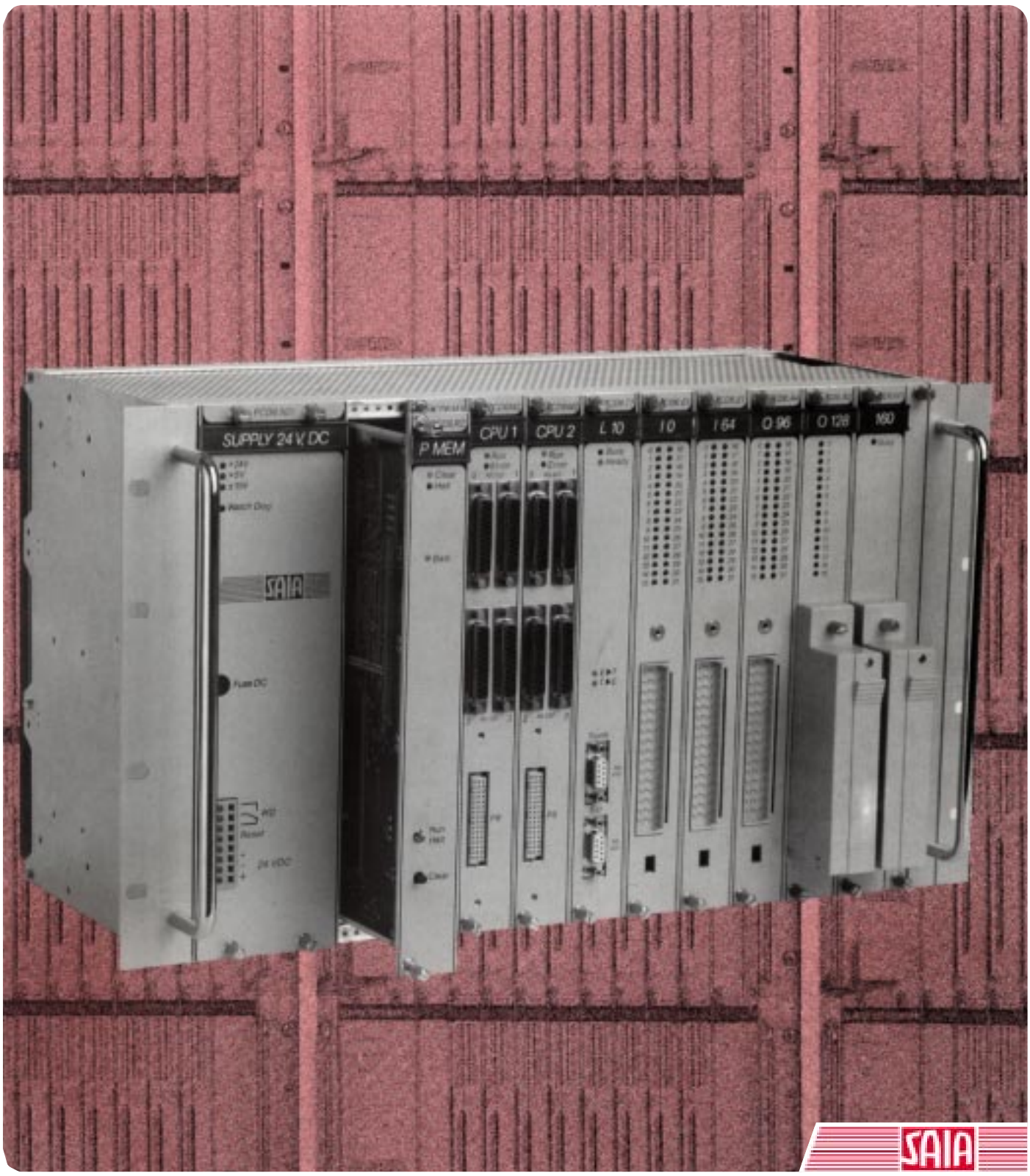
SAIA-Burgess Electronics

SWITCHES • MOTORS • CONTROLLERS

SAIA®PCD

Process Control Devices

PCD6 Series Hardware Manual



Edition 26/735 E3

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SAIA® Process Control Devices

HARDWARE

PCD6 series

Edition 26/735 E3 - 04.1999

Subject to technical changes

Updates

Manual : Hardware PCD6 series - Edition E3

Date	Chapter	Page	Description
06.10.2000	5.5	5-7	Compatibility table for FW mix (M300 and M1/M2)
06.10.2000	5.6	5-8	EEPROM configuration memory : SYSWR K 6000
06.10.2000	5.7.7	5-21 / 5-23	PROFIBUS-DP connection

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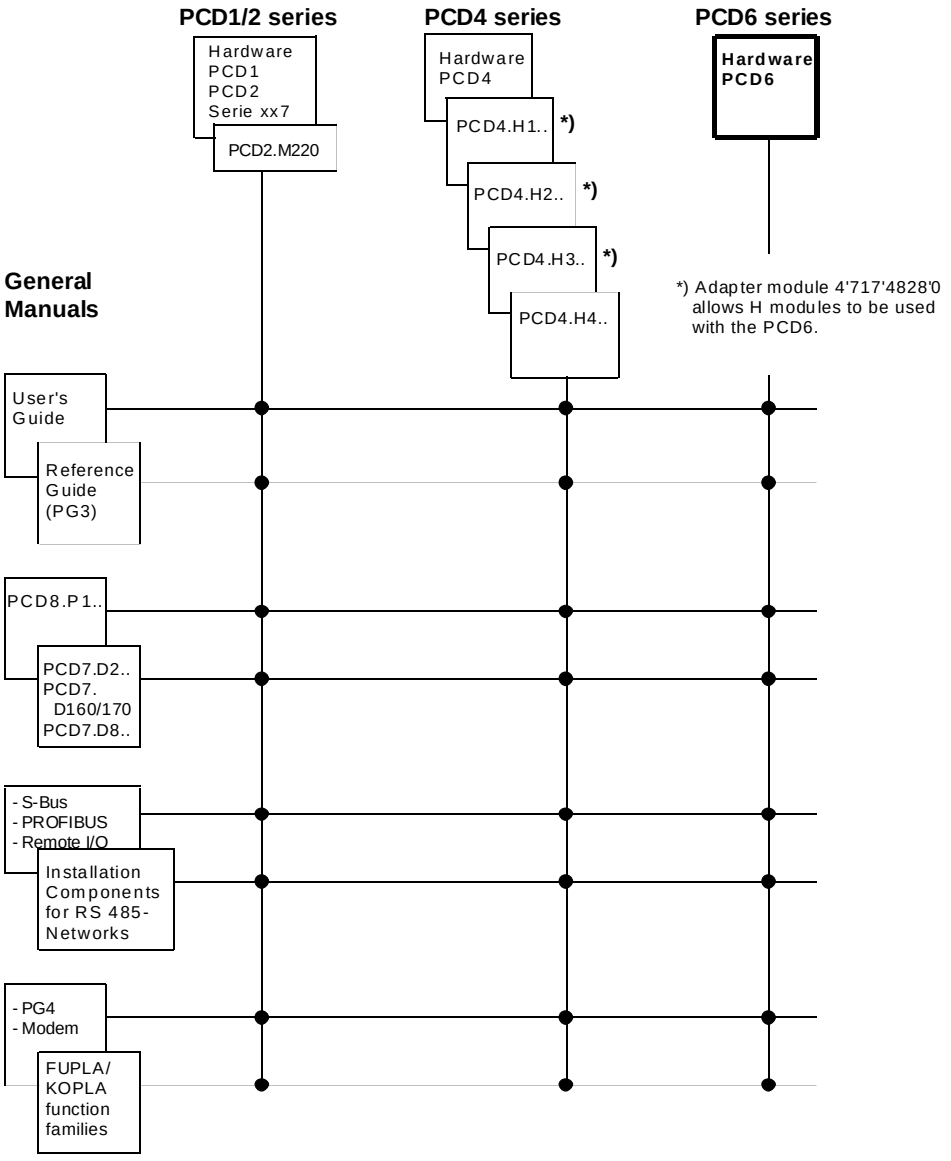
Please note:

A number of detailed manuals are available to aid installation and operation of the SAIA PCD. These are for use by technically qualified staff, who may also have successfully completed one of our "workshops".

To obtain the best performance from your SAIA PCD, closely follow the guidelines for assembly, wiring, programming and commissioning given in these manuals. In this way, you will also become one of the many enthusiastic SAIA PCD users.

If you have any technical suggestions or recommendations for improvements to the manuals, please let us know. A form is provided on the last page of this manual for your comments.

Summary



Reliability and safety of electronic controllers

SAIA-Burgess Electronics Ltd. is a company which devotes the greatest care to the design, development and manufacture of its products:

- state-of-the-art technology
- compliance with standards
- ISO 9001 certification
- international approvals: e.g. Germanischer Lloyd, UL, Det Norske Veritas, CE mark ...
- choice of high-quality componentry
- quality control checks at various stages of production
- in-circuit tests
- run-in (burn-in at 85°C for 48h)

Despite every care, the excellent quality which results from this does have its limits. It is therefore necessary, for example, to reckon with the natural failure of components. For this reason SAIA-Burgess Electronics Ltd. provides a guarantee according to the "General terms and conditions of supply".

The plant engineer must in turn also contribute his share to the reliable operation of an installation. He is therefore responsible for ensuring that controller use conforms to the technical data and that no excessive stresses are placed on it, e.g. with regard to temperature ranges, overvoltages and noise fields or mechanical stresses.

In addition, the plant engineer is also responsible for ensuring that a faulty product in no case leads to personal injury or even death, nor to the damage or destruction of property. The relevant safety regulations should always be observed. Dangerous faults must be recognized by additional measures and any consequences prevented. For example, outputs which are important for safety should lead back to inputs and be monitored from software. Consistent use should be made of the diagnostic elements of the PCD, such as the watchdog, exception organization blocks (XOB) and test or diagnostic instructions.

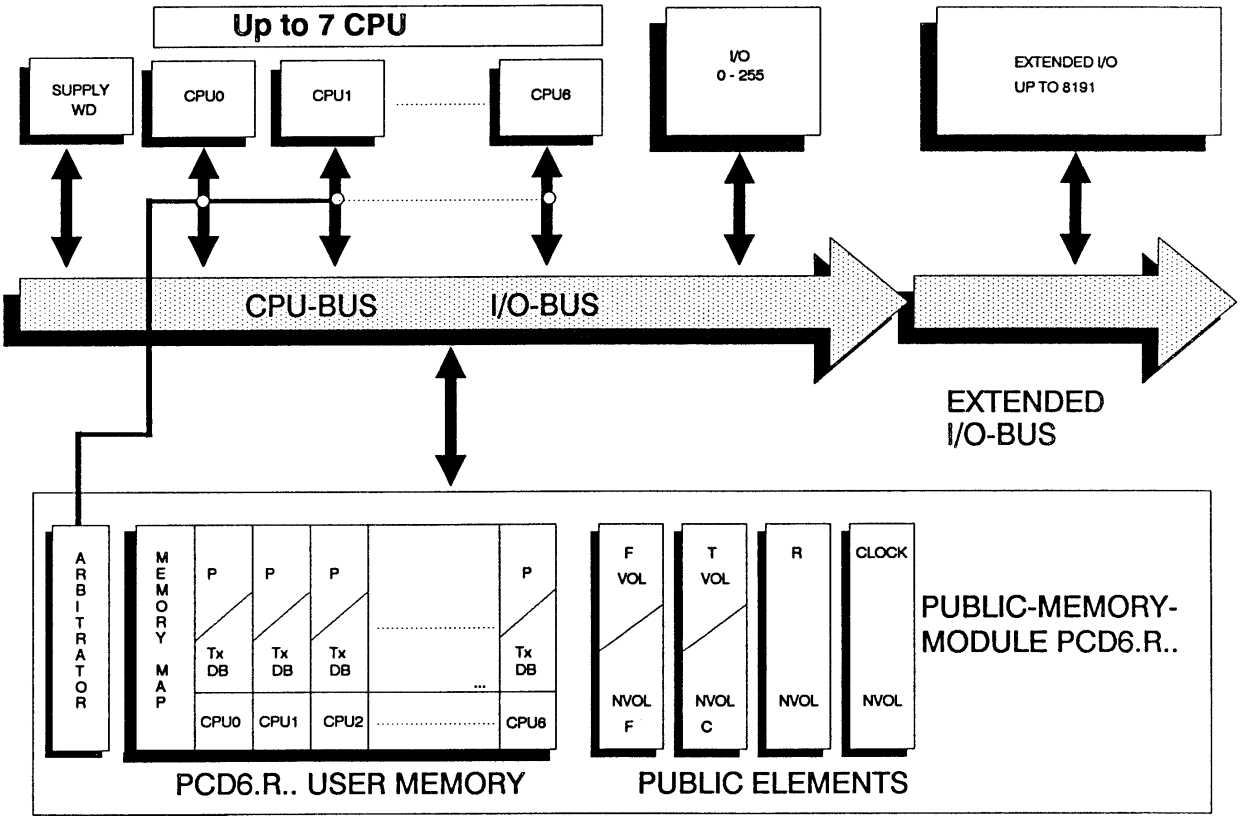
If all these points are taken into consideration, the SAIA PCD will provide you with a modern, safe programmable controller to control, regulate and monitor your installation with reliability for many years.

1. The modular system structure

The series PCD6 offers maximum extension versatility with regard to the number of processor modules as well as to the number of input and output modules. Owing to its modular structure, the PCD6 series may be adapted to all requirements ranging from the basic system with a single processor module and up to 256 inputs/outputs to the large multi-processor system with 5120 I/O or it may be upgraded gradually in accordance with the users' requirements.

The 19-inch rack units, which have proved worthwhile with the PCA2 series for years, are used as housings. All functional modules are inserted in these rack units and connected at the rear via the bus board.

1.1 Block diagram for the multiprocessor system PCD6



P:	Program	F:	Flags	VOL:	volatile
Tx:	Text	T:	Timers	NVOL:	non volatile
DB:	Data blocks	C:	Counters		
		R:	Registers		
		CLOCK:	Date-time		

The **power supply module** generates all voltages for the internal power supply of the electronics. This module also accommodates the program monitoring circuit ”watchdog” (WD).

The **public memory module** has a central function. It incorporates all common registers such as the timers, counters, data registers and date-time as well as the arbitrator which controls the access to the bus in multiprocessor systems.

As evident from the drawing, the 8192 flags (F) may be divided into a random number of volatile (VOL) and non-volatile (NVOL) flags. The register of the timers (T) and counters (C) of 1600 x 32 bits may also be adapted by the user in accordance with his requirements, whereby the timers are always volatile, the counters, however, are always non-volatile. The non-volatile data register (R) of 4096 x 32 bits is also available for all processor modules.

The **user memory of the multiprocessor system for programs (P), texts (Tx) and data blocks (DB)** is a pc-board which is plugged onto the public memory module and equipped with a battery-buffered RAM or EPROM. The programming tool ”Install” is used to assign each processor module its own program and text area.

The **system bus** in the rack unit is the data path which is shared by all system components. The **processor modules for bit and word processing** and **communication** as well as the **LAN2-processor module** are placed to specially reserved plug-in locations.

The locations to the right of the processor modules may be used to accommodate in**put and output modules** (I/O) both for digital and analogue signals as desired.

In the same rack, a maximum of 5 rack units each of 256 I/O or up to 1280 I/O can be addressed by using the **bus extension cable.**

Connecting modules and a **rack extension cable** allow equipping up to 4 such racks with I/O modules which results in a maximum extension of 5120 I/O.

1.2 System data

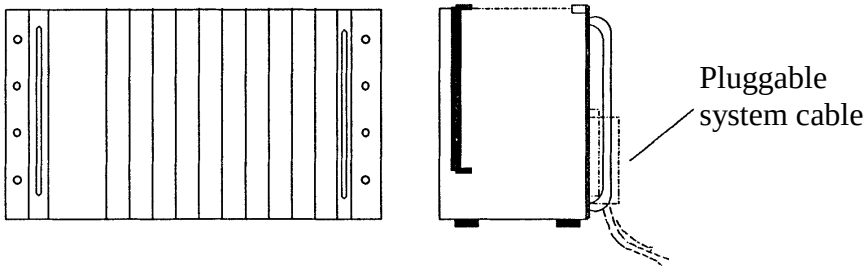
Processor modules	1 to 7 Equipped with bit and word processor, communication processor and LAN2-processor as required (only 1 LAN2-processor per system)
Execution time	approx. 6 µs per logic instruction (directly without a process image)
User memory with ..R1../..R5..	RAM battery-buffered or EPROM 64 K program lines (of 32 bits) or up to 256 K text or data characters or mixed
with ..R2../..R6..	256 K program lines (of 32 bits) or up to 1 M text or data characters or mixed Separate data blocks corresponding to max. 192 K register (program and text appropriately reduced)
Number of inputs and outputs	Max. 256 in the same rack unit, 1280 in the same rack (with 5 rack units each of 256 I/O) 5120 in 4 racks (each with 5 rack units) Address range 0...8191
Serial interfaces	4 per communications processor, i.e. max. 28 interfaces for 7 processor modules 4 per single processor ..M540
Types of interface	RS 232c, RS 422/485, 20 mA current loop
Flags	8192 (can be divided into volatile and non-volatile flags)
Timers/counters	1600, 31 bits, division is programmable (timers are always volatile, while counters are always non-volatile)
Time base	Programmable in the range 10 ms to 10 s
Data register	4096 x 32 bits (non-volatile) loadable in the user program or externally from disk, using the whole user program the data capacity will reach max. 1 Mbyte (see user memory)
Data formats	Decimal, hexadecimal, BCD, binary or floating-point (exponential representation)
Index register	16 x 13 bits (per processor)

Cyclic organization blocks (COB)	16 (per processor)
Exception organization blocks (XOB)	up to 32 (per processsor)
Program blocks (PB)	300 (per processor)
Function blocks (FB)	1000 (per processor), parameterizable
Sequential blocks (SB)	32 (per processor) for GRAFTEC programming (2000 steps and 2000 transitions, up to 32 parallel branches)
Texts and data blocks	4000 + 4000 (per processor) up to 3 subordinate text levels
Special texts	Output of date, time, logic states, register and counter contents in different formats (with decimal point), directly or indirectly addressable
SAIA®LAN2	32 stations along a twisted-pair cable which is 1200 m in length. With a repeater expandable up to 8 times the size
Date-time (hardware date-time)	Week, day of the week, year, month, date, hour, minute, second Accuracy: better than15 s/month Power reserve: 2 months
Operating temperature range	0...50°C (below rack units) without forced ventilation
Interference protection of the digital I/O and power supply	according to IEC 1131-2 class III (2 and 4 kV)
Supply voltages (nominal)	for power supply modules 230 VAC, 50 Hz 24 VDC smoothed or 18 VDC full-wave rectified

2. The rack units PCD6.C..

The rack units of the series PCD6 can be installed in every 19-inch rack. As the operating elements and connecting terminals are accessible at the front, expensive swing out frames are not required. All modules are shielded. The rack units may also be wall-mounted by using fastening brackets. The height is 6 units, thus corresponding to the housing dimensions of the PCA2 series. All rack units are provided with the parallel bus and the appropriate bus connectors on the rear panel.

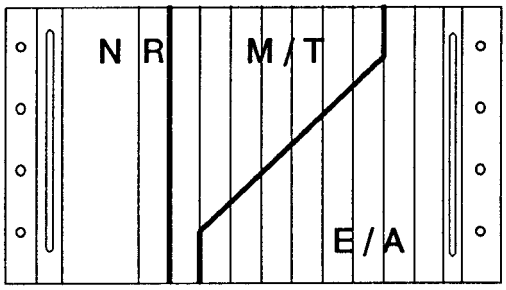
Each rack unit is supplied with the required voltages by its own power supply module and provides room for 10 additional modules (processor modules, I/O modules).



2.1 The basic system with 32 to 256 I/O

The basic system requires a main rack unit PCD6.C100 or PCD6.C110.

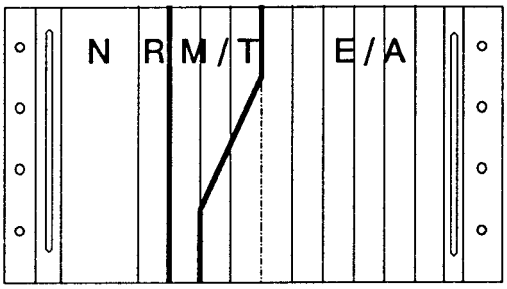
2.1.1 PCD6.C100 for 1 to 7 processor modules



Configuration:

N: Power supply module
R: Public memory module ..R1.. or ..R2..
M/T: 1 to 7 processor modules
E/A: 2 to 8 I/O modules [1])

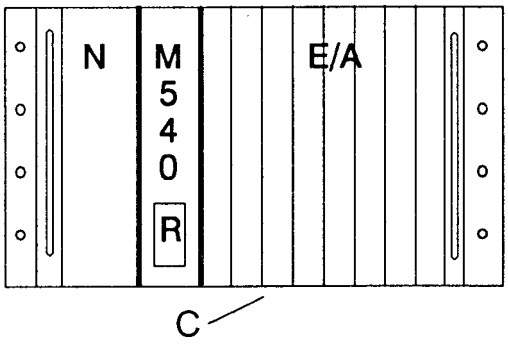
2.1.2 PCD6.C110 for 1 to 3 processor modules



Configuration:

N: Power supply module
R: Public memory module ..Rl .. or ..R2..
M/T: 1 to 3 processor modules
E/A: 6 to 8 I/O modules [1])

2.1.3 With single processor module ..M540



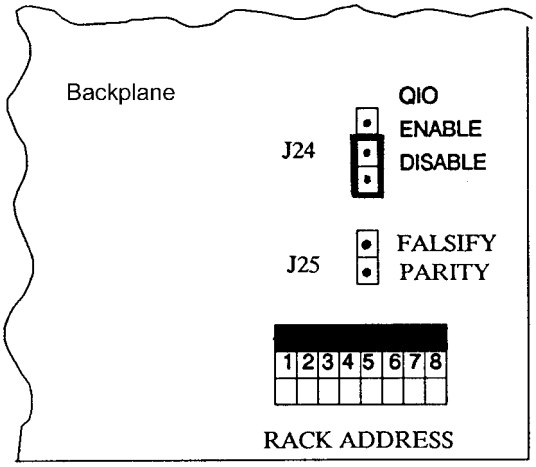
Configuration:

C: Main rack unit ..C110 (or ..C100)
N: Power supp1y module
R: Memory module (PCD7.R..) pluggable in processor module ..M540
M: Single processor module PCD6.M540
E/A: up to 8 I/O modules [1])

[1]) I/O modules include digital I/O modules as well as analogue modules or signal-processing modules such as fast counters.

The main rack unit is always assigned rack unit number 0. The range of I/O addresses is 0 to 255.

Rack unit number and jumper positions:



J24: QIO ENABLE [1])
Jumper setting ex works in position DISABLE (see XOB5)

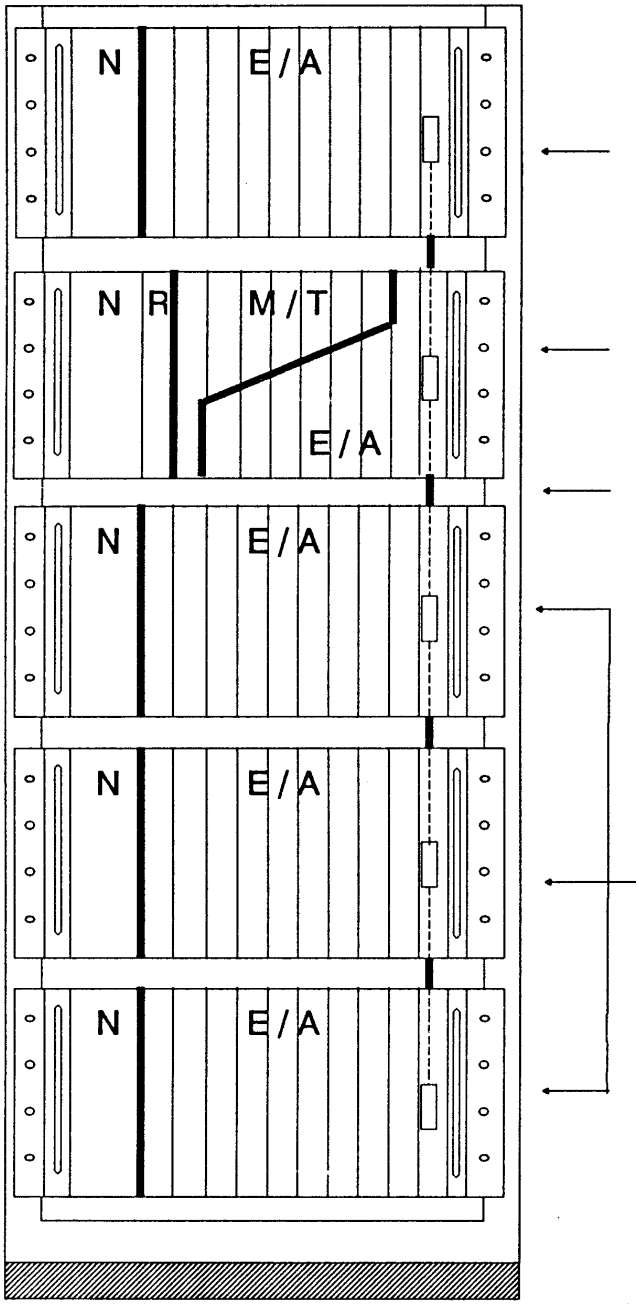
J25: FALSIFY PARITY
Only for factory end-test

RACK ADDRESS:
DIL-switch for rack unit number (for PCD6.C1.. only number 0 is allowed).

Backplane: rear panel board in the main rack unit.

[1]) ENABLE may be set only with the new PCD6 I/O modules.
For PCA2 I/O modules the jumper must always remain in position DISABLE.

2.2 The 1-rack system for up to 1280 I/O



Extension rack unit PCD6.C200

Main rack unit PCD6.C100 or ..C110 for multiprocessor modules ..M1.., ..M2.., ..T1.. or for single processor module ..M540

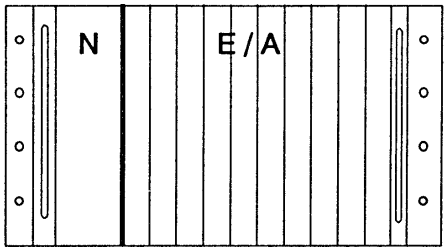
Bus extension cable PCD6.K100

Extension rack unit PCD6.C200

Each main rack unit can be connected to a maximum of 4 extension rack units in the same rack. Extension is achieved by connecting the bus extension cable directly to the backplane sockets of each rack unit without occupying an I/O socket (max. cable length = 5 m). The cables are designed in such a way that a space of 2 height units = 88.4 mm is left between two rack units for connecting the I/O system cables.

The main rack unit may be installed in any position desired in the rack.

2.2.1 PCD6.C200: Extension rack unit for each with up to 256 I/O and max. 10 modules



Configuration:

N: Power supply module
E/A: up to 10 I/O modules

The rack unit number (0–31) is set on every rack unit via a 8-digit DIL-switch. The switch settings are summarized in chapter ”Setting the rack unit number of the PCD6 rack units”.

In order to achieve continuous addressing when using modules with 16 element addresses, several rack units can be assigned the same rack unit number.

Important: No extension rack unit may use rack unit number 0.

2.2.2 PCD6.K100: Bus extension cable with 5 connectors

Bus extension cable (flat-strip cable with 5 connectors) for connection of up to 5 rack units. When 3 or 4 rack units are employed, the unnecessary cable can be coiled up or cut off with scissors.

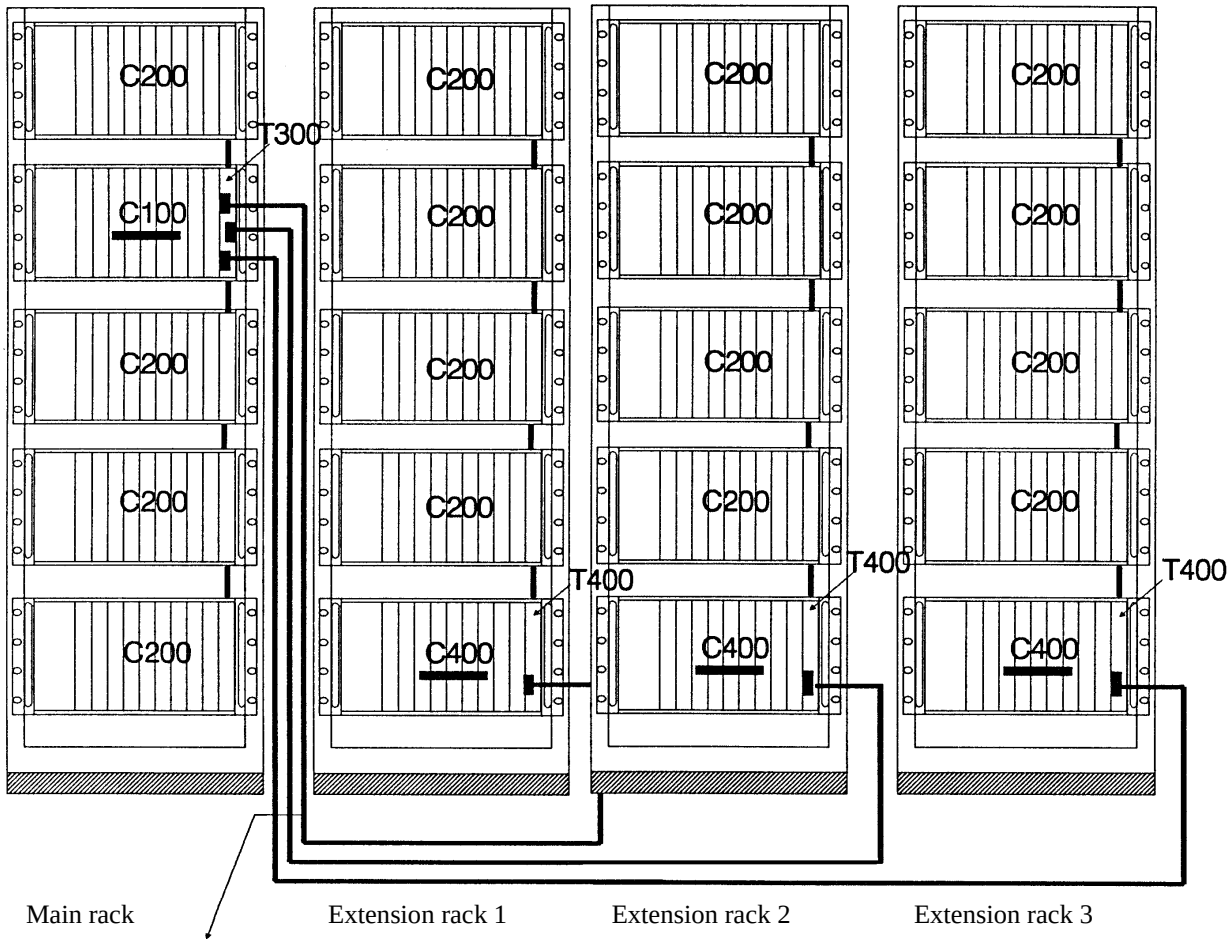
2.2.3 PCD6.K110: Bus extension cable with 2 connectors

Bus extension cable (flat-strip cable with just 2 connectors) for connection of 2 rack units.

2.3 Maximum extension with up to 5120 I/O

PCD6.T300: Connecting module for main rack

3 x PCD6.C400: Extension rack unit for connecting module
3 x PCD6.T400: Connecting module for extension rack

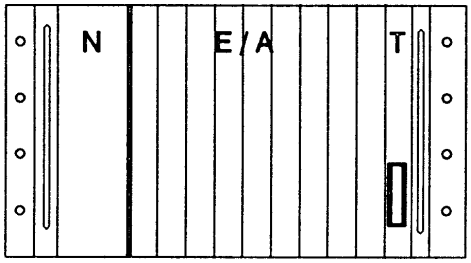


Rack connecting cable PCD6.K400/..K410

The extension rack unit PCD6.C400 may be placed to any position desired in the rack.

The maximum extension level permits connection of 3 additional racks, each with 5 rack units, to the main rack which corresponds to a capacity of 5120 I/O. A connecting module PCD6.T300 which connects the extension racks is required in the main rack to control the 3 additional racks. The rack connecting cable PCD6.K4.. is attached to the connecting module PCD6.T400 which must be inserted in the special extension rack unit PCD6.C400. The connecting cable must not exceed 10 m in length.

2.3.1 PCD6.C400: Extension rack unit for connecting module PCD6.T400 and 256 I/O in max. 9 modules

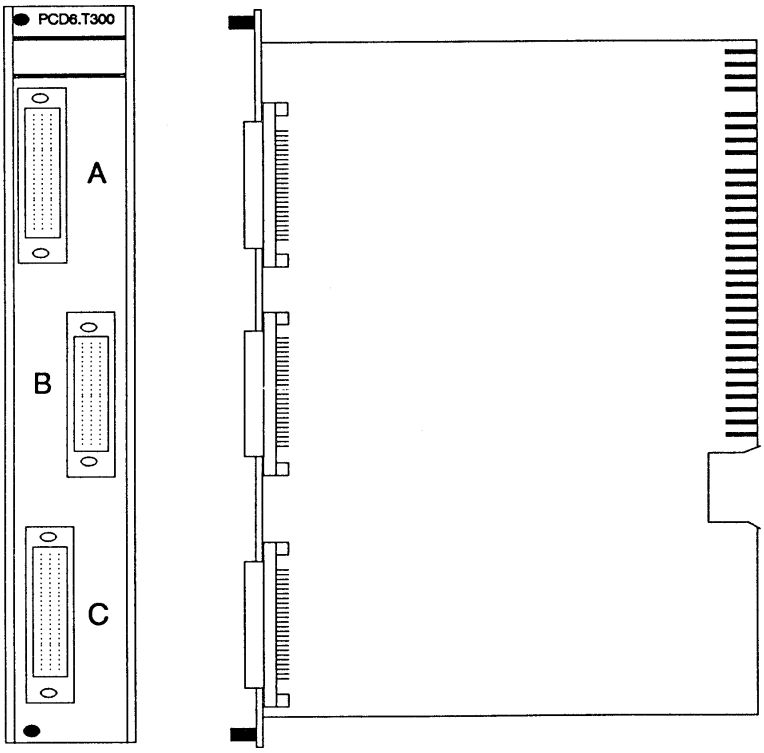


..C400

Configuration:

N: Power supply module
E/A: max. 9 I/O modules
T: Connecting module PCD6.T400 (this module must be inserted in the rack unit in the first position on the right-hand side). The rack unit number is set on the connecting module PCD6.T400.

2.3.2 PCD6.T300: Main rack connecting module

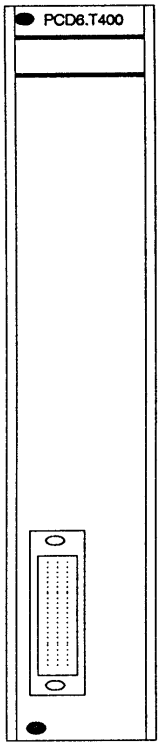


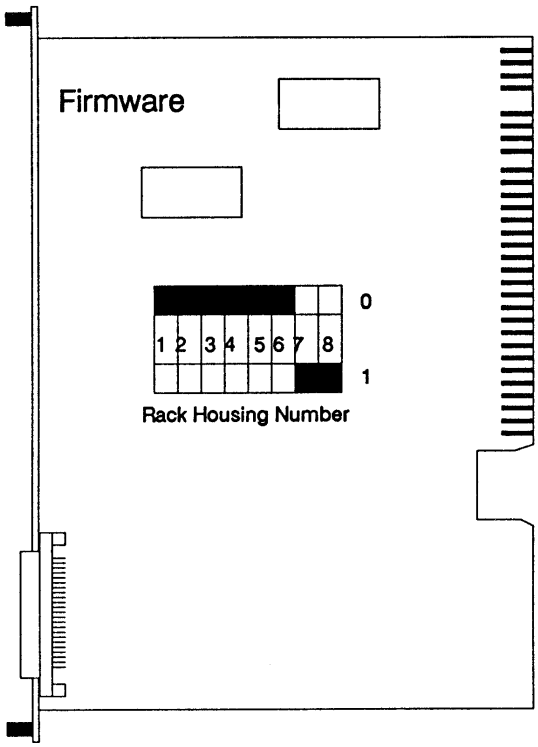
The connecting module is inserted in the main rack unit PCD6.C100/ ..C110 in the first position on the right-hand side.

The rack connecting cable PCD6.K400/..K410 is attached to the extension racks via 3 D-Sub connectors (50-pole, female) on the front panel. The connector designations A, B and C do not affect addressing in the extension racks. The detection of what kind of extension rack is connected works automatically.

Power consumption (internal from 5 V-bus)	Extension A	1500 mA
	Extension A+ B	2100 mA
	Extension A+B+C	2700 mA

2.3.3 PCD6.T400: Extension rack connecting module





This connecting module is inserted in the extension rack unit PCD6.C400 in the first position on the right-hand side. It is used to establish the connection to the main rack unit with the rack connecting cable PCD6.K400/..K410.

The rack unit number of the extension rack unit PCD6.C400 is selected with the DIL-switches of this module rather than in the rack unit PCD6.C400. Addressing see chapter ”Setting the rack unit numbers of rack unit PCD6.C..”.

Power consumption
(internal from 5 V-bus) 500mA

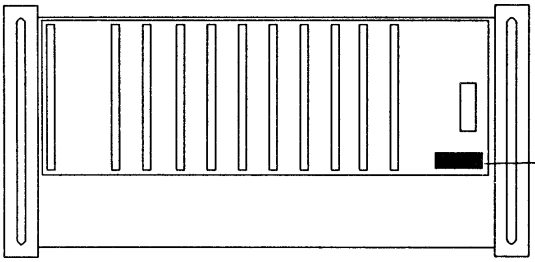
2.3.4 PCD6.K400: Rack connecting cable (5 m)

The rack connecting cable ends on both sides with a 50-pole, screw-fastened D-Sub connector (male). It is 5 m in length.

2.3.5 PCD6.K410: Rack connecting cable (10 m)

ditto, however, it is 10 m in length.

2.4 Setting the rack unit numbers of rack unit PCD6.C..



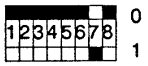
Rack unit number	DIL-switch position	Element address range
0 *)	00000000	**0** - 255
1	00000001	**256** - 511
2	00000010	**512** - 767
3	00000011	**768** - 1023
4	00000100	**1024** - 1279
5	00000101	**1280** - 1535
6	00000110	**1536** - 1791
7	00000111	**1792** - 2047
8	00001000	**2084** - 2303
9	00001001	**2304** - 2559
10	00001010	**2560** - 2815
11	00001011	**2816** - 3071
12	00001100	**3072** - 3327
13	00001101	**3328** - 3583
14	00001110	**3584** - 3839
15	00001111	**3840** - 4095
16	00001000	**4096** - 4351
17	00010001	**4352** - 4607
18	00010010	**4608** - 4863
19	00010011	**4864** - 5119
20	00010100	**5120** - 5375
21	00010101	**5376** - 5631
22	00010110	**5632** - 5887
23	00010111	**5888** - 6143
24	00011000	**6144** - 6399
25	00011001	**6400** - 6655
26	00011010	**6656** - 6911
27	00011011	**6912** - 7167
28	00011100	**7168** - 7423
29	00011101	**7424** - 7679
30	00011110	**7680** - 7935
31	00011111	**7936** - 8191

Basic address of rack unit

DIL-switch:

Rack unit no. 1
Addr. 256 - 511

Rack unit no. 2
Addr. 512 - 767



Rack unit no. 3
Addr. 768 - 1023

Rack unit no. 4
Addr. 1024 – 1279

and so forth ...

Rack unit no. 31
Addr. 7936 - 8191

pressed 

*) Rack unit number 0 may only be used for the main rack unit PCD6.C1..

2.5 Addressing of inputs and outputs in the PCD6 system

The inputs and outputs as well as all other elements in the PCD6 system are addressed by using decimal numbers and therefore easy to understand. An input or output module has 16 or 32 addresses.

In order to find the absolute I/O addresses in the range of 0 to 8191, unambiguous labelling of the modules is essential. For this purpose, a set of labels is delivered with each rack unit.

The absolute address of an input or output is determined as follows:

rack unit basic address
\+ DIL-address of the module
\+ relative address of the module input or output

Use the above mentioned labels to ensure correct labelling of the modules.

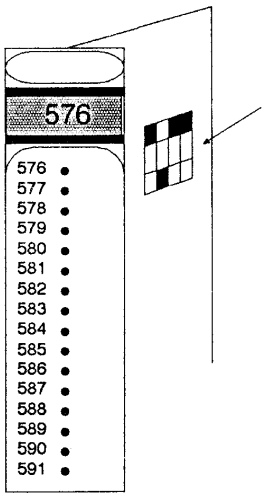
The plug-in location within the same rack unit does not affect input and output addressing.

Example:

Rack unit no. 2 with rack unit basic address **512**

Inserted label with the basic module address:
512 + 64 = **576**

Sticker with the absolute addresses



DIL-address **64** of the module (setting see following table)

Please try yourself after addressing by testing and setting 1 address per module with the programming unit. Use the input simulation unit PCD6.S100 for testing the inputs.

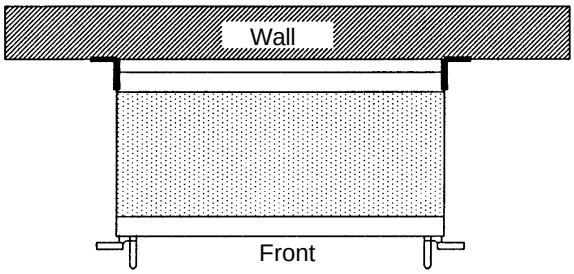
This simple test avoids searching for ”errors” which result from incorrectly set addresses.

Basic address of the modules in the various rack units

Rack unit no. is identical to rack unit basic address	**0** **0**	**1** **256**	**2** **512**	**3** **768**	**4** **1024**	**5** **1280**	**...** **...**
Module DIL-switch	**Basic addresses of the modules**						
	**0**	**256**	**512**	**768**	**1024**	**1280**	**...**
	16	272	528	784	1040	1296	...
	**32**	**288**	**544**	**800**	**1056**	**1312**	**...**
	48	304	560	816	1072	1328	...
	**64**	**320**	**576**	**832**	**1088**	**1344**	**...**
	80	336	592	848	1104	1360	...
	**96**	**352**	**608**	**864**	**1120**	**1376**	**...**
	112	368	624	880	1136	1392	...
	**128**	**384**	**640**	**896**	**1152**	**1408**	**...**
	144	400	656	912	1168	1424	...
	**160**	**416**	**672**	**928**	**1184**	**1440**	**...**
	176	432	688	944	1200	1456	...
	**192**	**448**	**704**	**960**	**1216**	**1472**	**...**
	208	464	720	976	1232	1488	...
	**224**	**480**	**736**	**992**	**1248**	**1504**	**...**
	240	496	752	1008	1264	1520 ...	

2.6 Housing accessories

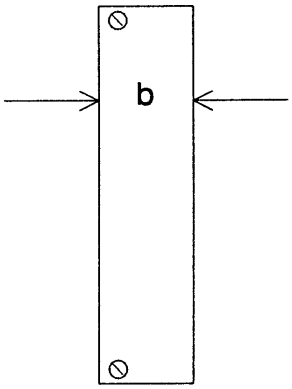
Fastening brackets for wall-mounting (Order no. 4’121’4889’0)



Two fastening brackets may be screwed to the back of the module to facilitate wall-mounting. Refer to the dimension drawing.

Cover panels

Width b = 12.5 mm Order no. 4’107’4870’0
Width b = 34.4 mm Order no. 4’107’4871’0



3. PCD6.M540 Single processor module PCD7.R... Memory module

3.1 Application

The single processor module is for creating smaller PCD systems in a PCD6 rack. It is modelled on the PCD4's M140 processor. Its characteristics are therefore similar to the PCD4's:

- uses the same memory modular as the PCD4, but with up to 256 Kbytes or 428 Kbytes for program, text and data blocks

- up to 1280 inputs/outputs

- 4 serial communications interfaces (2 x RS232, 1 x RS422/485, 1 x 20mA current loop)

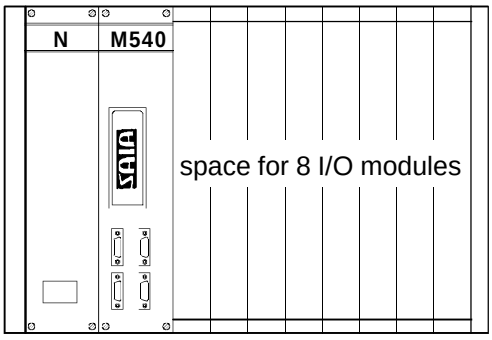
- communications via the LAN1, S-BUS and LAC networks, but not via the LAN2

- compatible instruction set, same as for PCD4.M140 and PCD6.M2..

- constructed using SMT components

The single processor module is inserted next to the power supply module in a PCD6.C100 or C110 rack unit, and is fastened with 4 screws. It occupies two card slots.

PCD6.C1..

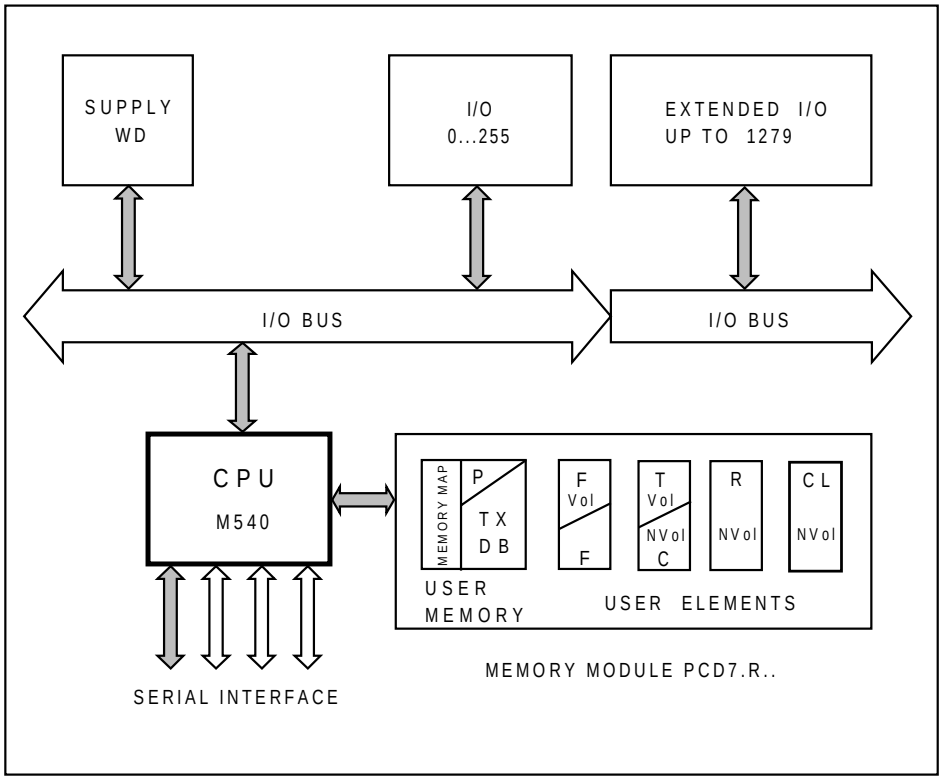


The ..C200 extension rack units can be used with a PCD6.K100 bus extension cable to expand the I/O capacity to 5 rack units with a maximum of 1280 inputs/outputs.

3.2 Architecture and layout

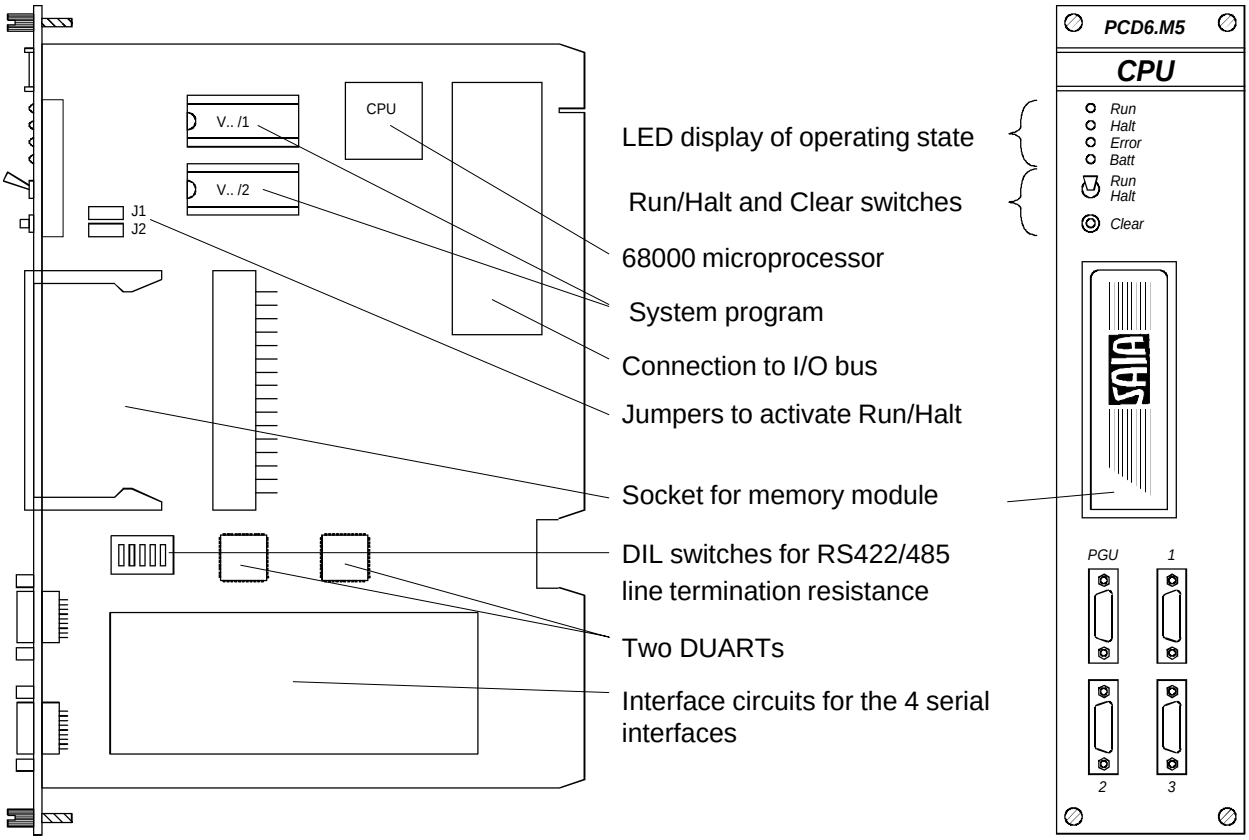
Architecture

The following block diagram shows the clear and simple layout of a PCD6 with a single processor.



P	Program	F	Flag	CL	Real-time clock
TX	Text	T	Timer	Vol	Volatile
DB	Data blocks	C	Counter	NVol	Non-Volatile
		R	Register		

Hardware



Serial interfaces	- PGU:	RS232c for connecting the programming unit
	- connector 1:	RS422/485
	- connector 2:	RS232c
	- connector 3:	20mA current loop
Connectors	The 4 connectors on the front plate are 9-pin D-Type connectors (female)	

3.3 Characteristic data of the processor module

µP	16-bit microprocessor 68000
Number of instructions	as for processor module PCD6.M2..
No. of interfaces which are independent of each other	4, interface No. 0 for PGU
Baud rates (individually selectable for each interface)	38400, 19200, 9600, 4800, 2400, 1200, 600, 300, 150, 110 bps (maximum transmission rate for 20mA current loop is 9600bps).

Execution time (processing speed)

As this processor module gives communication priority treatment, the processing speed reduces according to the number of assigned interfaces and the density of data transferred via each interface.

An average reduction to approx. 80% is assumed (to 90% without an active interface, or down to 40% if all four interfaces are assigned and data is constantly transferred on all 4 interfaces).

Execution time:

- Bit processing	e.g.:	ANH	I 0	=	6... 10µs
- Word processing	e.g.:	ADD	R 0 R 1 R 2	=	35... 60µs

Number of addressable inputs and outputs	1280 per system
Number of cyclic organization blocks (COB)	16
Number of index registers (13 bits)	16 (one per COB)
Number of exception organization blocks (XOB)	12 at present (can be increased to 32)

Number of program blocks (PB) [1]	300
Number of parameterizable function blocks (FB) [1]	1000
Number of sequential blocks (SB) (for GRAFTEC)	32
Number of GRAFTEC steps	2000 steps and 2000 transitions with up to 32 active parallel branches
Number of texts or data blocs (for text output via serial interfaces)	4000
Power consumption (internal from 5V bus)	800mA

All user memories (programs, texts, flags, registers, counter and timer registers, etc.) and the hardware date-time are resident on the memory modulel PCD7.R...

1) PB and FB calls may be nested to 7 levels.

The firmware

The firmware (system program) is located on 2 EPROMs of the type 27C512 (access time less than or equal to 200 ns). These two EPROMs are numbered "1" and "2" and carry indications of the firmware version number V....

PCD6.M5 V001/1	PCD6.M5 V001/2

Firmware is subject to upward compatible firmware changes.

3.4 Operating states of the processor module

Every processor module can have the following operating states: START, HALT, RUN, CONDITIONAL RUN, STOP and RESET.

These states are displayed by 4 LEDs on the front panel:

RUN	Yellow LED
HALT	Red LED
ERROR	Yellow LED
BATT	Red LED

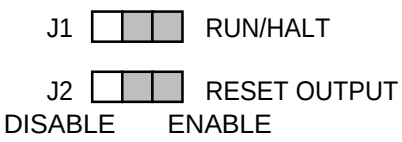
State	LED	Meaning
START	RUN on HALT on ERROR on	Self-check for approx. 1 sec when switched on, or after a "Restart" (Lamp check)
RUN	RUN on HALT off ERROR off	Normal processing of the user program after START, if no PG is connected.
COND. RUN	RUN flashing HALT off ERROR off	Conditional RUN. A breakpoint has been set by the debugger (Run Until...) which is not yet satisfied.
STOP	RUN off HALT off ERROR off	If the PCD is on and the PG connected and running the debugger, then the CPU has not yet been put into RUN, or was stopped by the PG. Or a breakpoint has been satisfied.
HALT	RUN off HALT on ERROR off	Serious error in user program, hardware error or HALT instruction processed, or no program loaded.
RESET	RUN on HALT on ERROR on	The supply voltage is too low or there is an EXTERNAL RESET.
RUN or COND. RUN despite ERROR	RUN on or flashing HALT off ERROR on	A self-check interrupted during the processing of a program and the corresponding XOB is not programmed.
	BATT on	The battery in the memory is no longer working, or is not yet working because the controller has been powered off for a long period. (XOB 2 is called)

3.5 Run/Halt switch and Clear button

The ..M540 processor module is fitted with a Run/Halt switch and a Clear button. The front-panel LEDs indicate the processor's status.

RUN/HALT and RESET OUTPUT jumpers

Setting jumpers J1 and J2 influences the behaviour of the processor in certain states:



Jumper positions drawn to show factory settings

Jumper	Position	Effect
J1	ENABLE	RUN/HALT and CLEAR switches are active
J1	DISABLE	Run/Halt and Clear switches are inoperative
J2	ENABLE	In the HALT state, all outputs are reset. This HALT can be triggered by the Run/ Halt switch, a HALT instruction or an XOB.
J2	DISABLE	In the HALT state, outputs are unchanged

Caution: If jumper J2 is in the ENABLE position during the commissioning phase, and the PCD is run in "Trace" or "Run Until" mode, all outputs are turned off each time the program stops. This can be very confusing.

Important: If PCD6.W3.. series analogue modules are used, then "Trace" mode must NOT be used while jumper J2 is in the ENABLE position, otherwise invalid readings may occur.

HALT/CLEAR - ENABLE jumper

With jumper J1 (RUN/HALT) is in the ENABLE position, the following functions result:

- If the **RUN/HALT switch** is in the HALT position, the processor module immediately goes into the HALT state. This switch has higher priority than the PG commands Run, Trace and Restart. The red HALT LED on the processor module is illuminated in the HALT state.

- If the RUN/HALT switch is switched from HALT to RUN, the processor executes a **cold start**, i.e. the self-check is executed, all volatile elements are set low and the cold start user routine (XOB 16) is executed.

- If the **CLEAR button** is pressed **while** the switch is being switched from the HALT to the RUN position, **all elements, with the exception of the registers, are set low or to zero** (also all no-volatile flags and counters). At all other times the CLEAR button has no effect.

The EXTERNAL RESET function

If a 0V signal (Ground) is connected to screw terminal "R" (External Reset) of the supply module, the processor immediately goes into RESET and all outputs are set low within a maximum of 2 ms, indepen-dently of the "Reset Output - Enable" jumper. Removal of the 0V signal gives a cold start.

To prevent the processor starting itself up again, this should be done in user software. (e.g. wait at the beginning of XOB 16 until an input is switched on).

This "Hardware Reset" has effects on the voltage monitoring of the power supply module, and works in the same way as the "Reset", if the supply voltage is too low.

3.6 The 4 serial data interfaces

All interfaces are attached to a 9-pin D-type connector (female) on the front panel. The connecting cable can be secured with 2 screws.

3.6.1 The PGU serial interface (RS 232c, channel 0)

During commissioning, the PGU connector is used with the programming unit. Cables PCD8.K100 or ..K110 should be used for connecting the programming unit.

This interface is of the type RS 232c. Pin assignment and data are as follows:

Pin No.		Function
3	TX	Transmit Data
2	RX	Receive Data
7	RTS	Request To Send
8	CTS	Clear To Send
5	SGN	Signal Ground
4	NC	Not Connected
6	DSR	PGU Connected
9	+5V	Supply +5V (P100)
1	PGD	Protective Ground

Use of the PGU interface as a data channel

The following facts should be noted:

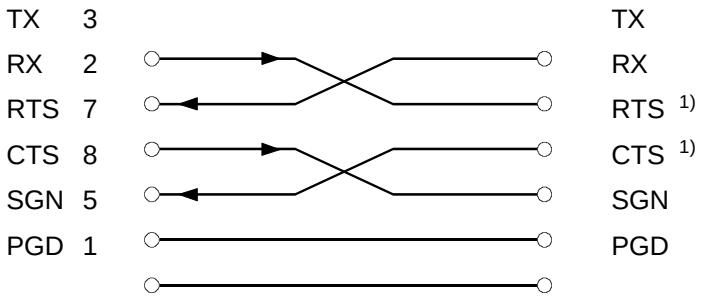
- During PCD4 power-up, the firmware automatically assigns the PGU interface for connection to a programming unit at 9600 bps.

- If any other peripheral device is to be connected, it should be reassigned as channel 0, using the SASI instruction.

- If a programming unit is plugged in during operation, the switchover to PGU mode is done automatically.

- To use the interface once again as a data channel, it must be reassigned as channel 0 again using the SASI instruction.

Connection example for channel 0 (PGU) as general purpose serial interface



The connector type and pin numbering must be adapted for the peripheral unit.

1) When communicating with terminals, it is important to check if some connections are provided by jumpers (RTS-CTS), or must be set High or Low with the "SOCL" instruction.

3.6.2 Interface No. 2: RS 232c (IBM Standard)

This interface also has the necessary control lines for connection to a modem.

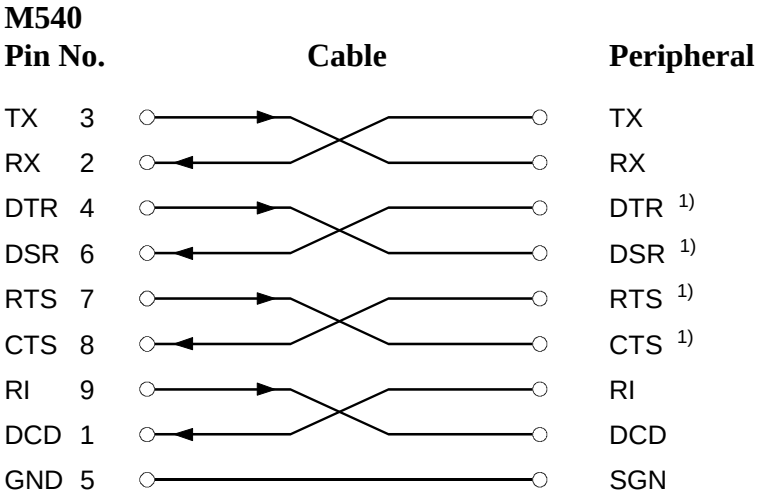
M540 Pin No.		Function
3	TX	Transmit Data
2	RX	Receive Data
4	DTR	Data Terminal Ready
6	DSR	Data Set Ready
7	RTS	Request To Send
8	CTS	Clear To Send
9	RI	Ring Indicator
1	DCD	Data Carrier Detect
5	GND	Ground

Signal type	Logical state	Required value	Nominal value
Data signal	0 (space)	+ 3V...+15V	+ 7V
	1 (mark)	-15V... - 3V	- 7V
Control/	0 (off)	-15V... - 3V	- 7V
Message signal	1 (on)	+ 3V...+15V	+ 7V

The idle state of data signals is "mark". The idle state for control/message signals is “off”.

Connection example for RS 232

For serial interface No. 2 :



Adapt connector type and connections according to the peripheral.

1) For communication with serial terminals (VDUs), check which connections should be made. Set/clear the control signals using the SOCL instruction.

3.6.3 Interface No.3: 20mA Current Loop *

Pin No.		Function	
4	TS	Transmitter Source	Transmitter
2	TA	Transmitter Anode	
3	TC	Transmitter Cathode	
5	TG	Transmitter Ground	
9	RS	Receiver Source	Receiver
8	RA	Receiver Anode	
7	RC	Receiver Cathode	
5	RG	Receiver Ground	

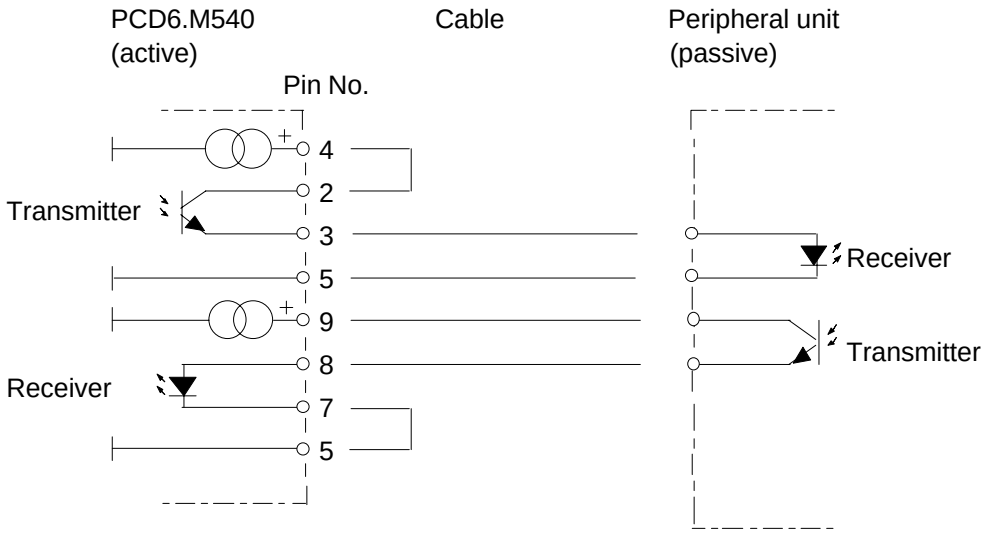
Signal type	Required value	Nominal value
Power for logic L (space)	-20.0 mA... +2.0 mA	0 mA
Power for logic H (mark)	+12.0 mA...+24.0 mA	+20.0 mA
Neutral Voltage TS, RS	+11.1 V... +14.9 V	+13.0 V
Short circuit power on TS, RS	+18.0 mA...+29.6 mA	+23.2 mA

The idle state for data signals is "mark".

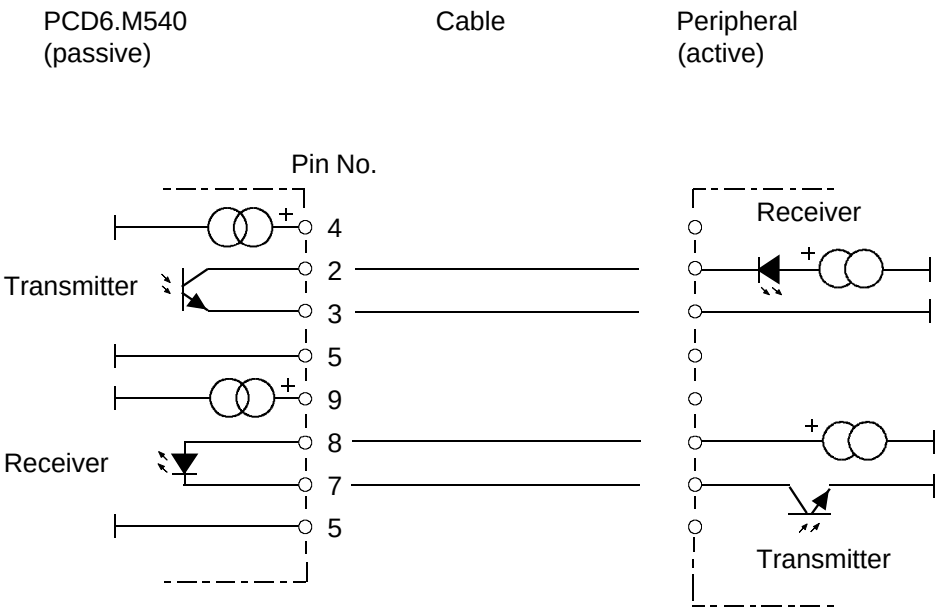
By wiring to the cable connector, the user selects either an "active" or "passive" circuit.

