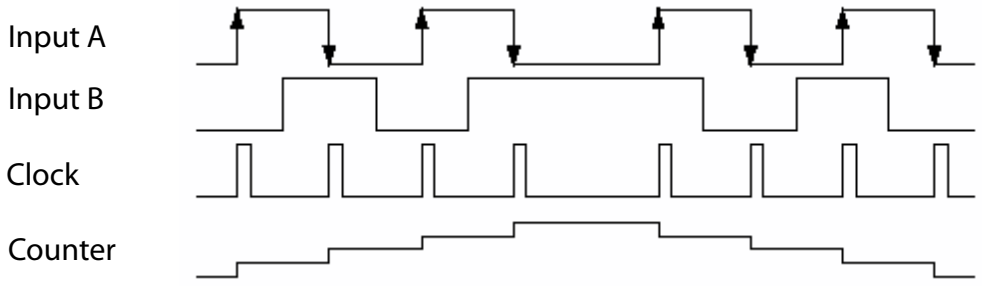


Modes x1, x2: Up/down counting mode for 2-phase incremental shaft encoder at inputs A and B.

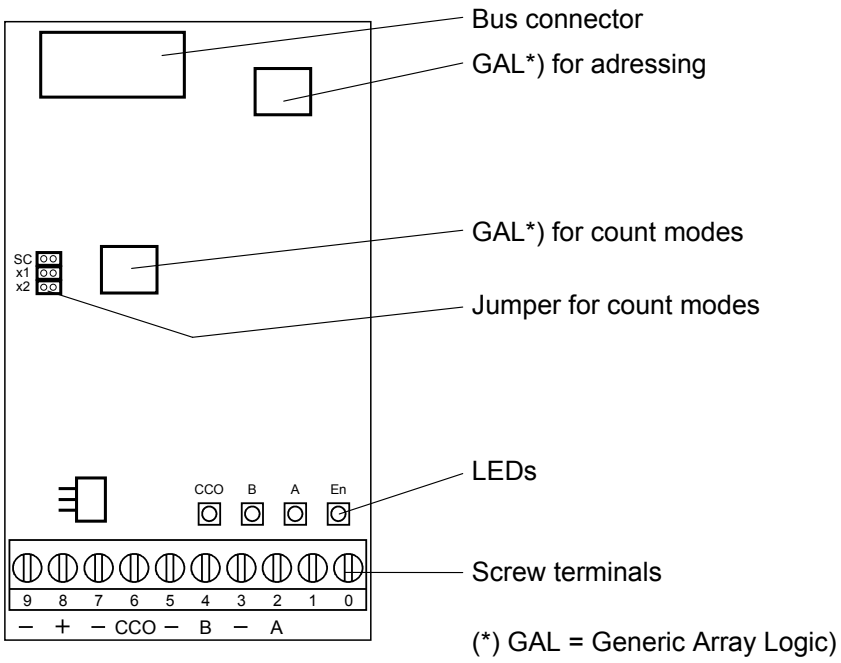
x1



x2



Block diagram



Operating principle

This can be largely derived from the block diagram. It is only necessary to add some explanation about the counter output circuit:

The output of the internal counter is identified as “Counter Flag”. The user has no hardware access to it. This counter flag is set to “1” whenever the counter is loaded or by means of a separate instruction.

The flag is set to “0” in up-counting mode: when counter value 65,535 is reached

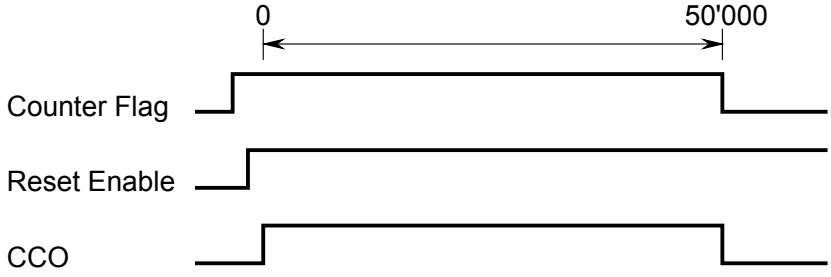
in down-counting mode: when counter value 0 is reached

To reset a CCO hardware output which had previously been set high by the user program, it is necessary to differentiate between two cases:

a) count range between 0…65,535 (normal case)

b) count range exceeding 65,535

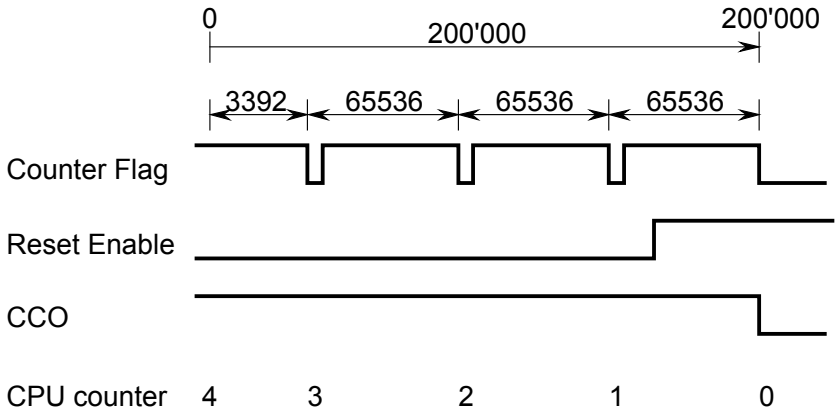
Case a): Resetting the counter flag results in a simultaneous reset of the CCO output.



The “Reset-Enable” should be activated **before** the counter reaches zero.

Case b): If the count range has to extend beyond the value 65,535, “Reset Enable” can be activated later, i.e. between the penultimate and the last time the counter reaches zero. This means that the CCO output is only reset after several passes of the counter. The number of passes is counted by a CPU counter.

For example, output CCO should be switched off after 200,000 count signals.



Programming

Classic: Programming examples for the PCD2.H100 can be found in a separate manual and on the TCS Support site (www.sbc-support.ch + getting started).
xx7: the firmware reads in the values according to the configuration (I/O Builder)

Watchdog: This module cannot be used on the base address 240 (or 496 for the PCD2.M17x), because it would interact with the watchdog, and would cause a malfunction.

For details, please refer to the “Watchdog” section, which describes the correct use of the watchdog in conjunction with PCD2 components.

5.15.2 PCD2.H110, general purpose counting / measuring module up to 100 kHz

Application

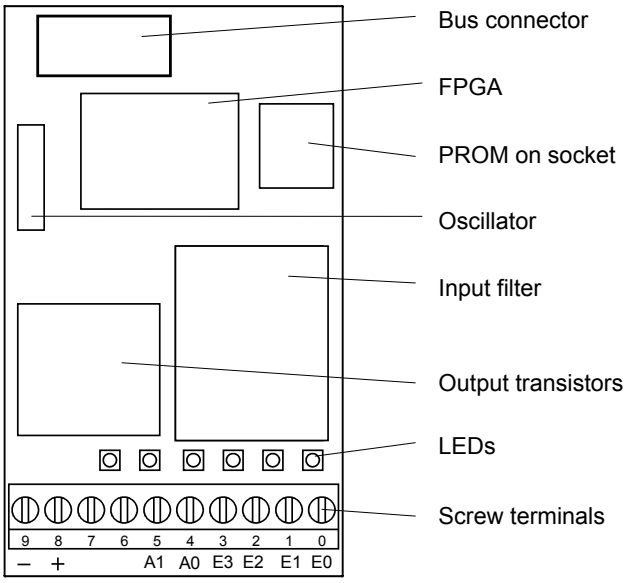
Measuring and fast counting module for general counting and simple motion control tasks; also for specific applications such as frequency measurement, period and pulse length measurement, etc. The module is equipped with an FPGA (Field Programmable Gate Array) and can be programmed for special high volume applications by using a plug-in PROM.

Technical data

Number of systems:	1
Counting range:	0…16,777,215 (24 bit)
Counting frequency:	up to 100 kHz
Data protection:	All data in this module are volatile (non-volatile PCD registers are available).
Digital inputs	
Number of inputs: Terminal 0 = E0 Terminal 1 = E1 Terminal 2 = E2 Terminal 3 = E3	4 Input “A”: for counting and measuring Input “B”: for counting only Input “Enable C”: for use as counting module Input “Enable M”: for use as measuring module
Nominal voltage:	24 VDC “low” range: -30…+5 V “high” range: +15…30 V for source operation
Input current:	typically 6.5 mA
Input filer:	150 kHz
Circuit type:	electrically connected
Digital outputs	
Number of outputs: Terminal 4 A0: Terminal 5 A1:	2 Output “CCO” (for counter) Output “TCO” (for measuring functions)
Current range:	5…500 mA (max. current leakage 1 mA) (min. load resistance 48 Ω in voltage range 5…24 V).
Frequency:	≤ 100 kHz
Voltage range:	5…32 V smoothed, residual ripple max. 10 %
Circuit type:	Electrically coupled, not short circuit protected, positive switching
Voltage drop:	typically < 0.5 V at 500 mA
Output delay:	< 1 µs, (longer for inductive load due to protective diode).
Power supply	
External supply	5…32 VDC, (for supply of CCO output only)
Internal current consumption: (from +5 V bus)	max. 90 mA
Internal current consumption: (from V+ bus)	0 mA
External current consumption:	max. 2 A (all outputs)
Operational conditions	
Ambient temperature	operation: 0…+55 °C without forced ventilation, storage: -20…+85 °C
Noise immunity:	EC mark according to EN 61 000-6-3 and EN 61 000-6-2
Programming:	Based on PCD user program and pre-programmed function blocks (FB).

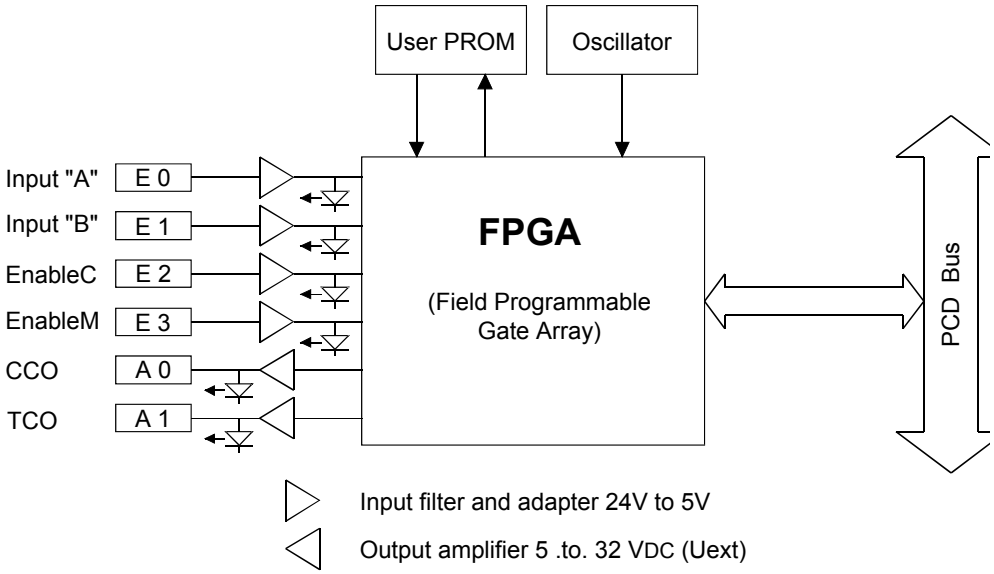
Terminals:	Pluggable 10-pole screw terminal block (4 405 4847 0), for wires up to 1.5 mm²

LEDs and connection terminals



LED 0	State of input “A”
LED 1	State of input “B”
LED 2	State of input “EnableC”
LED 3	State of input “EnableM”
LED 4	State of output “CCO”

Block diagram



For further details, please refer to manual 26/755 “PCD2.H110 - Universal counting and measuring module”.

