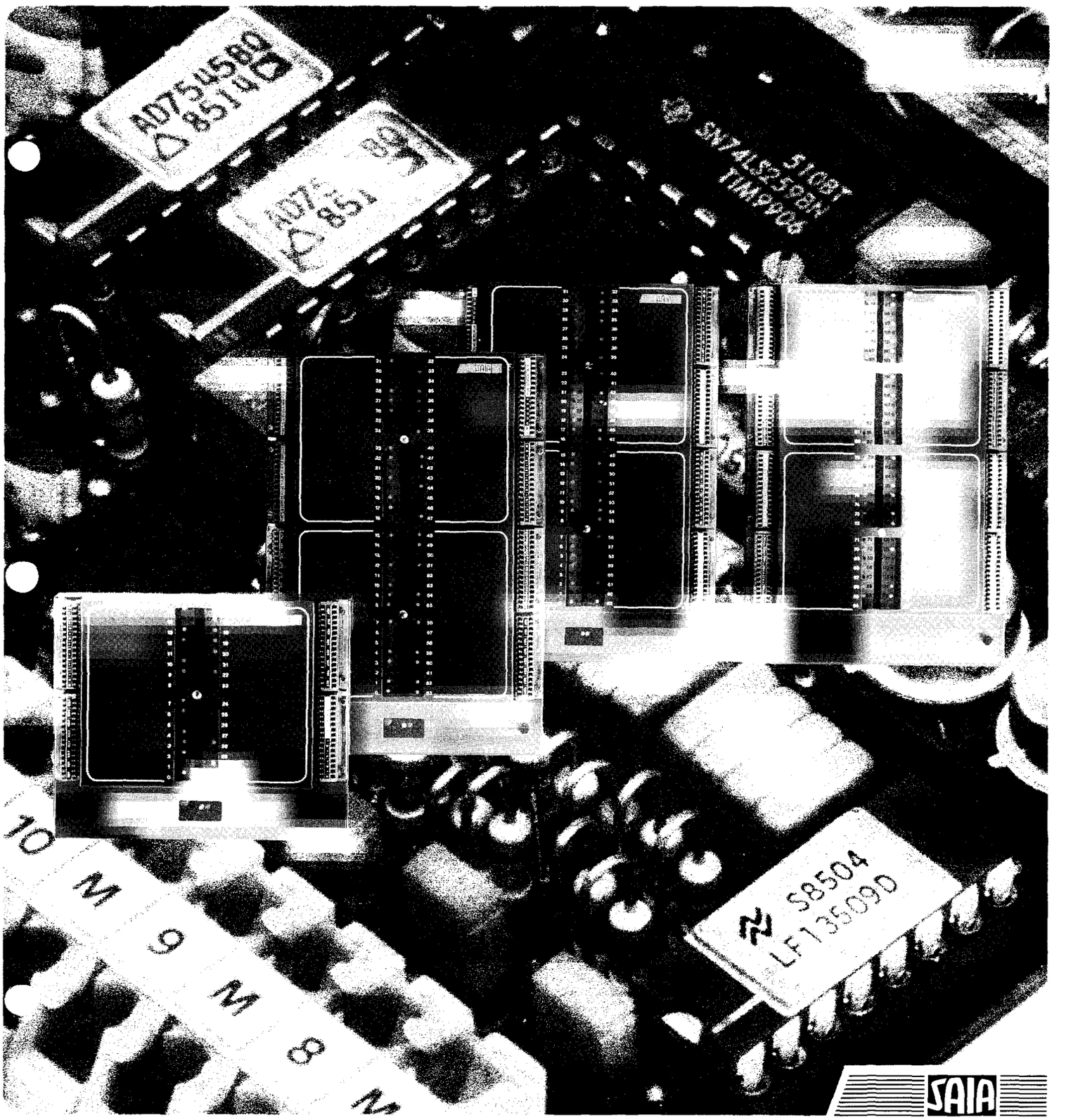
SAIA®PLC
Programmable controllers

Manual of the series PCA 1 Hardware



English edition 26/719 E1

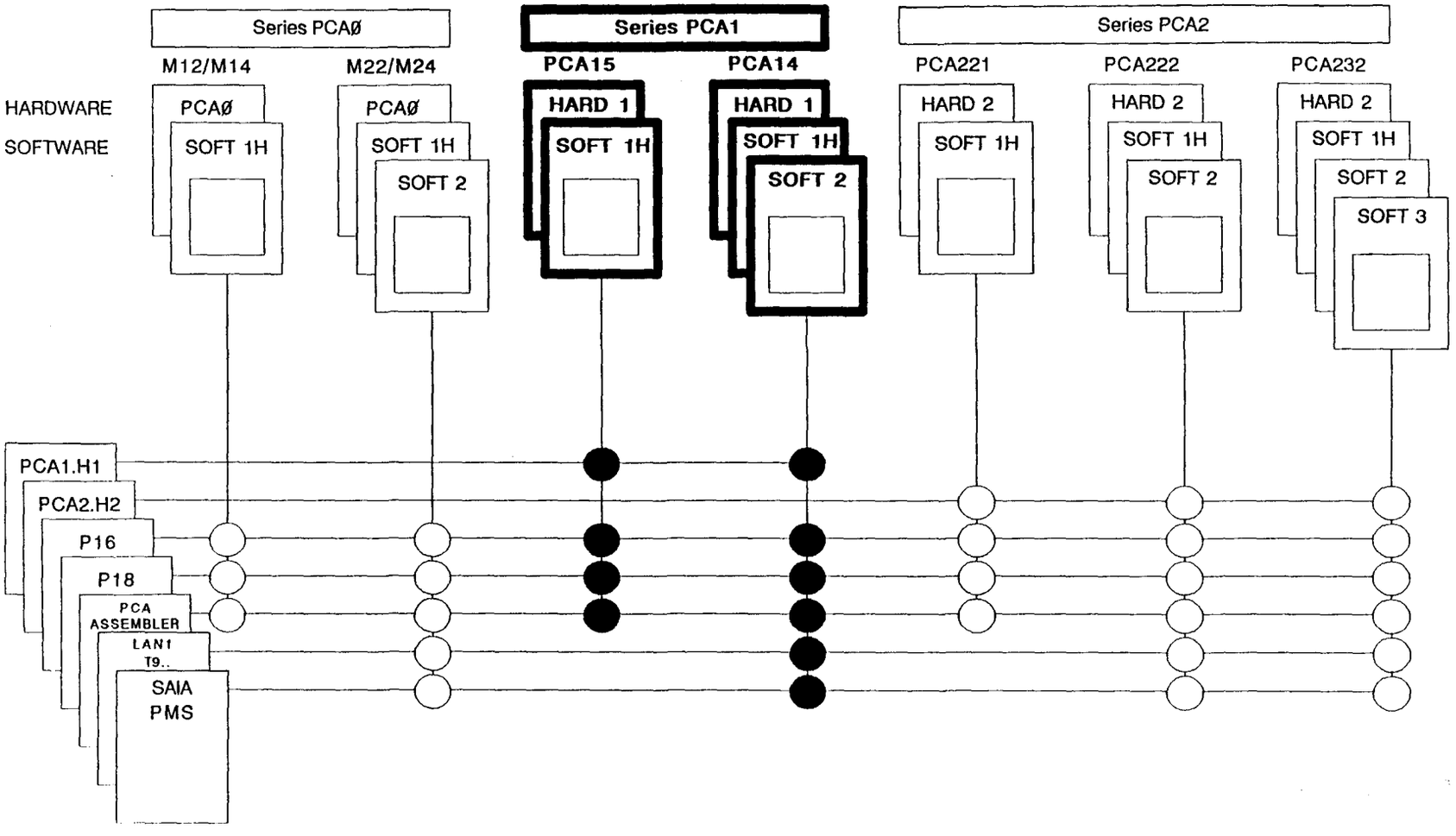
HARDWARE - PCA1

GENERAL

PART A BASIC MODULES

PART B INPUT/OUTPUT MODULES as well as ADDITIONAL and DISPLAY MODULES

PART C OPERATING MODES


Series PCAØ
Series PCA1
Series PCA2
M12/M14
M22/M24
PCA15
PCA14
PCA221
PCA222
PCA232
HARDWARE
SOFTWARE
PCAØ
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LAN1 T9..
SAIA PMS

Overview of the SAIA® PLC, system family PCA

	Series PCA0	Series PCA1	Series PCA2
Soft level 3 Soft level 2 + 32 word instructions for - arithmetic ± 9 digits - data transfer - word register			PCA232 ..C30 User memory 8K program steps + 8K text characters + 8K byte data ..M32 256 or 512 I/O
Soft level 2 Soft level 1H + Serial interface + Date-time + Data register + Parameter instructions (soft interrupt, FIFO, PID)	Standard versions and OEM PCA0.M22 .M22 max. 32 I/O PCA0.M24 ..M24 max. 64 I/O User memory max. 4K program steps max. 4K text characters/data	**PCA14** PCA141 ..M41 32(56) PCA147 ..M47 64(112) PCA147 + ..C45 ..M47 ..C45 128(224) I/O User memory max. 8K program steps max. 8K text characters/data	PCA222 ..C30 ..M22 256 or 512 I/O User memory max. 8K program steps max. 8K text characters/data
Soft level 1H Instruction set with 32 basic instructions for - timers and counters - parallel programs and subroutines - indexing, etc. 20 additional instructions for - arithmetic - data transfer - check-sum	Standard versions PCA0.M12 .M12 24/32 I/O PCA0.M14 ..M14 48/64 I/O User memory max. 4K program steps	**PCA15** PCA151 ..M51 32(56) PCA156 ..M56 64(112) PCA157 + ..C45 ..M57 ..C45 128(224) I/O User memory max. 4K program steps	PCA221 ..C30 ..M21 256 or 512 I/O User memory max. 8K program steps

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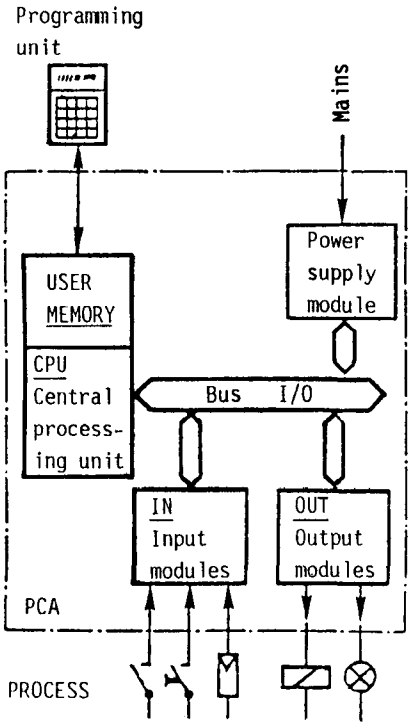
Selling price: sFr 60.-

PART A Hardware

A 1 System structure

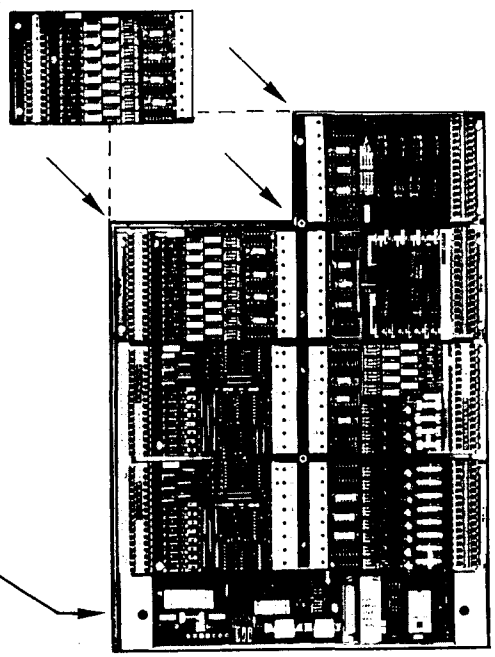
A 1.1 Block circuit diagram of the SAIA°PLC



The SAIA°PLC is subdivided into the following hardware modules:
- Central processing unit CPU
- User MEMORY
- SUPPLY module
- Serial communication interface
- Input modules (digital or analog)
- Output modules (digital or analog)

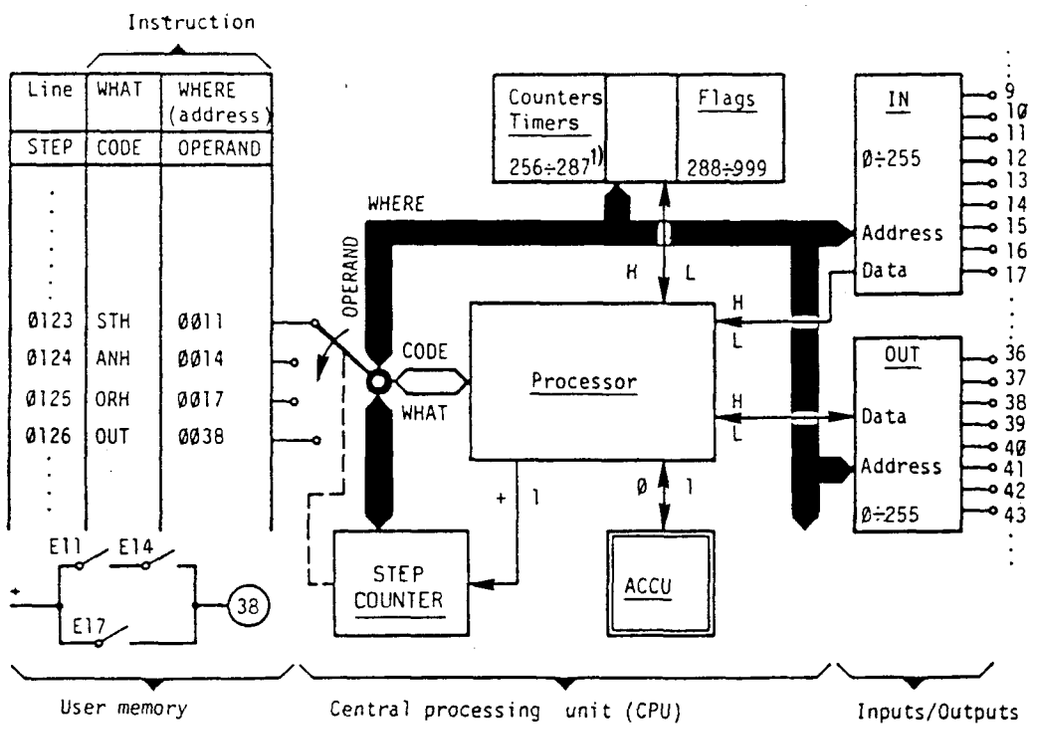
All listed modules can be plugged onto the common bus.
Program input takes place via the programming unit.

4 or 8 plug-in locations for I/O modules which may be arranged as desired



Basic module (without I/O) comprising processor section (CPU), supply section and rack. Some basic modules allow the connection to an extension housing.

A 1.2 Functional description of the SAIA°PLC



The instructions for linking the input signals and formation of the actual output states are entered by the user in the user memory, arranged in "words". Each word having a length of 16 bits comprises a complete instruction, subdivided into CODE and OPERAND. The CODE states "what" is to be executed, whilst the OPERAND states "where" the element in question is located.

The instructions are read and interpreted consecutively by the CPU. After an instruction has been processed, the step counter reading is incremented by 1 and the next instruction in the user memory is read. Additionally, the logical states of the elements (H or L) are interrogated by the CPU via the data bus. Each linkage result is stored in the accumulator (ACCU). With an output instruction, the result of the operation for example is transferred to an output.

The CPU contains all units required for auxiliary functions, such as e.g. timer and counter registers, flag memories, index registers, etc. The return addresses for subroutines are stored in additional memories.

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1) The registers 288 to 479 may be used as counters with the PCA14 from version V6.Ø34 onwards.

A 2 Technical data of system series PCA15

CPU	µP 8Ø85.2, system program V6.3.. [1]
Cycle time	7Øµs per program line (average of logic instructions)
Instruction set	Software level 1H 32 basic instructions + 2Ø additional instructions for transfer functions, arithmetics (+, -, x, ÷) and check sum
Parallel programs and subroutines	Up to 16 parallel programs, any number of subroutines nested down through 3 levels
Index register	1 per parallel program (max. 16)
User memory	1K, 2K or 4K program lines on EPROM, RAM or buffered RAM chip
Inputs and outputs	32, 64 or 128 input/output addresses corresponding to the housing size Up to 56, 112 or 224 inputs/outputs corresponding to the housing size, with compact module PCA1.B9Ø or B8Ø
Flag memory	712 flags, 235 of which are non-volatile 477 are volatile or non-volatile [2]
Timer and counter or arithmetic registers	32 timer or counter registers + 32 counter registers, volatile [2]
Counting or computing capacity	65'535 (2^{16}-1) per counter register, extendible as desired by means of cascading
Time range	Ø.1...6553s (Ø.Ø1...655s) [2]

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[1] When switching on the PLC, the CPU system version is displayed on the programming unit ..P1Ø or ..PØ5 for one second.

[2] Please refer to PCA15, page 8A for modification possibilities

A 2.1 Versions of system series PCA15

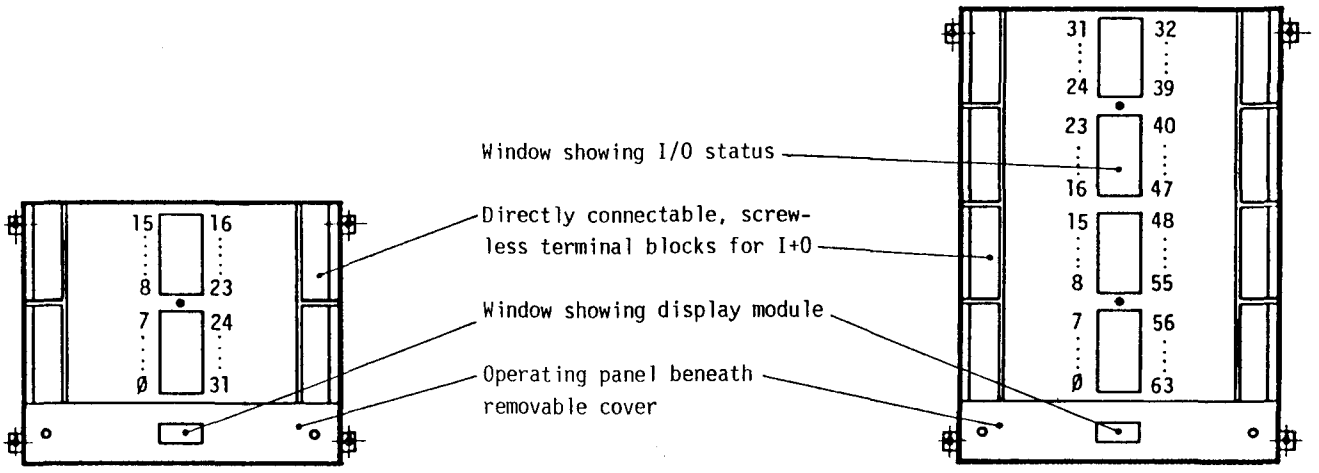
3 versions are available, corresponding to the required number of input and output addresses.

Type of system PCA151

32 I+0 addresses
56 I+0 with compact module PCA1.B9Ø

Type of system PCA156

64 I+0 addresses
112 I+0 with compact module PCA1.B9Ø



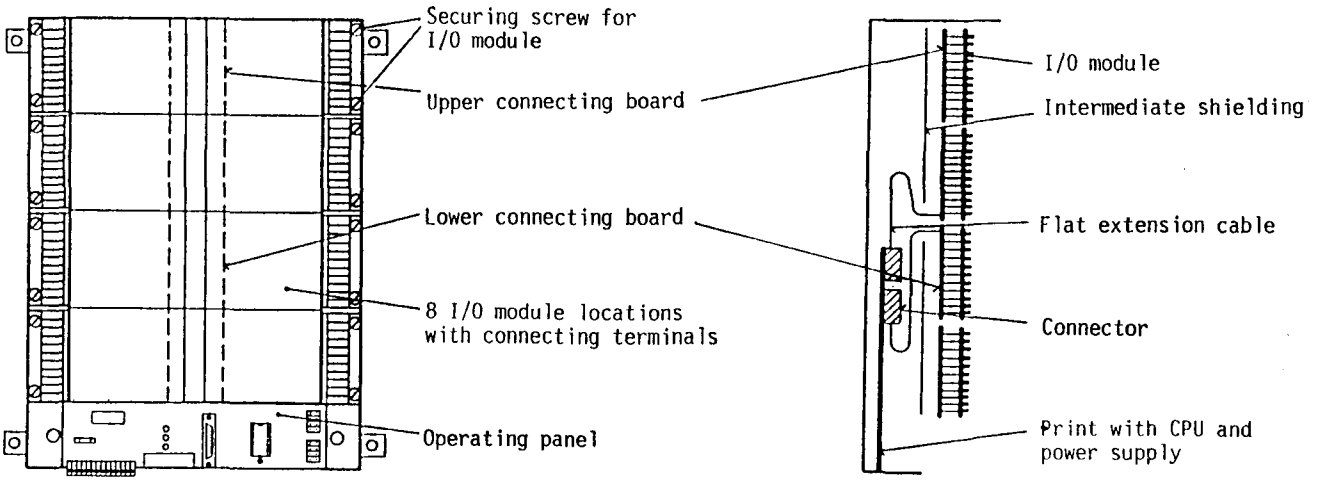
Basic module PCA1.M51

Basic module PCA1.M56

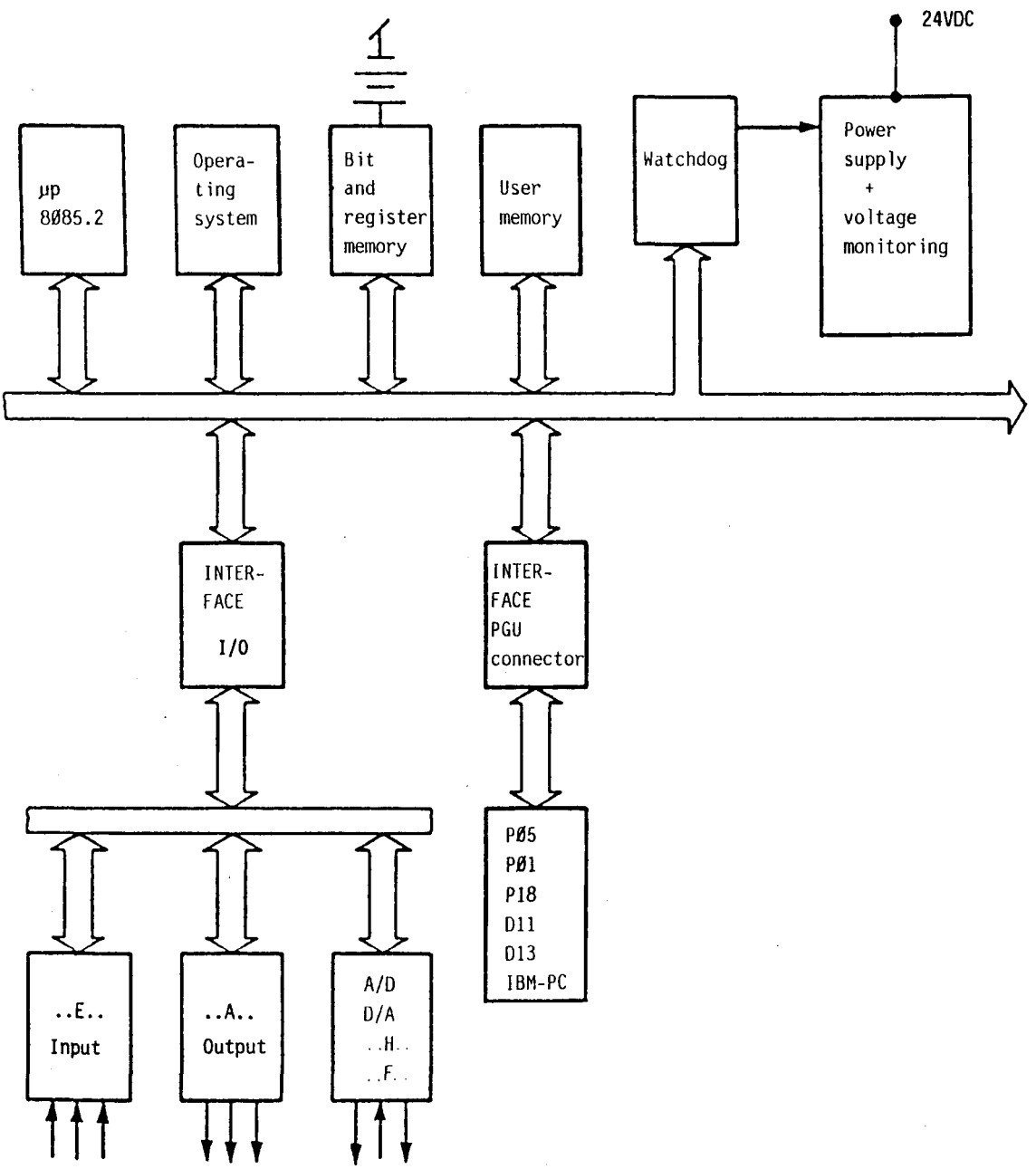
PCA1.M51 and PCA1.M56 Basic modules

In addition to the processor (CPU), the basic modules of the system series PCA15 also include the internal power supply and the housing.

Presentation (PCA1.M56)



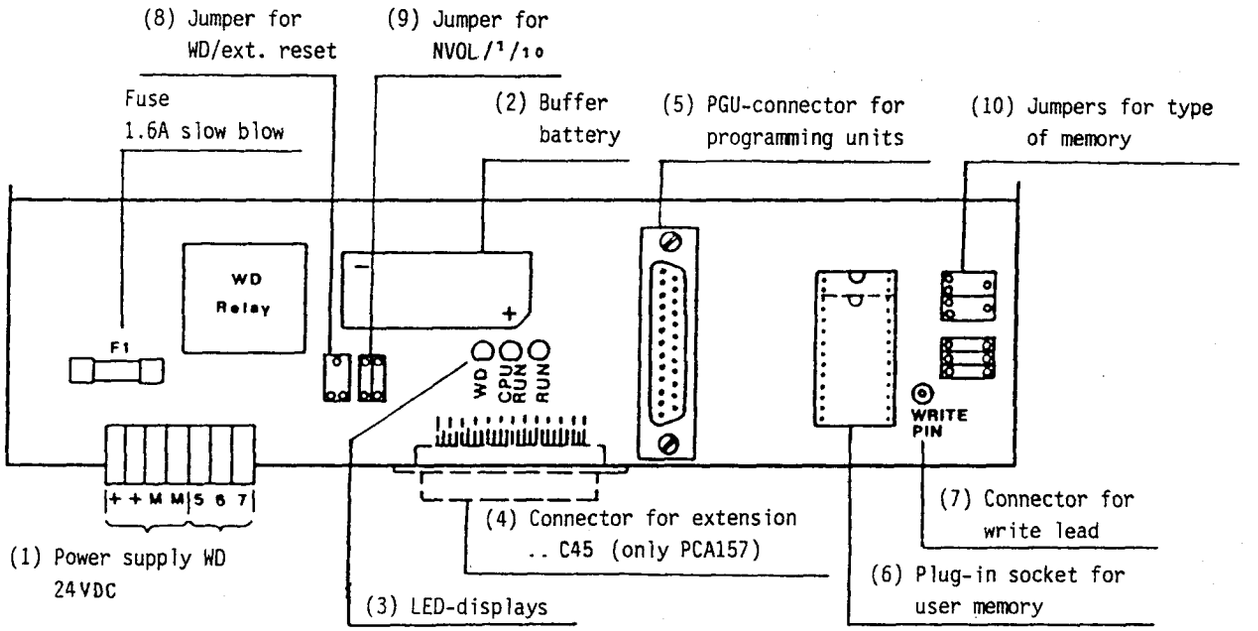
A 2.2 Block circuit diagram PCA15



A 2.3 Basic modules

A 2.3.1 Operating panel of the basic modules PCA1.M51/M56/M57

All operating elements for the PCA15 are clearly arranged on the operating panel which can be covered.



(1) The terminal board is plugged onto the circuit board. Wires with cross-sections up to 1.5 mm² are accepted by the screw terminals.

(2) The buffered battery supplies the non-volatile flags, counters/timers and, if used, the 6116 or 6264 RAM chip user memory. Data are retained approx. 2 months with the PLC switched off. The pluggable NiCd cell lasts approx. 5 years (order no. for spare batteries: no. 4'507'1360'0).

(3) The LED "CPU RUN" (yellow) blinks every 2s during normal operation. When the time base is set to 0.01s, the blinking rate is 0.2s. If the LED stays on or off, there is either no power available, the PLC is in RESET mode, the CPU has a malfunction or a trap has been produced in the software sequence.

The LED "RUN" (green) is illuminated when the CPU is in the operating mode RUN and the user program is executed normally.

The watchdog monitoring indicator (green) is illuminated when the watchdog relay is excited.

(4) The 25-pole connector for the extension cable (only on the PCA157) allows connection to housing ..C45 which means that the number of I+O addresses is increased from 64 to 128 I+O or 112 to 224 I+O respectively.

(5) The 25-pole PGU connector is used to connect the programming unit ..P05 or any other programming unit by using the programming interface PCA0.P01. Also the display modules PCA1.D11 and ..D13 can be connected here.

(6) The 28-pole plug-in socket accomodates the user memory. When inserting, please make sure that the index groove is at the top. If memory chips with a 24-pole socket are used (e.g. 6116, 2716, 2732A), please insert in such a way that they are flush with the lower edge of the socket.

The following memory chips can be used:

- unbuffered RAM chips, on plug-in socket
  No. 4'5Ø2'4512'Ø (type 6116) for 1K program lines (24-pole)
  No. 4'5Ø2'4718'Ø (type 6264 or 8464) for 4K program lines (28-pole)

  Comment: The RAM 6116 and 6264 or 8464 allow writing, erasing and modification of a program. On voltage failure, the memory contents are stored via the buffered battery for approx. 2 months. The program, however, is not transportable, because the data stored is lost, if the RAM chip is removed.