*) Maximum transmission rate for 20 mA current loop is 9600 bps.

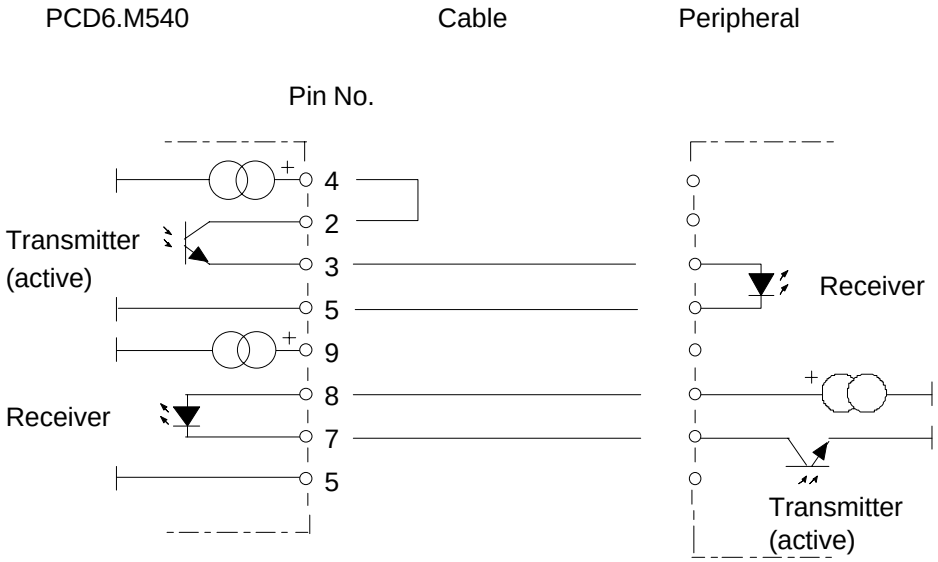
Connection examples for 20 mA current loop
a) PCD6 active



b) PCD6 passive



c) PCD6 transmitter and peripheral transmitter active



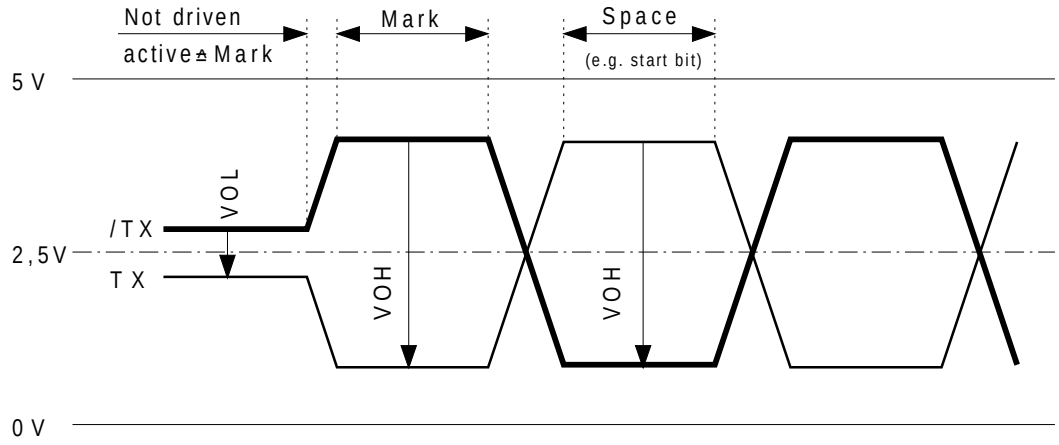
3.6.4 Serial interface No.1 as RS 422

Depending on the "SASI" instruction assignment, the interface can work as either RS 422 or RS 485.

Pin No.		Function
3	TX	Transmit Data
4	/TX	Transmit Data
2	RX	Receive Data
1	/RX	Receive Data
7	RTS	Request To Send
9	/RTS	Request To Send
8	CTS	Clear To Send
6	/CTS	Clear To Send
5	PGN	Protective Ground

Signal type	Logical state	Polarity
Data signal	0 (space)	TX positive to /TX
	1 (mark)	/TX positive to TX
Control/Message signal	0 (off)	/RTS positive to RTS
	1 (on)	RTS positive to /RTS

Signalling sequence /TX to TX



VOH = 2V min (with load) ... 5V max (without load)

VOL = 0V min ... 0.5V max

Terminal example for RS 422

PCD6.M540		Cable	Peripheral
TX	3		TX
/TX	4		/TX
RX	2		RX
/RX	1		/RX
RTS	7		RTS
/RTS	9		/RTS
CTS	8		CTS
/CTS	6		/CTS
PGN	5		PGN

Adapt connector type and connections according to the peripheral.

3.6.5 Serial interface no. 1 as RS 485

Serial interface no. 1 can be assigned as RS 485 by using the SASI instruction as follows:

- MODE: MC4 or
- MODE: SS1, SM1, SS0, SM0 (S-BUS)

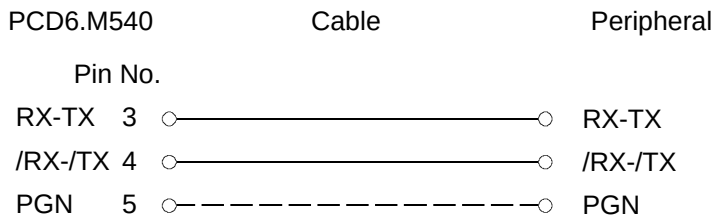
Details on these operating modes can be found in the "Reference Guide" and the "Communications Manual".

The following pins only are used for RS 485:

Pin No.	Function	Meaning
3	RX- TX	Data
4	/RX-/TX	/Data
5	PGN	Protective Ground

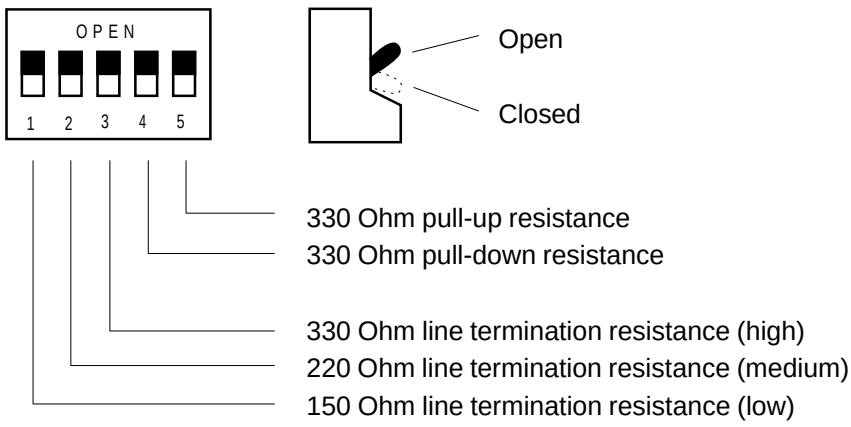
Signal levels are the same as for RS 422.

Example of RS485 connection (point-point)



A point-point connection also requires pull-up and pull-down resistors to be connected to the line. If the lines are long, termination resistors are also needed. This is done using the 5-way DIL switches, as follows:

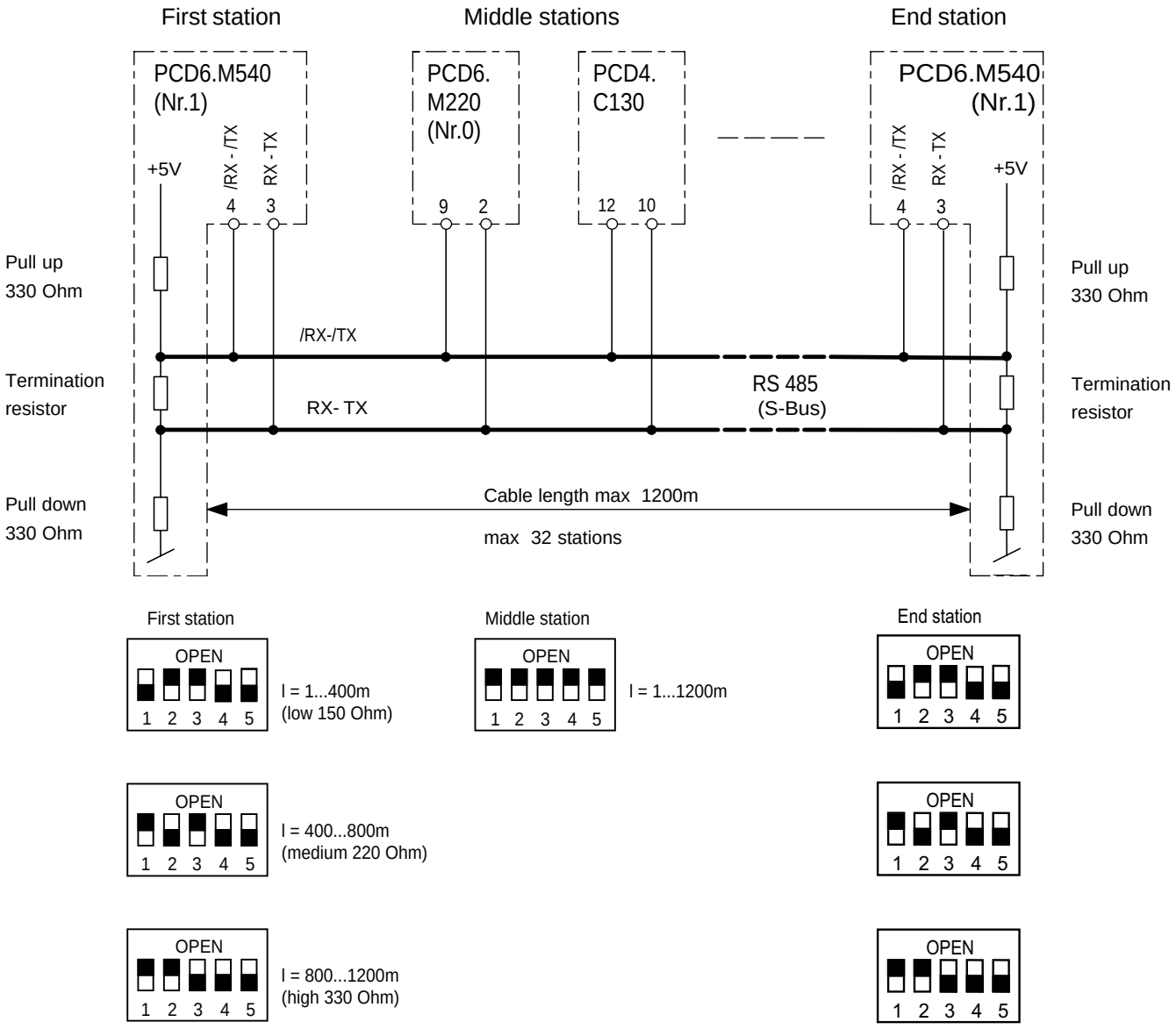
DIL switches on the single processor module PCD6.M540



The factory setting for all switches is OPEN.

Setting the pull-up, pull-down and line termination resistors for RS 485

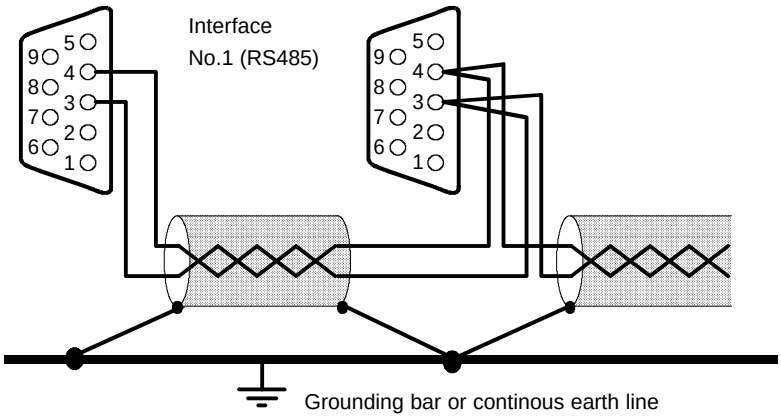
To suppress interference and avoid reflections, every processor module contains damping resistors, which should be connected in accordance with the following diagram. Branch cables should not exceed 0.5 m.
Resistances are set with the 5-way DIL switches, as shown in the diagram below.



The factory setting for all switches is OPEN.

Switching on the DIL switches selects the above resistances and includes them in the network. The details given on cable length are for guidance only. In an actual installation, the line termination resistances would be set accordingly.

Connecting and routing an RS 485 line



When preparing the bus cable, make sure that the data lines are not mixed up - always tie "RX - TX" to "RX - TX" and "/RX - /TX" to "/RX - /TX". In addition verify that the bus cable also remains permanently connected if one or two connectors are unplugged.

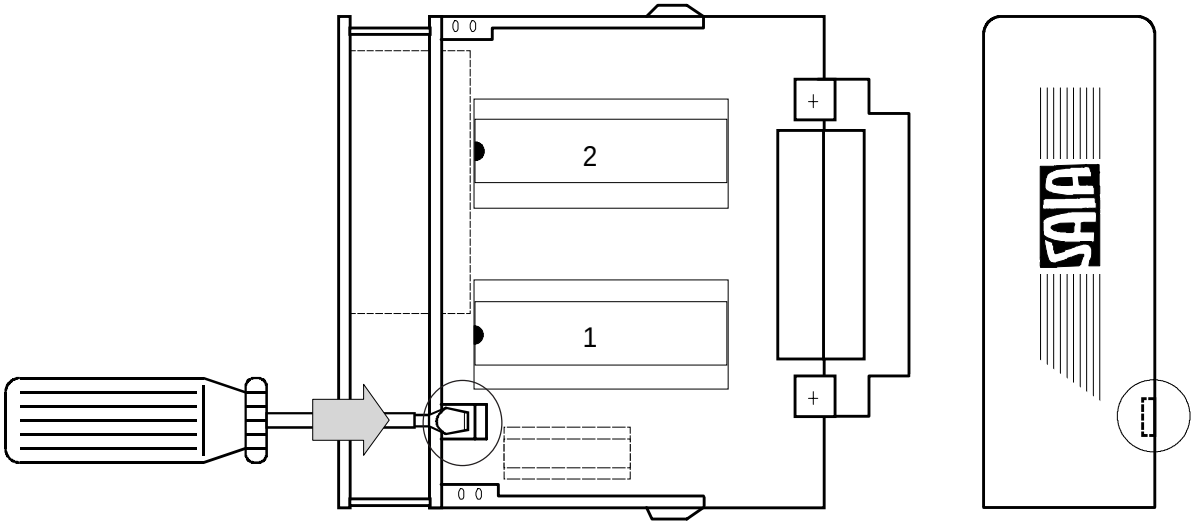
Use male, 9-pole D-Sub connectors with fastening screws for bus cable connection. Use a screened twisted pair of min. 0.5 mm^2 for the cable.

The bus cable shielding should be fully connected at **both ends** to the grounding bar or continous earth line. This reduces the potential difference between stations to a minimum.

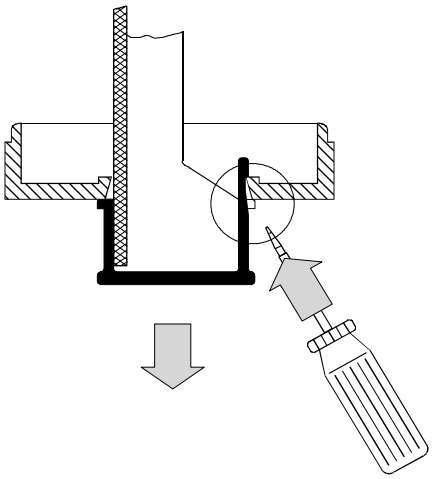
In addition, it is recommanded that the buscable should not be laid directly beside motor cables with heavy interference, unless they have also been shielded.

3.7 PCD7.R.. memory modules

The memory module has a central function within the system. It contains the user programs, texts and data blocs, with their memory map, all flags, registers, timers, counters and the hardware clock. The memory module is inserted in the recess provided in the front panel processor module.



The memory module is provided with a security clip to prevent it from falling out during transportation and heavy vibrations. To remove the module, a screwdriver No.1 or 2 is needed. The screwdriver must be inserted and the memory module simultaneously removed.



3.7.1 Specifications

User memory
For program, text and data blocs
PCD7.R..: max. 256K bytes
PCD7.R310: max. 428K bytes

Flags
8192 x 1 bit flags
The division of non-volatile and volatile flags is done by the DEFVM instruction.

Registers
4096 x 32 bit registers
All registers are always non-volatile

Data formats
The standard format is decimal.
Range: -2147483648 ... +2147483647
-2^{31} ... $+2^{31}-1$
These alternative formats are supported:
Binary: 31 bits with +/- sign
Hexadecimal: 0 ... FFFFFFFF
BCD: 0 ... 1999999999
Floating Point:
$9.223371*10^{18}$ ... $5.421011*10^{-20}$
$-9.223371*10^{18}$... $-2.710506*10^{-20}$

Timers/Counters
1600 x 31 bits
The division between timers and counters is done by the DEFTC instruction. No more than 450 timers should be defined.

All counters are non-volatile.
All timers are volatile.

Data formats
As for registers, but positive values only and without floating point.

Timebase for timers
1/100s ... 10s. The timebase is defined with the DEFTB instruction.

Hardware clock	Week, day of week, year, month, date, day, hour, minute, second
Precision	Better than 15s/month at Ta = 15 ... 30°C
Battery power reserve	2 months (see next chapter)
Power consumption (5V bus)	all memory modules 140 mA each

3.7.2 The battery

The rechargeable NiCd battery prevents loss of data when the controller is switched off (user program and text on RAM, registers, counters and non-volatile flags, history log) and also powers the hardware clock.

The "Batt" LED on the front panel of the processor module shows the battery state (PCD6 powered on):

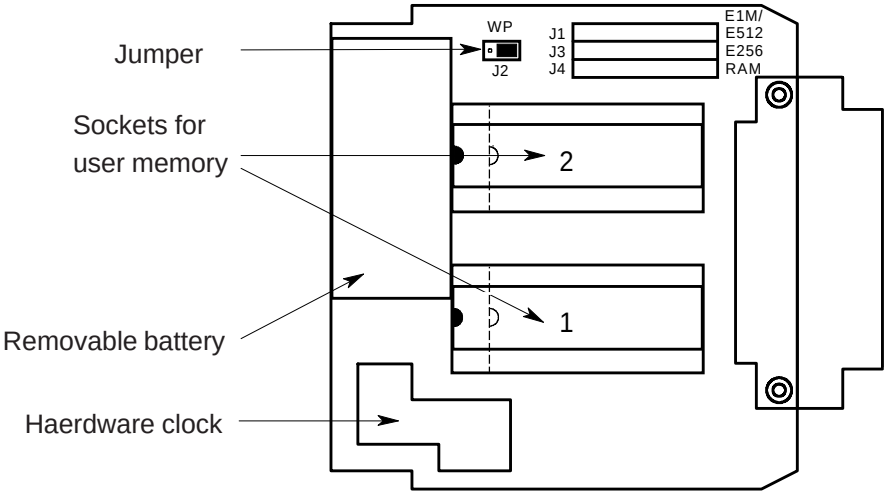
LED Batt	=	off	:	Battery ok.
LED Batt	=	on (red)	:	Battery low

The battery is located on the memory module. The battery change due date is written on a label on the memory module's handle. To change the battery, pull out the memory module, and undo the two screws which connect the module's handle to the printed circuit board. Before replacing the battery, the date in memory (registers, counters, flags etc.) can be saved using the programming tools, then restored after the new battery has been inserted and has been in use for short time.

Data:	- Fully charged battery power reserve in unpowered memory module	2 months
	- Battery charge-up time	15 hours
	- Life expectancy	5 years
	- Nominal voltage	2.4 V
Item number		4 507 1360 0

3.7.3 PCD7.R.. with 256K bytes of user memory

Layout



Type summary

Three different modules are available:

- PCD7.R110 for EPROM with hardware clock
- PCD7.R210 fitted with 64K bytes RAM * with hardware clock
- PCD7.R220 fitted with 256K bytes RAM * with hardware clock

The following can be used as EPROM:

° Type 27C256-15 , Item number 4'502'5327'0
fitted with 2 EPROMs resulting in 64K bytes user memory
(insert EPROMs aligned to the right)

° Type 27C512-15 , Item number 4'502'3958 '0
fitted with 2 EPROMs resulting in 128K bytes user memory
(insert EPROMs aligned to the right)

° Type 27C1001-10 , Item number 4'502'7126 '0
fitted with 2 EPROMs resulting in 256K bytes user memory

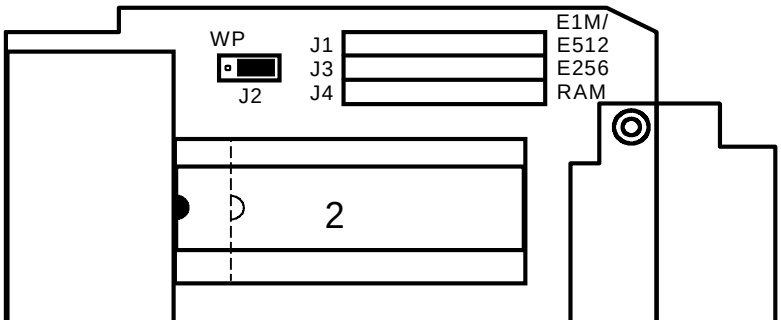
NOTE: A 256K byte user memory can store the following data:

- 64K of program lines at 32 bits each, or
- 64K of data at 32 bits each in data blocks, or
- 256K of text characters at 8 bits each

Up to the max. capacity of 256K bytes, on the same memory, any combination of program, text and datablocks is possible.

*) SAIA will not accept any claims about loss of data unless the original RAM memory equipped by SAIA is used.

Setting the jumpers



Insertion of jumpers allows the following memory chips to be fitted:

Memory	Jumper position (large jumper block)	Resultant memory size in PCD6.M540
EPROM	J3 : 2 x 27C256-20 EPROM's	64 K bytes [1]
	J1 : 2 x 27C512-20 EPROM's	128 K bytes
	J1 : 2 x 27C1001-15 EPROM's	256 K bytes
RAM (factory fitted)	J4 : 2 x 256 K bit RAM	64 K bytes
	J4 : 2 x 1M bit RAM	256 K bytes

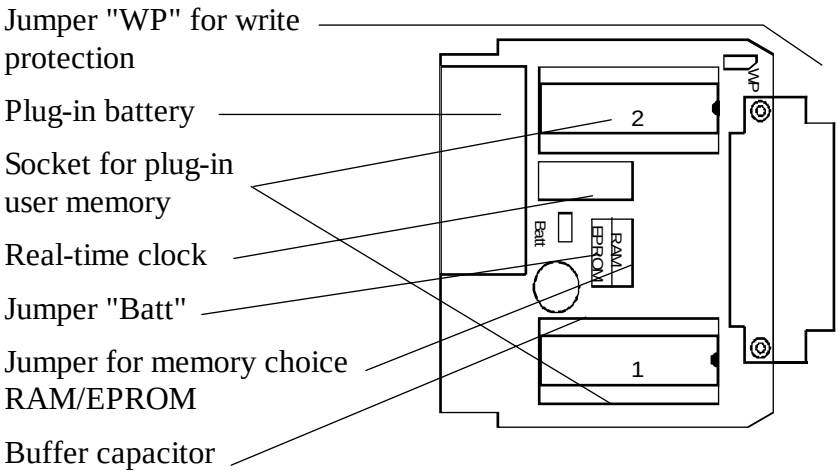
1) In the models for EPROM (type ..R110) the factory setting for the jumper is position J3

The **single jumper J2** is for write protection when RAM memory is used.

Position WP : Write Protected

The factory setting is "not write protected".

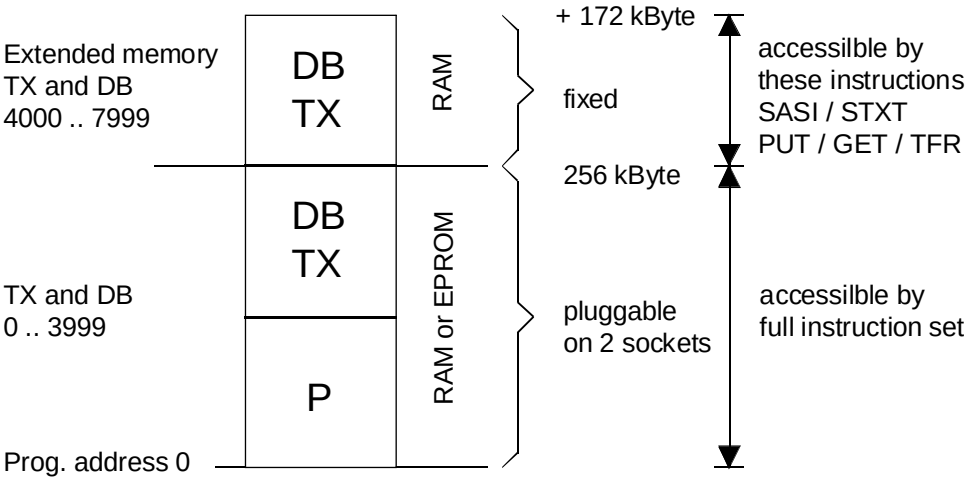
3.7.4 PCD7.R3.. with user memory up to 428 KBytes



Type summary

- PCD7.R310 without user program, with hardware clock (RTC)

Division of memory



Equipment and jumper positions

Memory	Type	Order number	Jumper positions	Results in PCD memory *)
EPROM	27C512-10 27C1001-10 **)	4 502 3958 0 4 502 7126 0	EPROM : 2 x 512 KBit 2 x 1 MBit	128 KByte 256 KByte
RAM	62256LP-10 TC551001BPL-10	4 502 5414 0 4 502 7013 0	RAM : 2 x 256 KBit 2 x 1 MBit	64 KByte 256 KByte

*) additional 172 KByte RAM for TX and DB

**) Fujitsu MBM 27C1001-10
Nippon Electric UPC1001D-10
Toshiba TC571000D-10

By the enlargement if fixed RAM memory, the capacity of the R3 module can be increased to 428 KBytes. For example, it is possible to insert 2 EPROMs in the 2 sockets producing a total of 256 KBytes for fixed programs, texts and data blocks. Read/write data blocks and texts are stored in the additional 172 KBytes of RAM. In this way, the 172 KBytes can be used to store approx. 40 K of 32-bit registers, transferable as required to CPU registers R 0... R 4095 with the PUT, GET and TFR instructions.

Note :

- 1 element of 1 data block in address range 0... 3999 uses 8 bytes
- 1 element of 1 data block in address range 4000... 7999 uses 4 bytes

The **small jumper "+5V/BATT"** can be used to disconnect the real-time clock from the battery. This results in longer data protection. However, in this operating mode the clock will only run when the PCD is powered up :

- Jumper at "BATT" setting : clock runs from battery *) (running always)
- Jumper at "+5V" setting : clock disconnected from battery

*) Factory setting of jumper

With RAM, **the small "WP" jumper** can be used to protect memory from being overwritten :

- Jumper "WP" in position "WP": write protected

Standard factory setting : not write protected.

If the memory is fitted with EPROMS, the "WP" jumper is not significant.

Changing the battery

There are 2 different ways of replacing the battery without loss of data, depending on circumstances :

a) Changing the battery while the PCD4 is running (live) :
To lift off the plastic handle only (not the board), a screw is removed from the side. Lift off the handle and take out battery from the side of the socket. Insert new battery and screw down handle.

b) Changing the battery when memory module has been taken out :
Remove plastic handle in the same way and change the battery. A buffer capacitor protects data for at least 30 sec. when the battery is exchanged.

Mechanics

The memory module PCD7.R3 is longer compared to the previous types by 3 mm, what would hardly be disturbing in the case of the PCD6.M540, since the two finger guard rails of the rack in any case further protrude. (With a PCD4 these 3 mm are to be taken into account for installation in a enclosure).

Compatibility

The PCD7.R3 modules' expanded memory capacity can be utilized by all firmware and Programming Utilities versions starting from the following :

- PCD6.M540 (HW version "C") : Firmware V002

- PCD Programming Utilities : Software V1.7

The new PCD7.R3 memory modules can also be used with older CPUS. However, memory expansion above 256K Bytes cannot be utilized in this case.

Almost all older user programs will run with the PCD7.R3.

Notes :

4. Processor modules PCD6.M100 and M2x0 *)

The **PCD6.M100** is the processor module for fast bit and word processing. The instruction set allows bit and word processing, whole-number and floating-point arithmetics as well as PID-control. Other features include self-diagnosis and programmable diagnosis with the aid of up to 32 system interrupts (XOB).

The **PCD6.M2x0** is the processor module which performs communication tasks. An effizient instruction set allows using four types of interfaces RS 232c, RS 422/RS 485 or 20 mA current loop. They can operate independently of each other at a transmission speed of up to 19200 bauds.

This processor module contains the entire instruction set of the processor module PCD6.M100 in addition to the communication instruction set. Consequently, user programs can also be processed involving bit and word processing, whole-number and floating-point arithmetics as well as PID-control. This processor module is totally independent, i.e. communication tasks as well as control and monitoring tasks can be performed simultaneously. If more than four interfaces are required, up to seven PCD6.M2x0 can be employed in a multiprocessor system.

In addition, it features self-diagnosis and programmable diagnosis using up to 32 system interrupts (XOB).

Communication interfaces

The wide range of communication processor modules includes various interfaces and combinations of interfaces which allow solving the common communication problems. The following versions are available :

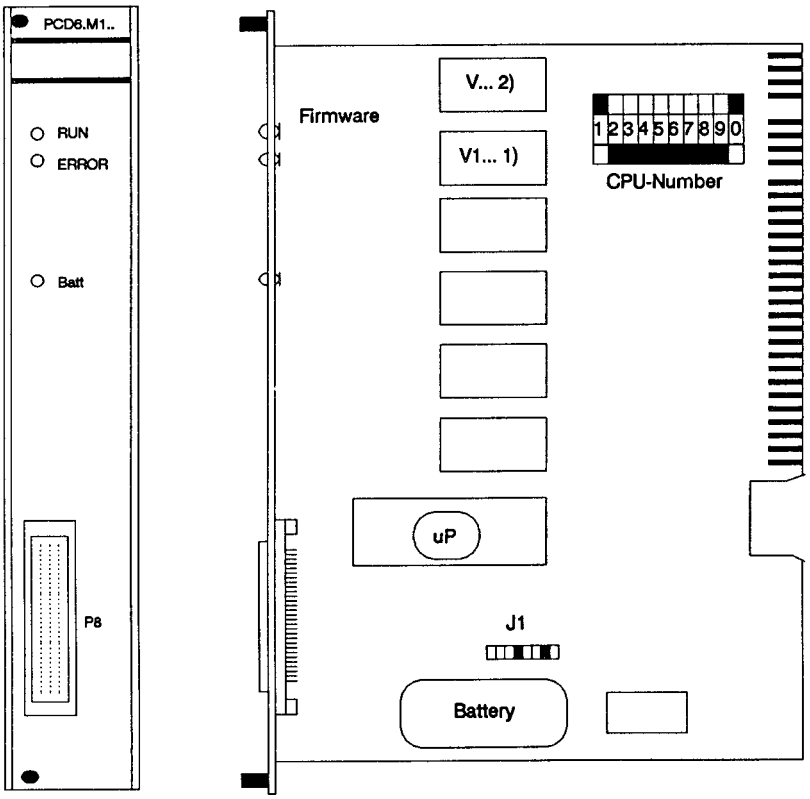
PCD6.M210	4 x RS 232c	up to 19200 bauds	
PCD6.M220	1 x RS 422/485	up to 19200 bauds	channel 0 [2)]
	1 x RS 422	up to 19200 bauds	channel 1
	2 x RS 232c	up to 19200 bauds	channels 2 & 3
PCD6.M230	2 x 20 mA CL	up to 9600 bauds [1)]	channels 0 & 1
	2 x RS 232c	up to 19200 bauds	channels 2 & 3
PCD6.M250	4 x 20 mA CL	up to 9600 bauds [1)]	
PCD6.M260	4 x RS 422/485	up to 38400 bauds	for S-Bus

1) Special version up to 19200 bauds for 20 mA current loop can be delivered on demand

2) S-Bus up to 38400 bauds (dependent of the firmware version)

*) These processors modules are not any more available, they have been replaced by the processor module PCD6.M300 (see chapter 5)

4.1 Front panel and structure of the PCD6.M100



CPU number : DIL-switch for CPU number

Firmware : 2 EPROMs with system program

V... = number of firmware version

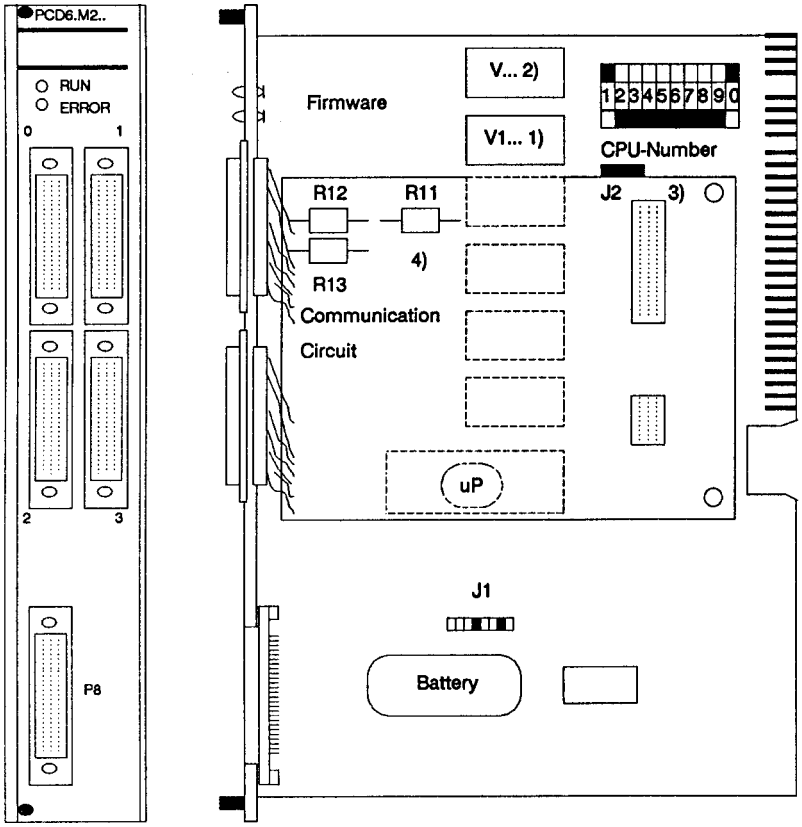
µP : microprocessor 68000

P8 : connector for connecting programmimg unit

J1 : jumper (not for user)

Battery : buffered battery (NiCd for history file)

4.2 Front panel and structure of the PCD6.M2x0



CPU number : DIL-switch for CPU number

Firmware : 2 EPROMs with system program

V... = number of firmware version

Interface connectors 0... 3 : D-Sub connector, female, 25-pole

µP : microprocessor 68000

P8 : connector for connecting programmimg unit

J1 : jumper (not for user)

J2 : see text below

Battery : buffered battery (NiCd for history file)

Communication circuit : additional pc-board with interface driver

Type PCD6.M220 3) Jumper J2 was intended to change communication **channel 0** from RS 422 to RS 485. However, J2 is ineffectual, as the type of interface for channel 0 is determined by the software with the SASI assignment. RS 485 is set for channel 0 with the following assignment :

- Mode MC4 (individual character)
- Mode SS1 or SM1 (S-Bus)

Type PCD6.M220 4) The terminating resistor (R13 = 150 Ω) and the two pull-up/pull-down resistors (R11 = R12 = 330 Ω) are soldered here as of version A (ex-works: Spring 1992). These resistors are only to be left on the initial and terminating stations of an RS 485 bus. All three resistors are to be removed with cutting pliers on all intermediate stations (see chap 4.9.4)

Type PCD6.M260 5) With the jumpers at CH0... CH3 it is possible to switch the line termination resistors and pull-up/pull-down resistors into the closed position or the open position. Termination takes place only at the first or last station on an RS 485 bus. For all intermediate stations, and in RS 422 operation, the jumpers should be left in the open position. If one of the 4-pole jumpers in the array of connectors is inserted nearer to the printed circuit board, the position is closed. Otherwise, the position is selected as open. **Factory setting is open**.

For more informations, consult the manual "Installation components for RS 485 networks"

4.3 Characteristic data of the processor M100 and M2x0

PCD6.M100

µP		16-bit microprocessor 68000
Number of instructions		more than 100, with four different addressing modes
Execution time :		
Bit processing	e.g. : `ANH I 0`	= 5.4 µs

Word processing (32 bits)	e.g. : `ADD R 0`
	`R 1`
	`R 2`
		= 31 µs

PCD6.M2x0

µP	16-bit microprocessor 68000
Number of instructions	like processor module PCD6.M100 + additional instructions for communication
Number of interfaces which are independent of each other	4 (assign only as many interfaces as actually required for the following reasons)
Baud rates (individually selectable for each interface)	38400, 19200, 9600, 4800, 2400, 1200, 600, 300, 150, 110 bauds

Execution time (processing speed)

As this processor module gives communication processes priority treatment, the processing speed of the bit and word commands is reduced in comparison with the processor module PCD6.M100 depending on the number of assigned interfaces and on the density of data transferred via each interface.

An average reduction to approx. 80% is assumed (to 90% without an active interface; down to 40%, if all four interfaces are assigned and data is permanently transferred on all 4 interfaces).

Execution time :

Bit processing	e.g. : `ANH I 0`	= 6... 10 µs

Word processing (32 bits)	e.g. : `ADD R 0`
	`R 1`
	`R 2`
		= 35... 60 µs

4.4 Common data of the processor M100 and M2x0

µP	16-bit microprocessor 68000
Number of addressable inputs and outputs	8192 per system
Number of cyclic organization blocks (COB)	16
Number of index registers (13 bits)	17 (one per COB + 1 for all XOB)
Number of exception organization blocks (XOB)	up to 32
Number of program blocks (PB) [1)]	300
Number of parameterizable function blocks (FB) [1)]	1000
Number of sequential blocks (SB) (for GRAFTEC)	32
Number of GRAFTEC steps	2000 steps and 2000 transitions
Number of texts resp. data blocks (for text output via serial interfaces and for the SAIA® LAN2)	4000 + 4000 (per processor)
Power consumption (internal from 5 V-bus)	M100 : 600 mA M2x0 : 830 mA

All user memories (programs, texts, data blocks, flags, registers, counter and timer registers, etc.) and the hardware date-time are resident on the public memory module PCD6.R1../R2.. For detailed information refer to the documentation of the public memory module.

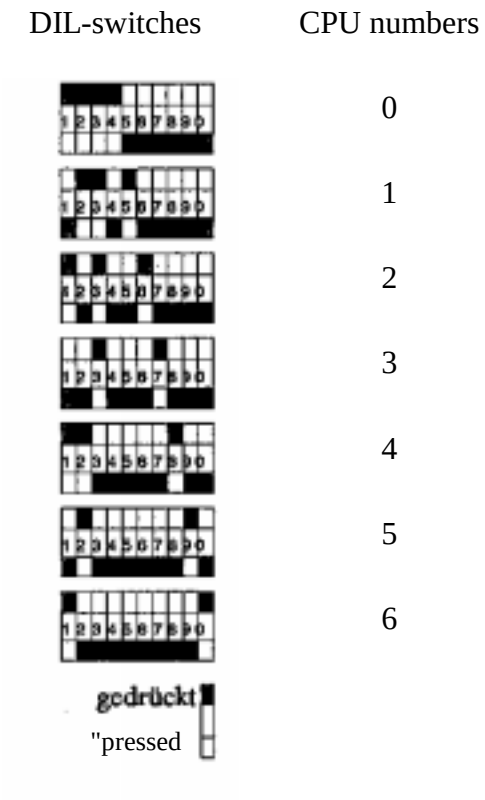
[1)] PB and FB may be nested down ihrough 7 levels separately or mixed as desired.

4.5 CPU numbering

The CPU number (= processor module address) is used to distinguish the processor modules in a multiprocessor system. The selected CPU number determines the priority of access to the bus. A decrease in priority results in an increase in execution time. Number 0 has the highest and number 6 the lowest prioritiy, i.e. CPU 0 operates at virtually unreduced speed. The execution time is hardly increased with 4 and less processor modules in the same system.

A few rules for numbering CPUs :

- Only the numbers 0 to 6 are admissible.
- At least one CPU must be assigned the number 0.
- A number must not be assigned to more than one CPU.
- CPUs for fast control tasks are assigned the numbers 0 to 3, which results in short and constant response times.
- CPUs for slow functions such as mathematic operations, data acquisition, logging, control, communication, etc. are assigned the higher numbers 4 to 6.
- The SAIA® LAN2 processor module PCD6.T1.. always uses CPU number 6.



4.6 Operating states of the processor modules

The processor module operates in the following states :

START, HALT, RUN, CONDITIONAL RUN and STOP.

These states are displayed by LEDs on the front panel of each processor module PCD6.M100 and M2x0 :

RUN	Yellow LED	
ERROR	Yellow LED	
BATT	Red/Green LED	(only PCD6.M100)

State	LED	Meaning
START	RUN on ERROR on	Self-diagnosis takes approx. 1 sec on starting or restarting (lamp test).
RUN	RUN on ERROR off	Normal execution of the user program after START if no PGU is connected.
COND.RUN	RUN blinks ERROR off	Conditional RUN mode. A condition was set in the debugger (RUN until...), which has not been fulfilled yet.
STOP	RUN off ERROR off	If PCD is switched on, the PGU is connected and run in the debugger : - CPU has not been started, - CPU was stopped by PGU, - the condition is fulfilled after a CONDITIONAL RUN.
HALT	RUN off ERROR on	Fatal error in the user program, hardware error or HALT instruction executed.
RUN or COND.RUN ERROR	RUN on or blinks ERROR on	Self-diagnosis was activated during program execution. The corresponding XOB, however, was not programmed.
(only M100)	BATT on	see chapter 4.8 "Battery"

On the one hand, the public memory module PCD6.R110 or..R210 can influence the operating states of the processor modules and, on the other hand, react in response to certain operating states (e.g. resetting of all outputs in case of errors). For detailed information refer to the documentation of the public memory modules.

4.7 Firmware

The firmware (system program) is resident in 2 EPROMs of the type 27C512 (access time ≤ 200 ns). These two EPROMs are numbered "l" and "2" and labelled with the firmware version V... e.g. :

PCD6.Ml.. V009/1	PCD6.Ml.. V009/2

or

PCD6.M2.. V009/1	PCD6.M2.. V009/2

The firmware is subject to change (upwards-compatibility is ensured).

Caution : When using more than one processor in the same rack system take care that all the firmware **must have** the same version number.

Remarks : Since beginning of 1998, the PCD6.M300 is the new standard processor module for the PCD6 series.
A compatibility table for firmware mix between PCD6.M1/M2 and PCD6.M3 is located in the next chapter "PCD6.M300" in the section 5.5 "Firmware".

4.8 Battery

The rechargeable NiCd battery is only used to save "historical" data (information about irregularities in the CPU : error flag, battery failure, hardware error, etc...).

LED Batt	=	Green	Battery in order	PCD6.M100
LED Batt	=	Red	Battery not in order or not provided (XOB 2 is called)	only

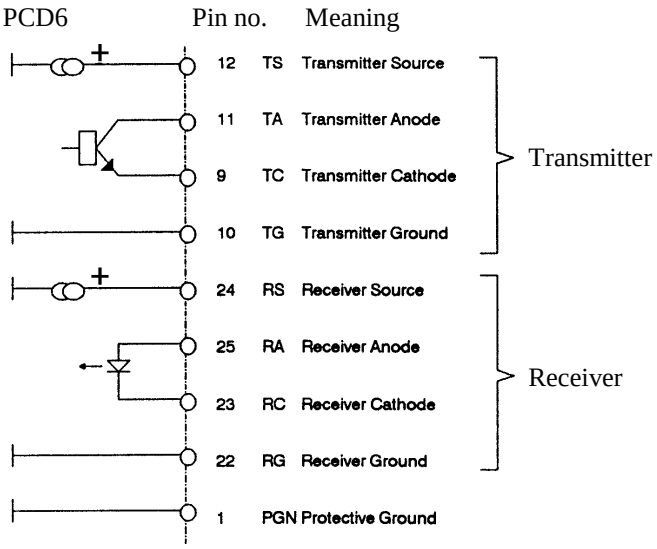
User program and texts on RAM, non-volatile flags, counter, timer and register values are not saved by this battery, but stored in the public memory module.

Information about battery replacement is given on the inside of the front panel.

Data :	Data protection when module is not supplied with power and battery completely charged	2 months
	Turn-on time for complete charging of battery	15 h
	Life expectancy	5 years
	Nominal voltage	2.4 V
Order number :	(for replacement)	4 507 1360 0

4.9 Pin assignment and data of the communication interfaces (25-pole, D-Sub connector, female)

4.9.1 20 mA interface (current loop)

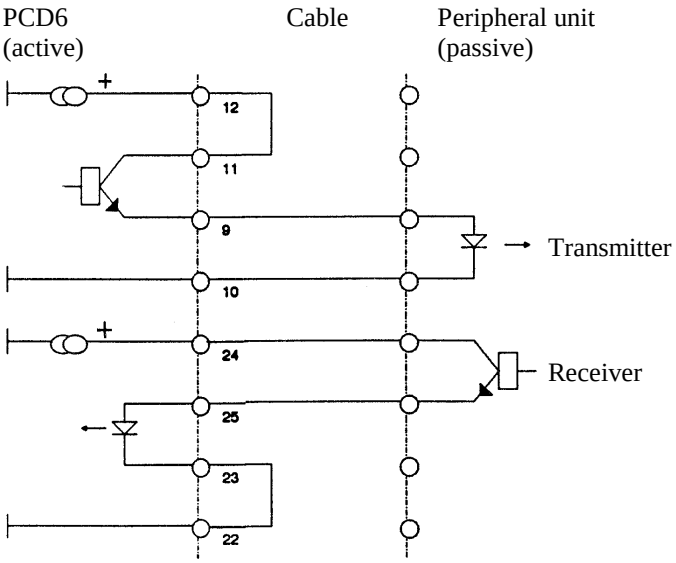


Signal type	Scheduled value	Rated value
Logic L current (space)	–20 mA...+2 mA	0 mA
Logic H current (mark)	+12 mA...+24 mA	+20 mA
Floating voltage at TS, RS	+11.1 V...+14 V	+13 V
Short-circuit current at TS, RS	+18 mA...+29.6 mA	+23.2 mA

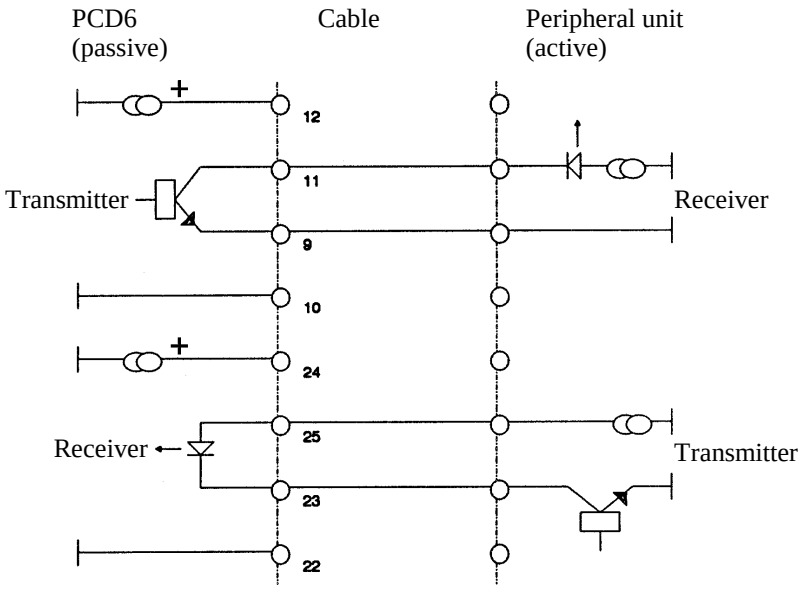
The idle condition of the data signals is ”mark”.

The user selects the circuit type ”active” or ”passive” with the jumpers on the D-Sub connector.

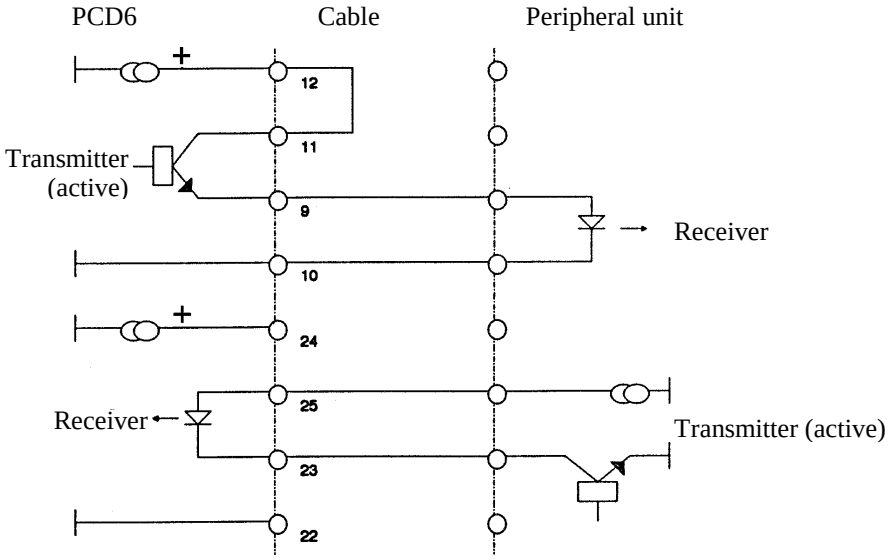
Example a) PCD6 active



Example b) PCD6 passive

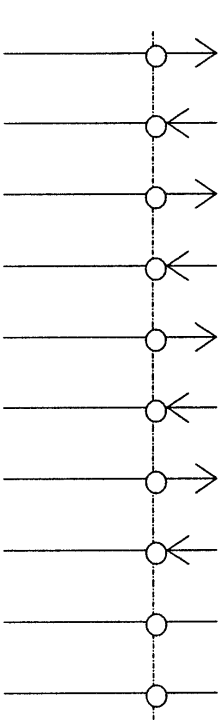


Example c) Transmitter of PCD6 and peripheral unit active



4.9.2 RS 232c interface

The assignment of the female 25-pole D-Sub connector corresponds to that of a DTE (= data terminal equipment).



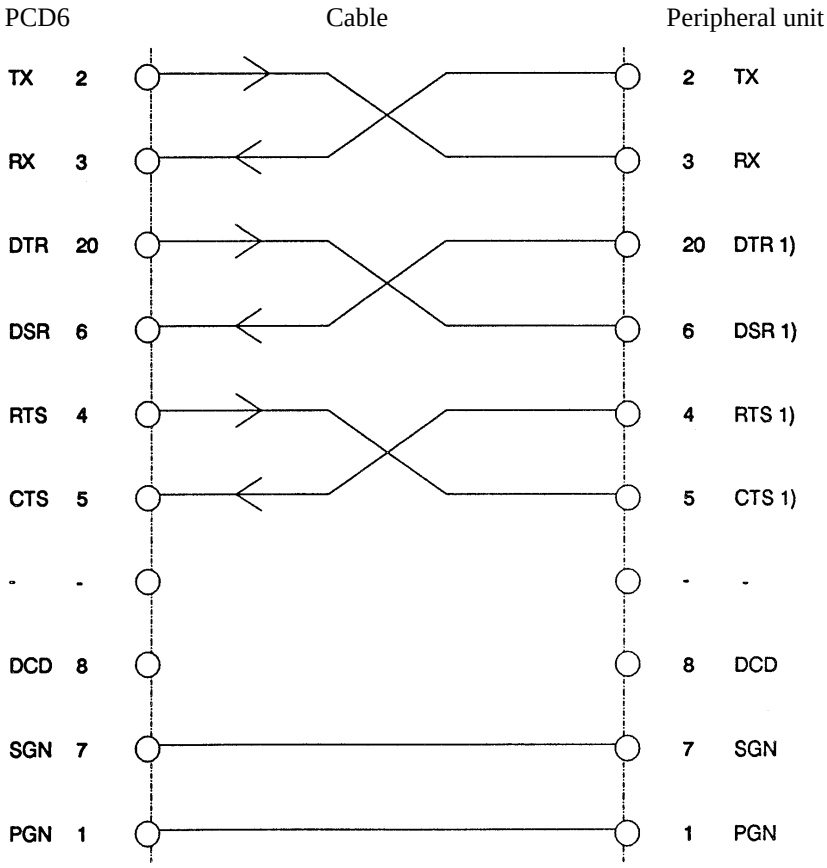
Pin-no.		Meaning	
2	TX	Transmit Data	Transmitted data
3	RX	Receive Data	Received data
20	DTR	Data Terminal Ready	Terminal ready
6	DSR	Data Set Ready	Readiness of operation
4	RTS	Request To Send	Switch on transmitter
5	CTS	Clear To Send	Ready to send
8	DCD	Data Carrier Detect	Received signal level
7	SGN	Signal Ground	Signal ground
1	PGN	Protective Ground	Protective ground

Although the undefined signal is available on the supplementary pc-board, it has no function and it is not wired on the female connector.

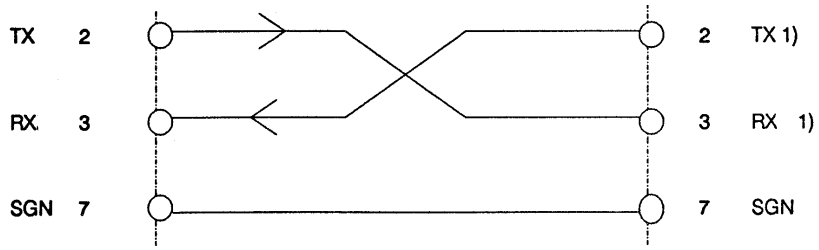
Signal type	**Logic state**	**Scheduled value**	**Rated value**
Data signal	0 (space)	+3 V...+15 V	+7 V
	1 (mark)	–15 V...–3	–7 V
Control/	0 (off)	–15 V...–3 V	–7 V
message signal	1 (on)	+3 V...+15 V	+7 V

The idle condition of the data signals is ”mark” and ”off” for the control and message signals.

Example of connection with all lines wired (standard cable RS 232)



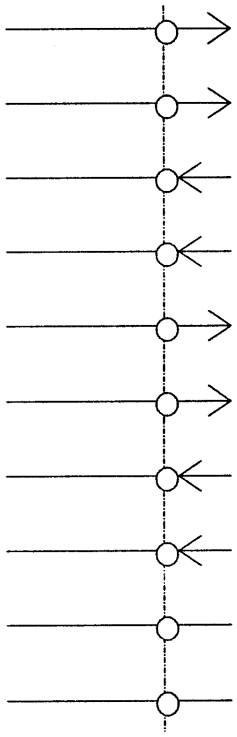
Example of connection for simple applications, e.g. mode MC0 (mode C without control lines)



1) When communicating with terminals, check if certain connections must be provided with jumpers or set to ”H” or ”L” with the command ”SOCL”.

4.9.3 RS 422 interface

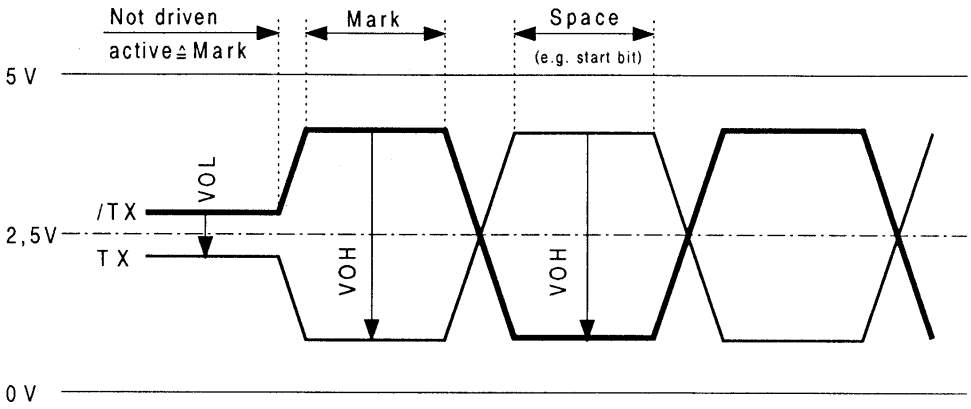
Assignment of the female 25-pole D-Sub connector



Pin no.		Meaning	
2	TX	Transmit Data	Transmitted data
9	/TX		
4	RX	Receive Data	Received data
11	/RX		
3	RTS	Request To Send	Switch on transmitter
10	/RTS		
5	CTS	Clear To Send	Ready to send
12	/CTS		
13	SGN	Signal Ground	Signal ground
1	PGN	Protective Ground	Protective ground

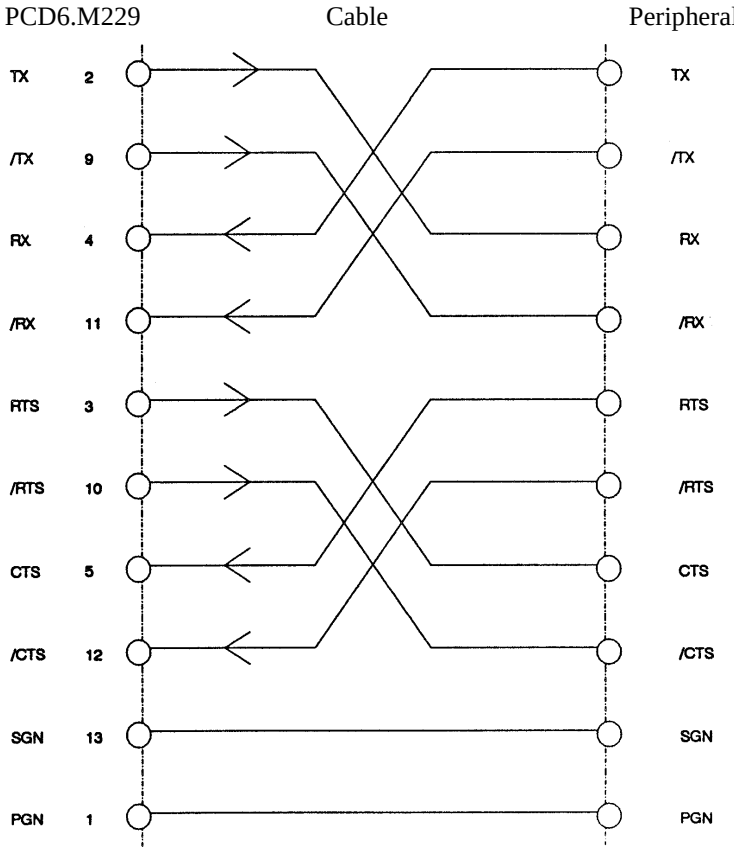
Signal type	Logic state	Polarity
Data signal	0 (space)	TX positive to /TX
	1 (mark)	/TX positive to TX
Control/	0 (off)	/RTS positive to RTS
message signal	1 (on)	RTS positive to /RTS

Signalling sequence /TX to TX



VOH = 2 V min. (with load) ... 5 V max. (without load)
VOL = 0 V min. ... 0.5 V max.

Example of connection for a peripheral unit (RS 422)



Type of connector and pin assignment must be accommodate to the peripheral unit.

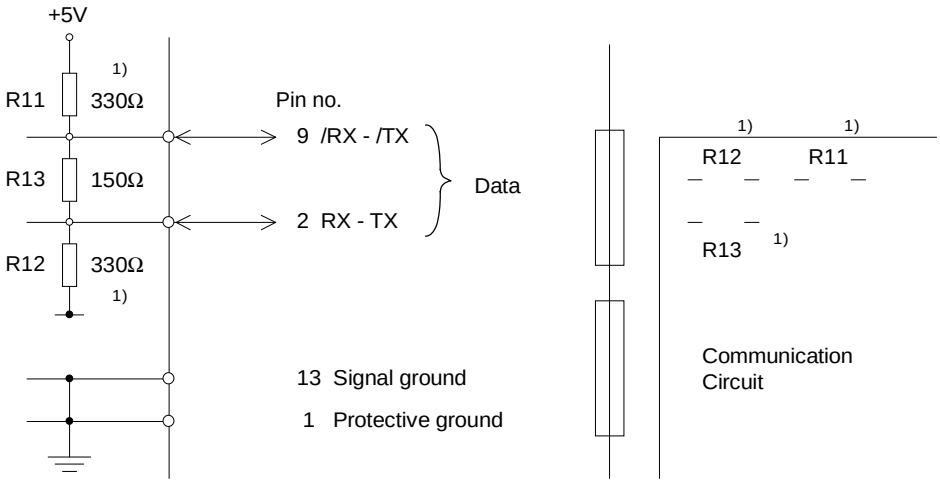
4.9.4 RS 485 bus interface for module ..M220, channel 0, or ..M260, channel 0 to 3

The following assignement will define the interface as RS485 using the SASI instruction (only interface 0 on ..M220)

- MODE: MC4 or
- MODE: SS1, SM1 (S-Bus)

Details see "Reference Guide" or S-Bus manual.

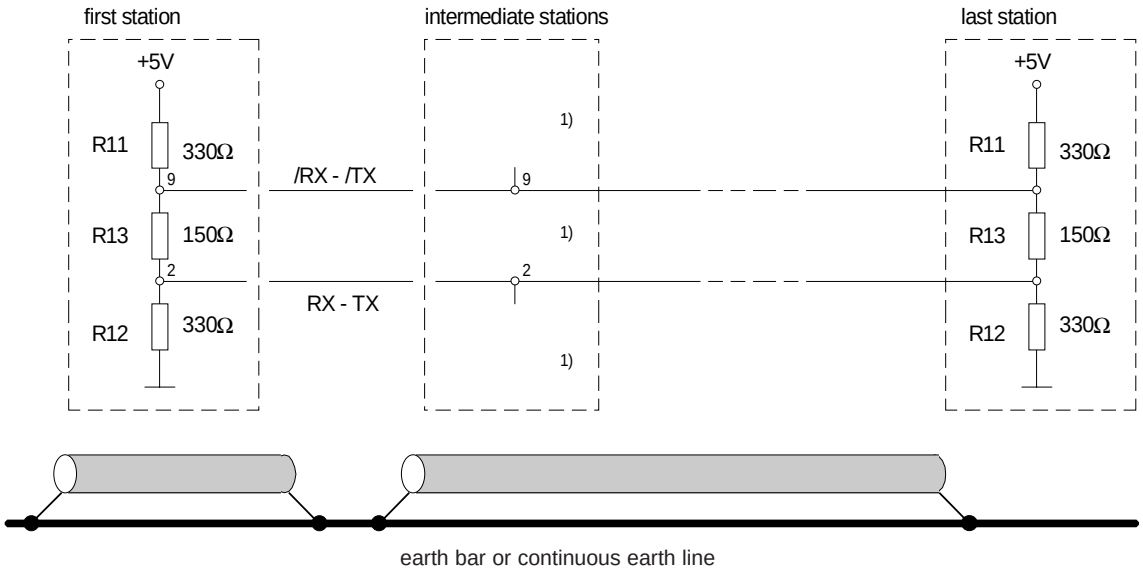
The following pins only are used for RS485:



The signal levels are VOH = 3...4.2 V
VOL = 0.8...1.5 V

Connection and placement of bus lines

Cable: Stranded cable of min. 0,5 mm^2, 2-core, twisted and shielded. Segment length for 32 stations is max. 1200m.



1) Resistors R11, R12 and R13 should be removed from all intermediate stations (see also chapter 4.2).
See also the manual "Installation components for RS485 networks".

5. Processor module PCD6.M300

PCD6.M300 is the new standard processor module for the PCD6 series. Compared with the earlier M100 and M2x0 CPUs, the M300 differs in the following main points :

- Direct programming interface for S-Bus protocol, without the PCD8.P800 interface processor.
- 4 serial ports, user-configured by inserting interface modules
- Connection to PROFIBUS FMS or DP
- 9-pole, D-type connectors for all interfaces
- 2 interrupt inputs
- Processing speed 3 times faster
- EEPROM for storage of some settings

The PCD6.M300 processor module will run with the earlier M100 and M2x0 CPUs in the same rack. However, to do this the M100 and M2x0 CPUs must be provided with special firmware.

In addition to its powerful communications capabilities, the instruction set allows bit and word processing, integer and floating point calculation, plus PID control. The processor module is completely autonomous, i.e. communications tasks can be managed simultaneously with control and monitoring tasks. If more than 4 interfaces are required, it is possible to integrate up to six PCD6.M300 in one multiprocessor system.

Other features include self-diagnosis and programmable error handling with the help of up to 32 system interrupts (XOB).