Watchdog: This module cannot be used on the base address 240 (or 496 for the PCD2.M17x), because it would interact with the watchdog, and would cause a malfunction. For details, please refer to the “Watchdog” section, which describes the correct use of the watchdog in conjunction with PCD2 components.

5.16 SSI interface modules

PCD2.H150	**SSI interface module**

I/O modules and I/O terminal blocks may only be plugged in and removed when the PCD is disconnected from the power supply.

5.16.1 PCD2.H150, SSI interface module for absolute encoder

Application

The PCD2.H150 Module is an interface module for the SSI standard. (SSI = Synchronous Serial Interface). The SSI standard is used with most absolute encoders. Details of SSI specifications can be obtained from the STEGMANN company's brochure: "SSI-Technical Information".

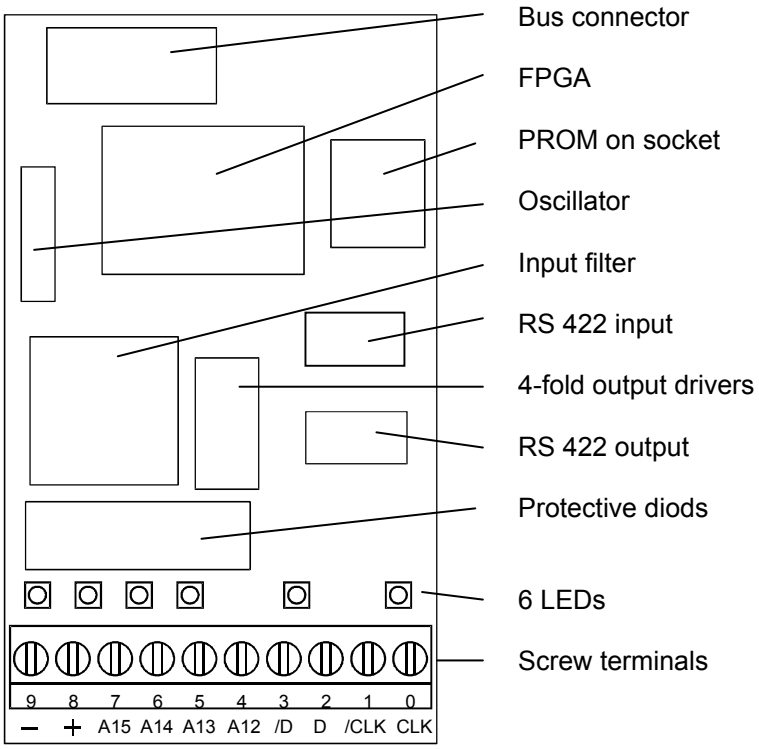
The hardware consists of an RS 422 port for the SSI interface and 4 general-purpose digital outputs. Functionality is provided by an FPGA (field programmable gate array).

Technical data

Resolution:	configurable for 8…29 data bits and 0…2 control bits
Clock frequency:	configurable for 100 kHz, 200 kHz, 300 kHz and 500 kHz (input filter designed for 500 kHz)
Frequency has to be selected depending on cable length:	Cable length Frequency < 50 m max. 500 kHz < 100 m max. 300 kHz < 200 m max. 200 kHz < 400 m max. 100 kHz
Data code:	configurable - Gray or binary
Read mode:	Normal (single read). Ring mode: 'double read and compare' (not all encoders support this function)
Offset position:	An offset can be defined when initializing the PCD2.H150. The defined offset is always subtracted in the FBs. The 'Set Zero' command also uses this offset register.
Execution time:	typically 1.5 ms for reading the SSI value
Cable break detection:	detected with the FB 'timeout' (10 ms)
Flags	'fTimeout', (for cable break, encoder fault or incorrect addressing) 'fPar_Err', (if an incorrect FB parameter is sent) 'fRing_err' (if compare error in 'double read')
SSI interface	
1 input for SSI data	RS 422, electrically isolated
1 output for SSI clock	RS 422, electrically connected, as the encoder input is normally isolated
Digital outputs	
Number of outputs: Terminal 4 = A12: Terminal 5 = A13: Terminal 6 = A14: Terminal 7 = A15:	4 Speed high Speed low Dir + positive direction Dir - negative direction
Switching capacity:	0.5 A each in the range 10…32 VDC, residual ripple max. 10 %
Short circuit protection:	yes, I_{max}=1.5 A
Electrical isolation:	no
Voltage drop:	max. 0.3 V at 0.5 A
Circuit type:	positive switching
Output delay:	typically 50 µs, max. 100 µs, ohmic load
Power supply	
Internal current consumption: (from +5 V bus)	25 mA
Internal current consumption: (from V+ bus)	0 mA

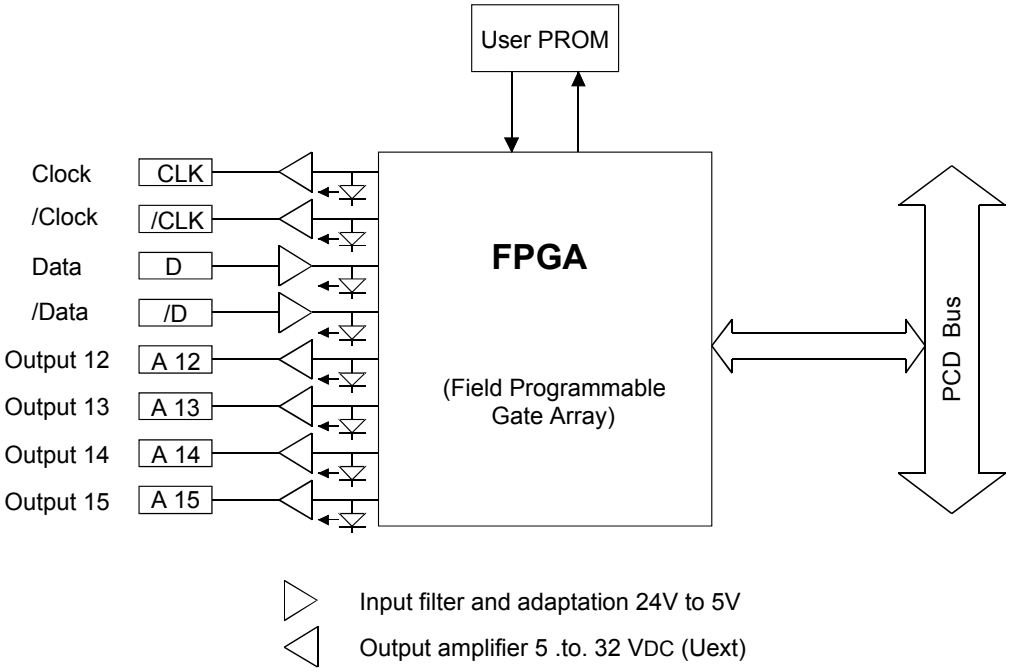
External current consumption:	For all outputs max. 2 A, residual ripple max. 10 %
Operational conditions	
Ambient temperature	operation: 0…+55 °C without forced ventilation, storage: -20…+85 °C
Noise immunity:	EC mark according to EN 61 000-6-3 and EN 61 000-6-2
Programming:	Based on PCD user program and pre-programmed function blocks (FB).
Terminals:	Pluggable 10-pole screw terminal block (4 405 4847 0), for wires up to 1.5 mm²

LEDs and connection terminals



LED 0: SSI output ‘Clock’
LED 2: SSI input ‘Data’
LED 4: State of output 12
LED 5: State of output 13
LED 6: State of output 14
LED 7: State of output 15

Block diagram



For further details, please refer to manual 26/761 “PCD2.H150 - SSI interface for absolute encoder”.

Watchdog: This module cannot be used on the base address 240 (or 496 for the PCD2.M17x), because it would interact with the watchdog, and would cause a malfunction.

For details, please refer to the “Watchdog” section, which describes the correct use of the watchdog in conjunction with PCD2 components.

5.17 Motion control modules for stepper motors

PCD2.H210	Motion control module for stepper motors

I/O modules and I/O terminal blocks may only be plugged in and removed when the PCD is disconnected from the power supply.

5.17.1 PCD2.H210, Motion control module for stepper motors

Application

The PCD2.H210 Module provides fully autonomous control and monitoring of stepper motor travel, with run-up and braking ramps. The commands for stepper motor motion cycles are transmitted to the module by function blocks in the user program.

During motion, the SM processor monitors the frequency profile and the acceleration and braking ramps to move the axis to the destination position without loss of steps. Each module controls an independent axis. The module supplies a monophase pulse string which is conveyed to a suitable electronic drive. The module has 4 inputs and 4 outputs.

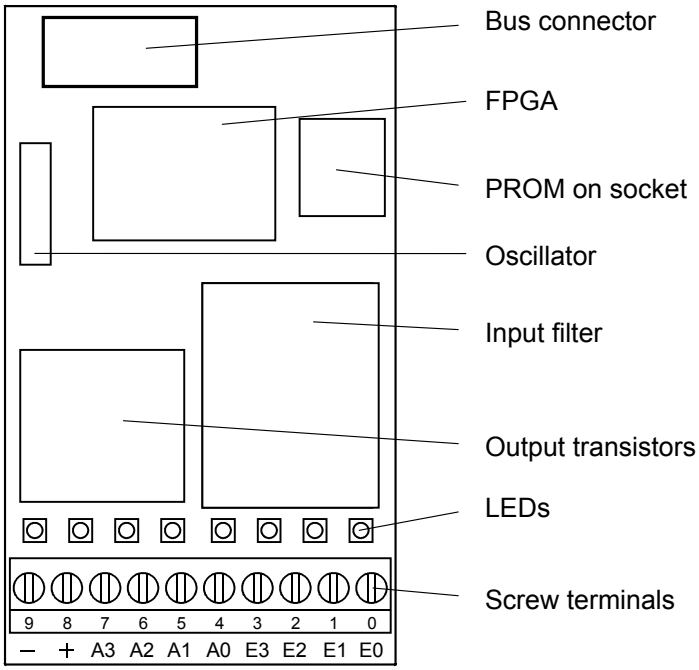
Technical data

Number of axes:	1
Positioning distance (counting range):	0…16,777,215 (24 bit)
Frequency ranges (selectable) *):	9.5…2,431 Hz 19…4,864 Hz 38…9,727 Hz 76…19,454 Hz
Acceleration *):	0.6…1224 kHz/s, non-linear range division depending on the selected frequency range
Profile generator:	with symmetrical acceleration and braking ramps
Data protection:	All data in this module are volatile (non-volatile PCD registers are available).
Digital inputs	
Number of inputs: Terminal 0 = E0 Terminal 1 = E1 Terminal 2 = E2 Terminal 3 = E3	4 configurable as emergency stop or for general use configurable as limit switch LS1 or for general use configurable as reference switch or for general use configurable as limit switch LS2 or for general use
Nominal voltage:	24 VDC “low” range: -30…+5 V “high” range: +15…30 V for source operation only, for safety reasons, normally-closed contacts (negative logic) should be used
Input current:	typically 6.5 mA
Input filer:	< 1ms
Circuit type:	electrically connected
Digital outputs	
Number of outputs: Terminal 4 A0: Terminal 5 A1: Terminal 6 A2: Terminal 7 A3:	4 Output “PUL” (pulses for motor) Output “DIR” (direction of motor rotation) programmable as required programmable as required
Switching capacity:	0.5 A each in the range 5…32 V, residual ripple max.
Short circuit protection:	no
Electrical isolation:	no
Voltage drop:	max. 0.3 V at 500 mA
Output delay:	< 1 µs, (longer for inductive load due to protective diode).