- buffered RAM chips, on plug-in socket
  PCA1.R92 for 2K program lines (24-pole, with write lead) [1]
  PCA1.R95 for 4K program lines (28-pole) } see page 81B
  PCA1.R96 for 4K program lines (28-pole) }

  In contrast to the unbuffered RAM chip, the program in this memory is transportable, since it is protected by an integrated circuit and a lithium battery which lasts approx. 8 years (..R96 approx. 6 years). These chips are therefore particularly suitable for starting the controller.

- EPROM chips, on plug-in socket
  No. 4'5Ø2'4373'Ø (type 2716) for 1K program lines (24-pole)
  No. 4'5Ø2'4644'Ø (type 2732A) for 2K program lines (24-pole)
  No. 4'5Ø2'4719'Ø (type 2764) for 4K program lines (28-pole)

  According to the prior art, reliable operation of user programs over a period of several years is only ensured, if EPROM memories are used. The manufacturers chosen by us guarantee program safety for at least 1Ø years.

  It is recommended to protect the window of the EPROM by means of a sticker to prevent the memory from being accidently subjected to UV-radiation.

(7) Connector for the write lead for the types PCA1.R91/R92/R94 (..R91 and ..R94 are no more available).

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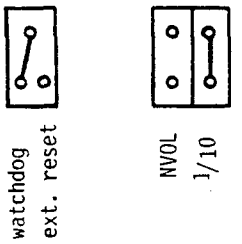
[1] Attention: Neither the write lead nor the connector WR must be touched or get into contact with the frame, since otherwise changes in contents may occur.

Function of the preselection jumpers



(8) Watchdog/external reset (factory setting: jumper in position watchdog)
According to the block circuit diagram in chapter "Power supply", terminal 7 of the terminal board can be preselected either for the break contact of the WD-relay or as a fast reset input (see chapter "Fast external RESET circuit").

(9) NVOL (factory setting: not inserted)
If the jumper is inserted, all flags, timer and counter registers are non-volatile (retentive).

1/1Ø (factory setting: jumper inserted)
If the jumper is inserted, the time-base is 1/1Øs. If the jumper is not inserted, the time-base is to 1/1ØØs.

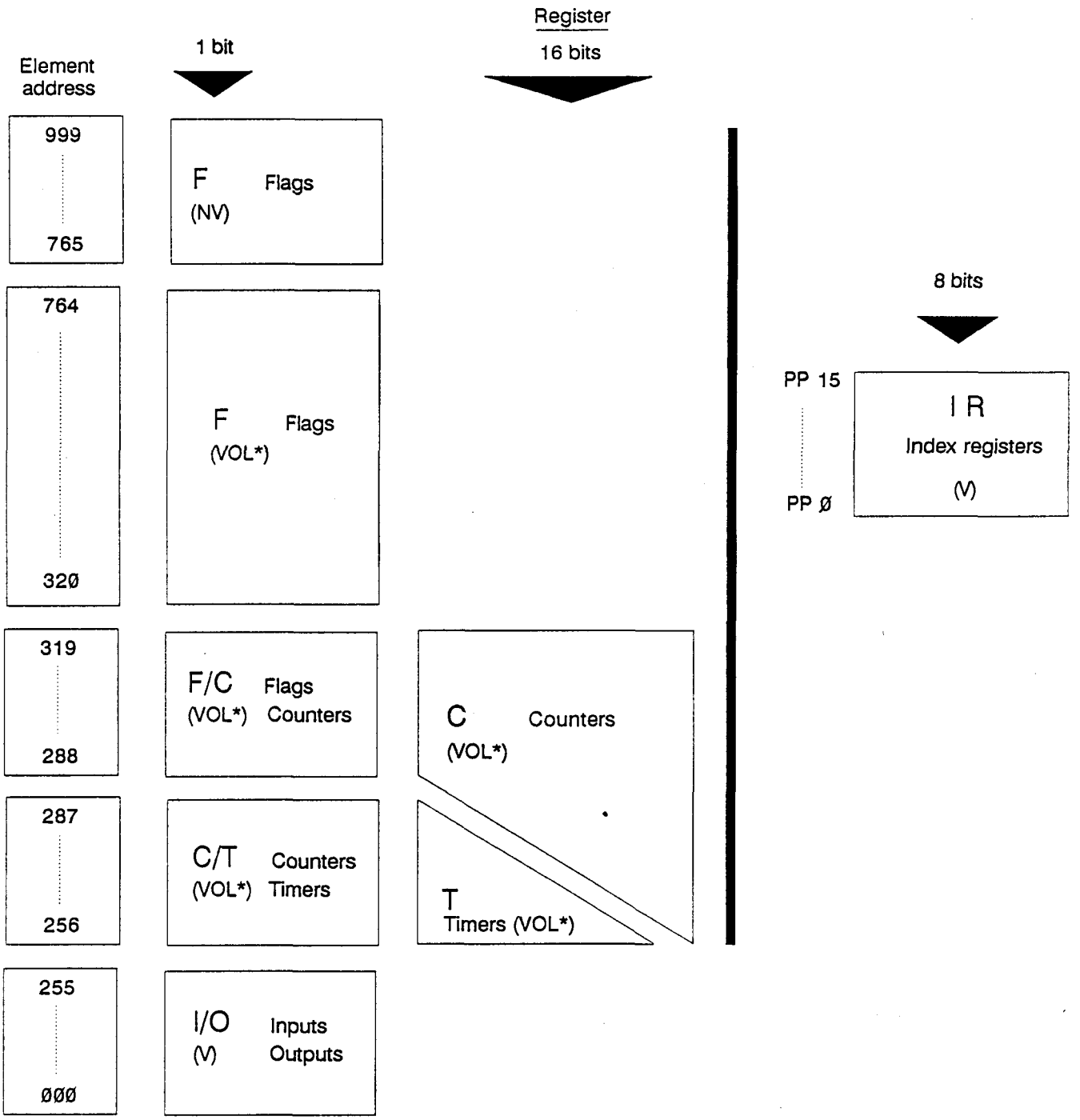
(10) Preselection for the user memory
Corresponding to the type of memory and storage capacity the jumpers must be inserted differently (see the following table).

Attention: Do not use any other combinations, as these can cause damage to the CPU.

		RAM		buffered RAM				EPROM		
R95 EPROM	3)	6116	6264 8464	R91 1)	R92	R94 1)	R95 R96	2716	2732A	2764
RAM										
2764			2)				2)			
8464 R95										
	3)									
6116										
2716										
8464 2732/64										

1) memory chips which are no more available
2) position "write disable"
3) factory setting for ..R95/..R96

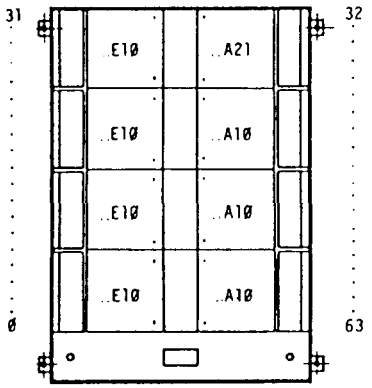
2.4 Register organization

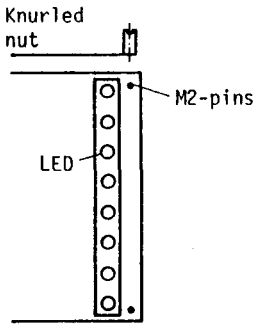


(V) volatile
(NV) non-volatile
(VOL*) volatile, can be made non-volatile with jumper NVOL

A 2.5 Brief instruction for operating a PCA15

a) Installation of I/O modules

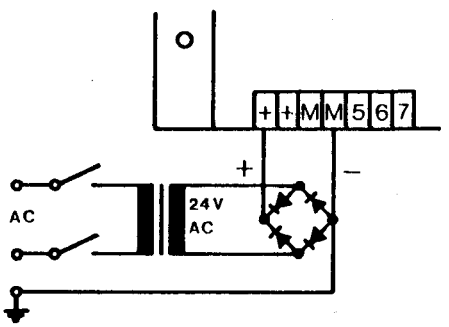




In order to try out the programming examples, it is recommended that addresses Ø...31 of a PCA156 should be equipped with ..E1Ø I-modules, while O-modules should use the addresses 32...63.

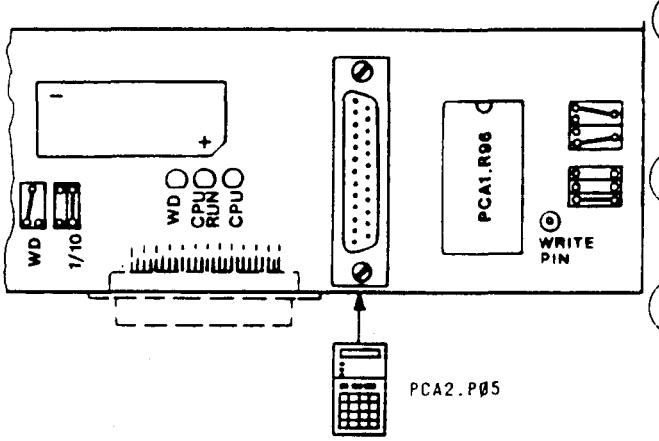
1. Undo fastening screw to remove the cover and lift.
2. Center I/O modules above the two M2-pins and carefully press them into the blade connectors.
3. Tighten M2-knurled nuts and cheese head screws with tooth washers on the terminal side.
4. Provide the LEDs with the corresponding address labels.

b) Power supply



5. Take a transformer (for "playing" 3ØVA are sufficient) with a secondary voltage of 24VAC and connect the terminals + and M of the PLC via the bridge rectifier.
6. A switch has the advantage that all resettable elements and the STEP-counter can easily be reset to their defined starting positions by switching off the PLC.

c) Connecting the user memory ..R96 and the programming unit ..PØ5



7. All jumpers must be positioned as evident from the figure (factory setting), so that the PCA1.R96 buffered RAM chip can be used.
8. Insert the buffered RAM chip ..R96 as shown with the index groove at the top.
9. Connect the ..PØ5 programming unit at the 25-pole PGU-connector.

d) Example program "Blinker"

(10.) Switch on the power supply of the PLC. The yellow "CPU RUN" of the 3 LEDs on the operating panel blinks, 1s on, 1s off, while the green LED does not light up.

(11.) Actuate the mode selecting key [P] (PROG) at the programming unit for approx. 1/2s, until the LED "PROG" lights up.

(12.) Type in the following "Blinker" program:

	STEP	CODE	OPERAND
A,E	(ØØØØ)[1]	(ØØ)	(ØØØØ)
E	(ØØØ1)	Ø2	256
E	(ØØØ2)	14	256
E	(ØØØ3)	ØØ	5
E	(ØØØ4)	13	32
E	(ØØØ5)	2Ø	1
E	(ØØØ6)	(ØØ)	(ØØØØ)

Programm in mnemocode

```
┌─►STL  256
│  STR  256
│        Ø.5s
│  COO   32
└── JMP    1
```

[1] The values in brackets need not be keyed in, but will be displayed.

(13.) Actuate the mode selecting key [R] (RUN) for approx. 1/2s.

--> Red LED "RUN" on ..PØ5 is illuminated
--> Green LED "RUN" on PCA15 is illuminated
--> Program will be run, i.e. output 32 will blink Ø.5s on and Ø.5s off (frequency 1Hz).

(14.) If the time base is to be changed to 1/1ØØs proceed as follows: switch off the PLC, remove jumper from 1/1Ø and insert at 1/1ØØ. Switch the PLC on again. Push the mode selecting key [R] (RUN) for approx. 1/2s.

--> Output 32 blinks ten times faster, i.e. at 1ØHz. The selection of the time base 1/1ØØs is also evident from the higher blinking frequency of the yellow LED "CPU RUN".

e) Example program "Blinker" with watchdog activated

If it is desired that the watchdog function be activated for the preceding example program, the instruction COO 255 must be added to this circulating program. To ensure that this instruction is executed in every cycle independently of the blinker program, SEA must precede it. This alteration is programmed as follows:

(15.) Actuate the mode selecting key [P] (PROG) for approx. 1/2s.

(16.) Type in:

A	5	(2Ø)	(1)
E	(ØØØ5)	19	Ø
E	(ØØØ6)	13	255
E	(ØØØ7)	2Ø	1
E	(ØØØ8)	(ØØ)	(ØØØØ)

Mnemocode

```
▲ SEA    Ø
│ COO  255
└─JMP    1
```

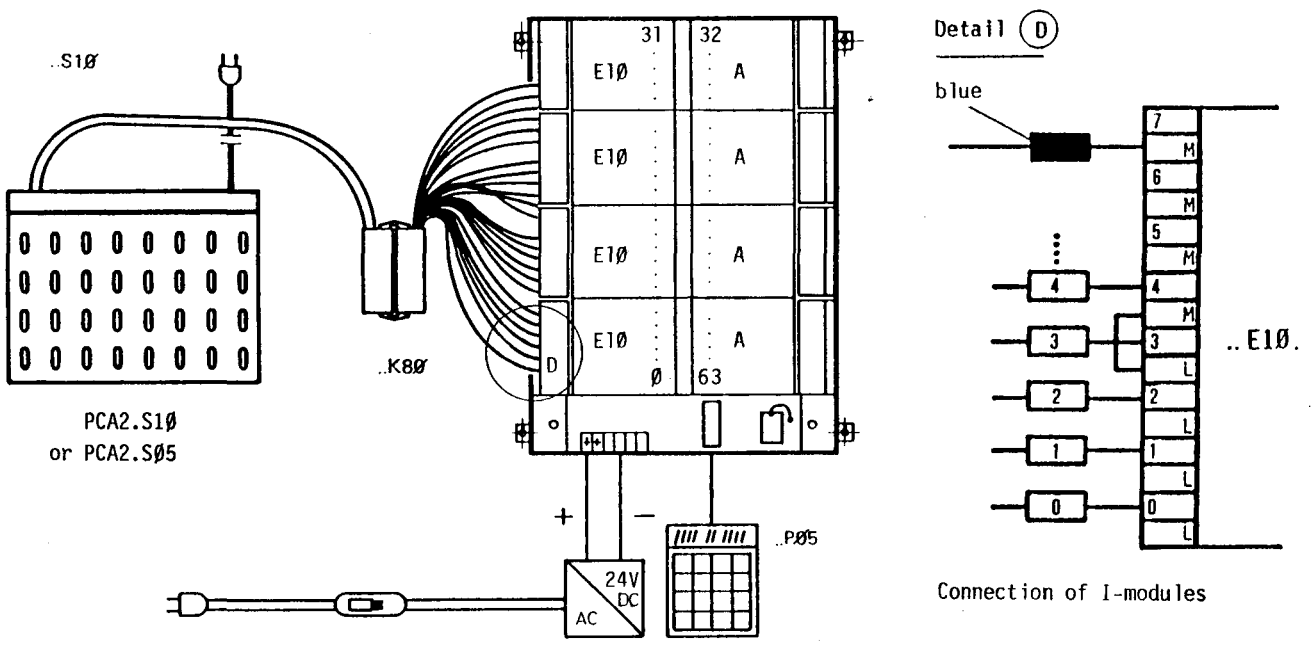
(17.) Actuate the mode selecting key [R] (RUN) for approx. 1/2s.

--> The program will be run and the green WD lamp will light because the watchdog circuit receives a frequency of approx. 1ØØØHz. If an operating mode is selected other than "RUN" the WD relay will release and the green WD lamp will go out. In order to provide effective protection for the controller, terminals 5 and 6 should be wired as described in chapter A 5.4 "The watchdog monitoring circuit".

f) Connection of the input simulation unit

A complete programming work station is obtained by using the PCA2.S1Ø input simulation unit with a PCA1.K8Ø connecting cable; many program examples can be tested with it.

(18.)



If a program starts, for example, at address 11Ø, proceed as follows:

(19.) Actuate the mode selecting key [S] (STEP) for approx. 1/2s and type in

[A] 11Ø [+]

(20.) Actuate the mode selecting key [R] (RUN) for approx. 1/2s

--> Program starts to run from address 11Ø.

Proceed similarly for all other examples.

A 3 Technical data of system series PCA14

CPU	µP 8Ø85.2, system program V6.Ø.. [1]
Cycle time	7Øµs (per program line, average)
Instruction set	32 basic instructions, 2Ø additional instructions for arithmetics, text output, communication and parameter functions
Parameter functions	- PID-loops - Shift registers - Check sum - Interrupt management
Number of parallel programs	16 (PP 15 for interrupt control)
Number of index registers	16 (1 per parallel program)
Number of subroutines	as desired, 3 levels per parallel program
User memory	1K, 2K, 4K or 8K program lines on EPROM, RAM or buffered RAM memory
Text or data memory	2K, 4K or 8K character or data bytes on EPROM, RAM or buffered RAM memory, memory extension up to 4ØK characters with modules PCA1.R2Ø/R25
Number of input and output addresses (depending on the housing size)	32, 64, 128
Max. no. of inputs + outputs (B9Ø)	56, 112, 224
Flags	712 (477 volatile [2], 235 non-volatile)
No. of timers	32 (ADD 256...287)
No. of counters or arithmetic reg.	224 (ADD 256...479) as of V6.Ø34
Counting capacity or arithmetic registers	65 535 (2^{16}-1) with cascading as desired
Time range	Ø.1 (Ø,Ø1)s...6553 (655)s
Date-time (software) [3]	Week, day of the week, year, month, day, hour, minute, second
Accuracy of date-time [3]	<3s/day
Serial data interface	2ØmA current loop, active or passive depending on cabling, for input/output of text or communication acc. to DIN 66Ø19 Baud rate 11Ø...96ØØ bauds [4]

1) When switching on the PLC, the system version is displayed on the programming unit P1Ø or PØ5 for one second. For this reason, the operating mode selector switch has to be in operating mode RUN.
2) Please refer to the text for modification possibilities.
3) Hardware date-time see chapter PCA1.E4Ø.
4) Owing to the high baud rates an appropriate program structure is required.

A 3.1 Versions of system series PCA14

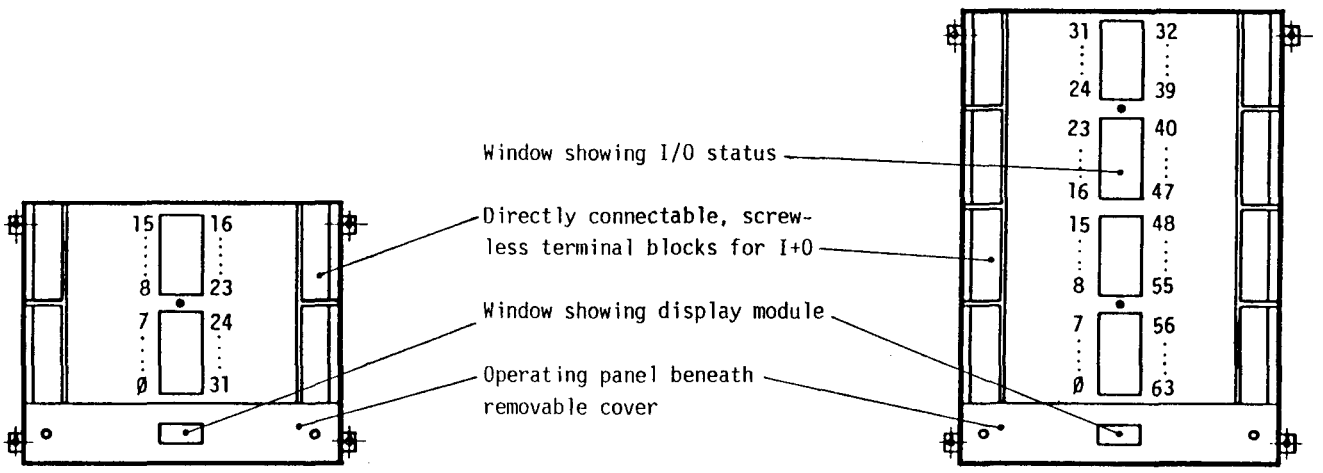
3 versions are available, corresponding to the required number of input and output addresses (PCA1.M47 and extension housing ..C45, see chapter A 4).

Type of system PCA141

for 32 I+0 addresses
≙ 56 I+0 with module B9Ø

Type of system PCA147

for 64 I+0 addresses
≙ 112 I+0 with module B9Ø



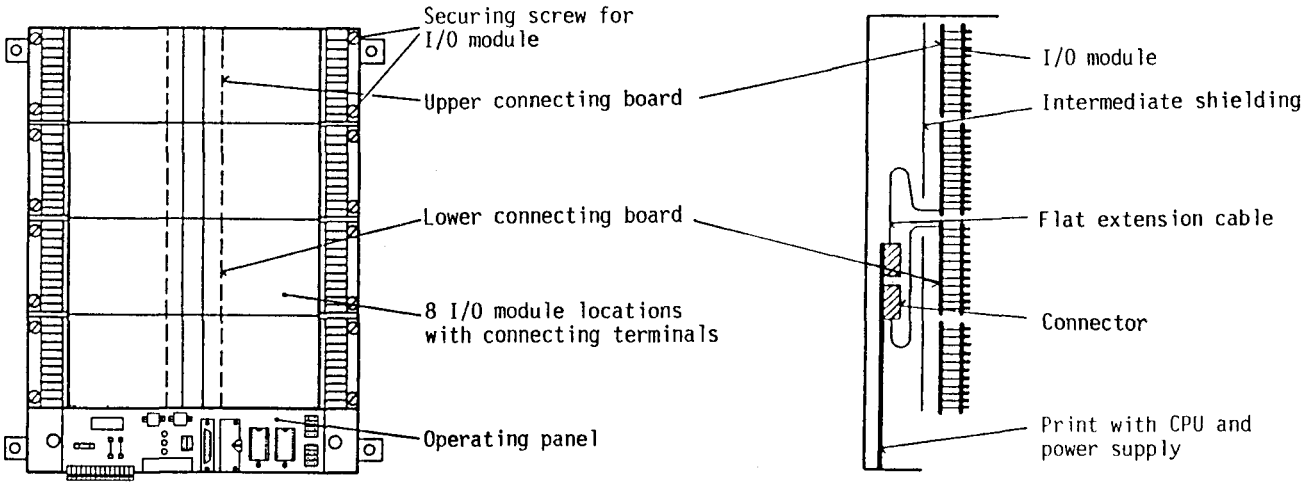
Basic module PCA1.M41

Basic module PCA1.M47

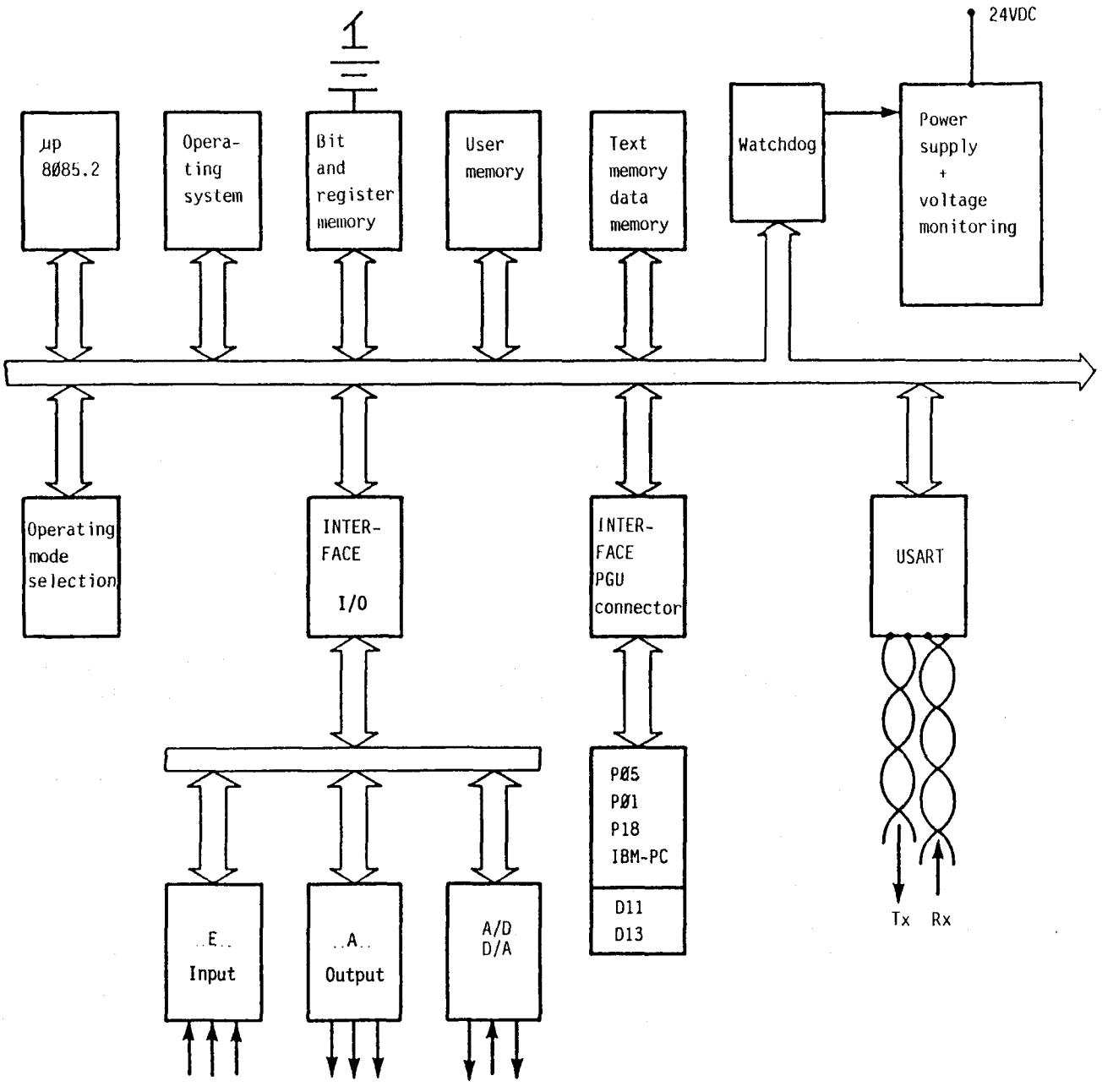
Types PCA1.M41 and M47 basic modules

In addition to the processor (CPU), the basic module of the system series PCA14 also includes the internal power supply and the housing.

Presentation (type of system PCA1.M47)



A 3.2 Block circuit diagram PCA14

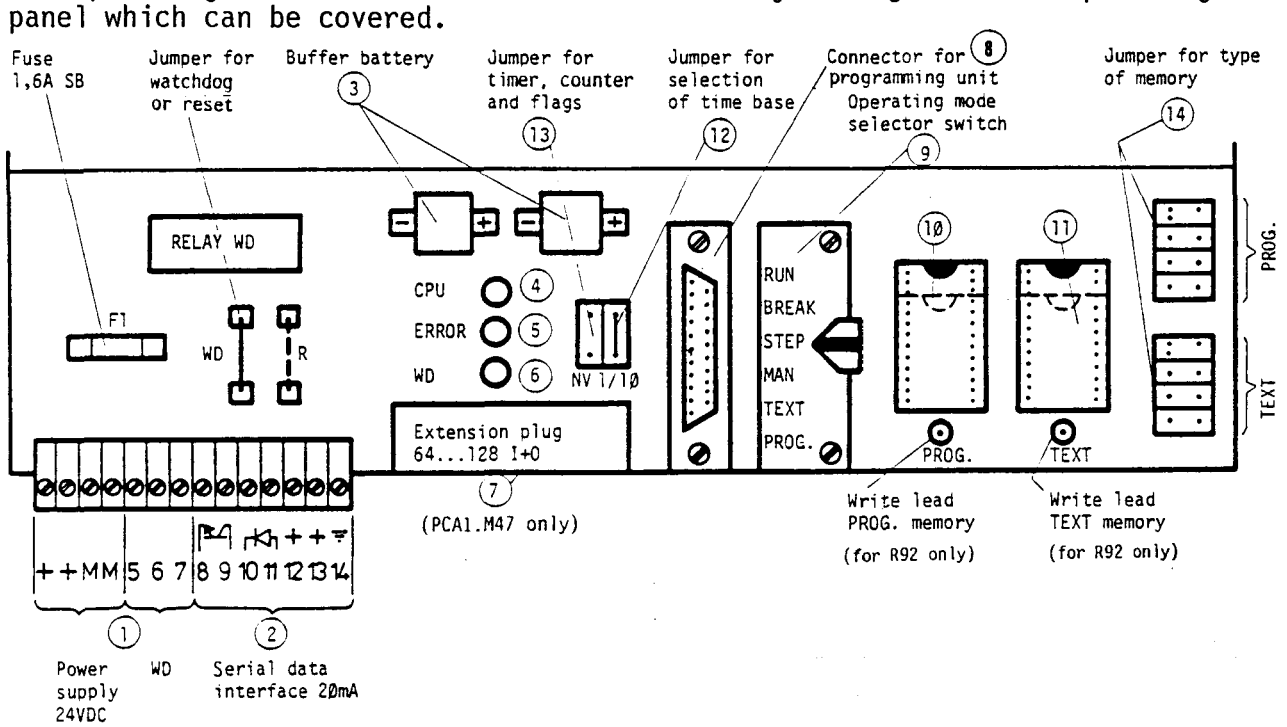


PCA141/46/47

A 3.3 Basic modules

A 3.3.1 Operating panel of the basic modules PCA1.M41/M47

All operating elements for the PCA14 are clearly arranged on the operating panel which can be covered.



(1) The terminal strip is plugged onto the circuit board. Wires with diameters up to 1.5 mm² are accepted by the screw terminals.

(2) The serial data interface is connected on the circuit board. Depending on wiring, it can be defined whether the PCA14 is active or passive at the 20mA-current loop.

(3) The buffer battery supplies the retentive flags, counters/timers and, if used, the 6116 or 6264 RAM chip user memory. The data is protected for approx. 2 months when the PLC is switched off. The NiCd cells last approx. 5 years. Spare battery no. 4'507'1195'0. A new version with a plug-in battery is available as of 1989 (no. 4'507'1360'0).