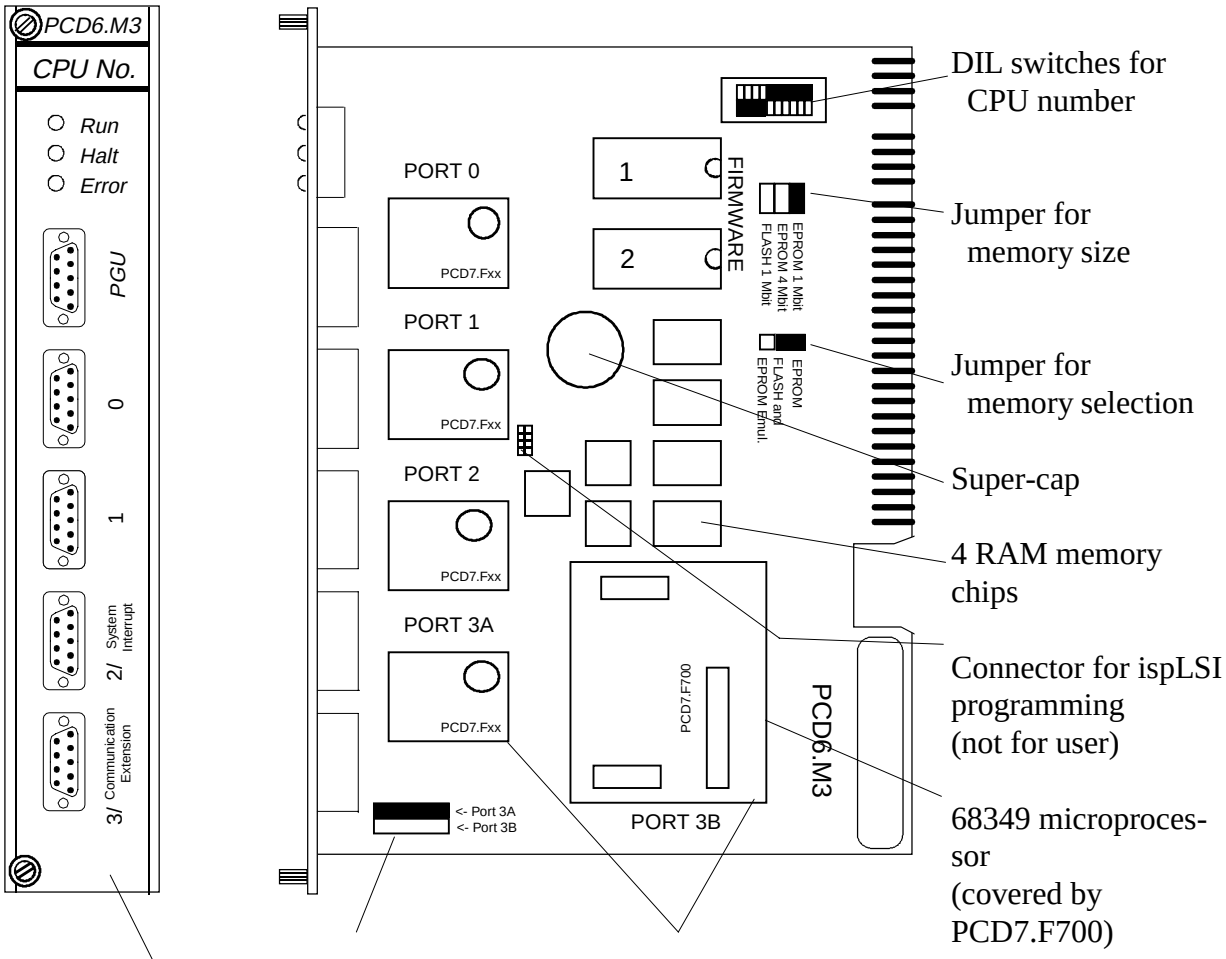
Restrictions :

- Maximum 6 CPUs can be used per rack system (numbering between 0 and 6 is retained).
- Instructions DEFTR and SYSCMP cannot be used.

Remarks :

- The "Reset Outputs" mechanism on download only works if a new M3 CPU is used as CPU 0.
- The new PID algorithm is used by default. It is possible to select between the old and the new with SYSWR.
- The PCD8.P100 service unit cannot be used (S-Bus protocol is used for the PGU port)
- When interrupt inputs are in use serial port no. 2 cannot be used.

5.1 Front panel and structure



Jumper for port 3A or 3B

Interface module for port 3, selectable as PROFIBUS (port 3B) or standard (port 3A)

The front panel contains :

- strip label for CPU number
- 3 LEDs "RUN" yellow
  "HALT" red
  "ERROR" red
- PGU port no. 4
- Port numbers 0, 1, 2 and 3

All ports are on screw-fastened, 9-pole, D type, female connectors.

5.2 Characteristic data

Microprocessor	Motorola 68349 FT-25
Number of instructions	more than 100, with four different addressing methods
Execution time : Bit processing	2 .. 5 µs [1]
Word processing	10 .. 20 µs [1]
Number of addressable inputs and outputs	8192 per system
Number of cyclic organization blocks (COB)	16
Number of index registers (13 bit)	17 (1 each per COB + 1 for all XOB)
Number of exception organization blocks (XOB)	max. 32
Number of program blocks (PB) [2]	300
Number of parameter setting function blocks (FB) [2]	1000
Number of sequential blocks (SB) (for GRAFTEC)	32
Number of GRAFTEC steps	2000 steps and 2000 transitions
Number of text and data blocks (DB)	4000 + 4000 (per processor)
5 V current consumption (from PCD6 bus)	approx. 600 mA, without interface modules

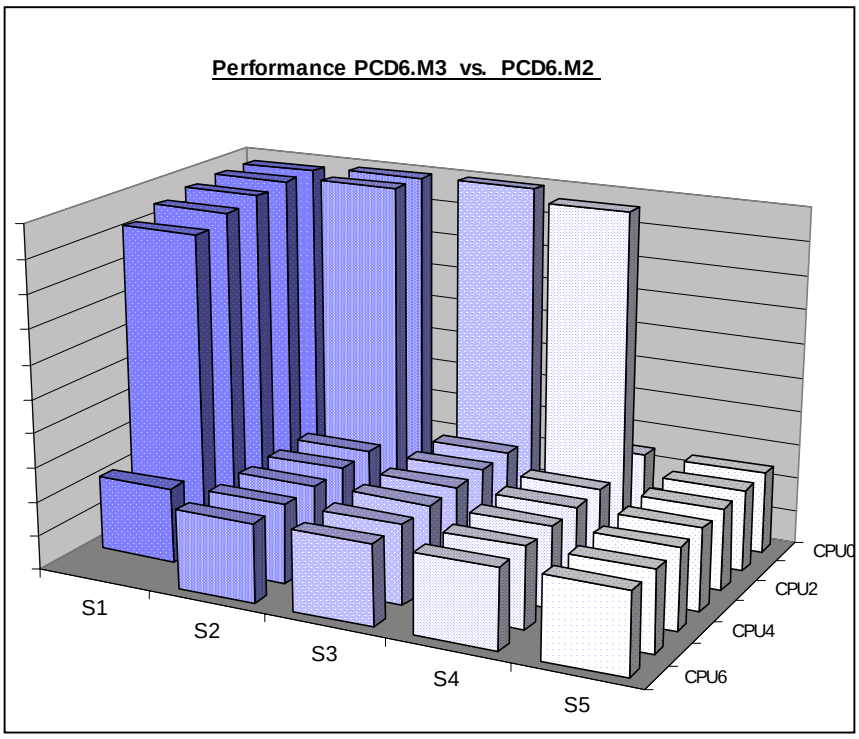
All user memory (programs, text, data blocks, flags, registers, counters, timers, etc.) and the real-time clock are located in the public memory module PCD6.R1../R2... Information can be obtained from the chapter on public memory modules.

[1] Depending on communications workload of the serial interfaces.
[2] PBs and FBs can be combined at will and nested in up to 7 levels.

Instead of a battery, the CPU PCD6.M300 has a maintenance-free super-cap (large capacitor). It enables the history list to be retained for approx. 8 days. (The M100 and M2x0 CPUs were equipped with batteries).

Storage of history data	by means of super-cap
History list retention time	8 days
Super-cap charging time	1 hour

It should be remembered that registers, counters, flags, real-time clock, user program, text and data blocks are on RAM supplied by the battery in the public memory module. When this battery is fully charged, 2 months data protection can be expected (see chapter 7 "Public memory modules").



S1: CPU0…CPU5 = PCD6.M3

S2: CPU0 + CPU1 = PCD6.M3
CPU2…CPU6 = PCD6.M2

S3: CPU0 = PCD6.M3
CPU1…CPU6 = PCD6.M2

S4: CPU1 = PCD6.M3
CPU0 + CPU2…CPU6 = PCD6.M2

S5: CPU0…CPU6 = PCD6.M2

S = System

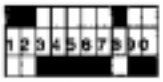
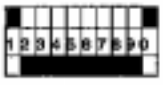
5.3 CPU numbering

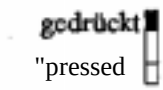
The CPU number (= address of the processor module) serves to differentiate processor modules within a multi-processor system. The choice of CPU number defines the bus access priority. Processing time increases with lower priority. CPU 0 has the highest priority, CPU 6 has the lowest, i.e. the operating speed of CPU 0 is unaffected. With 4 or fewer processor modules in the same system, the slightly longer processing time is hardly noticeable.

Some rules for numbering CPUs :

- The number of CPU in one and same system is 6 maximum
- Only numbers 0 to 6 are permitted
- At least one CPU must be assigned as CPU 0
- Each number may only be assigned to a single CPU
- CPUs for fast control tasks are given numbers 0 to 3, producing reaction times which are short and constant.
- CPUs for slower functions, such as mathematical operations, data capture, logging, regulation, communication, etc., are given the higher numbers 4 to 6.

The SAIA® LAN2 processor module (PCD6.T1..) generally has CPU number 6.

DIL switches	CPU numbers
	0
	1
	2
	3
	4
	5
	6



5.4 Operating states of the processor module

The processor can be in one of the following operating states :
START, RUN, COND. RUN, STOP, HALT, RESET and ERROR.

Indication is by 3 LEDs :

RUN	LED yellow
HALT	LED red
ERROR	LED red

State	LED	Meaning
START	RUN on HALT on ERROR on	Self-check for approx. 1 sec at power-up or after a restart (lamp check)
RUN	RUN on HALT off ERROR off	Normal processing of user program after START, when no PG is connected.
COND. RUN	RUN flashes HALT off ERROR off	Conditional RUN. A breakpoint condition has been set (RUN Until..) with a debugger
STOP	RUN off HALT off ERROR off	The PCD was powered on with a PG connected and running a debugger, this means the CPU has not yet started, or has been stopped by the PG, or the condition required by a COND. RUN has been met.
HALT	RUN off HALT on ERROR off	Serious error in user program, hardware error or HALT instruction executed, or no program has been loaded.
RESET	RUN on HALT on ERROR on	The supply voltage is too low.
RUN or COND. RUN despite ERROR	RUN on or flashing HALT off ERROR on	An error was detected by the user program, but the XOB to handle the error has not been programmed.

5.5 Firmware

The firmware (system program) is located on 2 EPROMs, type 128 kBit * 8 (access time ≤ 100 ns). These two EPROMs are numbered "1" and "2" and bear a code designating the firmware version : V...

PCD6.M3.. V030/1	PCD6.M3.. V030/2

Subject to upwardly compatible firmware modifications.

Caution : Insertion of firmware-EPROMs differs by 180° from the CPUs of the M100 and M2x0 !

If a wrongly inserted EPROM is powered up, it will be destroyed !

When using more than one processor in the same rack system take care that all the firmware **must have** the same version number !

Compatibility table for FW mix between PCD6.M3 and PCD6.M1/M2

PCD6.M3 FW version	PCD6.M1/M2 compatible FW
ß09	$99 or $9A
$0A	$99 or $9A
V001 (first official version)	$9B or $9C
V002	V00A (last official version)
V030	V00A

Remarks : If you don't use one of these combinations, the CPU 0 will announce that you cannot use your PCD6 system.
The message "CPU FIRMWARE MIX" will appear on the CPU 0 and all CPUs will go in HALT status.

5.6 EEPROM configuration memory

The PCD6.M300 includes a small memory providing permanent storage of the settings for the S-BUS, modem connection (max. 250 characters, resp. 232 with S-Bus Gateway) and some production data. To a limited extent, the user also has the possibility of utilizing this memory to write into registers (K 2000 .. K 2049) as well as to write the S-Bus station number K 6000).

The contents of 50 registers (50 x 32 bit) can be read with the command SYSRD or written with SYSWR.

SYSRD	**Kx** or **Rx**	(source)
	Ry	(destination)

Kx = constant 2000 .. 2049 designates EEPROM registers 0 .. 49.
Rx = address of the register containing the above constant
Ry = address of the register in which the read value is stored

SYSWR	**Kx** or **Rx**	(source)
	Ry	(destination)

Kx = constant 2000 .. 2049 designates EEPROM registers 0 .. 49.
Rx = address of the register containing the above constant
Ry = address of the register from which the written value is taken

Please note :

The EEPROM register can be overwritten a maximum of 100,000 times. Therefore, the SYSWR K 20xx and K 6000 instructions should never be contained in program loops. Several EEPROM registers can be read in quick succession.

When writing, it should be noted that the instructions SYSWR K 20xx and K 6000 last approx. **20 ms** and that during this time no other user instructions are processed. For this reason it should not be used in XOB 0 either.

5.7 Communication interfaces

Communication interfaces 1 ... 3 of the PCD6.M300 are configured with plug-on modules. These configurations are possible :

PGU interface (no. 4) :	fixed RS 232 (not modular)	
Interface no. 0 :	PCD7.F110	RS 422/RS 485
	PCD7.F120	RS 232 (suitable for modem)
	PCD7.F130	20 mA current loop
	PCD7.F150	RS 485, galvanically isolated
Interface no. 1 :	PCD7.F110	RS 422/RS 485
	PCD7.F120	RS 232 (suitable for modem)
	PCD7.F130	20 mA current loop
	PCD7.F150	RS 485, galvanically isolated
Interface no. 2 :	PCD7.F110	RS 422/RS 485
	PCD7.F120	RS 232 (suitable for modem)
	PCD7.F130	20 mA current loop
	PCD7.F150	RS 485, galvanically isolated
	Via the PCD7.F110, 2 interrupt inputs run from the front connector to the main circuit board.	
Interface no. 3A :	PCD7.F110	RS 422/RS 485
	PCD7.F120	RS 232 (suitable for modem)
	PCD7.F130	20 mA current loop
	PCD7.F150	RS 485, galvanically isolated
	or	
Interface no. 3B :	PCD7.F700	PROFIBUS-FMS
	PCD7.F750	PROFIBUS-DP Master
	PCD7.F770	PROFIBUS-DP Slave
	additional to equipment with 4-pole jumper, reversible	

The following baud rate combinations are not possible for the PGU port (4) and interface 0 (DUART 1), nor for interfaces 1 and 2 (DUART 2) :

	38.4 KBaud	+	38.4 KBaud
or	38.4 KBaud	+	19.2 KBaud
or	38.4 KBaud	+	150 Baud
or	38.4 KBaud	+	110 Baud

Any attempt to assign a prohibited combination will result in the error flag being set and XOB 13 called.

Interface 3 can be assigned as 38.4 KBaud without restriction.

All interfaces have 9-pole D-type connectors (female) on the front panel. Each plug can be secured with 2 screws.

Interface modules and the pin configurations of 9-pole D-type connectors are shown on the following pages.

5.7.1 Serial PGU port (RS 232)

During the commissioning phase, the programming unit (PG) is connected via this port. Cable type PCD8.K111 should be used for this purpose.

This is an RS 232c type port. Pin configuration is as follows :

Pin no.		Meaning	
3	TX	Transmit Data	
2	RX	Receive Data	
7	RTS	Request To Send	
8	CTS	Clear To Send	
5	SGN	Signal Ground	
4	NC	Not Connected	
6	DSR	PGU Connected	
9	+5V	Supply +5V (P100)	max. 200 mA
1	PGD	Protective Ground	

The signals and logic states are identical to those for the PCD7.F120 interface module, described in section 5.7.3.

Use of the PGU port as general-purpose interface 4 :

To do this, consider the following facts :

- When the PCD6 powers up, the PGU port is automatically configured by the firmware for connection to a programming unit at 9600 Baud.

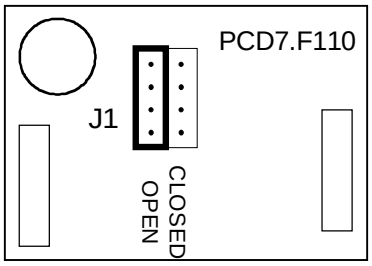
- If any other peripheral device is to be connected, the interface must be assigned by this instruction in the user program :

```
SASI 4      ; 4 = PGU port
     100    ; Any configuration text number
```

- If a programming unit is connected to interface 4 during operation, it automatically reverts back to PGU mode.

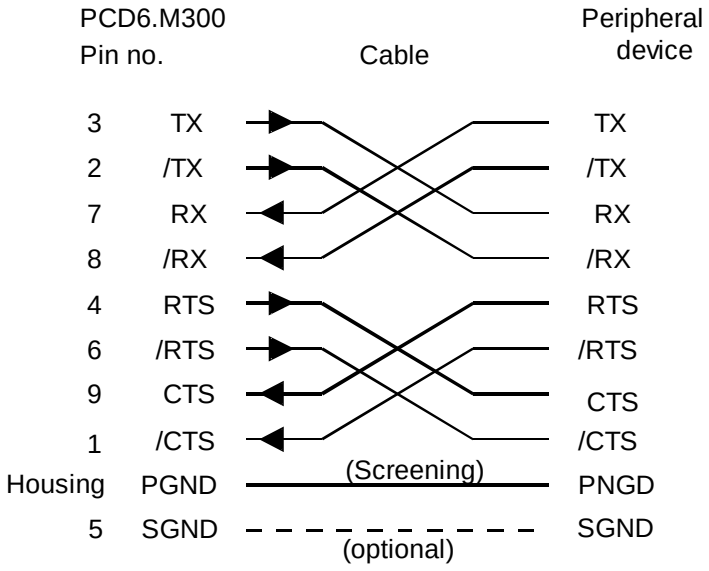
- To re-enable the PGU port as interface 4 for a peripheral device, the port must be assigned again with the SASI instruction.

5.7.2 PCD7.F110 for RS 422/RS 485

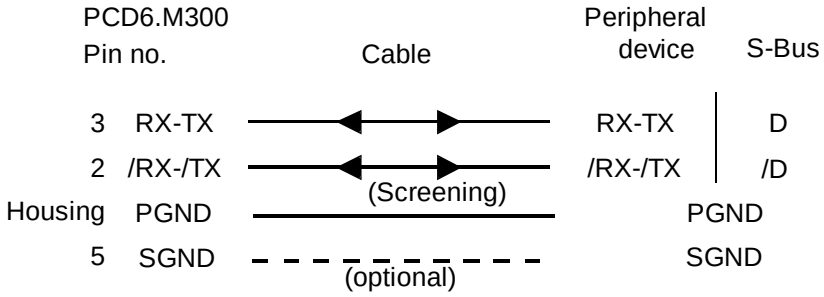


PCD7.F110 with jumper "open - closed" (on plug side) to switch line termination resistors on or off.

Connection for RS 422 :



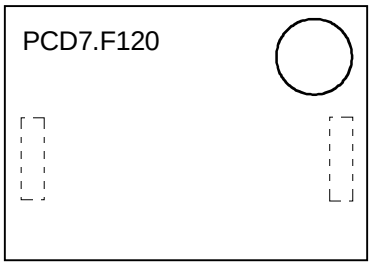
Connection for RS 485 :



For choice of line termination resistors, see 5.7.5.

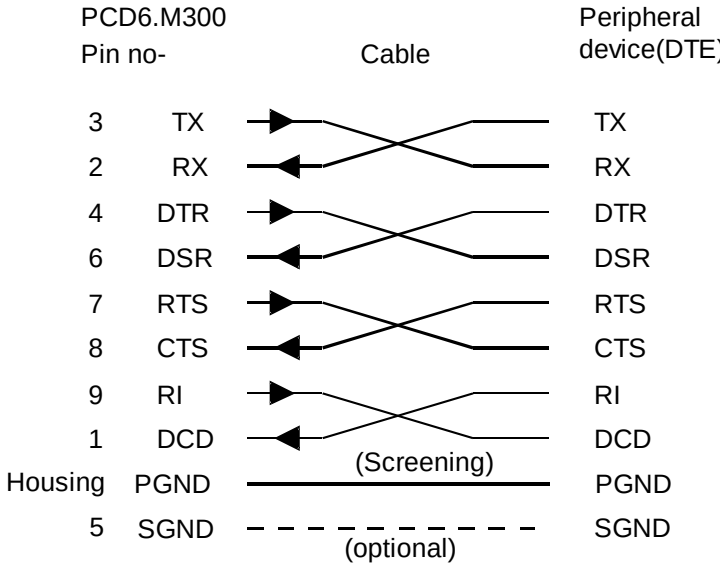
For installation, please consult the manual "Installation components for RS 485 networks".

5.7.3 PCD7.F120 for RS 232

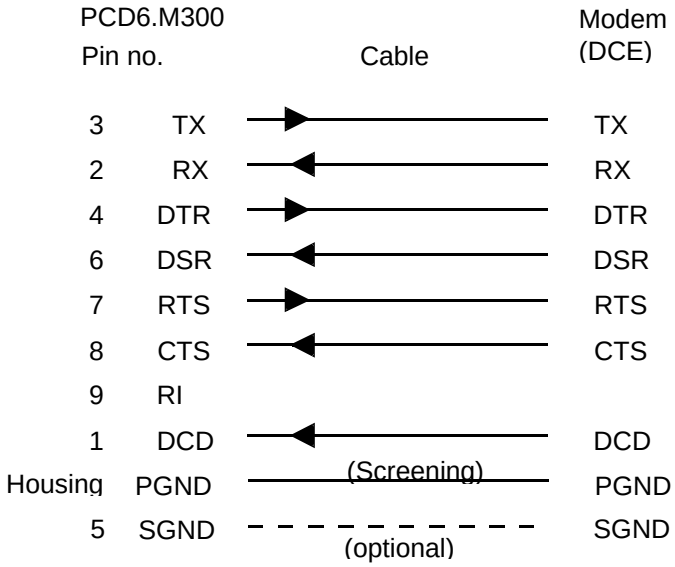


This interface module has no jumpers, nor any other adjusting capabilities.

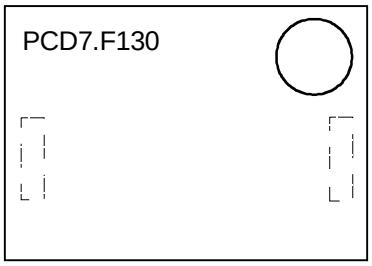
Connection for peripheral device (DTE = Data Terminal Equipment) **:**



Connection for modem (DCE = Data Communication Equipment) **:**



5.7.4 PCD7.F130 for 20 mA current loop



This interface module has no jumpers, nor any other adjusting capabilities.

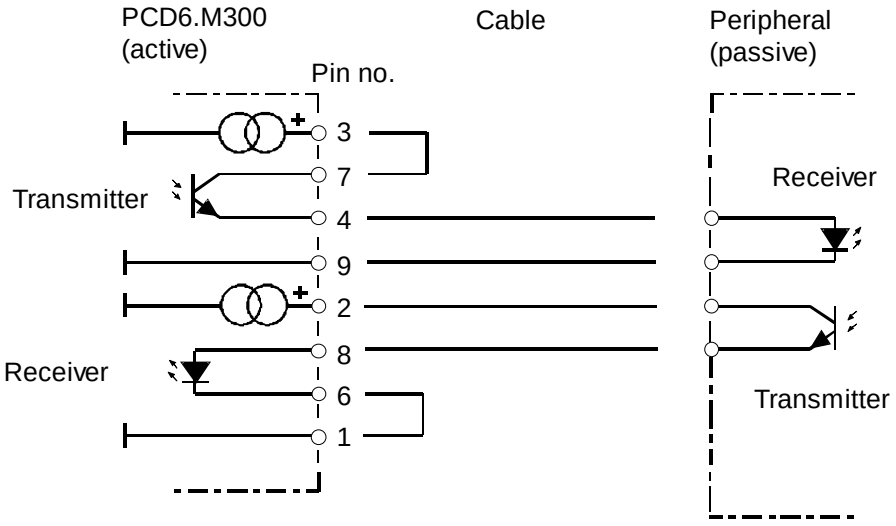
Connection 3 :	TS	Transmitter Source	Transmitter
Connection 7 :	TA	Transmitter Anode	
Connection 4 :	TC	Transmitter Cathode	
Connection 9 :	TG	Transmitter Ground	
Connection 2 :	RS	Receiver Source	Receiver
Connection 8 :	RA	Receiver Anode	
Connection 6 :	RC	Receiver Cathode	
Connection 1 :	RG	Receiver Ground	

Signal type	Set value	Nominal value	
Current for logic L (space)	- 20 mA...	+2 mA	0 mA
Current for logic H (mark)	+12 mA...	+24 mA	+20 mA
No-load voltage at TS, RS	+16 V...	+24 V	+24 V
Short-circuit voltage at TS, RS	+18 mA...	+29.6 mA	+23.2 mA

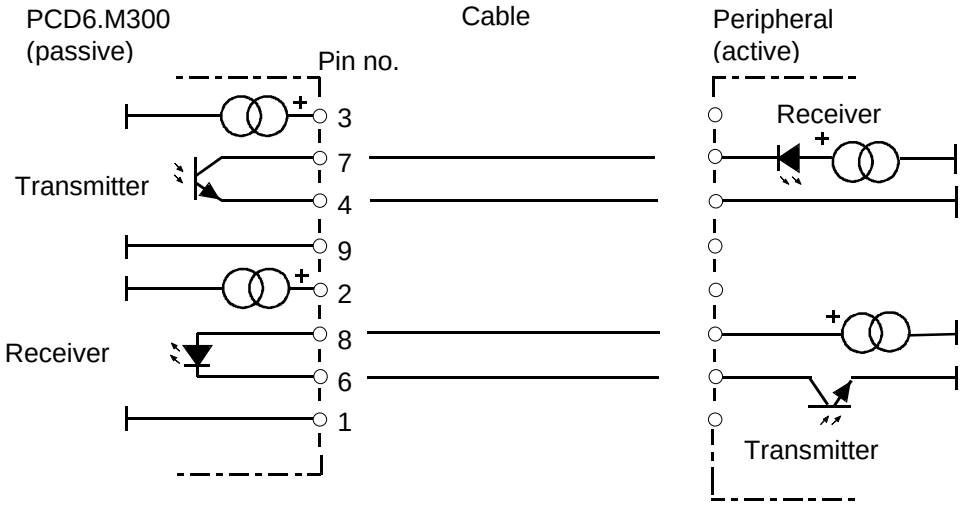
The neutral state for data signals is "mark".

Connection examples for 20 mA current loop :

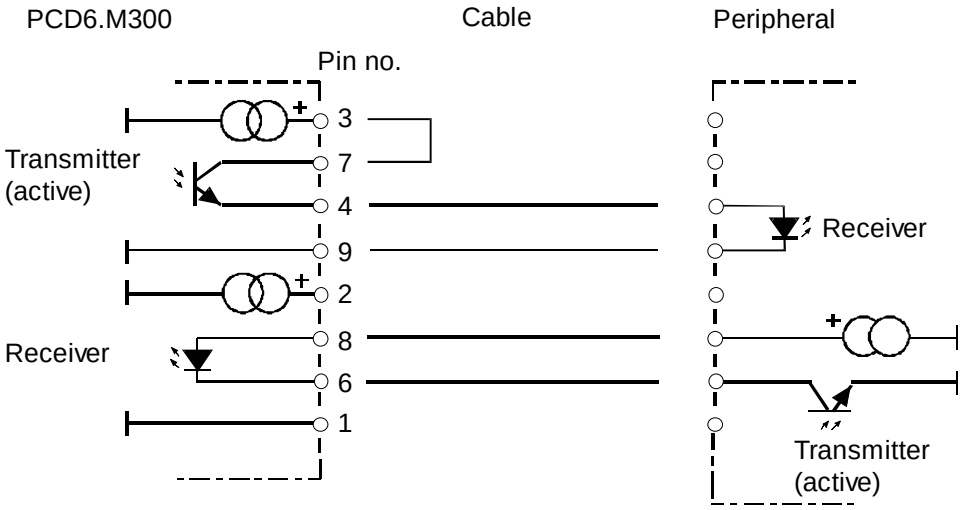
a) PCD6 active



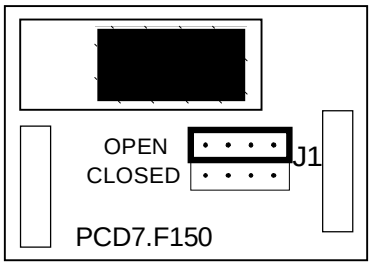
b) PCD6 passive



c) PCD6 and peripheral device transmitters active



5.7.5 PCD7.F150 for RS 485 with galvanic isolation

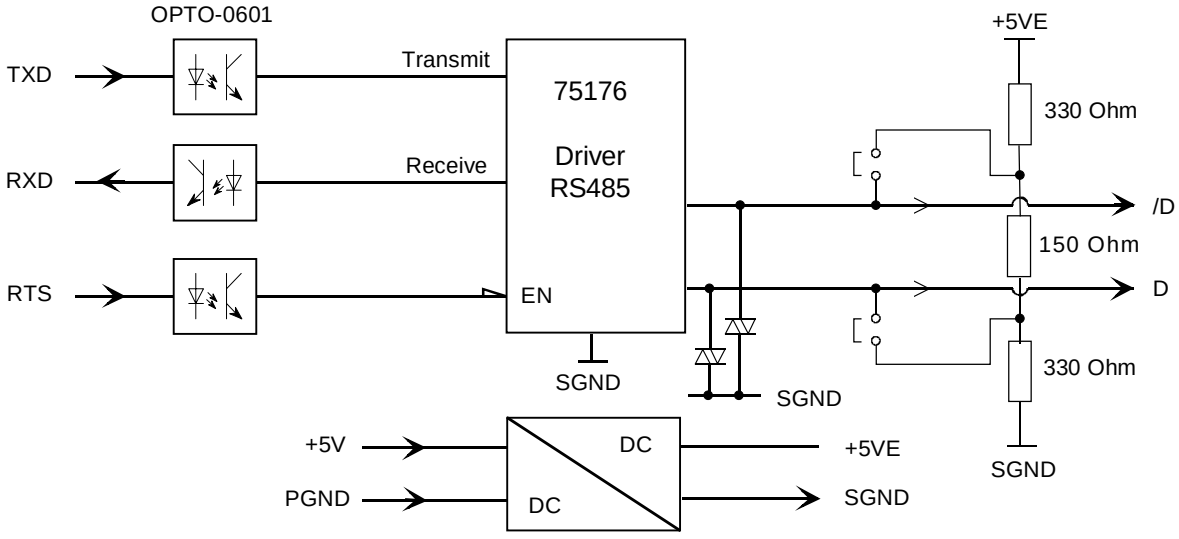


PCD7.F150 with jumper "open - closed" (on plug side) to switch line termination resistors on or off.

Connection :

PCD6.M300 Pin no.		Cable	Peripheral device	S-Bus
3	RX-TX	———	RX-TX	D
2	/RX-/TX	———	/RX-/TX	/D
9	SGND (galvanically isolated) must be connected to cable screening			
Housing	PGND			

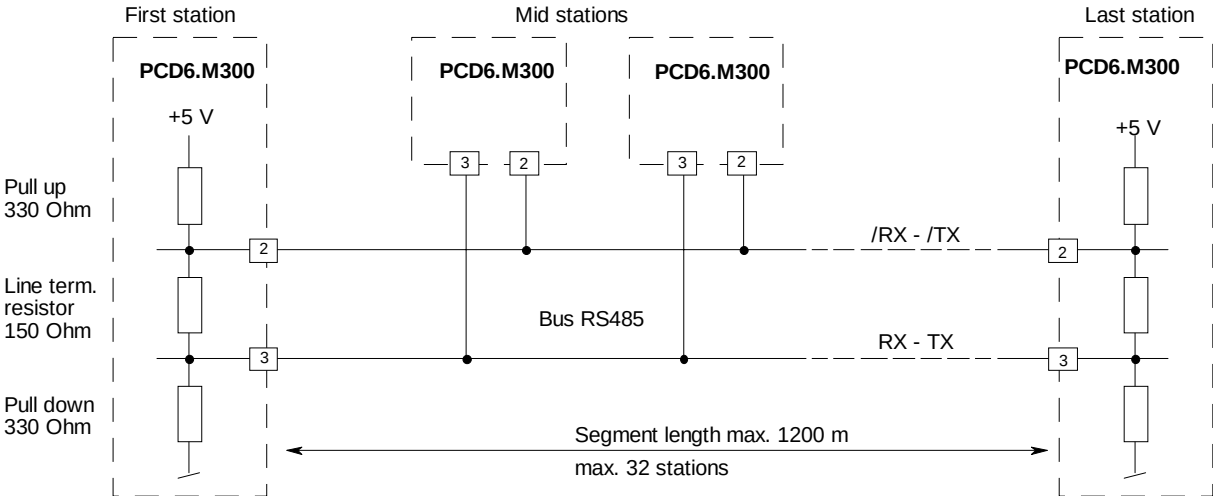
Block diagram :



Please note : Common mode: 50 V, bounded by capacitors between the data lines and PGND (on base module).

For installation, please consult the manual "Installation components for RS 485 networks".

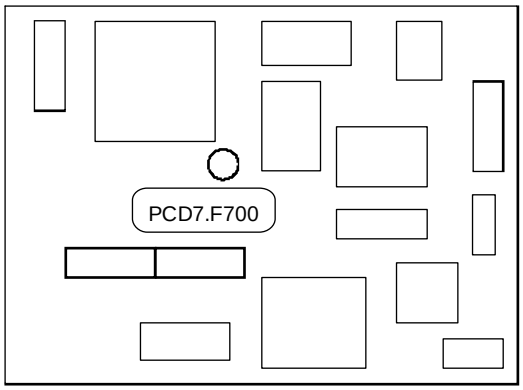
Choice of line termination resistors :



Instructions :

- For the first and last stations, jumper J1 must be in the "CLOSED" position.
- For all other stations, jumper J1 must be left in the "OPEN" position (position on delivery).
- See also manual "Installation components for RS 485 networks"

5.7.6 PCD7.F700 for PROFIBUS- FMS connection

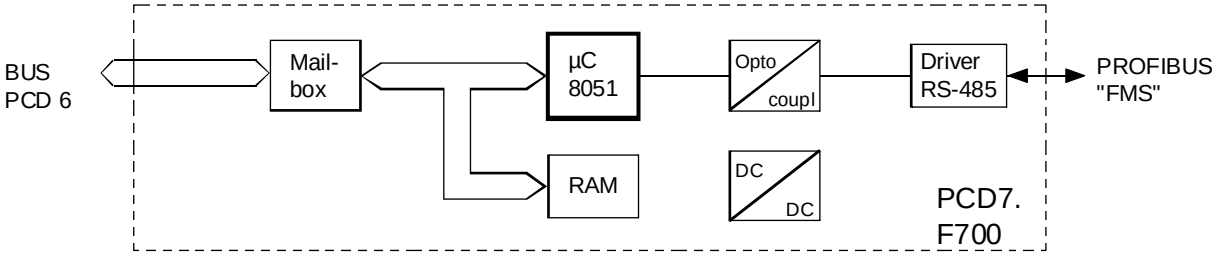


The PCD7.F700 module works on interface 3 and is also inserted at that port. A 4-pole jumper activates either this module or an F1xx. (see section 5.1 : Front panel and structure)

Use of the PCD7.F700 PROFIBUS-FMS connection gives the PCD6 series access to the PROFIBUS communications environment. With appropriate configuration, the PCD6 can therefore be used as an FMS master or FMS slave. (FMS = Field Message Specification)

Block diagram :

The PCD7.F700 module contains the PROFIBUS controller (8051) and the RS 485 driver. PROFIBUS communication is triggered by the user program, via the main 68349 processor.



Connection of PROFIBUS :

The PROFIBUS connection is via interface no. 3, 9-pole D-type connector on the front panel.

Pin configuration is as follows :

	PROFIBUS standard	SAIA	
Pin 3	RxD/TxD-P	/D	Receive/Transmit Data P
Pin 8	RxD/TxD-N	D	Receive/Transmit Data N
Pin 5	DGND	SGND	Signal Ground
Pin 1	SHIELD	PGND	Shield, Protective Ground

Important : The shield must be connected to the metal part of the plug. Mechanical screwing of the box half to the pin half must use an electrically conductive screw joint.

All PROFIBUS port connections, except pin 1 (PGND), are galvanically isolated from the rest of the module, with a 100 Ω resistor between SGND and PGNG bringing the galvanically isolated circuit close to PGND (frame).

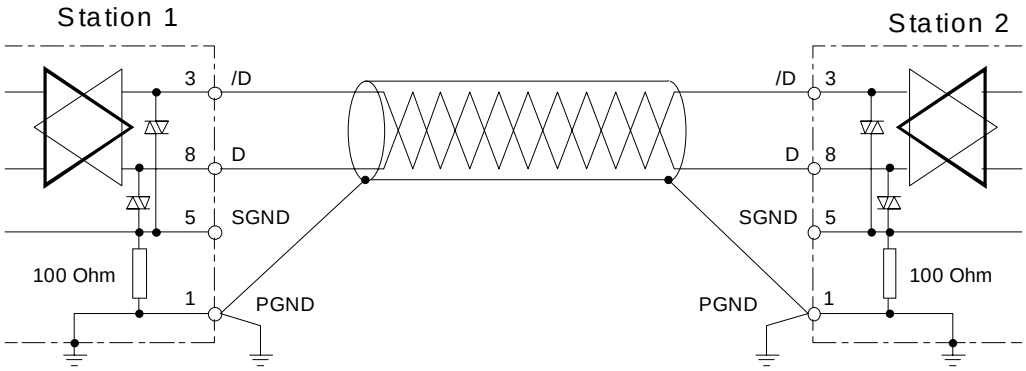
D and /D are protected against peak overvoltages by integral 10 V transient suppresser diodes.

Data on the PROFIBUS-Connection :

For details, please request the comprehensive PROFIBUS manual using order reference 26/742 E.

Please note that the number of channels and communications objects correspond to those for the PCD4.M445.

Connection, installing the bus, earthing concept :



Important: The two signal lines "D" and "/D" **must not** be mixed up !

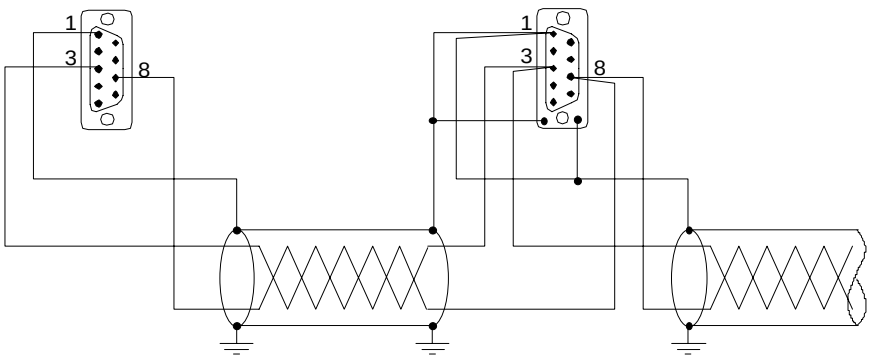
For the wiring layout shown in the above drawing, the potential difference between the data reference potential SGND of all stations must not exceed ± 5 Volts.

Bus cable

For the bus cable, use screened, twisted, 2-core cable. Surge impedance should be in the range 100 to 130 Ω at f > 100 kHz; cable capacity should be close to < 100 pF/m and wire cross section should be at least 0.22 mm^2 (AWG 24). The maximum permissible signal loss is 6 dB.

Recommendations for proven types of bus cable :

Manufacturer :	Cable type :
• Volland AG	UNITRONIC-BUS
• CABLOSWISS	1 x 2 x AWG24
• Kromberg & Schubert	371'502



Care should be taken to ensure that the bus remains continuously connected, even when one or more connectors are withdrawn.

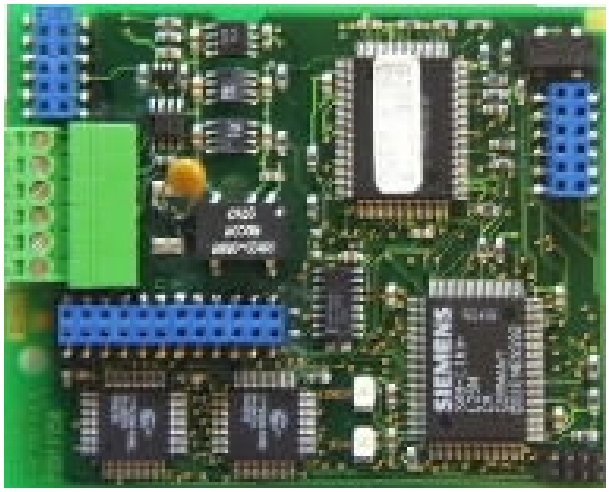
5.7.7 PROFIBUS-DP connection

PROFIBUS-DP (DP = **D**ecentralized **P**eripherals**)**

Optimized for high speed, this PROFIBUS-DP version has been especially tailored for communication between automation systems and local peripherals, enabling plug-and-play for field devices.
PROFIBUS-FMS and DP use the same transmission technology and the same bus access protocol. Both versions can therefore run simultaneously and in combination on a single cable.

5.7.7.1 PROFIBUS-DP master card PCD7.F750

Use of the PCD7.F750 PROFIBUS-DP connection enables PCD6 series, with the processor module PCD6.M300, to be switched into the PROFIBUS-DP master communications environment.



View of PCD7.F750

Technical data PCD7.F750

Function	PROFIBUS-DP master class 1 E (DPM1 with extension)
Maximum number of stations	32 per segment / max. 126 per system (with repeaters)
PROFIBUS ASIC	ASPC2
Baud rate (kbit/s)	9.6 -12000
Internal current consumption from 5V bus	max. 400 mA
Current output DP+5V	max. 50 mA short-circuit proof with PTC
Galvanic isolation	between PCD-GND and PROFIBUS connection GND

5.7.7.2 PROFIBUS-DP slave card PCD7.F770

Use of the PCD7.F770 PROFIBUS-DP connection enables PCD6 series, with the PCD6.M300 processor module, to be switched into the PROFIBUS-DP slave communications environment.

Remark : Only the PROFIBUS-DP slave card PCD7.F770 can be used with the PCD6.M300.

View of PCD7.F770

Technical data PCD7.F770

Function	PROFIBUS-DP slave E
Maximum number of stations	32 per segment / max. 126 per system (with repeaters)
PROFIBUS ASIC	SPC4.1
Baud rate (kbit/s)	9.6-12000
Internal current consumption from 5V bus	Max. 250 mA
Current output DP+5V	Max. 50 mA short circuit-proof with PTC
Galvanic isolation	between PCD-GND and PROFIBUS GND

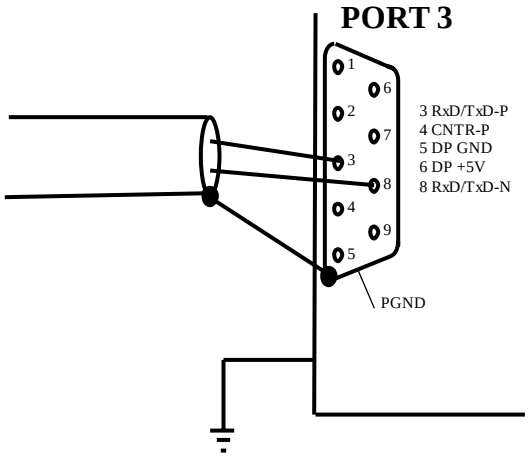
For more detailed information, please consult the manual :

"PROFIBUS-DP with SAIA® PCD"

Order reference : PUBLI-26/765 E.

5.7.7.3 Connection of PROFIBUS-DP modules

For the PCD6.M300, the PROFIBUS-DP connection is achieved via the 9-pole, D-type connector on port no. 3 (jumper for port no. 3 must be set to 3B).



PCD6.M300 connection

Meaning of connections

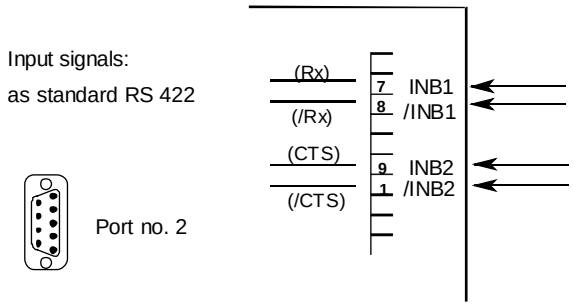
Signal	Meaning	PCD6. M300 connection	Standard A-B connection	Standard cable green/red
CNTR-P / RTS	Control signal for repeater	4		
PGND	Screen / protective earth	housing		
RxD/TxD-N	Receive / transmit data, minus	8	A	green
RxD/TxD-P	Receive / transmit data, plus	3	B	red
DP GND	Ground for DP +5V	5		
DP +5V	5V supply for line termination resistors	6		
CNTR-N	Control signal for repeater	---		

Detailed information can be found in the manual: "Installation components for RS 485 networks" (order number 26/740 E).

5.8 Interrupt inputs

5.8.1 Interrupt inputs of the PCD6.M300

Both interrupt inputs "INB1" and "INB2" can be accessed from the front panel via the 9-pole, D-type connector on serial port no. 2. Port no. 2 can be used either as a serial port **or** as an interrupt port. Simultaneous use as a serial port and an interrupt port is **not** possible. Use of interrupt inputs requires equipment of the PCD7.F110 (RS 422/RS 485) interface module.



5.8.2 Method of operation

A positive edge at interrupt input "INB1" calls XOB 20; a positive edge at interrupt input "INB2" calls XOB 25. The maximum reaction time to call XOB 20 or XOB 25 is **1 ms**. The user is left free to define which alarm or count functions are to be executed within interrupt XOB.

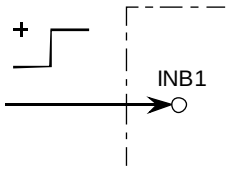
Since these are differential "RS 422" inputs, signals of +5 V should be supplied. If an XOB is already being processed when an interrupt signal arrives, XOB 20 or XOB 25 will only be processed after completion of the current XOB. If two interrupt signals arrive simultaneously at "INB1" and "INB2", XOB 20 is called first and XOB 25 afterwards. During processing of XOB 16 (coldstart) incoming interrupt signals are ignored and will be lost.

5.8.3 Initialization of interrupt inputs

Port no. 2 is standard provision for serial communications. If an XOB 20 or XOB 25 is detected in the user program, port no. 2 is automatically initialized as an interrupt port. However, if the port has already been assigned as a serial interface, this assignment remains and the debugger displays the message "PRT2 DBL ASSIGND" while the CPU goes into HALT. If the port has been initialized as an interrupt port and assignment takes place as a serial interface, the error flag is set and XOB 13 is called, or the error LED comes on.

5.8.4 Alarm function

When a positive edge arrives at INB1 output 32 should reset within max. 1 ms, regardless of the user program.




```
XOB         20
RES    0    32
EXOB
```

5.8.5 Count function up to 2 kHz

The interrupt inputs can also be used for count functions up to approximatively 2 kHz.

Example: After the arrival of 200 pulses with a frequency of 1 kHz at interrupt input "INB1", output 33, which has previously been set with digital input 5, is to be reset.

```
COB         0
            0
 :
 :
STH    I    5     ;  If input 5 receives H-signal,
DYN    F    5
LD     C    10    ;     counter 10 is loaded
            200   ;     with value 200 and
SET    O    33    ;     output 33 is set.
 :
 :
ECOB


XOB         20    ;  If INB1 receives positive edge,
DEC    C    10    ;     the counter 10 is decremented
STL    C    10    ;     and, when it reaches zero,
RES    O    33    ;     output 33 is reset.

EXOB
```

Notes :

6. The SAIA LAN2 (PCD6.T1..)

6.1 General

The SAIA®LAN2 local area network allows the construction of a remote control system, which is characterised by ease of application and data transfer security.

For example, with the SAIA®LAN2 the following tasks can be easily done:

- Transfer of process data (read and write the logical states of I, O, F and the contents of R, C, T) between different PCDs (PCD4 and PCD6).

- Simultaneous transfer of non-urgent and urgent data and commands.

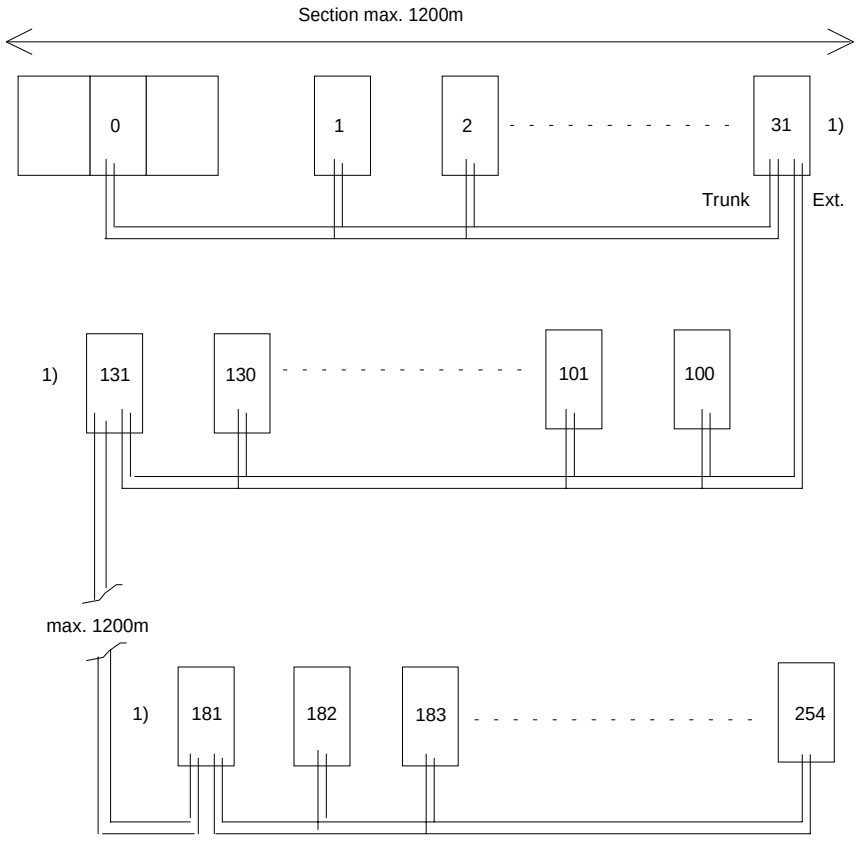
- Reasonably-priced remote I/O system without decentral intelligence within the limits of response times.

- Read and change the status of any other station (Run - Halt - Disconnect - Connect - Timeout)

The data line consists of a two-core, twisted and screened cable (RS485). It is attached to the screw terminals of the supply and processor bus module.

A network consists of sections: one segment has up to 32 stations and can be as long as 1200m. The LAN2 processor module PCD6.T110 with its built-in repeater allows the physical connection of two sections. The connection between two PCD6.T110 can again be 1200 m in length.

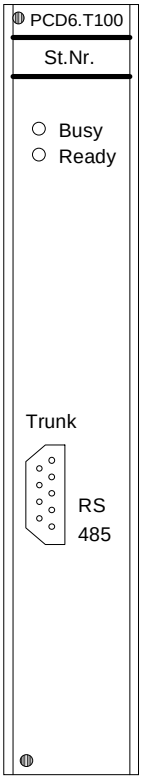
Up to 255 stations can be connected to the network.

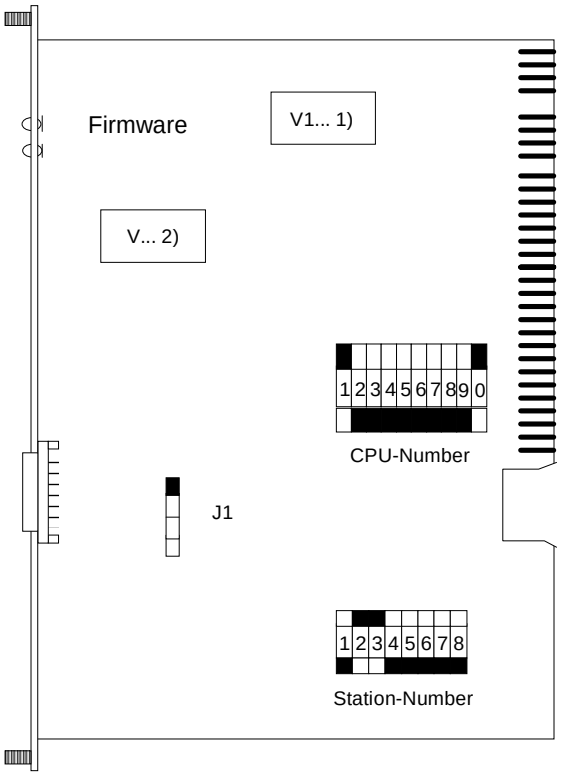


1) Stations 31, 131 and 181 are provided with the repeater built into the LAN2 PCD6.T110 processor module. In this example, station 131 only has the task of bridging a cable distance which is longer than 1200m.

The repeater function can only be realized using a PCD6 station.
Other repeaters with galvanical separation will be available end 1992.

6.2 Front panel and structure





Firmware:
2 EPROMs with system program

V... :
firmware version number

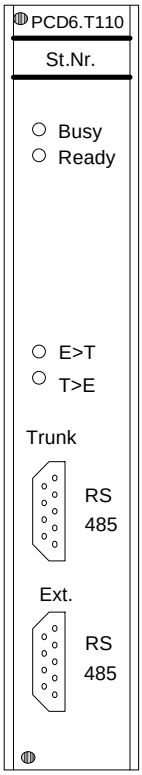
CPU number:
DIL-switch for CPU number

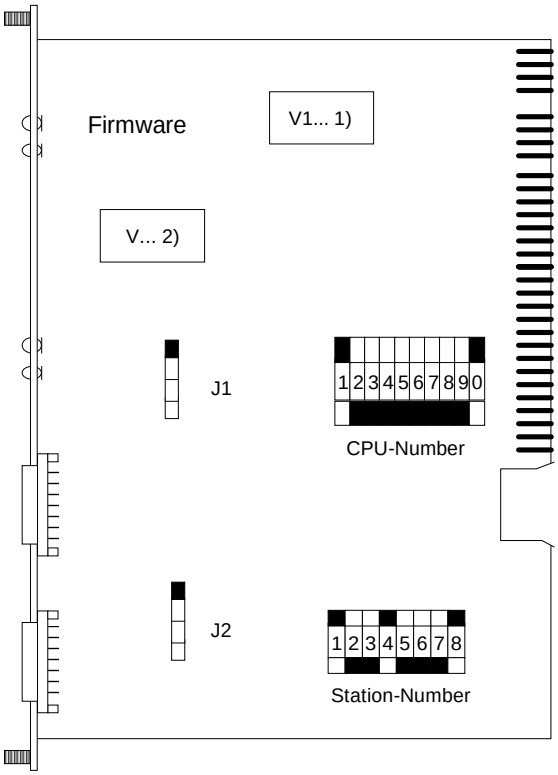
Station number:
DIL-switch for station number

Trunk:
LAN2 bus connector D-Sub connector, 9-pole, female

J1:
Jumper for bus cable terminating resistor

This figure shows the module PCD6.T100: station module





Firmware:
2 EPROMs with system program

V... :
firmware version number

CPU number:
DIL-switch for CPU number

Station number:
DIL-switch for station number

Trunk:
LAN2 bus connector D-Sub connector, 9-pole, female, primary bus

Ext.:
LAN2 bus connector D-Sub connector, 9-pole, female, external bus

J1, J2:
Jumper for bus cable terminating resistor

This figure shows the module PCD6.T110: station module with intergrated bus amplifier (repeater)

6.3 Function and installation

The LAN2 processor module PCD6.T100 or ..T110 manages the data transfer via the bus independently, thus relieving the strain on the other control processor modules ..M100 or ..M2..

Every control processor module ..M100 oder ..M2.. can delegate a task to the LAN2 processor module at any time.

The LAN2 processor module PCD6.T100 or ..T110 can be inserted in the main rack unit in each of the 7 or 3 plug-in locations which are reserved for processors.

6.4 Operating mode

The bus system SAIA®LAN2 functions according to the "Token Passing Bus" principle, i.e. a station is given the permission to transmit by the bus (token). Any data waiting to be served will be transmitted and the token is passed on by the station. If there is no data to transmit, the token is immediately passed on.
The transmitted data consists of 1 "frame" = 32 data bytes. If a telegram to be transmitted exceeds 1 frame, it will be transmitted frame by frame, whereby the token passes all active stations between two frames. Thus, it is ensured that each station is quickly enabled to transmit data.

When "bombarding" a station (several stations are transmitting simultaneously to the same station) a maximum of 64 requests can be stored and processed one after the other.

6.5 Start-up and missing station procedure

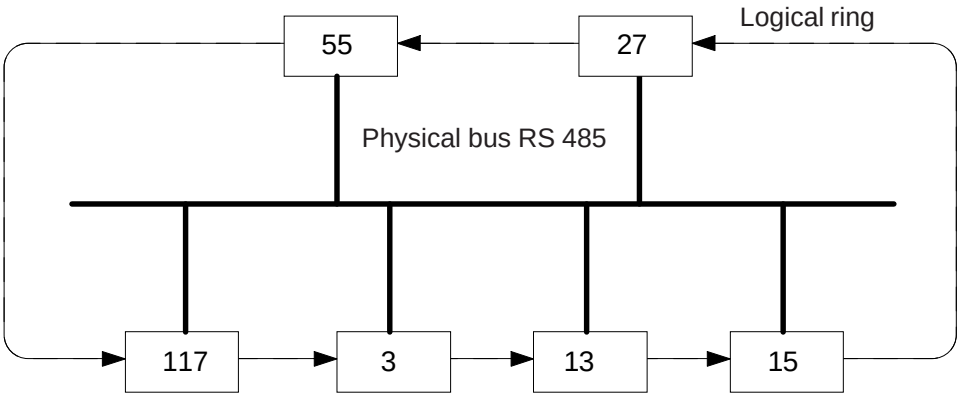
When the system is switched on, every station is invited to report its presence. In this way the logical ring can be set up. This operation is called the configuration burst and lasts for about 15 seconds. The system now operates as previously described.

If a station is down, its predecessor will send it the token once. If the station cannot pass on the token, a reconfiguration burst occurs (duration approx. 15 seconds) and the logical ring is thus reconfigured.

If a new station is connected to the network during operation, which is permitted but not recommended, the token is lost and a reconfiguration burst occurs.

Of course, during a reconfiguration burst the message which had just been sent will be lost. However, since receipt has not been acknowledged to the transmitting station, it will retransmit after a timeout. In this case, **only the two stations involved are delayed by the timeout**. The rest of the data exchange proceeds normally after the reconfiguration burst.

Logical ring and physical bus



Configuration of the logical ring and token passing starts with the station with the lowest station number and follows the stations in ascending order, irrespective of where the station is connected within the physical bus.

6.6 Specifications

Physical interface	RS 485
Allocation process	Token passing
Frame structure	SDLC (Synchronous Data Link Control)
Bus line	2-core twisted and screened (recomm.) cable section: 2 x 0.75 mm^2
Length of bus line	Up to 1200 m per section
Number of stations	Up to 32 per section
Number of sections	Up to 8, each connected to a PCD6.T110 repeater
Error recognition	CRC 16
Gross data rate	62.5 KBits/sec
Data volume per transmission	32 bytes of data = 1 frame 1 frame = 256 I/O/F = 8 R/C/T
Timing	Dependent of the number of stations in the ring and of the number of stations transmitting simultaneously.
Typical reaction times	In a 16 station network the following reaction times can be assumed, if only one station is transmitting in each case:

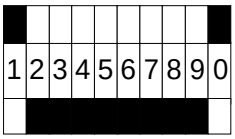
- Transmission of 1 flag to 1 output typ. 40ms
- Transmission of 256 flag to 256 outputs typ. 400ms
- Transmission of 1 register of 32 bit to one other register typ. 70ms
- Transmission of 8 registers of 32 bit to 8 other registers (i.e. 256 bits) typ. 110ms

Resistance to interference	2,5 kV according to IEC 801-4 (capacitative link)
Power Consumption from internal 5V bus	250mA

6.7 CPU numbering

The LAN2 processor module always uses CPU number 6 in the main rack unit (factory setting).

CPU number 6




pressed

Although a different CPU number can be selected, this is not recommended. The LAN2 processor module also uses CPU number 6 in a remote system which is fitted with only one LAN processor module and one public memory module or a pure amplifier station (with LAN2 repeater, without a processor module ..M100 or ..M2..) in addition to input and output modules.

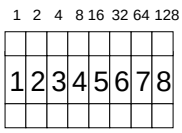
6.8 LAN2 station numbering

The address of a station in the logic ring of a SAIA®LAN2 system is referred to as station number. The station numbers may be selected as desired in the range 0 to 254. Each station number must not be used more than once in a system. Station number 255 is reserved for a special LAN2 function and must not be used.

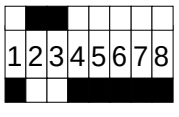
The station numbers are set via the 8-digit DIL-switch in binary notation.

Valence

DIL-switch: Switch number

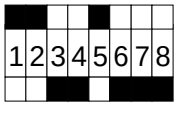


Examples: Station number 6

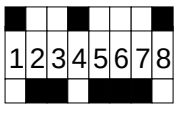



pressed

Station number 19



Station number 137



The station number is inserted behind a window on the front panel (dark-red labels which are delivered with each module).

6.9 Operating modes

The LAN2 processor modules operate in the following modes: START, READY, BUSY (CONNECT or DISCONNECT connects or disconnects the LAN2 processor module from the CPU bus via the software and does not represent an operating state as such).

The operating states are displayed by 2 LEDs, "READY" (green) and "BUSY" (red).

Start: Two cases are distinguished:

- Basic rack unit equipped with ..M100/..M2.. and LAN2 processor module.

  Upon system start, the LAN2 processor module performs a self-test which takes approx. 15s. During this test both LEDs light up.

- Basic rack unit only fitted with LAN2 processor module (and public memory module without memory board) and possibly with I/O modules.

  Upon system start, the LAN2 processor module performs a self-test and configures the stations which takes approx. 15s. Meanwhile, the BUSY LED is permanently lit and the READY LED blinks.

Ready: The READY LED must be permanently lit from now on. Should this not be the case, an error has occurred.

Busy: The Busy LED is always on when the LAN2 processor module is receiving or transmitting data. Also if the processor is waiting for a timeout due to a bad or not possible connection (e.g. remote station not switched on) the Busy LED is on.

The LAN2 processor module with repeater PCD6.T110 is fitted with two more LEDs, E > T and T > E indicating the data transfer in the two possible directions whereby E = extension and T = trunk (internal bus, trunk).

6.10 Firmware

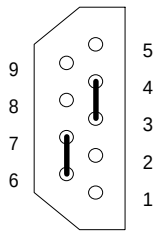
The firmware (system program) is resident in 2 EPROMs of the type 27C256 (access time ≤250 ns). These two EPROMs are numbered "1" and "2" and labelled with the firmware version V... .

PCD6.T100 V005/1	PCD6.T100 V005/2

The firmware is subject to change (upwards-compatibility is ensured).

6.11 Pin assignment, cables, terminating resistors

The connector(s) on the front panel are female, 9-pole D-Sub connectors. The pins of both connectors are assigned as follows: (..T100 has 1 connector, ..T110 has 2 connectors):

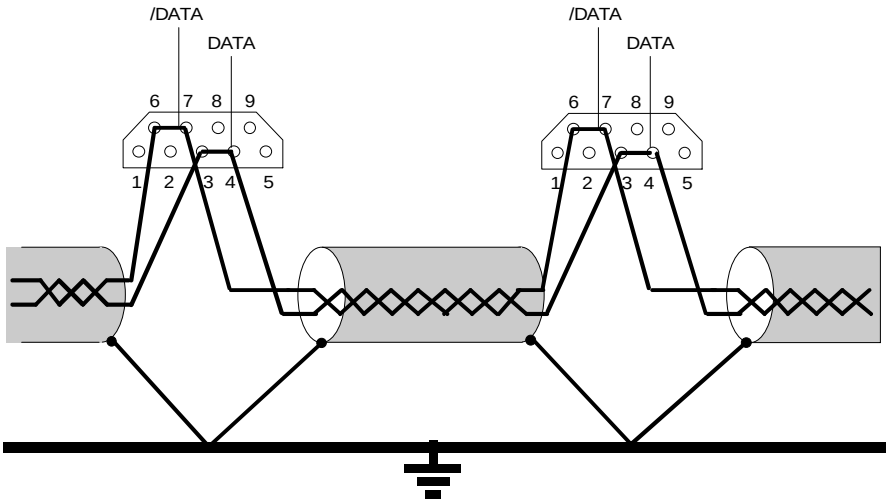


Front view

1	Protection Ground	must not be wired (shield connected on both side)
2	*	
3	DATA	optional **
4	DATA	must be wired
5	*	
6	/DATA	must be wired
7	/DATA	optinal **
8	Signal Ground	optinal
9	*	

*) not connected in the LAN2 processor module

**) DATA and /DATA are tied to 2 adjacent connector pins respectively which results in increased reliabilty and facilitates soldering, as usually 2 wires must be soldered.



When preparing the bus cable, make sure that the data lines are not mixed up - always tie "DATA" to "DATA" and "/DATA" to "/DATA". In addition, verify that pins 3 and 4 as well as 6 and 7 are connected on the connector to ensure that the bus cable also remains permanently connected if one or two connectors are unplugged.