Power supply	
Internal current consumption: (from +5 V bus)	85 mA
Internal current consumption: (from V+ bus)	0 mA
External current consumption:	max. 2 A (all outputs), residual ripple max. 10 %
Operational conditions	
Ambient temperature	operation: 0…+55 °C without forced ventilation, storage: -20…+85 °C
Noise immunity:	EC mark according to EN 61 000-6-3 and EN 61 000-6-2
Programming:	Based on PCD user program and pre-programmed function blocks (FB).
Terminals:	Pluggable 10-pole screw terminal block (4 405 4847 0), for wires up to 1.5 mm²

***)** For further information, please refer to manual 26/760, “PCD2.H210 - motion control modules for stepper motors”.

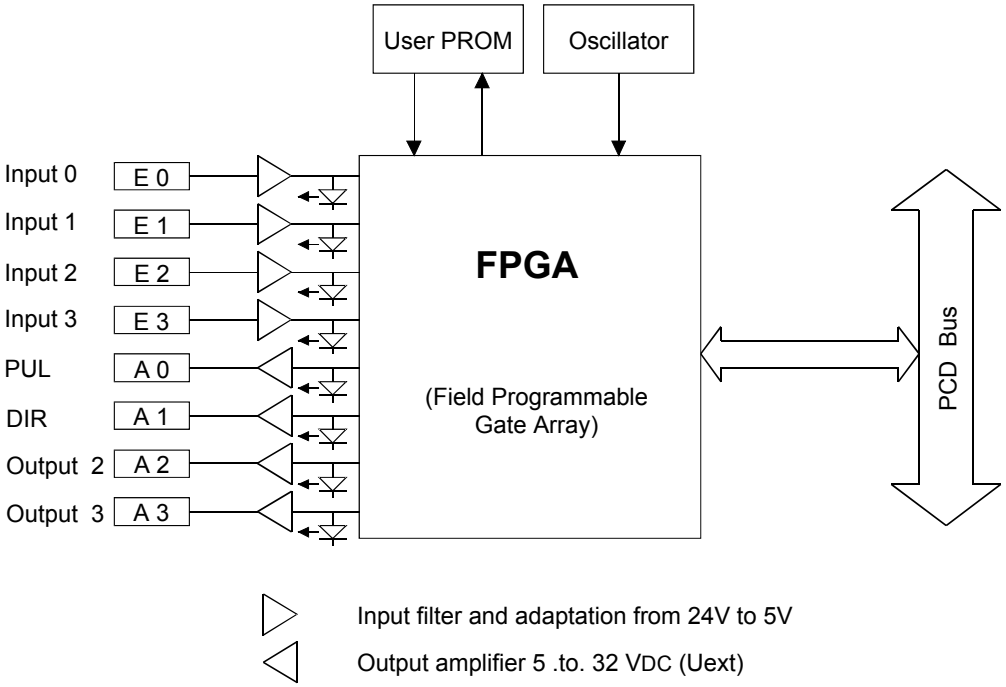
LEDs and connection terminals



LED 0:	*) Voltage at input 0:	(Emergency stop)
LED 1:	*) Voltage at input 1:	(LS1)
LED 2:	*) Voltage at input 2:	(REF)
LED 3:	*) Voltage at input 3:	(LS2)
LED 4:	Voltage at output 0:	PUL
LED 5:	Voltage at output 1:	DIR
LED 6:	Voltage at output 2	
LED 7:	Voltage at output 3	

*) status inverted when used as a limit switch

Block diagram



For further information, please refer to manual 26/760, “PCD2.H210 - motion control modules for stepper motors”

Watchdog: This module cannot be used on the base address 240 (or 496 for the PCD2.M17x), because it would interact with the watchdog, and would cause a malfunction.

For details, please refer to the “Watchdog” section, which describes the correct use of the watchdog in conjunction with PCD2 components.

5.18 Motion control modules for servo-motors

PCD2.H310	**Motion control module for servo-motors, 1-axis encoder, 24 V**
PCD2.H311	**Motion control module for servo-motors, 1-axis encoder, 5 V**
PCD2.H320	**Motion control module for servo-drives, 2-axis with 24 V**
PCD2.H322	**Motion control module for servo-drives, 1-axis with 24 V encoder (slave operation)**
PCD2.H325	**Motion control module for servo-drives, 2-axis with 5 V and SSI absolute value encoder**
PCD2.H327	**Motion control module for servo-drives, 1-axis with 5 V encoder and SSI absolute value encoder (slave operation)**

I/O modules and I/O terminal blocks may only be plugged in and removed when the PCD is disconnected from the power supply.

5.18.1 PCD2.H31x, motion control module for servo-motors, 1-axis encoder

Application

The PCD2.H31x motion control module is an intelligent I/O module. The module is used to position a single axis with variable speed control DC or AC servomotors. This requires the drive unit to have a power stage and incremental shaft encoder for capturing position or speed.

Each module contains a single-chip processor that independently controls every movement according to parameters supplied by the user program (velocity, acceleration and destination position). The axes are controlled independently of each other, which means that no interpolation is possible to trace curved paths. On the other hand, linking of multiple axes (point-point) in quasi-synchronous operation cane be programmed.

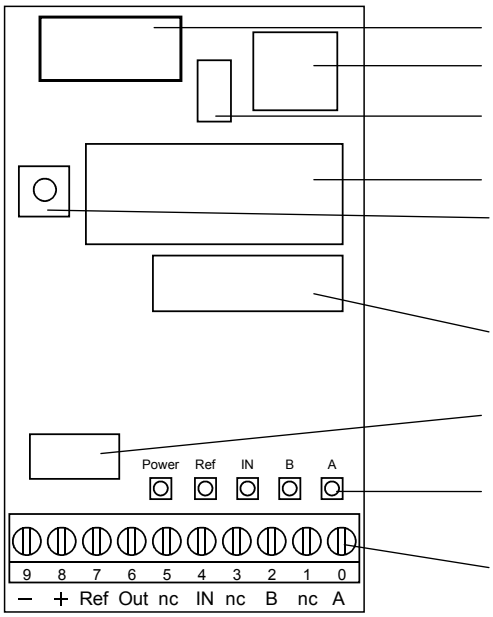
Technical data

Number of axes:	1
Motion parameters	
31-bit registers are used for destination position, velocity and acceleration, numerical range ± 2^{30}	
Position:	Resolution selectable (depending on mechanical factor)
Velocity:	Resolution selectable (depending on mechanical factor)
Acceleration:	Resolution selectable (depending on mechanical factor)
PID controller:	Sample time 341 µs, programmable proportional, integral and differential factors. Sample time for differential part can be programmed separately.
Analogue controller output:	Velocity set point ±10 V (resolution 12 bit)
Counting frequency:	max. 50 kHz
Digital inputs to PCD2.H310	
Number of inputs:	1 encoder A, B, IN, 1 reference input
Nominal voltage:	24 V typically “low” range: 0…+4 V “high” range: +15…30 V for source operation only
Input current:	typically 6 mA
Circuit type:	electrically connected
Reaction time:	30 µs
Encoder frequency:	max. 100 kHz
Digital inputs to PCD2.H311	
Number of inputs:	1 encoder A, /A, B, /B, IN, /IN, (no reference input)
Input voltage:	5 V typically
Signal level:	antivalent inputs according to RS 422
Hysteresis:	max. 200 mV
Line termination resistance:	150 Ω
Encoder frequency:	max. 100 kHz
Analogue outputs for PCD2.H310/311	
Analogue controller output:	resolution 12 bit (with sign bit)
Short circuit protection:	yes
Electrical isolation:	no
Output voltage *):	±10 V, accuracy of adjustment ±5 mV
Circuit type:	positive switching
Minimum load impedance:	3 kΩ

*)	Balancing output voltage is carried out in the factory. The user is strongly advised not to adjust the tuning potentiometer.
5 V supply for 5 V encoder for PCD2.H311	
5 V output:	5 V supply of encoder
Short circuit protection:	yes
Electrical isolation:	no
Output voltage:	5 V
Max. load current:	300 mA
Short circuit current:	400 mA (this current also loads the PCD's +5 V bus)
Power supply	
Internal current consumption: (from +5 V bus)	max. 140 mA typically 125 mA
Internal current consumption: (from V+ bus)	0 mA
External current consumption:	max. 15 mA, typically 10 mA, residual ripple max. 10 %
Operational conditions	
Ambient temperature	operation: 0…+55 °C without forced ventilation, storage: -20…+85 °C
Noise immunity:	EC mark according to EN 61 000-6-3 and EN 61 000-6-2
Programming:	Based on PCD user program and pre-programmed function blocks (FB).
Terminals:	Pluggable 10-pole screw terminal block (4 405 4847 0), for wires up to 1.5 mm²

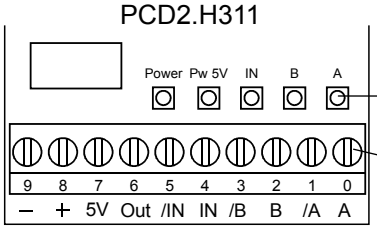
LEDs and connection terminals

PCD2.H310



Bus connector
Adressing circuit
Connector for address programming. (not for user)
Processor
Potentiometer for balancing output voltage (not for user)
DAC (D/A converter)
Supply
LEDs
Screw terminals

PCD2.H311



LEDs
Screw terminals

LED “A”	State of encoder input “A”
LED “B”	State of encoder input “B”
LED “IN”	State of index input
LED “Ref”	State of reference switch (H310)
LED “Pw 5 V”	Supply (5 V) to encoder (H311)
LED “Power”	Supply ± 15 V

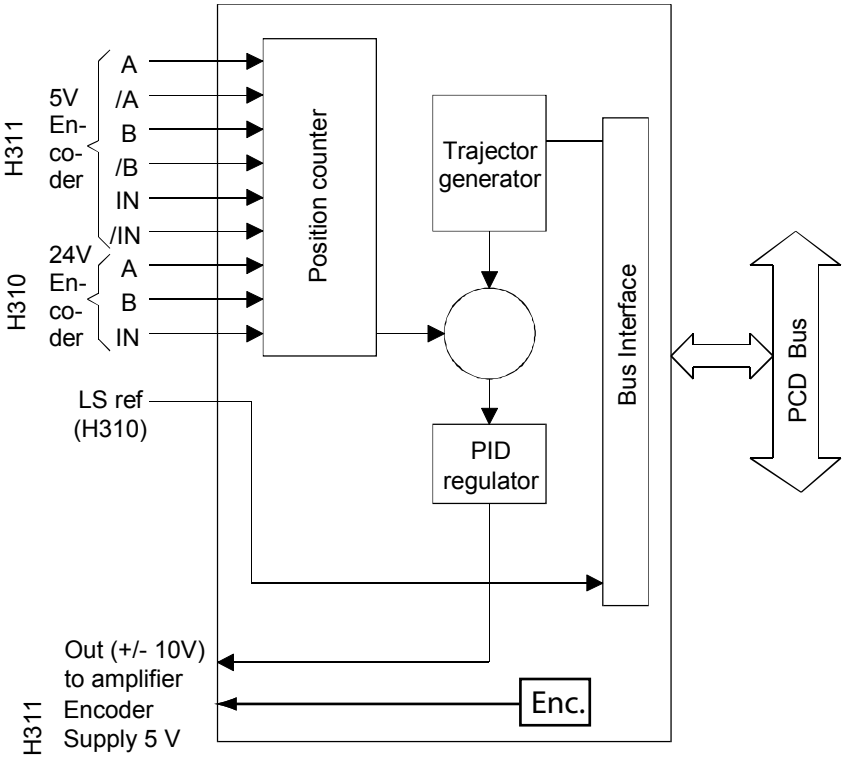
Terminals - PCD2.H310

− and **+** = external supply terminals
Ref = digital input for the reference switch
Out = analogue controller output
A, B, IN = encoder signals
nc = terminals not used

Terminals - PCD2.H311

− and **+** = external supply terminals
5 V = output for 5 V supply to encoder (300 mA max.)
Out = analogue controller output
A, B, IN = non-inverted encoder signals
/A, /B, /IN = inverted encoder signals

Block diagram



For further information, please refer to manual 26/762, “PCD2.H31x - motion control module for stepper motors”

Watchdog: This module cannot be used on the base address 240 (or 496 for the PCD2.M17x), because it would interact with the watchdog, and would cause a malfunction.