(4) The CPU monitoring lamp (yellow) blinks every 2s during normal operation. When the time-base is set to 0.01s, the blinking rate is 0.2s. If the light stays on or off, there is either no power available, the PLC is in RESET mode, the CPU has a malfunction or a trap has been produced in the software sequence.

(5) The ERROR lamp (red) indicates errors at the serial data interface. For details refer to chapter "The serial data interface" (see manual software level 2).

(6) The watchdog monitoring lamp (red) is illuminated when the watchdog relay is excited. Please refer to chapter "The watchdog monitoring circuit" for details.

(7) The 25-pole connector of the extension cable (only on the PCA147) allows an increase in I/O from 64 or 112 to 128 or 224 inputs/outputs owing to the connecting cable attached to the extension housing ..C45.

(8) The 25-pole connector (PGU) is used to connect the programming unit. A latch is not provided, because the mode selected on the operating mode selector switch remains operative (unlike the PCA2) when the programming unit is removed.

(9) The operating mode selector switch is used for starting up, trouble-shooting and editing of texts. Position "LCM" (transfer from e.g. RAM to EPROM) is not available, because this function is not possible with the PCA1; the PCA2.P16 copying unit is required.

(10)
(11) The two 28-pole sockets accomodate the user or text memory "PROG" or "TEXT" respectively (see chapter "Organization of program and text memory"). When inserting them, make sure that the groove points to the top. If 25-pole sockets are used (e.g. 6116, 2716, 2732A), please insert in such a way that they are flush with the lower edge of the socket. The following memory types can be used.

. RAM chip on socket

4 5Ø2 4512 Ø (type 6116)	for 1K program lines (24-pole)
4 5Ø2 4718 Ø (type 6264 or 8464)	for 4K program lines (28-pole)

Comment: The 6116 and 6264 or 8464 RAMs allow writing, erasing and modification of a program. On power failure, the memory contents are stored by the buffer battery for approx. 2 months. The program, however, is not transportable, because the data stored is lost, if the RAM chip is removed.

. Buffered RAM memory module

Type PCA1.R92	for 2K program lines (24-pole) [1]	see chapter B 2
Type PCA1.R95	for 4K program lines (28-pole)	
Type PCA1.R96	for 4K program lines (28-pole)	

User programs can be introduced on the left socket (PROG) as well as on the right socket (TEXT). Text can only be introduced on the right socket. For programming or introduction of texts please insert the write lead for the left socket on the left and that for the right socket on the right. In order to avoid program mutations interrupt both connections during continuous operation in the RUN mode.

Contrary to the 6116 or 6264 RAM chip, the program in this memory is transportable, since it is protected by an integrated circuit and a lithium battery which lasts approx. 8 years. This module is therefore particularly suitable for starting up the controller.

For copying of programs please refer to chapter "PCA2.P16 EPROM-copying unit".

---

1) Attention: Neither the wire lead nor the connector WR must be touched or get into contact with the ground, since otherwise changes in contents may occur.

. EPROM chips on socket
No. 4 5Ø2 4373 Ø (type 2716) for 1K program lines (24-pole)
No. 4 5Ø2 4644 Ø (type 2732A) for 2K program lines (24-pole)
No. 4 5Ø2 4719 Ø (type 2764) for 4K program lines (28-pole)

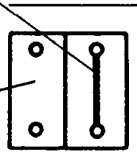
According to prior art, reliable operation of user programs over a period of several years is only ensured, if EPROM memories are used. The manufacturers chosen by us guarantee program safety for at least 1Ø years.

It is recommended to protect the window of the EPROM by means of a sticker in order to prevent the memory from being accidently subjected to UV-radiation.

An extension of the text and data memory up to 4ØK bytes is possible by using the modules PCA2.R2Ø and R25.

(12) (13) (14) The selector jumpers allow various selections:

. The selection of the time base for the timers

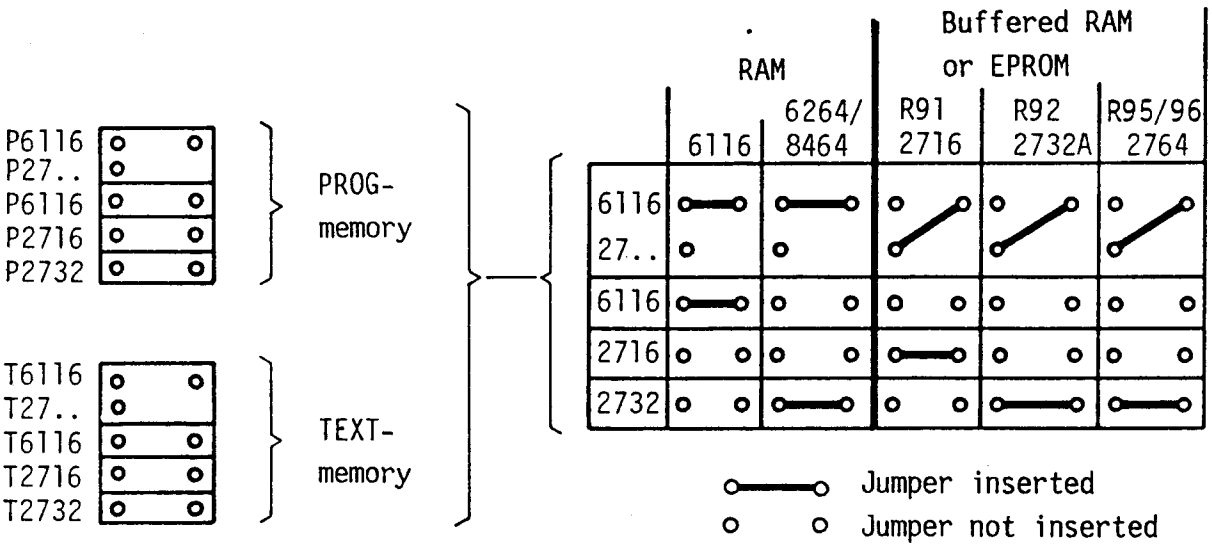


NV 1/1Ø

1/1Øs: jumper inserted (factory setting)
1/1ØØs: jumper not inserted

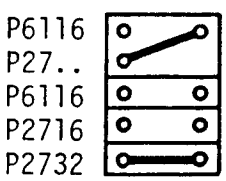
. The selection of the retentive flags (13)
If the jumper is inserted, all flags, timers and counter registers are retentive. If the jumper is not inserted (factory setting), only the flags 765...999 are retentive.

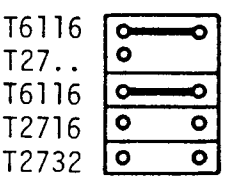
. The selection of the user or text memory (14)
When using the various RAM or EPROM for user program or text, the jumpers have to be inserted as is shown in the following table.



Attention: Do not use any other plug combinations, as these can cause damage to the CPU!

Example: When using an EPROM 2732 for the user program (P) and a RAM 6116 for the text (T), insert the jumpers as follows:





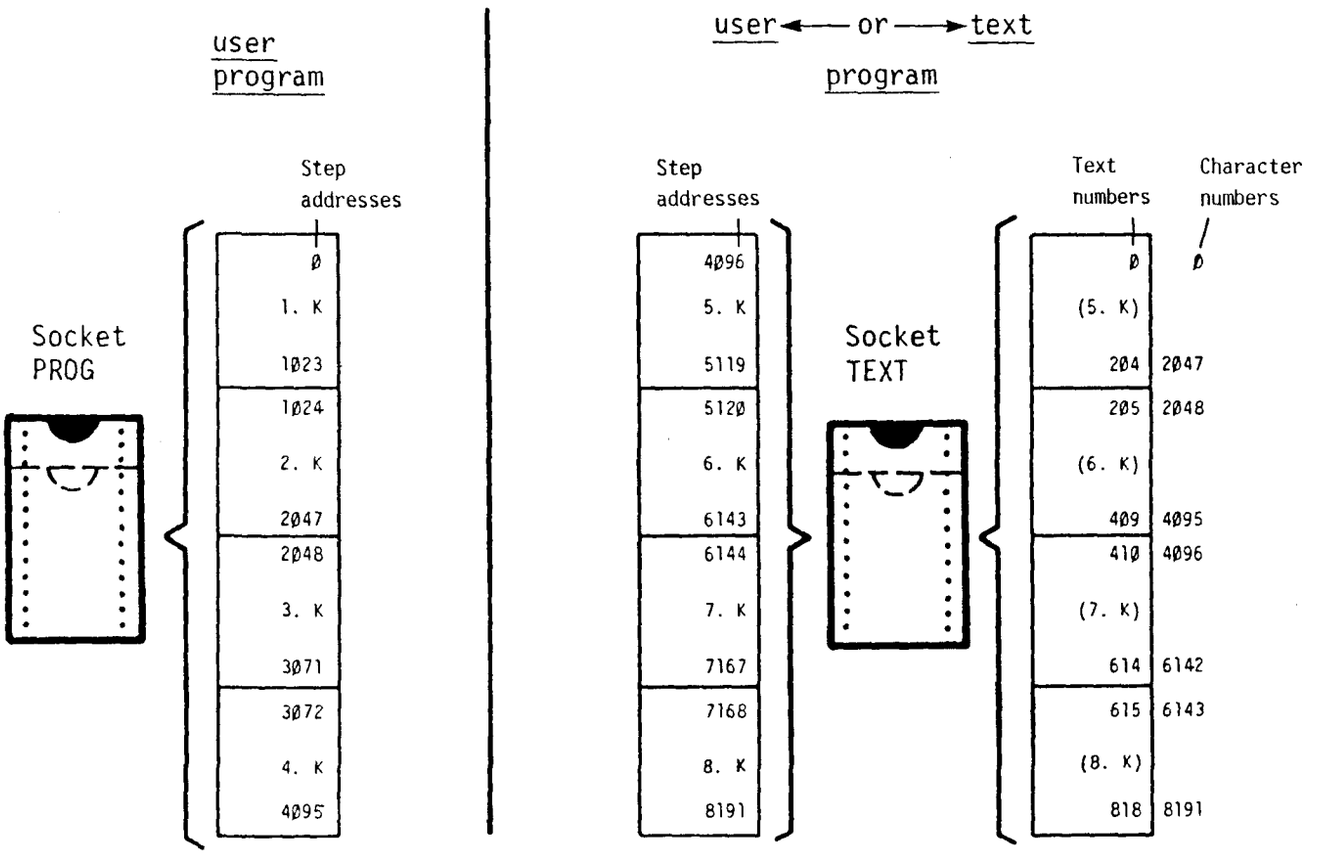
Note:
The preselection jumpers of the PCA14 for RAM R91 or EPROM 2716 respectively are inserted (factory setting).

A 3.4 Organization of program and text memory

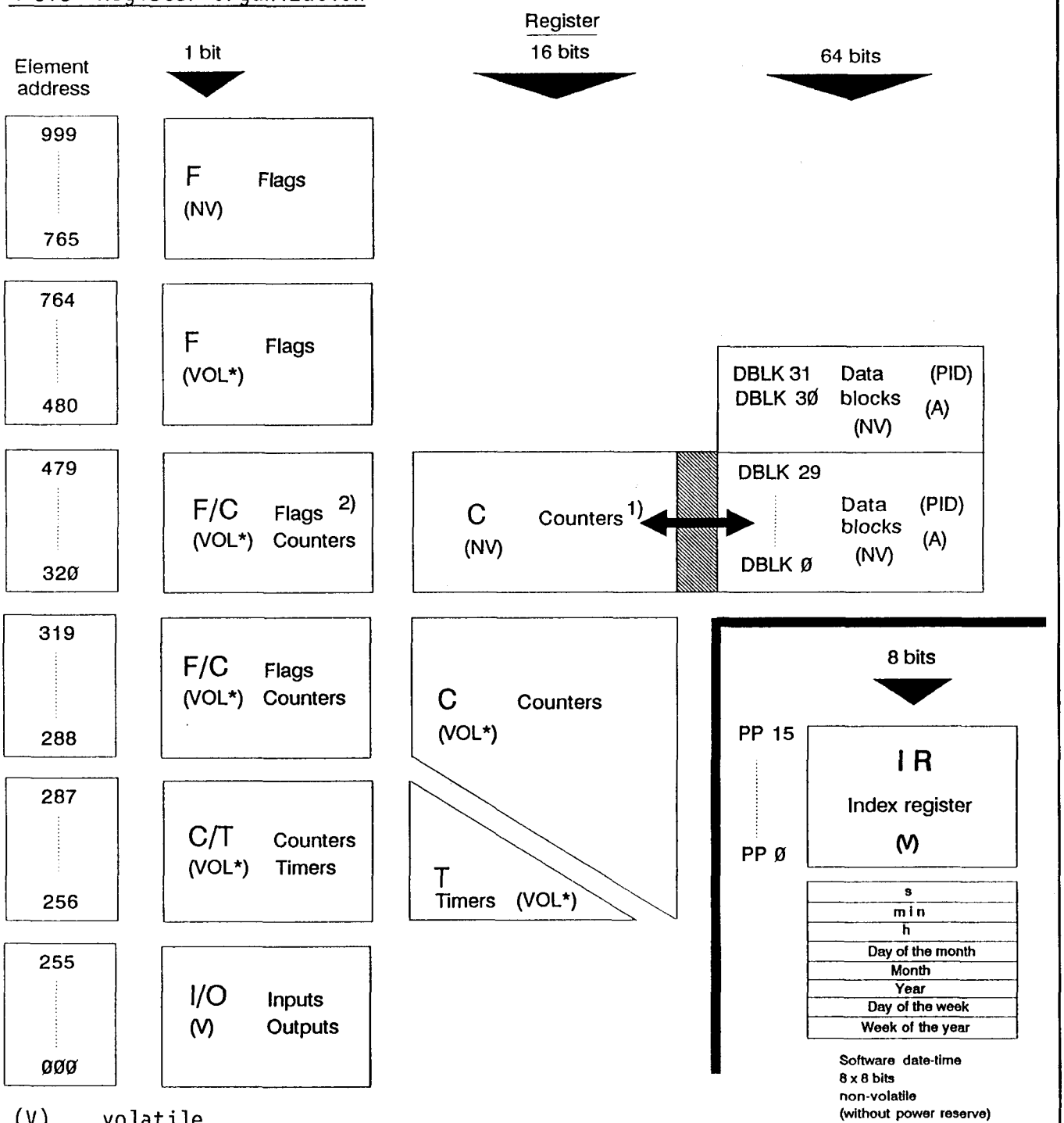
All RAM, EPROM or buffered RAM-memory modules mentioned in paragraph "28-pole socket for user memory" can be used both for user programs and texts.

User programs can have a length of up to 8K program lines (at 16 bits). With user programs having a length of more than 4K, the first 4K are stored in the PROG memory on the left (1K...4K) and up to 4K more can be stored in the TEXT memory on the right (5K...8K).
If, e.g., only 2K-memories are available and a user program of > 2K has to be prepared, the 1. and the 2.K can be stored on the left socket PROG (addresses Ø...2Ø47) and the 3. and the 4.K on the right socket (addresses 4Ø96...6143).

Texts having a length of up to 8K characters (at 8 bits) can only be stored in the TEXT memory on the right.



A 3.5 Register organization



(V) volatile
(NV) non-volatile
(VOL*) volatile, can be made non-volatile with jumper NVOL
(A) jumper A open: all 32 DBLK are non-volatile

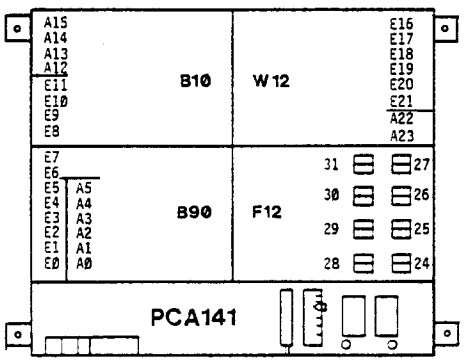
---

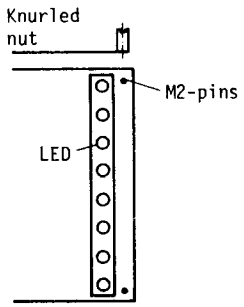
1) Counter registers C32Ø...C479 and PID-data blocks Ø...29 use the same memory area. It is therefore recommended to start with DBLK 31 for PID-control tasks.
2) The counter registers C32Ø...C479 are available from system program version V6.Ø34 onwards.

Notes:

A 3.6 Instructions for operating a PCA14 in brief

a) Installation of I/O modules

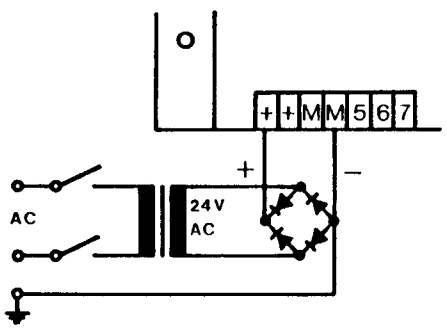




In order to test the programming examples, the I/O-equipment must be selected as evident from the accompanying figure. For a short test it suffices to install the I/O-module B9Ø using the address range Ø...7.

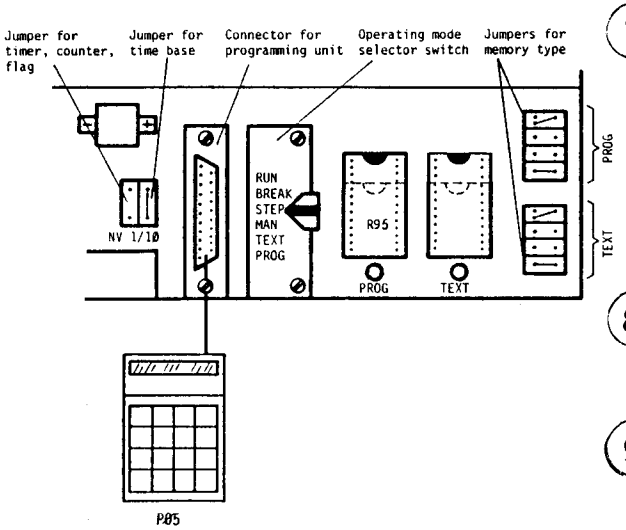
1. Undo fastening screw of the cover and lift.
2. Center I/O-modules above the two M2-pins and carefully press them into the blade connectors.
3. Tighten knurled nuts M2 and ZK-screws with tooth washers on the terminal side.
4. Provide the LEDs with the corresponding address labels.

b) Power supply



5. Take a transformer (for "playing" 3ØVA is enough) with a secondary voltage of 24VAC and connect the terminals + and M of the PLC via a bridge rectifier.
6. A switch has the advantage that all resettable elements and the STEP-counter can easily be reset to their defined starting positions by switching off the PLC.

c) Connection of the user memory or text memory R95 or R96 and the programming unit PØ5



7. For employment of the buffered RAM memory module R95/96 the preselection jumpers on the outer right must be inserted correspondingly (see fig.). For the following simple example (without text output) it is sufficient to use the program memory and to insert the jumpers in position "PROG" accordingly.
8. The buffered RAM-module R95/96 must be inserted in the marked position - notch at the top.
9. The programming unit PØ5 is connected to the 25-pole connector.

d) Programming example "Blinker"

(10.) Set operating mode selector switch to "PROG".

(11.) Switch on power supply of the PLC. The CPU lamp (yellow) flashes 1s on, 1s off. The watchdog lamp (red) is not illuminated.

(12.) Enter the following blinker program:

	STEP	CODE	OPERAND	Program in mnemocode	
A,E	(ØØØØ)*	(ØØ)	(ØØØØ)		
E	(ØØØ1)	Ø1	1	STH	E1
E	(ØØØ2)	Ø4	256	ANL	T 256
E	(ØØØ3)	14	256	STR	T 256
E	(ØØØ4)	ØØ	5		Ø.5 s
E	(ØØØ5)	13	4ØØ	COO	M4ØØ
E	(ØØØ6)	Ø1	4ØØ	STH	M4ØØ
E	(ØØØ7)	1Ø	5	OUT	A5
E	(ØØØ8)	2Ø	1	JMP	1
E	(ØØØ9)	(ØØ)	(ØØØØ)		

*) The values in brackets do not have to be entered, but they are displayed.

(13.) Set the operating mode selector switch to "RUN". Switch PLC off and on again.
→ The program is executed. In order that output A5 flashes, a voltage of +24V must be applied to input E1. The easiest way to do this is to lead a wire from the power supply terminal + to input terminal E1. As long as this connection exists, A5 flashes at a frequency of 1Hz (if present, the jumper on the BØØ-module must be "-" (minus)).

(14.) If the time base is to be changed to 1/1ØØs, proceed as follows:
Switch off PLC, remove jumper "1/1Ø". Switch on PLC again.
→ Output A5 flashes 1Ø times faster, i.e. at 1ØHz. The selection of the time base of 1/1ØØs is also recognizable by the higher flashing frequency of the CPU-lamp (yellow).

e) Blinker example with watchdog activated

If in the preceding example the watchdog is to be activated, the instruction COO 255 must be added to this circulating program. In order that this instruction be executed during each cycle independently of the indicator program, it must be preceded by SEA.
This is programmed as follows:

(15.) Set operating mode selector switch to "PROG".

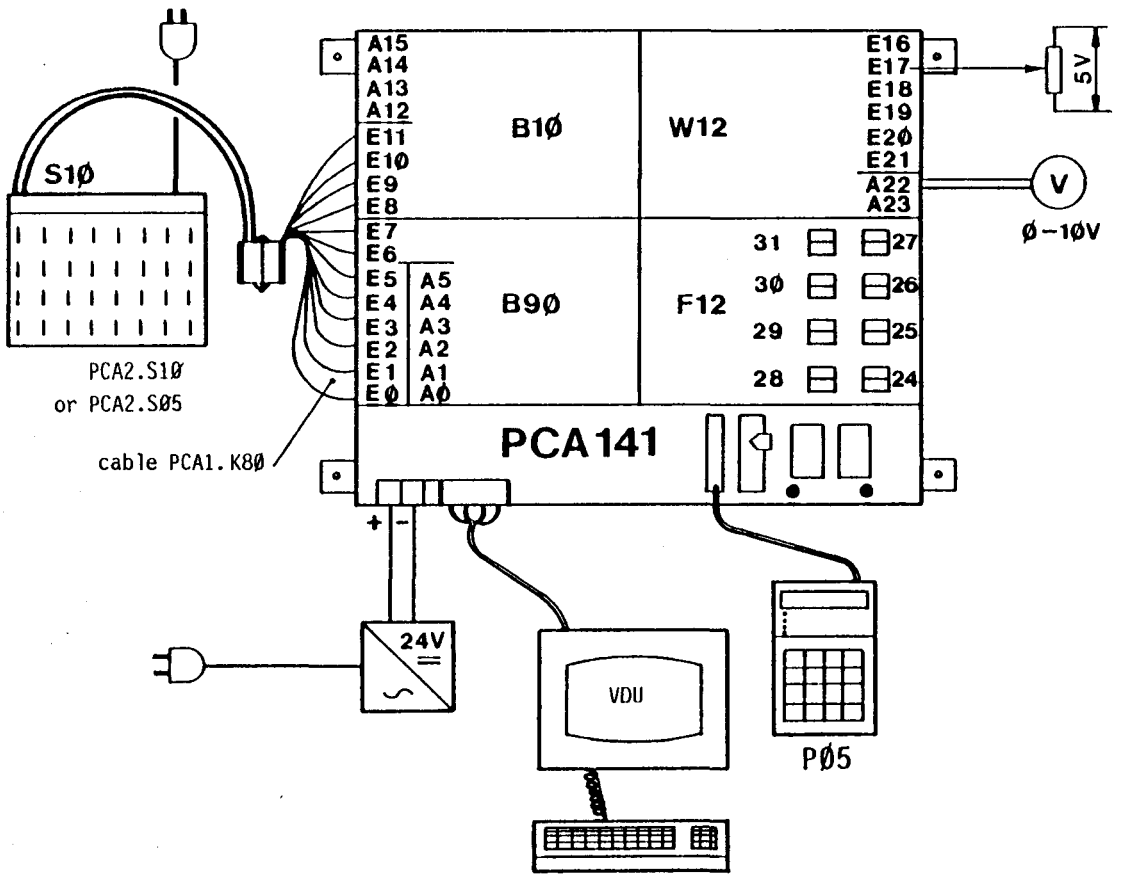
(16.) Enter:

				Mnemocode	
A	8	(2Ø)	(1)		
E	(ØØØ8)	19	Ø	SEA	Ø
E	(ØØØ9)	13	255	COO	255
E	(ØØ1Ø)	2Ø	1	JMP	1
E	(ØØ11)	(ØØ)	(ØØØØ)		

17. Set operating mode selector to "RUN" again.
→ The program is executed, the red WD-lamp is illuminated, as the WD-circuit receives a frequency of approx. 7ØØHz. If the operating mode selector switch is set to any other position than "RUN", the WD-relay is released, the red WD-lamp goes out. In order to provide effective WD-protection for the controller, the connectors 5 and 6 and the power supply line must be wired accordingly.

f) Connection of the input simulation unit PCA2.S1Ø

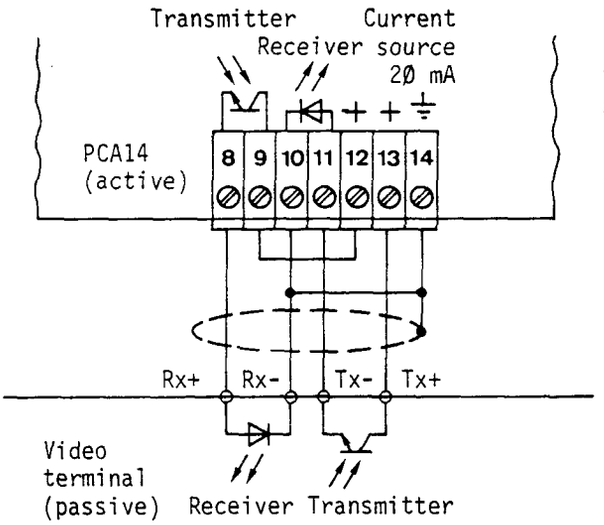
18. The input simulation unit, further modules, a variable DC-voltage of Ø...5V as well as a voltmeter Ø...1ØVDC (1ØkΩ) and a video terminal with a 2ØmA-data input (or with an adapter 2ØmA/(RS232c) form a complete program developing and simulation unit for the following programming examples.



The above configuration corresponds to the simulation case V-PCX8.

g) Installation of the 20mA-serial data interface with a video terminal for text input and output

g1) Establishing the cable connection PCA14 <---> video terminal



It must be provided that the video terminal is fitted with a 20mA-current loop interface for full-duplex operation (or a suitable adapter 20mA/RS 232c).

19. The cable connection (max. length of 100m) can be established according to the accompanying figure. The terminal must be "passive", i.e. the 20mA are supplied by the PCA14.

g2) Installation of the text memory module

20. The RAM-memory module R95/96 is inserted to the right of the user memory for the storage of texts. The jumpers are preselected according to chapter point (7.) of this chapter.

g3) Selection of the communication parameters

They are defined according to chapter "Activation of the interface via the software ...".

21. Assumed values for setting the video terminal:
Most of the following values can be preselected via the DIL-switches. If a switch or a key for "Full Duplex" is available, it should be locked in position (for details refer to the manual of the video terminal).

Communication parameters for PAS 100 (assumed)

. Baud rate	4800	6
. Data bits	7	0
. Parity	yes	128
. Even	yes	256
. Stop-bit	1	512
Total		902

This value must be added in line 2 of the 10-line assignment instruction PAS 100.

g4) Activation of the PCA14 data interface
as editor and for checking the text output

22. The PAS 1ØØ-instruction for activating the editor and test output of the text just edited is given at the end of the user memory e.g. at address 4ØØ1.

```
4ØØ1   PAS    29    1ØØ
4ØØ2          ØØ    9Ø2     Transmission parameters (48ØØ bauds etc.)
4ØØ3          Ø1     12     Ø1 for text editor, A12 for Text Busy
4ØØ4          ØØ    254     } The higher address of 2 elements
4ØØ5          ØØ    254     } permanently remain "L", e.g.
4ØØ6          ØØ      Ø     | elements 254 and 253
   .           .      .     |
   .           .      .     } NUL
   .           .      .     |
4Ø1Ø          ØØ      Ø     |

4Ø11   PAS    29     23     } Text output from text no. 3Ø on
4Ø12          ØØ     3Ø     }
4Ø13   JMP    2Ø      Ø
4Ø14          ØØ   4Ø11      (Ø1    1963)
```

g5) Enter a text into the text memory

23. Set operating mode selector switch to "STEP".

24. By pressing [A] 4ØØ1 [+] on the PØ5 input unit jump to the beginning of the assignment.

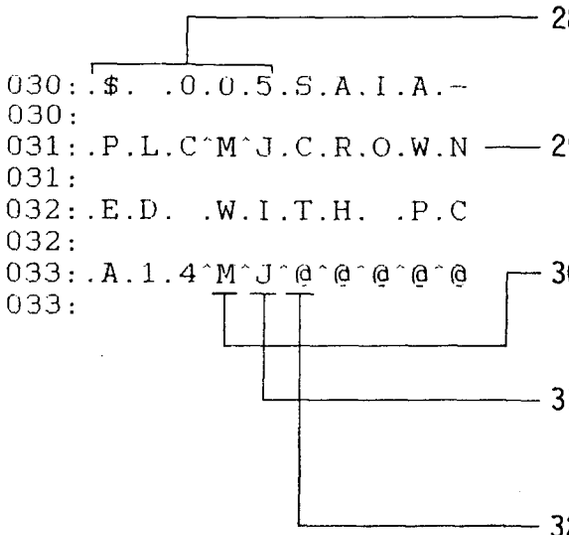
25. By pressing [+] execute assignment up to 4Ø11.

26. Type in Ø3Ø "CR" on the VDU terminal.

```
Ø3Ø "CR"

Ø3Ø:.A.B. . . . ^@^@^@^@
Ø3Ø:
```

The displayed text is random in case of an uncleared text memory. A point preceding a character means that this character is part of the visible section of the ASCII-table (32...127). Control instructions from the "control case" are preceded by an arrow or a ^.