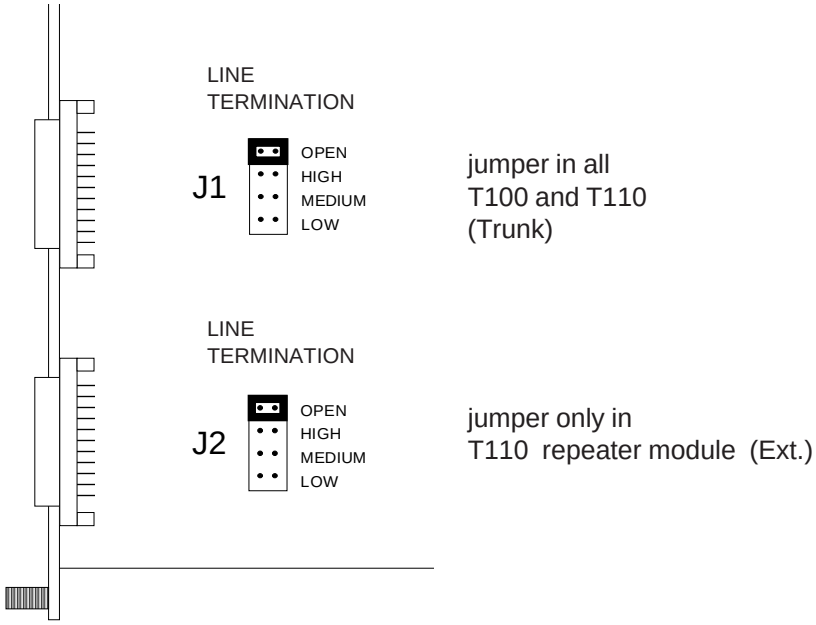
Use male, 9-pole D-Sub connectors with fastening screws for bus cable connection. Use a screened twisted pair for the cable.

The shielding of the LAN2 cable must be connected to ground at each end, and must also be connected to the GND terminal of the supply module.

It si recommended that the LAN cable is not layed directly beside motor power cables due to possible interference problems, unless the power cables are also shielded.

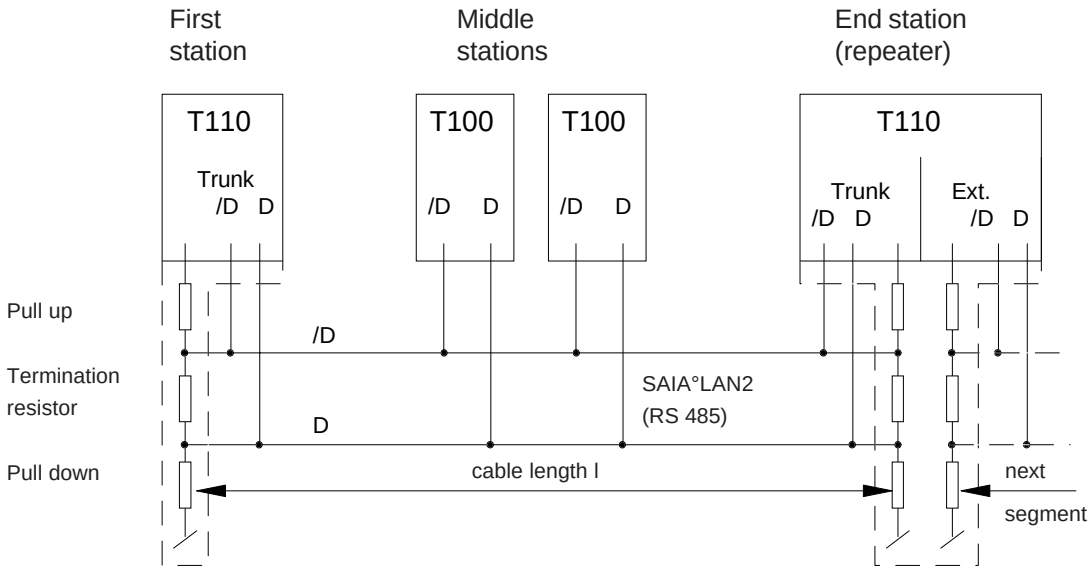
6.12 Line termination resistances

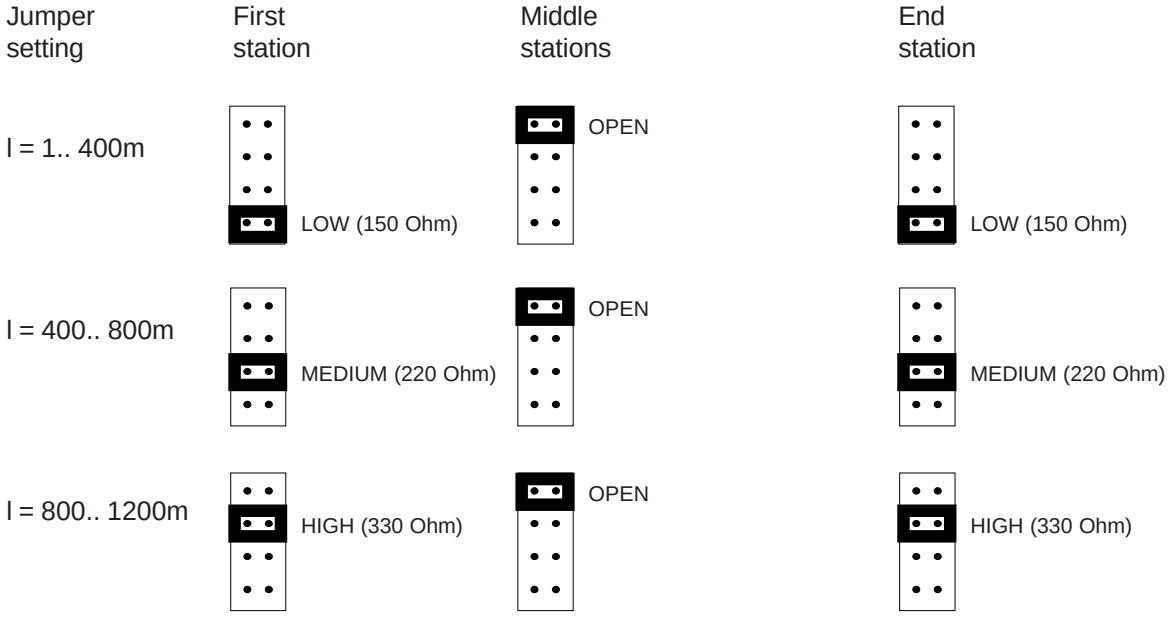
To avoid noise voltages and reflections, the LAN2 processor modules include damping resistors, which are enabled by jumpers located directly behind the front panel connectors. These jumpers are factory set to the "OPEN" position.



As the following diagram shows, line termination resistances are only enabled on the first and last stations on the line.

Every PCD6 LAN2 installation should use PCD6.T110 modules as first and last stations, as only these modules incorporate the pull-up and pull-down resistances. If a PCD4 is also used in the same LAN2 segment, the corresponding pull-up/pull-down resistances can be enabled there by means of DIL switches. As the following diagram shows, the first and last stations of each segment must have pull-up/ down resistors. In addition, the line termination resistances, which are dependent on cable length, should be enabled at both ends of each segment. Use the jumpers to do this.





IMPORTANT: If the network is extended, or if the end station is changed, ensure that the switches are correctly set in both the old and the new stations.

6.13 Commissioning the LAN2 network

Most LAN2 problems are caused because the network is not properly installed. The preceding instructions must be closely followed and double checked prior to commissioning the system.

Before sending process control data via the LAN2, it is imperative to check that the cables and each individual station is working perfectly by carrying out a functional test. This can be performed from any of the stations by using a short test program:

Example: Read operating state of Station 7

```
        Text  5   "007" ; Text to select Station 7

        COB        0
                   0
Begin:  LRXS       5    ; Read (via TEXT 5) the status
              F  100    ; of Stn. 7 and transfer to F100
        STH   F  100
        JR    L  Begin
        ECOB
```

Flag F100 is set high if communication with Station 7 was successful. Subsequent flags F101 to F109 must remain low as long as the station addressed is in "RUN" and the LAN2 network is working correctly.

Instead of flags, 10 outputs can also be used (e.g. from the A400 module). Changing the station number in TEXT 5 allows the same test to be carried out in turn with each station on the network.

Notes :

7. Public memory modules PCD6.R..

7.1 General description and summary

The public memory module has a central function in the system, as it accomodates the user programs, texts and data blocks of all processor modules with the entire corresponding memory management (memory map), all flags, registers, timers, counters and the hardware date-time. The bus arbitrator is also located on this module. It is the arbitrator which monitors, controls and manages the bus access in a multiprocessor system (several processors in the same system).

A piggy-back memory module containing the user programs, texts and data blocks is attached to the public memory module.

Modules for memory capacity up to 256K bytes:

PCD6.R100	Public memory module without switches
PCD6.R110	Public memory module with Run/Halt and Clear switches
PCD6.R5..	Memory modules with RAM or EPROM for user programs, texts and data blocks (max. 256K bytes)

Modules for memory capacity up to 1M byte:

PCD6.R210	Public memory module with Run/Halt and Clear switches
PCD6.R6..	Memory modules with RAM and/or EPROM for user programs, texts and data blocks (max. 1M byte)

For the M540 single processor module, economical PCD7.R.. memory modules are used (see chapter 3).

7.2 Common properties

7.2.1 Characteristic data

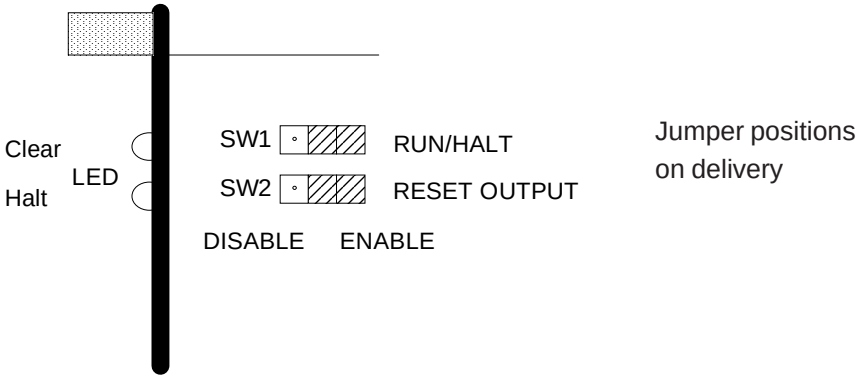
Flags	8192 flags, 1 bit The non-volatile and volatile flags are organized in the user program with the command DEFVM
Registers	4096 registers, 32 bits All registers are always non-volatile.
Data format	The standard format is decimal Range: -2147483648 ... +2147483647 -2^{31} ... $+(2^{31}-1)$ The following formats are admissible: Binary: 31 bits with preceding sign Hexadecimal: 0 ... FFFFFFFF BCD: 0 ... 2147483647 Floating point: $9.223371*10^{18}$ ... $5.421011*10^{-20}$ $-9.223371*10^{18}$ ... $-5.421011*10^{-20}$
Timers/ Counters	A total of 1600, 31 bits The timers/counters are defined in the user program with the command DEFTC A maximum of 450 timers can be defined. All counters are non-volatile. All timers are volatile.
Data format	See registers, however, only positive values and without floating point
Time base (timers)	1/100s ... 10s (identical for all processor modules) The time base is defined in the user program with the command DEFTB.
Hardware date-time	Week, day of the week, year, month, date, hour, minute, second
Accuracy	better than 15s/month at T_a = 15 ... 30°C
Power reserve	2 months (see battery specifications)
Internal power consumption (5V bus)	400 mA

7.2.2 Run/Halt switch and Clear key

The versions PCD6.R110 and ..R210 are equipped with the **Run/Halt** switch and the **Clear** key. The corresponding LEDs indicate the current state.

Jumpers RUN/HALT and RESET OUTPUT

In connection with the Run/Halt switch and the Clear key the two jumpers RUN/HALT and RESET OUTPUT are very important.



ENABLE RUN/HALT (SW1):	The Run/Halt switch is enabled
DISABLE RUN/HALT:	The Run/Halt switch is disabled
ENABLE RESET OUTPUT: (SW2)	In case of HALT of CPU 0, all other CPUs are also set to HALT. All outputs are reset. This HALT can be triggered by the Run/Halt switch, the Debugger or a XOB.
DISABLE RESET OUTPUT:	In case of HALT of CPU 0, all outputs remain in their current states. The CPUs 1 to 6, however, follow CPU 0 and assume the HALT state. If one of the CPUs 1 to 6 is set to HALT, the other CPUs and the outputs are not affected.

Function of RUN/HALT and CLEAR

- If switch Run/Halt is set to HALT, all processor modules immediately assume the HALT state. This switch has a higher priority than the PG commands Run, Trace and Restart. The red LED lights up in HALT state.

- If switch Run/Halt is set from HALT to RUN, all processor modules perform a cold start, i.e. self-diagnosis is effected, all volatile elements are reset and XOB 16 (user program initialization) is executed.

- If the Clear key is pressed, while the switch is set from HALT to RUN, all elements except the registers are reset or cleared. At any other time the Clear key has no effect. The yellow LED lights up until self-diagnosis is terminated and all elements are reset (it takes approx. 1s). The Clear key is only active, if the jumper RUN/HALT is placed to position ENABLE.

7.2.3 Battery

The rechargeable NiCd battery prevents data from being lost when the voltage is switched off (registers, counters and non-volatile flags) and serves as a power reserve for the hardware date-time.

LED *Batt*	= green	Battery in order (for ..R2..: LED *Batt* = off)
LED *Batt*	= red	Battery not in order or not provided (XOB 2 is called)

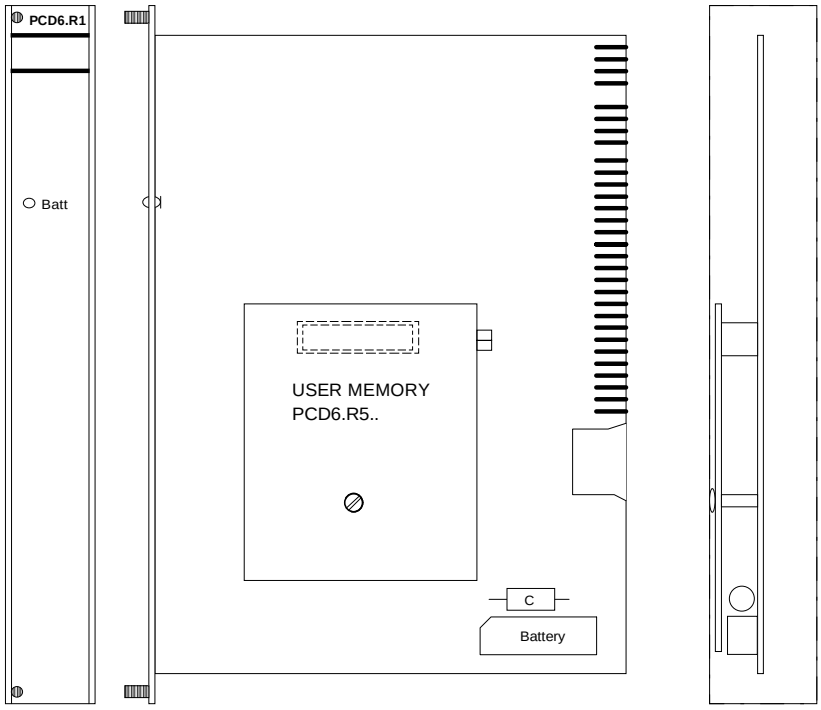
Information about battery replacement is given on the inside of the front panel. When exchanging the pluggable batteries, the data is retained for at least 20s with the aid of a capacitor.

Data:	Data protection when module is not supplied with power and battery completely charged	2 months
	Turn-on time for complete charging of battery	15h
	Life expectancy	5 years
	Nominal voltage	2.4V
Order number for spare battery		4 507 1360 0

7.3 Memory modules PCD6.R1.. and R5.. for up to 256K bytes

7.3.1 Public memory modules PCD6.R100 and R110

Module PCD6.R100

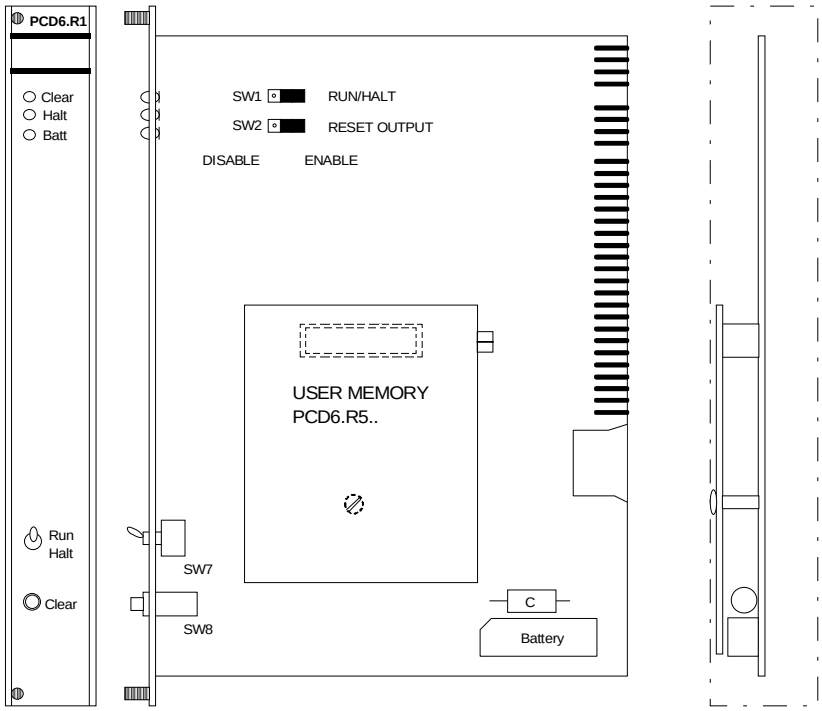


User Memory:
memory module

Battery:
buffer battery (NiCd)

C:
bypass capacitor for battery change (buffer duration at least 20sec.)

Module PCD6.R110



SW1: jumper
SW2: jumper
} see chap. 7.2.2

User Memory:
memory module

SW7: bistable toggle switch
SW8: pulse key

Battery:
buffer battery (NiCd)

C:
bypass capacitor for battery change (buffer duration at least 20sec.)

7.3.2 Memory modules PCD6.R5..

The PCD6.R5.. memory modules hold all user programs, texts and data blocks. Memory modules of the type ..R5 can only be used with main modules of the type ..R100 or ..R110.

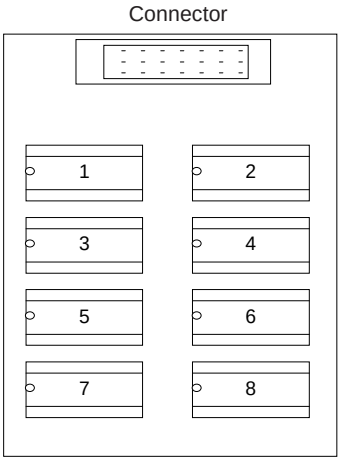
Characteristic data

PCD6.R500 for EPROM modules 27C256, not equipped
64K program lines or
32K registers in data blocks or
256K text characters or mixed *)
Order number for EPROM: 4 502 5677 0

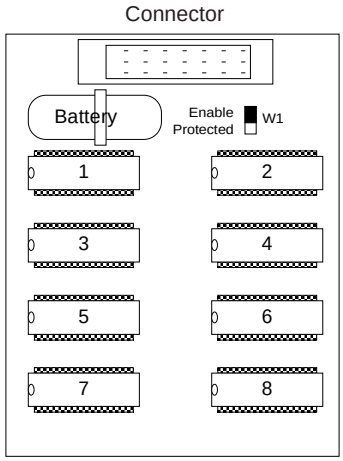
PCD6.R510 Euipped with RAM, battery-buffered
64K program lines or
32K registers in data blocks or
256K text characters or mixed *)
This RAM module is battery-buffered and can be write-protected with jumper W1 (see figure).
Battery: see preceding chapter

PCD6.R511 like PCD6.R510, but for
32K program lines or
16K registers in data blocks or
128K text characters or mixed *)

PCD6.R500



PCD6.R510



W1: jumper for write protection
Protected: write-protected
Enable: not write-protected

*) Programs, texts and data blocks can be mixed as desired for each CPU on the memory module.

EPROM addressing and programming on the memory module PCD6.R500

The switch box PCD8.P710 which can be used for programming EPROMS together with the commercially available EPROM programming unit is available for programming. The EPROMs 27C256 can only be employed in pairs in accordance with the following address code:

Locations	1 and 2		to	16K programm lines or 8K registers in data blocks or 64K text characters or mixed *)
Locations	1 to	4	to	32K programm lines or 16K registers in data blocks or 128K text characters or mixed *)
Locations	1 to	6	to	48K programm lines or 24K registers in data blocks or 192K text characters or mixed *)
Locations	1 to	8	to	64K programm lines or 32K registers in data blocks or 256K text characters or mixed *)

Write-protection of RAM memory module PCD6.R51..

The opraring mode can be selected by reinserting jumper W1:

The RAM module is write-protected

The RAM module is not write-protected
(state on delivery)

*) Programs, texts and data blocks can be mixed as desired for each CPU on the memory module.

7.4 Memory modules PCD6.R2.. and R6.. for up to 1M byte

These new modules include all the functions of the R1../R5.. types and offer the following additional capabilities:

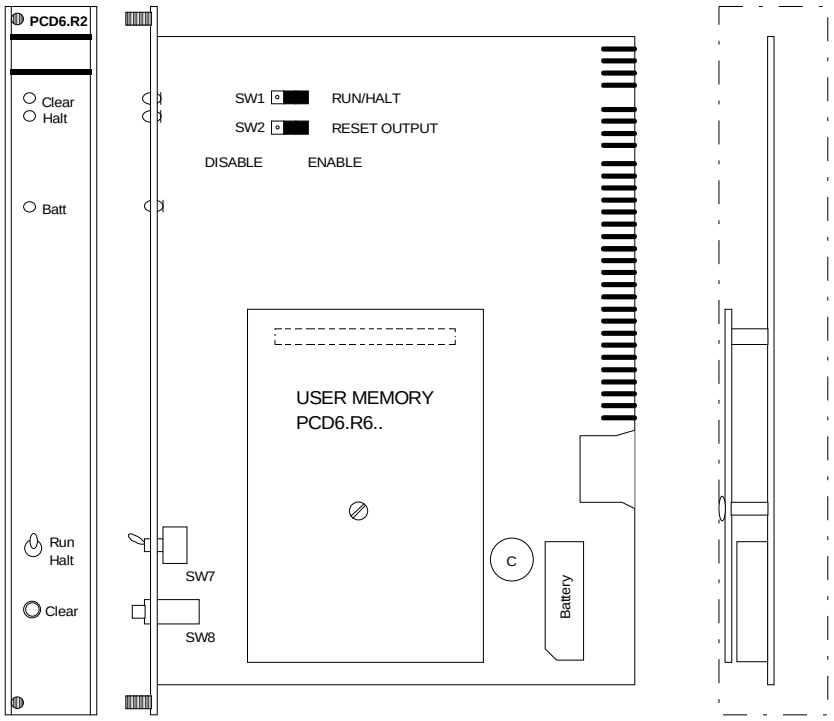
- four times the memory capacity, up to 1M byte;
- possibility to mix RAM and EPROM memory;
- additional memory area for texts and data blocks in the address range 4000..7999.

These new capabilities are dependent on CPU firmware and programming software:

CPU firmware	Programming Utilities	Contents	Size
V005	V1.5	PROG/TX/DB (0.. 3999):	256KB
V006	V1.6	PROG/TX/DB (0.. 3999):	1MB
V007 *	V1.7	PROG/TX/DB (0.. 3999) + extra TX/DB (4000.. 7999) + new TFR instruction	1MB

7.4.1 Public memory module PCD6.R210

The "Run/Halt" switches and the "Clear" key are enabled by jumpers (see chapter 7.2.2).



SW1: jumper
SW2: jumper
} see chap. 7.2.2

User memory: memory modul

SW7: bistable toggle switch
SW8: pulse key

Battery: buffer battery (NiCd)

C: bypass capacitor for battery change (buffer duration at least 20sec.)

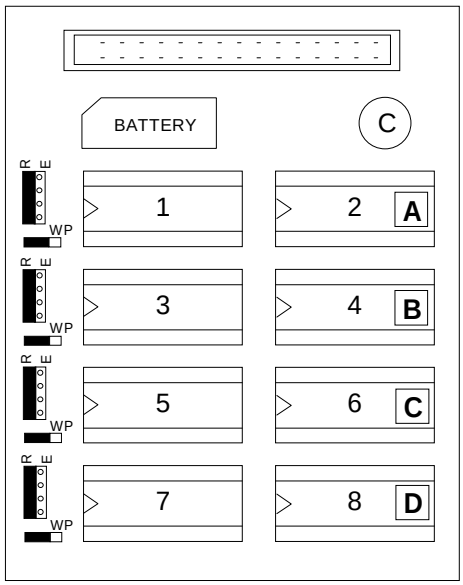
7.4.2 Memory module PCD6.R6..

The PCD6.R6.. memory modules hold all user programs, texts and data blocks.

Memory modules of the type R6.. can only be used with the ..R210 main module.

The R6.. memory modules are designed to be highly flexible and can be fitted with RAM and/or EPROM up to 1M byte (mixed RAM/EPROM is possible). The memory can also be partitioned into suitably sized segments for the user program, texts and data blocks for each CPU (this is done using the PCD Programming Utilities or hand held Programming Unit).

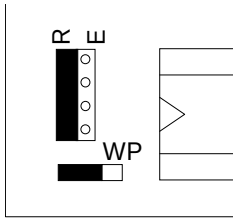
Memory module PCD6.R6..



Battery : buffer battery (NiCd)

C : bypass capacitor for battery change (buffer duration at least 20sec.)

A..D : memory blocks for RAM or EPROM



Drawing shows factory setting.

Jumper R: for RAM
E: for EPROM
WP: write protection for RAM, the setting shown is without write protection

Models

Type PCD6.R600	without user memory (for EPROM)
Type PCD6.R610	with 256KB RAM in memory block D
4'502'6149'0	EPROM type 27C1001-15, 1M bit
4'502'7013'0	RAM type TC 55 1001 PL-10, 1M bit

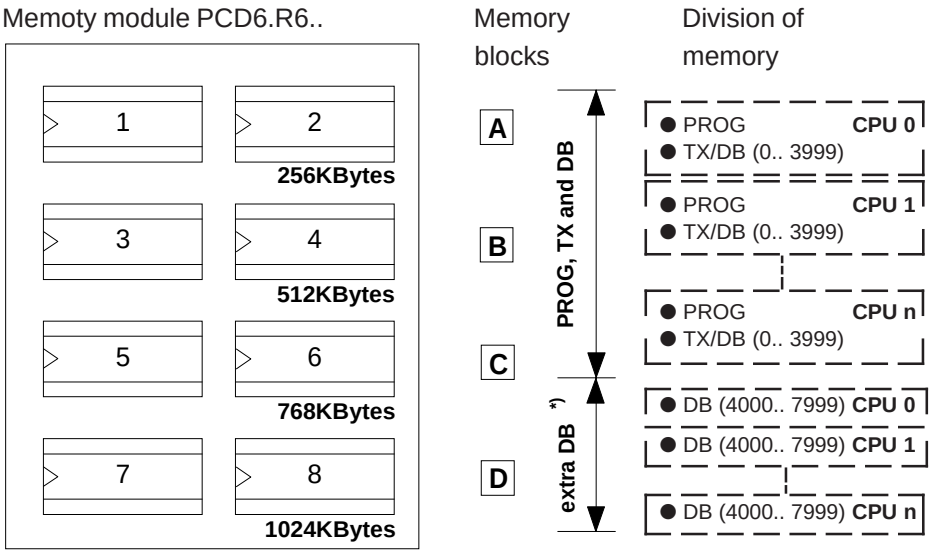
Note: There is a risk of data loss if non-SAIA memory chips are used.

Memory addressing

Use of memory is extremely flexible in the way it can be configured for individual requirements. The following memory areas can be allocated separately for each CPU:

- user program	(PROG):	0... 262'043 program lines	
- user text	(TX):	0... 3999	shared
- data blocks	(DB):	0... 3999	addresses
- extra texts	(TX):	4000... 7999	shared
- extra data blocks	(DB):	4000... 7999	addresses

Allocation for each CPU is done from the "Configure" menu of the PCD Programming Utilities, or using the hand held Programming Unit.



Additional information concerning Data Blocks

- Due to the organisation of the memory, an R/T/C (32 bits) stored in the DB address range 0... 3999 will require 8 bytes.
  The same R/T/C when stored in the address range 4000... 7999 will require only 4 bytes.

- With the instructions PUT and GET only whole blocks of R/T/C's can be transferred to/from a Data Block.
  With the new TFR instruction a single R/T/C can be transferred to/ from a Data Block (from firmware version PCD6.V007 upwards).

*) The base address for the start of the extra text and extra data block memory is assigned from the PCD Programming Utilities' "Configure" menu. This extra memory area can be mapped into memory blocks B, C or D.

Example:

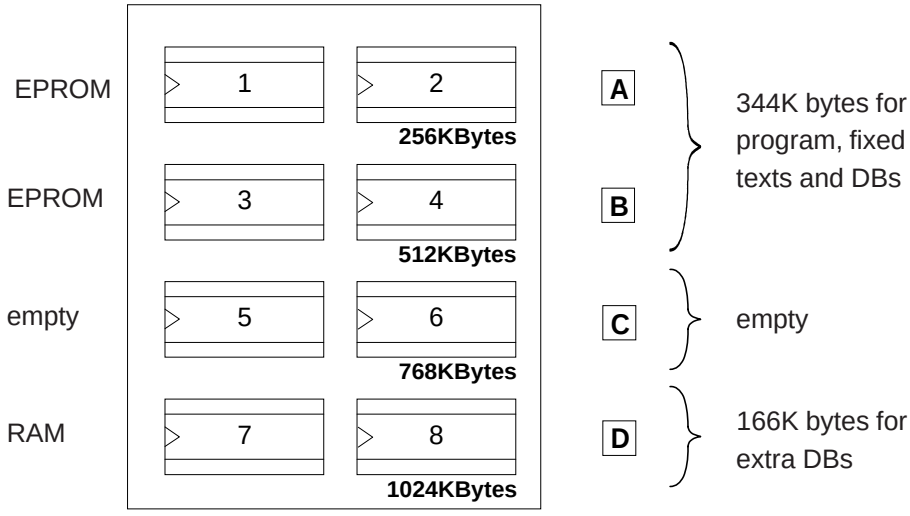
3 processors (CPU 0..CPU 2) with program, fixed texts and data blocks in EPROM, and extra data blocks in RAM.

CPU 0:	60K	program lines	=	240K bytes
	10K	bytes for fixed texts and DBs (of which 4KB = DBs = 512 registers)	=	10K bytes
	6K	bytes for extra DBs (=1.5K registers)	=	6K bytes
CPU 1:	20K	program lines	=	80K bytes
	6K	bytes for fixed texts (no DBs)	=	6K bytes
	160K	bytes for extra DBs (= 40K registers)	=	160K bytes
CPU 2:	6K	program lines	=	24K bytes
	80K	bytes for fixed texts and DBs (of which 64KB = DBs = 8K registers)	=	80K bytes
Total	86K	program lines } EPROM	=	440K bytes
	96K	bytes for fixed texts and DBs (of which 68KB = DBs = 8.5K registers)		
	166K	bytes for extra DBs (= 41.5K registers)	=	166K bytes

The following is required to accommodate this large volume of data:

- address blocks A and B with 4 EPROMs
- address block D with 2 RAMs

➜ use type PCD6.R610 (which includes ex. factory 256KB RAM) and fitted with 4 EPROMs.



Notes :

9. Power supply modules

The power supply modules provide the **internal** power for the PCD6 series. Interference suppressor filters and various monitoring circuits ensure reliable operation of the PCD even under tough industrial conditions (interference tests at 4 kV in accordance with IEC 801-4, class III). The power supply module is plugged into the first location on the left for each rack unit and fastened with 4 screws. If the entire controller is to be transported, the power supply module **must be packed separately** (owing to its weight). The bus connectors may otherwise be damaged by impact.

The following standard versions are available:

Type	Application
PCD6.N100 *)	AC voltage module for 230 VAC, 50 Hz, for digital I/O modules, incl. watchdog circuit
PCD6.N110	AC voltage module for 230 VAC, 50 Hz, for all I/O modules as ±15 V also supplied, incl. watchdog circuit
PCD6.N200 *)	DC voltage module for 24 VDC, for digital I/O modules, incl. watchdog circuit
PCD6.N210	DC voltage module for 24 VDC, for all I/O modules as ±15 V also supplied, incl. watchdog circuit

Other AC voltages (e.g. 115 VAC, 60 Hz) can be supplied on request. A key switch serving as a safety switch for the power supply is available as an optional accessory.

*) No longer available

9.1 PCD6.N1.. Power supply modules for 230 VAC, 50 Hz

Types

PCD6.N100	For digital I/O modules only
PCD6.N110	For all I/O modules, as ±15 V also supplied

Technical data

Supply voltage	230 VAC +10%/-15%, 50 Hz
Galvanic isolation	Yes, by transformer
Power consumption 230 VAC	..N100 max. 0.45 A ..N110 max. 0.60 A
Input fuses	Primary 1.6 A slow-blow Secondary 6.3 A slow-blow

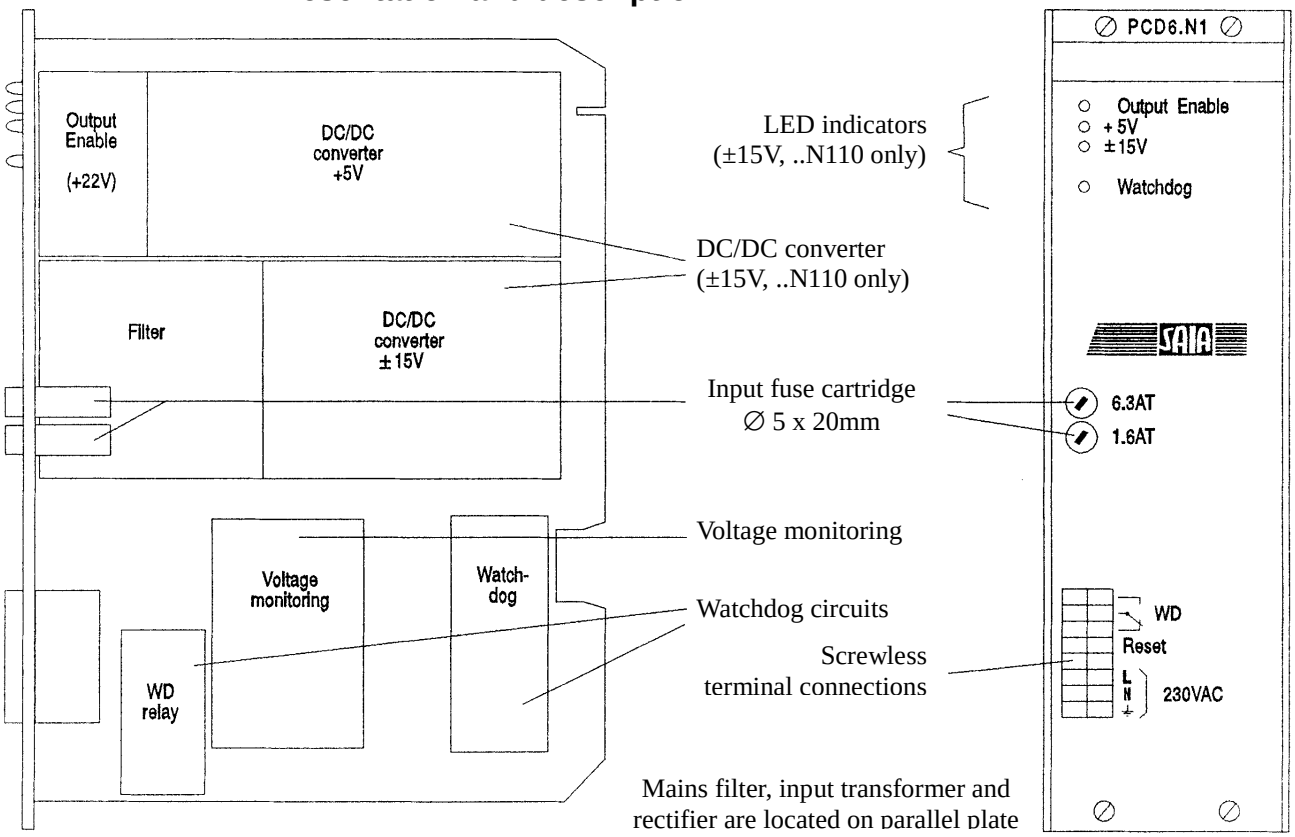
Output voltages and currents to PCD6 bus

	..N100	..N110
+5 V	8 A	8 A
+22 V	1 A	1 A
+15 V	—	0.8 A
–15 V	—	0.8 A

Short-circuit protection on all outputs

Voltage monitoring	Secondary voltage +24 VDC, +5 VDC and +15 VDC
Watchdog frequency	≥5 Hz on all addresses 255 + n * 256
Watchdog contact	Max. 0.5 A, 48 VAC or VDC
External reset	Fast reset input for program step counter, all timers, the volatile flags and for all digital outputs

Presentation and description



The PCD6.N.. power supply modules have performance characteristics designed such that they can supply all combinations of modules in a rack with the necessary voltages. When more than 4 processor modules are used in the same unit, we recommend checking the power requirement in accordance with section 9.3 for reasons of safety.

Voltage monitoring provides control when the PCD6 is switched on and off and ensures it is ”reset” if the voltage is low. This prevents the execution of uncontrolled mal functions.

Green LED indicators (Output Enable, +5 V, ±15 V) should be lit without exception under normal operating conditions. Output Enable means that all I/O module power supplies are available.

Yellow watchdog LED is only lit when the monitoring circuit is activated by the user program.

External reset. In any operating state, the PCD6 can be reset within 2 ms when ground potential (GND) is applied to the ”Reset” terminal. Reset means:

– all digital outputs are reset (independently of jumper ”Reset Output”)

– all timers and volatile flags are reset

– a cold start is always executed after a reset

Use of the watchdog

The **watchdog monitoring circuit** enables the correct execution of the user program to be monitored reliably. In case of error, effective safety measures can be taken.

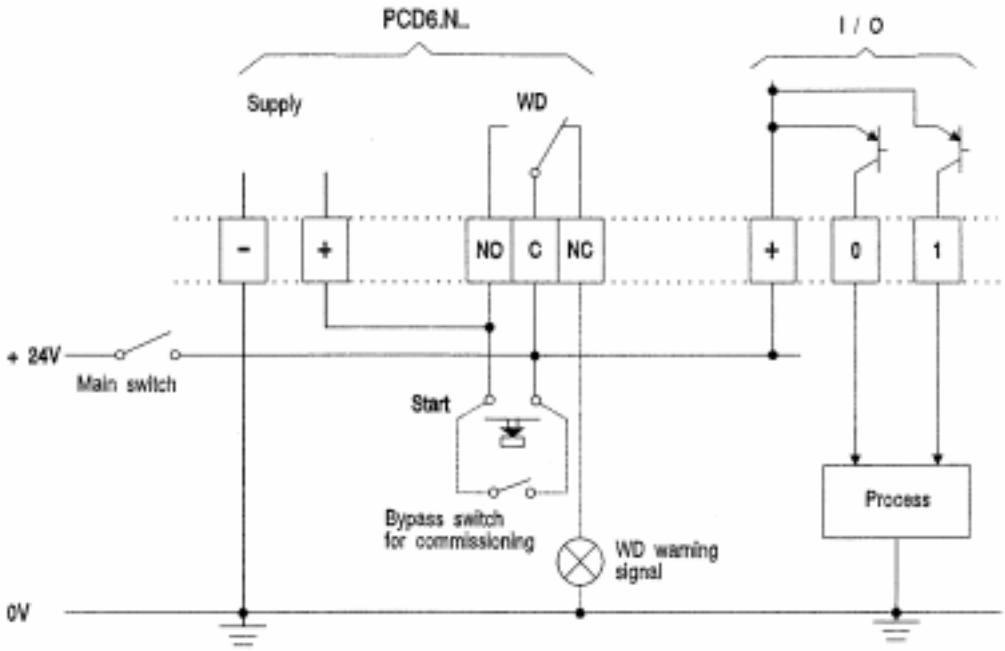
The **WD relay** remains active (working contact closed) as long as I/O address 255 (or 255 + n * 256 for extension rack units) receives an alternating signal of ≥5 Hz. This signal is easily produced by inserting the instruction **COM 0 255** in a COB which is being cyclically executed.

```
  COB    0   ; or 1...15
         0

( ACC    H   )

  COM    O   ; 255 (or  255 + n * 256 (for extension rack unit))
   :     :
   :     :

 ECOB
```

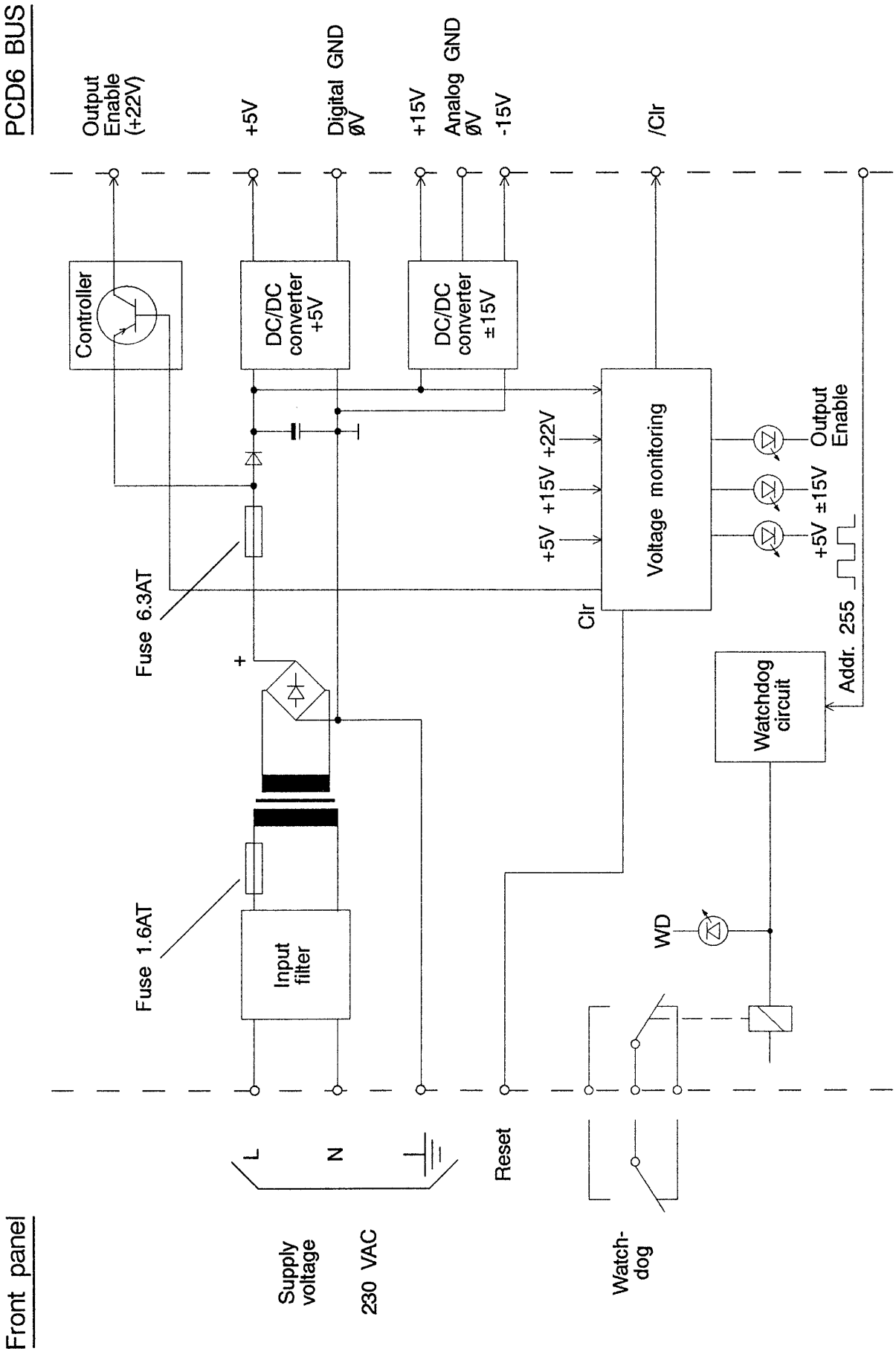
If a fault should arise in the user program or the CPU, or if any other operating mode than ”RUN” is chosen, the watchdog relay contact opens and the yellow ”Watchdog” LED is extinguished. Necessary safety measures can now be carried out using this watchdog relay contact.

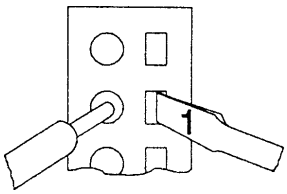
Note: Watchdog addresses 255 etc. should **not** be used as element addresses for digital inputs and outputs. In general, special modules such as analogue, motion control or fast counting modules must not be used at addresses 240...255 and 496...511 etc.

Connection diagram



Block diagram for ..N110 (..N100 without ±15 V converter)





Screwless terminal connections

Press screwdriver no. 1 firmly into the square aperture on the right. Insert the stripped wire into the round aperture on the left as far as it will go, remove the screwdriver. Check that the wire is firmly connected.

0.14 to 2.5 mm wires may be used. 6...9 mm of insulating material must be stripped off.

9.2 PCD6.N2.. Power supply modules for 24 VDC

Types

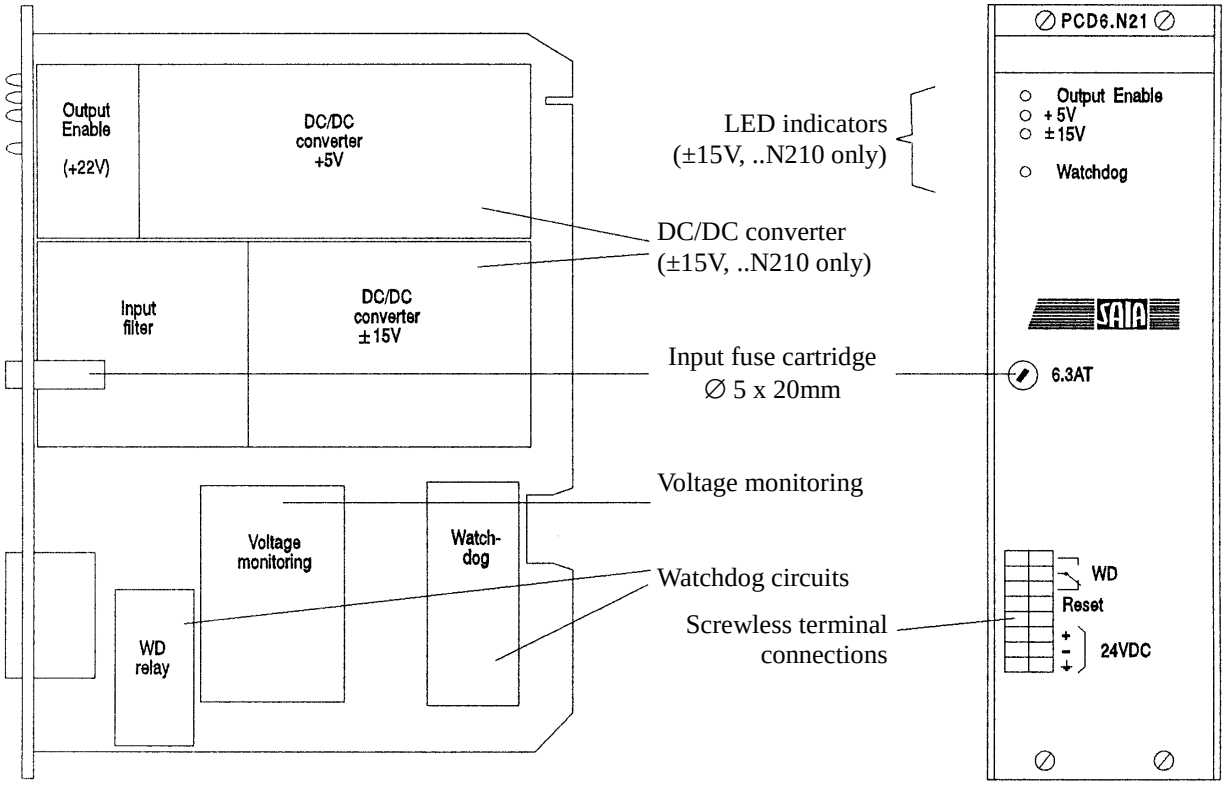
PCD6.N200	For digital I/O modules only
PCD6.N210	For all I/O modules, as ±15 V also supplied

Technical data

Supply voltage	Smoothed 24 VDC +20 %/-15 %, two-way rectification secondary voltage of the transformer 19 VAC +10%/-15%, transformer min. 200 VA
Galvanic isolation	No, supply voltage negative pole connected to ground
Power consumption 24 VDC	..N200 max. 4.5 A ..N210 max. 6.0 A
Input fuses	6.3 A slow-blow
Reverse voltage protection	Yes
Output voltages and currents to PCD6 bus	See table below
	Short-circuit protection on all outputs
Voltage monitoring	Secondary voltage +24 VDC, +5 VDC and +15 VDC
Watchdog frequency	≥5 Hz on all addresses 255 + n * 256
Watchdog contact	Max. 0.5 A, 48 VAC or VDC
External reset	Fast reset input for program step counter, all timers, the volatile flags and for all digital outputs

	..N200	..N210
+5 V	8 A	8 A
+22 V	1 A	1 A
+15 V	—	0.8 A
–15 V	—	0.8 A

Presentation and description



The PCD6.N.. power supply modules have performance characteristics designed such that they can supply all combinations of modules in a rack with the necessary voltages. When more than 4 processor modules are used in the same unit, we recommend checking the power requirement in accordance with section 9.3 for reasons of safety.

Voltage monitoring provides control when the PCD6 is switched on and off and ensures it is ”reset” if the voltage is low. This prevents the execution of uncontrolled mal functions.

Green LED indicators (Output Enable, +5 V, ±15 V) should be lit without exception under normal operating conditions. Output Enable means that all I/O module power supplies are available.

Yellow watchdog LED is only lit when the monitoring circuit is activated by the user program.

External reset. In any operating state, the PCD6 can be reset within 2 ms when ground potential (GND) is applied to the ”Reset” terminal. Reset means:

– all digital outputs are reset (independently of jumper ”Reset Output”)

– all timers and volatile flags are reset

– a cold start is always executed after a reset

Use of the watchdog

The **watchdog monitoring circuit** enables the correct execution of the user program to be monitored reliably. In case of error, effective safety measures can be taken.

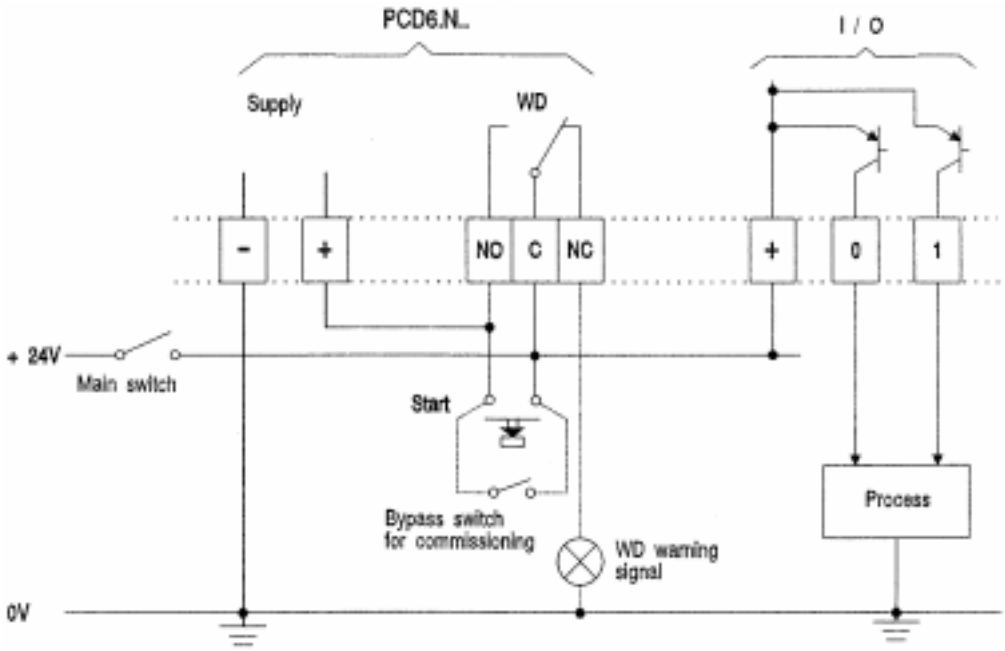
The **WD relay** remains active (working contact closed) as long as I/O address 255 (or 255 + n * 256 for extension rack units) receives an alternating signal of ≥5 Hz. This signal is easily produced by inserting the instruction **COM 0 255** in a COB which is being cyclically executed.

```
  COB    0   ; or  1...15
         0

( ACC    H   )

  COM    O   ; 255 (or  255 + n * 256 (for extension rack unit))
   :     :
   :     :

 ECOB
```

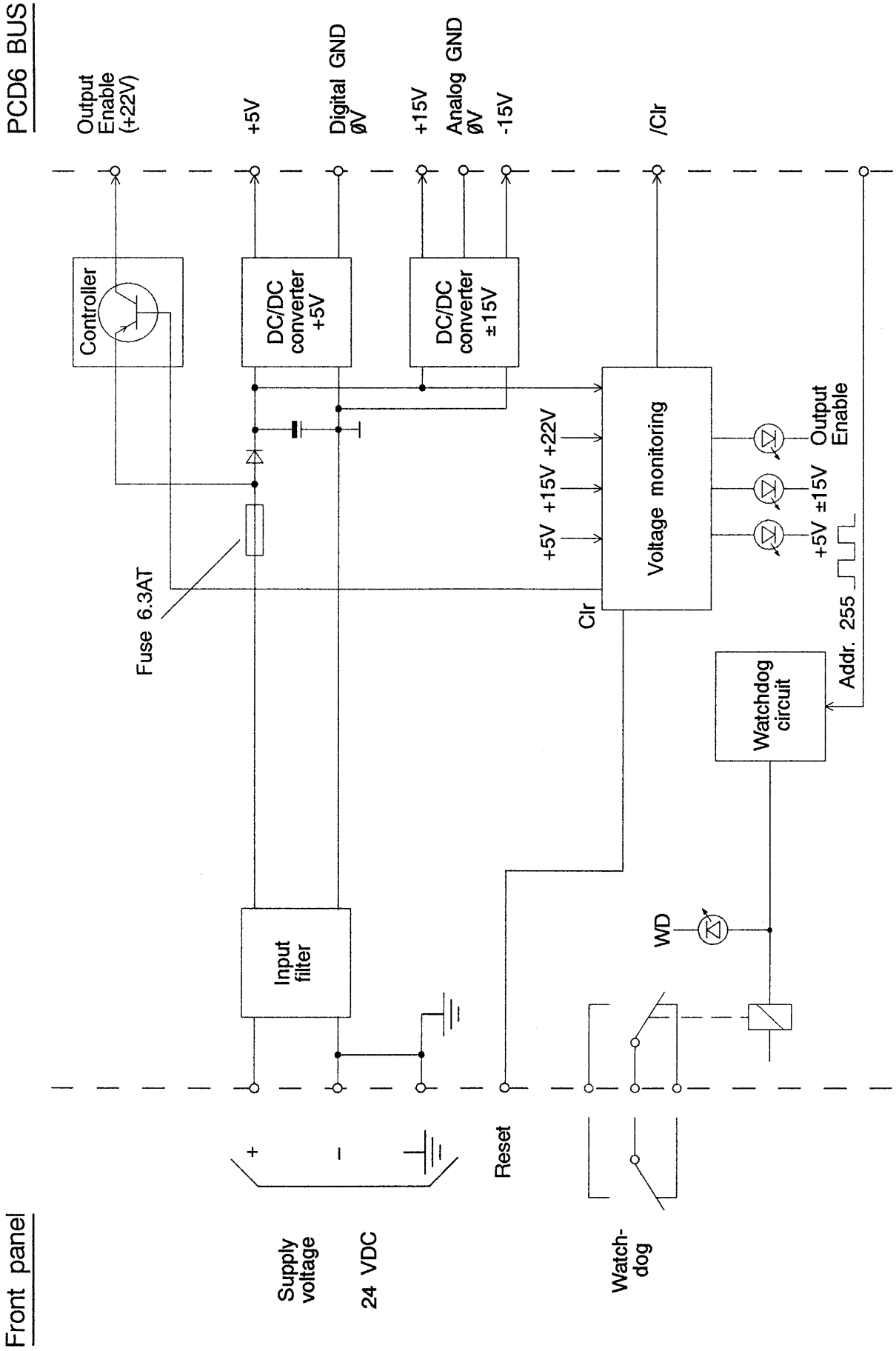
If a fault should arise in the user program or the CPU, or if any other operating mode than RUN is chosen, the watchdog relay contact opens and the yellow ”Watchdog” LED is extinguished. Necessary safety measures can now be carried out using this watchdog relay contact.

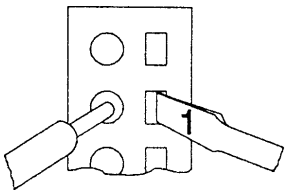
Note: Watchdog addresses 255 etc. should **not** be used as element addresses for digital inputs and outputs. In general, special modules such as analogue, motion control or fast counting modules must not be used at addresses 240...255 and 496...511 etc.

Connection diagram



Block diagram for ..N210 (..N200 without ±15 V converter)





Screwless terminal connections

Press screwdriver no. 1 firmly into the square aperture on the right. Insert the stripped wire into the round aperture on the left as far as it will go, remove the screwdriver. Check that the wire is firmly connected.

0.14 to 2.5 mm wires may be used. 6...9 mm of insulating material must be stripped off.

9.3 Power requirements of PCD6 modules

The PCD6 power supply modules provide the **internal** power for all PCD6 modules at +5 V, +15 V and -15 V.

Capacity of the PCD6.N.. power supply modules

Type PCD6	I at +5 V mA	I at +15 V mA	I at -15 V mA
N100	8000	–	–
N110	8000	800	800
N200	8000	–	–
N210	8000	800	800

Power requirements of the PCD6 modules

Type PCD6 (PCD8)	I at +5 V mA		I at +15 V mA		I at -15 V / mA	
	max.	mean[1)]	max.	mean[1)]	max.	mean[1)]
C100	150	150				
C110	150	150				
C200	150	150				
C400	–	–				
T300	2700[2)]	1500[2)]				
T400	500	500				
M100	600	600				
M2..	850	850				
M540	800	800				
R1../R5..	620	620				
R2../R6..	400	400				
T1..	250	250				
E100	10	10				
A200	50	25				
A350	120	60				
A400	250	110				
W1..	60	60	50	50	50	50
W3..	35	35	35	35	20	20
W400	20	20	85	60	30	30
P800	380	380				
P100	120	120				

[1]) Statistical mean when 50% of all I/Os are active
[2]) Depending on whether 1 or 3 extension plugs are used.

Example: 3 Communications processors and 6 I/O modules

Type PCD6 (PCD8)	I at +5 V mA		I at + 15 V mA		I at -15 V mA	
	max.	mean[1)]	max.	mean[1)]	max.	mean[1)]
1 x C110 1 x R1../R5.. 3 x M2..	150 620 2550	150 620 2550				
2 x E100 3 x A400 1 x W400	20 600 20	20 330 20	85	60	30	30
(1 x P800) (1 x P100)	(380) (120)	(380) (120)				
Total	3960 (500)	3690 (500)	85	60	30	30
Test	<8000	< 8000	< 800	< 800	< 800	< 800

There is a reserve of approx. 50% at 5 V in the case of this average configuration of the main unit.

These strong power supply modules can only be overloaded by an extreme configuration:

– 7 processors ..M2..
– plus connecting module ..T300 loaded on all 3 connectors for a total of 5120 I/Os

Practically all other combinations are not considered critical as far as power requirement is concerned.

Notes :

10. General information on I/O modules

The PCD6 series design offers great versatility with regard to I/O modules, thus allowing the use of the previous PCA2 modules as well as all the new specific PCD6 I/O modules. What are the differences?

– The module connectors are different and incompatible. Therefore, two different types of system cables are required.

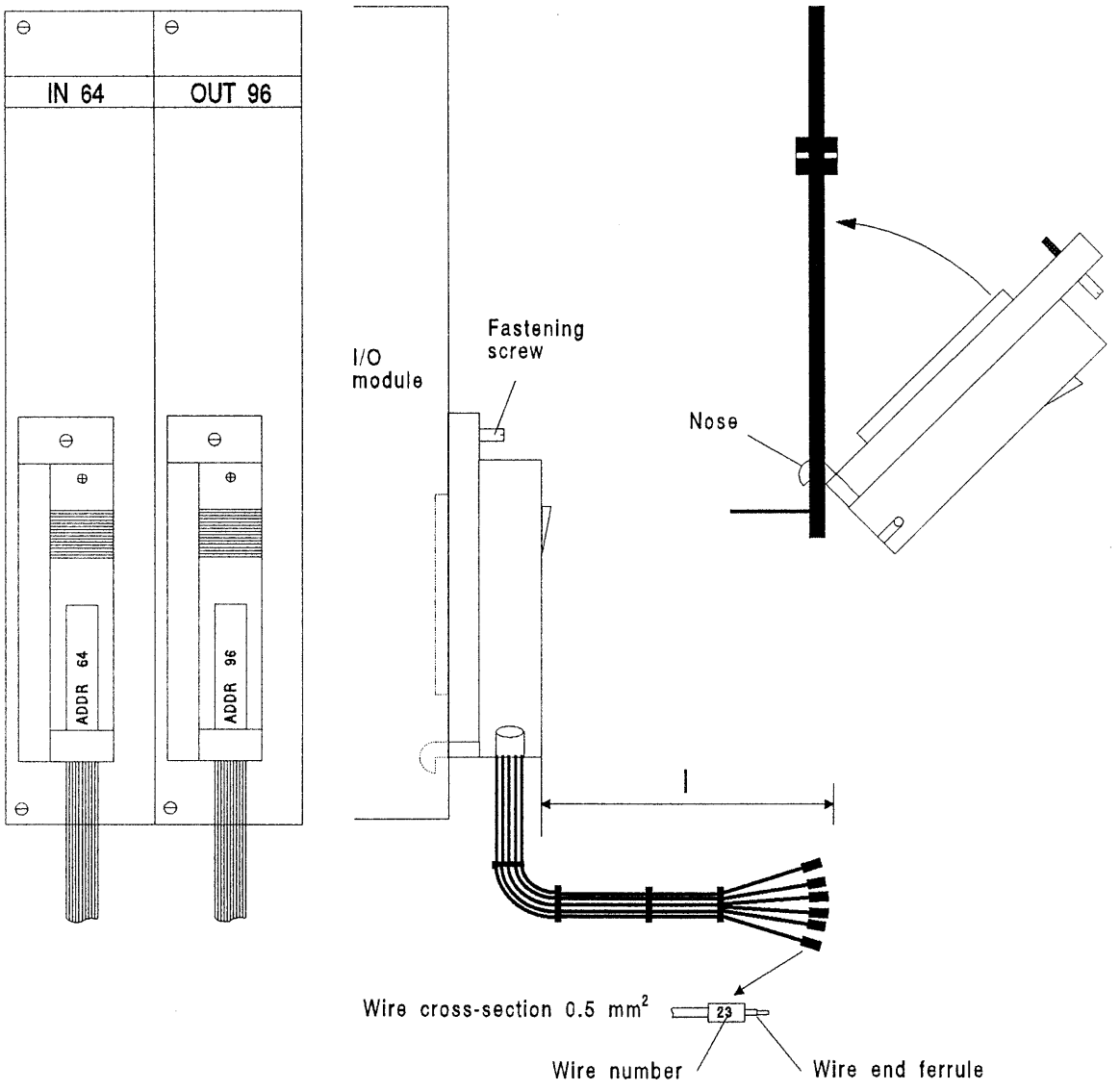
– The Q-I/O test, i.e. the automatic check verifying whether an I/O module is missing in the system, may only be carried out with the new PCD6 modules. (Except the latest PCA2 modules PCA2.A21.. and ..E60.. which can be rendered Q-I/O compatible by inserting a jumper).

– The new PCD6 modules largely employ SMD technology and ASIC for bus control. Reliability could thus be increased even more.

The PCD6 modules will be available longer in the future than the ”old” PCA2 modules.

It must be pointed out, however, that PCA2 modules may be combined with PCD6 modules in the same system as desired during the transition period, provided that the different front connectors are aesthetically acceptable. It must also be noted that the intricate modules between PCA2 and PCD6 must be handled differently regarding the user program (e.g. the ALGI/ALGO commands may only be used for the input and output of analogue values for the PCA2.W1.. module). All PCD6 analogue modules require the new PCD6 power supply modules supplying the ±15 V regulated voltages via the bus.

10.1 PCD6.K.. System cable and module connectors for the I/O modules



Connection to the front connectors of the input and output modules is easily effected with the aid of the so-called system cables. These cables are provided with the lockable module connector at one end and with numbered wire end ferrules at the other end. The numbers of the individual wires exactly correspond to the numbers in the pin assignment diagrams as evident from the respective I/O documentation.

The cable as such is not jacketed but rather consists of single wires which are held together by several ties attached approx. every 20 cm. This allows laying the system cables in any cable duct with great flexibility. If the cable must be spliced, the respective ties can easily be undone.