For details, please refer to the “Watchdog” section, which describes the correct use of the watchdog in conjunction with PCD2 components.

5.18.2 PCD2.H32x, motion control modules for servo-drives

There are four module types available:

PCD2.H320: 2 axes with 24 V encoder
PCD2.H325: 2 axes with 5 V and SSI absolute value encoder
PCD2.H322: 1 axis (slave operation) with 24 V encoder
PCD2.H327: 1 axis (slave operation) with 5 V and SSI absolute value encoder

The PCD2.H32x motion control modules are intelligent I/O modules in the PCD2 series. They are used to position two independent axes, with one variable speed AC or DC drive (servo-motor) each, or two axes as an electronic transmission.
This requires the drive unit to have a power stage and incremental shaft encoder for capturing position or speed. Displacement control may also be achieved with an SSI absolute value encoder.
Each module contains a DSP processor that independently controls every movement according to parameters supplied by the user program: velocity, acceleration and destination position ("PID control"). This enables each axis to execute independent movements, perform S-curve and trapezoidal motion profiles, change velocity and acceleration, perform interrupt functions and record the current axis position during motion.

In a PCD2 with expansion housing, up to 7 PCD2.H32x modules can be operated in parallel.

Technical data

Function-specific data		
Number of systems:	2	for H320/5
	1	for H322/7 + 1 H100 counter input 4 DI + 1 DO

Motion parameters	
31-bit registers are used for destination position, velocity and acceleration, numerical range $\pm 2^{30}$)	
Position	Units and resolution selectable (depending on mechanical factor)
Velocity	Units and resolution selectable (depending on mechanical factor)
Acceleration	Units and resolution selectable (depending on mechanical factor)
PID controller	Sample time 100 µs / axis, programmable proportional, integral and differential factors. Sample time for differential part can be programmed separately. Additional velocity and acceleration feed-forward (all 16 bit values)
Analogue controller output	Velocity set point ± 10 V (resolution 12 bit)
Counting frequency	max. 125 kHz for H320/5 max. 250 kHz for H322/7

Digital inputs for all PCD2.H32x modules per axis	
Number of inputs	1 reference input “REF” [1)] 2 limit switch inputs “LS1 / LS2” [1)] 1 synchronization input “SI” [2)]
Input voltage	24 VDC (6 to 32 VDC) smoothed, max. residual ripple 10 %
“Low” range	-30…+5 V
“High” range	+15…+32 V
Input current at 24 VDC	7 mA (typically)
Circuit type	electrically connected
Reaction time	300 µs
1) For safety reasons, normally-closed (NC) or PNP sensors should be used for the reference and limit switches. For this reason, these inputs work in sink mode (negative logic, i.e. LED = on when 0 V at input). 2) The synchronization input works in source mode (positive logic)	

Digital outputs for all PCD2.H32x modules		
	Axis 1	**Axis 2**
Outputs	SO	SO
Supply	Uext	Uext
U_{ext} (typically 24 VDC)	6…32 VDC	6…32 VDC
I out	5…500 mA	5…500 mA
Voltage drop at 500 mA	< 0.3 V	< 0.3 V
Short circuit protection	Yes [1)]	Yes [1)]
Electrical isolation	No	No
1) The short circuit current is restricted to max. 1.6 A		

Analogue outputs for modules PCD2.H320 and PCD2.H325		
	Axis 1	**Axis 2**
Outputs	OUT	OUT
Resolution (incl. sign bit)	12 bit	12 bit
Short circuit protection	Yes	Yes
Electrical isolation	No	No
Output voltage fluctuation [1)]	+/- 10 V	+/- 10 V
Minimum load impedance	3 kΩ	3 kΩ
1) Setting accuracy ± 5 mV. Balancing output voltage is carried out in the factory, and the value is stored in a digitally programmable potentiometer		

Analogue outputs for modules PCD2.H322 and PCD2.H327		
	Axis 1	**Axis 2**
Outputs	OUT	NC
Resolution (incl. sign bit)	12 bit	-
Short circuit protection	Yes	-
Electrical isolation	No	-
Output voltage fluctuation [1)]	+/- 10 V	-
Minimum load impedance	3 kΩ	-
1) Setting accuracy ± 5 mV. Balancing output voltage is carried out in the factory, and the value is stored in a digitally programmable potentiometer		

Encoder inputs for modules PCD2.H320 and PCD2.H322		
	Axis 1	**Axis 2**
Inputs	A B IN	A B IN
Number of inputs	3	3
Input voltage (typical)	24 V	24 V
Signal state L (Low)	-30…+5 V	-30…+5 V
Signal state H (High)	+15…+32 V	+15…+32 V
Input current (typical) H320 H322	7 mA 7 mA	7mA 2mA
Source operation (positive logic)	x	x
F_{max}	125 kHz [1)]	125 kHz [1)]
[1)] Internal counting frequency 500 kHz		

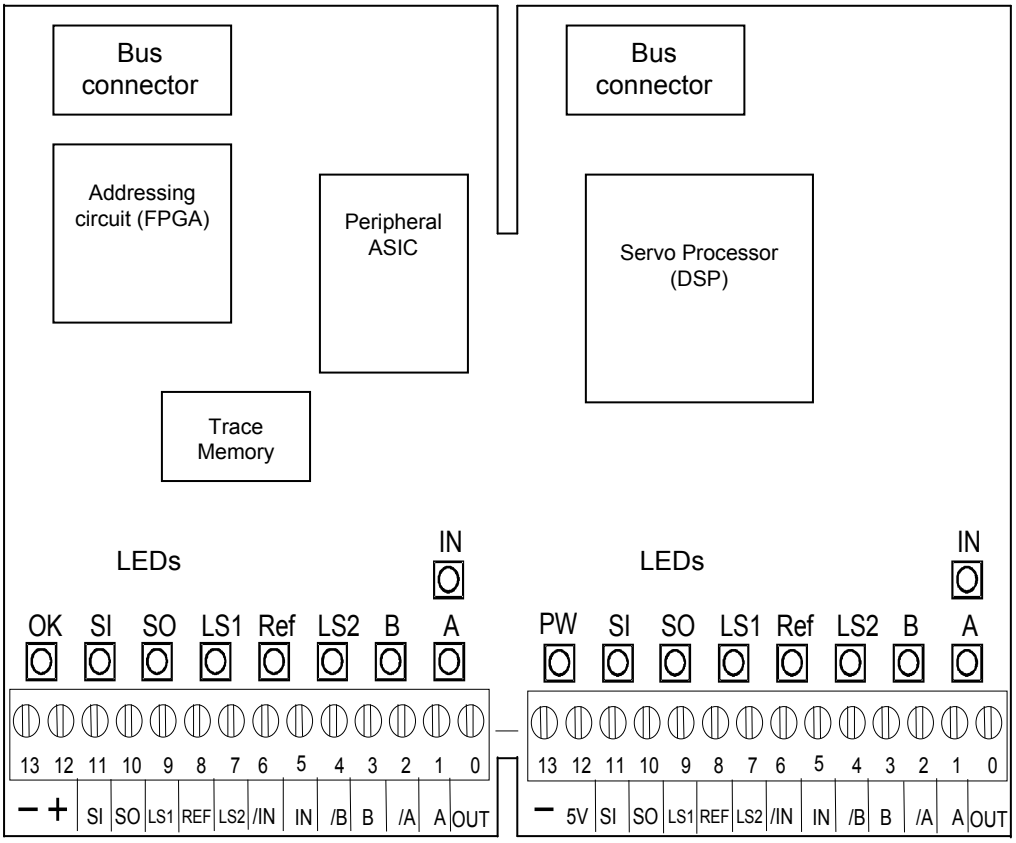
Encoder inputs for modules PCD2.H325 and PCD2.H327		
	Axis 1	**Axis 2**
Inputs	A,/A B,/B IN,/IN	A,/A B,/B IN,/IN
Number of inputs	6	6
Input voltage (typical)	RS422	RS422
Input impedance (typical) H325 H327	150 Ω 150 Ω	150 Ω 1500 Ω
F_{max}	250 kHz [1)]	250 kHz [1)]
[1)] Internal counting frequency 1 MHz		

5 V supply for 5 V encoder modules PCD2.H325 and PCD2.H327	
Short circuit protection	Yes
Electrical isolation	No
Output voltage	5 V
Max. load current	300 mA
Short circuit current	400 mA
Overvoltage protection	TVS diode 39 V +/- 10 %
Reverse voltage protection	No

Power supply to all modules	
Internal current consumption: from +5 V bus (without encoder)	typically 210 mA, max. 230 mA (250 mA in SSI operation)
Internal current consumption: from V+ bus (without encoder)	15…20 mA
External current consumption:	0…2 mA (without load current) 1 A for outputs
Total current consumption for all I/O modules including encoders must not exceed 1.6 A. PCD2.H32x modules should be plugged onto the base unit wherever possible (not the expansion housing).	
Operational conditions	
Ambient temperature	operation: 0…+55 °C without forced ventilation, storage: -20…+85 °C
Noise immunity:	EC mark according to EN 61 000-6-3 and EN 61 000-6-2
Programming:	Based on PCD user program and pre-programmed function blocks (FB).
Terminals:	Pluggable 10-pole spring terminal block (4 405 4847 0), for wires up to 1.5 mm²

5

LEDs and connection terminals



Screw terminal block J4, Axis 2 Screw terminal block J5, Axis 1

2xLED “IN”	State of index input
2x LED “A”	State of encoder input “A”
2xLED “B”	State of encoder input “B”
2x LED “LS2”	State of limit switch 2
2x LED “Ref”	State of reference switch
2x LED “LS1”	State of limit switch 1
2x LED “SO”	State of synchronization output
2x LED “SI”	State of synchronization input
1x LED “PWR”	State of internal voltage (+/- 15 V)
1x LED “OK”	State of controller

On this circuit board there are components that are sensitive to electrostatic discharges. For further information, refer to Appendix B, “Icons”.