Display on the screen



27. To activate the text input mode, press keys [CTRL] and [T] (CTRL/T) simultaneously.

28. Then enter 5 spaces using the special character [$], the followed by the SAIA°PLC logo.

29. Note that as soon as 1Ø characters have been entered, the screen automatically proceeds to the following text number.

30. To enter "CR" without changing the text mode, [^] must be pressed first. The CPU answers with ^M (CTRL/M = "CR").

31. To enter "LF" = Line Feed, [CTRL/J] is pressed which corresponds to "LP" ^J appears.

32. NUL is entered to end text input. This is possible via [CTRL/@] (may differ from one peripheral unit to another).

33. To exit from the editor mode enter ["CR"].

g6) Output of this text

34. With [+] [+] on the PØ5 unit the program loop 4Ø11 to 4Ø14 is executed once, as a result of which the text is output.

SAIA°PLC CROWNED WITH PCA14

After this sample text has been input/output successfully, the programming examples in the "Software" manual can be entered and tested.

g4) Activation of the PCA14 data interface
as editor and for checking the text output

22. The PAS 1ØØ-instruction for activating the editor and test output of the text just edited is given at the end of the user memory e.g. at address 4ØØ1.

```
4ØØ1   PAS    29    1ØØ
4ØØ2          ØØ    9Ø2     Transmission parameters (48ØØ bauds etc.)
4ØØ3          Ø1     12     Ø1 for text editor, A12 for Text Busy
4ØØ4          ØØ    254     } The higher address of 2 elements
4ØØ5          ØØ    254     } permanently remain "L", e.g.
4ØØ6          ØØ      Ø     } elements 254 and 253
   .           .      .     }
   .           .      .     } NUL
   .           .      .     }
4Ø1Ø          ØØ      Ø     }

4Ø11   PAS    29     23     } Text output from text no. 3Ø on
4Ø12          ØØ     3Ø     }
4Ø13   JMP    2Ø      Ø
4Ø14          ØØ   4Ø11      (Ø1    1963)
```

g5) Enter a text into the text memory

23. Set operating mode selector switch to "STEP".

24. By pressing [A] 4ØØ1 [+] on the PØ5 input unit jump to the beginning of the assignment.

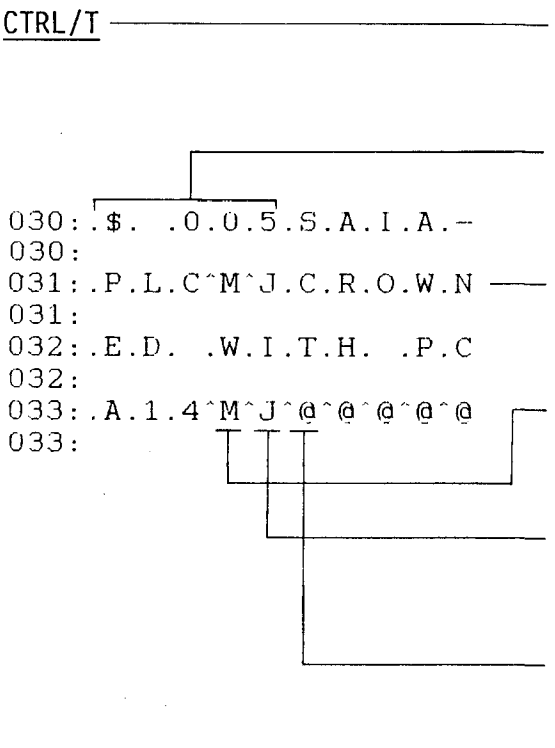
25. By pressing [+] execute assignment up to 4Ø11.

26. Type in Ø3Ø "CR" on the VDU terminal.

```
Ø3Ø "CR"

Ø3Ø:.A.B. . . . ^@^@^@^@
Ø3Ø:
```

The displayed text is random in case of an uncleared text memory. A point preceding a character means that this character is part of the visible section of the ASCII-table (32...127). Control instructions from the "control case" are preceded by an arrow or a ^.

Display on the screen



27. To activate the text input mode, press keys [CTRL] and [T] (CTRL/T) simultaneously.

28. Then enter 5 spaces using the special character [$], the followed by the SAIA°PLC logo.

29. Note that as soon as 1Ø characters have been entered, the screen automatically proceeds to the following text number.

30. To enter "CR" without changing the text mode, [^] must be pressed first. The CPU answers with ^M (CTRL/M = "CR").

31. To enter "LF" = Line Feed, [CTRL/J] is pressed which corresponds to "LP" ^J appears.

32. NUL is entered to end text input. This is possible via [CTRL/@] (may differ from one peripheral unit to another).

33. To exit from the editor mode enter ["CR"].

g6) Output of this text

34. With [+] [+] on the PØ5 unit the program loop 4Ø11 to 4Ø14 is executed once, as a result of which the text is output.

```
SAIA°PLC
CROWNED WITH PCA14
```

After this sample text has been input/output successfully, the programming examples in the "Software" manual can be entered and tested.

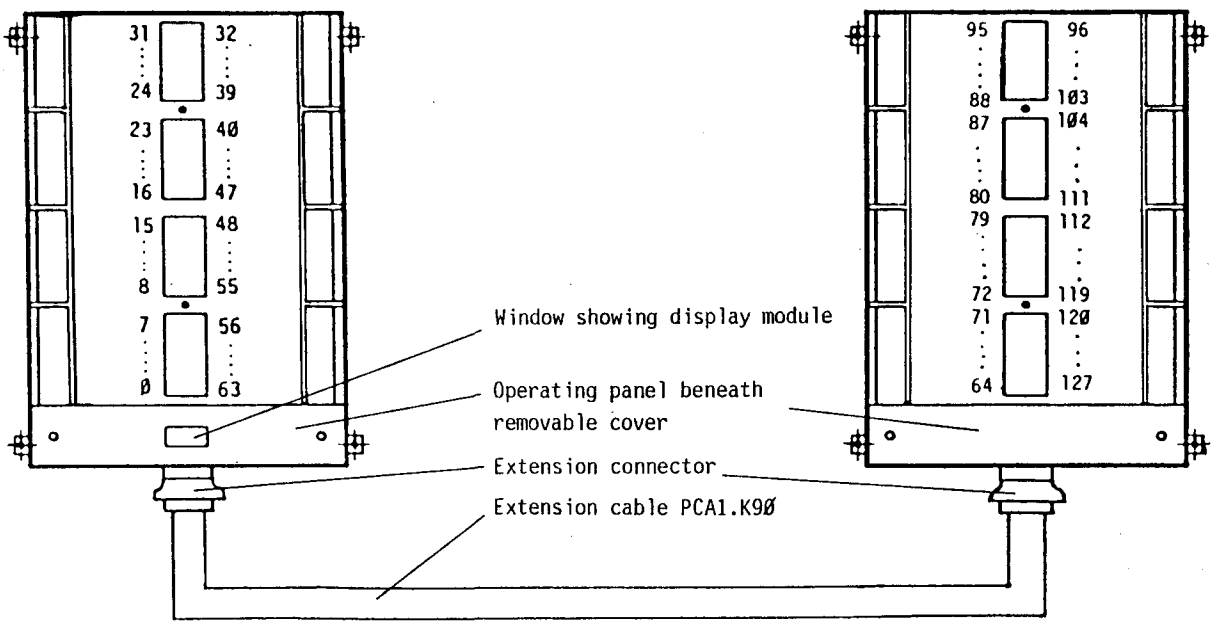
A 4 Extension housing ..C45

A 4.1 Basic module PCA1.M57/M47 with extension housing PCA1.C45

In addition to the entire circuitry of the PCA1.M47/M57, the basic module PCA1.M56 also contains the switching circuits and the connector for connection to the extension housing.

The extension housing PCA1.C45 is connected via the connecting cable PCA1.K9Ø. It also has a power supply unit of its own.

A 4.2 Type of system PCA157/147 with extension housing PCA1.C45
128 I+O addresses, 224 I+O with compact module PCA1.B9Ø



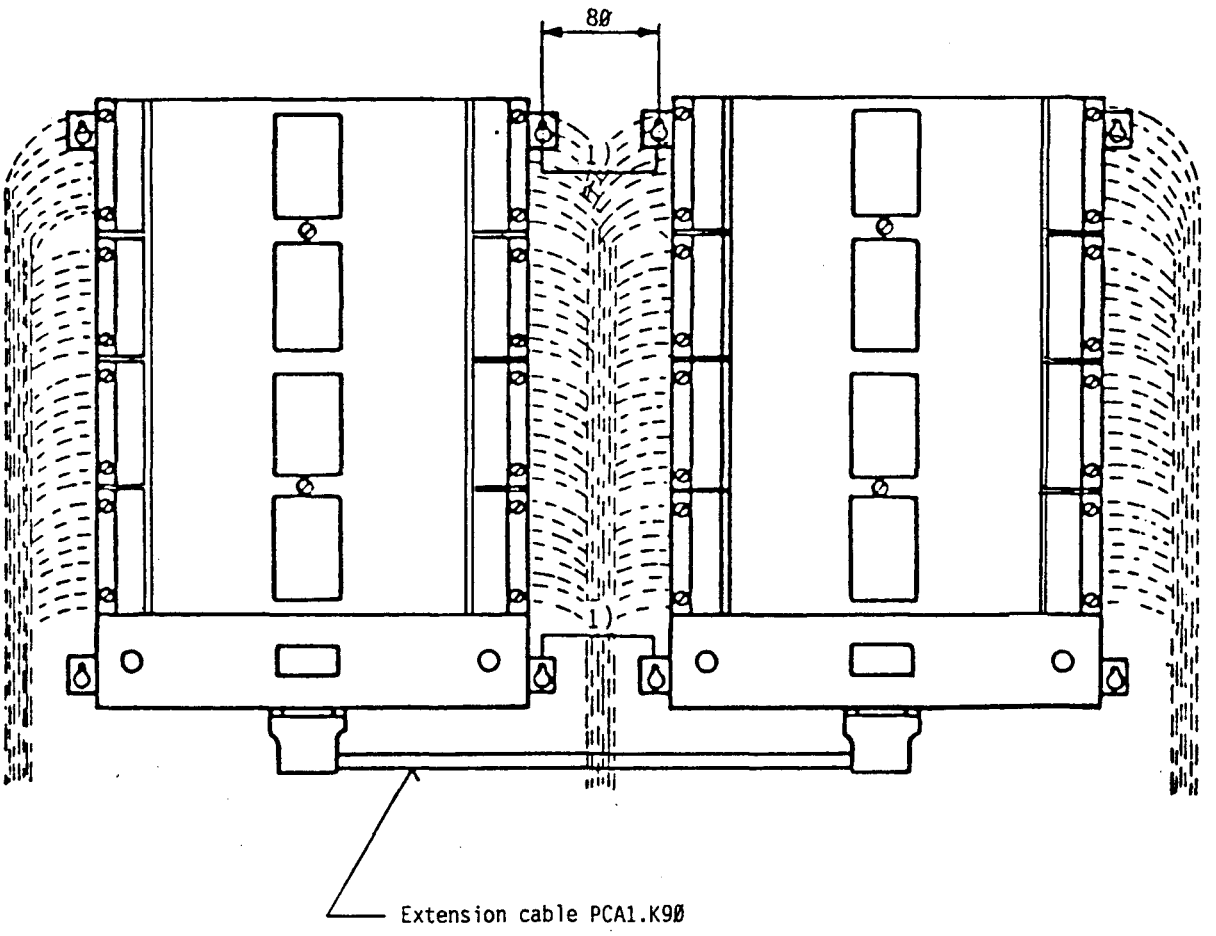
Basic module PCA1.M57 or PCA1.M47 Extension housing PCA1.C45

The three versions are completely compatible as regards hardware and software and can be equipped with all the old and new I/O modules of the series PCA1.

A 4.3 Arrangement of the PCA157/147 with extension housing ..C45

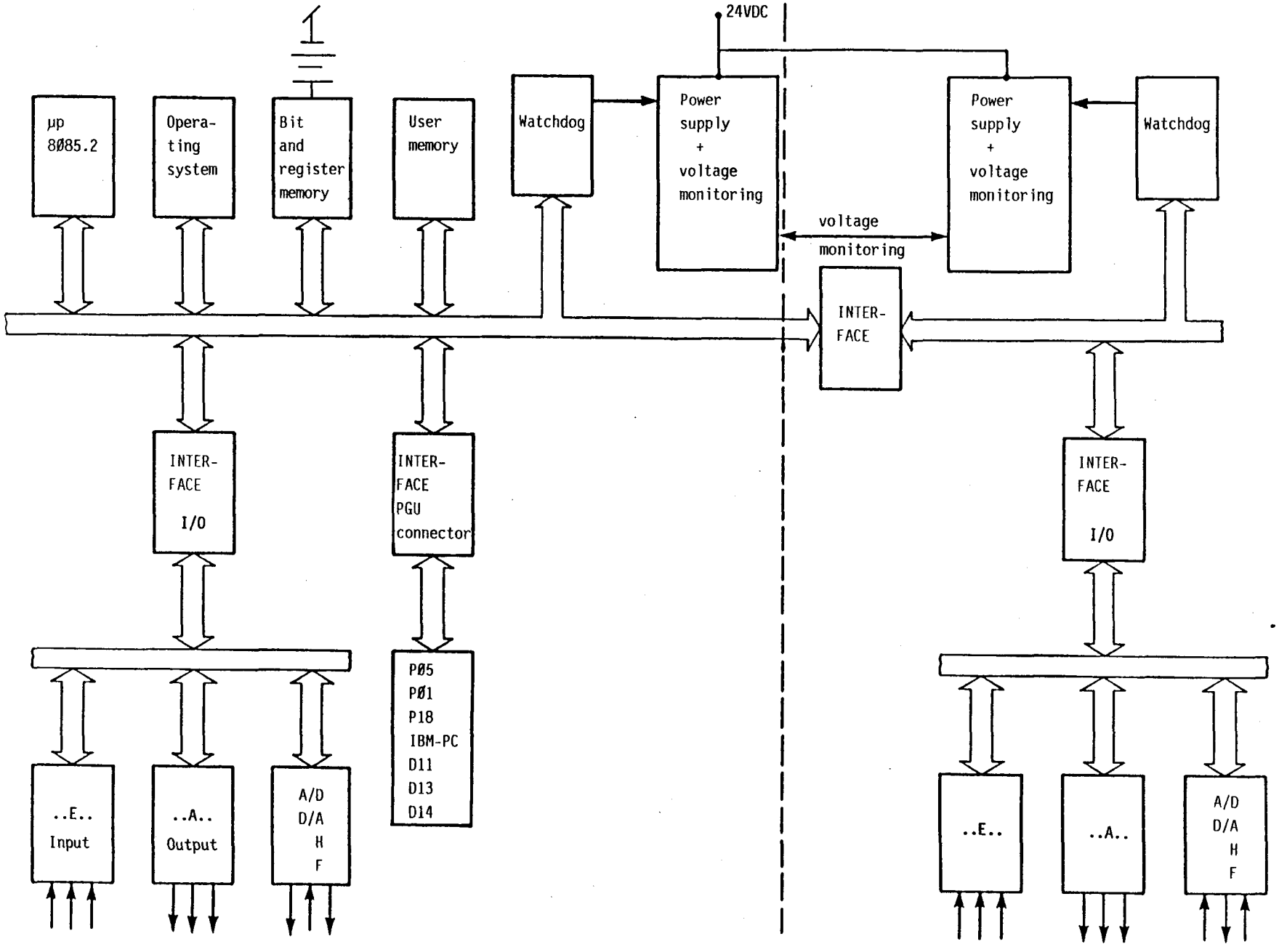
Basic module
PCA1.M47/M57

Extension housing
PCA1.C45



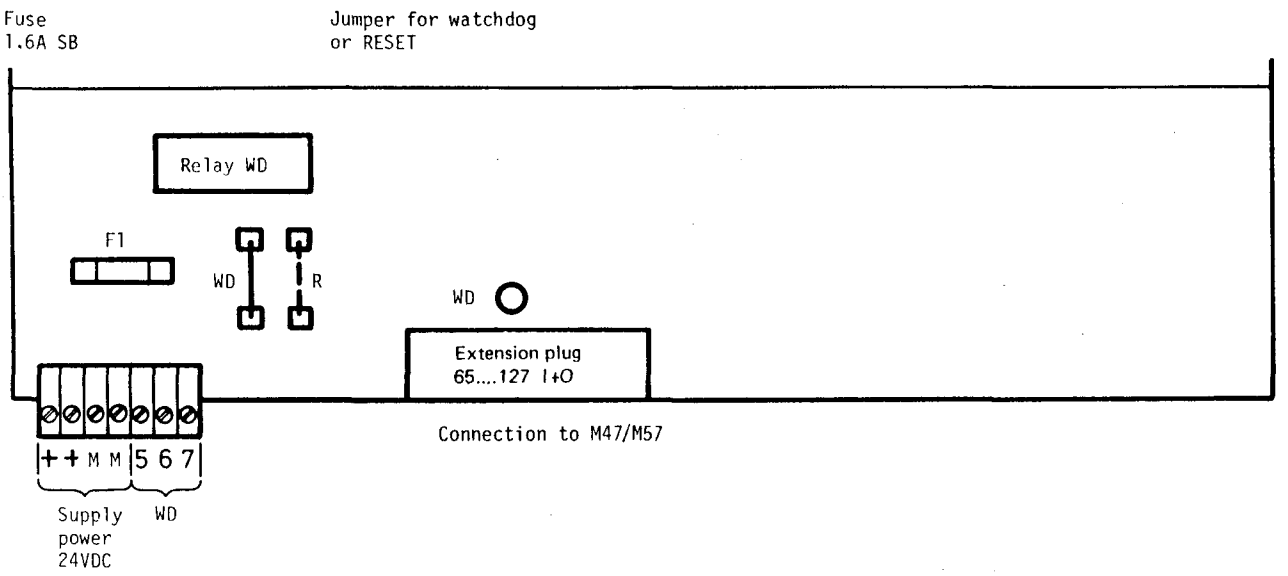
1) There has to be a good metallic bond between both housings.

The extension cable PCA1.K9Ø is screened so that the I/O wiring and other lines can be laid above this cable.


24VDC
µp 8Ø85.2
Opera-ting system
Bit and register memory
User memory
Watchdog
Power supply + voltage monitoring
voltage monitoring
Power supply + voltage monitoring
Watchdog
INTER-FACE
INTER-FACE I/O
INTER-FACE PGU connector
P0Ø5
PØ1
P18
IBM-PC
D11
D13
D14
..E.. Input
..A.. Output
A/D D/A H F
PCA157/147
INTER-FACE I/O
..E..
..A..
A/D D/A H F
Extension housing PCA1.C45

A 4.5 Operating panel of extension housing ..C45

As with PCA157/147, all operating elements for extension housing ..C45 are logically arranged on the operating panel which can be covered.



The operating elements described here have the same functions as those of the PCA1 (see chapter "Operating panel").

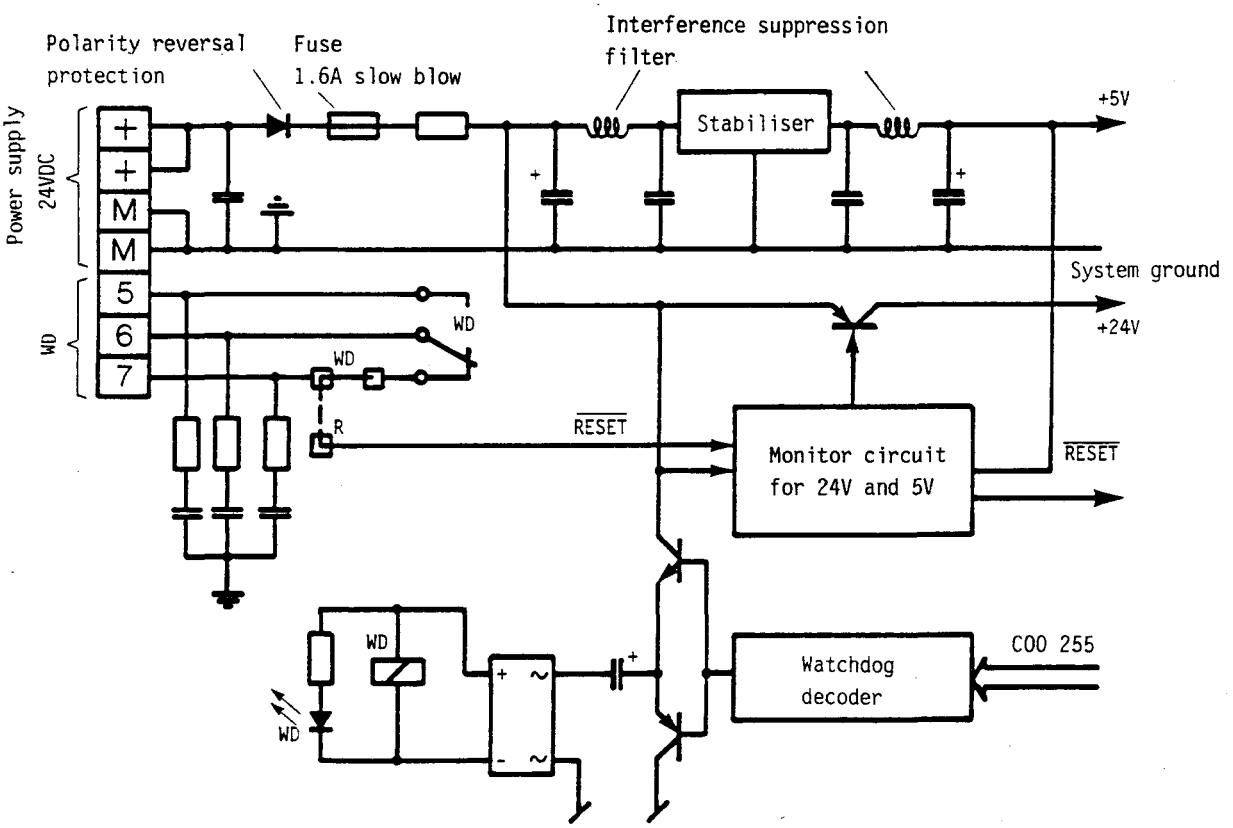
A 5 Power supply, watchdog, reset, dimensions

A 5.1 Power supply of PCA1

Supply voltage V_{in}	24VDC, smoothed or pulsating
Voltage tolerance	normally ±2Ø% (see following page for details)
Supply current	max. 1A for basic modules and ..C45
Output voltages to electronics	24VDC, smoothed, for internal output driver 5VDC, stabilised ±3%, for remaining electronics
Output current 5V	1.1A
Ambient temperature Ta	Ø...5Ø°C (see following page for details)

As indicated on the following page, the PCA15 can be operated with pulsating (P) or smoothed (G) direct current. It may also be connected to the same power supply available for the sensors and actuators. Several components protect the PLC against interference voltages, polarity reversal and low voltages. The 5VDC for supply of the electronic components is generated by a stabiliser.

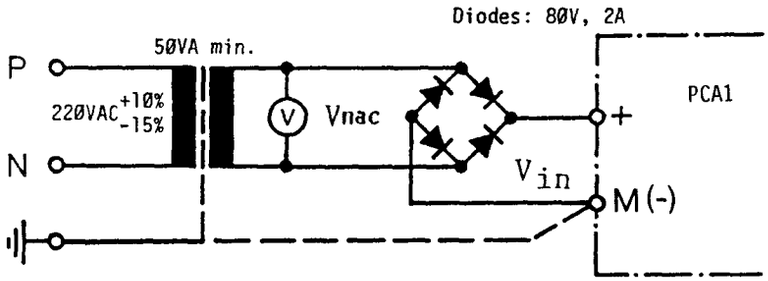
Block circuit diagram for PCA1 and extension housing ..C45



A 5.2 Various external power supply circuits

In order to provide the PCA1 and the extension housing ..C45 with the reasonably priced power supplies, a stabiliser has been included in the power section of the PCA1 and the extension housing ..C45, in addition to interference and polarity reversal protection. In case of PCA1.A2.. output modules, this smoothed 24VDC is used for the internal excitation of the relays. One differentiates between two types of power supply, "P" and "G".

P Power supply with pulsating DC from a transformer with a bridge rectifier



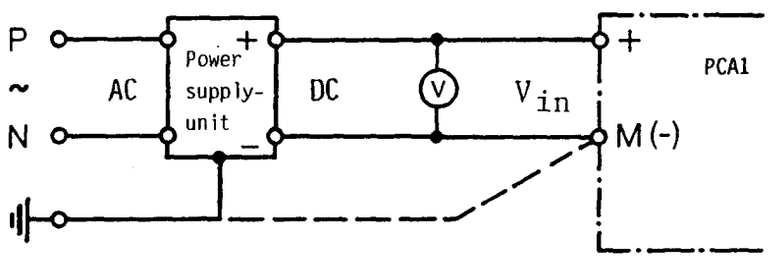
The following information is based on the assumption that the mains supply and therefore the secondary voltage will vary +10/-15%; the AC voltages are based on 220VAC primary.

P1 Without relay output modules
Secondary alternating voltage V_{nac}: 22...24.5VAC (T_a = 0...50°C)
(complete range incl. primary voltage fluctuations of +10/-15%: 18.7...27VAC).

P2 With max. 4 relay output modules PCA1.A2..
Secondary alternating voltage V_{nac}: 24VAC (T_a = 0...50°C)
(complete range incl. primary voltage fluctuations of +10/-15%: 20.4...26.4VAC)

P optimal For all combinations V_{nac}: 24VAC

G Power supply with smoothed DC from power supply unit



It is assumed that the external power supply will not only smoothen but will also stabilise the DC voltage.

G1 Without relay output modules
Direct voltage range V_{in}: 20...32VDC (T_a = 0...50°C)

G2 With max. 4 relay output modules PCA1.A2..
Direct voltage range V_{in}: 24...30VDC (T_a = 0...50°C)
Direct voltage range V_{in}: 22...32VDC (T_a = 0...35°C)

G optimal For all combinations V_{in}: 26VDC

A 5.3 Voltage monitoring

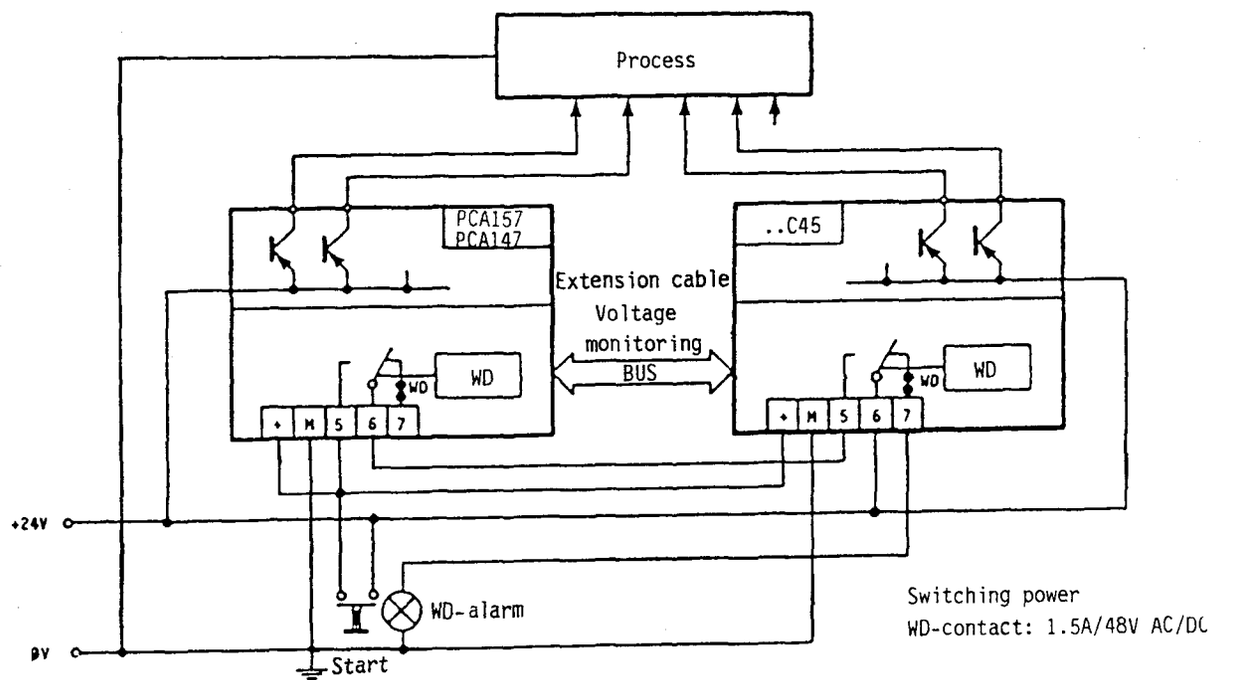
Both the supply voltage V_{in} and the 5V of the PCA1 and the extension housing the CPU is set in RESET mode, i.e. all volatile flags as well as all outputs are reset. When the input voltage is switched on (or switched on again), the CPU is cleared for operation after 100ms. This delay allows safe resetting of all outputs and provides a clearly defined starting position for program execution.

A 5.4 Watchdog monitoring circuit

Both the PCA15/14 and the housing ..C45 incorporate this circuit. The two watchdog circuits of the PCA157/147 and the extension housing ..C45 are connected with an extension cable. Via the watchdog circuit, correct user program execution can be monitored reliably and, if a malfunction occurs, effective safety measures can be taken.

The watchdog relay remains excited (contact 5 and 6 closed) as long as address 255 receives a square-wave signal of ≥ 5Hz. This signal is generated easily with the COO 255 instruction in a circulating monitoring program. Terminals 5 and 6 remain connected (refer to the block circuit diagram for "Power supply") as long as the CPU functions properly in the RUN mode. If a malfunction occurs in the CPU or if any operating mode but RUN is selected, contact 5 and 6 opens and the WD warning lamp is illuminated.