Labelling of I/O modules and connectors

The following labels are delivered with every main PCD6.C1.. rack:

– Red address labels numbered from 0...1264 which are inserted in the top I/O module holder

– Grey address labels numbered from 0...1264 which are adhered to the connector shell of the system cables

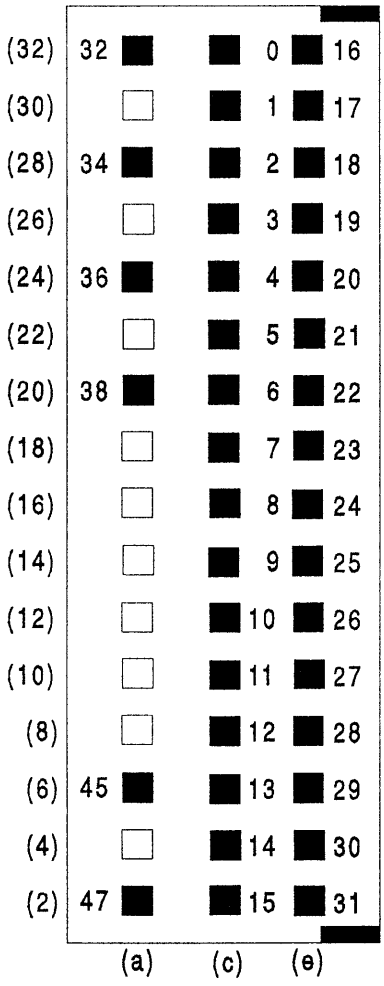
– Grey address labels numbered from 0...1264 which are adhered to the front panels of the I/O modules next to the LEDs

I/O module addressing is described in detail in chapter 2.5.

Connector cover and test probe

The connector cover may be detached by removing the Phillips screw in order to provide access to every connector pin with a thin test probe. Thus, the connector pins can be accessed during operation with the test probe. The test probe must be inserted above the cable. All wires are crimped to the connector contacts resulting in reliable contact. It must be noted that the connector pin numbers do not correspond to the wire numbers of the cable. Both types of numbering will be explained in the following. They are also evident in the respective I/O module documentation.

Pin assignment and type designation



View to module front or connector rear

0...47 Wire numbers of system cable

■ Used connector pins with cable (38 wires each 0.5 mm^2)

□ Unused pins without a cable

(2)...(32) ┐ Pin numbers
(a) (c) (e) ┘ of connector

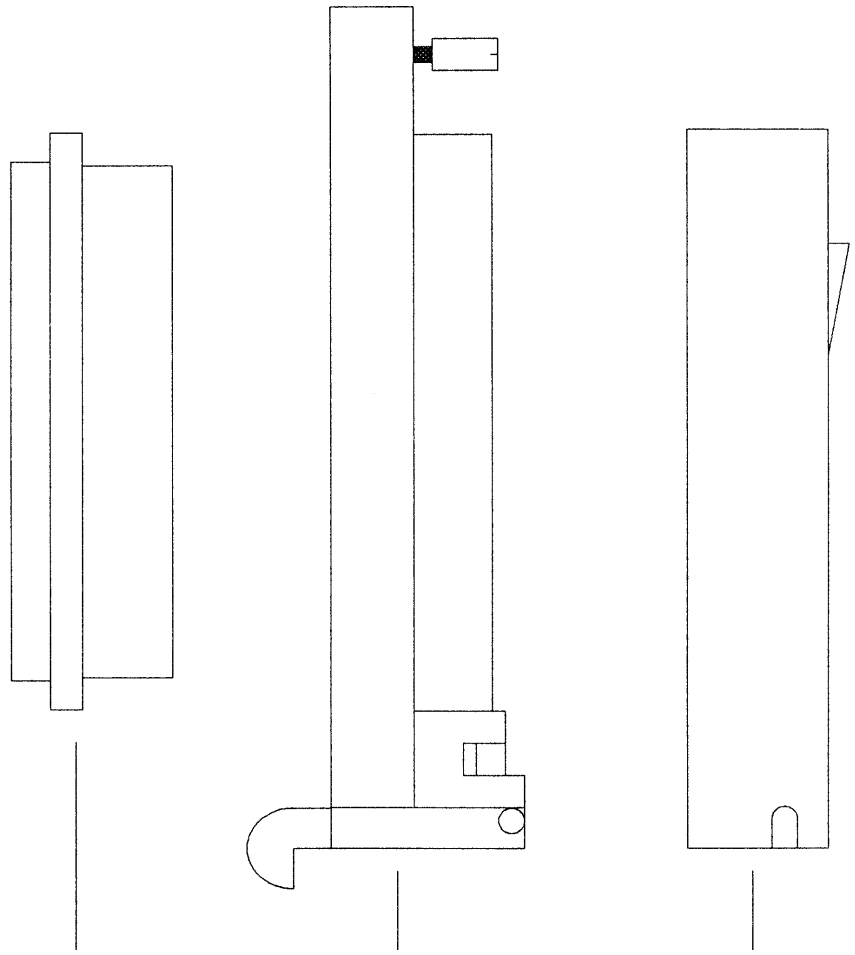
Cable lengths

PCD6.K212: 2.5 m
PCD6.K214: 4.0 m

Module connector type PCD6.K200 without cable

In applications where special cables are required, the user may also adapt them to his requirements himself.

The following items are delivered under the type designation PCD6.K200:



Connector unit Fastening unit Connector cover

The tulip contact springs (with gold-plated contact part) which are inserted in the connector unit are crimp connections for litz wires from 0.14 to 0.56 mm^2. Such tulip contact springs can be obtained from:

Crimp connections
order no. 4’408’4861’0 (pack contains 100 pieces)

Maximum current loading of the contact is
6 A at an ambient temperature of 20°C
4.8 A at an ambient temperature of 50°C

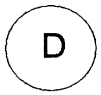
The following items cannot be obtained from SAIA, but from HARTING (Germany) or their branches:

– Crimp connections on an endless strip (approx. 300 contacts) under Harting order no. 0 906 000 9481

– Simple crimping tool for single contacts and connection wires from 0,14...0,56 mm
  Harting order no. 09 99 000 0076
  Sleeve 09 99 000 0086

– Harting also offers more efficient tools ranging up to the automatic crimping device.

Harting Co. addresses and the most important branches:



Germany
Harting Elektronik GmbH
Postfach 1140 - D-4992 Espelkamp
Tel. (0 57 72) 47-1
Fax (0 57 72) 33 02

France
HARTING ELEKTRONIK S.A.R.L.
BP 24
F-94121 Fontenay-sous-Bois Cedex
Tel. (1) 48 77 06 26, Tx 2 12 583
Telefax (1) 48 77 14 28

Great Britain
HARTING ELEKTRONIK Ltd.
GB-Biggin Hill, Kent TN 16 3 BW
Tel. (09 59) 7 1411, Tx 95 168

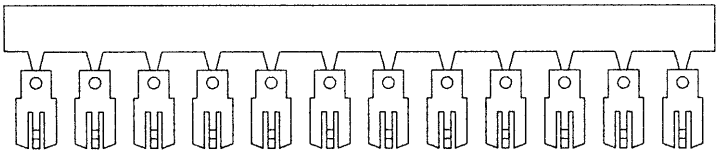
Italy
HARTING ELEKTRONIK S.P.A.
Via Como, 2
I-20096 Pioltello (Milano)
Tel. 02-9 24 03 66, 02-9 24 05 64
Tx 323 494

Switzerland
HARTING ELEKTRONIK AG
Industriestrasse 26
CH-8604 Volketswil
Tel. 01-946 09 66, Fax 01-946 09 70

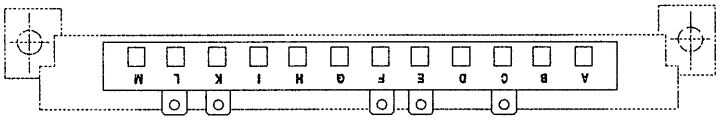
Addresses of other branches can be obtained from Harting Co.!

Module connector coding avoids confusion

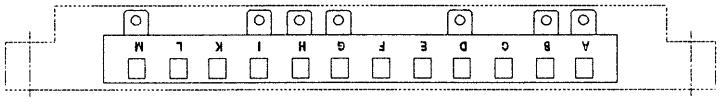
Every module connector and its mating connector can be prevented from being confused by means of coding pins. For this purpose, the connectors are provided with coding strips on the side each with 12 coding locations (A...M) in which a maximum of 900 coding patterns may be inserted with the aid of coding pins. Every system cable or single connector is provided with a comb of 12 coding pins.



Comb with
12 coding pins

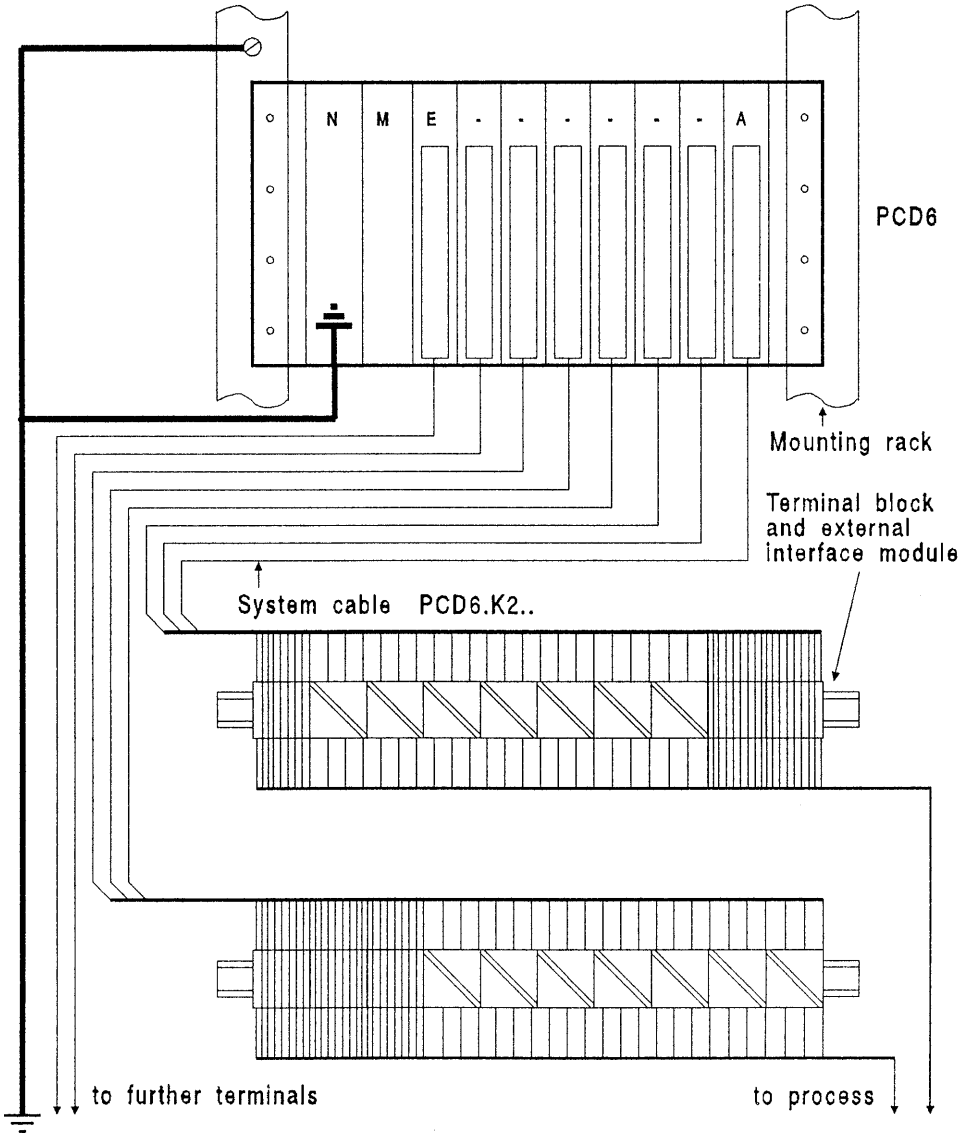


Intricate
coding example:
module connector



Cable connector

Cabling with system cables and external interfaces



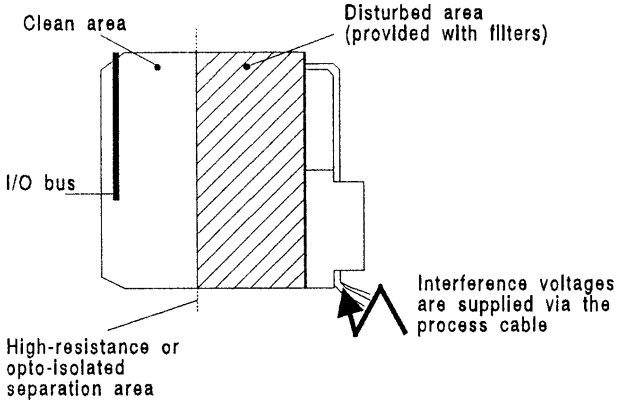
As evident from the above figure, the use of system cables with PCD6 permits simple and clearly arranged organization of the appropriate elements for connection to the process. It is important to properly connect the PCD6 to ground via the power supply module to ensure maximum noise immunity. All modules are grounded via the tightened front screws.

Noise immunity

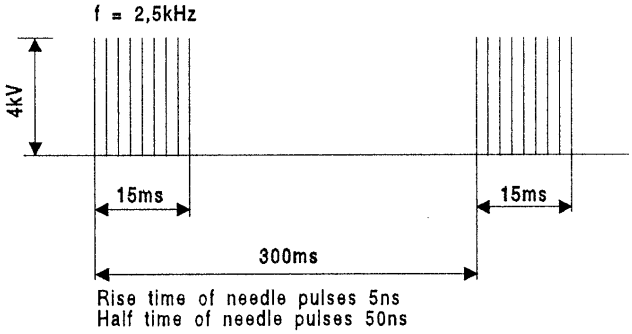
With digital I/O modules, the system cables as well as the cables between the switch cabinet and process may be laid in the usual cable ducts of contactor, valve and motor cables without causing problem provided that the distances do not exceed approx. 50 m. In case of longer distances, it is recommended to use a separate cable duct.

Noise immunity of the I/O modules is tested in accordance with IEC 801-4 to determine the reproducible values. This means that due to the elaborate circuit principle of the SAIA®PCD high voltage peaks (directly applied to the digital 24 V inputs/outputs) do not cause malfunction or destruction of the components (see following figures):

Structure of PCD6 (cross section)



Interference voltage test according to IEC 801-4 (4kV)



Notes :

11. Digital input/output modules

All digital I/O modules are subjected to the tough interference tests with 4 kV in accordance with IEC 801-4 to ensure maximum noise immunity and reliability.

All modules may be inserted in a PCD6.C.. rack unit in any position desired and fastened with knurled screws. This screw connection at the same time serves as a broad ground connection for the entire system.

The type designation of the module is visible on the front panel at the top and in detail on the connector side of the PC-board.

PCD6.E100 Moderately priced input module for source operation. 32 inputs electrically connected, suited for most electronic and electromechanical switching elements connected to 24 VDC.

PCD6.E610/..E611 Input module with electrical isolation for source or sink operation with 32 inputs. Suitable for most electronic and electro-mechanical switching elements at 24 VDC. Type PCD6.E611 has a short input delay of typ. 0.1/0.3 ms.

PCD6.A200 Output module with 16 relays (NO contacts) for AC or DC. Switch rating 2 A at 250 VAC.
An integrated RC network eliminates arcing at low to medium switch ratings.

PCD6.A350 Transistor output module, 16 outputs galvanically isolated, short-circuit proof. Switching capacity 2 A, 24 VDC.

PCD6.A400 Most common output module with 32 transistor outputs 5...500 mA at 24 VDC. Circuits electrically connected in a voltage range from 5...32 VDC.

11.1 PCD6.E100 Digital input module, electrically connected

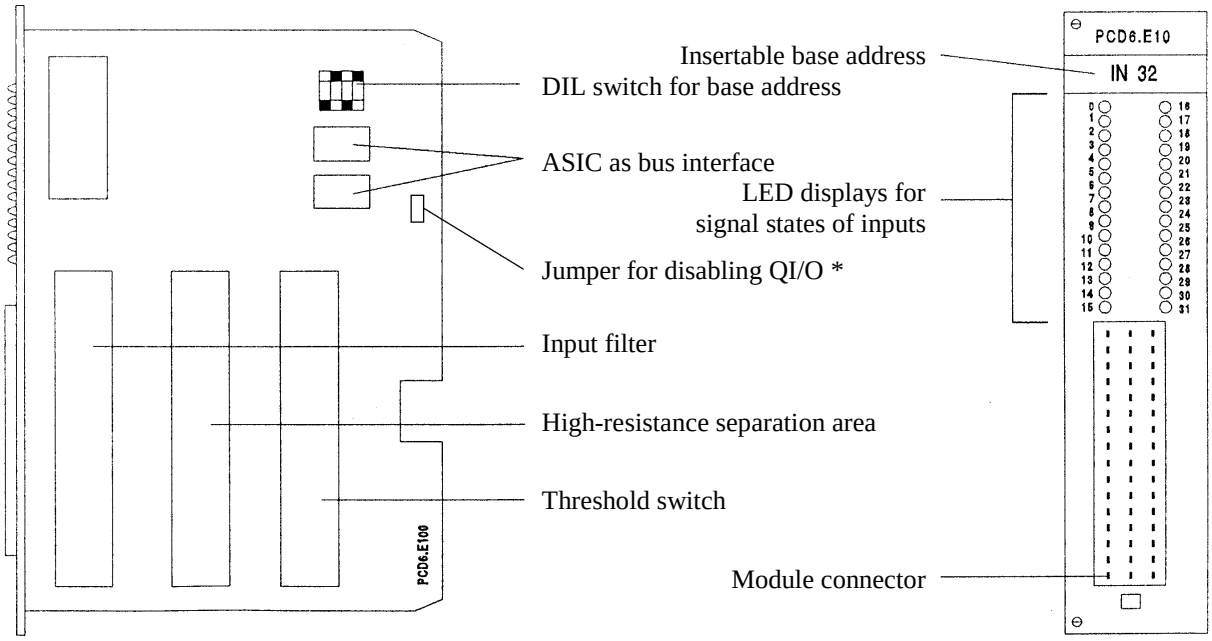
Application

Moderately priced input module for source operation with 32 inputs, electrically connected. Suited for most electronic and electrnmechanical switching elements connected to 24 VDC.

Technical data

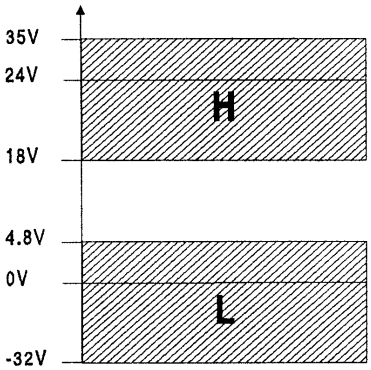
Number of inputs per module	32, electrically connected source operation only
Input voltage V_{in}	Nom. 24 VDC smoothed or pulsating
Input current	8 mA at 24 VDC
Input delay	Typ. 9 ms
Operating temperature	-20...+50°C
Storage temperature	-20...+85°C
Applied standards	IEC 1131-2, VDI 2880, NF C63-850
Noise immunity with IEC 801-4	4 kV direct, 2 kV capacitive coupling (whole brunch of pairs)
Number of assigned addresses	32
Internal current consumption from 5 V bus	10 mA

Presentation



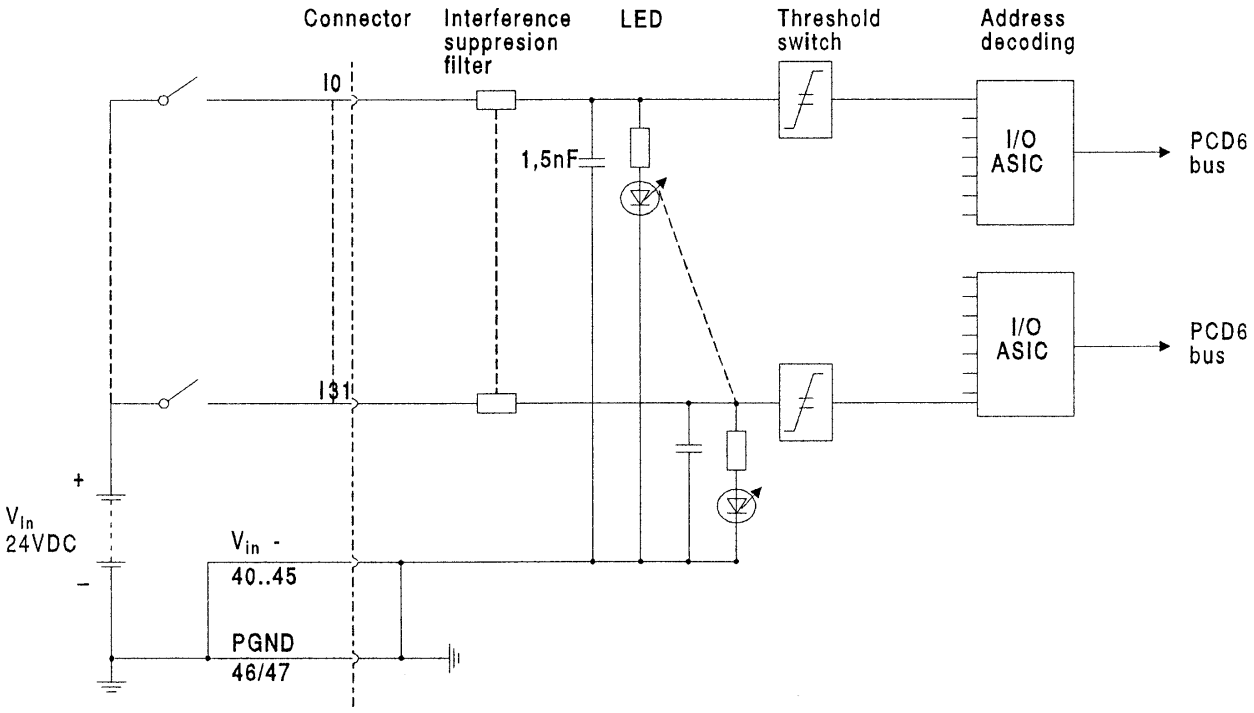
*) When employed on PCA2, remove jumper

Input signal definition



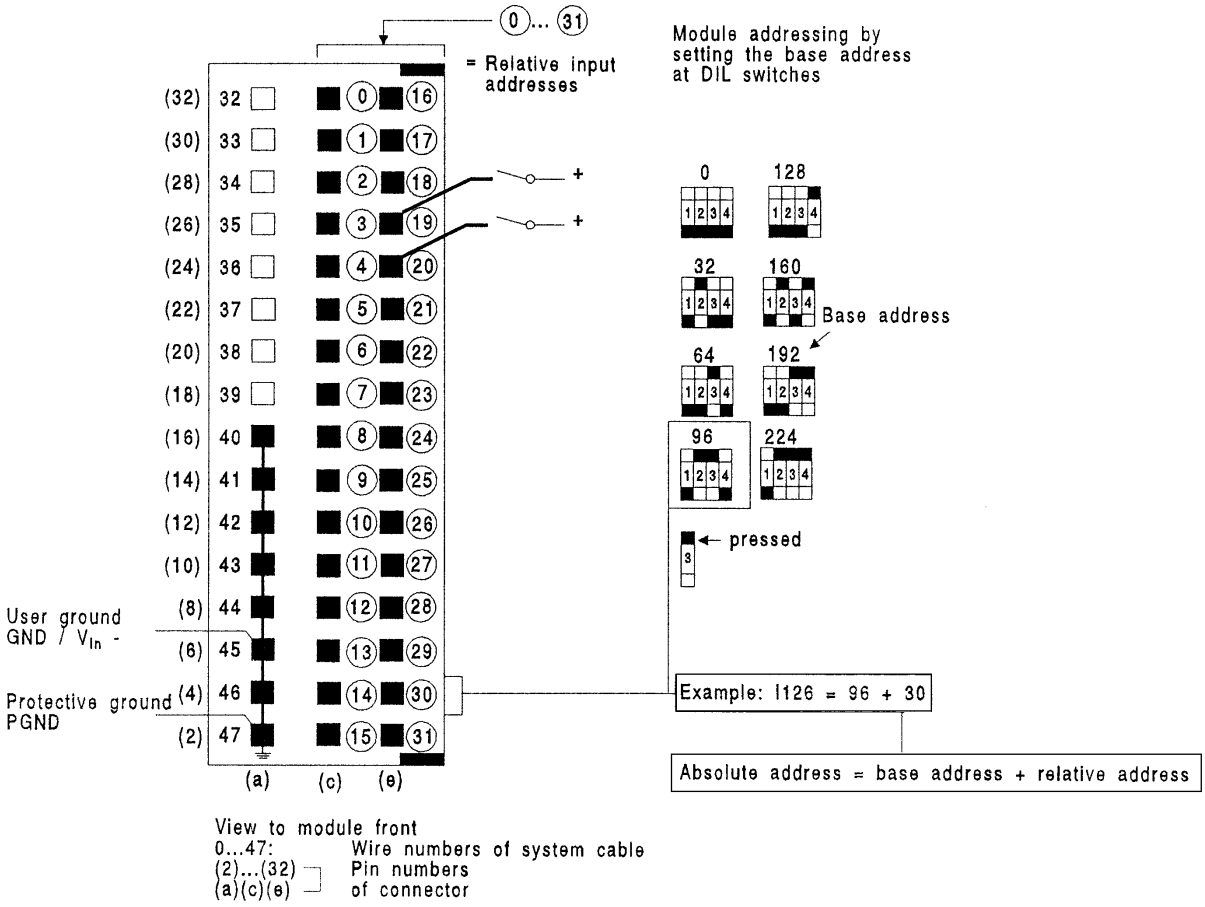
Two-way rectified DC-voltage is adequate as external supply voltage due to the input delay of 9 ms typically.

Input circuit (source operation)



Switch closed
(positive at input): Signal status ”H” = LED lights up
Switch open: Signal status ”L” = LED is out
0...47: Wire number of system cable
PCD6.K2..: Recommended system cable

Pin assignment diagram



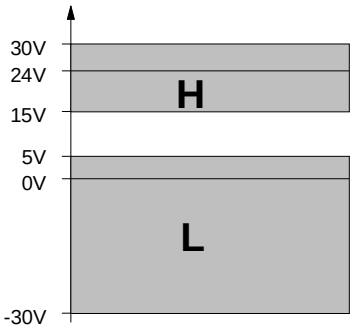
11.2 PCD6.E610/..E611 Digital input module with electrical isolation

Application

Input module with electrical isolation for source or sink operation with 32 inputs. Suitable for most electronic and electro-mechanical switching elernents at 24 VDC. Type PCD6.E611 has a short input delay of typ. 0.1/0.3ms.

Technical information

Number of inputs per module	32, electrically isolated by optocouplers source or sink operation
Input signals	..E610: nom. 24 VDC smoothed or pulsating ..E611: nom. 24 VDC smoothed with ripple of max. 10% Special: 5 to 48 VDC on request

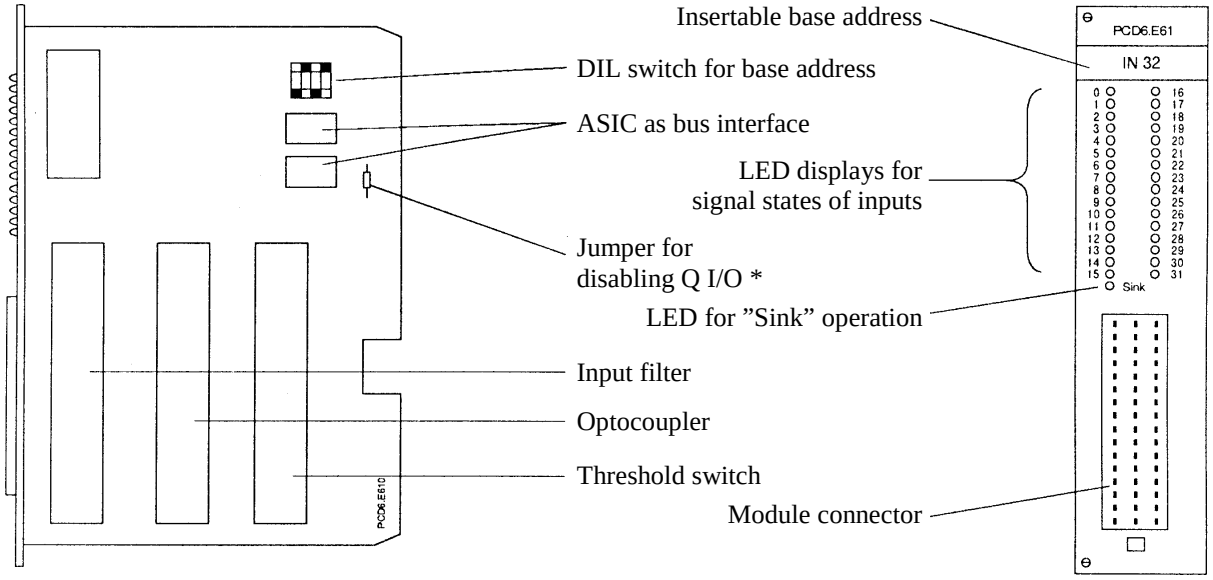


Because of the typical input delay of 8 ms for type ..E610, full-wave rectified DC is adequate for external supply.

Typ ..E611 needs smoothed DC voltage.

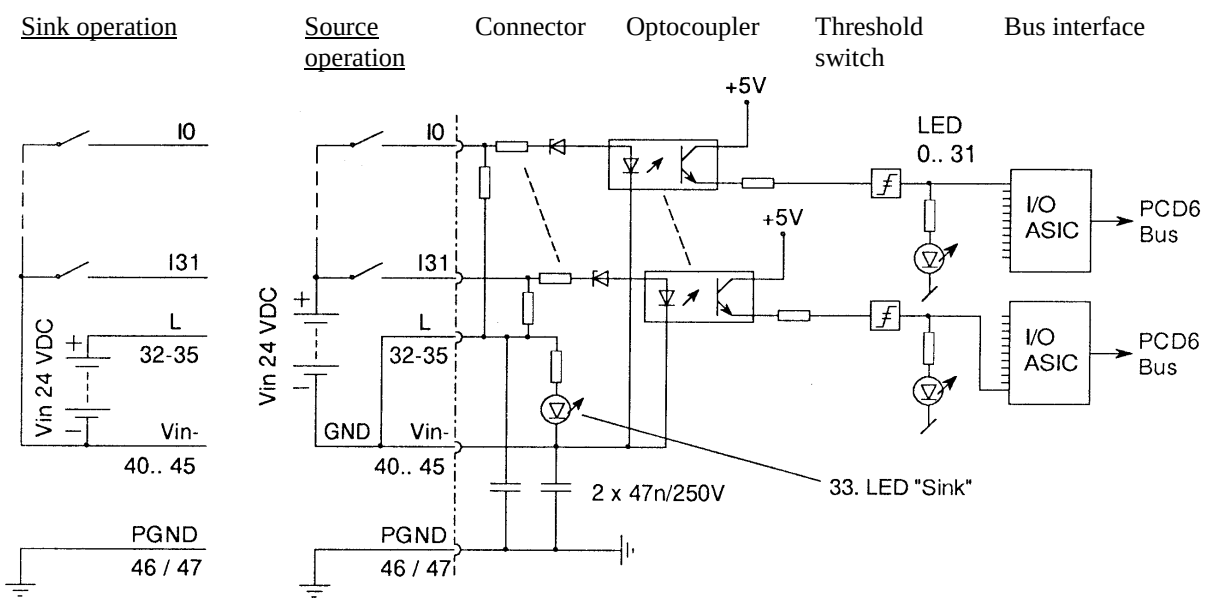
Supply voltage V_{in}	for source operation: min. 15 V for sink operation: min. 18 V
Input current (24 VDC)	for source operation: 12 mA for sink operation: 5.5 mA
Input delay (L-H / H-L)	..E610: typ. 8 ms/8 ms ..E611: typ. 0.1 ms /0.3 ms
Resistance to interference as IEC 1131-2	4 kV direct coupling 2 kV capacitive coupling (whole brunch of pairs)
Electrical isolation voltage	200 VDC
Optocoupler isolation voltage	2.5 kV
Internal current consumption from 5 V-Bus	10...80 mA

Presentation



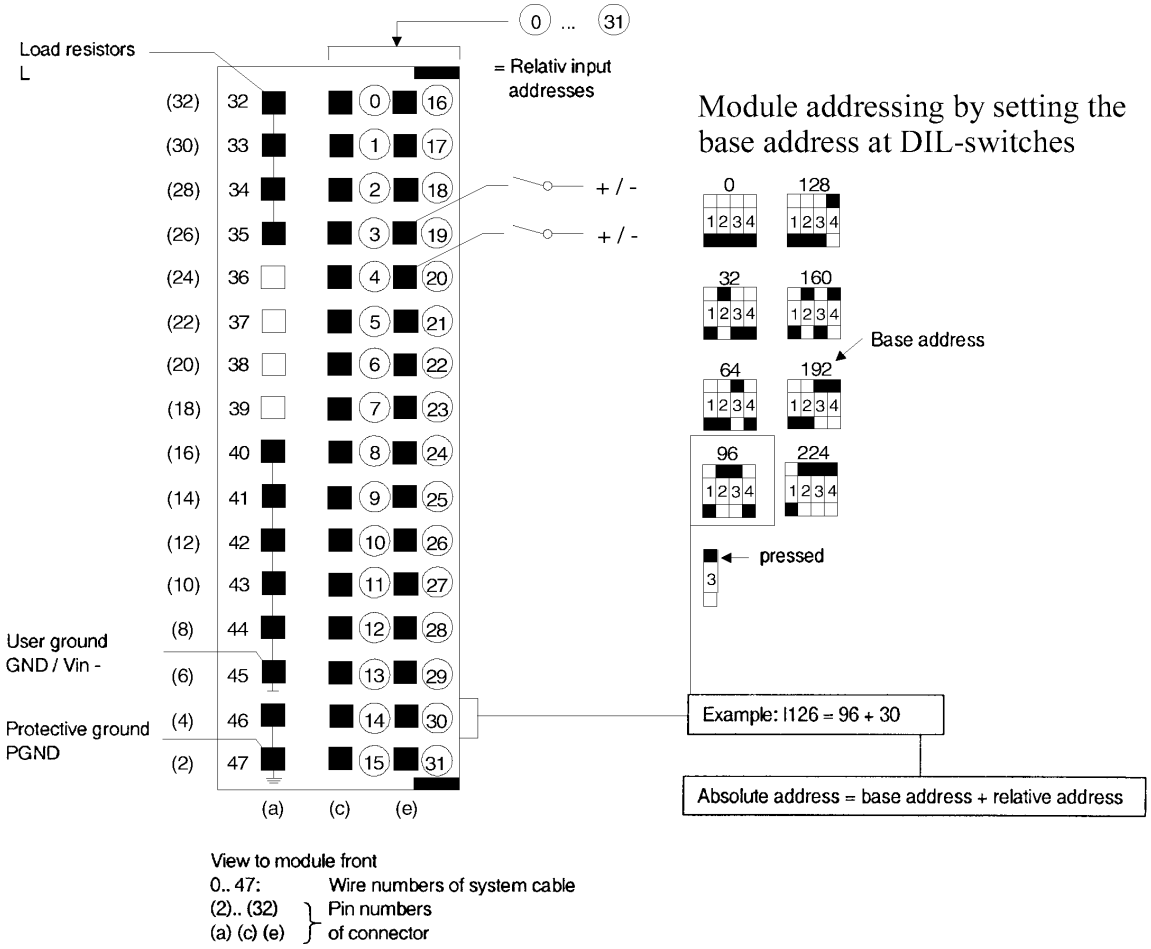
*) When employed on PCA2, remove jumper

Input circuit



Source operation	Switch closed:	Signal state "H" = LED on	33. LED "Sink" is off
	Switch open:	Signal state "L" = LED off	
Sink operation	Switch closed:	Signal state "L" = LED off	33. LED "Sink" is on
	Switch open:	Signal state "H" = LED on	

Pin assignment diagram



View to module front
0.. 47: Wire numbers of system cable
(2).. (32) } Pin numbers
(a) (c) (e) } of connector

11.3 PCD6.A200 Output module with relay contacts

Application

The module contains 16 relays with normally-open contacts for direct or alternating current up to 2 A, 250 VAC. It is especially suited wherever perfectly isolated AC switching circuits must be controlled with infrequent switching (see installation notes).

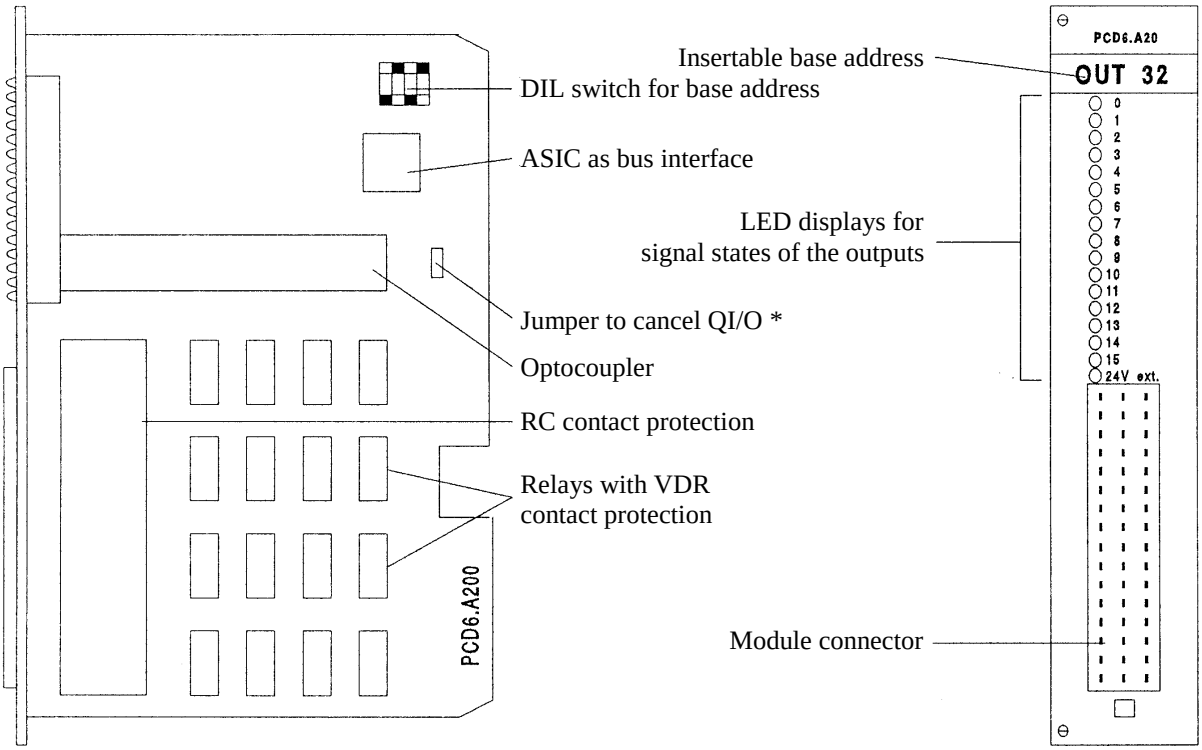
Technical information

Total outputs per module	16, isolated normally open contacts (NO)
Switch rating	2 A, 250 VAC AC1 1 A, 250 VAC AC11 2 A, 50 VDC DC1 1 A, 24 VDC DC11
Contact lifetime (AC1)	2 A, 220 VAC 1 million operations 1 A, 220 VAC 2 million operations 0.4 A, 220 VAC 4 million operations
Relay coil supply	Nominal 24 VDC smoothed or pulsed, 10 mA per relay

	Temp.	Smoothed DC	Pulsed DC
Voltage tolerance	20°C	18,5...37 VDC	14...28 V
Dependent on ambient	30°C	19,5...35 VDC	15...26,5 V
temperature	40°C	20,5...32 VDC	16...25 V
	50°C	21,5...30 VDC	17...23,5 V

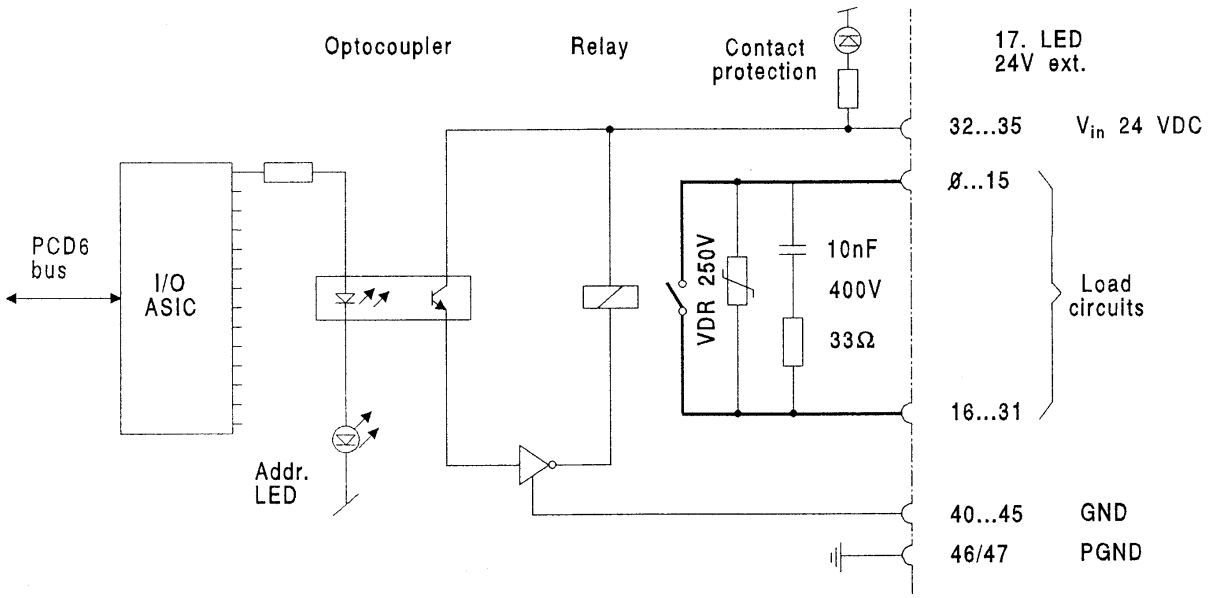
Typical output delay	typ. 7 ms
Operating temperature	-20...+50°C
Storage temperature	-20...+85°C
Conforms to standards	IEC 1131-2
Noise immunity with IEC 801-4	4 kV direct coupling 2 kV capacitive coupling
Internal current usage from 5 V bus	5...50 mA

Presentation



*) When employed on PCA2, remove jumper

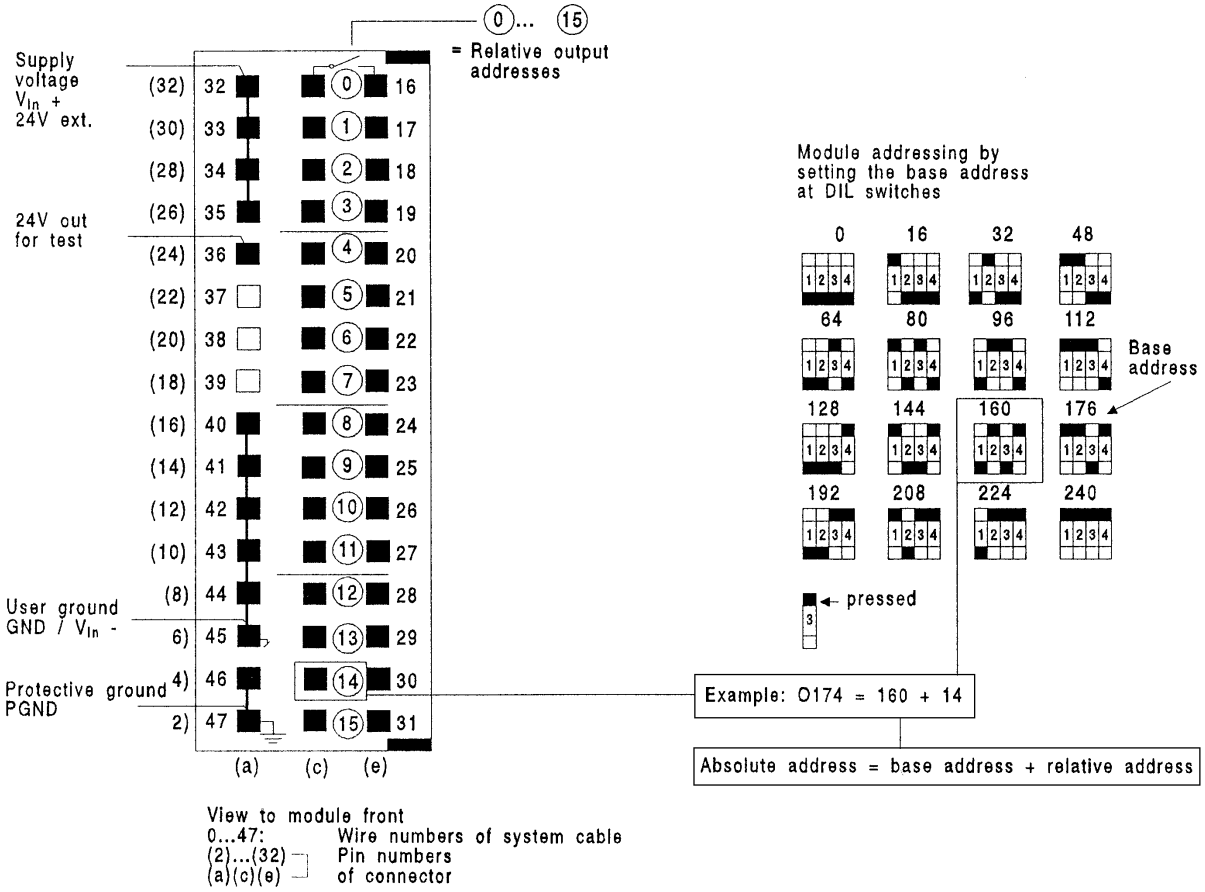
Output circuit



Relay energized (contact closed) LED lights up
Relay reset (contact open) LED is out

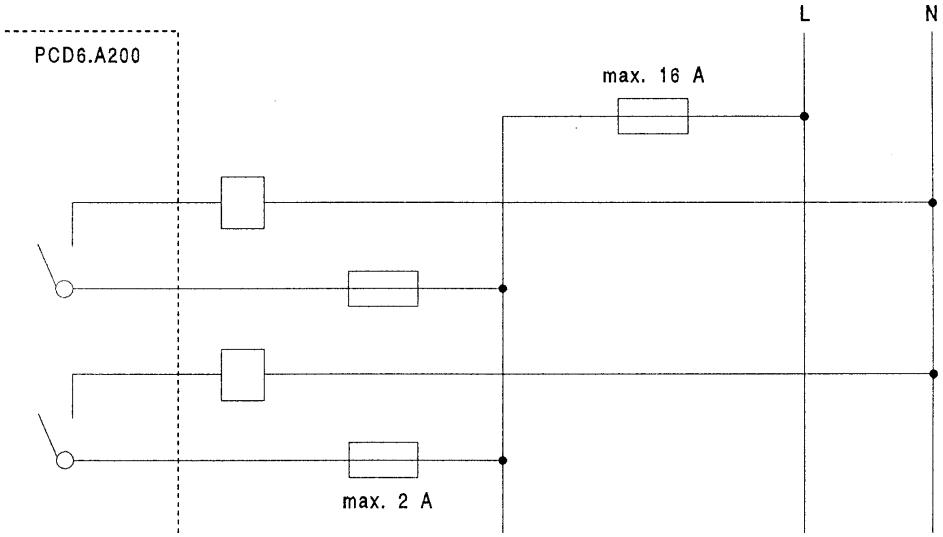
This requires 24 VDC at terminals V_{in}/GND and 17. LED (24 V ext.) to be lit.

Pin assignment diagram



Installation Notes

- 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 PCD6 system module is connected to a higher voltage (50...250 V), higher voltage approved components have to be used for all elements which arc galvanica11y 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 hy only one fuse. Each load circuit may be protected individually by a fuse of max. 2 A.



Switching inductive loads

Because of the physical properties of inductivity, 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.

Is should be noted here that, as part of the harmonization of standards throughout the EU, the EMC standards will be valid from 1996 (EMC Directive 89/336/EG). Two principles should therefore be emphasized:

1. **The protection against interferences from inductive loads is imperative.**

2. **Interference should be eliminated as close as possible to its source.**

It is therefore recommended that a protection circuit should be fitted at the load (often available as normal components on standardized contactors and valves).

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 (Ta ca. $L/RL * \sqrt{(RL*IL/0,7)}$.

For direct voltage the transistor output modules are recommended.

Relay manufacturer's information on RC unit dimensioning

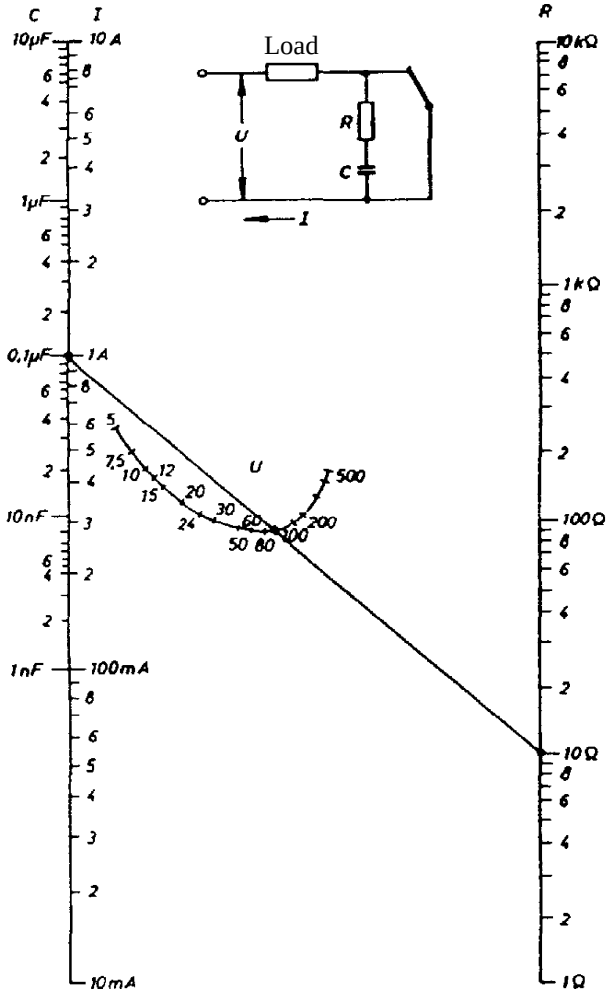
Wiring contact protection:

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. Table 1 should simplify the search for a favorable solution in each case. For the cancellation of arcing by means of an RC unit, see figure 3.

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.

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 threatens 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.

Dimensioning guide for RC combinations



Example:

U = 100 V; I = 1 A
C is found directly as 0.1 µF
R = 10 W (from line trough R scale)

11.4 PCD6.A350 Digital output module, electrically isolated, short-circuit proof, switching capacity 24 VDC, 2 A

Application

Highly-efficient output module with 16 transistor outputs 5 mA to 2 A, short-circuit proof and electrically isolated. Voltage range 8...32 VDC.

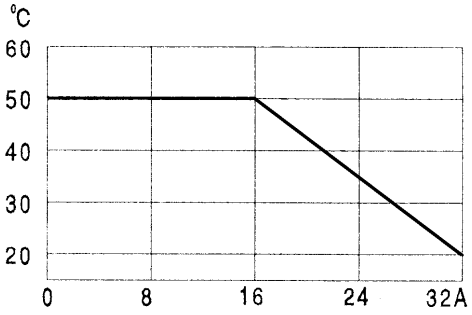
Technical data

Number of outputs per module	16, opto-isolated
Output current I_{out}	5 mA...2 A (leakage current max. 1 mA) Load impedance should not be less than 12 Ω in a voltage range 8...24 VDC.
Max. inductivity	150 mH at 1.5 A 80 mH at 2 A
Short-circuit behaviour	The output current is limited to 3.5 A on a short-circuited load circuit. In case of permanent overloading, the output switches off after a few seconds. From this moment on, starting attempts are made at intervals. If overloading is terminated, the output automatically switches back on.
Operating mode	Source operation (positive switching)
Total current per module	See diagram
Voltage range V_{out}	8...32 VDC, smoothed
Residual ripple of V_{out}	Max. 10%
Voltage drop	Max. 2 V at I = 2 A
Common mode strength	Max. 72 Vpp
Output delay typ.	Switching on: 10 µs – ohmic Switching off: 100 µs current range 5 mA...2A
Operating temperature	-20...+50°C
Storage temperature	-20...+85°C

Applied standards	IEC 1131-2, DIN 19230 and 19232, VDI 2880, NF C63-850
Noise immunity with IEC 801-4	4 kV direct coupling 2 kV capacitive coupling
Number of assigned addresses	16
Internal current consumption	Max. 120 mA from 5 V bus

Current load/ambient temperature diagram

Ambient temperature underneath the module (in case of normal mounting position: vent holes, top and bottom)



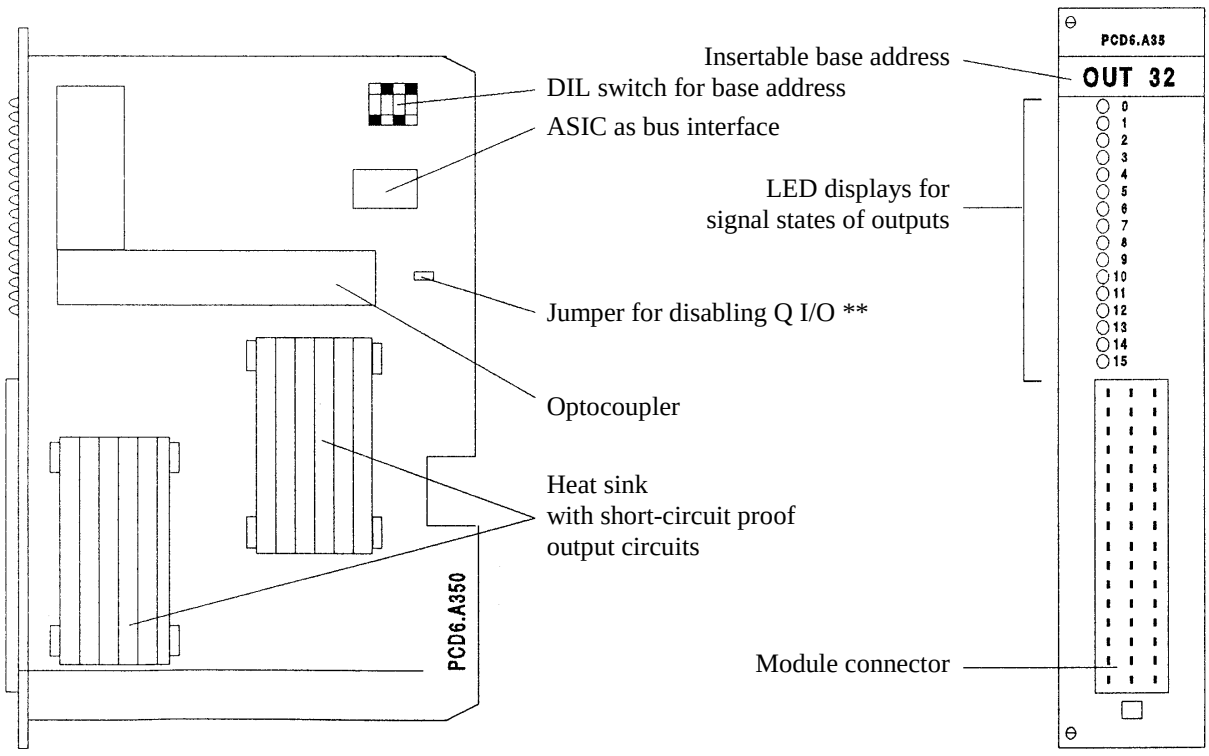
Average total continuous current of all outputs of the same module

Example: (V_{out} = 24 VDC)

8 valves each of 48 W (50% duty cycle)*	8 A
4 valves each of 48 W (75% duty cycle)*	6 A
4 connectors each of 24 W (95% duty cycle)*	4 A
Average total current	18 A
Admissible ambient temperature	50°C

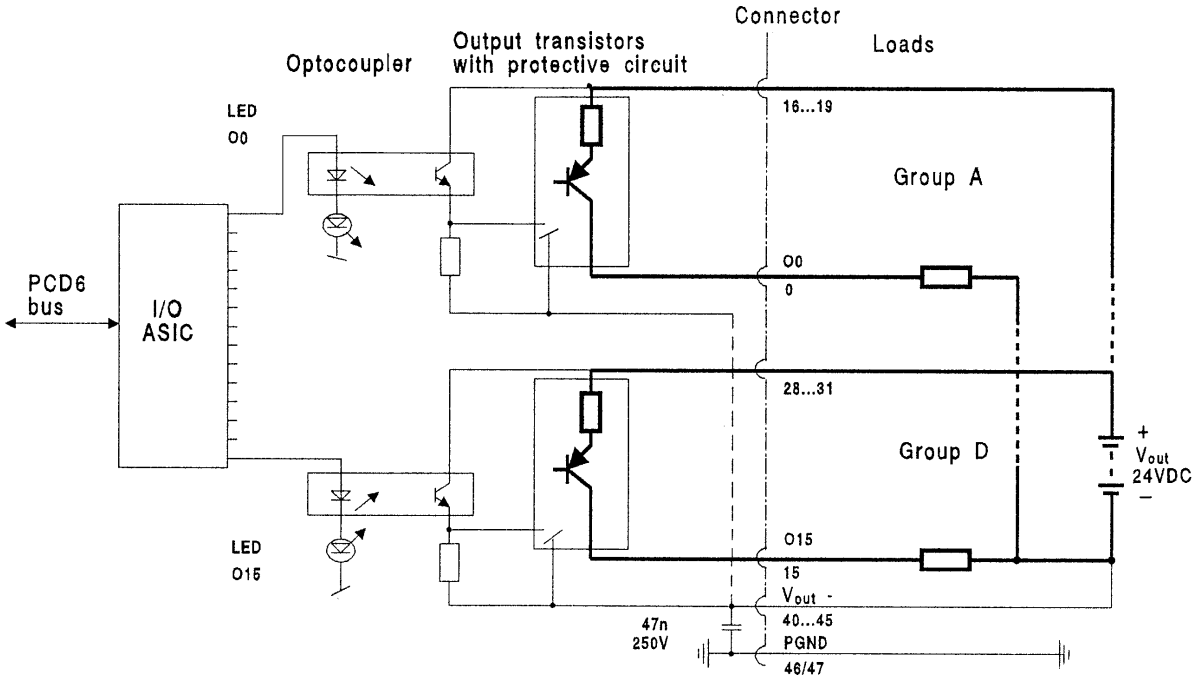
*) Thermal time constant of the module: approx. 5 min

Presentation



**) When employed on PCA2, remove jumper

Output circuit



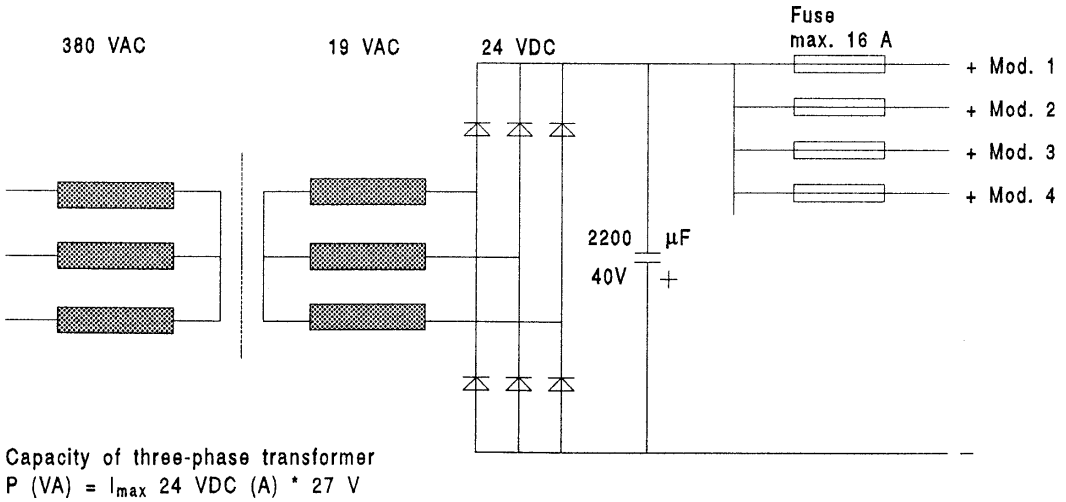
Output circuit

Output conducting (set):	LED lights up
Output non-conducting (reset):	LED is out
0...47:	Wire numbers of system cable
PCD6.K2..:	Recommended system cable

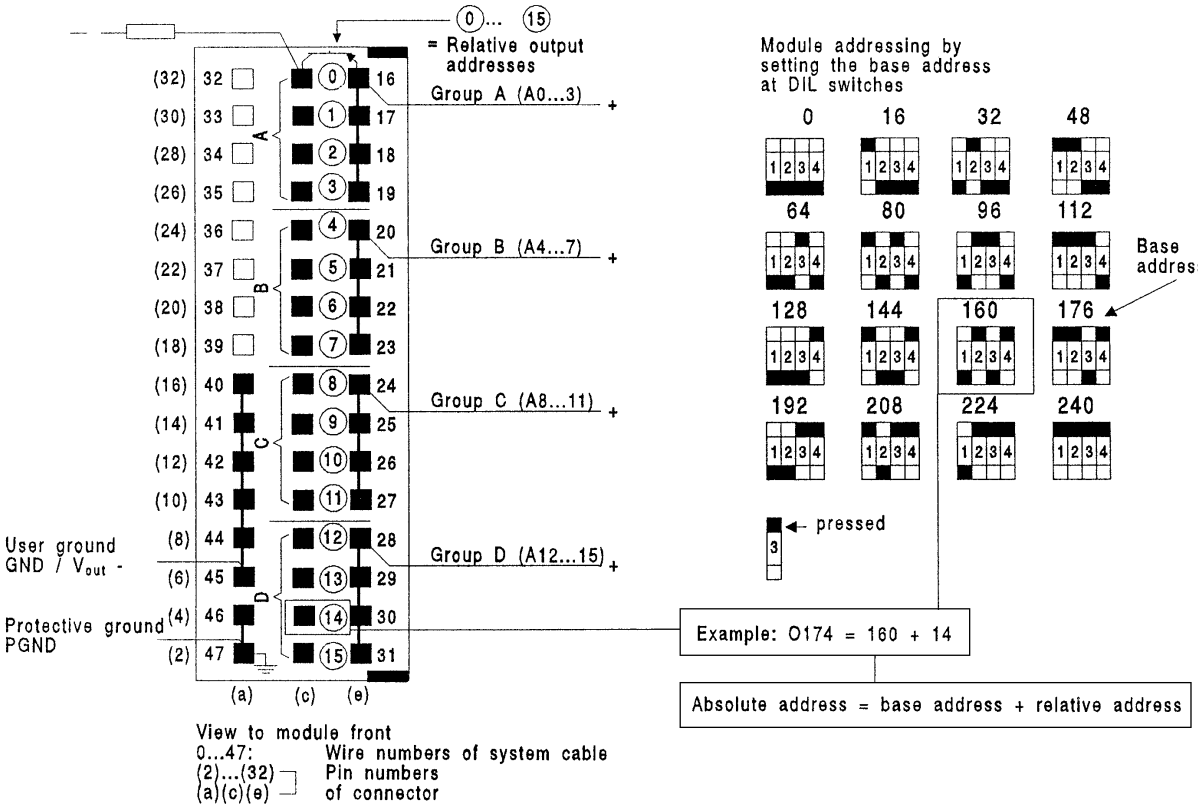
The 16 outputs are divided into 4 groups A, B, C and D with 4 outputs respectively. The positive voltage is supplied separately for every group. This allows applying different voltages to the same module in the range from 8...32 V. The negative pole, however, is common to all 4 groups.

User voltage

The following user voltage is recommended to keep the ripple content to a minimum. A capacitor on the DC voltage side is absolutely necessary to compensate for switch-on peaks, e.g. in case of lamp loading.



Pin assignment diagram



11.5 PCD6.A400 Digital output module, electrically connected, switching capacity 24 VDC, 0.5 A

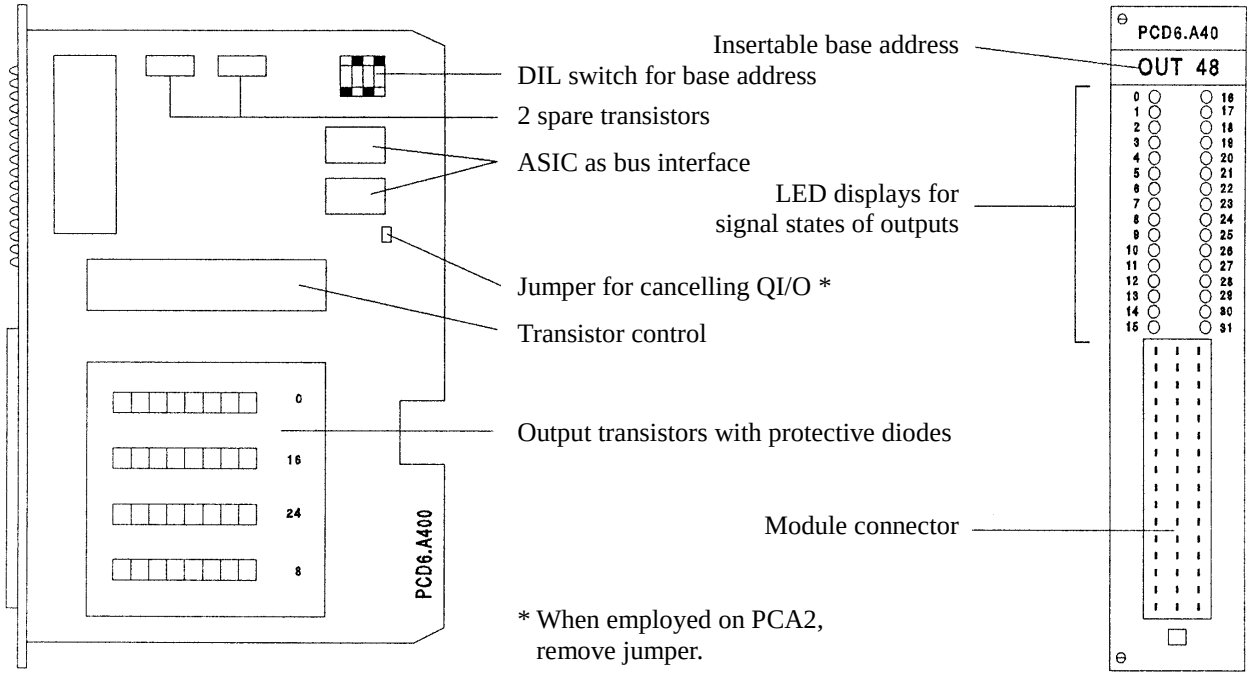
Application

Moderately priced output module with 32 transistor outputs in 4 groups, 5...500 mA, no short-circuit protection. Circuits are electrically connected in the voltage range from 5 to 32 VDC.