Inputs per axis				
Module type	**PCD2.H320**	**PCD2.H322**	**PCD2.H325**	**PCD2.H327**
Terminal 1 = “A”	Encoder signal “A”			
Terminal 2 = “/A”	Not used		Encoder signal “/A”	
Terminal 3 = “B”	Encoder signal “B”			
Terminal 4 = “/B”	Not used		Encoder signal “/B”	
Terminal 5 = IN”	Encoder signal “IN”			
Terminal 6 = /IN”	Not used		Encoder signal “/IN”	
Terminal 7 = “LS2”	Limit switch 2			
Terminal 8 = REF”	Reference switch			
Terminal 9 = “LS1”	Limit switch 1			
Terminal 11 = SI”	Synchronization input			
Screw terminal block J5, axis 1				
Terminal 12 = “5 V”	Not used		Supply output +5 VDC for encoder	
Terminal 13 = “-”	Ground (PGND)			
Screw terminal block J4, axis 2				
Terminal 12 =“+”	External supply + 24 VDC smoothed, for SO			
Terminal 13 = “-”	Ground (PGND)			
Outputs per axis				
Module type	**PCD2.H320**	**PCD2.H322**	**PCD2.H325**	**PCD2.H327**
Terminal 0 = “OUT”	Analogue control output. (Slave) axis 1 only			
Terminal 10 = “SO”	Synchronization output			

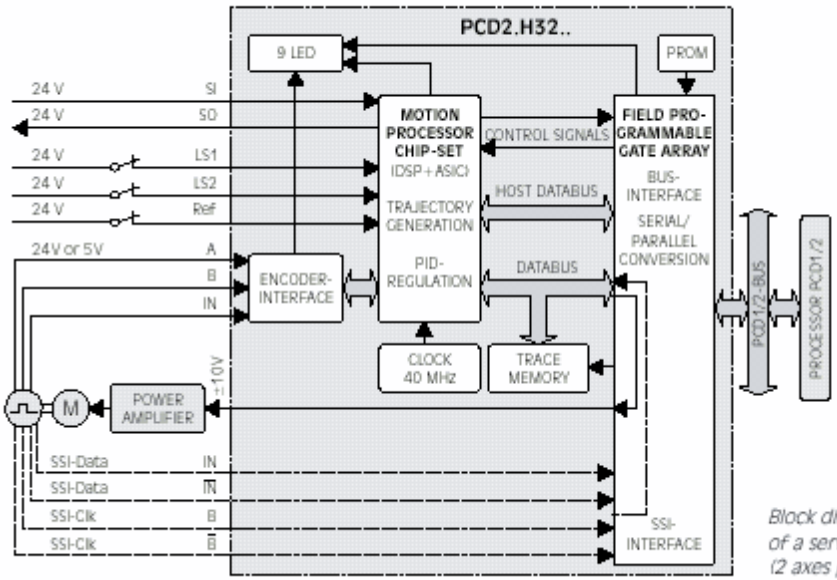
Software queries

The elements listed in the table below can be queried by the user (examples for module 1). The module type and the FPGA version can be obtained with the ‘FB Exec’ function and the ‘RdIdent’ instruction.

Inputs	**Description**
REF_1s2	REFerence switch
LS1_1s2	Limit switch 1
LS2_1s2	Limit switch 2
AxisSelect_1_2 (output)	RES = axis 1, SET = axis 2
AxisIn_1s2	State of axis synchronization input
AxisOut_1s2	State of axis synchronization output
AxisEvent_1_2	Axis event interrupt
PowerError_1_2	Internal supply error
PowerEncError_1_2	Encoder supply error
CableBreak_1s2	Cable break
SSI_timeout_1s2	SSI timeout
OK_LED_1_2	State of controller (OK LED)
HostIOError_1_2	Host I/O error

(_1s2 selection of axis via “Axis Select” output)
(_1_2 affects whole module)

Block diagram



Block diagram of a servodrive for 1 axis (2 axes per module)

For further information, please refer to manual 26/772, “PCD2.H32x - motion control modules for servo-drives”

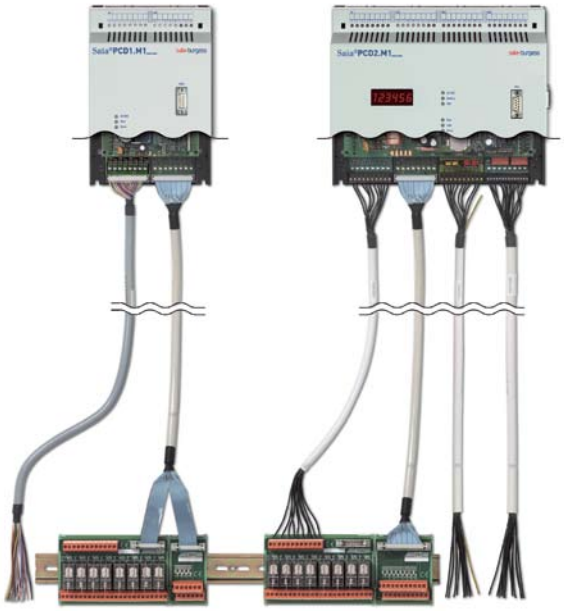
Watchdog: This module cannot be used on the base address 240 (or 496 for the PCD2.M17x), because it would interact with the watchdog, and would cause a malfunction.

For details, please refer to the “Watchdog” section, which describes the correct use of the watchdog in conjunction with PCD2 components.

6 System cables and adapters

6.1 System cables with I/O module connections to the PCD

The route to easy, fast connection is via these preconfigured cables. The connector is ready mounted at the PCD end of the cable, so it just has to be plugged in to connect. At the process end there are ribbon connectors to the terminal adapters or the relay interface, or 0.5 mm^2 or 0.25 mm^2 strands, numbered and colour-coded.



All the cables are described in the manual 26-792 connection system

7 Maintenance

Saia® PCD1 and PCD2 components are maintenance-free, apart from some CPUs (PCD1.M130 and PCD2.Mxxx), where the battery needs to be changed occasionally.

7.1 Changing the battery on the PCD1.M13x and PCD2.Mxxx CPUs

When is it necessary to change the battery?

The battery voltage is monitored by the CPU. The „Battery“ LED lights up and XOB 2 is called if

- the battery voltage is below 2.4 V or above 3.5 V
- the battery is flat or shows an interrupt
- the battery is missing

In these cases, the battery should be changed. We recommend changing the batteries with the PCD attached to the power supply, to avoid any loss of data.

CPU type	Buffer	Buffer time
PCD1.M110	Super Cap (soldered, maintenance-free)	30 days[1) 2)]
PCD1.M120/M125	Super Cap (soldered, maintenance-free)	7 days[2)]
PCD1.M130/M135	CR 2032 lithium battery	1-3 years[3)]
PCD2.M110/M120 hardware version < H	2 × alkaline batteries size LR03/AAA/AM4/Micro	1-5 years[3)]
PCD2.M110/M120 hardware version >= H	CR 2032 lithium battery	1-3 years[3)]
PCD2.M150/M170/M480	CR 2032 lithium battery	1-3 years[3)]

1) The PCD1.M110 has no hardware clock, so the buffer time is greater than it is for the PCD1.M120

2) The total load time of the PCD1.M110, PCD1.M120 and PCD1.M125 amounts to approx. 30 minutes

3) Depending on the ambient temperature; the higher the temperature, the shorter the buffer time

The PCD1.M110, PCD2.M120 and PCD2.M125 CPUs have soldered-on buffer capacitors, making them **maintenance-free**.

Observe the polarity of the batteries:

- For alkaline batteries, the polarity can be seen on the socket
- Insert CR 2032 coin cell in such a way that the positive pole is visible

Effect of changing the battery too late:

- all RAM contents are lost, i.e.

- Resources (registers, flags, timers, counters etc.)
- Extension memory (text/DBs ≥ 4000)
- User program, if in RAM

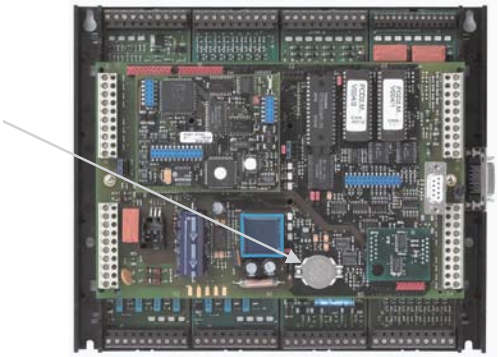
- The hardware clock (Real Time Clock) loses the current date

- The date and the hour can be written after changing the battery with the «SAIA Online Debug» in PG5.
  For this the following command mus be written:

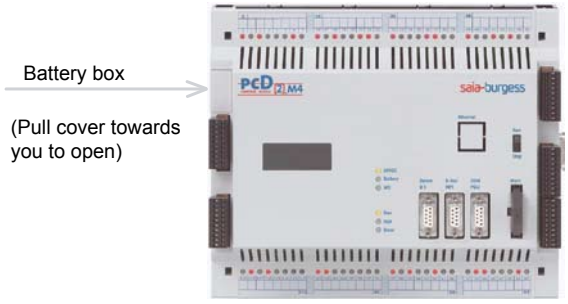
  Write clocK dd/mm/yy hh:mm:ss [week-of-year [day-of-week]] CR

The batteries are easy to locate on all CPU types. On the PCD2.M170 and PCD2.M480 the whole cover does not have to be removed; it is sufficient to open the battery compartment on the side to gain access to the battery.

PCD1.M130/135



PCD2.M110/120/150



PCD2.M170/480

7

7.2 Updating firmware

7.2.1 Updating firmware on the PCD2.M110/M120

The firmware versions for the PCD2.M110/M120 are generally upwardly compatible in terms of hardware, so old CPUs can be fitted with new firmware, in order to take advantage of new functions. Unfortunately, we cannot guarantee to provide this feature in the future, but it has helped many customers in the past and we will try to retain it as long as possible.

At this point, the following known restrictions apply:

- Hardware version D1 from July/August 1995 only works with firmware version $34; a firmware update is not possible with these controllers
- The use of intelligent communication modules such as Profibus DP, LON and Ethernet requires the minimum hardware and firmware versions. Please refer to the manuals for the communication modules

The firmware for the PCD2.M110/M120 is stored in two EPROMs. **With an EPROM burner (e.g. Galep-4), new firmware chips can be burned at any time.** The file with the latest firmware version is available to download from www.sbc-support. Blank firmware chips can be obtained under item-no. 4 502 7126 0 (two chips per CPU need to be ordered).

7.2.2 Updating firmware on the PCD2.M150

The firmware versions for the PCD2.M150 are generally upwardly compatible in terms of hardware, so old CPUs can be fitted with new firmware, in order to take advantage of new functions. Unfortunately, we cannot guarantee to provide this feature in the future, but it has helped many customers in the past and we will try to retain it as long as possible.

The firmware for the PCD2.M150 is stored in two Flash EPROMs. **With an EPROM burner (e.g. Galep-4), new firmware chips can be burned at any time**; updating via download, as with the M170/M480 is not possible. The file with the latest firmware version is available to download from www.sbc-support. Blank firmware chips can be obtained under item-no. 4 502 7341 0 (two chips per CPU need to be ordered).

7.2.3 Updating firmware on the PCD1.M1x5, PCD2.M170 and PCD2.M480

The firmware versions for the PCD1.M1x5, PCD2.M170 and PCD2.M480 are generally upwardly compatible in terms of hardware, so old CPUs can be fitted with new firmware, in order to take advantage of new functions. Unfortunately, we cannot guarantee to provide this feature in the future, but it has helped many customers in the past and we will try to retain it as long as possible.

The firmware for the PCD1.M1x5, PCD2.M170 and PCD2.M480 is stored in a Flash EPROM, soldered to the motherboard. A firmware update can be applied by downloading a new version within PG5. The procedure is as follows:

- Go to www.sbc-support and download the latest firmware version
- Establish a connection between the PG5 and the CPU, as for a download of an application (depending on the facilities available, serially via PGU cable, modem[1)], USB, Ethernet)
- Open the Online Configurator and go offline
- From the Tools menu, select “Update Firmware”, then use the Browse function to

select a path to the file for the new firmware version. Ensure that only one file is selected for downloading.