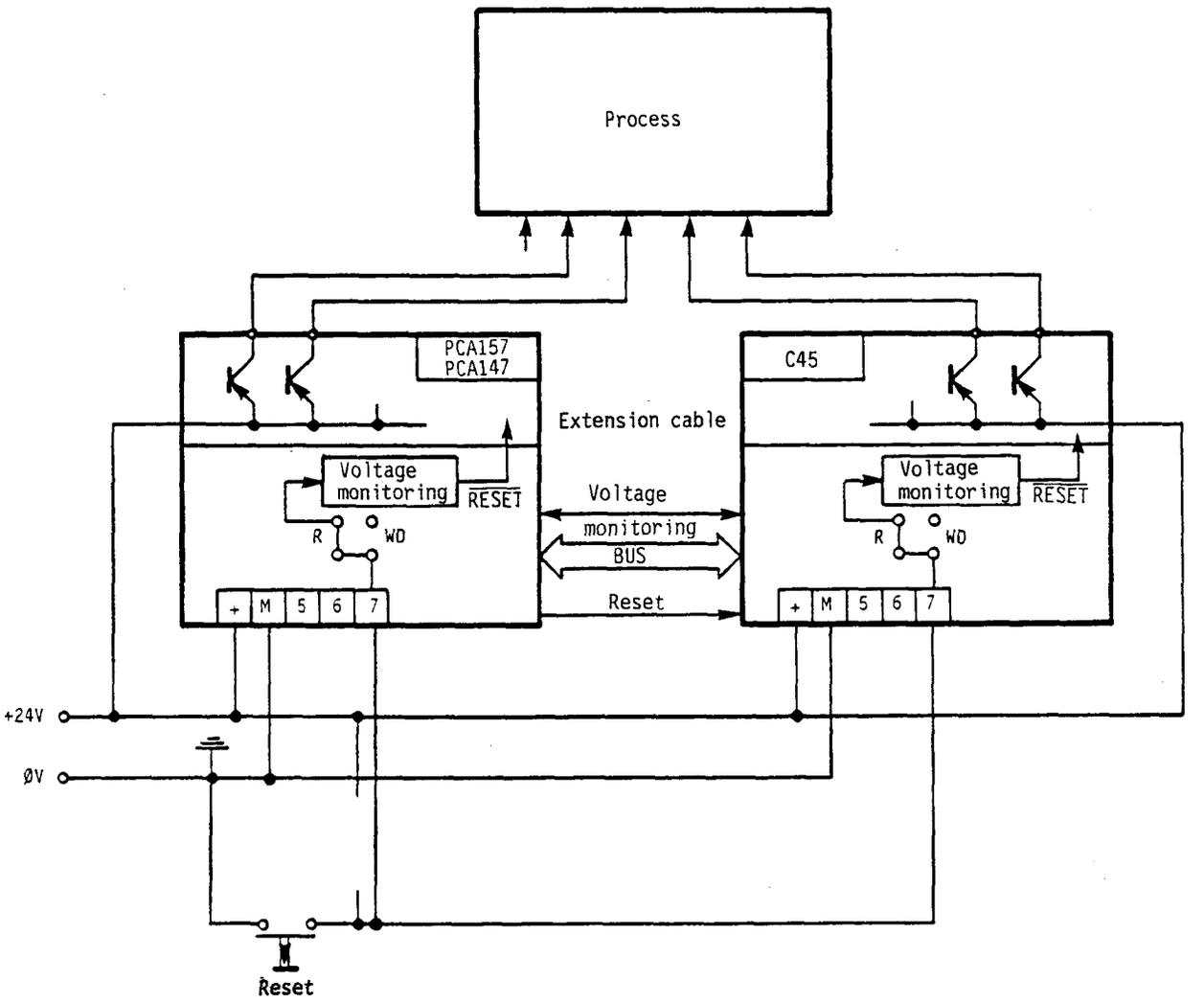
The following safety circuit is recommended (factory setting of watchdog jumper(s)), where the WD-contact 5 interrupts the power supply of the PLC (as well as of the extension housing ..C45) in case of drop of a WD-relay. The CPU provides resetting of the outputs. The breaking capacity of WD-contacts 5, 6 and 7 is 1.5A, 48VAC or DC. The WD-contact is therefore not to be used for direct switching of the total output current.



A 5.5 Fast external RESET circuit

The watchdog monitoring circuit is in any case recommended as a safety measure. As an alternative, the external reset can be used for an extremely fast resetting of the microprocessor and all the outputs.

Terminal 7 can be connected to the RESET circuit (instead of being connected to the WD-contact) by moving the jumper from WD to RESET. After applying the ground potential (M) at terminal 7, all the outputs are reset within 2ms. They remain reset for at least 100ms. If a RESET signal is applied over a longer time, the outputs remain reset for t +25ms. Apart from the outputs, all the other volatile (non-retentive) registers are reset.



Notes:

Circuit information:

(1) The PLC-housing, the supply terminal M, and the negative pole of the 24VDC supply (except with opto-isolated I/=s) are to be connected to a good, common ground.

(2) The entire 24V supply can be a pulsating DC. It is only necessary to have a smoothed, regulated voltage where this is demanded by the transmitter or the load. Proximity switches for example, have to some extent, close voltage limits and will in most cases only tolerate ripple of up to 10%.

(3) Watchdog monitoring (C00 255) is active in the circuit shown. If a mains failure should occur, all outputs are reset. To start again when power returns, a start pulse is necessary.

(4) If in sink operation, the load resistors (L) are connected to a regulated +24V supply, NPN proximity switches can also be fitted here.

(5) NAMUR proximity switches are connected to NAMUR inputs type E11.*

(6) With the opto-isolated input circuit type E20 - independent of the type of connection - the closing of a contact or the driving of a proximity switch, produces an "H" signal. In this event the supply voltages can be of differing potentials.

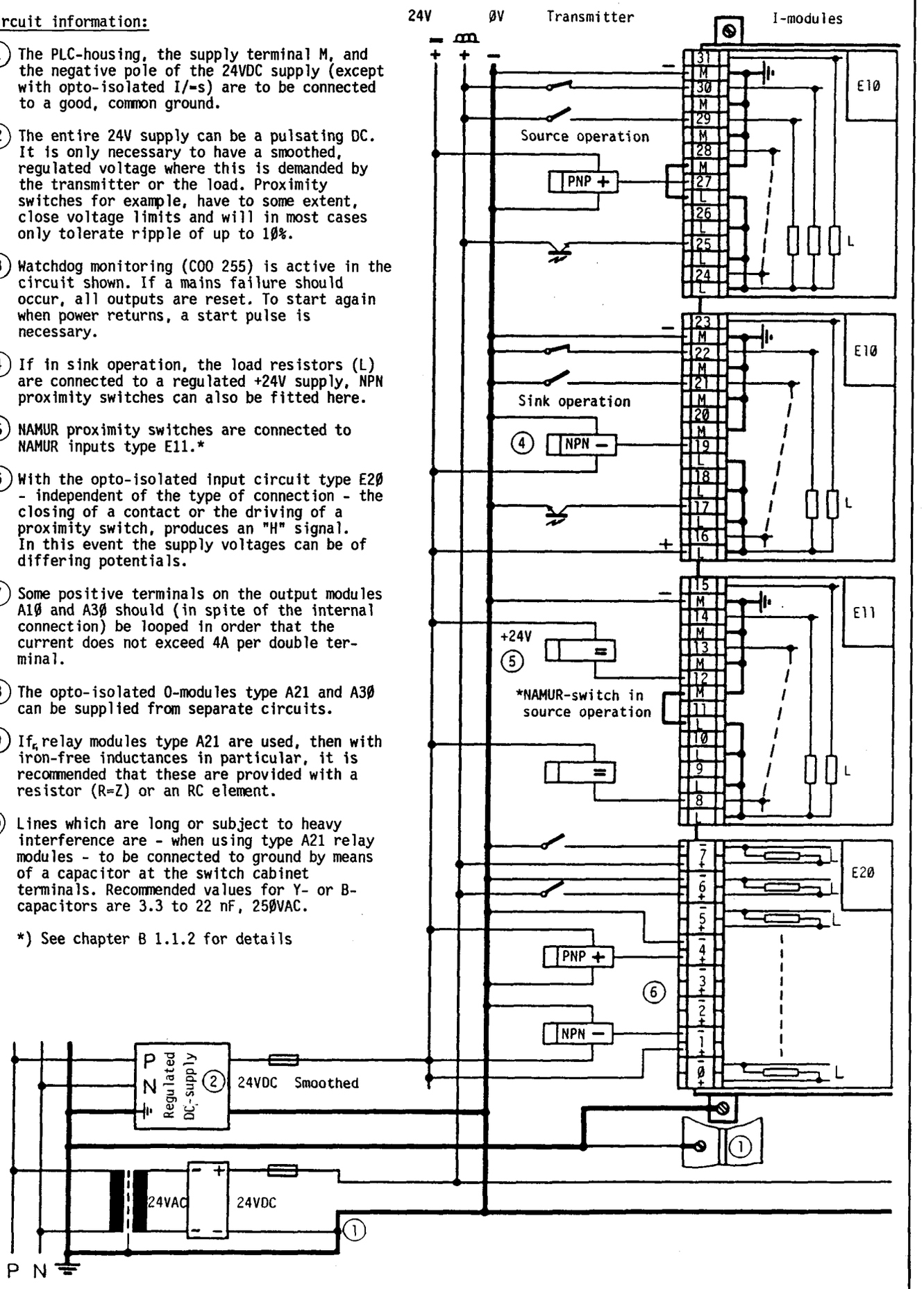
(7) Some positive terminals on the output modules A10 and A30 should (in spite of the internal connection) be looped in order that the current does not exceed 4A per double terminal.

(8) The opto-isolated O-modules type A21 and A30 can be supplied from separate circuits.

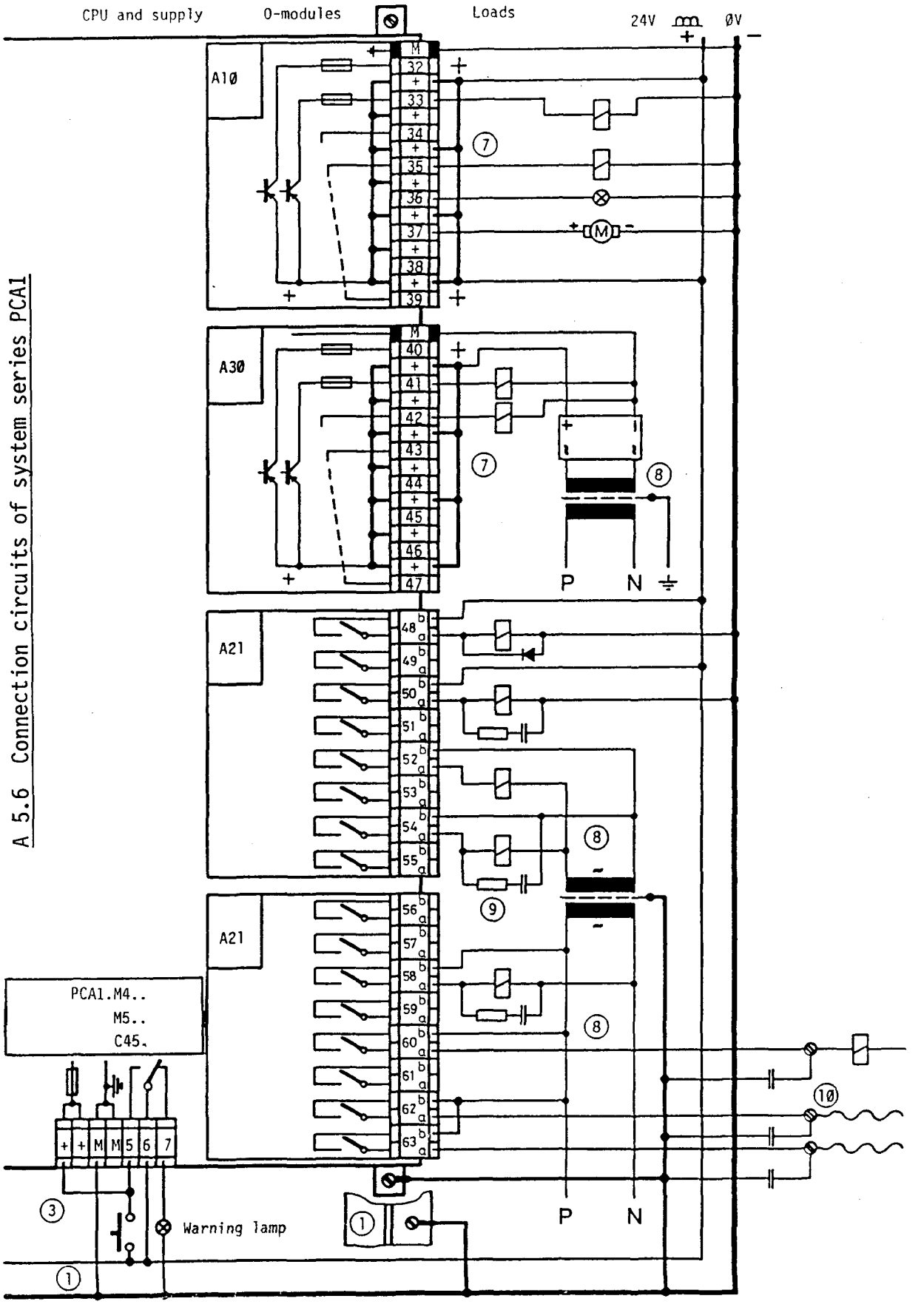
(9) If relay modules type A21 are used, then with iron-free inductances in particular, it is recommended that these are provided with a resistor (R=Z) or an RC element.

(10) Lines which are long or subject to heavy interference are - when using type A21 relay modules - to be connected to ground by means of a capacitor at the switch cabinet terminals. Recommended values for Y- or B-capacitors are 3.3 to 22 nF, 250VAC.

*) See chapter B 1.1.2 for details



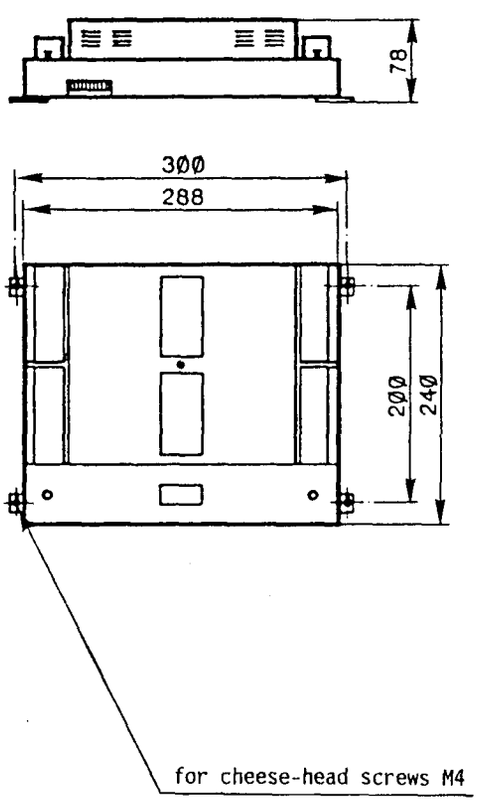
A 5.6 Connection circuits of system series PCA1



A 5.7 Dimensions of system series PCA1

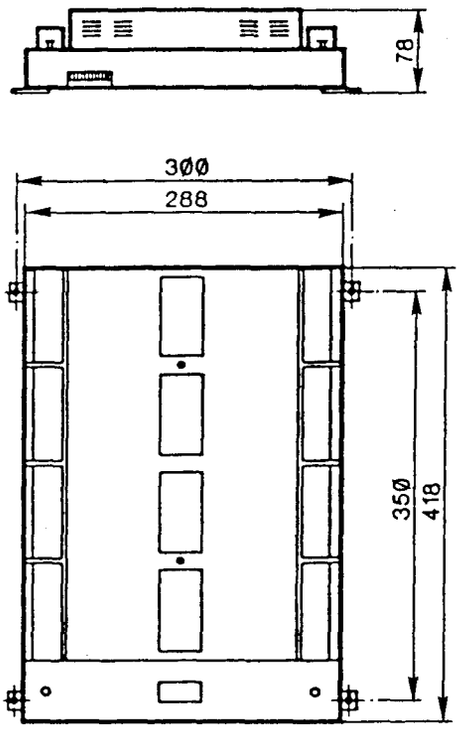
Small housing
for 4 I/O modules

max. 32 or 56 I+0



Large housing
for 8 I/O modules

max. 64 or 112 I+0



System type	Basic module, CPU incl. housing	System type	Basic module, CPU incl. housing
PCA141	PCA1.M41	PCA147	PCA1.M47
PCA151	PCA1.M51	PCA156	PCA1.M56
		PCA157	PCA1.M57 + PCA1.C45

B 1 Plug-in input/output modules

B 1.1 I+O modules of series PCA1

- Modules with 8 digital inputs

  PCA1.E1Ø - electrically connected,
  24V- smoothed or pulsating,
  Input current: 1ØmA

  PCA1.E11 - for NAMUR proximity switch,
  24V- smoothed
  Input current: Ø...6mA

  PCA1.E2Ø - opto-isolated,
  24V- smoothed or pulsating,
  Input current: 12mA

  PCA1.E5Ø - 11Ø...24ØVAC, opto-isolated
  Input current: 1ØmA, 22ØVAC

- Modules with 8 digital outputs

  PCA1.A1Ø - 5...36VDC electrically connected,
  1(2)A, positive switching

  PCA1.A21 - 25ØVAC/3A, opto-isolated,
  output with relay contacts

  PCA1.A3Ø - 5...36VDC, opto-isolated,
  1(2)A, positive switching

  PCA1.A5Ø - 24...24ØVAC/1A opto-isolated, Triac

- Combined digital input/output modules

  PCA1.B1Ø - 4 inputs 24VDC smoothed or pulsating, electrically connected,
  4 outputs 24VDC, 1(2)A electrically connected, positive switching

  PCA1.B8Ø - 8 inputs, 24VDC smoothed or pulsating, electrically connected
  6 outputs, 8...32VDC, 5mA...Ø.5A positive switching,
  smoothed and short-circuit protected

  PCA1.B9Ø - 8 inputs 24VDC smoothed or pulsating, electrically connected,
  6 outputs 24VDC, Ø.5A electrically connected, positive switching

- Combined date-time and input module

  PCA1.E4Ø - Date-time with power reserve
  7 digital inputs 24VDC smoothed or pulsating,
  electrically connected
  Input current: 1ØmA

- Analog input/output modules

  PCA1.W1.. - 6 input channels of 8 bits each, Ø...5V (Ø...1ØV bzw. Ø...2ØmA) electrically connected
  Ø...2 output channels of 7 bits each, Ø...1ØV (Ø...2.56V) electrically connected

  PCA1.W2.. - 2 or 4 analog output channels of 12 bits Ø...1ØV (Ø...5V, -5...5V, -1Ø...1ØV)

  PCA1.W3.. - 4 input channels of 12 bits (Ø...1ØV, -5...5V, -1Ø...1ØV) Ø or 2 output channels of 12 bits Ø...1ØV (Ø...5V, -5...5V, -1Ø...1ØV)

  PCA1.W4Ø - 6 input channels of 8 bits for PT 1ØØ temperature sensor for sensors with 2, 3 or 4 conductors

- Preselector modules for input of numerical values

  PCA1.F11 - for direct selection of 4 two-digit BCD-preselector switches

  PCA1.F12 - for direct selection of 8 two-digit BCD-preselector switches

- Data line switching module with conversion 2ØmA/RS 232c

  PCA1.F21 - for 1 interface with conversion 2ØmA/RS 232c

  PCA1.F22 - for 2 interfaces with conversion 2ØmA/RS 232c

- Counter module up to 1ØkHz

  PCA1.H1.. - Counter, frequency generator and frequency measurement

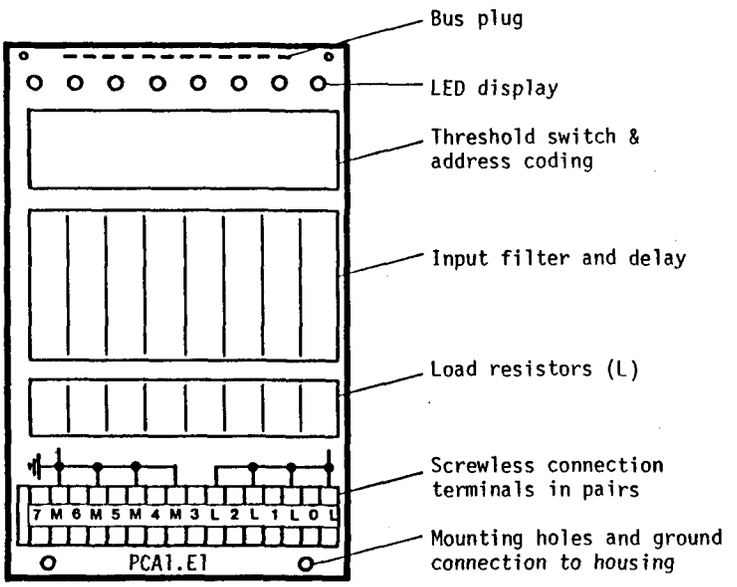
- Internal power consumption of the PCA1 modules

B 1.1.1 Type PCA1.E1Ø Electrically connected input module

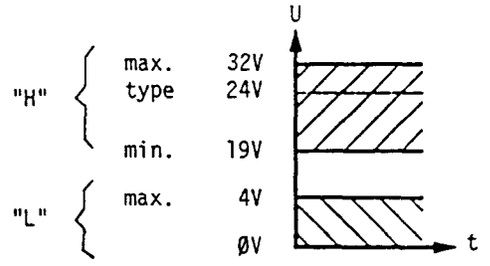
Technical data

Number of inputs per module	8, electrically connected
Input voltage V_{in}	24VDC, smoothed or pulsating
Input current at 24VDC	1ØmA
Input delay (typical)	8ms

Presentation and terminal layout



Definition of input voltages



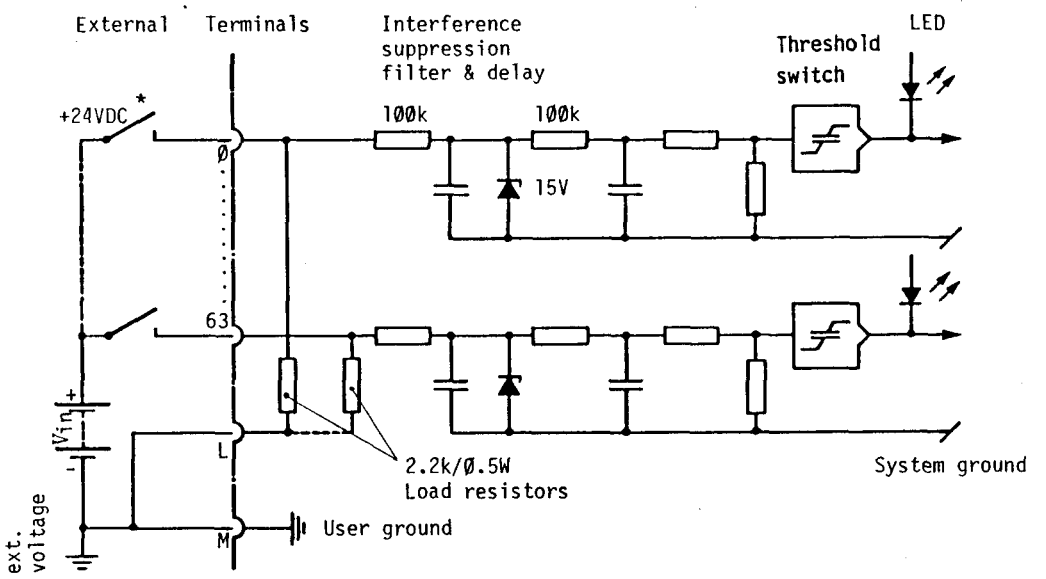
Because of the input delay of 8ms, pulsating DC is adequate as external supply voltage.

Connection terminals for the I+O modules: By depressing the grey rib with a screwdriver, the screwless terminal is opened for one wire of max. 1.5mm². Two terminals for the same connection are located opposite one another to facilitate installation of jumpers when needed. Plug-in connectors on request.

Input circuit

This module can be used either in source or sink operation, depending on the external circuitry.

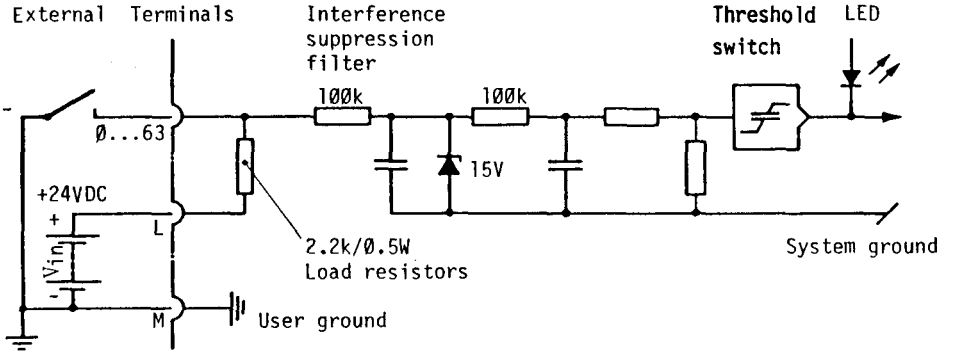
Source operation or positive logic (normal case):



*) PCA1.E1Ø is also suitable for NAMUR proximity switches which can carry a current of 1ØmA at 24VDC and 2.2kΩ.

Switch closed (positive at input): "H" ≙ LED ON
Switch open (negative at input): "L" ≙ LED OFF

Sink operation or negative logic:



Switch closed (negative at input): "L" ≙ LED OFF
Switch open (positive at input): "H" ≙ LED ON

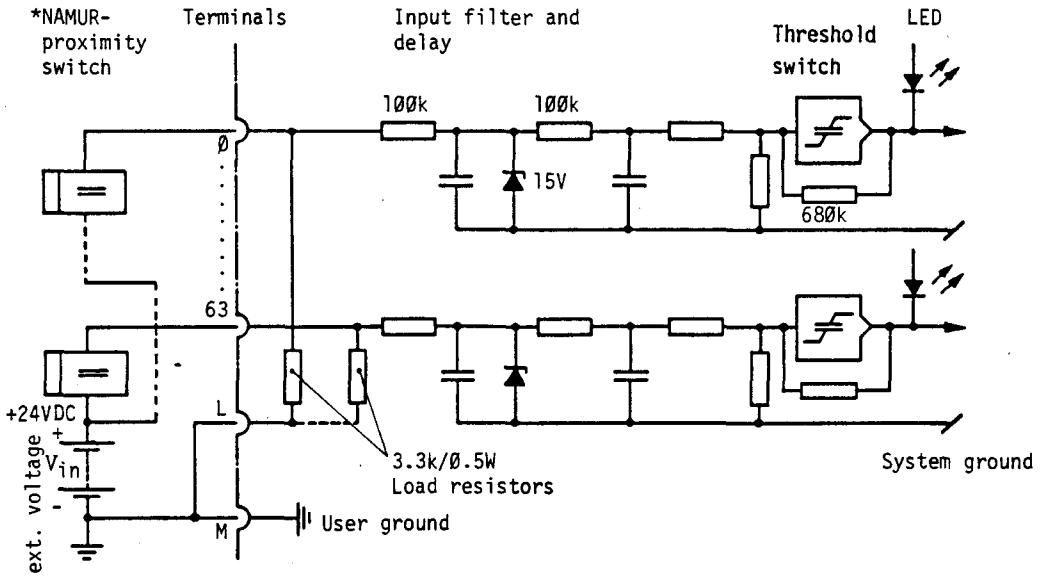
B 1.1.2 Type PCA1.E11 Input module for NAMUR proximity switches

On the basis of the object distance NAMUR proximity switches give a current of Ø...6mA. To take these special conditions into consideration, two resistors are changed per input in the NAMUR version as opposed to the standard PCA1.E1Ø.

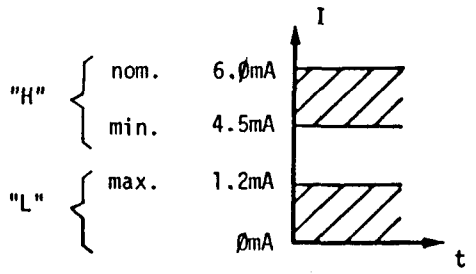
Technical data

Number of inputs per module	8, electrically connected
Voltage source in series with NAMUR proximity switches V_{in}	24VDC smoothed
Input delay (typical)	8ms

Input circuit



Definition of input current



"H": LED ON = proximity switch de-energized

"L": LED OFF = proximity switch energized

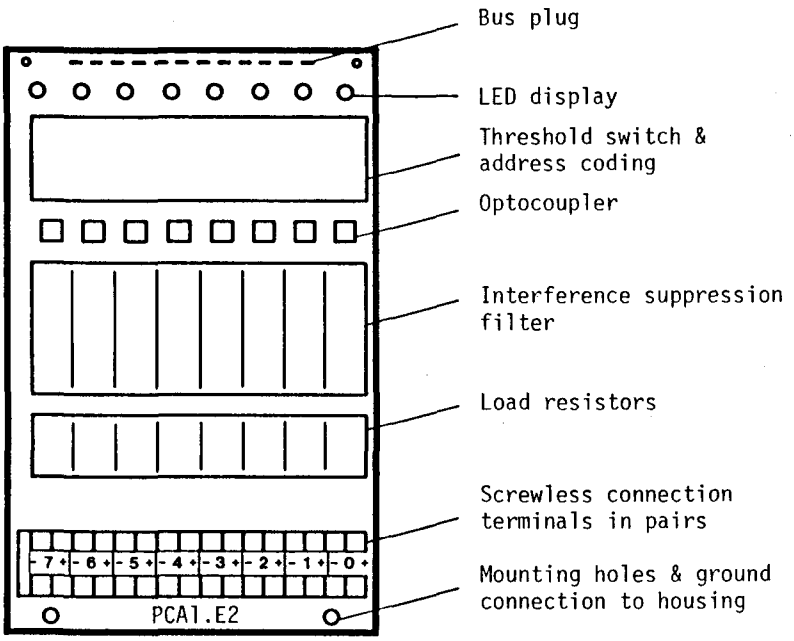
*) PCA1.E11 is suitable for NAMUR proximity switches which can carry a current of 6mA at 24VDC and 3.3kΩ.