Technical data

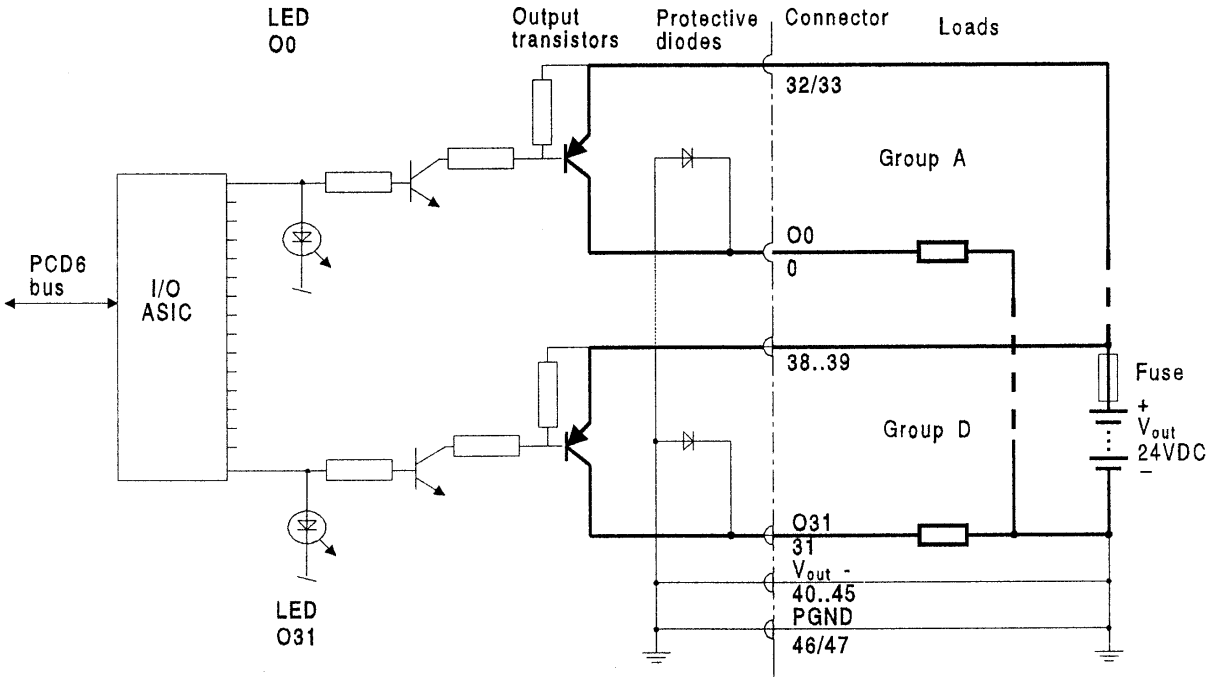
Number of outputs per module	32 (4 x 8) electrically connected
Output current I_{out}	5...500 mA (leakage current max. 1 mA) Load impedance should be at least 48 Ω in the voltage range from 5...24 VDC.
Operating mode	Source operation (positive switching)
Total current per module	32 x 0.5 A = 16 A (100 % duty cycle)
Voltage range V_{out}	5...32 VDC smoothed 10...27 VDC pulsating
Voltage drop	1 V at 0.5A
Output delay typ.	10 µs at an ohmic load 5...500 mA, longer in case of inductive load because of the freewheeling diode
Operating temperature	-20...+50°C
Storage temperature	-20...+85°C
Applied standards	IEC 1131-2, DIN 19230 and 19232, VDI 2880, NF C63-850
Noise immunity with IEC 801-4	4 kV direct coupling 2 kV capacitive coupling
Number of assigned addresses	32
Internal current consumption from 5 V bus	10...250 mA

Presentation



* When employed on PCA2, remove jumper.

Output circuit

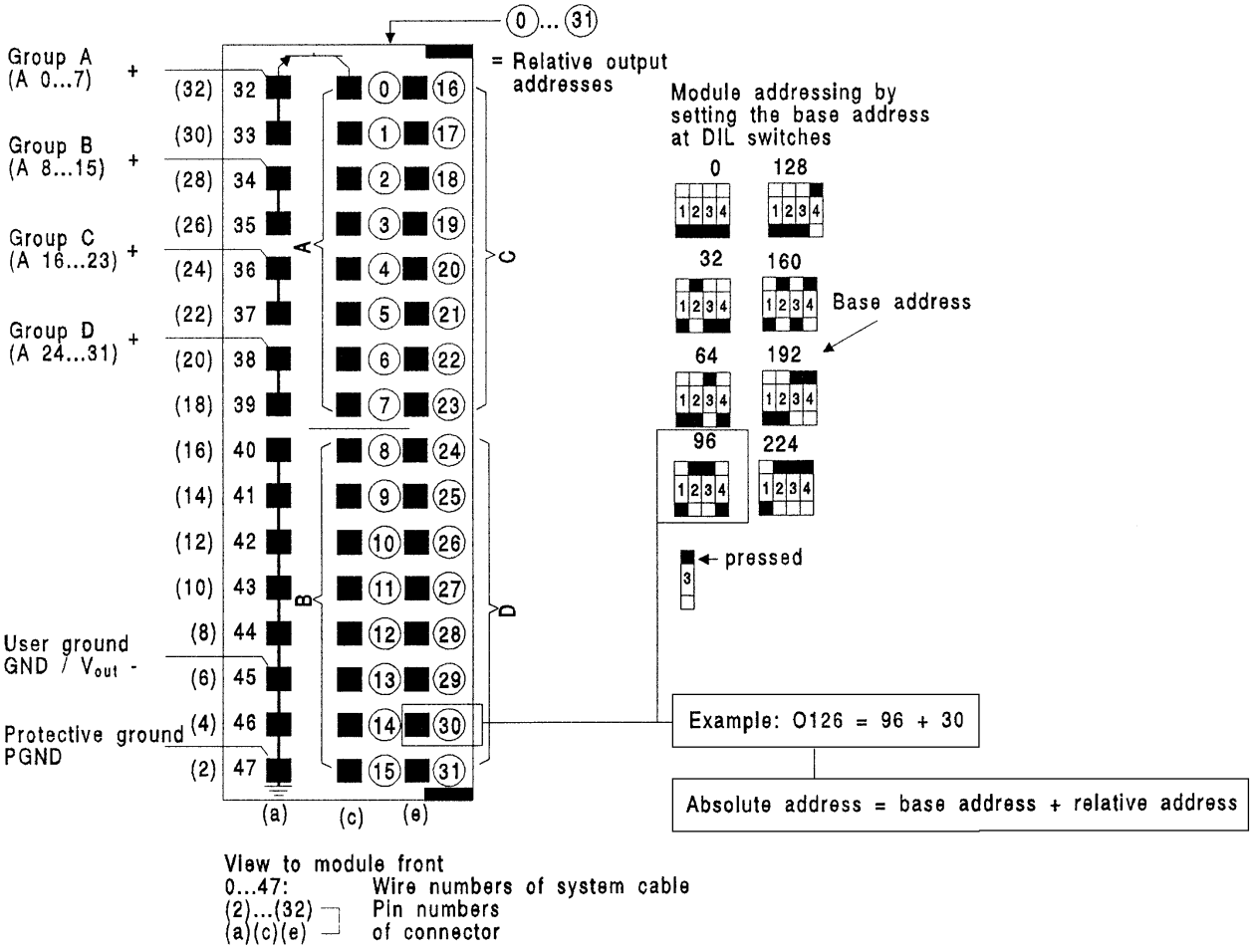


Output conducting (set): LED lights up
Output non-conducting (reset): LED is out

Fuse	It is recommended to protect every ..A400 module against short-circuits with a 10 A quick-acting fuse
0...47:	Wire numbers of system cable
PCD6.K2..:	Recommended system cable

The 32 outputs are divided into 4 groups A, B, C and D with 8 outputs respectively. Every group is separately supplied with positive voltage. Different voltages may thus be applied to the same module in the range from 5...32 V. The negative pole, which is connected to ground, is common to all 4 groups.

Pin assignment diagram



12. Analogue input/output modules

With analogue modules, a distinction is made between circuits with a short or long A/D or D/A conversion time. For slow processes such as temperature monitoring, ”slow” and thus less expensive analogue modules are usually sufficient. Both variants will be listed in the following as well as a classification into configurable modules for different input/output signals and modules for reversible signals.

PCD6.W1.. Fast analogue module with a 30 µs conversion time for the acquisition and control of rapid processes. 12 bit resolution. 8 inputs plus max. 4 output channels with the signal ranges 0...5 V to ±10 V and 0...20 mA or 4...20 mA. Connection of resistance thermometers Pt1000/Ni1000 is possible.

PCD6.W3.. Relatively slow input module for temperature measurement with an A/D conversion time of max. 120 ms. 16 inputs for voltages from ±100 mV to ±10 V or currents ±20 mA or 4...20 mA. 8 inputs for direct connection of resistance thermometers Pt100/1000 or Ni100/1000 or thermocouples. 12 bit resolution plus preceding sign.

PCD6.W400 Fast output module with an 8 bit resolution. D/A conversion time <5 µs. 16 outputs switchable for the output ranges 0...10 V, 0...20 mA or 4...20 mA.

12.1 PCD6.W1.. Fast analogue I/O module with 12 bit resolution

The ..W1.. analogue module consists of a base module and up to six add-on range modules which select the input and output voltage or current ranges. This enables the 8 input channels and 4 output channels to be configured independently.

It is also possible to directly connect 4 resistive temperature sensors (or resistance thermometers).

Module overview

Base module

PCD6.W100 Contains the input multiplexer with the A/D converter for 8 input channels via the range module and connections for 4 output channels.

Range modules

Inputs

PCD7.W101 Measurement range 0...10 V (±10 V or ±5 V)
Input resistance 10 MΩ

PCD7.W105 Measurement range 0...20 mA (±20 mA or ±10 mA)
Input resistance 499 Ω/0.1%

Time constant on input filter 1 ms

Outputs

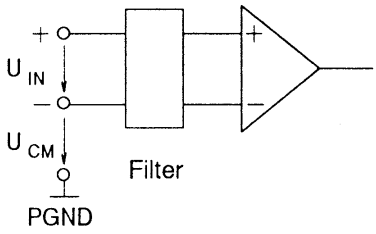
PCD7.W200: 1 channel Range 0...10 V, min. load resistance	3 kΩ
PCD7.W201: 1 channel Range 0...1 V, min. load resistance	300 Ω
PCD7.W202: 1 channel Range ±10 V, min. load resistance	3 kΩ
PCD7.W203: 1 channel Range ±1 V, min. load resistance	300 Ω
PCD7.W204: 1 channel Range 0...20 mA, max. circuit resistance	500 Ω
PCD7.W205: 1 channel Range 4...20 mA, max. circuit resistance	500 Ω
PCD7.W206: 1 channeI Range -10...0 V, min. load resistance	3 kΩ

Technical information of the base module

Inputs

Total input channels	8 voltage or current inputs and 4 inputs for resistive temperature sensors (Pt1000 or Ni1000).
Isolated	No
Measuring principle	Differential
Signal ranges	See range modules
Digital representation (resolution)	12 bits (0...4095) Unipolar or bipolar, selectable by jumper on the base module

A/D convertion time	≤30 µs
Accuracy (ref. to measured value)	0,45% ±2 LSB unipolar 0,45% ±6 LSB bipolar
Accuracy of repetition	Within 3 LSB
Temperature error	Typically 0.2% across temperature range 0...50°C
Max. overvoltage	60 VDC
Resistance to interference according to IEC 801-4	1 kV capacitance coupling without shielding 2 kV capacitance coupling with shielding
Common-mode behaviour	$U_{IN} + U_{CM} \leq \pm 12$ V CMR = 74 dB CMMR = 200 µV/V

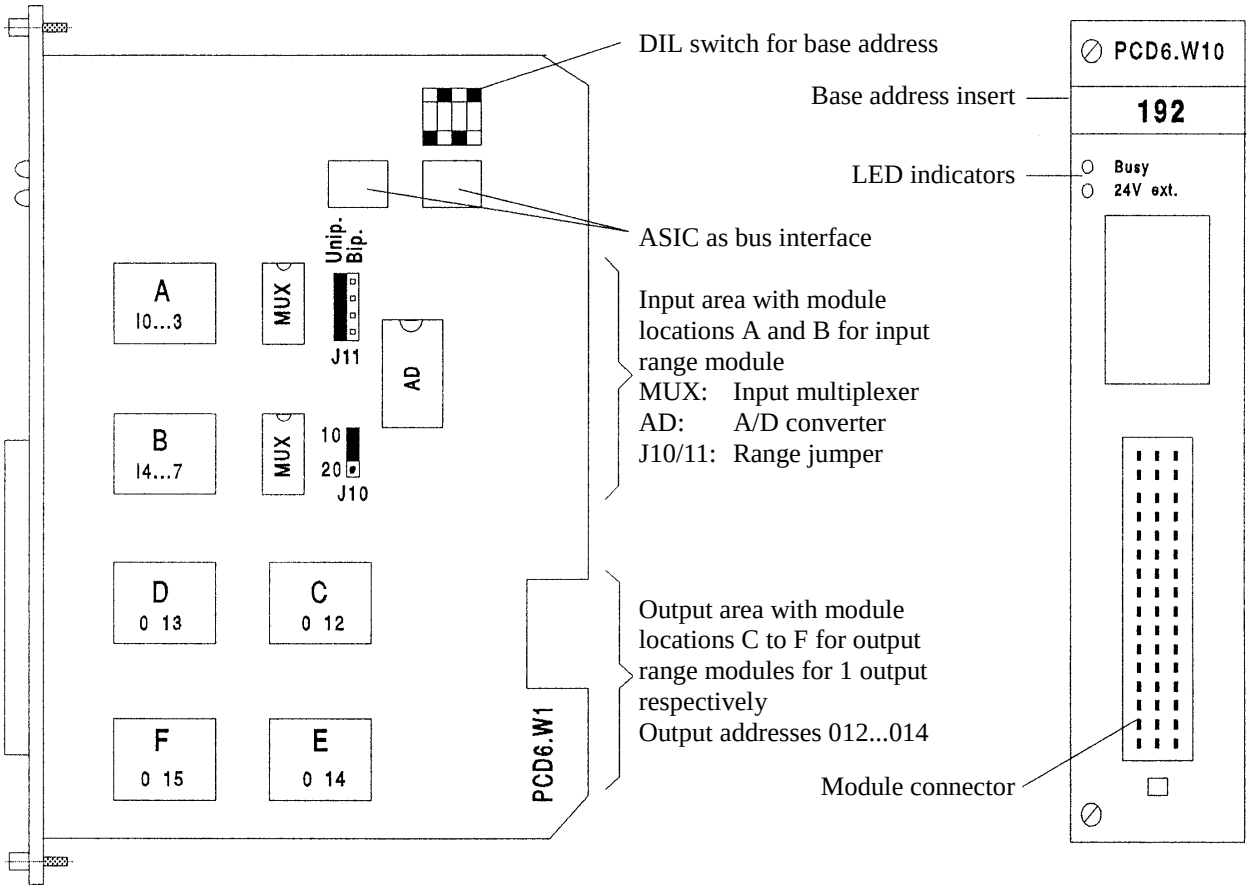


CM: Common Mode

Outputs

Total output channels	Max. 4, short-circuit protected
Isolated	No
Signal ranges	See range modules
Digital representation (resolution)	12 bits (0...4095), unipolar or bipolar depending on range module
D/A conversion time	≤20 µs
SENSE inputs	2 each per output, for precise voltage control
Resistance of OUT signal cables	Max. 200 Ω (total both cables)
Precision (referred to output value)	Voltage 1% ±5 mV Current 1,4% ±50 µA Constant current 2 mA ±l%
Temperature error	Typically 0.2% across temperature range 0...50°C
Ext. supply 24 VDC	Only required for current outputs, same quality as for supply module ..N2..
Current used internally from the PCD6 bus	+ 5 V 60 mA +15 V 50 mA –15 V 50 mA

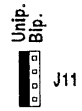
Presentation



The following functions are realized:

– The base PCB with bus interface, address coding, A/D converter with MUX, the range jumpers and the module locations to accommodate the range modules.

– The 2 module locations A and B may be configured as desired with input range modules PCD7.W101 and ..W105. The jumpers apply to the two module locations as follows:



”Unipolar” position	0...10 V, -10...0 V, 0...20 mA
”Bipolar” position	±10 V, ±5 V, ±20 mA, ±10 mA

Position 10:	Total range 10 V and 20 mA
Position 20	Total range 20 V and 40 mA

Factory setting: 10 unipolar

– The 4 module locations C...F may be configured as desired with the output range modules PCD7.W2..

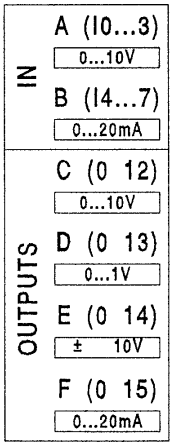
Inserting the range modules

The ..W1.. module must be pulled out of the rack unit in order to install the range modules.

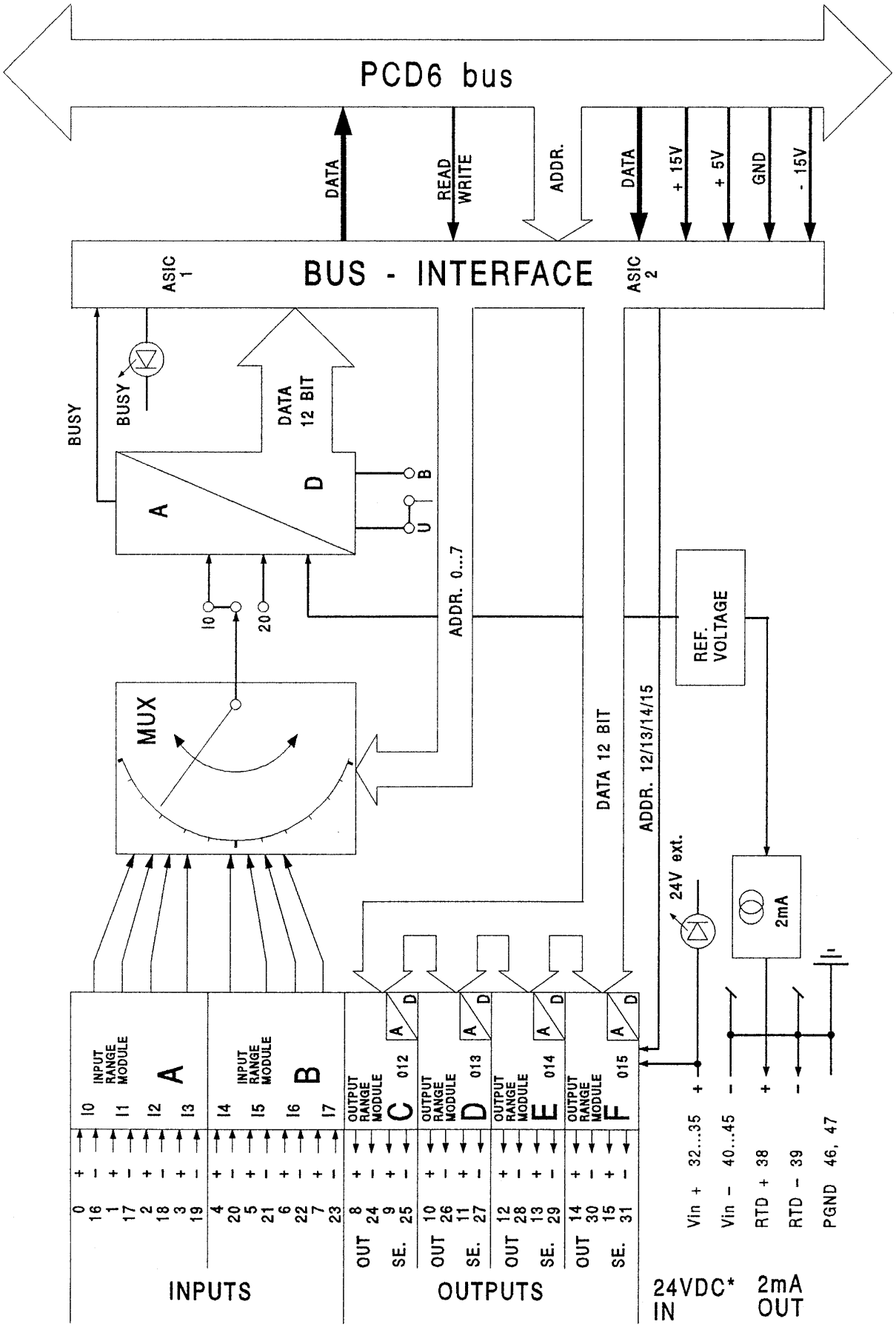
Please note that module locations A and B are designed for input modules only, locations C to F for output modules only.

Warning: The base PCB and the range modules both incorporate components which are sensitive to electrostatic discharges.

Various range modules can be inserted at the 6 module locations. Please do not forget to write the configuration in the spaces provided on the sticker for the front so that it may be seen from the outside.

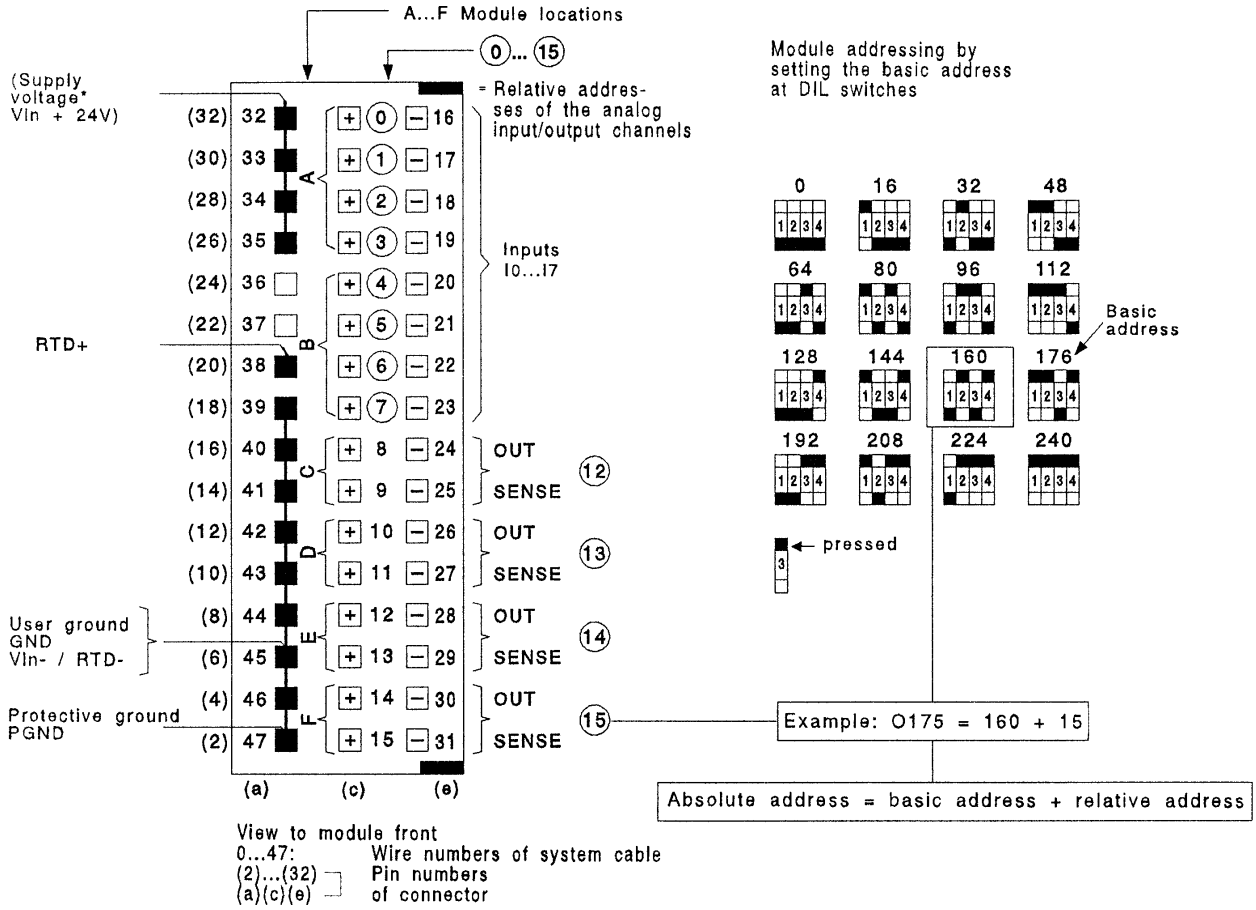


Block diagram



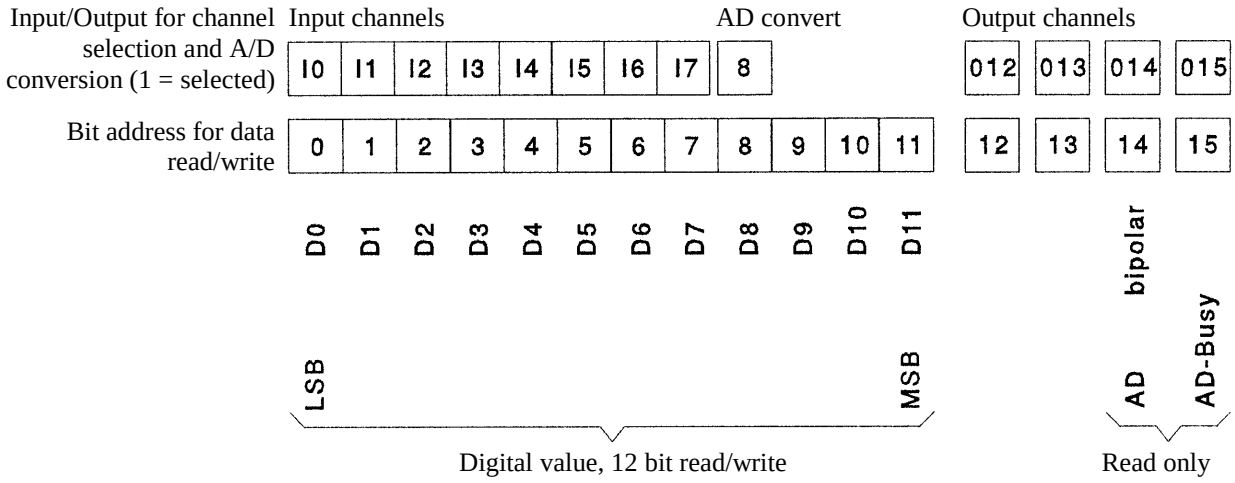
* Only required for current outputs

Connector assignment diagram and addressing



* Only required for current outputs

Programming and I/O addressing



If bit 14 ”AD bipolar” = 1: then jumper U/B is in the bipolar position for input range modules at, points A and B

If bit 15 ”AD busy” = 1: then A/D conversion is in progress

User program for reading analogue value

To read an analogue value from channel I2 into register R102.

```
(  ACC     H        )    (Accu must be 1)
   SET     O    2   *)   Select input channel 2 by setting bit I2
 RES **)   O    8   *)   Start A/D conversion by toggling
   SET     O    8   *)   address 8 (A/D convert)
   RES     O    8   *)
   STH     I    15  *)   High = conversion in progress (~30 µs)
    JR     H    -1       Wait or branch until conversion is complete
                         Conversion complete
  BITI          12       Read A/D value, 12 bits
          I     0   *)   bits from address 0 (LSB)
          R     102            into register R102
```

*) The base address of the module must be added to these operands.

**) If the 2 mA module type PCD7.W120 on location B is used, wait 10 ms before instruction RES.

User program to output an analogue value

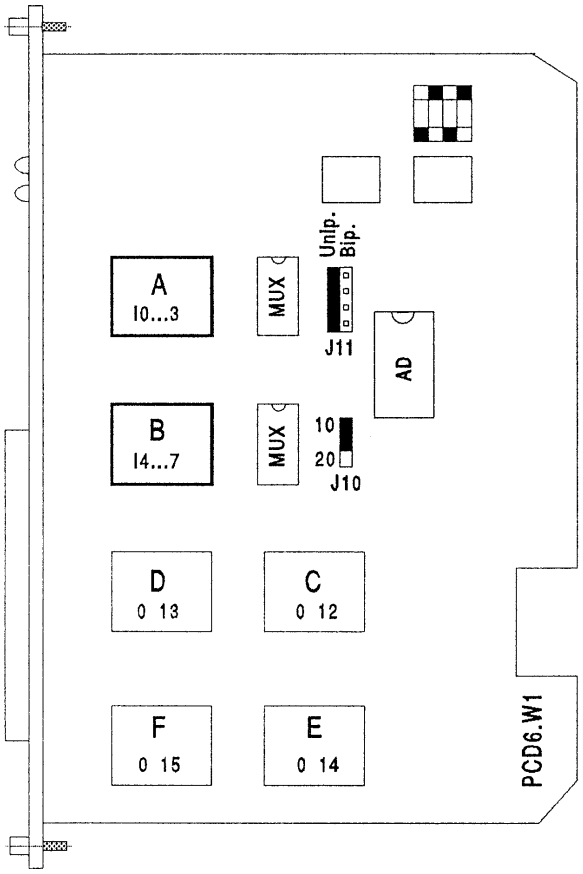
Outputs an analogue value from register R113 to output channel O13.

```
   BITO        12      Output 12 bits
               R   113         from register R113
               O   0 *)        to address 0 (LSB)
_____________________________________________________

(  ACC         H       )  (Accu must be, 1)
   SET         O   13 *)  Select output channel O13
   RES         O   13 *)       and start DA conversion
```

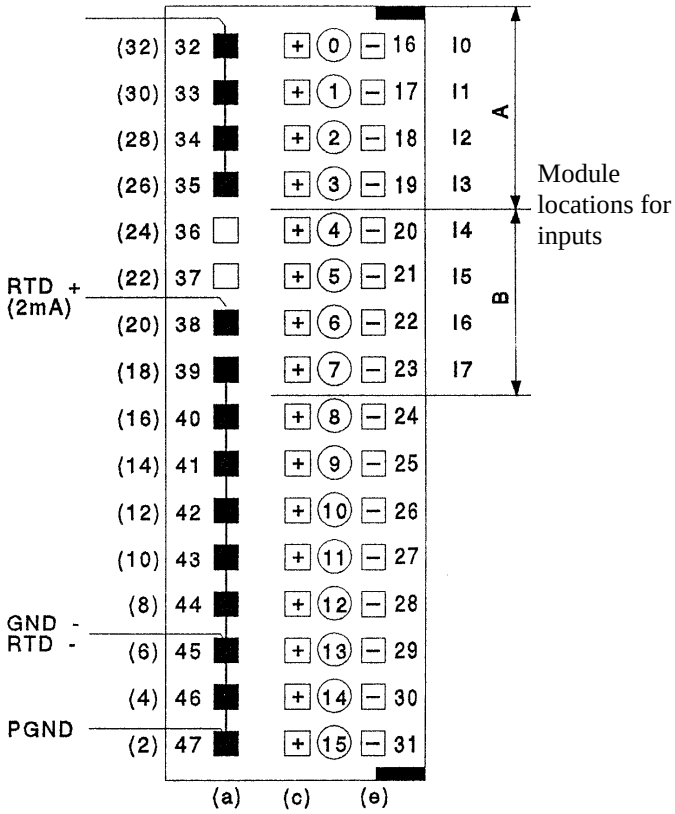
*) The base address of the module must be added to these operands.

Module connection of analogue inputs

Module locations A and B may be configured as desired with input range modules having 4 inputs respectively. It is possible to select between unipolar and bipolar input with jumpers J10 and J11.



Connector and wire assignment
view to module front



0...47: Wire numbers of system cable

Voltage inputs for ranges 0...10 V, ±10 V, ±5 V

Range module: PCD7.W101

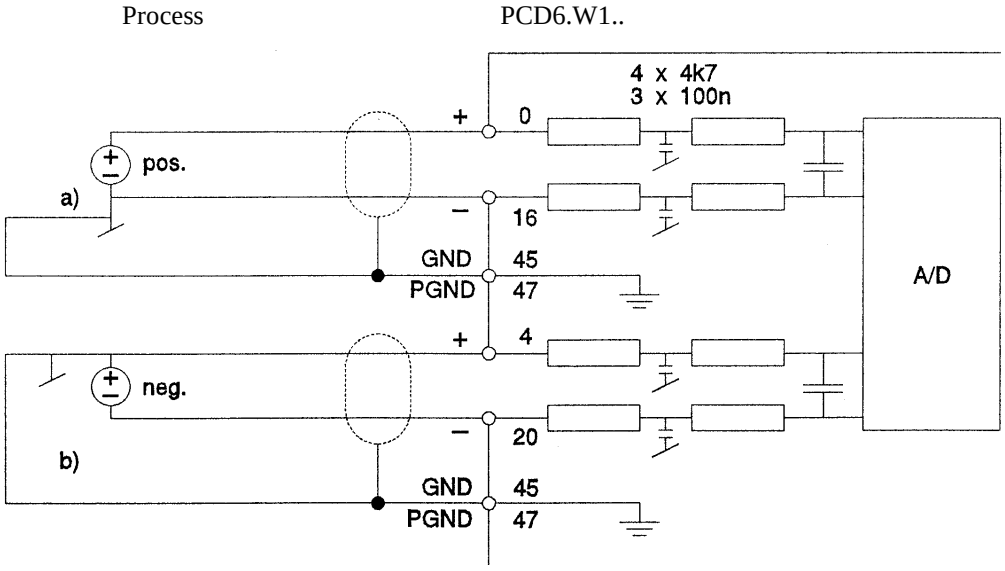
There are two jumpers on the base module for voltage range selection:

U = unipolar voltage
B = bipolar voltage
10 = entire voltage range of 10 V
20 = entire voltage range of 20 V (e.g. ±10 V)

Digital input values are as follows:

	Range module PCD7.W101		
Jumper U/B	U	B	B
Jumper 10/20	10	20	10
Signal	0...10 V	±10 V	± 5 V
Digital values			
4095	+10 V ↑	+10 V ↑	+5 V ↑
2048	+ 5 V |	0 V |	0 V |
0	0 V ↓	-10 V ↓	- 5 V ↓

Pt1000 or Ni1000 resistance thermometers can be connected using the 2 mA output of wire number 38.



Note

The process ground, or that of an input amplifier, must be connected to the ground of the analogue module (at terminal ”-”). In unipolar operation, the more positive potential is connected to the ”+” terminal. In this way, negative voltages (b) can also be measured.

Current inputs for ranges 0...20 mA, 4...20 mA, ±20 mA and ±10 mA

Range module: PCD7.W105

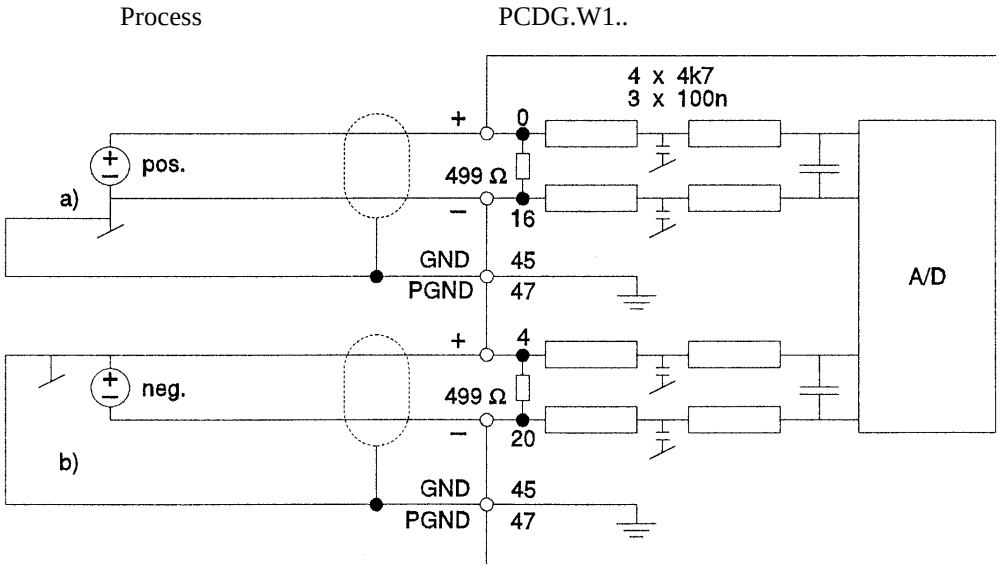
There are two jumpers on the base module fore selecting the current range:

U = unipolar input
B = bipolar input
10 = entire current range of 20 mA
20 = entire current range of 40 mA (e.g. ±20 mA)

Digital input values are as follows:

	Range module PCD7.W105		
Jumper U/B	U	B	B
Jumper 10/20	10	20	10
Signal	0...20 mA	±20 mA	±10 mA
Digital values			
4095	+20 mA ↑	+20 mA ↑	+10 mA ↑
2048	+10 mA ↑	0 mA ↑	0 mA ↑
819*	+ 4 mA*		
0	0 mA ↑	-20 mA ↓	-10 mA ↓

*) The same range module is fitted for current range 4...20 mA. The 4 mA current limit is controlled with the user program (digital value 819).



Note

The process ground, or that of an input amplifier, must be connected to the ground of the analogue module (at terminal ”-”). In unipolar operation, the more positive potential is connected to the ”+” terminal. In this way, negative voltages (b) can also be measured.

Connection of 4 Pt1000 or Ni1000 resistance thermometers

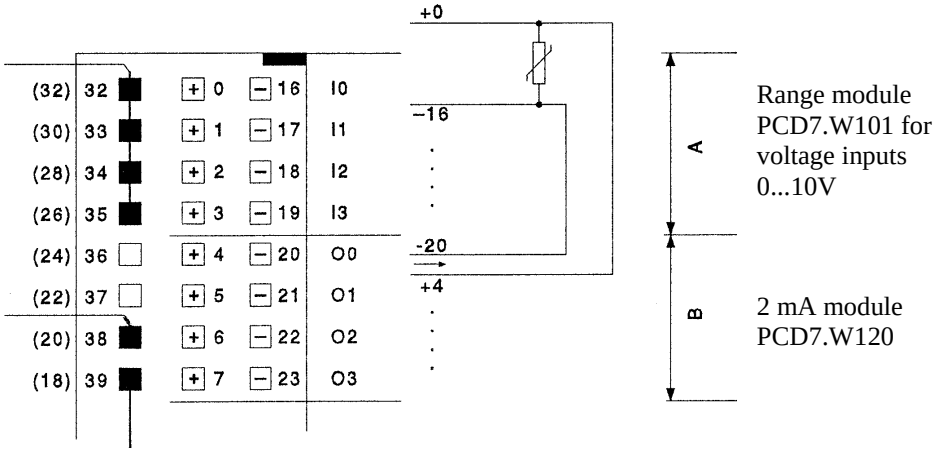
Range module on socket A:
PCD7.W101 (0...10 V) for 4 Pt1000 or Ni1000

Range module on socket B:
PCD7.W120 for 4 constant current outputs of 2 mA

The ..W120 modules provide a constant current of 2 mA up to a circuit resistance of 2000 Ω. The voltage drop at the resistance thermometers is supplied to the voltage range module on the socket A.

Important: Unused 2 mA outputs must be short-circuited.

Example for connection of channel I0:



Partial view to front of connector

Software

If the range modules are plugged onto the basic module correctly (voltage inputs on socket A, constant current outputs on socket B), the circuit recognizes that the configuration comprises resistance thermometers. Therefore, the user must only ensure appropriate handling of the voltage inputs in the software, as described in chapter ”User program”. A simplified temperature calculation using Pt1000 is shown overleaf.

Temperature measurement with Pt1000 and range module for 0...10 V

The temperature-dependent resistor Pt1000 shows a resistance of **R0 = 1000 Ω** at 0°C. In the temperature range from -20°C to +200°C resistance develops with an accuracy of 1% according to the following formula:

$R_T = R0\ (1 + 3.83 * 10^{-3} * T)$ T in °C

Sensitivity S on the measuring range module ±10 V under 2 mA is the following:

$S = 3.83 * 10^{-3}/°C * 4096\ LSB/10\ V * 0.002\ A * 1000\ \Omega = 3.14\ LSB/°C$

The 2 mA constant current results in a voltage of 2 V at 1000 Ω.
On measuring range module 10 V, this corresponds to a digital value of

4096 * 0.2 = 819, i.e.
1000 Ω = **0°C = 819 LSB = Offset**

With these two values a conclusion can be drawn from the digital measured value to the temperature in °C at all times.

$$\mathbf{T(°C) = \frac{digital\ measured\ value\ -\ 819}{3.14}}$$

or

$$\mathbf{digital\ measured\ value = 3.14 * T + 819}$$ T in °C

Example 1: digital measured value 1300 LSB

$$T = \frac{1300–819}{3.14} = \mathbf{+153.2°C}$$

Example 2: digital measured value 770 LSB

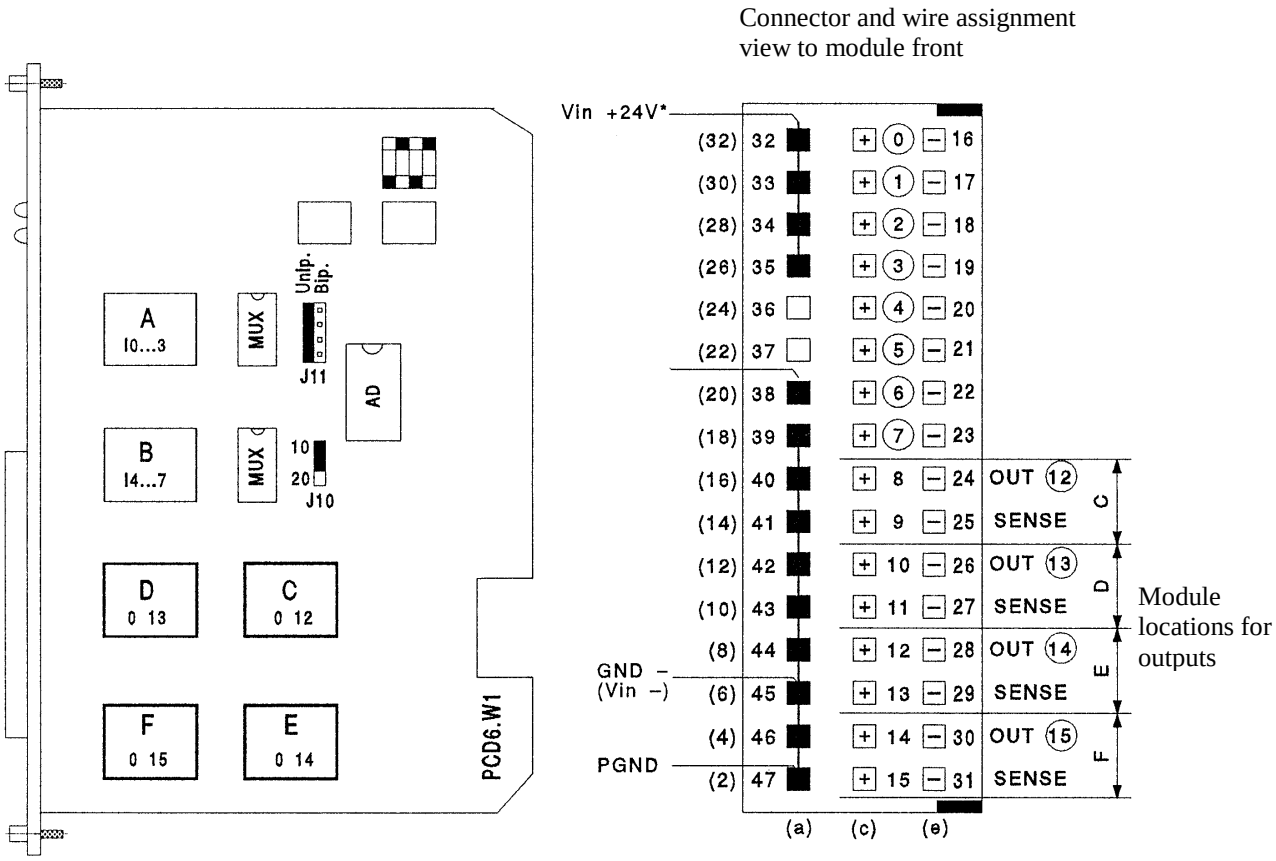
$$T = \frac{770–819}{3.14} = \mathbf{–15.6°C}$$

Example 3: 100°C corresponds to which digital measured value?

Digital measured value = 3.14 * 100 + 819 = **1133**

Connection of analogue outputs

On the PCD6.W100 base module, the 4 output channels can be individually configured from a selection of output range modules. Connectors C to E are provided for this.



0...47: Wire numbers of system cable

* The external 24 V supply is only required for current outputs (PCD7.W204 and ..W205 modules).

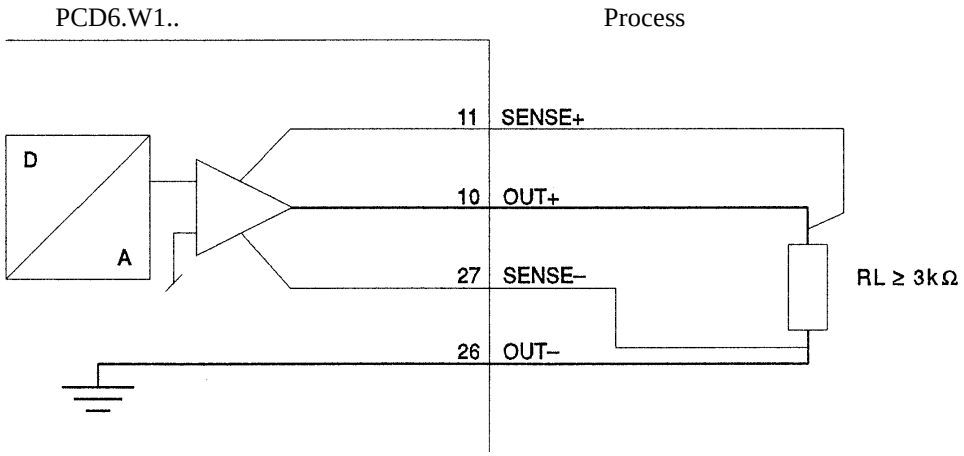
Voltage outputs 0...10 V, 0...1 V, ±10 V, ±1 V, –10...0 V

Range modules
PCD7.W200: 1 output channel for range 0...10 V
PCD7.W201: 1 output channel for range 0...1V
PCD7.W202: 1 output channel for range ±10 V
PCD7.W203: 1 output channel for range ±1 V
PCD7.W206: 1 output channel for range –10...0 V

Digital output values are as follows:

Digital values	Range module				
	..W200 (0...10 V)	..W201 (0...1 V)	..W202 (± 10 V)	..W203 (± 1 V)	..W206 (-10...0 V)
4095	+10 V ↑	+1 V ↑	+10 V ↑	+1 V ↑	0 V ↓
2048	+5 V ↑	+0,5 V ↑	0 V	0 V	-5 V ↓
0	0 ↑	0 ↑	-10 V ↓	-1 V ↓	-10 V ↓

Example for connection of output channel 13:



Note

Two ”SENSE” measurement cables are provided to increase voltage precision at the load resistor RL. These must be high impedance cables (I ≤0.2 mA), by which the effective voltage on RL is measured, and if necessary corrected. If the SENSE detectors are not required, then terminals 26 - 27 and 10 - 11 must be connected together.

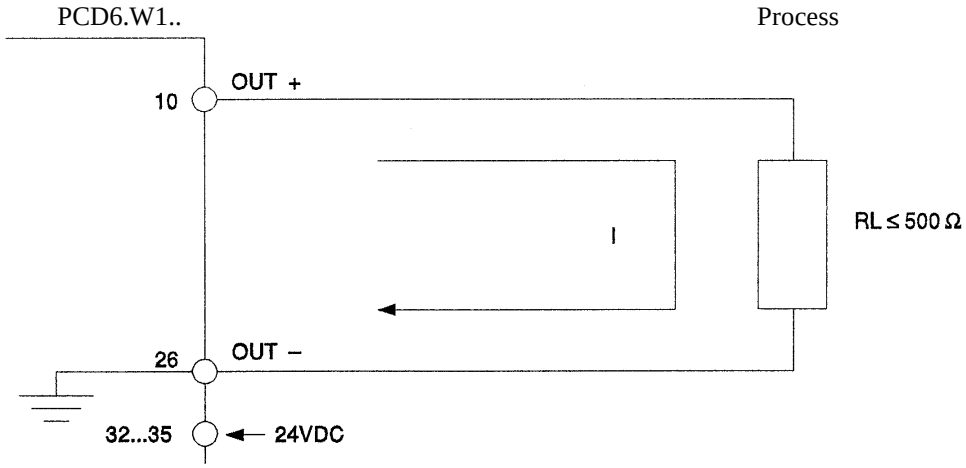
Current outputs 0...20 mA, 4...20 mA

Range modules:
PCD7.W204: 1 output channel for range 0...20 mA
PCD7.W205: 1 output channel for range 4...20 mA

Digital outputs are as follows:

Digital values	Range module	
	..W204 (0...20 mA)	..W205 (4...20 mA)
4095	+20 mA	+20 mA
2048	+10 mA	+12 mA
0	0 mA	+ 4 mA

Example for connection of output channel l3:



12.2 PCD6.W3.. Analogue input module for slow processes, 12 bit resolution + preceding sign

This analogue module also has modular design. It consists of a universal basic module and 1 to 4 measuring range modules. This allows measuring voltage ranges from ±100 mV to 10 V or current ranges 0...20 mA or 4...20 mA and to store the values digitally in registers. Connection of resistance thermometers or direct connection of thermocouples is possible by using the appropriate range modules. Different measuring range modules can be plugged onto the four sockets, thus meeting the individual requirements optimally.

List of modules

Basic modules

PCD6.W300: for employment in a 50 Hz environment with the corresponding clock frequency for antiphase noise suppression. Input multiplexer for max. 16 input channels. Special 2 mA constant current output.

PCD6.W301: for employment in a 60 Hz environment with the same functions as type ..W300.

Input range modules

PCD7.W100: 4 channels, measuring range ±10 V
Eingangswiderstand 200 kΩ/0,2%

PCD7.W101: 4 channels, measuring range ±1 V
input resistance ≥10 MΩ

PCD7.W102: 4 channels, measuring range ±100 mV
input resistance ≥10 MΩ

PCD7.W103: 4 channels, measuring range 20 mA bzw. 4...20 mA
input resistance 49,9 Ω/0,1%

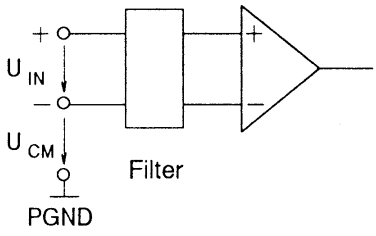
PCD7.W104: 4 channels, measuring range 4...20 mA for two-wire converter. Input resistance 49,9 Ω/0,1%

PCD7.W120: 4 constant current outputs 2 mA
for 4 Pt/Ni100 or Pt/Ni1000

Time constant of input filter 1 ms

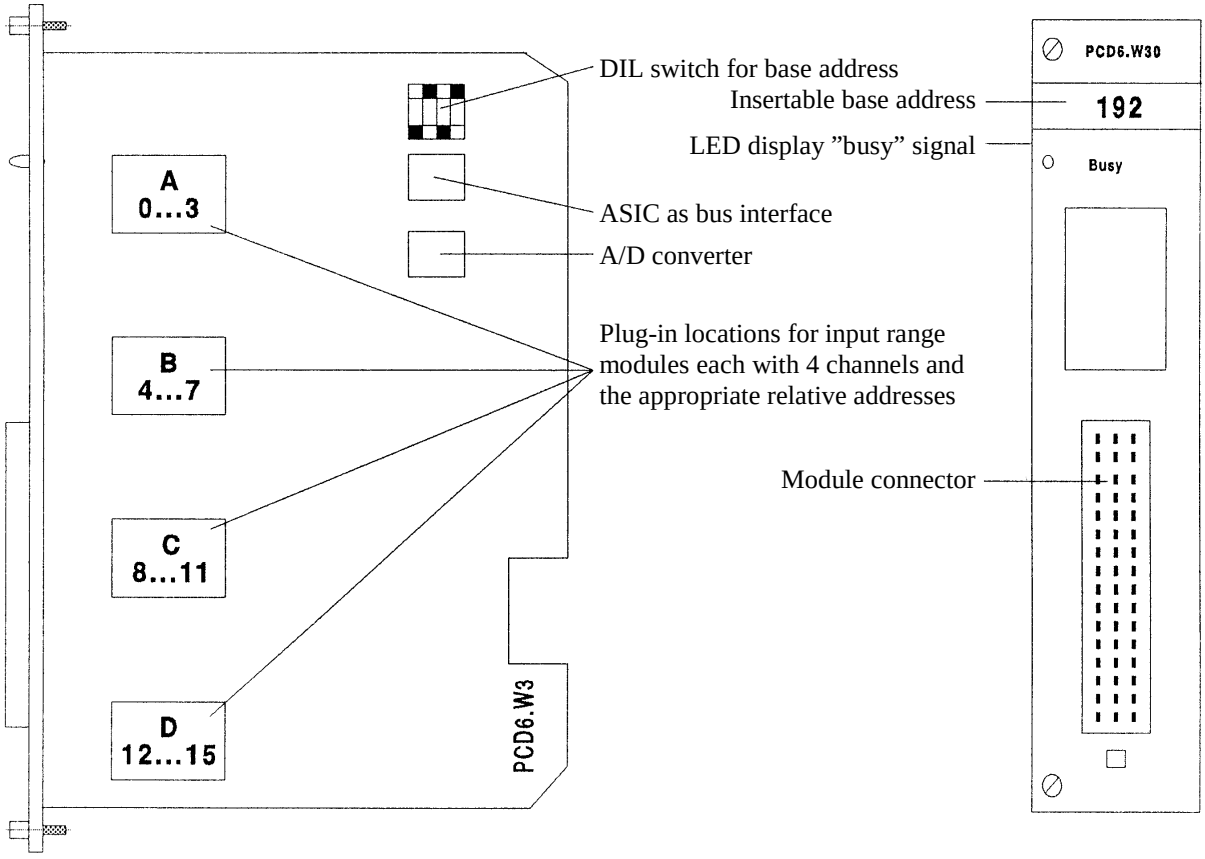
Technical data (basic module)

Number of inputs	16 voltage or current inputs or 8 inputs for resistance thermometers in four-wire technique (Pt100/1000 or Ni100/1000)
Electrical isolation	None (differences between negative potentials max. 1.5 V)
Input measuring principle	Differential
Input ranges	See measuring range modules
Digital representation (resolution)	12 bits + preceding sign (±4095)
Conversion principle	Integrating
Integration time	..W300 at 50 Hz: 120 ms ..W301 at 60 Hz: 16 2/3 ms
Conversion time max.	..W300 at 50 Hz: 120 ms ..W301 at 60 Hz: 100 ms
Permissible overvoltages	60 VDC
Resistance to interference according to IEC 801-4	1 kV capacitance coupling without shielding 2 kV capacitance coupling with shielding
Common-mode behaviour	$U_{IN} + U_{CM} \leq \pm 12$ V CMR = 74 dB CMMR = 200 µV/V
Error message	After exceeding the range >±4095
Accuracy	0.3% ±2 LSB (referring to measured value)
Repeat accuracy	Within 3LSB
Temperature error	Typical 0.8% across temperature range 0...50°C
Outputs	1 constant current output 2 mA ±1% for temperature compensation when connecting thermocouples
Ext. supply voltage	24 VDC required for current inputs from two-wire converter, voltage tolerance see ..N2.. modules
Current consumption internal from PCD6 bus	+ 5 V 35 mA +15 V 35 mA –15 V 20 mA



CM: Common Mode

Presentation



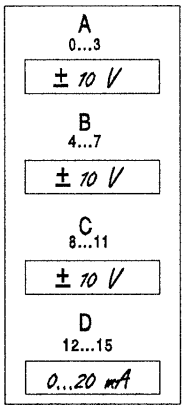
Attaching the range modules

The ..W3.. module must be removed from the rack unit to plug on the range modules.

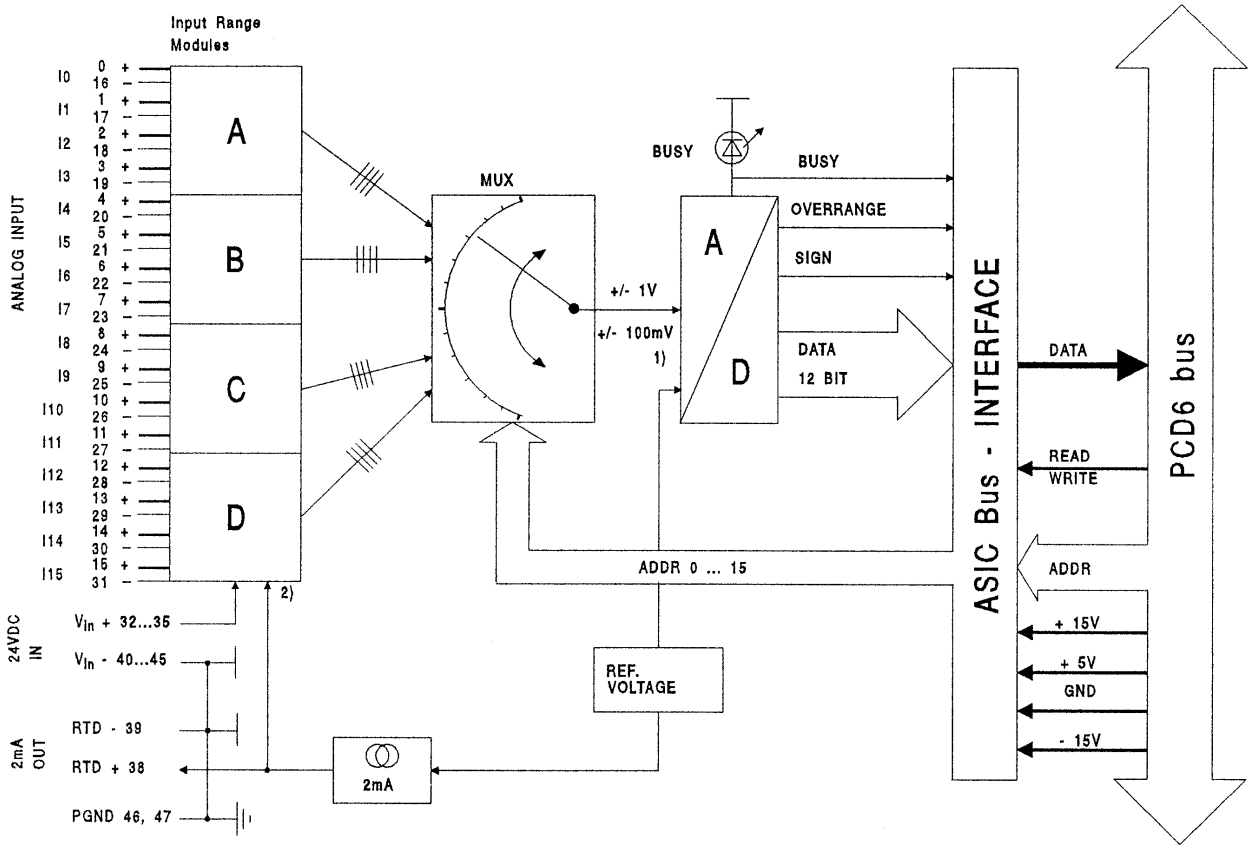
It must be noted that socket A is disposed at the top, socket D at the bottom.

Attention: The basic PC-board as well as the range modules accommodate components which are sensitive to electrostatic charging.

Different range modules may be plugged into the four sockets. Do not forget to note the configuration down on the front panel.



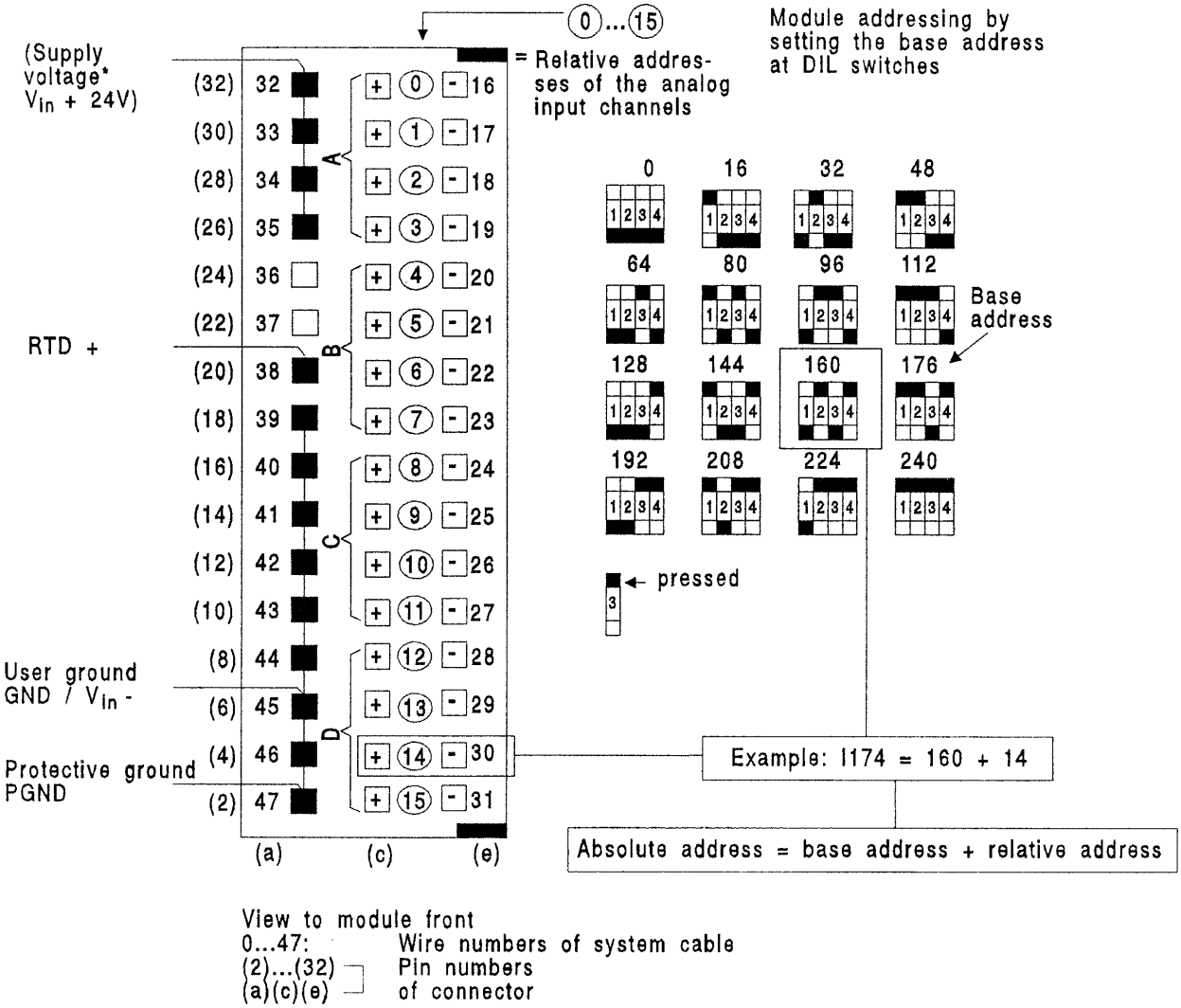
Block diagram



1) The A/D converter is switched to ±100 mV for the corresponding addresses by plugging in the ..W102 range module (±100 mV).

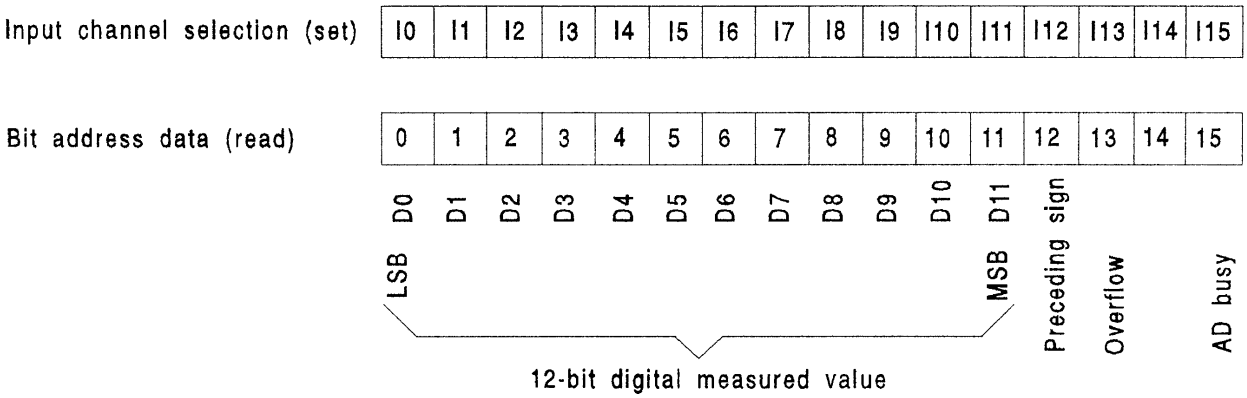
2) The 2 mA source is automatically switched to the corresponding terminals of this module (selectable in the same way as input channels 0...7) by plugging the ..W120 range modules for a 2 mA constant current into sockets C and D.