- Start the download
- After the download, the power supply to the PCD must not be interrupted for 2 minutes, or the CPU may become blocked in such a way that it has to be sent back to the factory

1) A modem connection is not always reliable, and an on-site visit may be necessary. Other connection options are preferable

A Appendix

A.1 Icons

	In manuals, this symbol refers the reader to further information in this manual or other manuals or technical information documents. As a rule there is no direct link to such documents.
	This symbol warns the reader of the risk to components from electrostatic discharges caused by touch. **Recommendation:** at least touch the Minus of the system (cabinet of PGU connector) before coming in contact with the electronic parts. Better is to use a grounding wrist strap with its cable attached to the Minus of the system.
	This sign accompanies instructions that must always be followed.
	Explanations beside this sign are valid only for the Saia-Burgess PCD Classic series.
	Explanations beside this sign are valid only for the Saia-Burgess PCD xx7 series.

A.2 Definitions of serial interfaces

A.2.1 RS 232

Designation of signal lines:

Data lines	TXD	Transmit data
	RXD	Receive data
Signal and response circuits	RTS	Request to send
	CTS	Clear to send
	DTR	Data terminal ready
	DSR	Data set ready
	RI	Ring indicator
	DCD	Data carrier detect

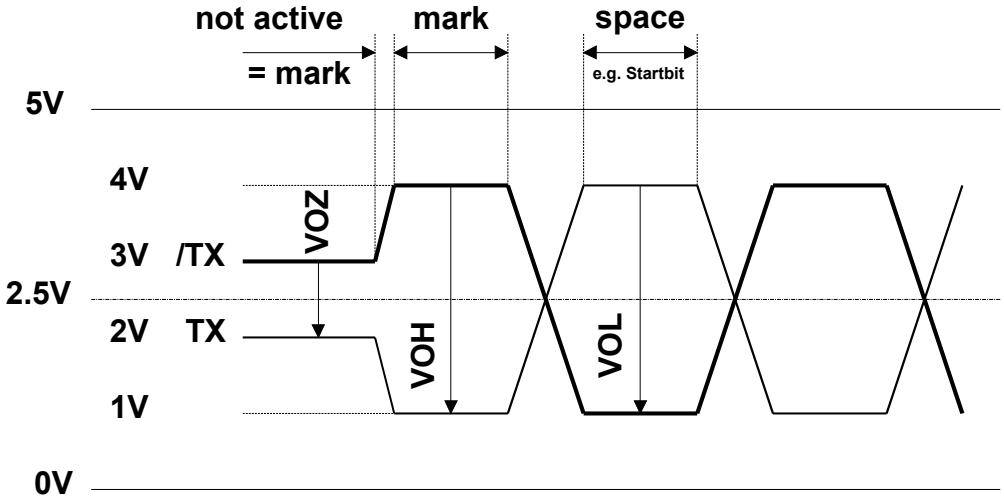
Signals to RS 232

Signal type	Logical state	Required value	Nominal value
Data signal	0 (space) 1 (mark)	+3 V to +15 V -15 V to -3 V	+7 V -7 V
Control/ message signal	0 (off) 1 (on)	-15 V to -3 V +3 V to +15 V	-7 V +7 V

The idle state of the data signals = “mark”
of the control and message signals = “off”

A.2.2 RS 485/422

Signals to RS 485 (RS 422)



VOZ = 0.9 V min … 1.7 V
VOH = 2 V min (with load) … 5 V max (without load)
VOL = -2 V … -5 V

In the idle state, RS 422 is in the “mark” position

RS 422:

Signal type	Logical state	Polarity
Data signal	0 (space) 1 (mark)	TX positive to /TX /TX positive to TX
Control/ message signal	0 (off) 1 (on)	/RTS positive to RTS RTS positive to /RTS

RS 485:

Signal type	Logical state	Polarity
Data signal	0 (space) 1 (mark)	RX-TX positive to /RX-/TX /RX-/TX positive to RX-TX

Not all manufacturers use the same connection configuration, so the data lines may need to be crossed

To guarantee error-free operation of an RS 485 network, the network should be terminated at both ends. Cable and line termination resistors should be selected in accordance with manual 26/740 “Installation components for RS 485 networks”.

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A.2.3 TTY/current loop

Signals to TTY/current loop

Terminal 11	TS	Transmitter Source	Transmitter
Terminal 13	TA	Transmitter Anode	
Terminal 16	TC	Transmitter Cathode	
Terminal 18	TG	Transmitter Ground	
Terminal 12	RS	Receiver Source	Receiver
Terminal 14	RA	Receiver Anode	
Terminal 17	RC	Receiver Cathode	
Terminal 19	RG	Receiver Ground	

Signal type	Required value	Nominal value
Power for logic L (space)	-20 mA to + 2 mA	0 mA
Power for logic H (mark)	+12 mA to +24 mA	+20 mA
Neutral voltage to TS, RS	+16 V to +24 V	+24 V
Short circuit power on TS, RS	+18 mA to +29.6 mA	+23.2 mA

The idle state of the data signals = “mark”
By wiring to the cable connector, the user selects either an “active” or “passive” circuit.

The max. transmission rate for 20 mA TTY/current loops is 9600 bps.

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A.3 Protocols on serial ports

A.3.1 Protocols supported by the firmware

Protocol overview and support by firmware for the different CPUs	Purpose	Supported by			
		PCD1.M1xx	PCD2.M110 PCD2.M120	PCD2.M150 PCD2.M170	PCD2.M480
PGU with **pin 6** (DSR) of the PGU connector **set to logical "1"** (P800, Full Protocol)	Programming, debugging; replaced on newer releases by an equivalent function with S-Bus Parity mode	×	✓	×	×
PGU with **pin 6** (DSR) of the PGU connector **set to logical "1"** (Parity mode, Full Protocol)	Programming, debugging	✓1)	×	✓1)	✓1)
S-Bus PGU on the PGU port, with **pin 6** (DSR) of the PGU connector **set to logical "0"** (Data, Parity or Break mode, Full Protocol)	Programming, debugging, visualization. Also allows access via gateway to stations within a different S-Bus network	✓2)	✓2)	✓2)	✓2)
Serial S-Bus on any serial port (Data, Parity or Break mode)	Exchange of data with other controllers or with RIOs; previously called just S-Bus	✓3)	✓3)	✓3)	✓3)4)
Mode D (reduced version of P800)	Exchange of data over point-to-point connections	✓5)	✓5)	✓5)	×
Character mode (MC1 to MC5)	Transmission of characters or text over serial ports; basis for creating own protocols in the user program	✓6)	✓6)	✓6)	✓

1) Requires the use of the PCD8.K111 programming cable

2) Requires an appropriate configuration in hardware settings

3) Requires an assignment of the port in the user program (SASI). For new applications, Data mode should always be selected. Exceptions: on PCD7.D7xx terminals, Parity mode is used

4) Break mode is not supported; Parity mode cannot be used on port 1

5) Obsolete; for new applications, use Serial S-Bus Data mode instead

6) MC5 Mode (RS 485 with immediate release of data line after transmission of the last character) requires the following minimum firmware versions:
PCD1.M1x0: V080
PCD2.M110/M120: V090
PCD2.M150: V0C0
PCD2.M170: V010

A.3.2 Protocols implemented in the user program

Based on Character mode (and a very good knowledge of LI programming), any desired protocols can be implemented.

Our system partners have already done this for a large number of protocols, enabling our controllers to communicate with components from a variety of manufacturers, e.g. via Modbus, M-Bus etc.

Please refer to the Links page at www.sbc-support.ch for links to system partners.

A.4 Installation direction and relays contact protection

A.4.1 Installation direction for switching low voltages

For reasons of safety it is not allowed that low voltages (up to 50 V) and higher voltages (50…250 V) are connected to the same module.

If a PCD system module is connected to a higher voltage (50…250 V) approved components for this voltage have to be used for all elements which are galvanically connected to the system.

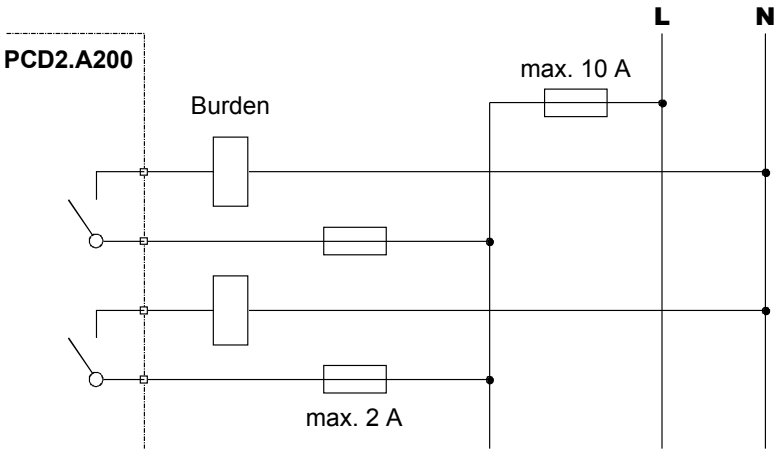
Using higher voltage (50…250 V), all connections to the relay contacts are to be connected on the same circuit. That means at one point in such a way that they are all protected against one AC-phase by only one fuse. Each load circuit may be protected individually by a fuse of max. 2 A.

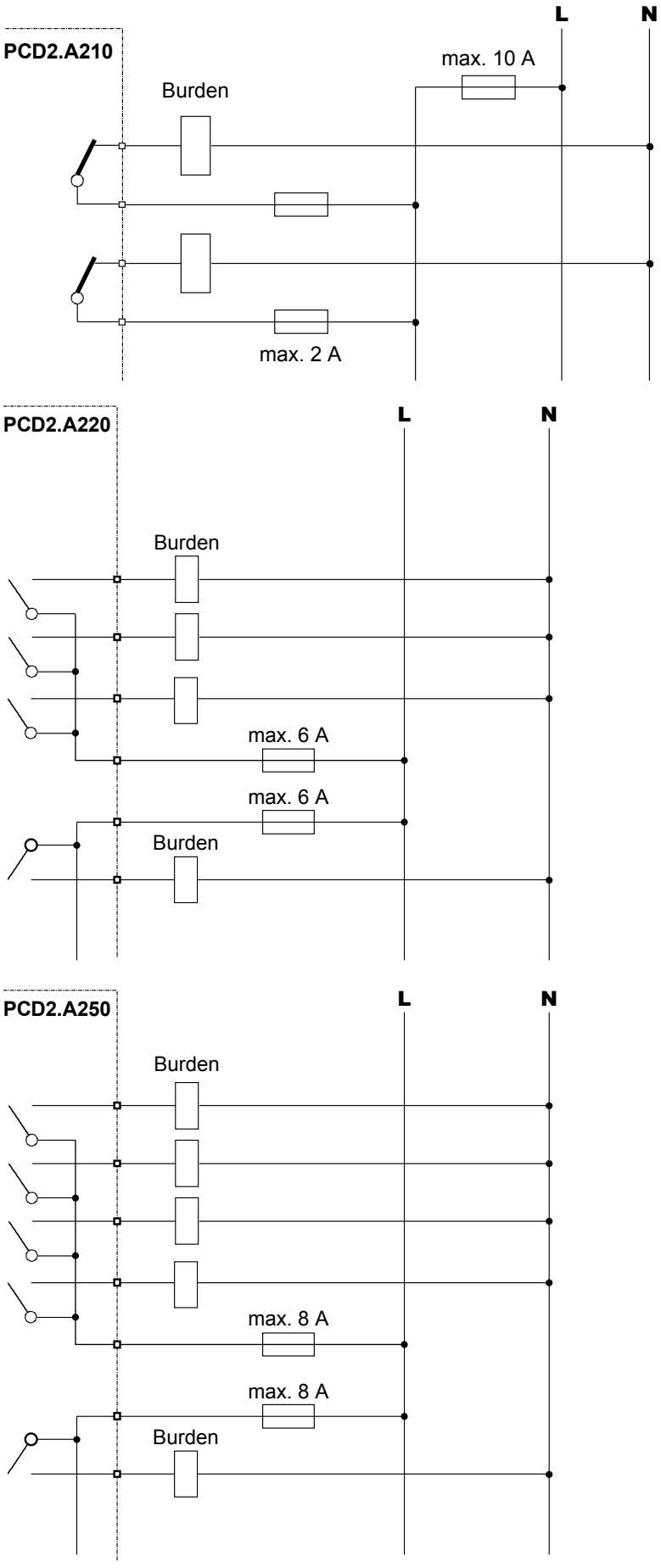
A.4.2 Installation direction for swithcing higher voltages

For reasons of safety it is not allowed that low voltages (up to 50 V) and higher voltages (50…250 V) are connected to the same module.