B 1.1.3 Type PCA1.E2Ø Opto-isolated input module

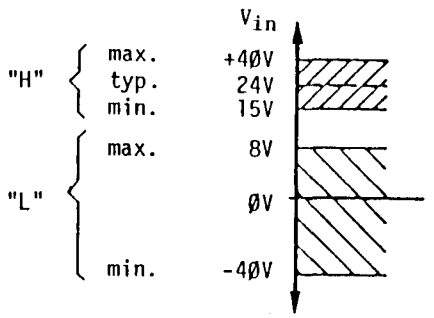
Technical data

Number of inputs per module	8, electrically isolated between process, CPU and mutually
Input voltage V_{in}	24VDC, smoothed or pulsating
Input current at 24VDC	12mA
Input delay (typical)	7ms
Dielectric strength of optocouplers	min. 2ØØØV

Presentation and terminal layout

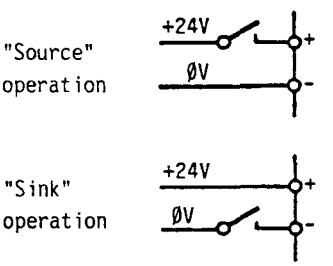


Definition of input voltage V_{in}



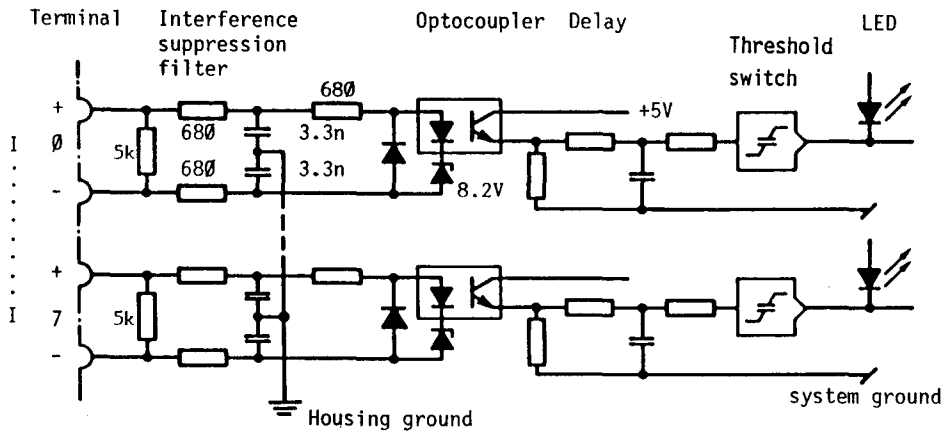
Pulsating DC is adequate as supply voltage because of 7ms input delay.

Input circuit operating modes



The LED lights in both cases when the input contact is closed.

Input circuit



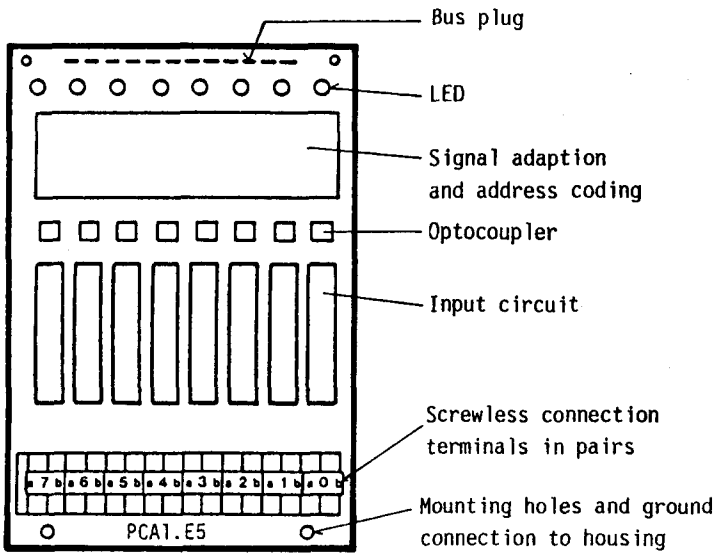
"H" ≙ LED ON ≙ voltage at input
"L" ≙ LED OFF ≙ no voltage at input

B 1.1.4 Type PCA1.E5Ø Opto-isolated input module for VAC

Technical data

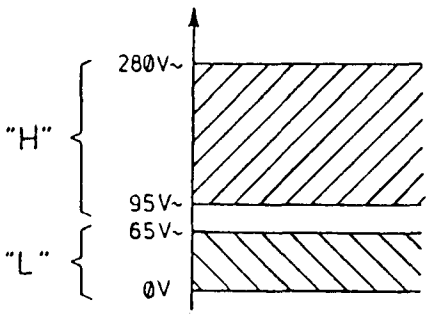
Number of inputs per module	8, galvanically isolated
Input voltage range	95...28ØVAC eff. (11Ø...24ØVAC nom.)
Input voltage at 22ØVAC	1ØmA
Overvoltage max.	15ØØV/1Øµs 5ØØV/ 3ms
Input delay (typical)	typ. 15ms
Isolation voltage of optocoupler	25ØØV eff.
Isolation resistance of optocoupler	1ØØMΩ

Presentation and terminal layout

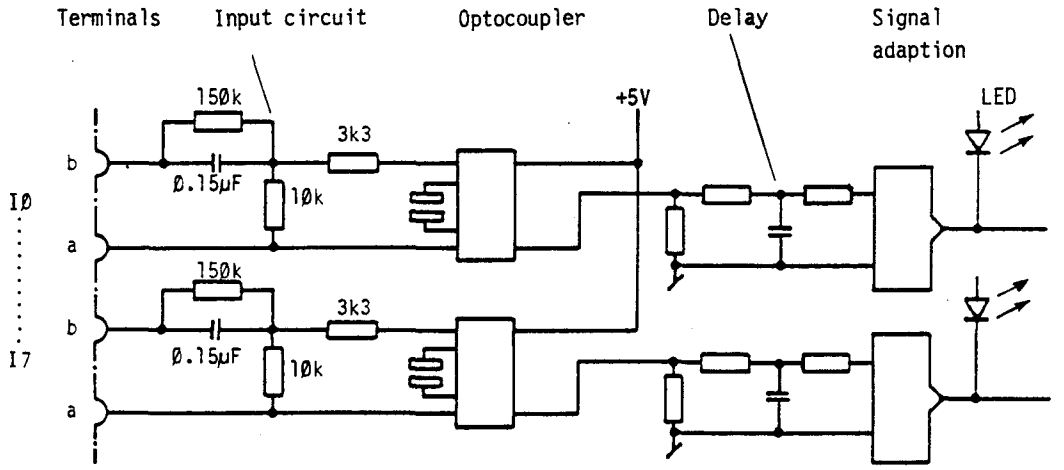


For opto-isolation very long lasting (>1ØØ'ØØØh) optocouplers are used. This results from the use of threshold switches in the diode circuit of the opto-coupler.

Definition of input voltage



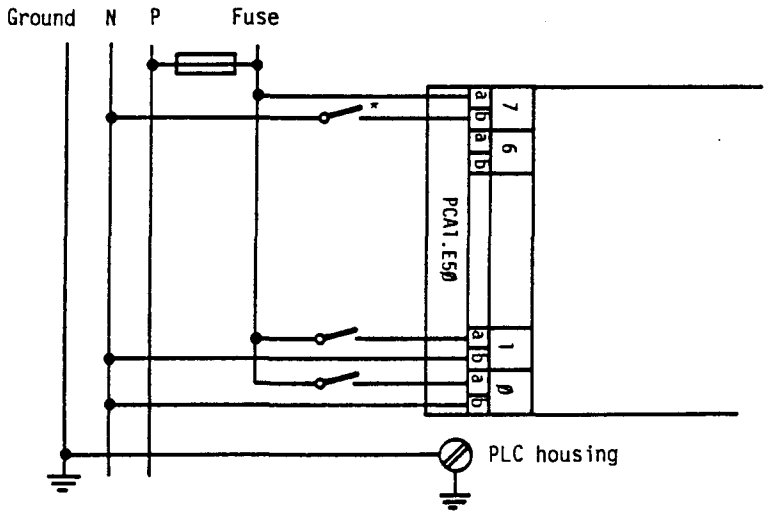
Input circuit



Warning

For reasons of protection of data transmission lines, displays and user input elements use low voltage material when connecting low voltage on the PLC.

All connections of an E5Ø-module are to be connected on the same circuit; that means at one point in such a way that they are all protected against <u>one</u> AC-phase by <u>one</u> fuse.



*) The neutral conductor is only to be interrupted if local regulations are not violated.

B 1.1.5 Type PCA1.A1Ø Electrically connected output module for 1(2)A

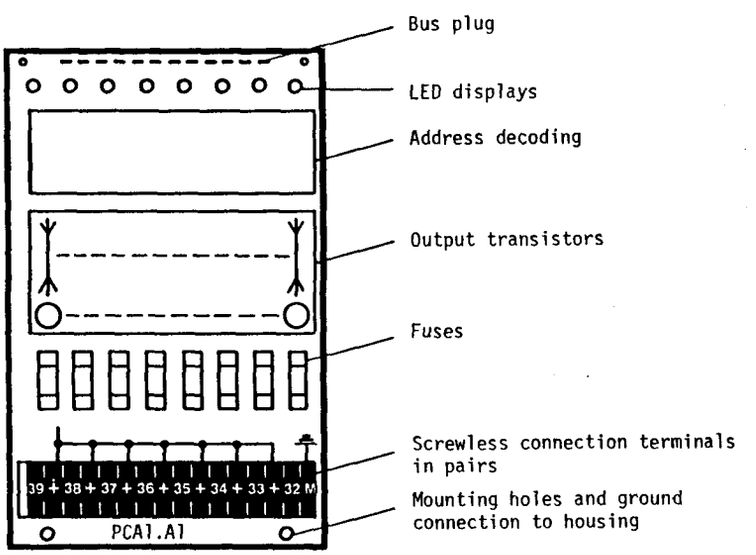
Technical data

Number of outputs per module	8, electrically connected
Output current	5mA - 1A (2A)* When operated at 5...25VDC, the load resistance should be at least 24Ω.
Short-circuit protection	1.6A quick-acting fuse
Operating mode	Source operating positive switching
Total current	See diagram
Voltage range V_{out}	5...36VDC, smoothed or pulsating
Voltage drop	max. 1.5V at I = 1A
Output delay (typical)	1Øµs (With an inductive load, the turn-off delay is greater due to the protective diode.)

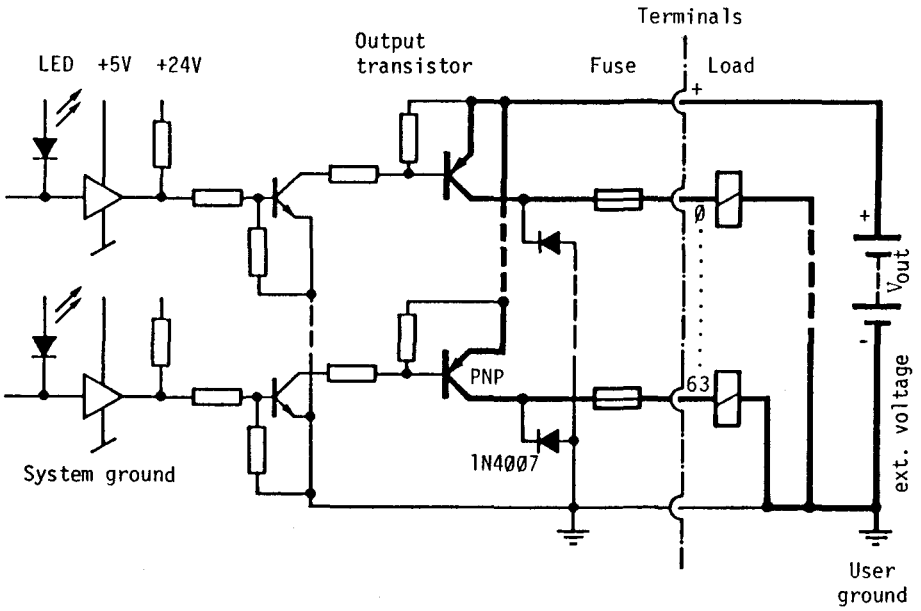
---

* Two outputs per module can carry a load of 2A each if the total current does not exceed that shown in the diagram. For such outputs, a quick-acting 2.5A fuse should be used. Please note however, that the voltage drop at the terminals is approx. 2.5V with a load of 2A.

Presentation and terminal layout



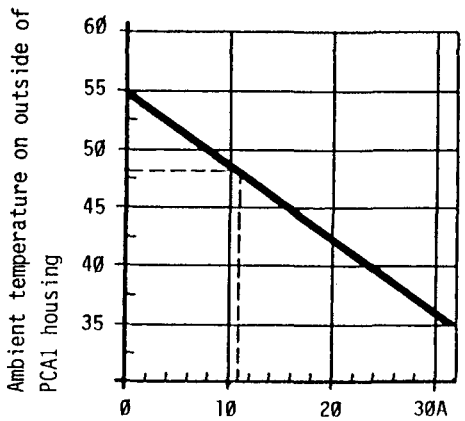
Output circuit



Output conducting (set) ≙ LED ON
Output non-conductive (reset) ≙ LED OFF

Max. permissible total current for complete PCA1 (housing for 8 I/O modules)

The average (thermal) continuous total current is relevant.



Example: 4Ø outputs assigned
V_{out} = 24V

	I mean
8 multiplex outputs at 1ØmA (1Ø%ED)	Ø.ØlA
6 display lamps at 2W (1ØØ%ED)	Ø.5ØA
16 valves at 24W (4Ø%ED)	6.4ØA
2 valves at 48W (25%ED)	1.ØØA
8 control relays at 8W (1ØØ%ED)	2.7ØA
Mean total current	1Ø.61A
Permissible ambient temperature	48°C

Note:

In spite of the internal loops of the positive, several terminals are to be used since the current is not to exceed 4A per double terminal.

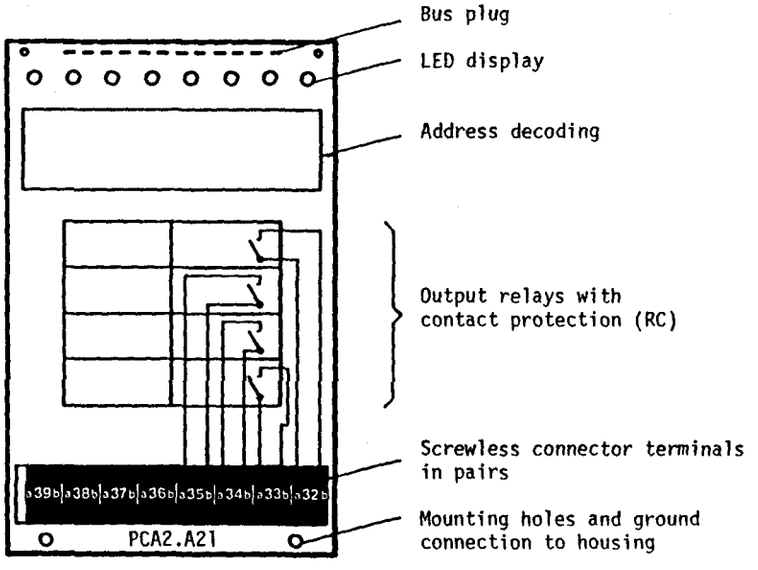
B 1.1.6 Type PCA1.A21 Output module with relay contacts

Technical data

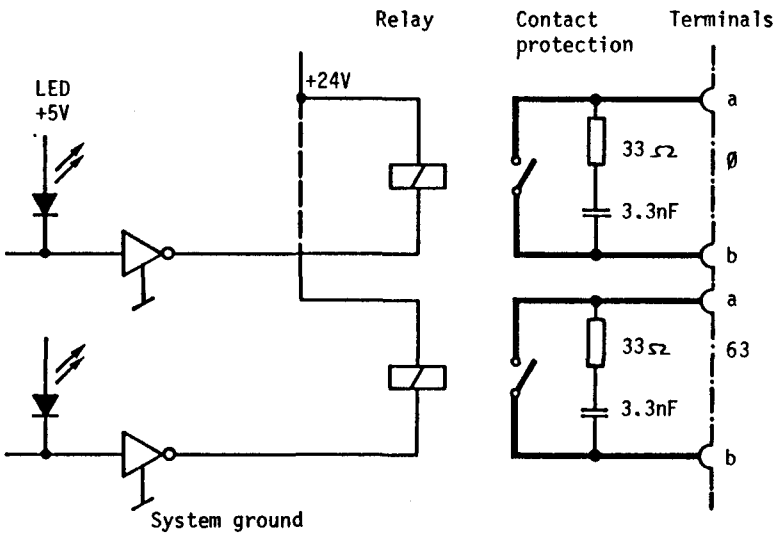
Number of outputs per module	8, galvanically isolated normally-open contacts
Power rating	3A, 25ØVAC AC1 1A, 25ØVAC AC11 (3A, 24VDC DC1)* (1A, 24VDC DC11)*
Contact protection	3.3nF mit 33Ω
Contact life (AC1)	3A, 22ØVAC Ø.1 mio. switching cycles 1.5A, 22ØVAC Ø.5 mio. switching cycles Ø.3A, 22ØVAC 5 mio. switching cycles

*) Transistor outputs A1Ø or A3Ø should be used when switching DC for reasons associated with contact life and to ensure positive switching.

Presentation and terminal layout



Output circuit



Important

For safety reasons however, it is recommended that extra-low voltages (up to 5ØV) and low voltages (51 to 25ØV) should not be used on the same card, or that one channel should be left unused between them.

If highly inductive, 22ØVAC loads are to be switched (e.g. control relays or valves), it is recommended that an additional spark protection be connected across the load or the contact. Thus, arcing to the coil circuit can be prevented successfully. The following values are recommended:

R (Ω) ≈ load Z (Ω)
C (µF) ≈ current (A)

For DC-voltages the transistor output modules are recommended.

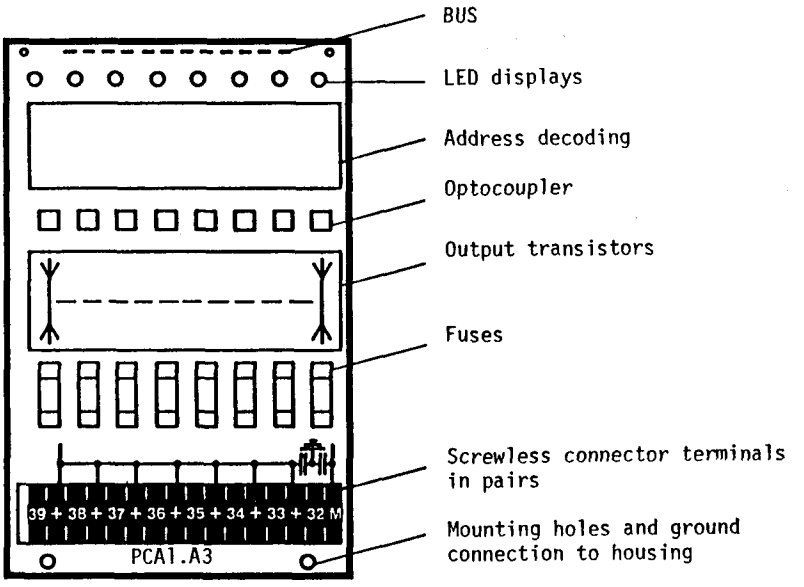
B 1.1.7 Type PCA1.A3Ø Opto-isolated output module for 1(2)A

Technical data

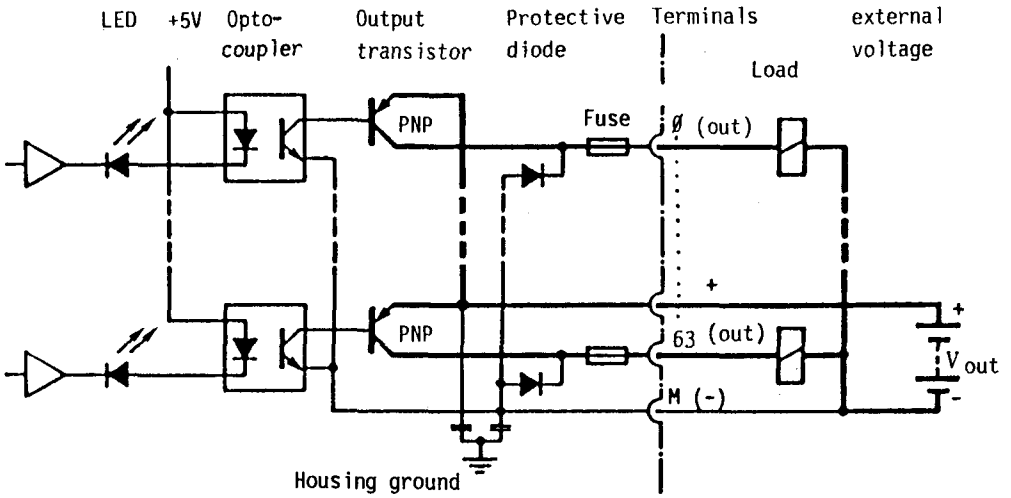
Number of outputs per module	8, galvanically isolated between process and CPU
Output current	5mA - 1A (2A) * When operated at 5...24VDC, the load resistance should be at least 24Ω.
Operating mode	Source operation (pos. switching voltage)
Short-circuit protection	1.6A quick-acting fuse
Total current	refer to graph
Voltage range V_{out}	5...36VDC
Voltage drop	max. 1.5V at I = 1A
Isolation voltage of optocouplers	2ØØØV
Output delay (typical)	5ØØµs (i.e. approx. 7 cycles at 7Øµs)

*) Two outputs per module can carry a load 2A each if the total current does not exceed that shown in the figure. For such outputs, a quick-acting 2.5A fuse should be used. Please note, however, that the voltage drop at the terminals is approx. 2.5V with a load of 2A.

Presentation and terminal layout



Output circuit



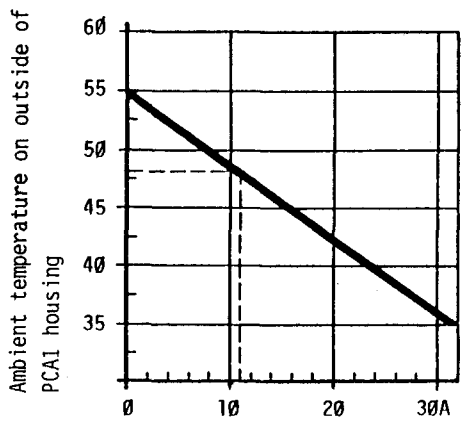
Output conducting (set) ≙ LED ON
Output non-conductive (reset) ≙ LED OFF

Note

Terminal M is to be connected to the negative of the external voltage. It is used for the internal supply of the module. Accordingly the positive terminal is omitted on the first output per card (in the example above on AØ). However because the positive terminals are looped, connection is via one of the remaining positive terminals.

Max. permissible total current for the entire PCA1 (housing for 8 I/O modules)

The average (thermal) continuous total current is relevant.



Example: (24V)	I mean
8 valves at 18W 100%ED	6.0A
4 valves at 48W 30%ED	2.4A
4 control relays at 12W 100%ED	2.0A
Mean total current	10.4A
Max. ambient temperature	48°C

Note:

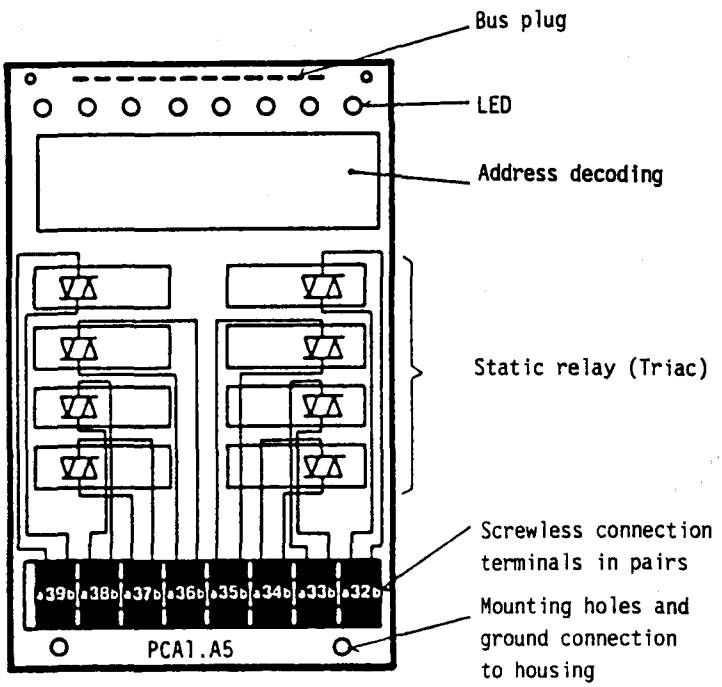
In spite of the internal loops of the positive, several terminals are to be used, since the current is not to exceed 4A per double terminal.

B 1.1.8 Type PCA1.A5Ø Output module for VAC with static relay (Triac)

Technical data

Number of outputs per module	8, galvanically isolated
Output voltage range	24...28ØVAC eff. (24...24ØVAC nom.)
Output current nom.	1A eff.
Output current min.	6ØmA eff.*
Overcurrent max.	28A peaks 2Øms, non-repetitive 7A peaks 1s, non-repetitive
Overvoltage max.	6ØØV peaks, non-repetitive
Voltage drop max.	1.4V
Isolation voltage of optocoupler	25ØØV eff.
Isolation resistance of optocoupler	1ØØMΩ

Presentation and terminal layout



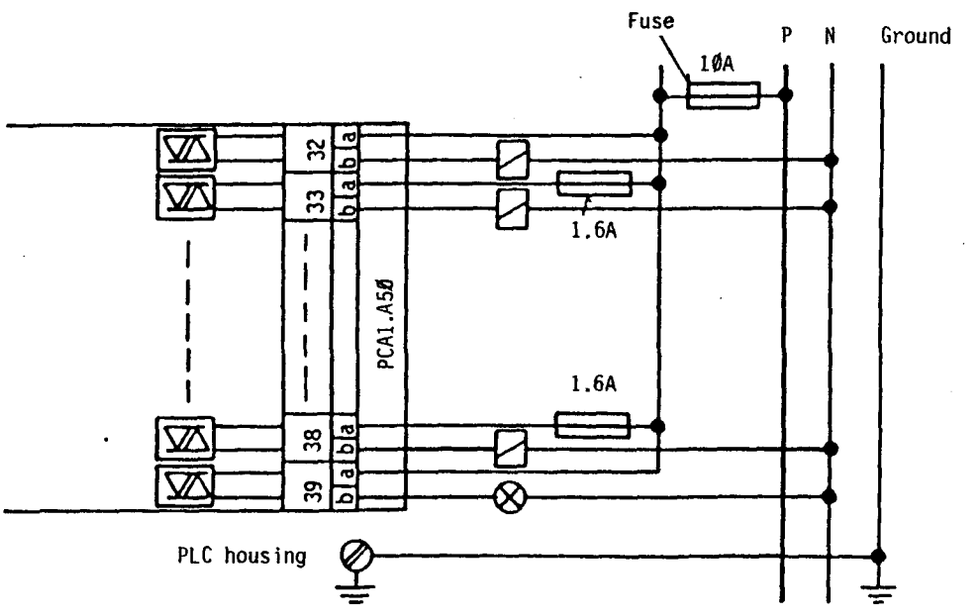
*) Important: Due to minimal current of 6ØmA, for example contactors with a hold-power of <13VA have to be provided by an adequate shunt over the coil!

The output module PCA1.A5Ø with static relay can be used to control resistor loads (lamps, heating equipment) and to control inductive loads (motors, valves, contactors). The outputs are opto-isolated against the CPU and against one another. The integrated zero-switches who set load at the zero-passage, have a very positive effect on lifetime, number of switch operations and interference suppression.

Warning

For reasons of protection of data transmission lines, displays and user input elements use low voltage material when connecting low voltage on the PLC.

All connections of an A5Ø-module are to be connected on the same circuit; that means at one point in such a way that they are all protected against one AC-phase by one fuse. Each load circuit may be protected individually by a fuse of max. 1.6A.



B 1.1.9 Type PCA1.B1Ø Electrically connected input/output module

The B1Ø module is a combination of modules E1Ø and A1Ø. The I/O-division and therefore also the modularity can be reduced to four.

Technical data

Inputs:

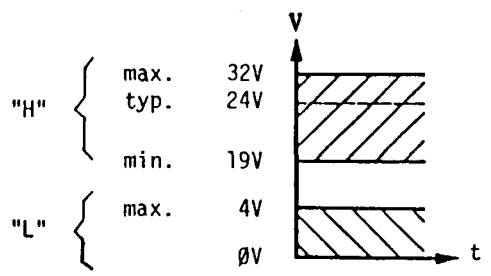
Number of inputs per module	4, electrically connected
Input voltage V_{in}	24VDC, smoothed or pulsating
Input current at 24V	1ØmA
Input delay (typical)	8ms
Operating modes	Source or sink operation, depending on connection

Outputs:

Number of outputs per module	4, electrically connected
Output voltage	5mA - 1A (2A) * When operated at 5...24V, the load resistance should be at least 24Ω.
Short-circuit protection	1.6A quick-acting fuse
Operating mode	Source operation (pos. switching voltage)
Total current	See diagram for type PCA1.A1Ø
Voltage range V_{out}	5...36VDC, smoothed or pulsating
Voltage drop	max. 1.5V at I = 1A
Output delay (typical)	1Øµs (with an inductive load, the turn-off delay is greater due to the protective diode.)