Pin assignment diagram and addressing



*) Only required if the PCD7.W104 range module is employed.

Significance of the 16 addresses



Bit 12 ”Preceding sign” = 1: negative value
Bit 13 ”Overflow” = 1: absolute amount >4095
Bit 15 ”AD Busy” = 1: AD conversion is being effected

User program

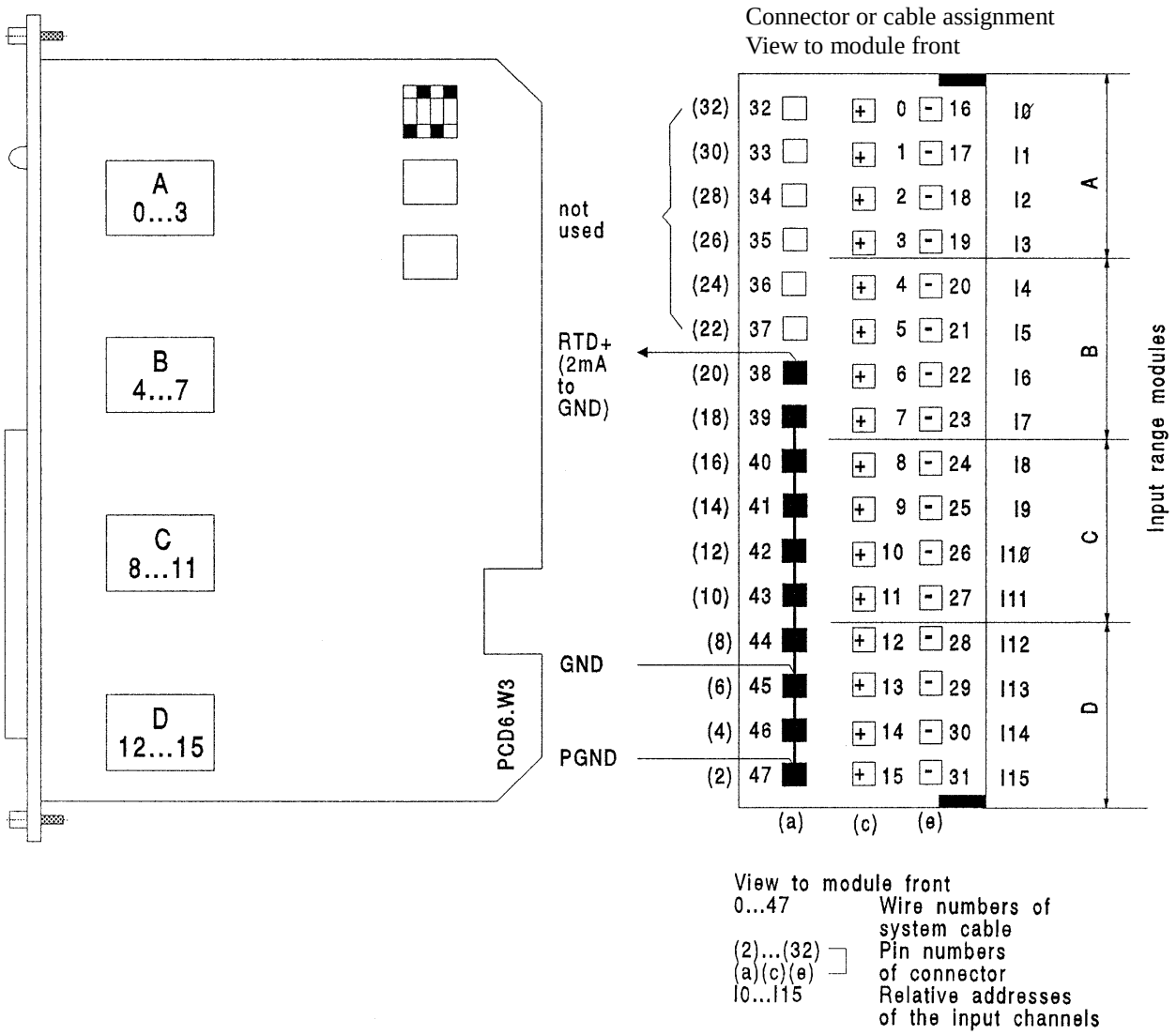
Reading in the analogue value from channel I3, AD conversion and data transfer to register R103

```
( ACC   H       )   (ACCU must he 1)
  SET   O   3 *)    Selecting channel I3 and triggering AD conversion
  STH   I   15*) ]  High = conversion takes max. 120 ms
  JR    H   -1   ]  (wait or branch)
 ------------------
 BITI       12     Read 12 bits
       I    0 *)   as of LSB address 0
       R    103    into register R103
 ------------------
  STH   I   12*) ]  Checking the preceding sign
  CFB   H        ]
  STH   I   13*) ]  Checking overflow (amount >4095)
  CFB   H        ]
```

*) The base address of the module must be added to these operands.

Module connection for different input signals

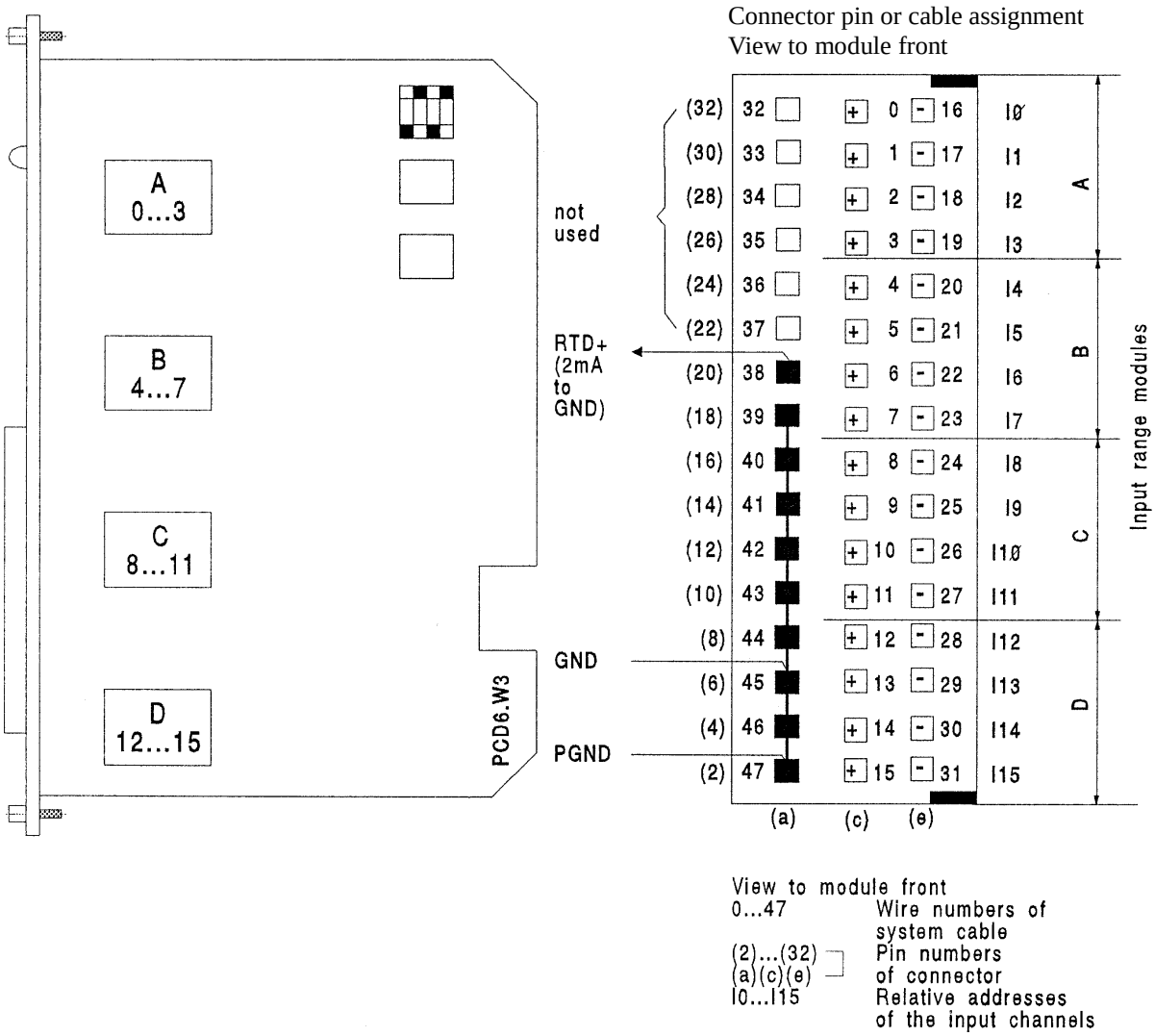
Voltage inputs for the ranges ±100 mV, ±1 V, ±10 V



Range modules **PCD7.W100:** Measuring range ±10 V = ±4095
PCD7.W101: Measuring range ±1 V = ±4095
PCD7.W102: Measuring range ±100 mV = ±4095

Module sockets A to D may be equipped with different range modules. The 2 mA constant current output RTD+ is always available irrespective of the range modules.

Current inputs for the ranges 20 mA and 4...20 mA



Range module PCD7.W103: Measuring range ±20 mA = ±4095

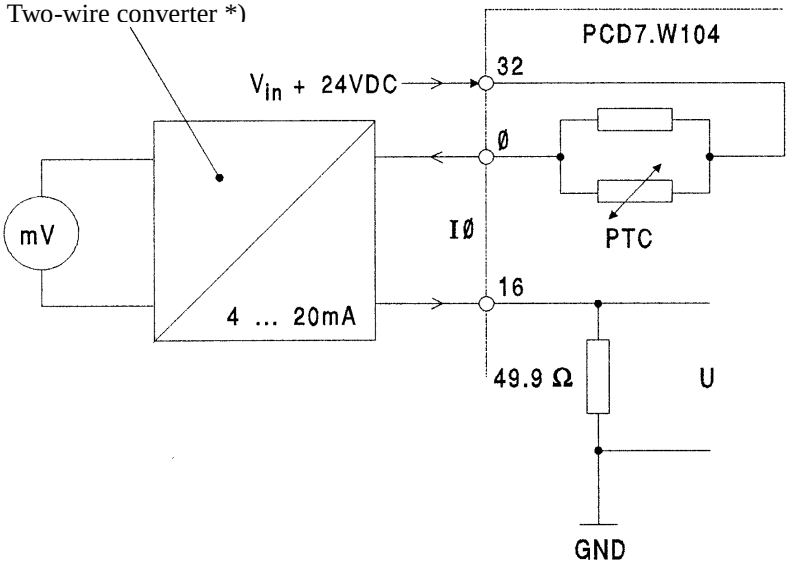
The same range module is employed for the range 4...20 mA. The current limits are monitored with the user program:

4 mA = + 819 (digital value)
20 mA = + 4095 (digital value)

Module sockets A to D may be equipped with different range modules (e.g. A...C: ±20 mA, D: ±10 V). The 2 mA constant current output RTD+ is always available irrespective of the range modules.

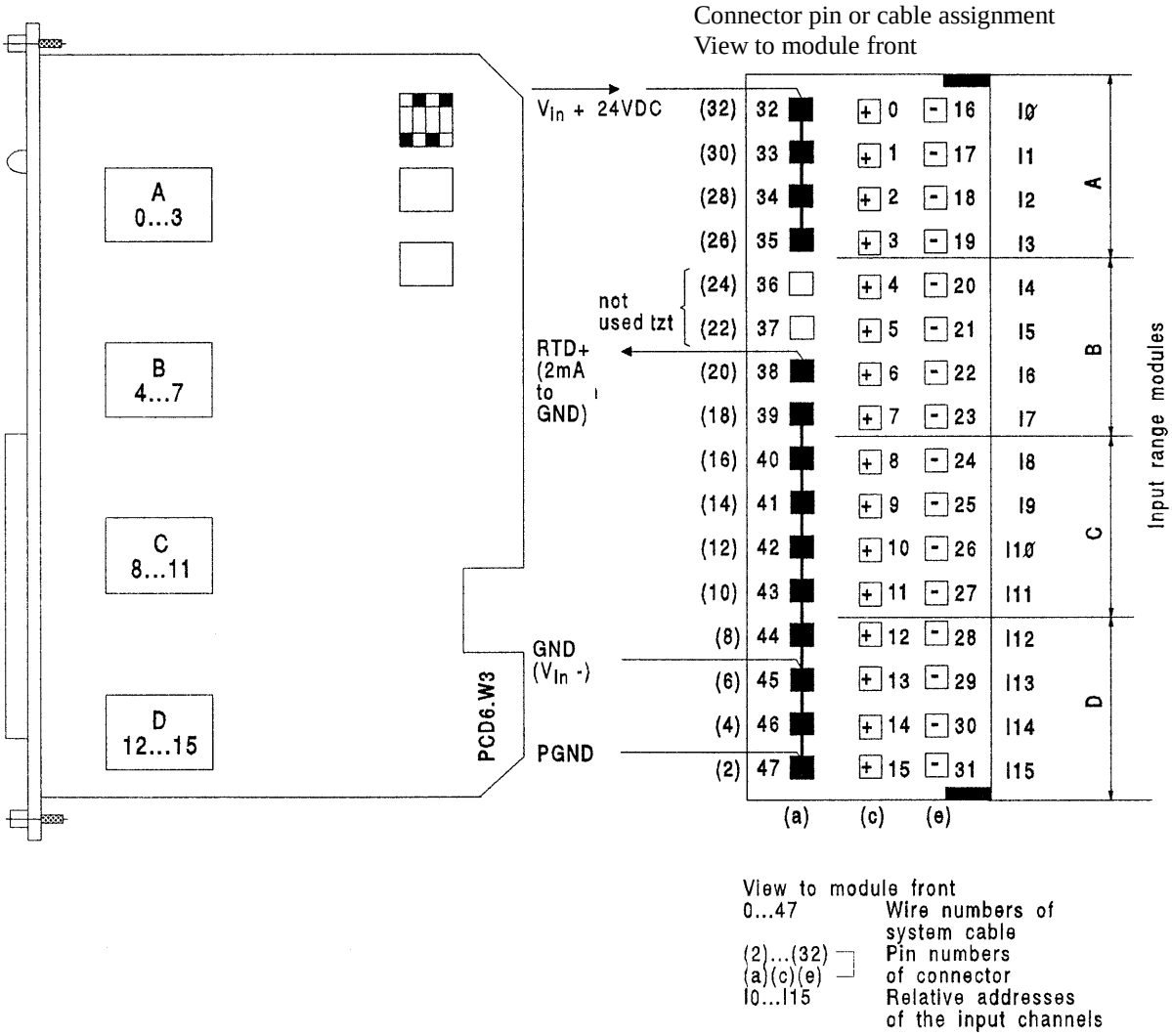
Current inputs for 4...20 mA from two-wire converter

Two-wire converter requires a 24 VDC supply voltage in the circuit as shown in the following diagram:



*) The range module ..W104 can also be used without the two-wire current converters for normal 20 mA inputs. To implement this, the inputs must be connected to the terminals (16, 17, 18) and the common ground terminal 45 (GND).

Current inputs from two-wire converter



Range module PCD7.W104: Measuring range 4...20 mA (two-wire converter)

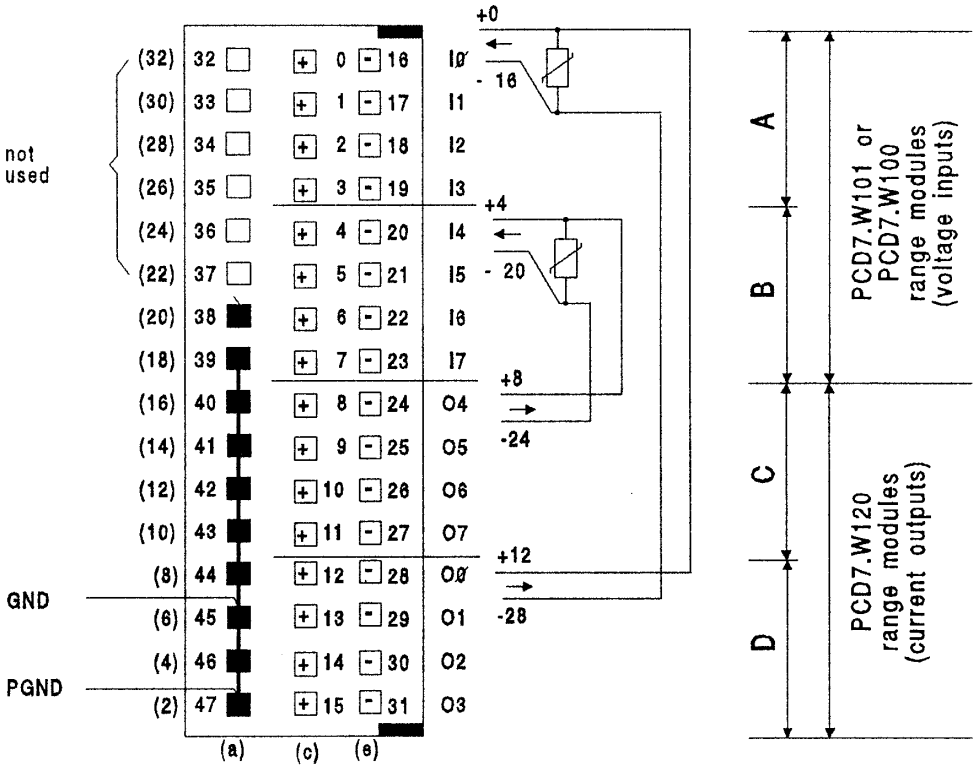
4 mA = + 819 (digital value)
20 mA = + 4095 (digital value)

A +24 VDC voltage must be applied to wire number 32 for supplying the converter. The requirements on this voltage are the same as for the PCD6.N2.. power supply module. Power consumption max. 0.4 A when connecting 16 converters.

Module sockets A to D may be equipped with different range modules (e.g. A: 4...20 mA, B: ±10 V etc.).

The 2 mA constant current output RTD+ is always available irrespective of the range modules.

Connection of 8 Pt100/1000 or Ni100/1000 resistance thermometers



View to module front
0...47 Wire numbers of system cable
(2)...(32) Pin numbers
(a)(c)(e) of connector
I0...I7 Relative addresses of the input channels
O0...O7 Relative addresses of the 2 mA outputs

Range module on sockets A and B:

PCD7.W101 (±1 V) for 4 Pt100 or Ni100
PCD7.W100 (±10 V) for 4 Pt1000 or Ni1000

Range module on sockets C and D:

PCD7.W120 for 4 constant current outputs of 2 mA

The ..W120 modules provide a constant current of 2 mA up to a circuit resistance of 2000 Ω . The voltage drop at the resistance thermometers is supplied to the voltage range module on the sockets A and B.

Important: Unused 2 mA outputs must be short-circuited. The RTD+ connection must not be used.

Software

If the range modules are plugged onto the basic module correctly (voltage inputs on sockets A and B, constant current outputs on sockets C and D), the circuit recognizes that the configuration comprises resistance thermometers. Therefore, the user must only ensure appropriate handling of the voltage inputs in the software, as described in chapter ”User program”.

Temperature measurement with Pt100 and range module for 0... ±1V

The temperature-dependent resistor Pt100 shows a resistance of **R0 = 100 Ω** at 0°C. In the temperature range from -20°C to +200°C resistance develops with an accuracy of 1% according to the following formula:

$R_T = R0 (1 + 3.83 * 10^{-3} * T)$ T in °C

Sensitivity S on the measuring range module ±1 V under 2 mA is the following:

S = 3.83 * 10^{-3}/°C * 4096 LSB/1 V * 0.002 A * 100 Ω = **3.14 LSB/°C**

The 2 mA constant current results in a voltage of 0.2 V at 100 Ω.
On measuring range module ±1V, this corresponds to a digital value of

4096 * 0.2 = 819, i.e.
100 Ω = 0°C = 819 LSB = Offset

With these two values a conclusion can be drawn from the digital measured value to the temperature in °C at all times.

$$\mathbf{T(°C) = \frac{digital\ measured\ value - 819}{3.14}}$$

or

digital measured value = 3.14 * T + 819 T in °C

Example 1: digital measured value 1300 LSB

$$T = \frac{1300-819}{3.14} = \mathbf{+153.2°C}$$

Example 2: digital measured value 770 LSB

$$T = \frac{770-819}{3.14} = \mathbf{-15.6°C}$$

Example 3: 100°C corresponds to which digital measured value?

Digital measured value = 3.14 * 100 + 819 = **1133**

Temperature measurement with Pt1000 and range module ±10 V

The same formulae apply as to Pt100.

Connecting thermocouples

Two points must be particularly noted when employing thermocouples:

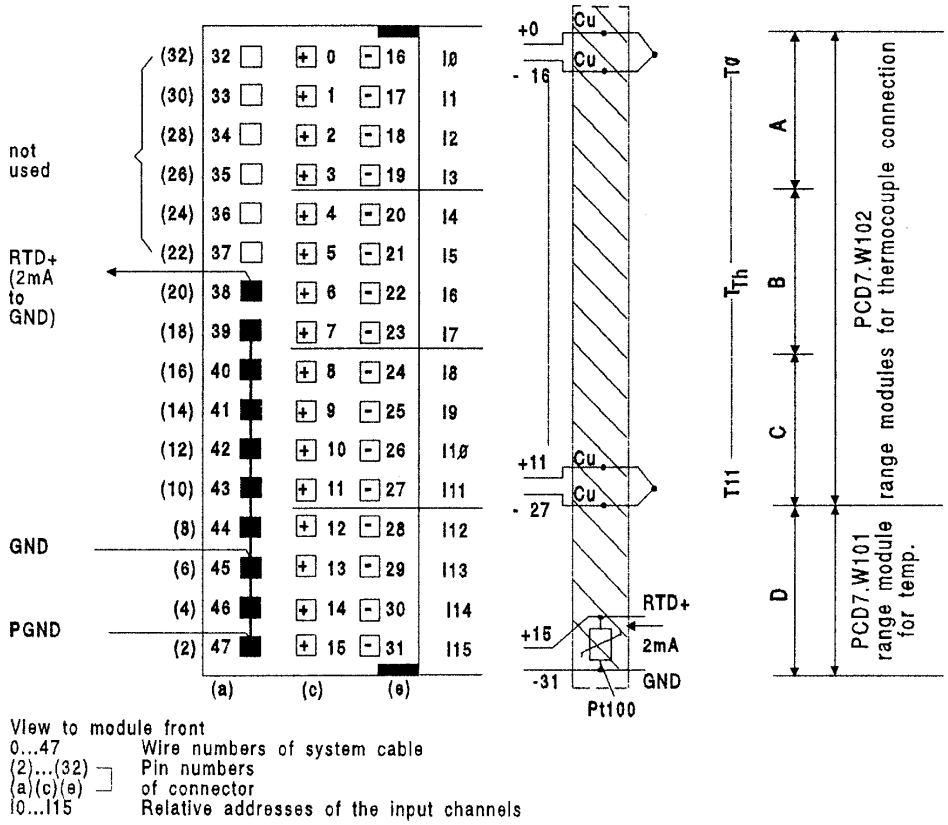
– Thermocouples only deliver very small voltages. Therefore, the voltage modules ±100 mV are employed.

– Thermocouples deliver a voltage as a function of the difference in temperature between the measuring point and the terminal of the thermocouple.

In order to obtain the actual temperature, the temperature must be measured at the terminal which can be effected with this module by an additional Pt100 resistance thermometer.

The actual temperature T_W then is:

$T_W = T_{Th} + T_K$ T_{Th} = Difference in temperature of the thermocouple
T_K = Temperature at the terminals of the thermocouple



Range modules on sockets A to C

PCD7.W102 (±100 mV) for 4 thermocouples

Range module on socket D

PCD7.W101 (±1 V) for 1 Pt100 input (3 inputs ±1 V remain free and may be used as desired)

The constant current 2 mA for Pt100 is supplied by terminal RTD+ (wire no. 38) of the basic PC-board.

12.3 PCD6.W400 Analogue output module, 16 x 8 bits

Fast output module with 16 output channels with 8 bits respectively. Different output signals which can be reversed with the aid of insertable jumpers. Suited for processes in which a large number of actuators must be controlled, such as used in the chemical industry or building automation.

List of types

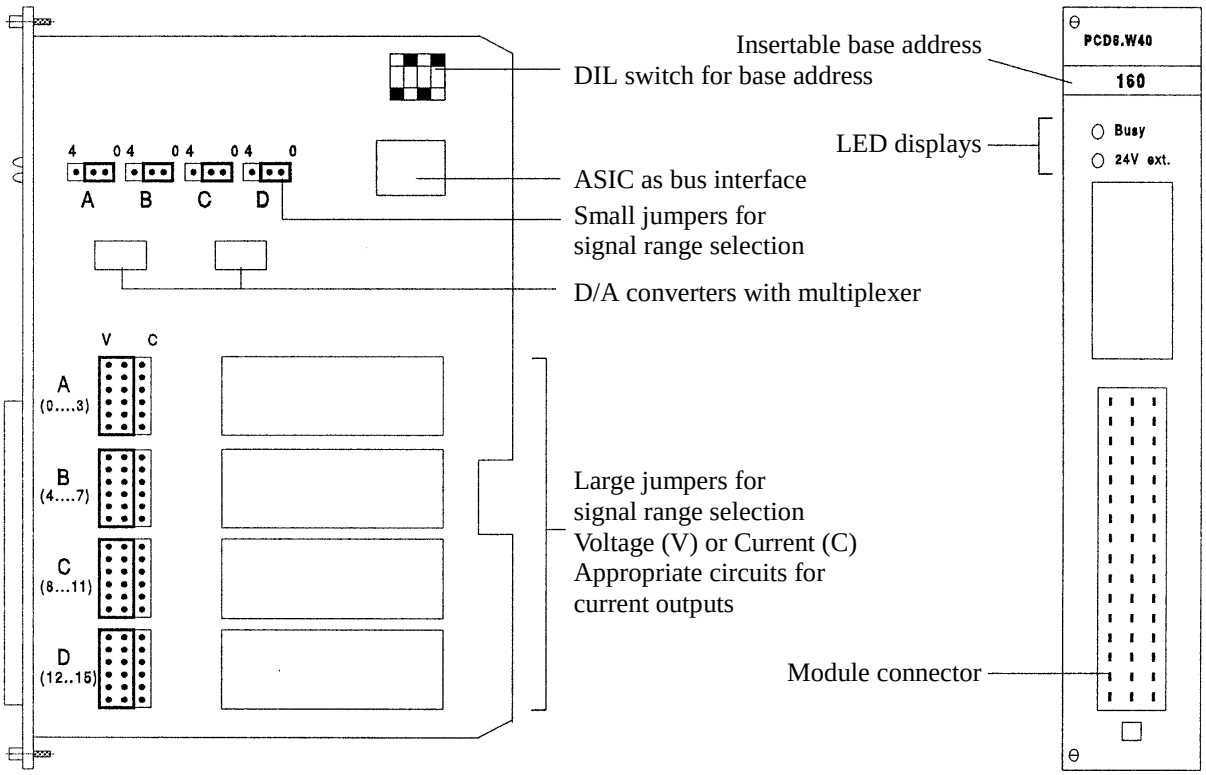
PCD6.W400	Universal module with 16 output channels with 8 bits respectively. Signals reversible (4 outputs each) for 0...10 V, 0...20 mA or 4...20 mA.

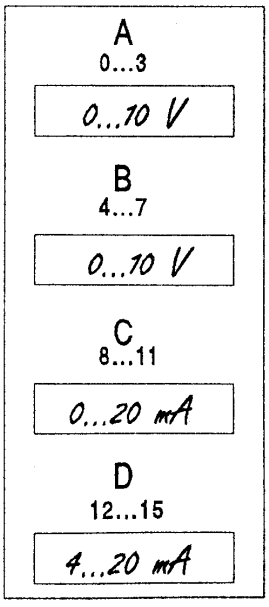
Technical data

Outputs	16 (in groups of 4), short-circuit protected
Signal ranges	0...10 V * ⎫ 0...20 mA ⎬ reversible due to jumpers in groups with 4 outputs 4...20 mA ⎭ respectively
Digital representation (resolution)	8 bits (0...255)
D/A conversion time	<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 (referring to 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 mV pp For 0...20 mA < 50 µA pp For 4...20 mA < 50 µA pp
Temperature error	Typ. 0.2% across the range 0...50°C
Ext. supply voltage 24 VDC	Max. 0.4 A required for current outputs Tolerance: see power supply for PCD6.N2..
Operating temperature	0...+50°C
Storage temperature	-20...+85°C
Resistance to interference according to IEC 801-4	1 kV capacitance coupling without shielding 2 kV capacitance coupling with shielding
Current consumption internal from PCD6 bus	+ 5 V max. 20mA +15 V max. 40 mA + max. 3.5mA/ channel/0...10V –15 V max. 50 mA

*) Factory setting

Presentation





Output signal selection with jumpers

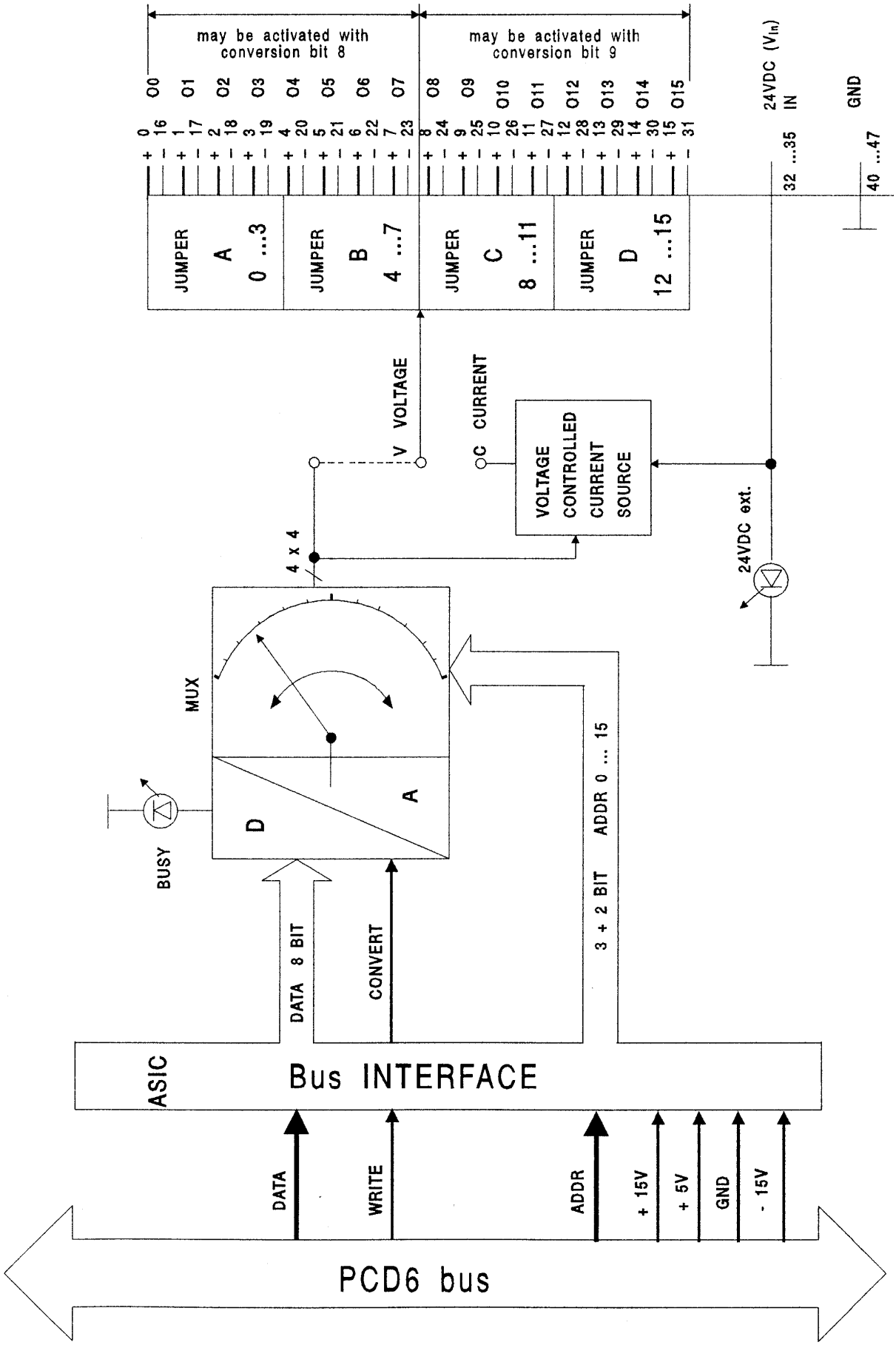
The large jumpers are used to select:
”V” = Voltage or ”C” = Current

The small jumpers are used to select
”0” = 0...10 V or 0...20 mA
”4” = 4...20 mA (large jumper set to ”C”)

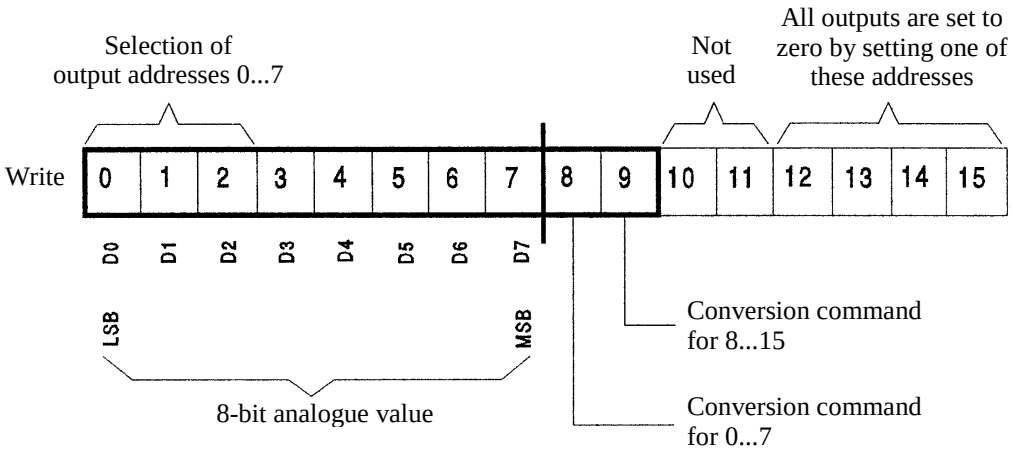
The factory setting is ”V” ”0”, i.e. 0...10 V.

The adhesive labels provided serve to make the selected ranges visible at the front, too.

Block diagram



Significance of the 16 addresses



Analogue value output procedure:

The desired output channel (0...7 binary) is written to bit numbers 0...2. The 8 bits for the analogue value to be output are then set. Bit 8 (for output channels 0...7) or bit 9 (for output channels 8...15) is finally set to 1 to trigger D/A conversion.

The output address and data is entered serially. Owing to the short D/A conversion time it is not necessary to wait for a ”Busy”.

User program

The value stored in register R144 must be output via output O44. Thereby, only the lower 8 bits of R144 are important. Output 44 is on the ..W4.. module having base address 32. The relative output address is 44 - 32 = 12.

```
( ACC   H          )   (ACCU must be 1)
  LD    R  143     ]   Load the relative address of output
           12 [1]  ]   channel 12 to R143
BITOR       3          The relative output address 12 (as of
        R   143        R143) is loaded into the D/A converter
        O   32 [2]     of module 32
BITOR       8      ]   The value to be output (8 bits) is transferred
        R   144    |   from register 144
        O   32 [2] ]   to the D/A converter of module 32
 SET    O   41 [3]     D/A conversion is triggered by activating
                       bit 9 (32+ 9 = 41)
```

[1]) The **relative** output address (without base address) is stated.

[2]) The **base address** of the module must be stated here.

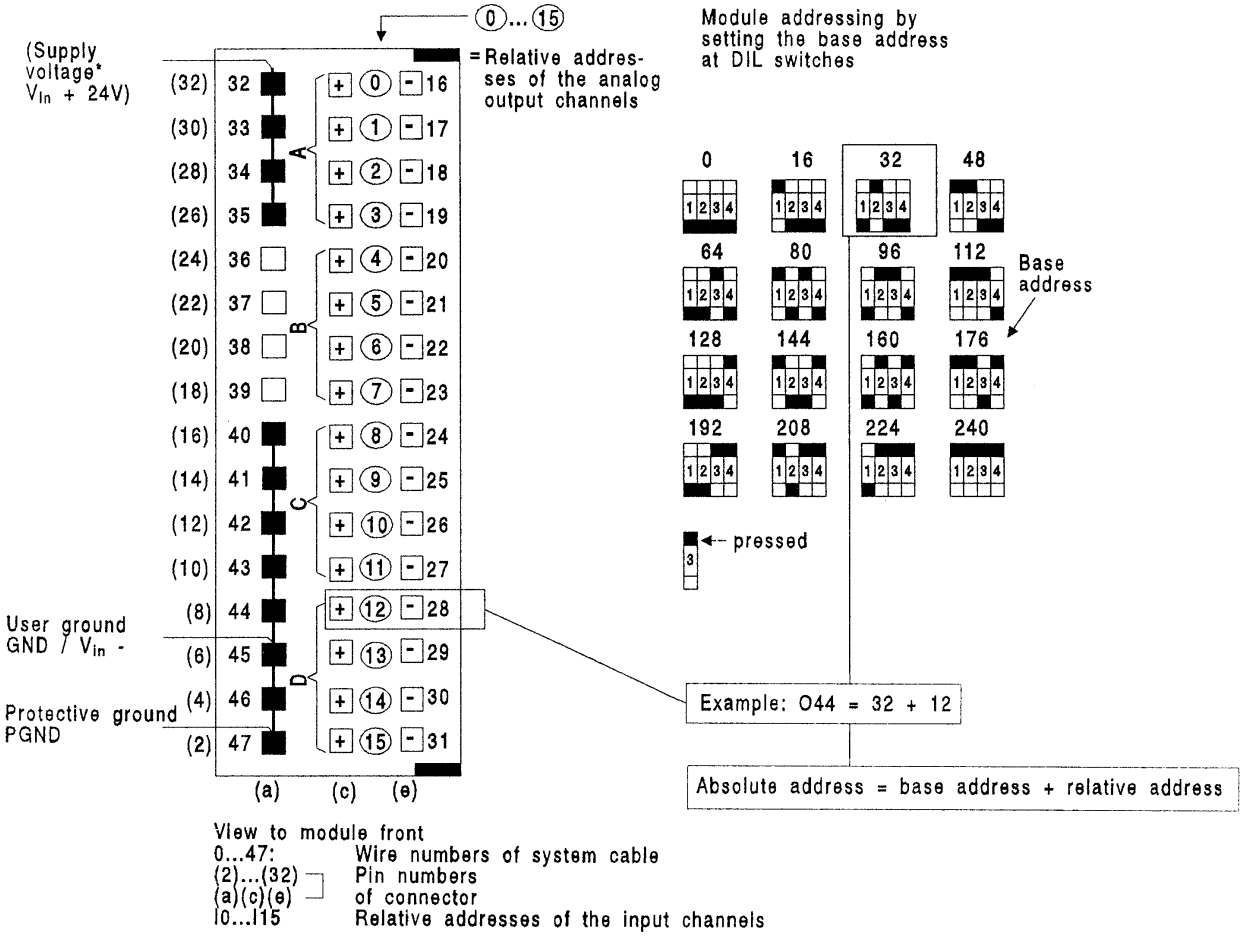
[3]) The **absolute address of bit 9** is required because channel 12 is in the higher address range 8...15.

Digital/analogue values and jumper positions

Large jumper Small jumper Signal range	V/C 0/4	V 0 0...10V	C 0 0...20 mA	C 4 4...20 mA
Digital values				
	255	10.0V	20 mA	20 mA
	128	5.0V*	10 mA*	12 mA*
	0	0	0	4 mA

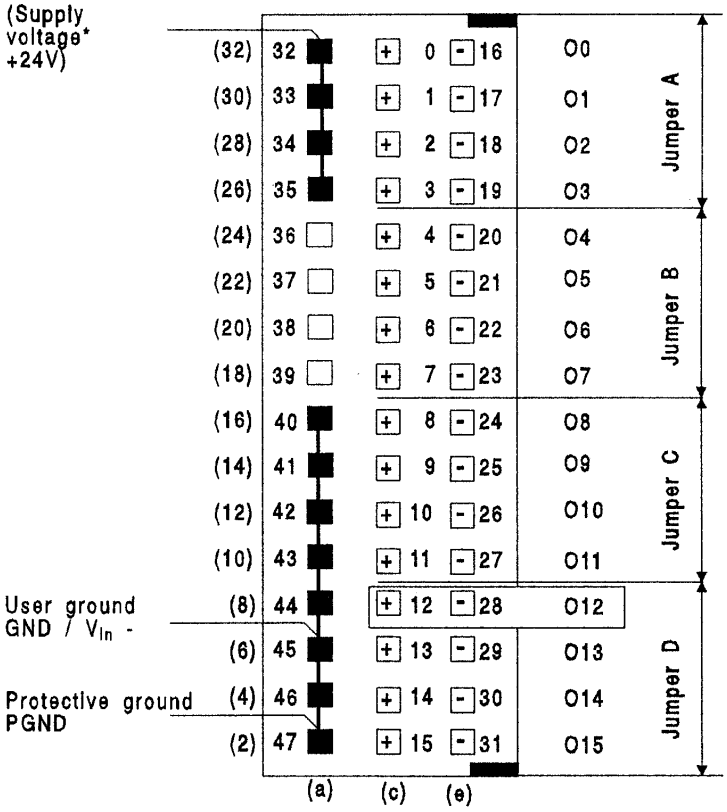
*) The exact values are 1/255 higher

Pin assignment diagram and addressing



*) Required, if current outputs are used.

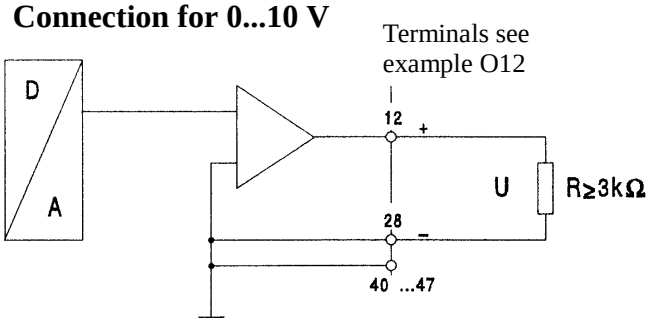
Connection of the analogue outputs



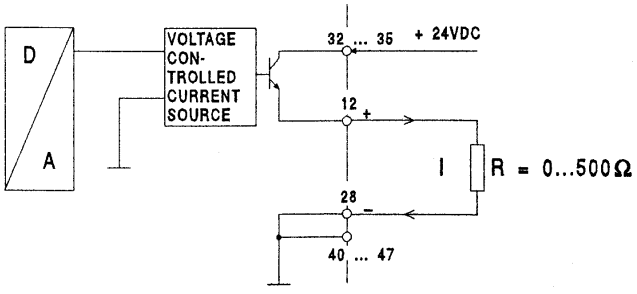
View to module front
0...47: Wire numbers of system cable
(2)...(32) Pin numbers
(a)(c)(e) of connector
O0...O15 Relative addresses of the output channels

*) Required, if current outputs are used.

Connection for 0...10 V



Connection for 0...20 mA or 4...20 mA
(selectable with jumpers)

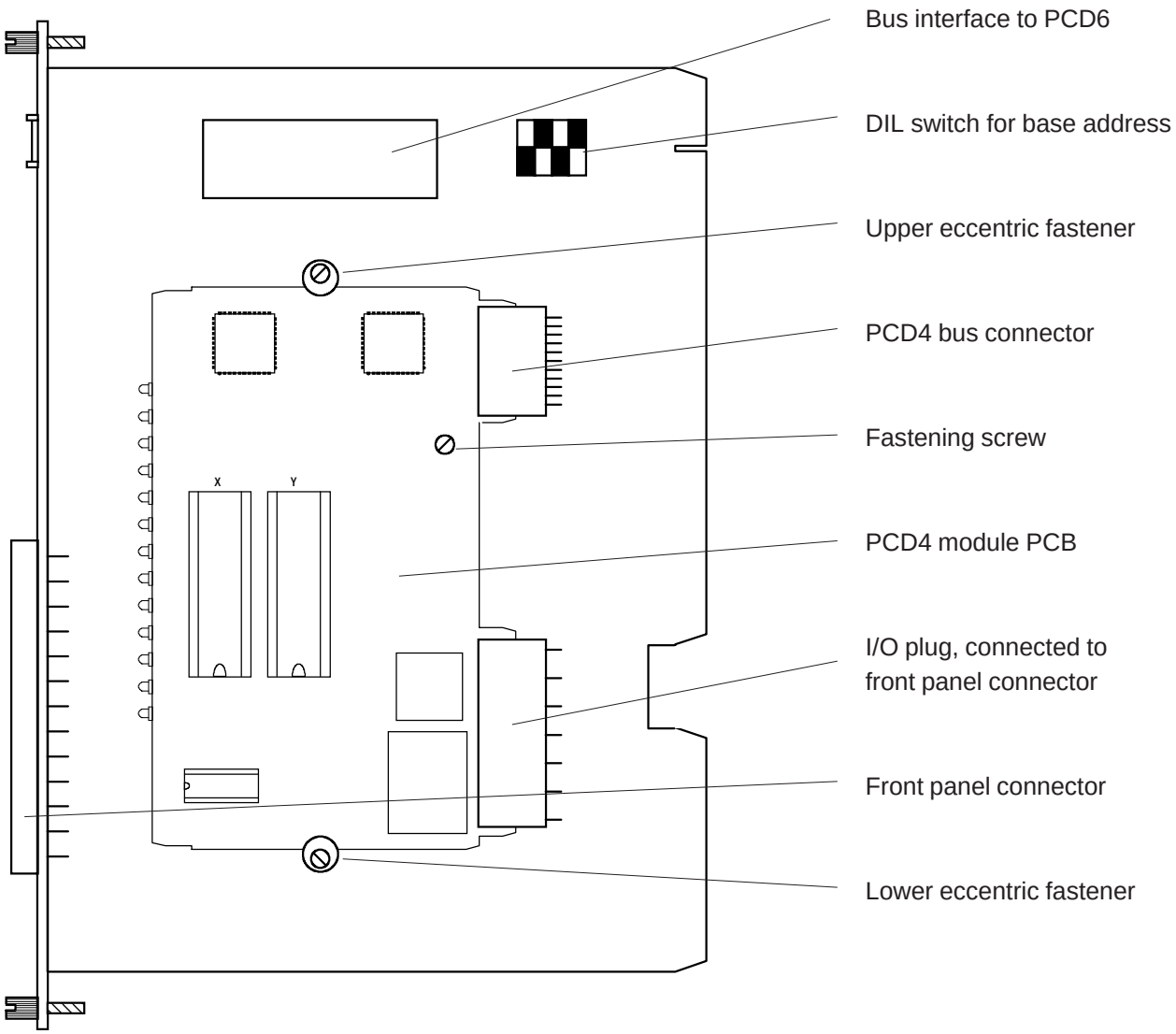


13. PCD4 → PCD6 Adapter Module Type 4'717'4828'0

Application

This adapter module enables PCD4 I/O modules to be used with the PCD6, on condition that there is only one printed circuit board used for the PCD4 module and that it has no forward connectors.
The module occupies 16 addresses. If the same base address is used, PCD4 programs can be run.

Layout

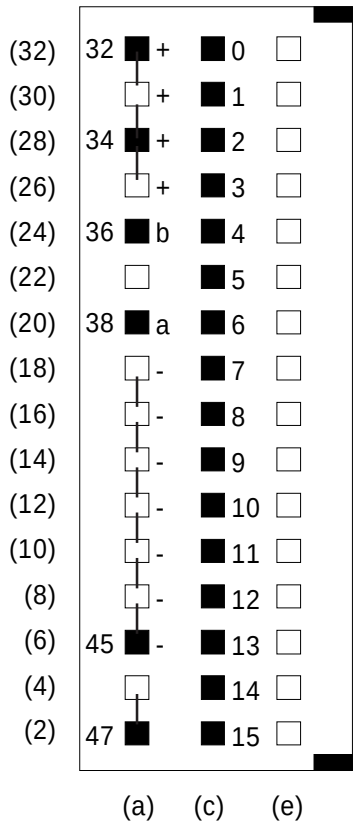


Assembly

- Remove the PCD4 module's printed board from housing
- Unscrew the fastening screw on the adapter module and turn the eccentric fastening outwards
- Push the PCD4 printed circuit board into the connector
- Secure the board with the fastening screw and eccentric fasteners
- To reduce the width, the covers of analogue range modules (PCD7.W..) should be removed
- If necessary, label the front panel

Note: The PCD4 module's LEDs are no longer visible in the assembled state.

Connections



Front view of module or rear view of connector

0...15, +, -, a, b — Corresponds to connections on the PCD4 bus modules

0... 15, 32... 47 — PCD6.K21 system cable core numbers

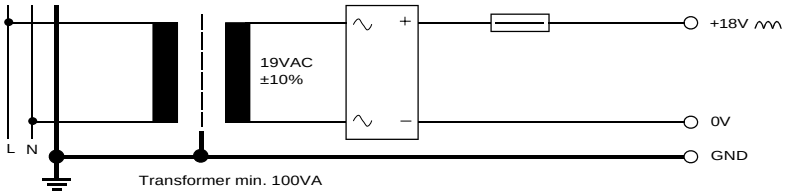
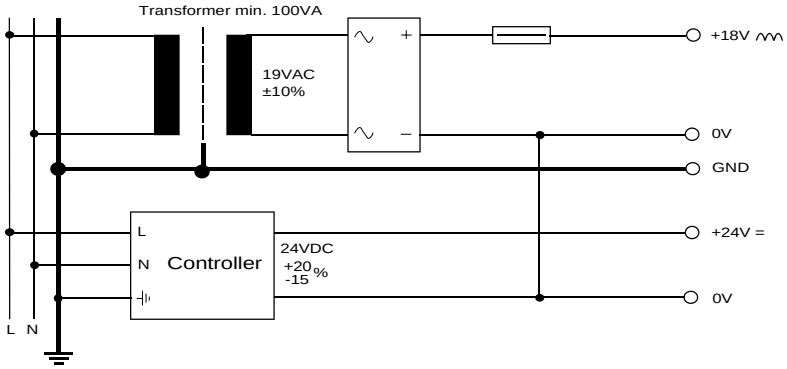
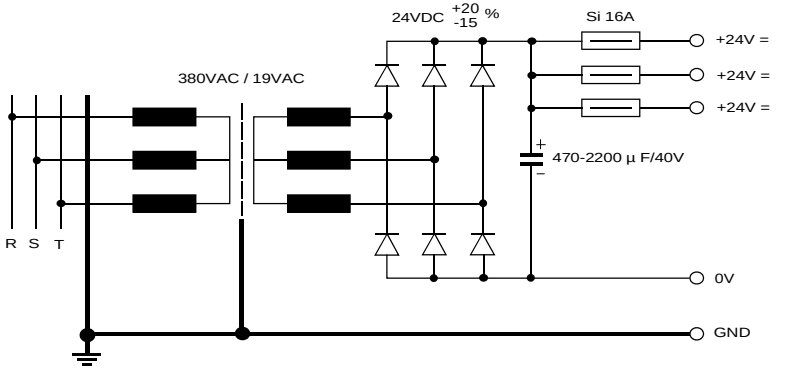
(2)... (32), (a) (c) (e) — Connector pin number

47 ■ — PGND frame ground

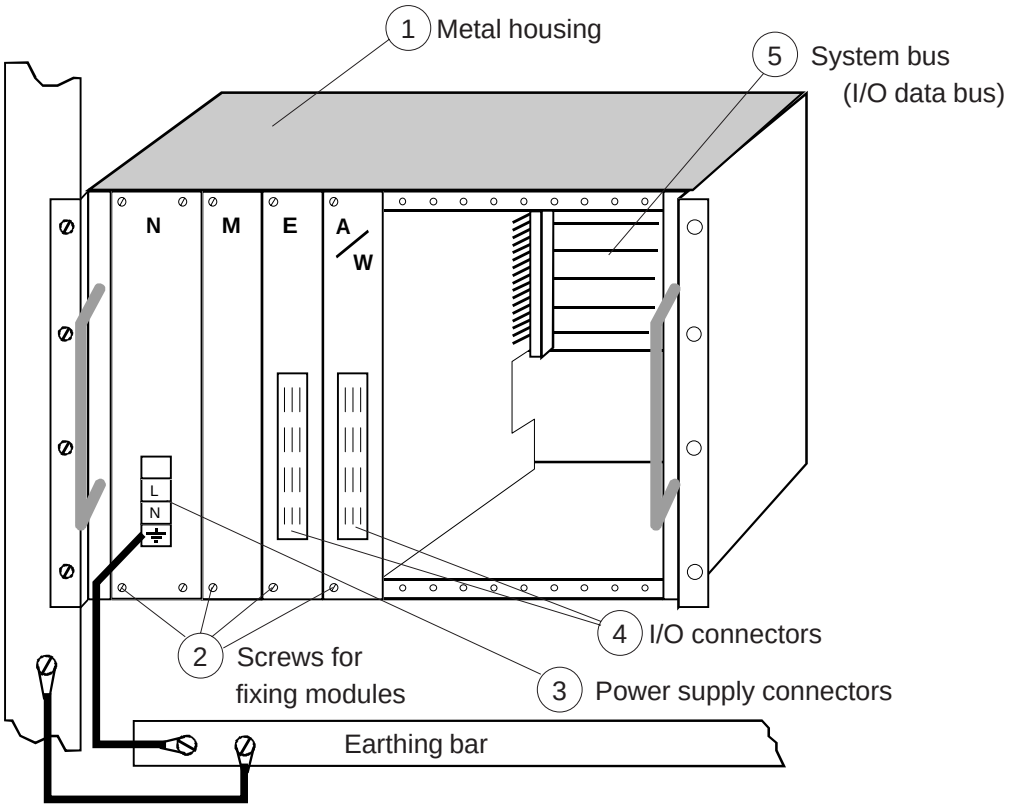
Note : When using the adapter module, connections are NOT the same as those of the future original PCD6 module.

14. Power supply and connection plan

14.1 Power supply 24VDC

Application		Sensors	Actuators	For modules
Simple, small installations		Electro-mechanical switches	Relays, lamps, small valves with <0,5A switching current	PCD6.N2.., E100, A400, A200, W1.., W3.., W400
Small to medium installations		Electro-mechanical switches and proximity switches, photoelectric barriers	Relays, lamps, displays, small valves with <0,5A switching current	PCD6.N2.., E100, A400, A200, W1.., W3.., W400, PCD7.D1..* PCA2.D12*, D14* *) These modules must be connected to 24 VDC smoothed
Medium to large installations		Electromechanical switches and proximity switches, photo-electric barriers	Relays, lamps, large valves, large contactors with consumtion up to 2A.	PCD6.N2.., E100, A350, A400, A200, W1.., W3.., W400, PCD7.D1.. PCA2.D12, D14

14.2 Grounding plan



1 All PCD6 housings are metal throughout (Fe and Al). They screen all electronic circuits from the outside.

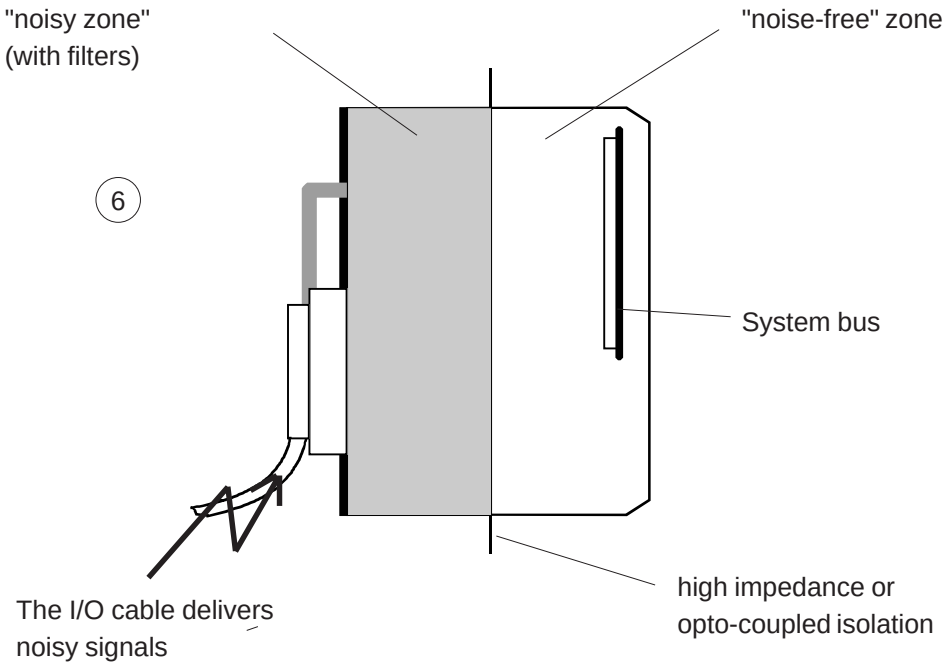
2 The front panels of all modules are also metal. **Screwing these modules down firmly** ensures a good connection with the housing.

3 On the power supply module, the grounding clip is connected directly to the metal front panel. A short, solid earth connection links it to the earthing bar and brings the whole housing to earth potential (same potential as the rack).

4 For each I/O/W/H module, connector points 46/47 are attached to the module front panel (PGND).

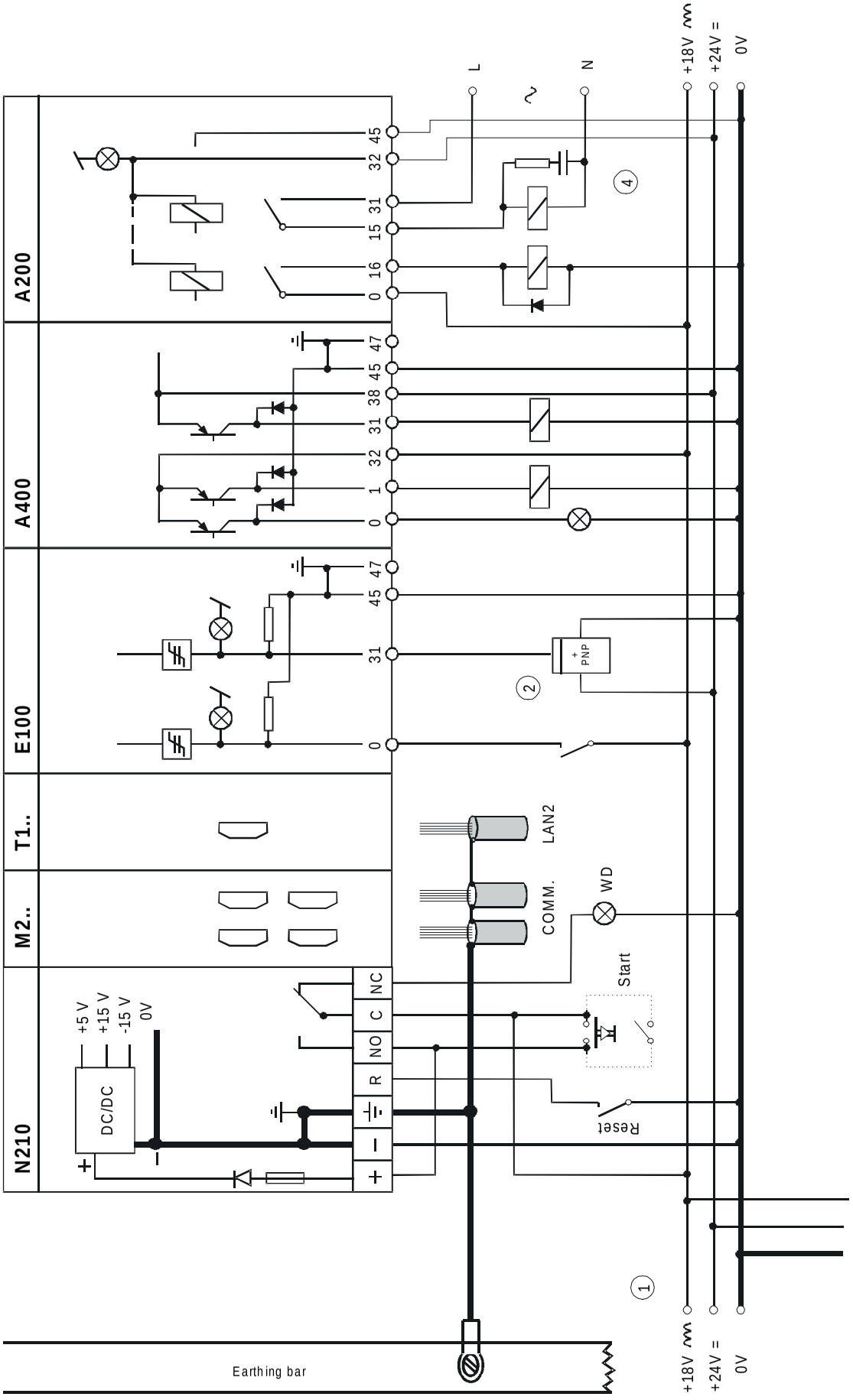
5 The system ground is separate and runs to all modules via the system bus.

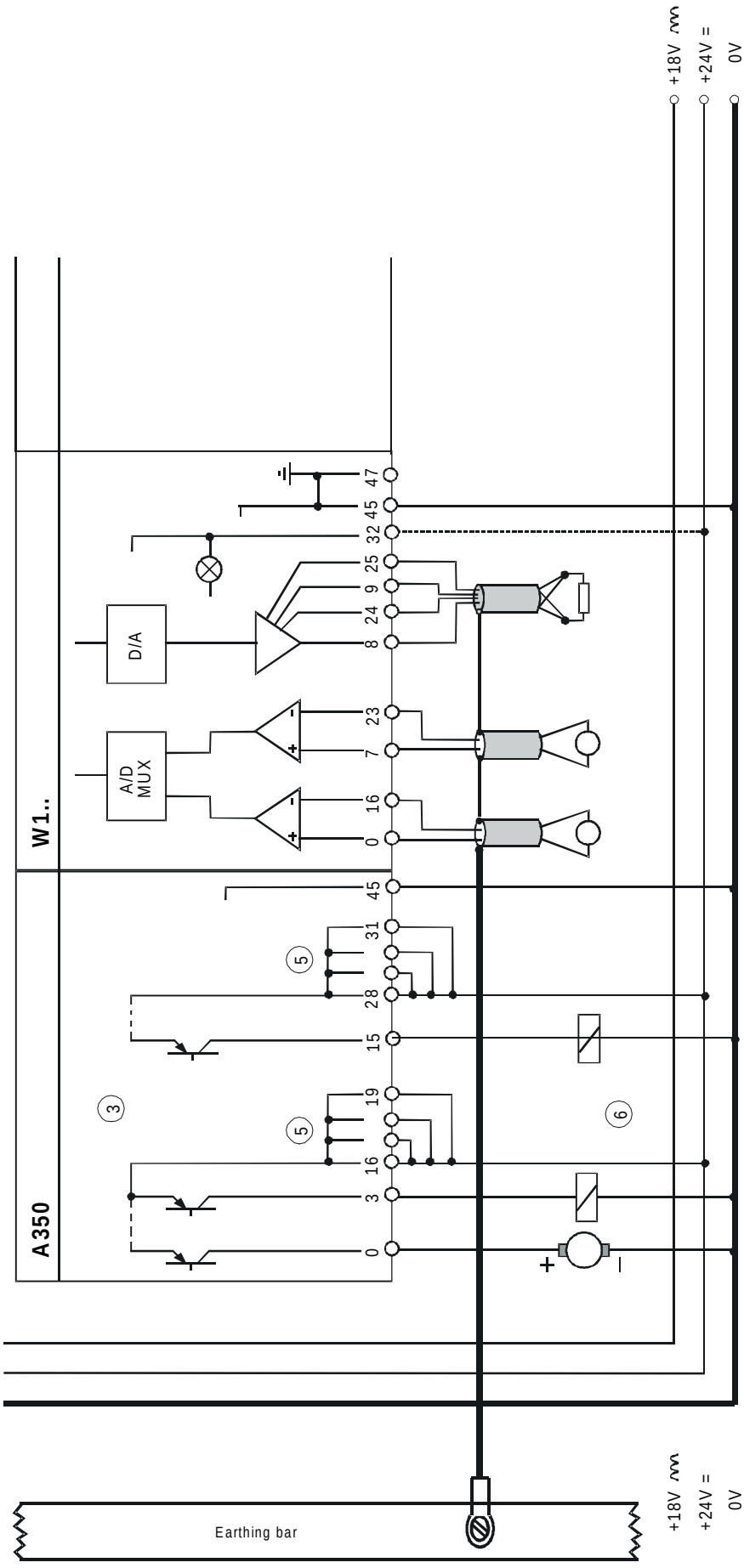
6 Each module has a "noisy" zone with noise filters (from the front panel I/O connector), and a "noise-free" zone which connects to the system bus. The zones are separated by high impedance or opto-couplers.



Important: For trouble-free operation in noisy environments, every PCD6 must be connected and earthed as shown.

Connection plan (supply 24VDC)





1) Use of a power supply with 3-phase transformer and bridge rectifier allows all inputs and outputs to be supplied from the same source. In this case, the two lines "+18V rectified" and "+24V = smoothed" can be viewed as a single shared line.