If a PCD system module is connected to a higher voltage (50…250 V) approved components for this voltage have to be used for all elements which are galvanically connected to the system.

Using higher voltage (50…250 V), all connections to the relay contacts are to be connected on the same circuit. That means at one point in such a way that they are all protected against one AC-phase by only one fuse. Each load circuit may be protected individually by a fuse of max. 2A.




PCD2.A210
L
N
max. 10 A
Burden
max. 2 A
PCD2.A220
L
N
Burden
max. 6 A
max. 6 A
Burden
PCD2.A250
L
N
Burden
max. 8 A
max. 8 A
Burden

A

A.4.3 Switching inductive loads

Because of the physical properties of inductive loads, it is not possible to disconnect inductance without interference. This interference must be minimized as far as possible. Although the PCD is immune to this interference, there are other devices which may be susceptible.

It should be noted here that, as part of the harmonization of standards throughout the EU, EMC standards have applied since 1996 (EMC Directive 89/336/EG). Two firm principles can therefore be stated:

- PROTECTION AGAINST INTERFERENCE FROM INDUCTIVE LOADS IS MANDATORY
- INTERFERENCE SHOULD BE ELIMINATED AS CLOSE AS POSSIBLE TO ITS SOURCE

Relay contacts on the present module have been wired. However, it is still recommended that a protection circuit should be fitted at the load.

(Often available as normal components on standardized contactors and valves).

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When switching direct voltage it is urgently recommended that a recovery diode is fitted above the load. This should even take place when, theoretically, an Ohmic load is switched. In practice, there will always be a proportion which is inductive (connection cable, resistance coil, etc.). In this case it should be noted that the switch-off time will be longer.

(Approximate Ta . L/RL * √ (RL * IL/0,7).

For direct voltage, transistor output modules are recommended.

A.4.4 Relay manufacturer's information on RC unit dimensioning

Wiring contact protection:

The purpose of contact protection wiring is to suppress switch arcing ("sparks") and thereby prolong the lifetime of the contacts. All protection wiring has disadvantages as well as advantages. For the cancellation of arcing by means of an RC unit, see adjacent diagram.

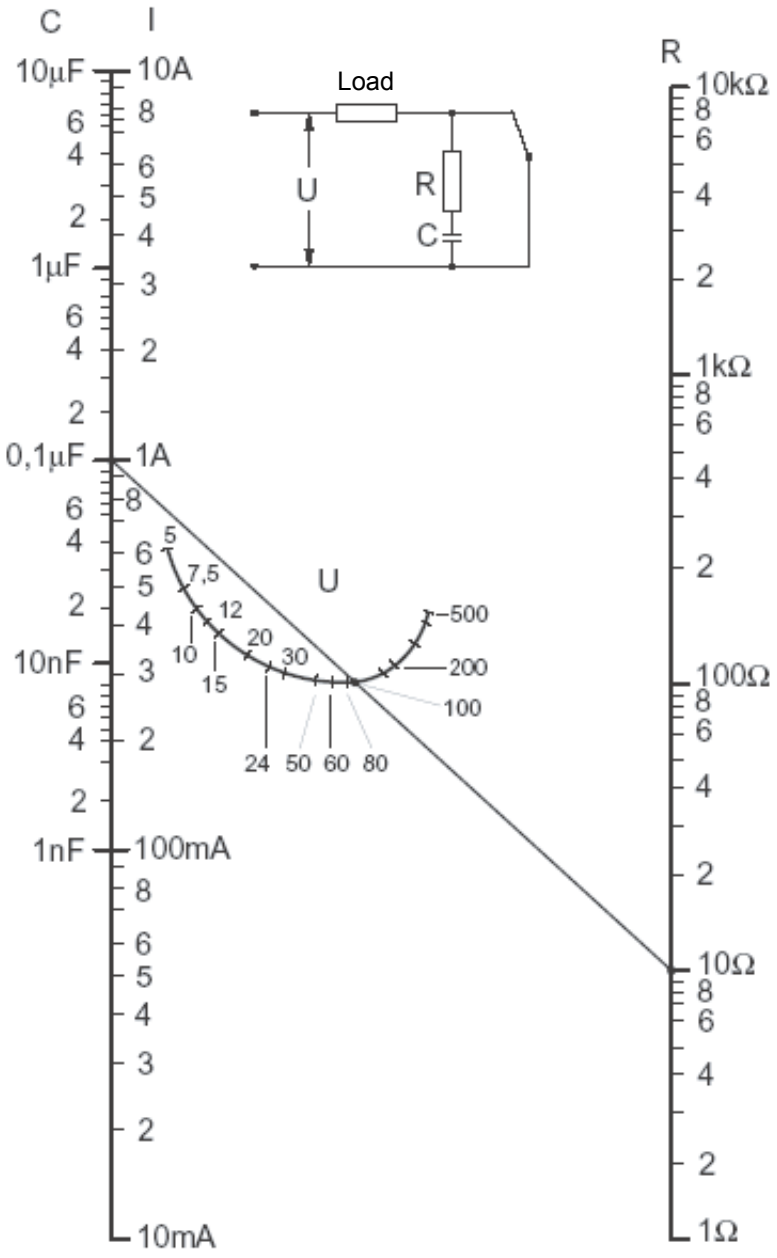
When switching off load circuits with inductive components (e.g. relay coils and magnet coils) the interruption of current results in overvoltage (standard inductance) at the switching contacts. This may amount to many times the operating voltage and so threaten the insulation of the load circuit. The resultant breaking spark leads to rapid wear of the relay contacts. For this reason contact protection wiring is particularly important with inductive load circuits. Values for the RC combination can also be determined from the adjacent diagram. However, for voltage U it is necessary to use the overvoltage arising from the interruption of current (e.g. measurable with an oscillograph). Current must be calculated from this voltage and the known resistance, against which the voltage was measured.

Screening units should only use anti-interference capacitors that comply with VDE 0565 T1 class X2. These capacitors are switchproof and designed for particularly high switching surges. They can also run directly on mains voltage.

The resistors used must withstand high voltages (pulse stability). With low resistance values in particular, voltage flashovers can occur at the ground helical section produced in the manufacturing process. For this reason, composite carbon resistors are often used in screening units. However, enamelled wire resistors or cement resistors with a large helical pitch are suitable.

Dimensioning guide:

The value for C is the direct result of the switching current. The resistance value R can be established by drawing a straight line through the corresponding points on the I and U curves and reading off the resistance at the intersection with the R curve.



Example:

U = 100 V I = 1 A

C is direct result with 0,1 µF

R = 10 Ω (point of intersection with R scale)

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A.4 Order codes

Type	Description	Weight
	Base units for 4 PCD2 I/O modules or modems	
PCD1.M110	up to 64 I/Os, 1 port, 17 KBytes RAM, 16 MHz	920 g
PCD1.M125	up to 64 I/Os, up to 4 ports, 128 KBytes RAM, 16 MHz	920 g
PCD1.M135	up to 64 I/Os, up to 4 ports, 128 KBytes RAM, 25 MHz	920 g
	Base units for 8 PCD2 I/O modules or modems	
PCD2.M110	up to 128 I/Os, 2 ports, 128 KBytes RAM, 16 MHz	860 g
PCD2.M120	up to 255 I/Os (with C100), up to 4 ports, 128 KBytes RAM, 16 MHz	920 g
PCD2.M150	up to 255 I/Os (with C100), up to 4 ports, 128 KBytes RAM, 25 MHz	920 g
PCD2.M170	up to 511 I/Os (with PCD3.LIO), up to 6 ports, 1 MByte RAM, 25 MHz	950 g
PCD2.M480	up to 1023 I/Os (with PCD3.LIO), up to 8 ports, 1 MByte RAM, latest µC technology, 162 MHz (230 Mips)	950 g
	Expansion housings	
PCD2.C100	for 8 additional I/O modules	560 g
PCD2.C150	for 4 additional I/O modules	350 g
	PCD3.RIO/LIO	
PCD3.C100	for 4 PCD3 I/O modules	350 g
PCD3.C110	for 2 PCD3 I/ O modules	180 g
PCD3.C200	for 4 PCD3 I/O modules, 24 VDC supply integrated	350 g
PCD4.C225	Coupling bus module with 2 module sockets for I/O modules from the PCD4 series	200 g
PCD3.T760	for 4 PCD3 I/O modules, Profibus DP, 24 VDC supply integrated	380 g
PCD3.T765 [1])	as PCD3.T760 + facility to implement user-specific software modules (plug-ins)	380 g
	PCD4 I/O bus modules	
PCD4.C220	with 2 additional module sockets	375 g
PCD4.C260	with 6 additional module sockets	1100 g
	Extension cable for expansion housing/coupling bus module	
PCD2.K100	Length 0.5 m (for mounting beneath each other with ..C1.., max. distance 150 mm)	65 g
PCD2.K110	Length 0.7 m (for mounting side-by-side with ..C1..)	70 g
PCD2.K106	Length 0.7 m (PCD2.Mxx0 ⇔ PCD3.LIO)	68 g
PCD3.K010	Connector (PCD3.LIO ⇔ PCD3.LIO)	40 g
PCD2.K120	Length 2 m (for coupling bus module)	200 g
PCD8.K111	Connecting cable to PC with 9-pole connector (PC ⇔ PGU)	200 g
	Additional memory components	
4 502 7013 0 [2])	RAM chip with 128 KBytes/1 Mbit	12 g
4 502 7175 0 [2])	RAM chip with 512 KBytes/4 Mbit	12 g
4 502 7126 0	EPROM chip with 128 KBytes/1 Mbit	12 g
4 502 7223 0	EPROM chip with 512 KBytes/4 Mbit	12 g
4 502 7141 0	Flash EPROM chip with 128 KBytes/1 Mbit	12 g
4 502 7224 0	Flash EPROM chip with 512 KBytes/4 Mbit	12 g
PCD7.R400	Flash card with 1 MByte for PCD2.M170/M480, for backup	6 g

1) On request.

2) Where non-Saia RAM components are used, there is a risk of losing data.