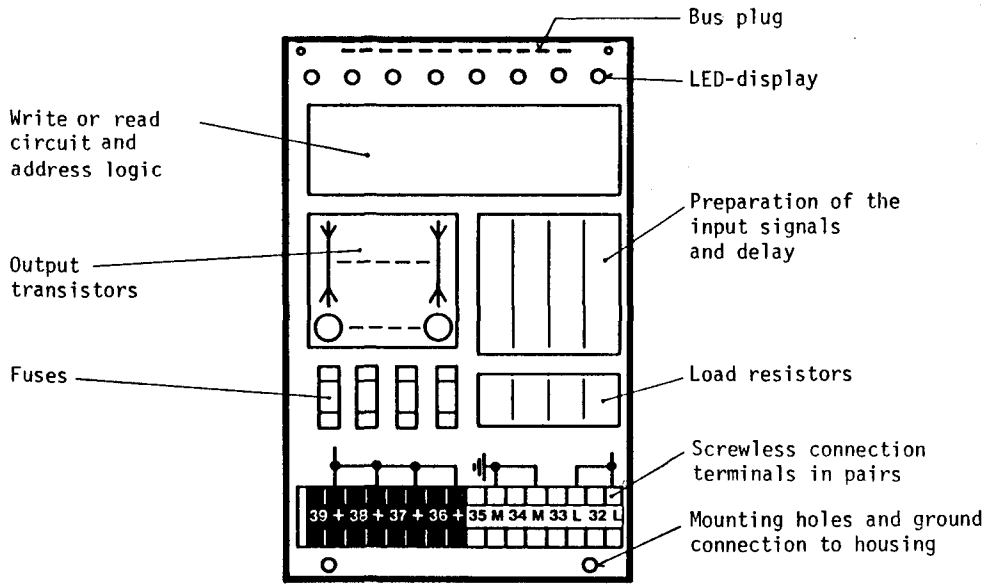
*) Two outputs per module can carry a load of 2A each if the total current does not exceed that shown in the figure. For such outputs, a quick-acting 2.5A fuse should be used. Please note however, that the voltage drop at the terminals is approx. 2.5V with a load of 2A.

Definition of the input voltages



Pulsating DC is adequate as supply voltage because of the 8ms input delay.

Presentation and terminal layout

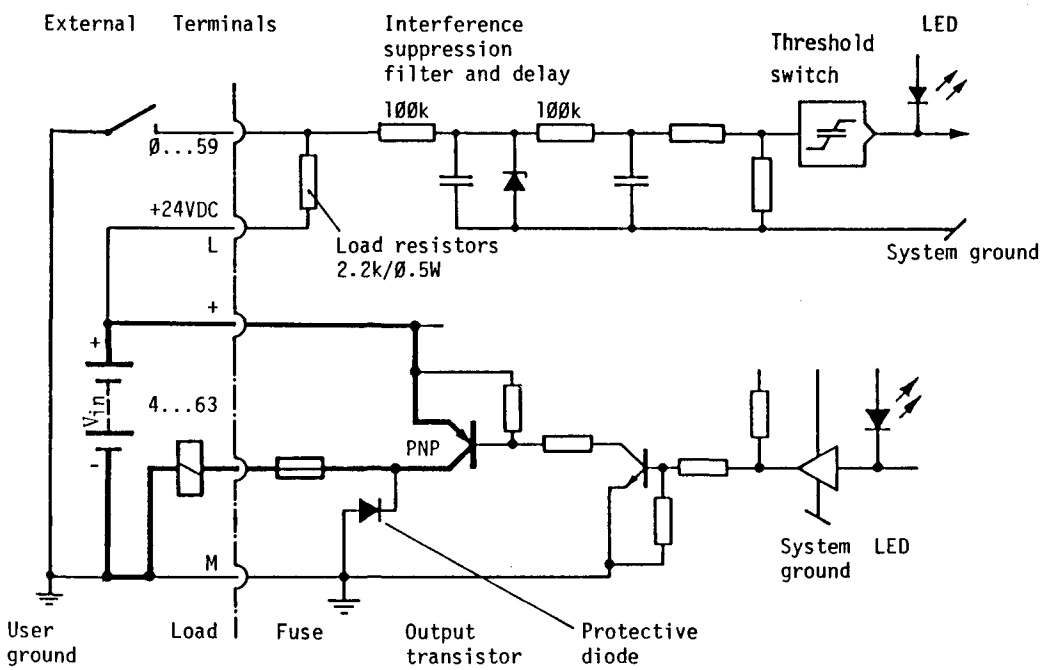


Input/output circuit

The inputs can be used in either source or sink operation, depending on the external circuitry.
The outputs can only be driven in source operation.

Inputs in sink operation or negative logic

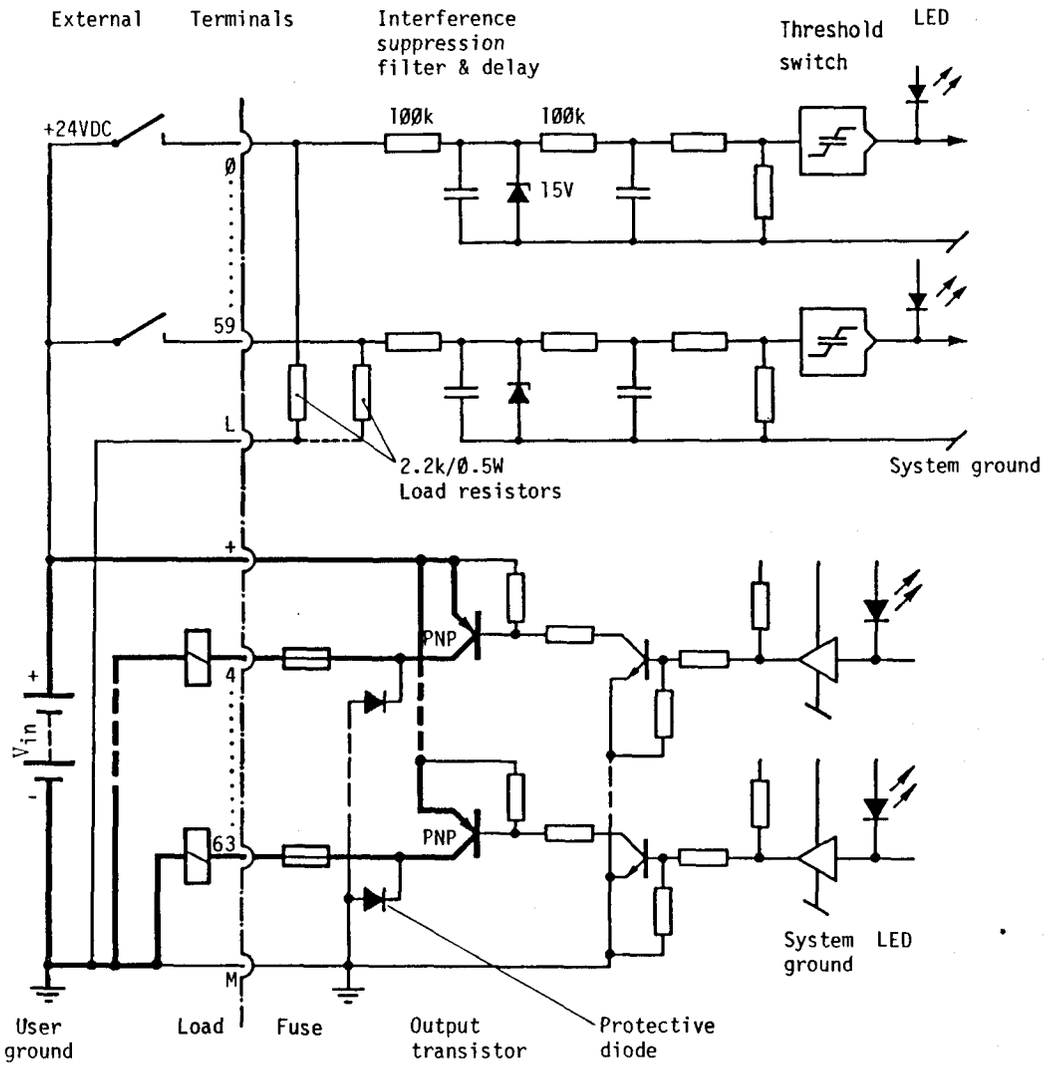
Switch closed (negative at input) : "L" ≙ LED OFF
Switch open (positive at input) : "H" ≙ LED ON



Output conducting (set) ≙ LED ON } Source
Output non-conductive (reset) ≙ LED OFF } operation

Inputs in source operation or positive logic (normal case)

Switch closed (positive at input): "H" ≙ LED ON
Switch open (negative at input) : "L" ≙ LED OFF



Output conducting (set) ≙ LED ON } Source
Output non-conductive (reset) ≙ LED OFF } operation

Max. permissible total current for complete PCA1 (housing for 8 I/O modules)

Refer to data on PCA1.A10 output module

B 1.1.10 PCA1.BØ Compact input/output module with short-circuit-protected outputs

The PCA1.BØ module is a compact input/output module similar to the PCA1.BØ, but with short-circuit-protected outputs. The inputs and outputs are electrically connected and fed by the same power supply unit. As they use the same addresses, only the instructions OUT, SEO and REO can be used for the outputs. Any interrogation commands refer to the corresponding inputs.

Technical data

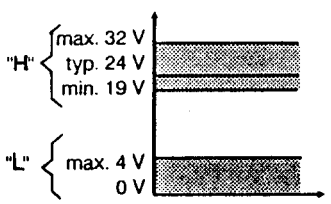
Inputs

Number of inputs per module	8, electrically connected
Input voltage V_{in}	24VDC, smoothed or pulsating
Input current at V_{in} = 24V	1ØmA
Input delay (typical)	9ms
Operating mode	Source or sink operation

Outputs

Number of outputs per module	6, electrically connected
Output current range	5mA - Ø.5A In the voltage range 5 - 24VDC the load resistance has to be at least 48Ω.
Operating mode	Source operation
Voltage range V_{out}	8 - 32V smoothed
Residual ripple of V_{out}	max. 1Ø%
Voltage drop	max. 1.5V at I = Ø.5A
Output delay (typical)	1Øµs In case of inductive load, the output delay is greater due to the freewheeling diode.

Input voltage



Owing to the input delay of 9ms, pulsating DC-voltage is sufficient for the external power supply (in source operation).

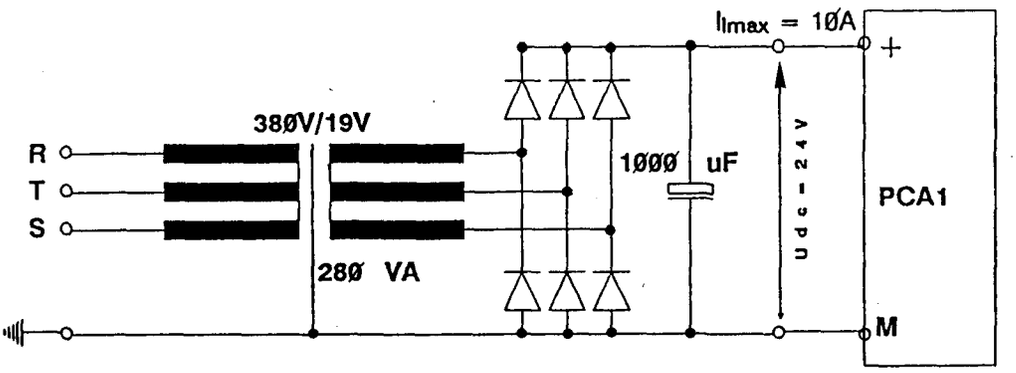
What to do in the event of a short-circuit

In a short-circuited load circuit, the output current is limited to 1A. If the short-circuit remains, the output is switched off after Ø.5 - 2s. From this moment on, every Ø.5s a new attempt is made of switching it on again. When the short-circuit is removed, the output is automatically switched on again.

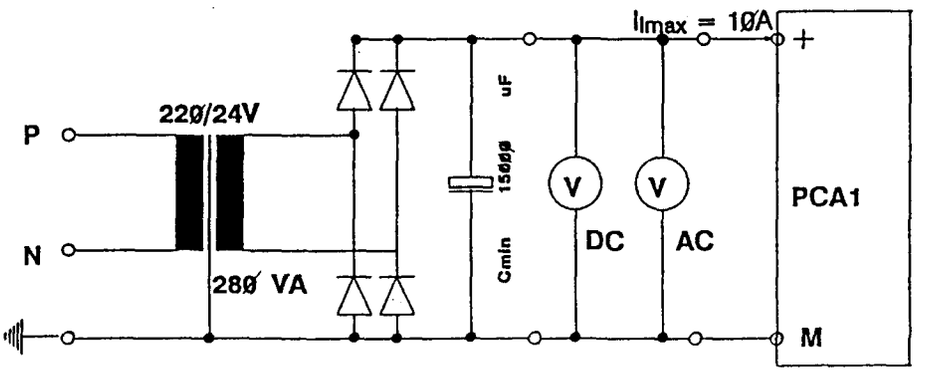
User power supply of the PCA1 when using the PCA1.B8Ø module

The short-circuit protection feature makes higher demands on the power supply of the PCA1.B8Ø module. Therefore, two suggestions will be made in the following with regard to the user power supply.

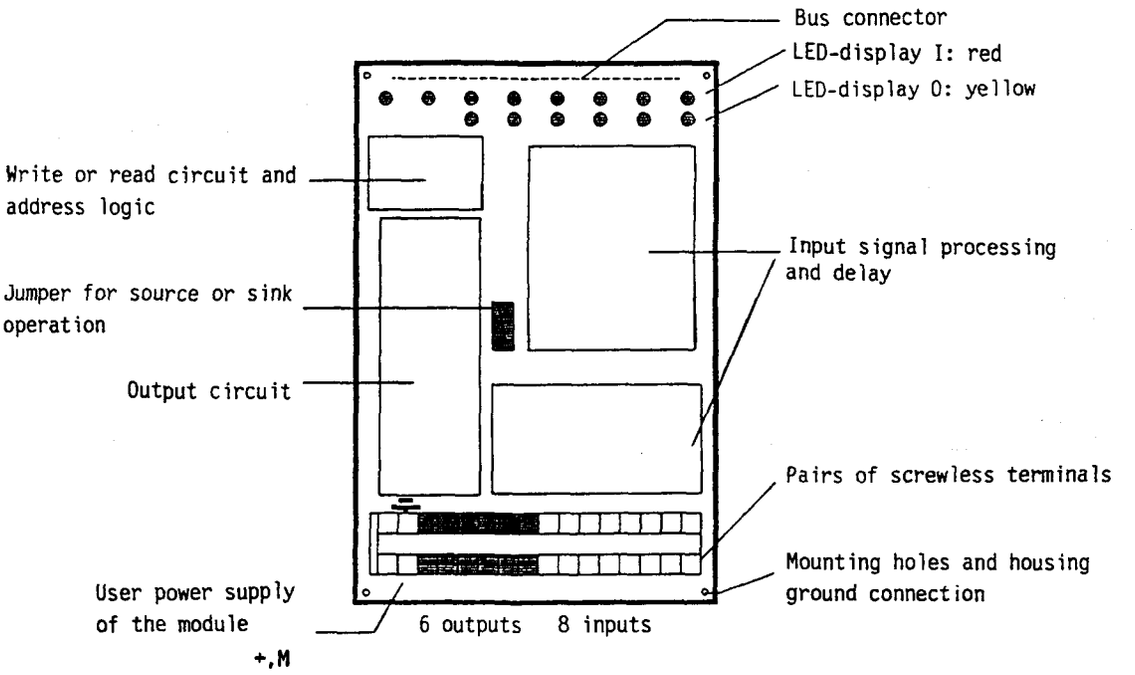
When using a 3-phase transformer



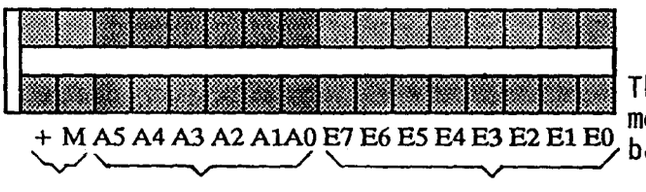
When using a 1-phase transformer



Presentation



Terminal assignment



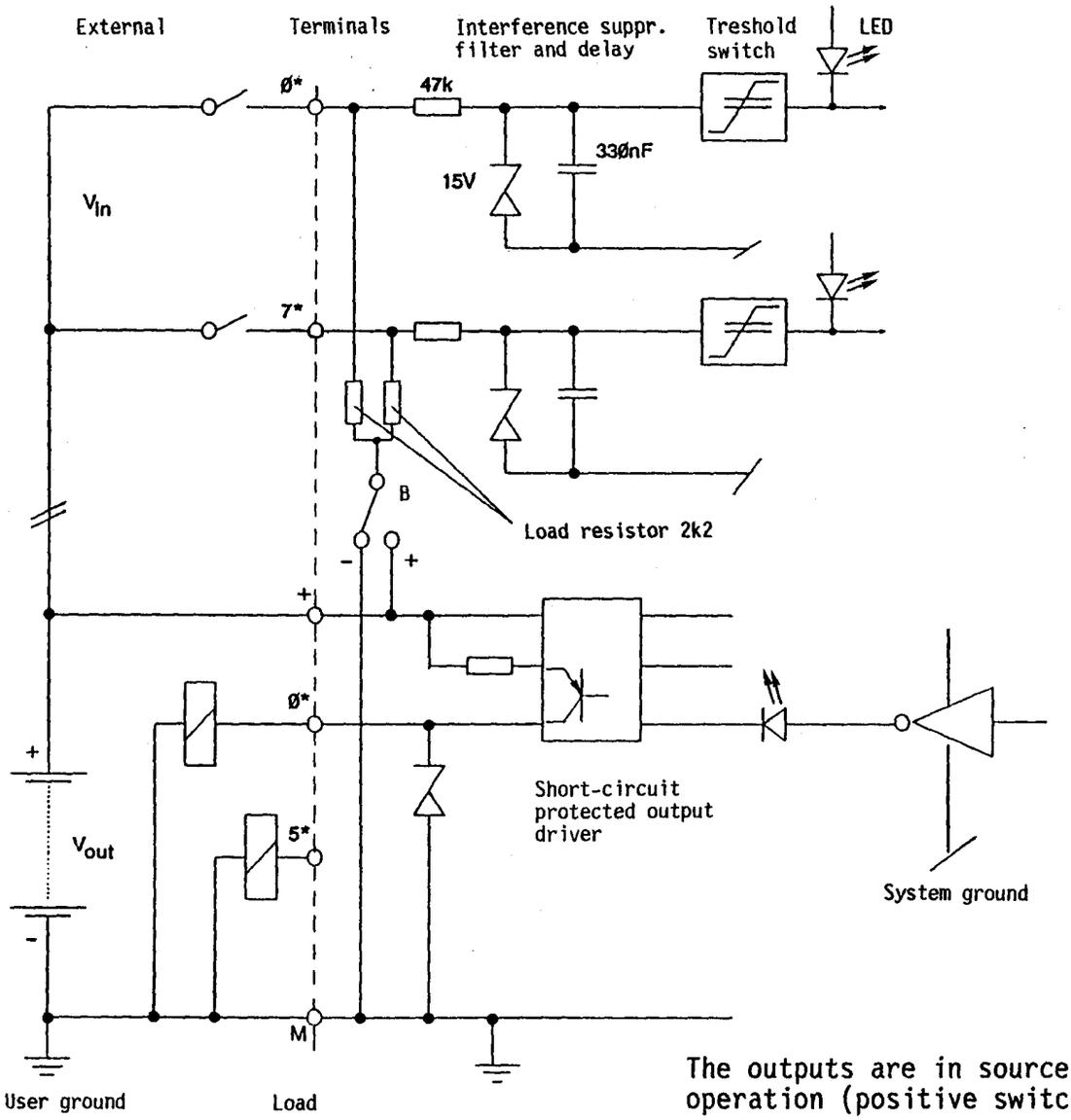
The terminal assignment is valid for basic address Ø.

Electric input and output circuit

Depending on the external circuitry, the inputs can be used in source or sink operation. Outputs can only be used in source operation.

Inputs in source operation or positive logic (normal case)

Switch closed (positive at input): "H" = LED ON
Switch open (negative at input) : "L" = LED OFF
Jumper B is in position "-".

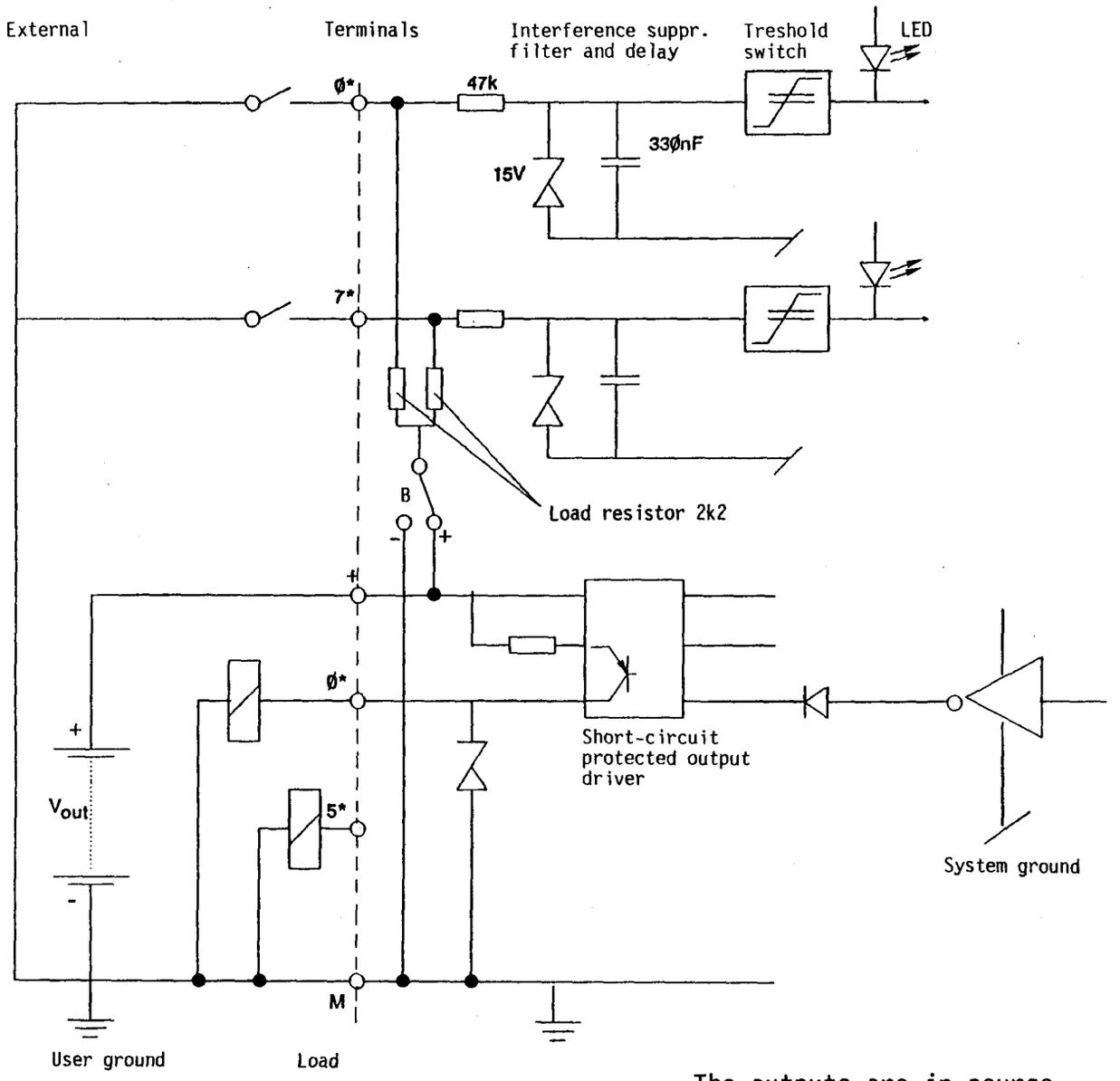


The outputs are in source operation (positive switching)

*) Absolute address = basic address + relative address
V_{out}: smoothed voltage V_{in}: smoothed or pulsating voltage

Inputs in sink operation or negative logic

Switch closed (negative at input): "L" = LED OFF
Switch open (positive at input) : "H" = LED ON
Jumper B is in position "+".



The outputs are in source operation (positive switching)

*) Absolute address = basic address + relative address

V_{out}: smoothed voltage

B 1.1.11 Type PCA1.BØ Electrically connected compact I/O module

The I/O capacity of the PCA1 series can be expanded economically to 56 or 112 inputs and outputs through this module. I/O circuits use a common supply voltage and operate in the source mode. Inputs and outputs use the same addresses. Only the three instructions OUT, SEO and REO can be used for outputs. Interrogation commands refer to the respective inputs.

Technical data

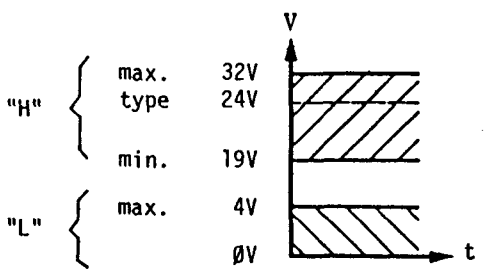
Inputs:

Number of inputs per module	8, electrically connected
Input voltage V_{in}	24VDC, smoothed or pulsating
Input current at 24V	1ØmA
Input delay (typical)	9ms
Operating mode	Source operation, sink operation by commuting jumper B

Outputs:

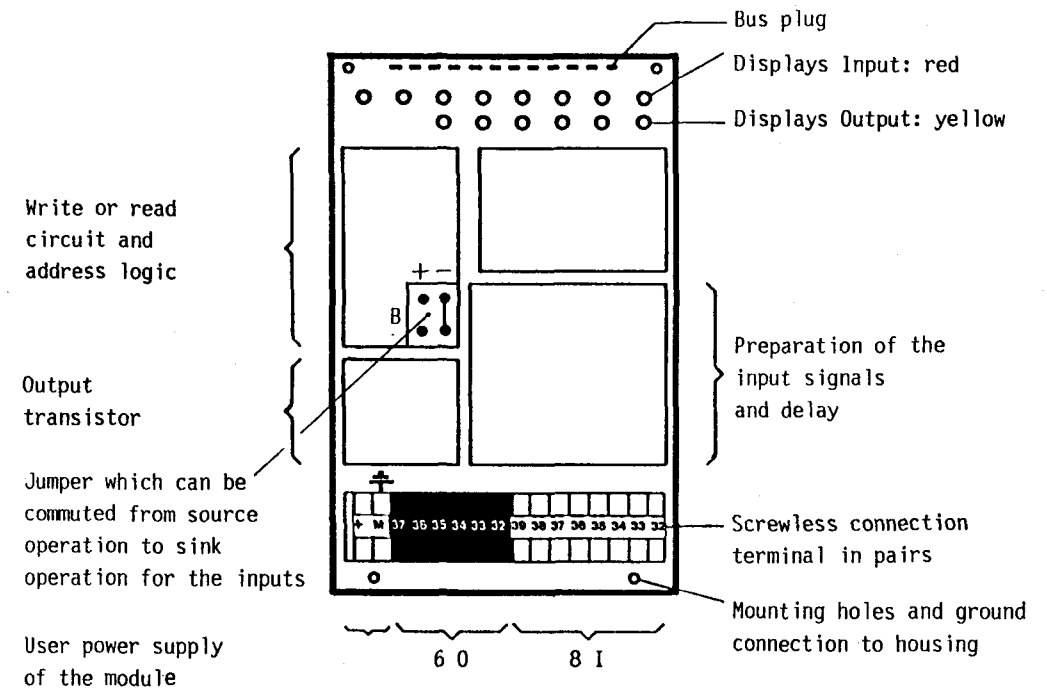
Number of outputs per module	6, electrically connected
Output voltage	5mA - Ø.5A When operated at 5...24VDC, the load resistance should be at least 48Ω.
Operating mode	Source operation (positive switching)
Voltage range V_{out}	5...36VDC, smoothed or pulsating
Voltage drop	max. 1.5V at I = Ø.5A
Output delay (typical)	1Øµs (With an inductive load, the turn-off delay is greater due to the free-wheeling diode.)

Definition of the input voltages



Pulsating DC is adequate as supply voltage because of the 9ms input delay.

Presentation and terminal layout

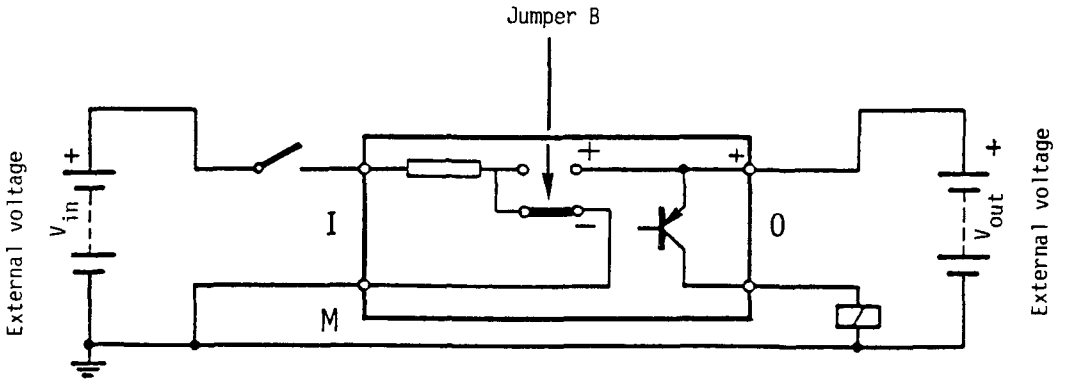


Input/output circuit

All inputs are switched to source operation (-) (factory setting). The inputs can be switched to sink operation by commuting jumper B to "+".

The outputs may only be used in sink operation.