2) Regulated voltage is only necessary if required by the transmitting device. For example, proximity switches demand narrower voltage tolerances and cannot generally cope with more than 10% ripple.

3) The galvanically isolated modules A350 can be supplied by separate circuits, as long as the potential difference to system ground does not excees 50V.

4) If relay modules are used, an external RC spark protection is recommended, particularly when switching inductive loads. Apart from avoiding undesired noise, this has the advantage of increasing the lifespan of the contacts. It is only permissible to connect either extra-low voltages or low voltages to the same relay module (see instructions for installation in the detailed description of the A200 module).

5) The positive terminals on the A350 module should be connected together (despite the internal connection). This prevents the current on an individual plug contact from exceeding 2A.

6) The entire 24 VDC supply can (especially for small systems) be provided by rectified direct current. However, smoothed direct current is required for electronically protected outputs (A350) as well as for input modules with a typical input delay of less than 6 ms (e.g. H1.., H2.., H3.., PCA2.D12 and D14).

Notes :

15. Programming accessories

15.1 Interface processor for programming unit PCD8.P800 (PG connection for multiprocessor modules ..M1/M2..)

15.1.1 General

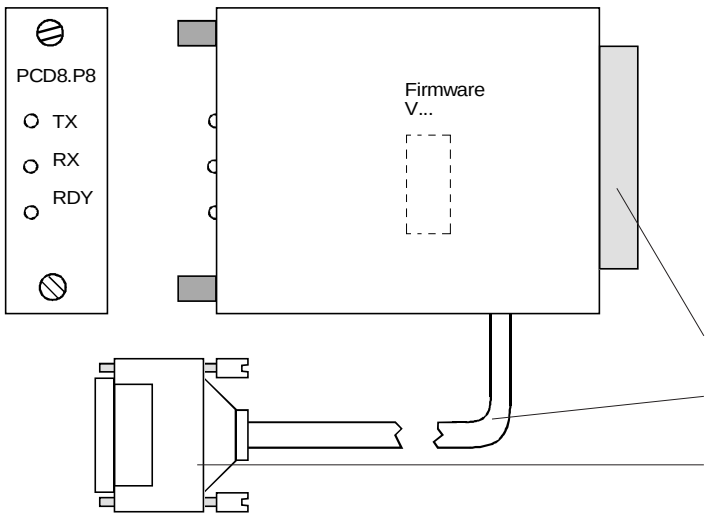
This module is part of the programming unit (PG) and is only used in combination with the latter for: system installation, loading of programs, on- and off-line tests, display functions, etc. The module has its own processor, thus relieving the strain on the CPU by performing time-consuming communication and monitoring functions so that the real-time behaviour of the CPU is only slightly affected in on-line operations.

The electronics is installed in a metal housing and fitted with a 48-pole connector which connects the module directly to the processor modules PCD6.M100 or PCD6.M2... It is fastened with 2 knurled nuts (parallel interface). The module is also equipped with a cable which is 1.8m in length and has a 25-pole D-Sub connector which establishes the connection to the programming unit (serial interface RS 232c).

The data transfer can be supervised via 2 LEDs (TX and RX, red). RDY (Ready, green) indicates that the PCD8.P800 has successfully passed its self-test upon starting (approx. 5s) and is now ready to assume its function as an interface processor.

For the singleprocessor module ..M540 no interface processor is needed (see chap. 3).

15.1.2 Rack unit and structure



Firmware: 1 EPROM with system program

V...: firmware version number

3 LED: TX, RX, RDY

Power consumption : 380mA
(from internal 5V bus)

Connector for processor module

Cable 1.8m in length

D-Sub connector (25-pole, female) for programming unit

15.1.3 Important notes for use

The PCD8.P800 must **not** be inserted or removed from the CPU while communication between the CPU and the programming unit takes place, i.e. when the PG is in mode DEBUG (testing aid) or UP/DOWN LOAD (reloader), as the CPU might block! (There is no risk of destroying it!).

Under no circumstances must an attempt be made to extend the cable between the CPU connector and the PCD8.P800, as interference caused by reflections might disturb the system bus!

The cable between the cable connector of the PCD8.P800 and the PG can be extended up to a maximum length of 15m (RS 232c).

Important: Make sure that the **ground** of the PCD6 and the programming unit is connected to the **same voltage**.

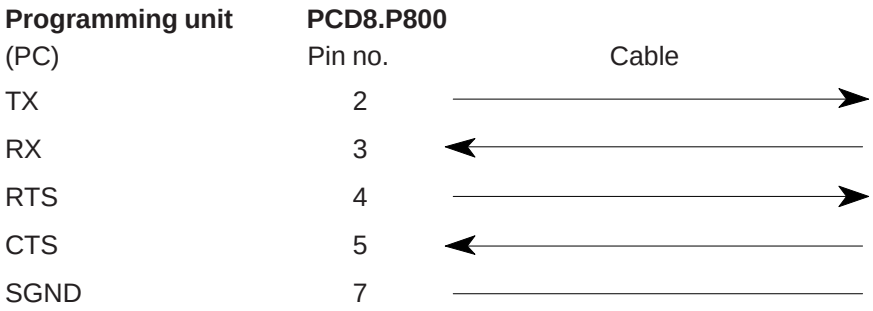
15.1.4 Pin assignment of the 25-pole cable connector (D-Sub, female)

Pin no.		Signal	Comment
1		-	
2		RXD	Receive Data (received data)
3		TXD	Transmit Data (transmitted data)
4		RDYIN	Ready In (ready input)
5		RDOUT	Ready Out (ready output)
6		-	
7		SGND	Signal Ground
8		-	
9		-	
10		-	
11		-	
12	1)	0V	for PCD8.P1.. (supply of hand-held PG)
13	1)	0V	for PCD8.P1.. (supply of hand-held PG)
14		-	
15		-	
16	1)	+5V	for PCD8.P1.. (supply of hand-held PG)
17		-	
18		-	
19		-	
20		-	
21	1)	+5V	for PCD8.P1.. (supply of hand-held PG)
22		-	
23	1)	+25V	for PCD8.P1.. (supply of hand-held PG)
24	1)	+25V	for PCD8.P1.. (supply of hand-held PG)
25		-	

\- not connected in the PCD8.P800

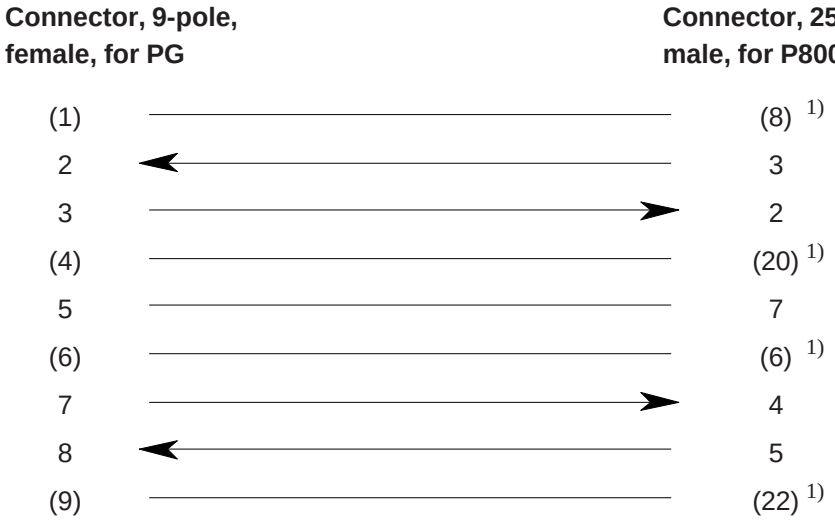
1) It must be noted that interface connector pins 12, 13, 16, 21, 23 and 24 of the personal computer are not assigned, as the supply lines for the hand-held programming unit PCD8.P1.. are tied to them. If this is not observed, the interface of the PC as well as the PCD8.P800 or the processor module might be damaged!

15.1.5 Interface assignment (25-pole connector)



15.1.6 Adapter cable 25-pole to 9-pole
(order number 4 421 8596 0)

AT-compatible Personal Computers are usually fitted with 9-pole D-Sub connectors for the serial interface. Therefore, an adapter is required to connect the PCD8.P800. These adapters are standardized and commercially available as cables of different lengths or as pure transition connectors. The adapter cable with the above order number is 2m in length.



1) These connections are not necessary for connecting the PCD8.P800.

15.2 PCD8.P100 Service and programming unit

15.2.1 Function

The PCD8.P100 (referred to as the P100) is a portable maintenance and programming unit for local maintenance work and small-scale programming. By means of the four-line, back-lit display, the complete PCD utilities debugger is at the user's disposal. Menu control and help functions make this unit easy to work with, even for the inexperienced maintenance engineer.

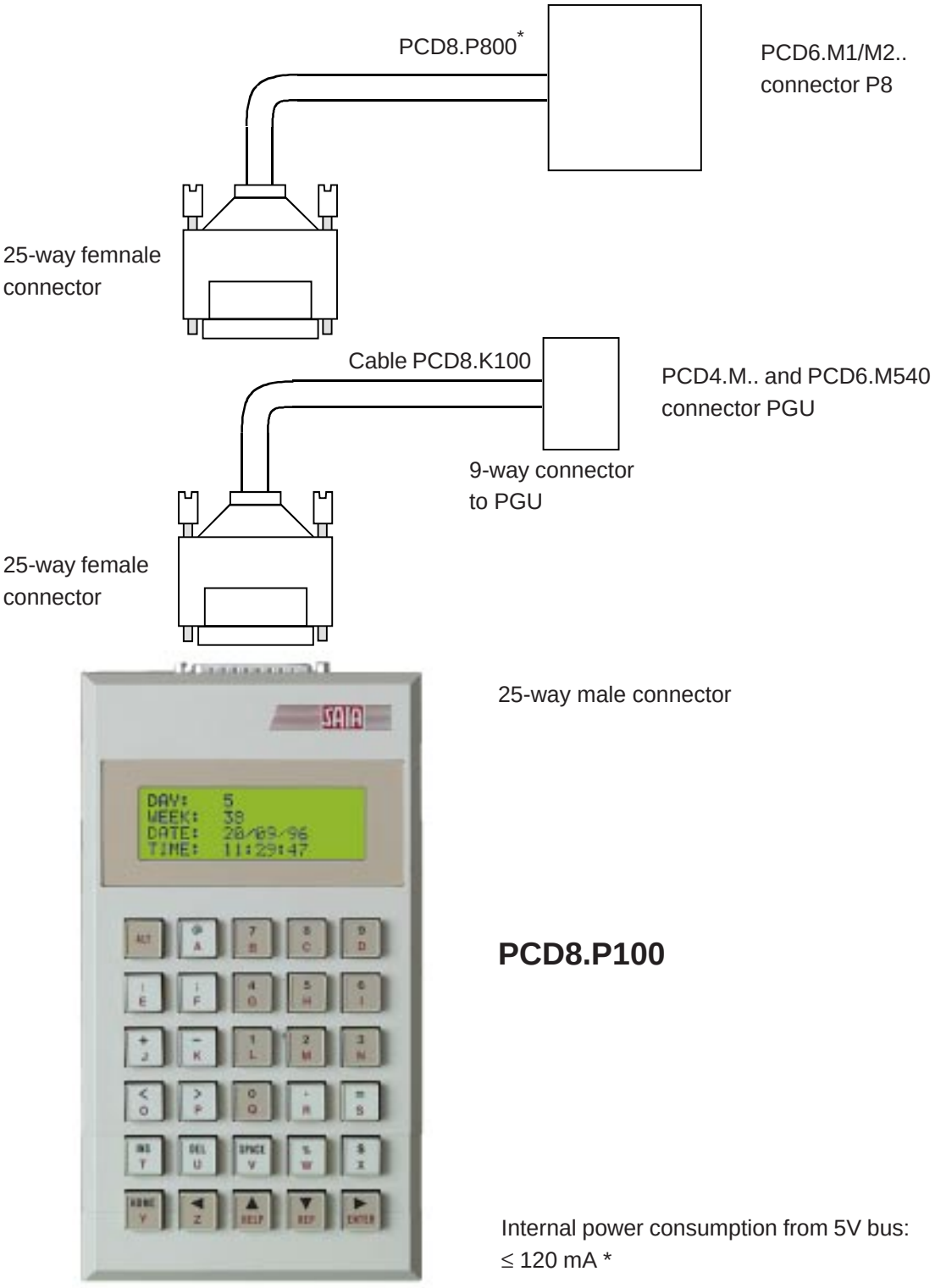
For maintenance engineers not entitled to change PLC data, three levels of access are available with a password.

It has the following main characteristics:

- 4 line x 20 character LC-Display, with backlight
- Alphanumeric keyboard with 30 keys
- Menu-driven functions. Alternative operation using the alphanumeric keys (as with the PCD utilities debugger)
- Syntx checking for each input, with immediate rejection of incorrect inputs
- "Repeat" command. The last 10 commands entered are stored in memory automatically, enabling the speedy re-execution of previous commands
- Context sennsitive help. Over 100 help screens provide quick information on operation if the manual is not to hand
- The P100 allows the display and modification of all elements, the program and the texts, as well as CPU status
- Provides control of all CPU's even in a multi-CPU environnement
- Password protection to prevent unauthorized access to PCD data can be programmed
- "Conditional Run" with a breakpoint condition set and single-step processing of one COB only or all COB's are possible
- Direct connection to the PCD4 or PCD6.M540 via cable and to the PCD6 systems M1.. and M2.. via the PCD8.P800 interface
- No internal battery as the P100 is powered from the PCD via the 5V bus
- Automatic power-up hardware tests of the P100

15.2.2 Connection to PCD4 and PCD6

The P100 has a standard 25-way male D-type connector. This provides serial connection via an RS-232 interface, and also brings the 5V supply to the unit.



PCD8.P100

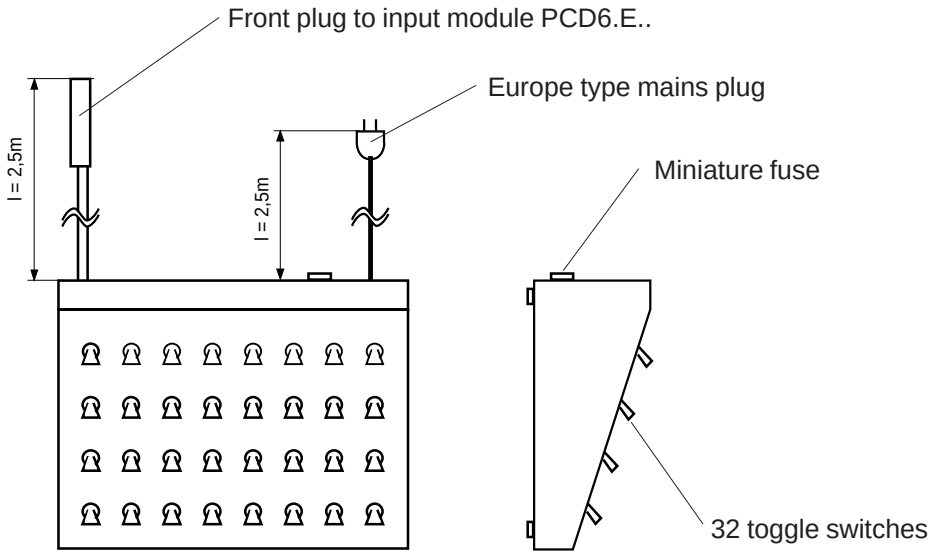
Internal power consumption from 5V bus:
≤ 120 mA *

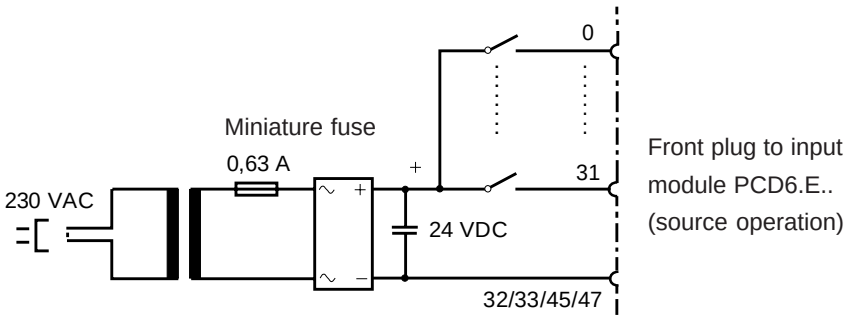
*) To ensure a good power supply, the PCD8.P800 must be at least revision "A" hardware.

15.3 PCD6.S100 D4 input simulation unit *)

Its purpose is to simulate input signals via toggle switches so that a program can be tested "at the desk". This considerably facilitates the commissioning of the actual control system.

A transformer with rectifier is supplied from a mains cable. From the rectifier is a branch to 32 numbered toggle switches, the signals of which are fed to the digital PCD inputs via a system cable and plug.



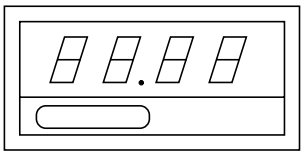


*) This simulator unit is not longer available.

Notes :

16. Display modules

16.1 PCA2.D12 Display module with 4 digits



General

The PCA2.D12 module is a remote display which can be controlled via SAIA®PCD outputs. It has a red 4-digit LED-Display and is able to indicate a decimal point. The display can be built in anywhere at a greater distance to the PCD e.g. in the door of a control cabinet or an operating panel. Due to data transmission being effected via outputs, several displays can be controlled by one PCD.

Structure and function

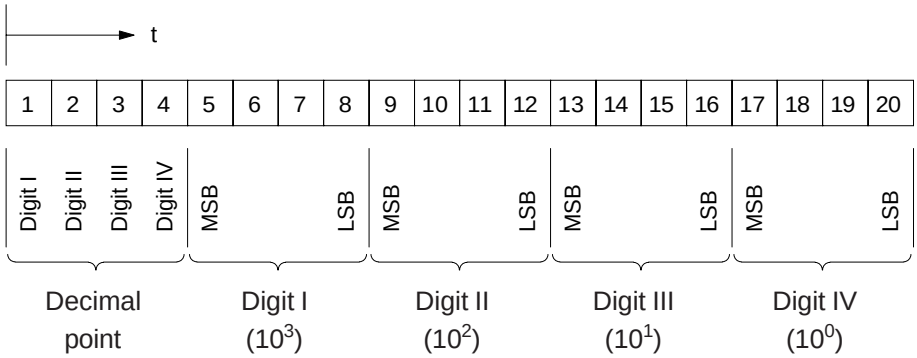
The module is in the same housing as the electronic totalizing counter of the CKG type. It consists of the following main components:

- power supply 24 VDC
- 3 inputs for 24 VDC
- decoder/driver
- 4-digit, 7-segment LED display with decimal point

The 3 outputs of the PCD resp. the 3 inputs of the display are designated "Enable", "Data" and "Clock". The **Enable signal** activates the display, i.e. Enable = "L" --> display is able to receive data, Enable = "H" --> display is inactive (it is not able to receive new data). Via the **"DATA"** line data in BCD-format is transmitted sequentially from the SAIA®PCD to the display. The display accepts each bit with the falling edge of the **"Clock"** signal.

For a complete indication (4 digits with or without decimal point) always 20 clock signals must be generated and 20 data bits must be transmitted (4 BCD-values + 4 bits for the decimal point).

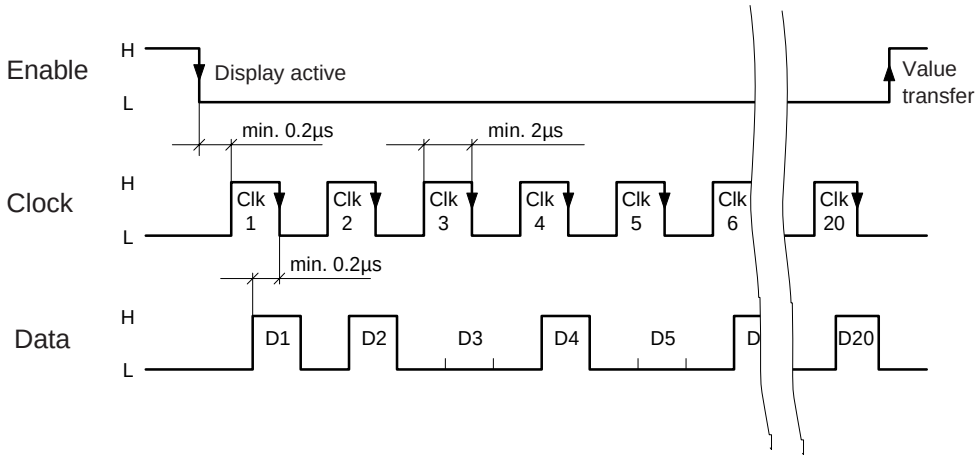
The following sequences of the 20 data bits must be adhered to:



The following 16 characters can be presented per segment:

Character	Code	Character	Code
0	0000	A	1010
1	0001	I	1011
2	0010	II	1100
3	0011	U	1101
4	0100	-	1110
5	0101	"blank"	1111
6	0110		
7	0111		
8	1000		
9	1001		

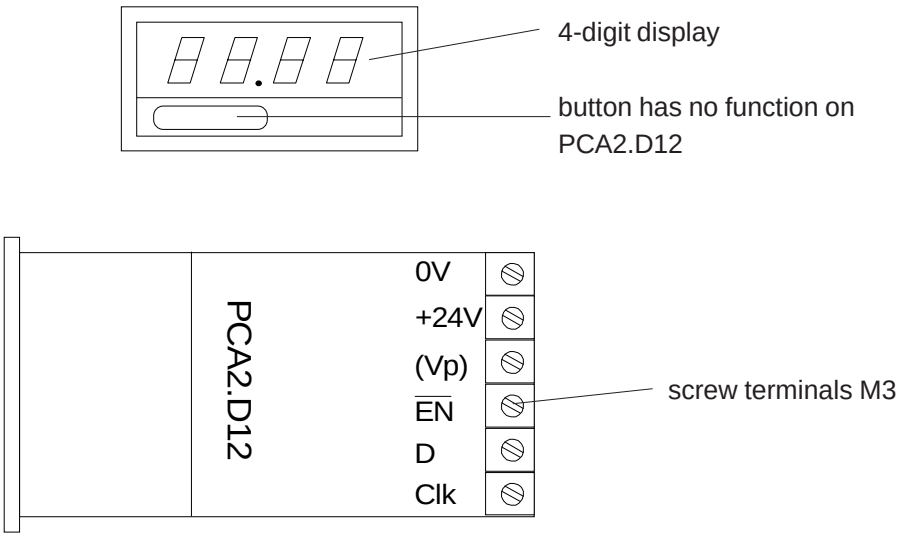
The connection between "Enable", "Clock" and "Data" is illustrated in the timedependency diagram:



For the generation of the "Clock" as well as for the transmission of data the user must write a short program (examples will follow at the end). In this program, all functions shown in the above diagram, must be realized.

The minimum clock pulses and waiting times are short, so that the instruction set of the SAIA®PCD can easily be applied directly without waiting for certain periods to elapse.

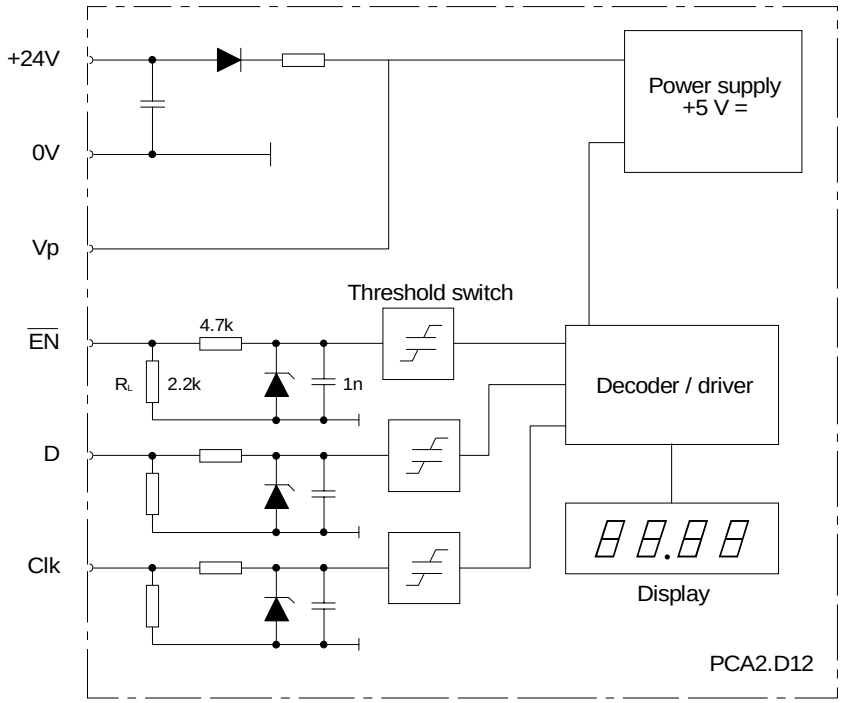
Presentation and terminal arrangement



Technical data

- Display	4-digit, 7 segment LED's
- Digit hight	10mm
- Supply voltage	24 VDC ±20%, two-way rectification is sufficient
- Current at 24VDC	60 mA
- Input voltage for EN, D, CLK	24 VDC, smoothed
- Input current for 24 VDC	10 mA
- Definition of the input voltage	"H": 19V... 32V "L": 0V... 4V
- Input delay	< 1ms
- Usable SAIA°PLC output modules	PCD4.A400, B900 PCD6.A400
- Control	serial via 3 PCD-outputs
- Dimension drawing	see chapter 18

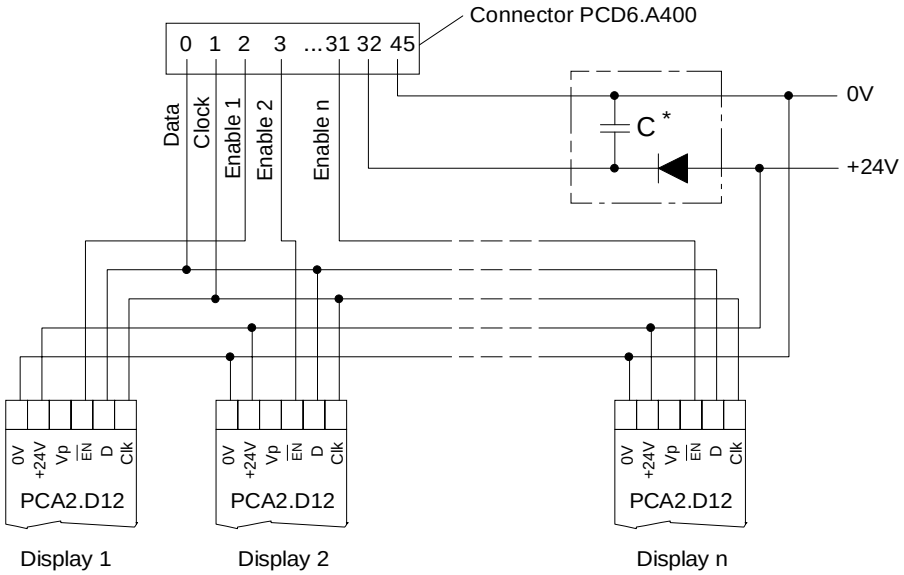
Input circuit and block circuit diagram



Connection of several displays

Since the PCA2.D12 module is able to transmit an "Enable" signal, i.e. it can be switched to be active or inactive, the same "Clock" and "Data" signals can be used for several displays. These are transmitted to each display simultaneously. The "Enable" signal decides which display is controlled. This means that for each display one "Enable" signal is necessary (1 output per display). This also means, however, that for as many displays as desired only one data and one clock output must be provided.

Wiring example: PCD6.A400

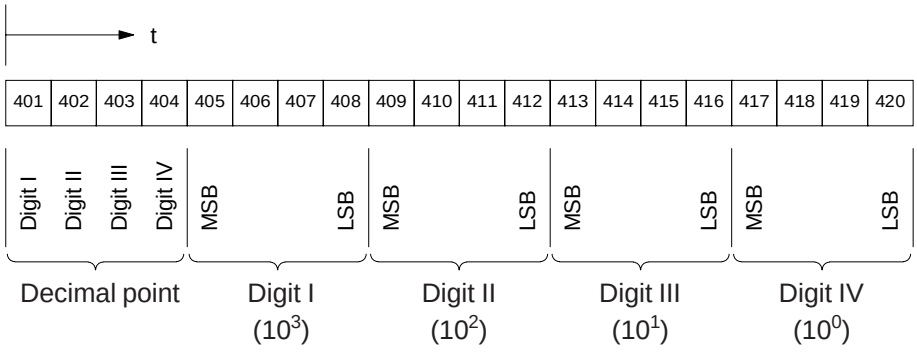


*) In the case of a pulsating DC-voltage the following must be observed:
- smoothing by capacitor C of 100 µF, 40V (sufficient for 5 displays)
- do not apply other loads to the voltage smoothed by C

Programming example PCA2.D12

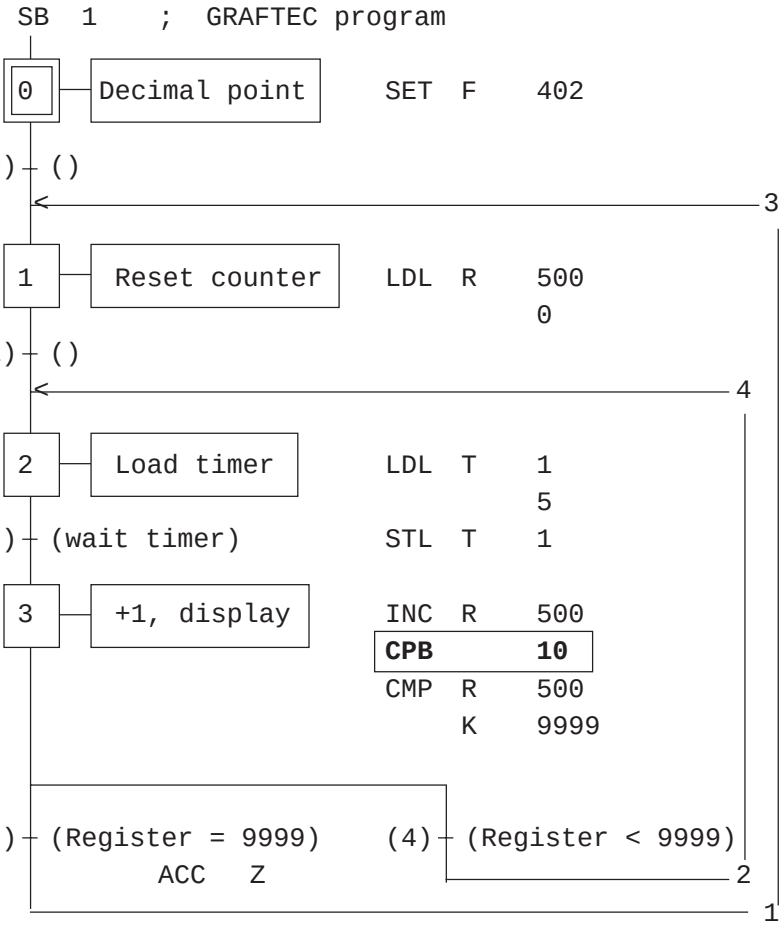
Task: Increment register R500 every half-second up to a value of 9999 and then reset to zero. The contents of this register should be displayed on the PCA2.D12 display module, with a decimal point in the 2nd position. The following outputs should be assigned for Clock, Data and Enable:

CLOCK:	Output A45
DATA:	Output A46
ENABLE:	Output A47
Flags used:	401 .. 420



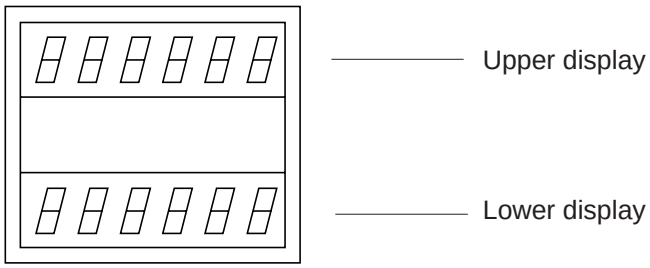
Program:

```
        COB     0         ;Main program
                0

        CSB     1

        ECOB
      ; ------------------------------------------------
```




```
        PB          10   ;Display routine for PCA2.D12
        DIGOR       4
                R   500
                F   405

        RES     O   47   ;ENABLE
        SEI     K   0
LOOP:   SET     0   45   ;CLOCK
        STHX    F   401
        OUT     0   46   ;DATA
        ACC     H
        RES     O   45   ;CLOCK
        INI     K   19
        JR      H   LOOP
        ACC     H
        SET     0   47   ;ENABLE

        EPB
```

16.2 PCA2.D14 Display module with 2 x 6 digits



General

The PCA2.D14 module is a remote display module which is controlled via 3 outputs of any SAIA®PCD. The module has two red 6-digit LED displays. Several PCA2.D14 can be connected in series in case of more than two displays.

Application and control

This module is especially useful to display counter values using the H-modules. The D14 can also be used with any 3 digital outputs to display process information.
When the PCA2.D14 is used without the H-modules, the information to be displaed is most easily transmitted serially with a standard program routine from a flag field via 3 SAIA®PCD outputs.

The following 16 characters per segment can be presented:

Character	Code	Character	Code
0	0000	A	1010
1	0001	I	1011
2	0010	II	1100
3	0011	U	1101
4	0100	-	1110
5	0101	"blank"	1111
6	0110		
7	0111		
8	1000		
9	1001		

Structure and function

The module is located in the same housing as the electronic totalizing counter CKG/AC.

Terminals: Screw terminals combined with connection strips (2.8 x 0.8 mm) for flat pluggable bushes or soldering.

PLC-output	Clock	----->	Clk	PCA2.D14
PLC-output	Data-In	----->	D-IN	
PLC-output	Enable	----->	EN	
Carry	Data-Out	<-----	D-OUT	
Voltage supply	+24V	----->	+24V	
Voltage supply	0V	----->	0V	

The data for a display of 2 x 6 digits are most easily presented in a complete flag field, e.g. F500... 547 in BCD-notation. If these values are kept in counters, they must be transferred to the flag fields first.

```
  500                                                    523
F  o o o o    o o o o    o o o o    o o o o    o o o o    o o o o   upper
  MSB   LSB                                             MSB   LSB  display
   100'000     10'000     1'000       100         10         1

  524                                                    547
F  o o o o    o o o o    o o o o    o o o o    o o o o    o o o o   lower
  MSB   LSB                                             MSB   LSB  display
   100'000     10'000     1'000       100         10         1
```

Technical data

- Display	2 times 6 digits, 7-segment LED
- Digit height	10 mm
- Supply voltage	24 VDC ±20%, full-wave rectified is sufficient
- Current at 24 VDC	100 mA
- Input voltage for EN, D, CLK	24 VDC, smoothed
- Input current at 24 VDC	10 mA

- Definition of the input level	"H": 19V... 32V "L": 0V... 4V
- Input delay	< 1 ms
- Usable SAIA®PCD output modules	PCD4.A400, B900 PCD6.A400
- Control	serielly via 3 SAIA®PCD-outputs irrespective of the number of D14
- Dimension drawing	see chapter 18

Connecting more than one D14 module

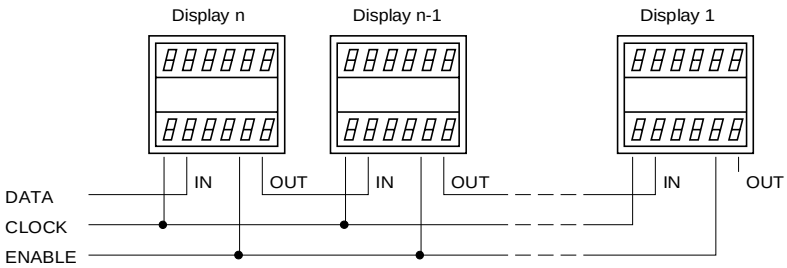
Several D14 modules can be connected in series, but take note of the following advantages and disadvantages:

+ Only three outputs are used

+ Only one software path to change even a single digit

- Processing is "n" times slower !

The following drawing shows several PCA2.D14 connected in series. Every D14 displays its own individual data.



The flag field containing the information to be displayed must be expanded correspondingly:

for 1 PCA2.D14 = 1x48 flags
for 2 PCA2.D14 = 2x48 flags (96 flags)
for 3 PCA2.D14 = 3x48 flags (144 flags) etc.

The routine in the user program remains the same, only the instruction "INI" must be changed accordingly:

for 1 PCA2.D14 = INI 47
for 2 PCA2.D14 = INI 95
for 3 PCA2.D14 = INI 143 etc.
for n PCA2.D14 = INI n*48-1

Programming example PCA2.D14

Task: Using a PCA2.D14 display module, show time of day in the upper display and date on the lower. The data is taken from the PCD hardware clock.

Elements used:

CLOCK	Output A 45
DATA	Output A 46
ENABLE	Output A 47
FLAGS	F 500-547
COUNTER	C 999

```
        COB         0    ;Main program
                    0

        RTIME  R    200  ;Clock in R 200, date in R 201
        CPB         20   ;Displayroutine for PCA2.D14

        ECOB
      ; ------------------------------------------------

        PB          20   ;Displayroutine for PCA2.D14
                         ;---------------------------
        DIGOR       6
               R    200  ;Value for upper display (6 digits)
               F    500  ;   on flags 500-523
        DIGOR       6
               R    201  ;Value for lower display (6 digits)
               F    524  ;   on flags 524-547

        ACC    H
        RES    O    47   ;ENABLE
        SEI    K    0
L1:     ACC    H
        SET    O    46   ;DATA
        LDL    C    999
                    4
L2:     SET    O    45   ;CLOCK
        RES    O    45   ;CLOCK
        DEC    C    999
        STH    C    999
        JR     H    L2
        ACC    H
        LDL    C    999
                    16
L3:     STHX   F    500
        OUT    O    46   ;DATA
        ACC    H
        SET    O    45   ;CLOCK
        RES    O    45   ;CLOCK
        INI    K    47
        JR     L    L4
        DEC    C    999
        STH    C    999
        JR     H    L3
        JR     L    L1
L4:     ACC    H
        SET    O    47   ;ENABLE

        EPB
```

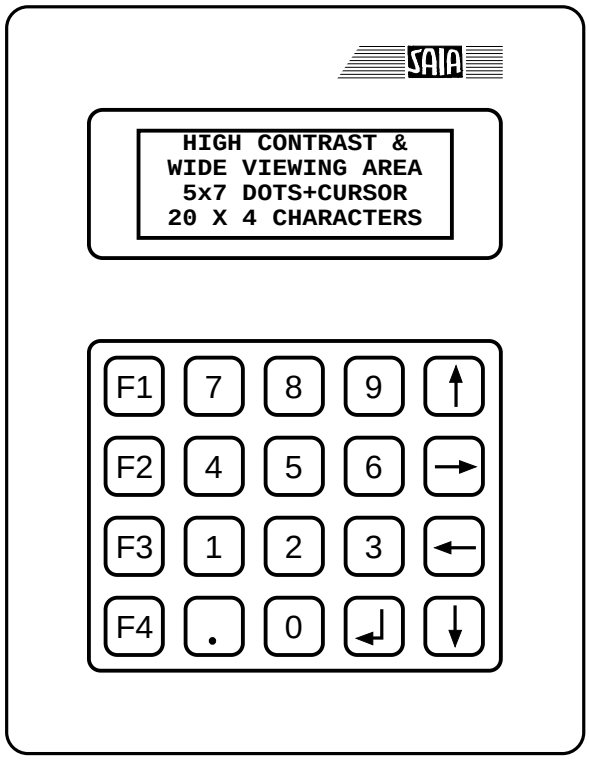
16.3 PCD7.D1.. Industrial control terminal *)

Application

SAIA-Burgess Electronics AG Murten has designed a new control terminal for connection to its PCA and PCD programmable logic controllers. Beneath the membrane front-panel are 20 short-stroke IP65 protected keys. Key labels are in the form of slide-in strips, which can be changed to meet individual requirements.

Particular importance has been placed on display quality. An advanced supertwist LC display of 4 x 20 characters, with LED backlighting has been used. This results in a display which has optimum contrast whatever the lighting conditions, with the LED backlighting giving a consistent, high-quality display with an MTBF of more than 100'000 h.

The SAIA®PCD's intelligent text output and single-character recognition provide a simple means to build up a menu-driven user interface.



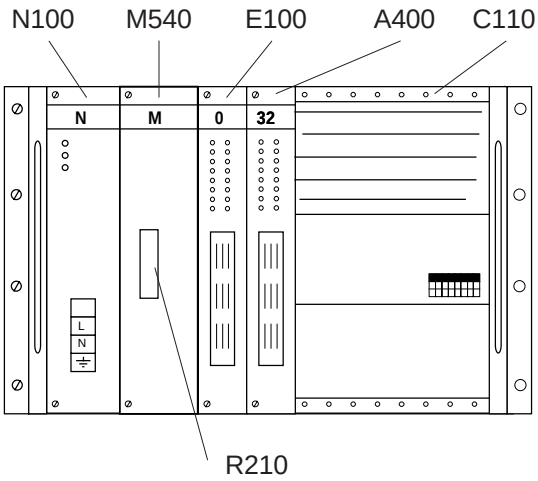
*) Replaced by PCD7.D202

Technical data

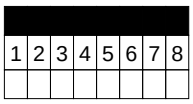
Housing	Metal box for front-panel mounting
Keys	20 short-stroke keys covered with polyester film, replaceable key labels.
Protection level	Front panel IP65 (sponge rubber insulation)
Display	4 x 20 characters with cursor, supertwist LC-display with LED backlighting
Lifetime of LED backlighting	100'000 h
Colour of front	pebble grey (RAL 7032)
Serial interface	RS-232 with RTS/CTS and 20 mA current loop (passive). Both interfaces supplied as standard. RS422/RS485 available on demand.
Baud rate	150 to 19200 bps, 8 bit and parity (current loop max. 9600 bps)
DIP switches	Apart from selection of transmission parameters, also enable: full duplex, half duplex, XON/XOFF protocol, automatic CR/LF and selection of page or scroll mode.
Supply	24 VDC +/- 20% smoothed 18 VDC +/- 15% from full wave rectified AC
Current	max. 200 mA
Environment	Storage temperature -20°C .. +70°C Operating temperature 0°C .. +50°C
Noise resistance	Supply 2 kV according to IEC 801-4 Data lines 1 kV according to IEC 801-4 Housing 4 kV according to IEC 801-2 The housing must be earthed.

17. Quick guide to PCD6 installation

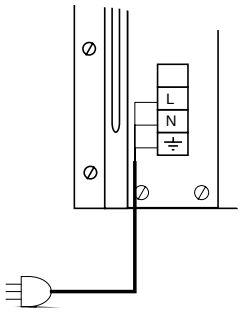
17.1 Assembly



For this example, a minimal assembly is assumed, based on the ..M540 single processor module. Alternative modules are given in brackets.



1) **Main rack unit** ..C110 (or C100)
On DIL switch (bottom right) set rack unit number "0" (factory setting).

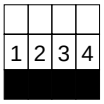


2) **Power supply module**
Insert PCD6.N100 (or N110) and tighten the 4 front panel screws firmly. Connect three-way mains cable (with earth) to screwless terminals.

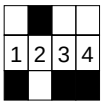
3) **Processor module** ..M540
Insert module and tighten front panel screws. Ensure that jumpers J1 and J2 are in "DISABLE" position, or set RUN/HALT switch to RUN position. If a ..M100 or M2.. multiprocessor module is used, its CPU number must be set to "0" (see section 4.3).

4) **Public memory module** PCD7.R210 (or ..R220)
Check jumpers are set for "RAM" and not "WP" (see chapter 3.7.3), and insert module.

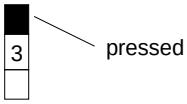
If public memory modules PCD6.R100/110 with ..R510/511 or PCD6.R210 with R600 (RAM assembled) are used for the multi-processor, jumper settings must also be checked in accordance with chapter 7.



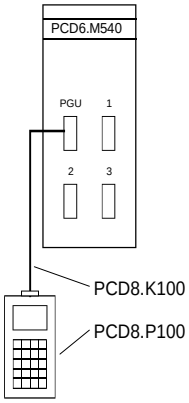
E100 module with base address 0



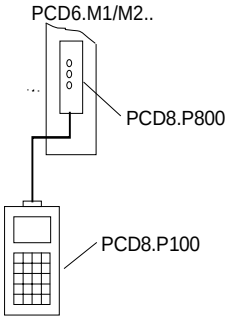
A400 module with base address 32



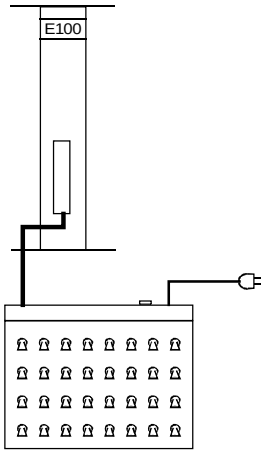
5) **I/O modules** ..E100 and ..A400 (or A200 or A350)
Insert modules where desired in rack unit, after setting correct base addresses.



6) **Programming and service unit** PCD8.P100
Plug P100 unit into "PGU" programming connector on front panel of ..M540 processor module.



If a M100 or M2.. processor is used, plug the PCD8.P800 interface co-processor into the "P8" connector, and connect the P100 to P800.



7) **Input simulator** PCD6.S100
Plug unit into front panel connector on ..E100 input module. Mains plug is connected to 220/230 VAC.

17.2 Entering a lamp flasher program

8) Switch on the supply voltage. After completion of the power-up tests, the P100 indicates status STOP. All processor LEDs are off.

- C P ENTER ALT Y

9) As a precaution, user memory should be cleared before entering the program. This is done with the "Clear Program and texts" command, by pressing the keys shown.

- W P 0 ENTER

10) Type: "Write", "Programm", <address> 0, ENTER

(0) COB SP 0 ENTER
SP 0 ENTER
STH SP SP I SP 3 ENTER
ANL SP SP T SP 9 ENTER
LD SP SP T SP 9 ENTER
SP 5 ENTER
COM SP SP O SP 32 ENTER
ECOB ENTER

11) The program can now be entered starting from address 0.
Incorrect entries can be deleted by pressing "ALT" and "DEL" simultaneously ("ALT+DEL").
Note: The P100 always indicates both Timers "T" and Counters "C" with a "C".

- **Cold start and RUN**

HOME
E C ENTER ALT Y
R ENTER

12) Next, a cold start must be done, then the PCD can be put into "RUN".

- **Programm**

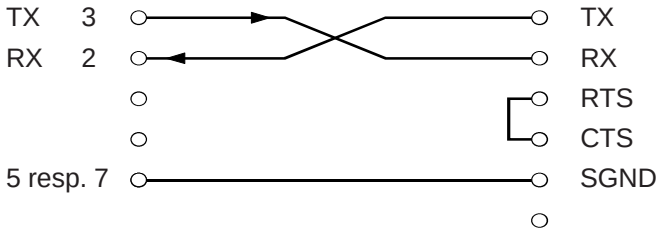
```
COB   0       ; Start of Cyclic
      0       ; Organization Block 0
-----------------------------------------
STH   I   3   ; If input 3 high
ANL   T   9   ; and timer 9 timed out
LD    T   9   ; } then timer 9 starts again
          5   ; } with 0.5 sec
COM   O   32  ; and toggles output 32
-----------------------------------------
ECOB          ; End of Cyclic
;               Organization Block
```

13) The "RUN" LED on the processor module goes on: the program is now running. If input 3 is switched on, output 32 will flash at the rate 0.5 sec on and 0.5 sec off.

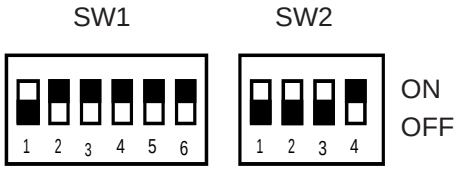
17.3 Outputting texts to the PCD7.D100 terminal via the RS232 serial interface

14) Depending on the processor module used, wiring on the processor side must run to a 9-pole or 25-pole connector (male). Pin numbers are dependent on processor type.
This concerns the following:
PCD6.M540, PCD6.M210, M220 or M230. Connector no. 2 is always used.

- Processor module channel no. 2 — Cable — Terminal PCD7.D100



15) Make up the cable for connecting the PCD6 channel no. 2 and the terminal D100 in MC0 mode (no control lines needed).
For processor ..M540 pin 5 must be used for signal ground.

- 

16) Provide a 24 VDC supply to the terminal D100. Leave the DIP switches in the factory setting.

- [S] [ENTER]

17) To enter the additional program, put the CPU into "STOP". The "RUN" LED on the processor module should go out.

- [W] [P] [0] [ENTER]

  [ALT] [INS] [ALT] [INS] [ALT] [INS] [ALT] [INS] [ALT] [INS]

```
XOB       16
SASI      2   ; Assign channel no. 2
          100 ; from text 100
EXOB
```

18) Entering the text output program on the P100.

By simultaneously depressing the "ALT" and "INS" keys ("ALT+INS") we first insert five blank lines before the COB, in which we enter the code shown to initialize the interface (channel no. 2 is initialized from the definition in TEXT 100).

- [▼] ,,, 14 ECOB

```
STH   O   32  ; if O32 high
DYN   F   0
ANL   O   46  ; and XBSY low
CPB   H   5   ; output text
ECOB          ; from PB 5
```

```
PB        5   ; Program Block 5
STXT      2   ; output to channel 2
          1   ; the text number 1
EPB
```

19) Use the down arrow key to step down to line 14, and overwrite line 14 and subsequent lines with the program shown.
Note: After instructions such as STH or ANL, the P100 always shows "I" (Input), even if an Output "O" is being referenced.

Text number 1, containing the date and time, should be output to the D100's display every second (synchronized with the flashing lamp).

- [HOME]
  [W] [X] [100] [ENTER]

```
UART:9600.8.E.1;MODE
:MC0;DIAG:O40.R100
```

```
40 ●
   ○
   ○
   ○
   ○
   ○
46 ● XBSY
47 ○
```

20) Now enter the serial interface definition text using:
"Write teXt 100".

U --> To enter the underlined characters (red alphabetic keys) the "ALT" key must be pressed simultaneously.

Note: If O40 is entered after "DIAG:", 8 diagnostic flags (in this case, outputs) are actually used. In our example, only O46 is referenced as the "text bus flag" XBSY.

[ALT]
[ENTER]

Save TEXT 100 by pressing "ALT+ENTER" simultaneously.

- [**1**] [**ENTER**]

21) The original "Write teXt 100" command is re-displayed.
Now write TEXT 1 by pressing "1" then "ENTER".

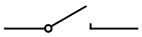
- `<12>  HAVE A NICE DA`
  `Y<13><10>    WITH TH`
  `E PCD6<13><10>$D<10>`
  `    $H<26>`

- ALT
  ENTER

- HOME
  E C ENTER ALT Y

- HOME R ENTER

- I3



→ O32 blinks
→ Text is output

22) Enter TEXT 1 to produce this display:

```
  HAVE A NICE DAY
    WITH A PCD6
92-04-26      (TIME)
(Date)      17:30:42
```

23) Save TEXT 1 with "ALT+ENTER".

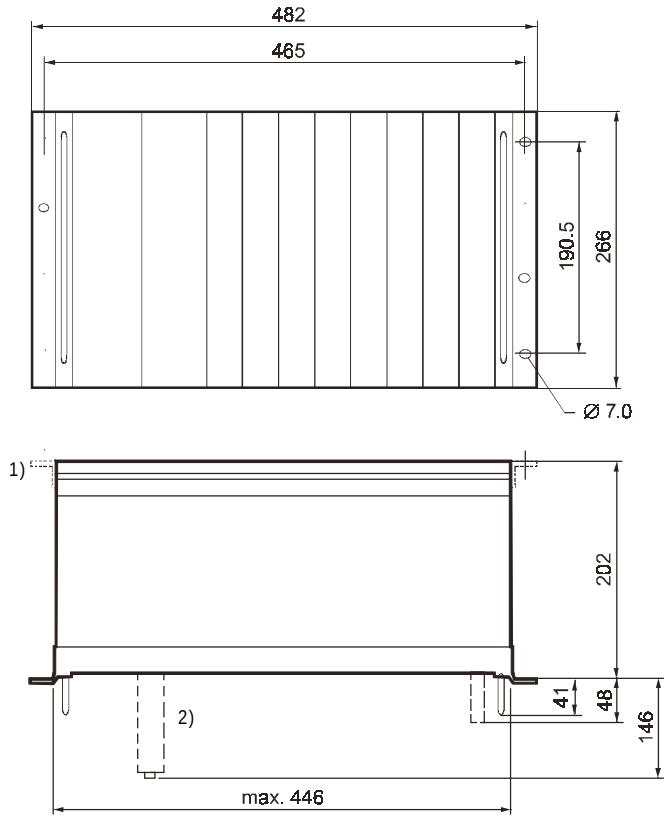
24) After entering program and text, another cold start must be done to reset the PLC.

25) Select "RUN" from main menu.

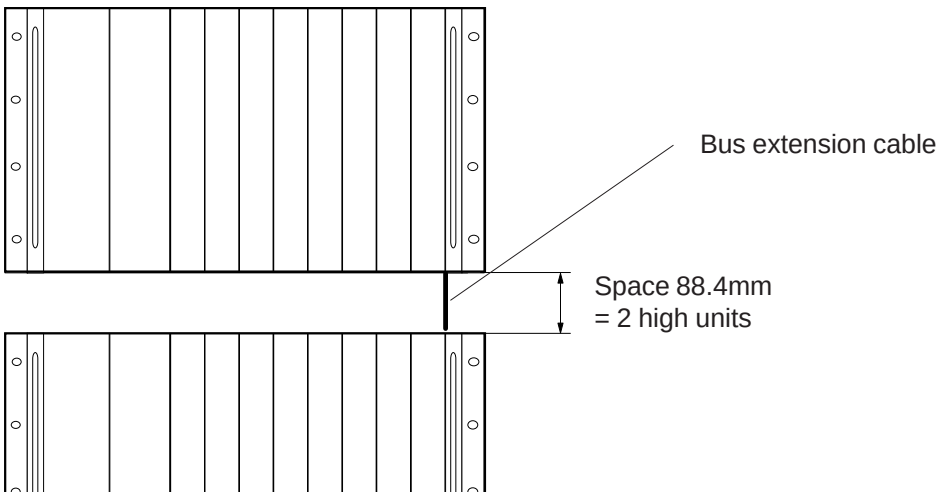
26) Closing switch I3 not only makes output LED O32 flash, but also outputs the text every second (it may be necessary to correct the time with the "Write clocK" command). Output O46 is turned on briefly every second, while the text is output (this is the "text busy flag" XBSY).

18. Dimensions

18.1 Housing for PCD6 series



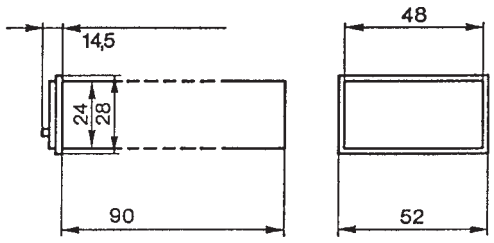
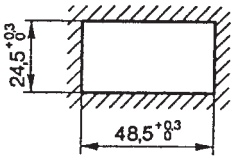
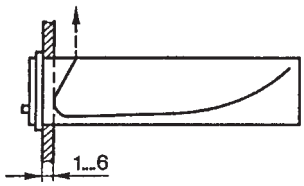
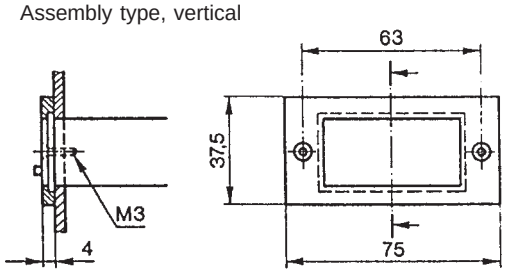
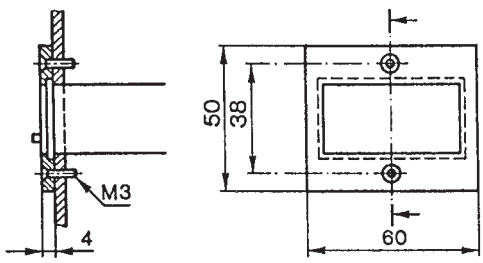
1) Fastening brackets for wall-mounting (accessory)
2) Interface processor PCD8.P800 to programming unit



18.2 Dimensions and installation of display module PCA2.D12

The display module can be installed in any position desired anywhere in a control cabinet door or an operating panel.

The display can be fastened in three ways:

Dimensions		
Opening for installation valid for both assembly types		
Fastening with clamping spring		Standard version
Fastening with frontal frame and 2 countersunk screws M3/90° with vertical frontal frame	Assembly type, vertical 	Accessories Order no.. 4'108'3671'0
with horizontal frontal frame	Assembly type, horizontal 	Order no. 4'108'3672'0

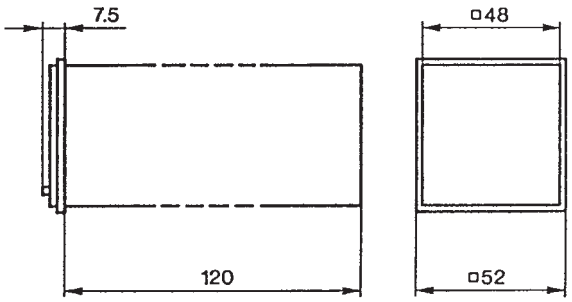
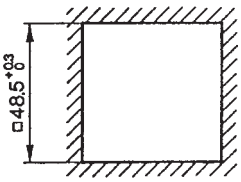
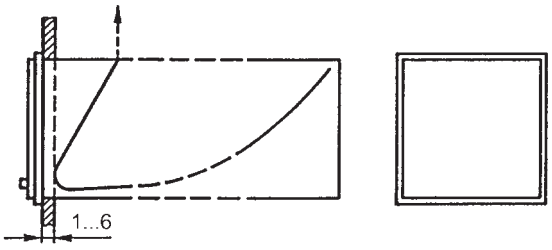
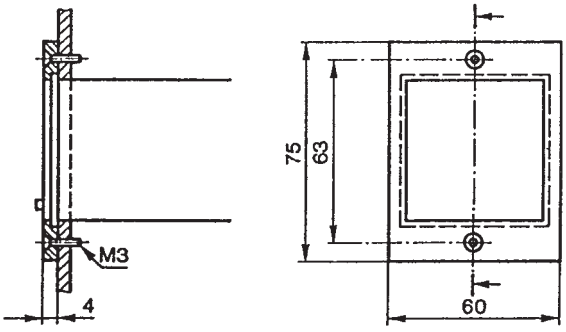
18.3 Dimensions and installation of display module PCA2.D14

The display module can be installed in any location desired.

It can be fastened in two ways:

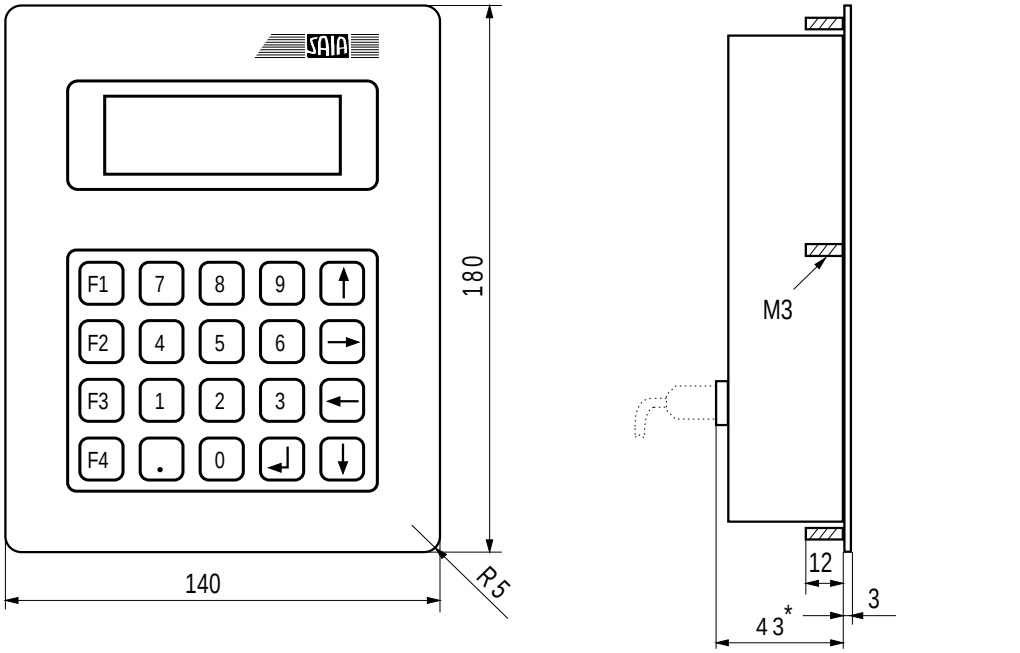
- with a clamping spring
- with a frontal frame and screws

(The claping spring and the frontal frame are supplied with every PCA2.D14).

Dimensions	
Opening for installation valid for both assembly types	
Fastening with clamping spring	
Fastening with frontal frame and 2 countersunk screws M3 / 90°	

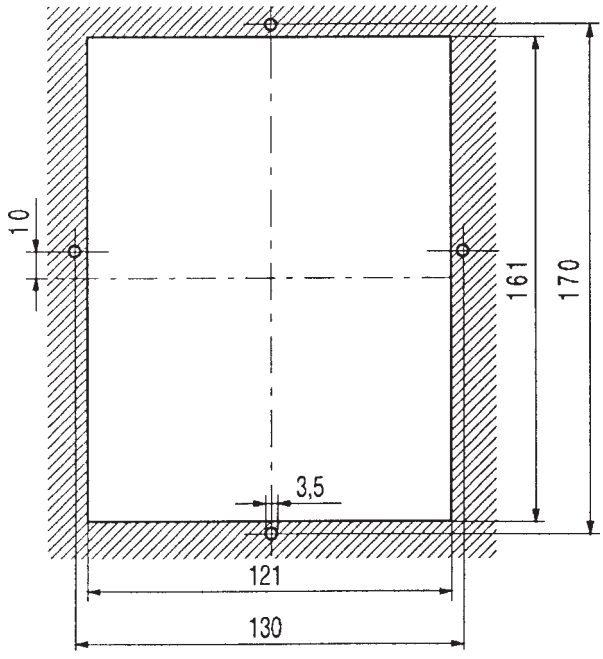
18.4 PCD7.D1.. Industrial control terminal

Dimensions



*) without D type connector

Aperture made in control panel



19. PCD6 Hardware type designations

Type		Part	Page
PCD6.	A200	11.2	11-5
	A350	11.3	11-9
	A400	11.4	11-13
	C100	2.1	2-2
	C110	2.1	2-2
	C200	2.2.1	2-5
	C400	2.3.1	2-7
	E100	11.1	11-2
	E610/E611	11.5	11-17
	K100	2.2.2	2-5
	K110	2.2.3	2-5
	K200	10.1	10-5
	K212	10.1	10-4
	K214	10.1	10-4
	K400	2.3.4	2-8
	K410	2.3.5	2-8
	M100	4	4-1
	M210	4	4-3
	M220	4	4-3
	M230	4	4-3
	M250	4	4-3
	M260	4	4-3
	M300	5	5-1
	M540	3	3-1
	N100	9.1	9-2
	N110	9.1	9-2
	N200	9.2	9-7
	N210	9.2	9-7
	R100	7.3.1	7-5
	R110	7.3.1	7-5
	R210	7.4.1	7-8
	R500	7.3.2	7-6
	R510	7.3.2	7-6
	R511	7.3.2	7-6
	R600	7.4.2	7-9
	R610	7.4.2	7-9
	S100 D4	15.3	15-7

Type		Part	Page
PCD6	T100	6	6-1
	T110	6	6-1
	T300	2.3.2	2-7
	T400	2.3.3	2-8
	W100	12.1	12-2
	W300	12.2	12-18
	W301	12.2	12-18
	W400	12.3	12-32
PCD7.	D100	18.4	18-4
	F110	5.7.2	5-12
	F120	5.7.3	5-13
	F130	5.7.4	5-14
	F150	5.7.5	5-16
	F700	5.7.6	5-18
	R110, R210, R220	3.7	3-18
	R3..	3.7.4	3-23
	W100, W101, W102, W103, W104, W105, W120	12.1 and 12.2	12-2 and 12-18
	W200, W201, W202, W203, W204, W205, W206	12.1	12-2

Type		Part	Page
PCD8.	K100	15.2.2	15-6
	P100	15.2	15-5
	P800	15.1	15-1
PCA2.	D12	16.1	16-1
	D14	16.2	16-7
4'107'4870'0		2.6.2	2-12
4'107'4871'0		2.6.2	2-12
4'408'4861'0		10.1	10-5
4'502'3958'0		3.7.3 / 3.7.4	3-21 / 3-23
4'502'5414'0		3.7.4	3-23
4'502'5677'0		3.7.3 / 7.3.2	3-21 / 7-6
4'502'6149'0		3.7.3 / 7.4.2	3-21 / 7-9
4'502'7013'0		3.7.4 / 7.4.2	3-23 / 7-9
4'502'7126'0		3.7.4	3-23
4'507'1360'0		3.7.2 / 4.8 / 7.2.3	3-20 / 4-9 / 7-4
4'717'4828'0		13	13-1

Notes :

From :

Company :
Department :
Name :
Address :

Tel. :

Date :

Send back to :

SAIA-Burgess Electronics Ltd.
Bahnhofstrasse 18
CH-3280 Murten (Switzerland)
http://www.saia-burgess.com

BA : Electronic Controllers

Manual Hardware PCD6

If you have any suggestions concerning the SAIA® PCD, or have found any errors in this manual, brief details would be appreciated.

Your suggestions :