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Type	Description	Weight
	Communication modules for socket A	
PCD7.F110 [3]	with RS 422/RS 485 interface (electrically connected)	8 g
PCD7.F120 [3]	with RS 232 interface (suitable for modem)	8 g
PCD7.F121 [3]	with RS 232 interface (suitable for modem), only for PCD2.M480	8 g
PCD7.F130 [3]	with interface for 20 mA current loop	8 g
PCD7.F150 [3]	with RS 485 interface (electrically isolated)	8 g
PCD7.F180 [3]	Belimo MP-Bus (based on RS 232)	8 g
	Function modules for socket B(1)	
PCD2.F510 [3]	with 6-digit display	40 g
PCD2.F520 [3]	with RS 232 and RS 422/RS 485 serial interfaces (can also be installed on socket B2)	35 g
PCD2.F522 [3]	switchable between 2 × RS 232 and 1 × RS 232 (suitable for modem)	40 g
PCD2.F530 [3]	with 6-digit display and RS 232, RS 422 and RS 485 serial interfaces	45 g
	Field bus connections for socket B(1) and B2	
PCD7.F700 [3]	Profibus FMS connection	45 g
PCD7.F750 [3]	Profibus DP connection (Master)	45 g
PCD7.F770 [3]	Profibus DP connection (Slave)	45 g
PCD7.F772 [3]	Profibus DP connection (Slave) and electrically isolated RS 485 interface	45 g
PCD7.F800 [3]	LonWorks® connection	45 g
PCD7.F802 [3]	LonWorks® connection and electrically isolated RS 485 interface	45 g
PCD7.F651 [3] [4]	Network connection with Ethernet module	45 g
	Modem modules for I/O module socket	
PCD2.T814	33.6 kbps analogue modem (RS 232 and TTL interface)	50 g
PCD2.T851	ISDN-TA digital modem (RS 232 and TTL interface)	50 g
	Accessories	
	Batteries	
4 507 4817 0	CR 2032 lithium battery (coin cell), for PCD1.M135 and PCD2.Mxx0	10 g
From electrical dealers	Alkaline batteries, size LR03/AAA/AM4/Micro for PCD2.M110/PCD2.M120 hardware version < H	
	Housing covers	
4 104 7338 0	Housing cover for PCD1 with space cut out for PCD7.D162 terminal	
4 104 7409 0	Housing cover for PCD1 with space cut out for RJ45 connector (TCP/IP)	
4 104 7410 0	Housing cover for PCD2.M150 with space cut out for RJ45 connector (TCP/IP)	
	Chips for firmware update	
4 502 7178 0	PCD1 (order 1 per CPU)	15 g
4 502 7126 0	PCD2.M110/M120 (order 2 per CPU)	15 g
4 502 7341 0	PCD2.M150 (order 2 per CPU)	15 g
	Spring terminal blocks	
	Pluggable screw terminal blocks	
4 405 4847 0	with 10 terminals (standard)	17 g
4 405 4869 0	with 14 terminals (for ..A250)	9 g

3) Please check compatibility with the base units in sections 4.1 and 4.2.
4) For PCD2.M170/M480 on socket B2, for PCD2.M150 on socket B with special housing cover 4 104 7410 0, or as configured system with type-no. PCD2.M150F651.
5) These modules can also be supplied complete on request (mark order “with spring terminal block”).

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Type	Description	Weight
	Digital input modules	
PCD2.E110	24 VDC, input delay typically 8 ms (pulsed voltage possible)	35 g
PCD2.E111	24 VDC, input delay typically 0.2 ms (smoothed voltage required)	35 g
PCD2.E112	12 VDC, input delay typically 8 ms (pulsed voltage possible)	35 g
PCD2.E116	5 VDC, input delay typically 0.2 ms (smoothed voltage required)	35 g
PCD2.E160	24 VDC, input delay typically 8 ms (pulsed voltage possible, connection via 34-pole system cable)	25 g
PCD2.E161	24 VDC, input delay typically 0.2 ms (smoothed voltage required, connection via 34-pole system cable)	25 g
PCD2.E165	24 VDC, input delay typically 8 ms (pulsed voltage possible, connection via 20-pole spring terminal block)	30 g
PCD2.E166	24 VDC, input delay typically 0.2 ms (smoothed voltage required, connection via 20-pole spring terminal block)	30 g
	Digital input modules, electrically isolated	
PCD2.E500	110…240 VAC, input delay typically 10 ms (electrically isolated)	55 g
PCD2.E610	24 VDC, input delay typically 10 ms (pulsed voltage possible)	40 g
PCD2.E611	24 VDC, input delay typically 1 ms (smoothed voltage required)	40 g
PCD2.E613	48 VDC, input delay typically 10 ms (pulsed voltage possible)	40 g
PCD2.E616	5 VDC, input delay typically 1 ms (smoothed voltage required)	40 g
	Digital output modules	
PCD2.A300	with 6 outputs 24 VDC/2 A	45 g
PCD2.A400	with 8 outputs 24 VDC/0.5 A	40 g
PCD2.A460	connection via 34-pole system cable	30 g
PCD2.A465	connection via 24-pole spring terminal block	35 g
	Digital output modules, electrically isolated	
PCD2.A200	with 4 make contacts 2 A/250 VAC or 2 A/50 VDC	60 g
PCD2.A210	with 4 break contacts 2 A/250 VAC or 2 A/50 VDC	60 g
PCD2.A220	with 6 make contacts 2 A/250 VAC or 2 A/50 VDC	65 g
PCD2.A250	with 8 make contacts 2 A/48 VAC or 2 A/50 VDC	65 g
PCD2.A410	with 8 outputs 24 VDC/0.5 A, electrically isolated	40 g
	Combined digital input and output module	
PCD2.B100	with 2 inputs and 2 transistor outputs, plus 4 selectable as inputs or outputs	45 g
	Multi-functional I/O modules	
PCD2.G400	10 digital inputs, 2 analogue inputs 10 bit, 6 analogue inputs 10 bit Pt/Ni 1000, 8 digital outputs, 6 analogue outputs 8 bit	79 g
PCD2.G410	16 digital inputs, 4 analogue inputs 10 bit, 4 relay outputs, 4 analogue outputs 8 bit	79 g

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Type	Description	Weight
	Analogue input modules	
PCD2.W100	12 bit resolution, 4 input channels, 0…10 V, -10…0 V or -10…+10 V	40 g
PCD2.W105	12 bit resolution, 4 input channels, 0…20 mA, -20…0 mA or -20…+20 mA	40 g
PCD2.W110	12 bit resolution, 4 Pt 100 input channels, each 2 mA (IEC 751) *for resistive temperature sensors, Temperature range: -50…+150 °C*	50 g
PCD2.W111	12 bit resolution, 4 Ni 100 input channels, each 2 mA (IEC 43 760) *for resistive temperature sensors, Temperature range: -50…+150 °C*	50 g
PCD2.W112	12 bit resolution, 4 Pt 1000 input channels, each 0.2 mA (IEC 751) *for resistive temperature sensors, Temperature range: -50…+150 °C*	50 g
PCD2.W113	12 bit resolution, 4 Ni 1000 input channels, each 0.2 mA (IEC 43 760) *for resistive temperature sensors, Temperature range: -50…+150 °C*	50 g
PCD2.W114	12 bit resolution, 4 Pt 100 input channels, each 0.2 mA (IEC 751) *for resistive temperature sensors, Temperature range: 0…+350 °C*	50 g
PCD2.W200	10 bit resolution, 8 input channels, 0…10 V	35 g
PCD2.W210	10 bit resolution, 8 input channels, 0…20 mA	35 g
PCD2.W220	10 bit resolution, 8 input channels *for Pt/Ni 1000 (2-wire) resistive temperature sensors, –50…+400 °C or +200 °C*	40 g
PCD2.W300	12 bit resolution, 8 input channels, 0…10 V	40 g
PCD2.W310	12 bit resolution, 8 input channels 0…20 mA	40 g
PCD2.W340	12 bit resolution, 8 input channels, jumper selectable: 0…10 V, 0…20 mA or *for 2-wire resistive temperature sensors* *(Pt 1000 for –50…+400 °C, or Ni 1000 for –50…+200 °C)*	40 g
PCD2.W350	12 bit resolution, 8 input channels *for 2-wire resistive temperature sensors* *(Pt 100 for –50…+600 °C, or Ni 100 for –50…+250 °C)*	40 g
PCD2.W360	12 bit resolution, 8 input channels *for 2-wire resistive temperature sensors* *(Pt 1000 for –50…+150 °C, resolution < 0.1 °C)*	40 g
	Analogue input modules, electrically isolated	
PCD2.W305	12 bit resolution, 7 input channels 0…10 V	55 g
PCD2.W315	12 bit resolution, 7 input channels 0…20 mA	55 g
PCD2.W325	12 bit resolution, 7 input channels -10 V…+10 V	55 g
	Analogue output modules	
PCD2.W400	8 bit resolution, Simple module: 4 channels 0…10 V (≥ 3 kΩ)	35 g
PCD2.W410	8 bit resolution, General purpose modules: 4 channels, jumper selectable, 0…10 V (≥ 3 kΩ) 0…20 mA (≤ 500 kΩ) or 4…20 mA (≤ 500 kΩ)	45 g
PCD2.W600	12 bit resolution, Simple module: 4 channels 0…10 V (≥ 3 kΩ)	40 g
PCD2.W610	12 bit resolution, General purpose modules: 4 channels, jumper selectable, 0…10 V and –10…+10 V (≥ 3 kΩ) 0…20 mA (≤ 500 Ω), further “mid/low” jumper to select switching sequence	45 g
	Combined Analogue input and output modules	
PCD2.W500	12 bit resolution, 2 input and 2 output channels for voltage signals	55 g
PCD2.W510 [1)]	12 bit resolution, 2 input channels for current signals and 2 output channels for voltage signals	55 g
	Combined Analogue input and output modules, electrically isolated	
PCD2.W525	14 bit resolution, 4 input and 4 output channels	85 g
	Analogue output modules, electrically isolated	
PCD2.W605	10 bit resolution, Simple module: 6 channels 0…10 V (≥ 3 kΩ)	60 g
PCD2.W615	10 bit resolution, Simple module: 4 channels 0…20 V (≤ 500 Ω)	60 g
PCD2.W625	10 bit resolution, Simple module: 6 channels -10 V…+10 V (≥ 3 kΩ)	60 g
	Weighing modules	
PCD2.W710 [1)]	18 bit resolution, weighing module, 1 weighing system for up to 4 weighing cells	40 g
PCD2.W720	18 bit resolution, weighing module, 2 weighing systems for up to 6 weighing cells	45 g

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Type	Description	Weight
	Temperature modules	
PCD2.W745	16 bit resolution, Temperature module for up to 4 measurement inputs	40 g

1) Special version, supplied on request

Type	Description	Weight
	Fast counting counting I/O modules	
PCD2.H100	Counting module up to 20 kHz	40 g
PCD2.H110	General purpose counting and measuring module up to 100 kHz	42 g
	SSI encoder modules	
PCD2.H150	SSI interface module	42 g
	Positioning modules for stepping motors	
PCD2.H210	Motion control module for one stepper motor axis	42 g
	Positioning modules for servo-drives	
PCD2.H310 [2])	Motion control module up to 100 kHz for servo-drives, 1 axis for 24 VDC encoder	48 g
PCD2.H311 [2])	Motion control module up to 100 kHz for servo-drives, 1 axis for 5 VDC/RS 422 encoder	48 g
PCD2.H320	Motion control module up to 125 kHz for servo-drives, 2 axes for 24 VDC encoder	66 g
PCD2.H325	Motion control module up to 125 kHz for servo-drives, 2 axes for 5 VDC/RS 422 encoder or SSI absolute angle transmitter (Slave only)	66 g
PCD2.H322	Motion control module up to 250 kHz for servo-drives, 1 axes for 24 VDC encoder	66 g
PCD2.H327	Motion control module up to 250 kHz for servo-drives, 1 axis for 5 VDC/RS 422 encoder or SSI absolute angle transmitter (Slave only)	66 g

2) Depending on the encoder, the 5 VDC supply may be loaded with up to 300 mA.

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