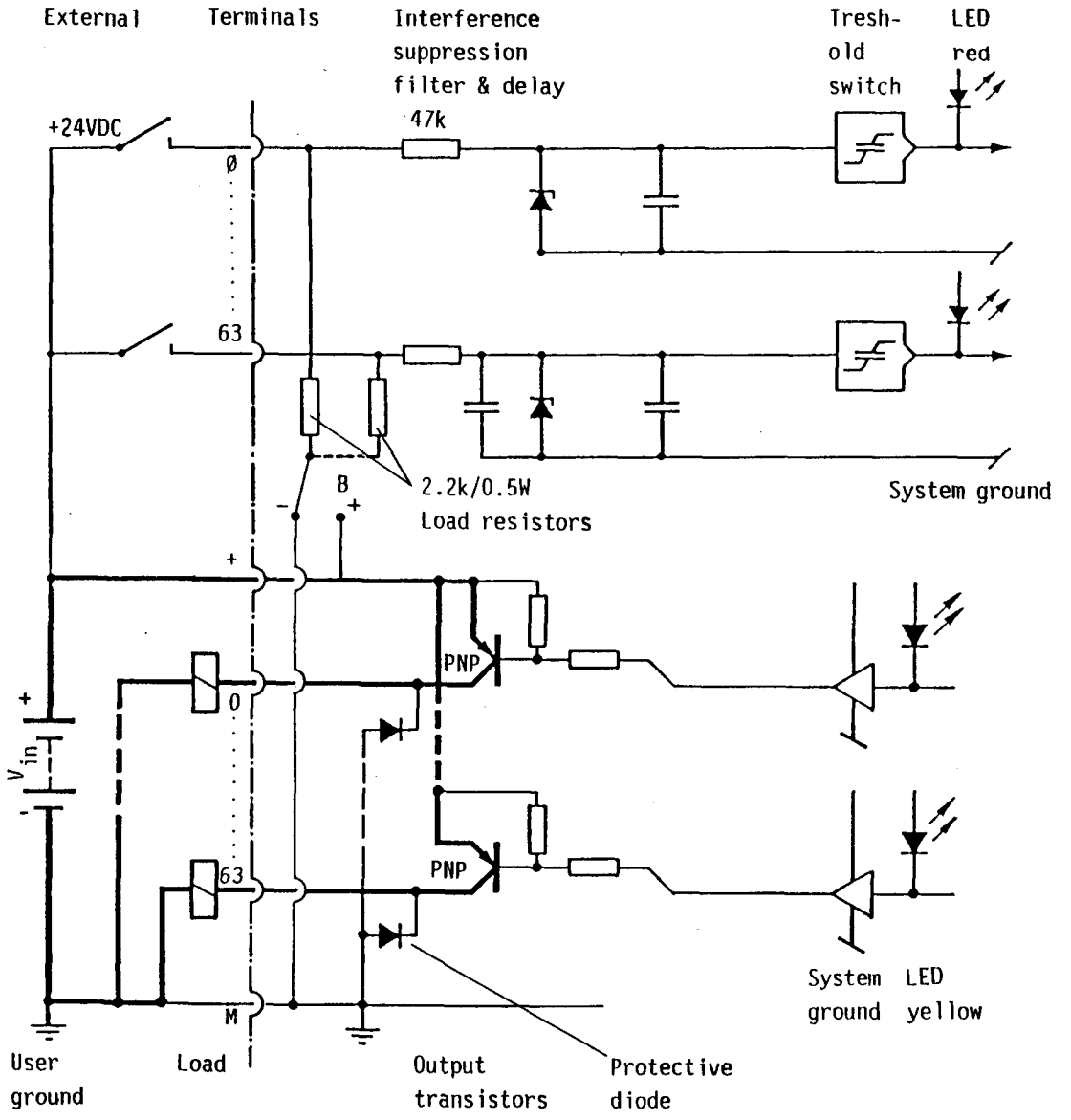
Connection of inputs and outputs



Factory setting: jumper B on "-": source operation

Inputs in source operation or positive logic
(factory setting: jumper B on "-")

Switch closed (positive at input): "H" = LED ON
Switch open (negative at input): "L" = LED OFF



Output conducting (set) = LED ON } Source
Output non-conductive (reset) = LED OFF } operation

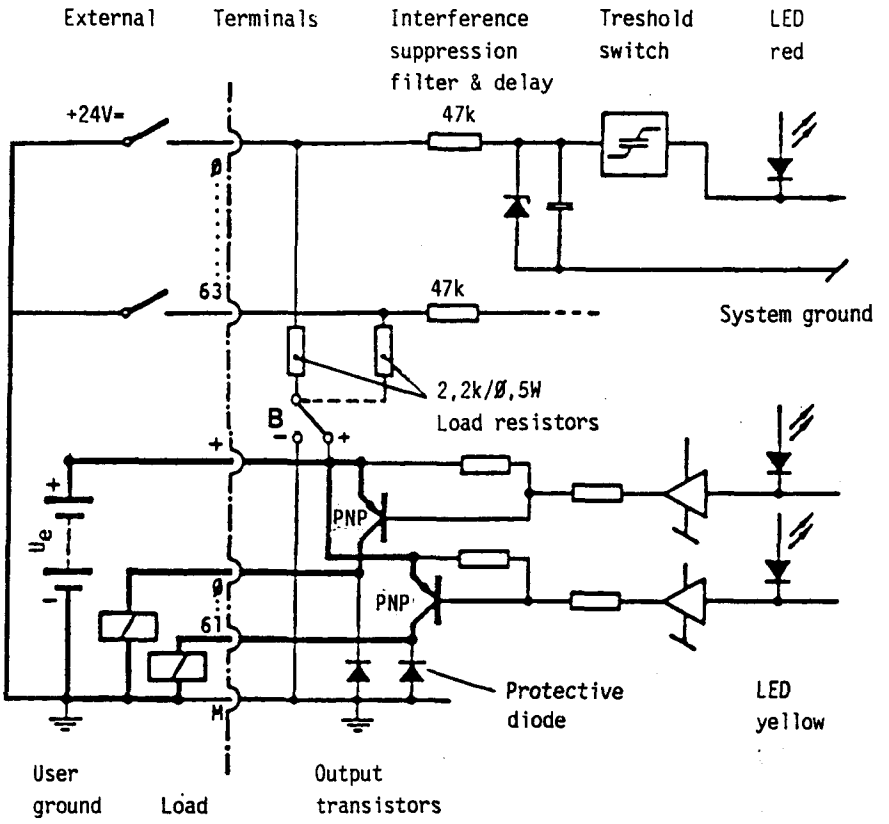
Inputs in sink operation or negative logic, outputs in source operation (jumper B on "+")

Inputs: Sink operation

- Switch closed (- at input): H ≙ LED OFF
- Switch open (+ at input): L ≙ LED ON

Outputs: Source operation

- Output conducting (set) ≙ LED ON
- Output non-conductive (reset) ≙ LED OFF



B 1.1.12 Type PCA1.E4Ø Combined date-time and input module (only PCA14)

In addition to 7 inputs, the module PCA1.E4Ø contains a precise date-time with power reserve. This buffered date-time can only be evaluated with the system series PCA14 in connection with its software date-time.

Technical data

Inputs:

Number of inputs per module	7, electrically connected (addr. 1...7)
Input voltage V_{in}	24VDC, smoothed or pulsating
Input current at 24VDC	1ØmA
Input delay (typical)	9ms
Operating mode	Source or sink operation

Date-time:

Accuracy	<15s/month at T = 15 - 3Ø°C
Power reserve	2 months due to NiCd battery 3)
Date-time values	Day of the week Ø1...Ø7 2) Year ØØ...99 Month Ø1...12 Day of the month Ø1...31 1) Hours ØØ...23 Minutes ØØ...59 Seconds ØØ...59
Internal power consumption of the module (5V)	15...7ØmA

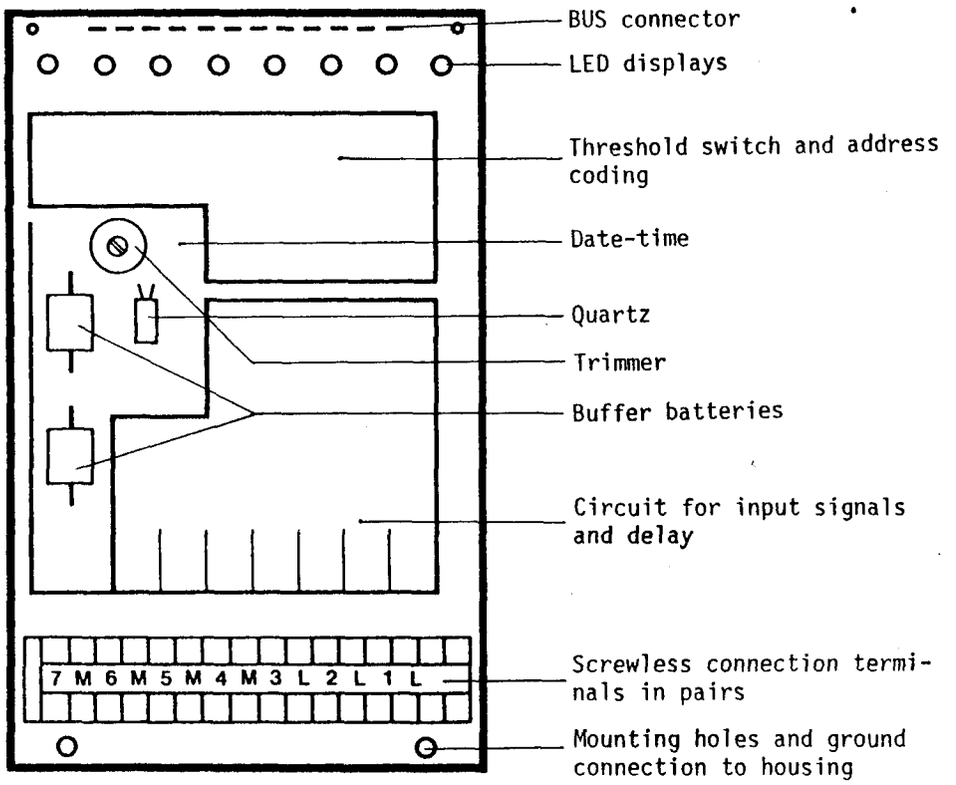
---

1) The date-time takes the various months and leap years into account.

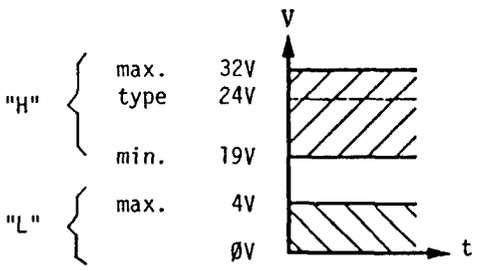
2) Day of the week Ø1 stands for Monday, Ø7 stands for Sunday.

3) Life of buffer battery approx. 5 years
Spare part no. 4'5Ø7'11'95Ø

Presentation and terminal layout



Definition of the input voltages



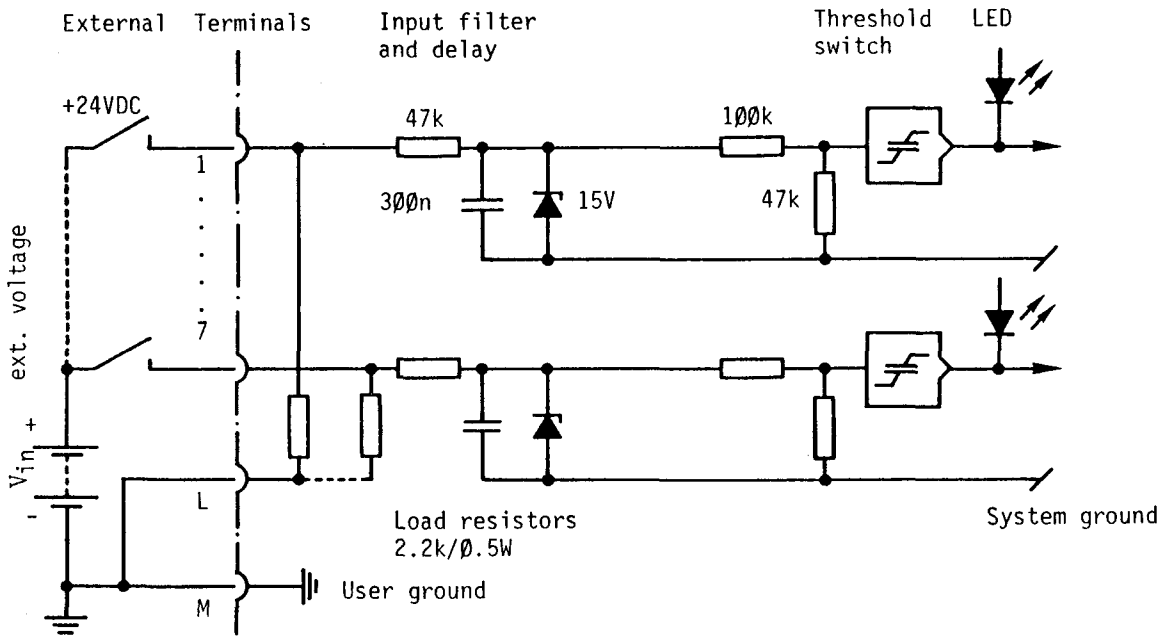
Pulsating DC-voltage is sufficient as supply voltage, because of the 9ms input delay.

The 7 inputs (addresses 1...7) can be used without restrictions and independently of the date-time. The address Ø is reserved for the data transfer from and to the date-time.

Input circuit

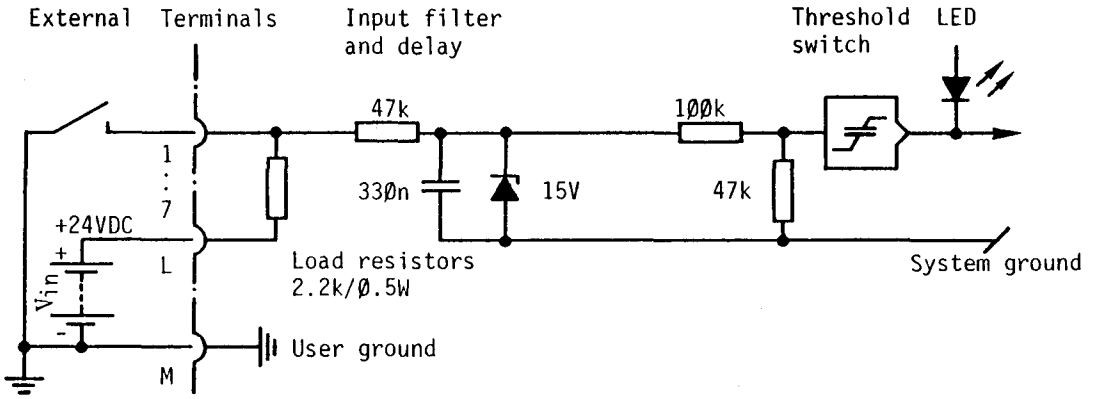
Depending on the external circuitry this module can be used either in source or sink operation.

Source operation or positive logic (normal case):



Switch closed (positive at input): "H" ≙ LED ON
Switch open (negative at input): "L" ≙ LED OFF

Sink operation or negative logic:



Switch closed (negative at input): "L" ≙ LED OFF
Switch open (positive at input): "H" ≙ LED ON

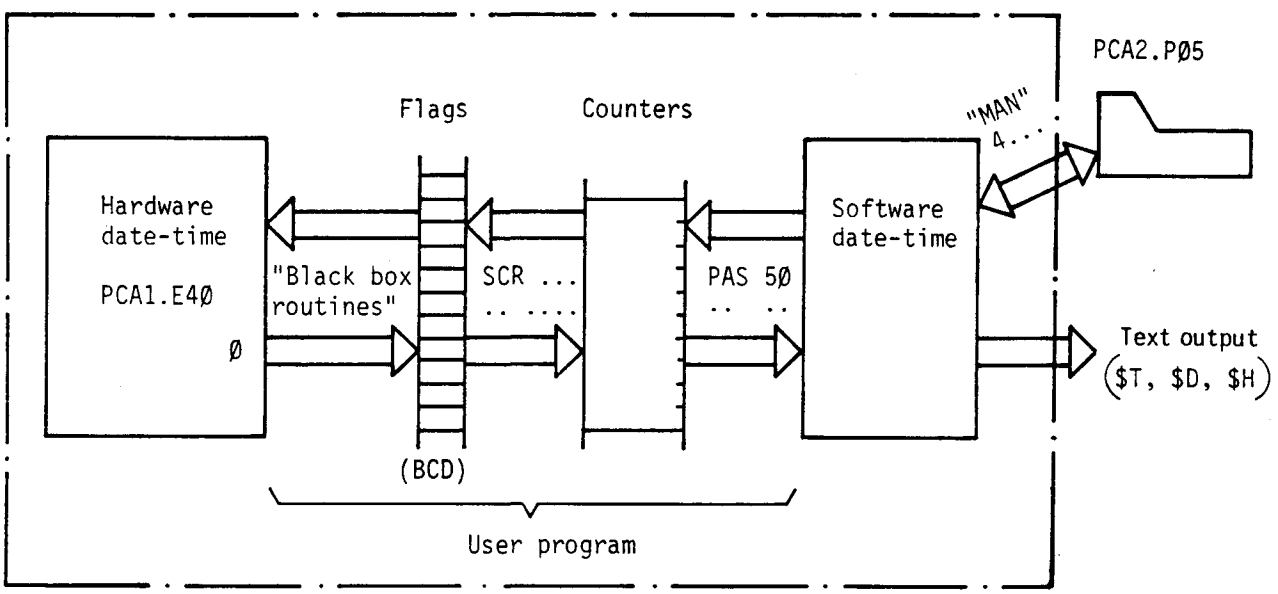
Handling of the date-time

Owing to its higher accuracy, the hardware date-time is considered the master as compared with the software date-time. The comfortable instructions such as PAS 5Ø and the special text characters $T, $H and $D (see PCA14 manual), however, refer only to the software date-time. It is therefore necessary to synchronize the hardware and the software date-time at times (e.g. every 24h). Moreover, the date and time values of the hardware date-time must be set on the first start-up.

Make sure that synchronization of the software date-time and setting of the hardware date-time are performed only when required in order to prevent the hardware date-time from being permanently blocked.

Its handling will be described in detail on the following pages.

Principle of the data transfer between software and hardware date-time



As evident from the above figure, a flag field (for the whole contents 6Ø or 68 flags) as well as 1 counter must be reserved for the duration of the data transfer between both date-times. The transfer from the hardware date-time to the flag field or vice versa is effected serially with the address Ø. The addresses 6 and 7 are used as control signals.

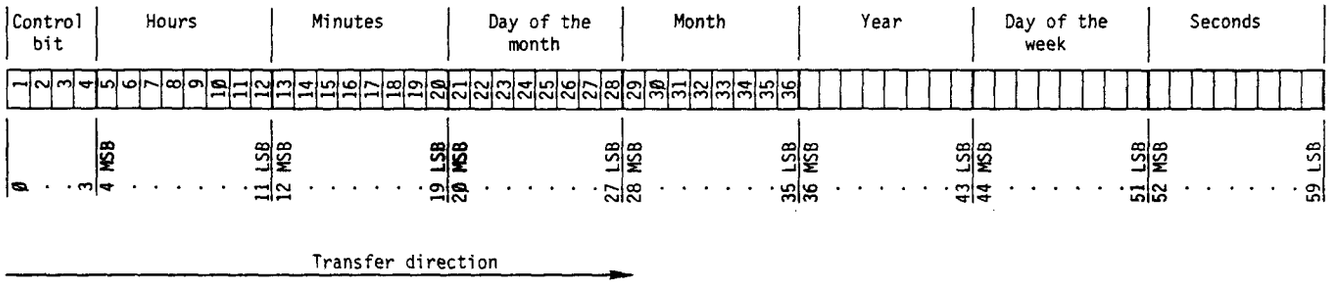
Address Ø: This address is used for the data transfer between the date-time and the flags.

Address 6: With address 6 a clock is generated. With every clock signal a data bit is received or transmitted by the hardware date-time.

Address 7: Chip select. In order to activate the data transfer, this address must be set to "H". As soon as the transmission is finished, address 7 must be reset to "L".

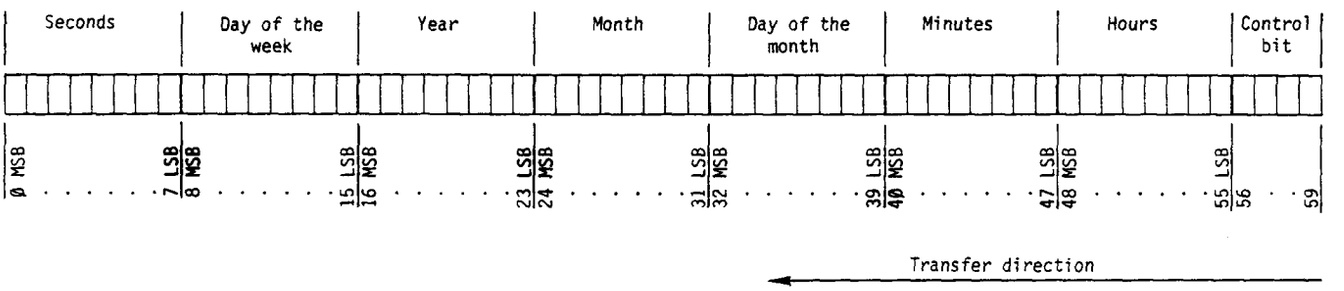
Format of the data transfer (4 control bits followed by 7 x 8 bits BCD)

a) Setting of the hardware date-time



MSB must be transmitted before LSB.
MSB = Most Significant Bit
LSB = Least Significant Bit

b) Reading of the hardware date-time



When reading the hardware date-time the individual bits are read in the sequence LSB...MSB. To guarantee that the format corresponds to the read-in instruction for 2 x 4 bits BCD (code 16 in the 2nd line of the instruction SCR), make sure that the LSB of the individual date-time values is at the highest flag address. For the sake of an optimum transfer routine "hardware date-time to software date-time" the control bits are fitted with the 4 highest (out of 60) flag addresses. This results in the above "inverse" transfer direction.

Function of the control bits

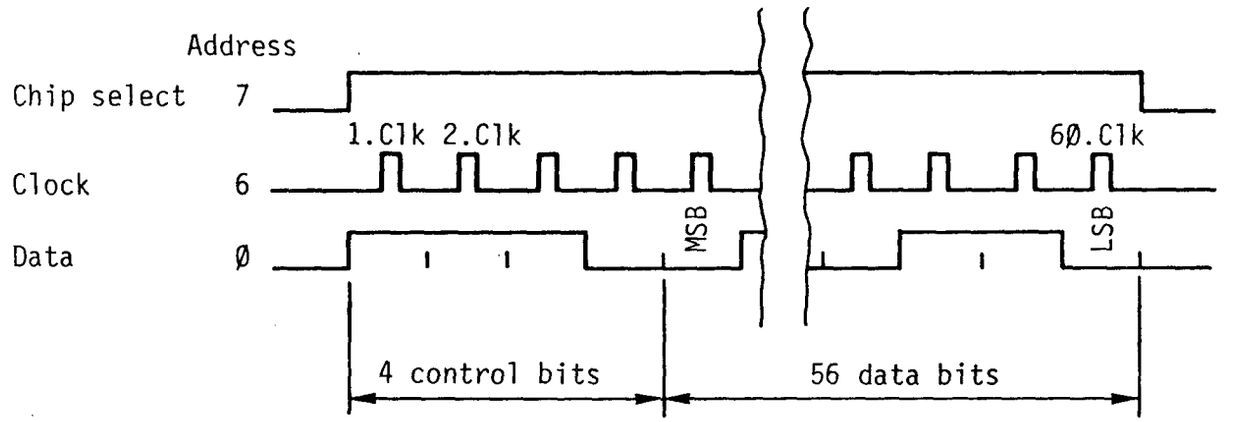
The 4 control bits tell the date-time "what to do". The first three bits received by the date-time define the data to be transmitted. The 4th bit is used to determine whether the date-time is set or read.

These 4 control bits must be transmitted before every data transfer, irrespective of whether the date-time is set or read.

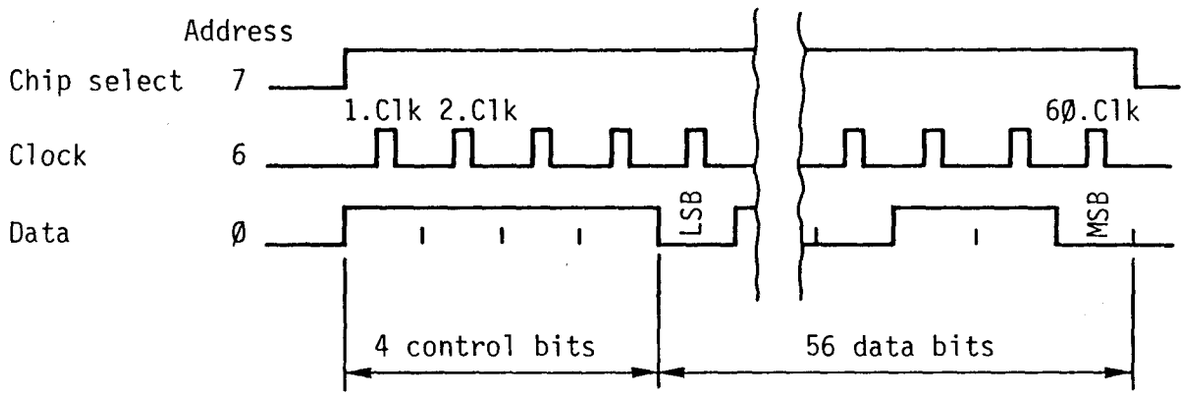
1.	2.	3.	4.	Bit
1	1	1	x	Whole contents
1	1	Ø	x	Year
1	Ø	1	x	Day of the week
1	Ø	Ø	x	Month
Ø	1	1	x	Day of the month
Ø	1	Ø	x	Hours
Ø	Ø	1	x	Minutes
Ø	Ø	Ø	x	Seconds
x	x	x	(Ø)	Set date-time
x	x	x	(1)	Read date-time

Transfer diagram

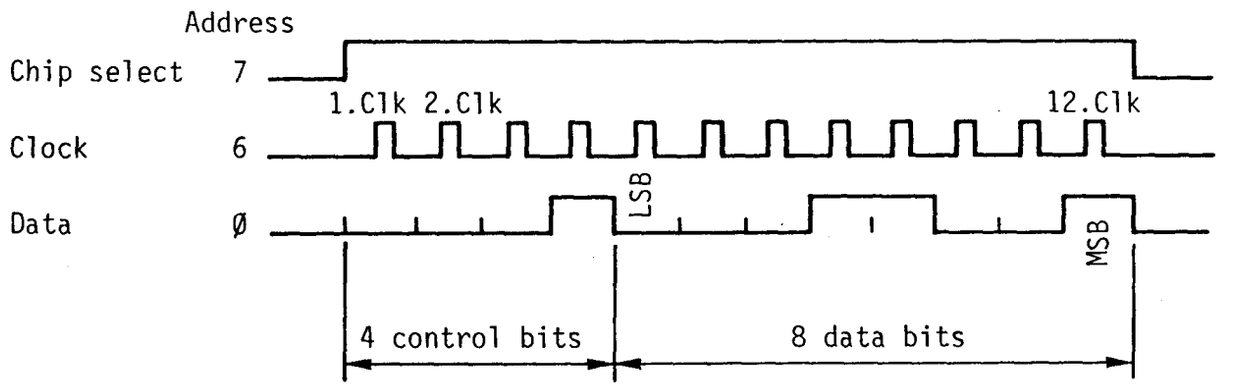
a) Setting the whole date-time contents



b) Reading the whole date-time contents



c) Reading the seconds



Examples

1. Setting the hardware date-time (whole contents)

During the first startup of the hardware date-time, the correct values must be set. Proceed as follows:

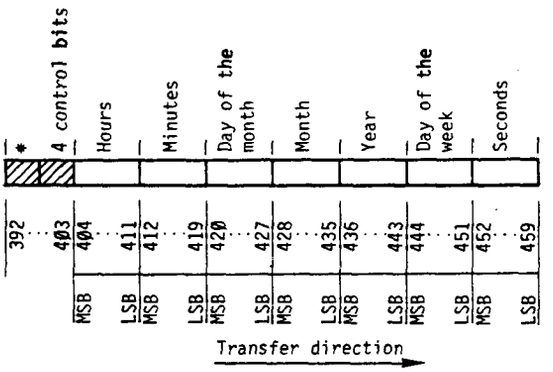
- The current date-time values are introduced into the software date-time (e.g. with a PCA2.P05, see chapter "Operating modes").
- In the STEP-mode the following routine is selected and executed. The hardware date-time automatically accepts the values of the software date-time and keeps on running, irrespective of whether the PLC stays switched on.

This procedure can be repeated, if after months the deviation from the actual date-time has become too great.

Program

```
4020   29   PAS   50
  21   17    17  260   } Seconds
  22   15   SCR  260
  23   20    20  459

  24   29   PAS   50
  25   11    11  260   } Day of the week
  26   15   SCR  260
  27   20    20  451

  28   29   PAS   50
  29   12    12  260   } Year
4030   15   SCR  260
  31   20    20  443

  32   29   PAS   50
  33   13    13  260   } Month
  34   15   SCR  260
  35   20    20  435

  36   29   PAS   50
  37   14    14  260   } Day of the month
  38   15   SCR  260
  39   20    20  427

4040   29   PAS   50
  41   16    16  260   } Minutes
  42   15   SCR  260
  43   20    20  419

  44   29   PAS   50
  45   15    15  260   } Hours
  46   15   SCR  260
  47   20    20  411
```

Transfer contents of the software date-time to flags



Flags ⟶ Hardware date-time

*) With code 20 in the 2nd line of the instruction SCR 20 bits BCD are transferred. Therefore, the flags 392...403 must also be reserved, with M400...M403 serving as control bits for the hardware date-time. On the whole, 68 flags are required for setting the hardware date-time.

```
4048   11   SEO   400
  49   11   SEO   401   } Control bits for
  50   11   SEO   402     hardware date-time
  51   12   REO   403

  52   11   SEO     7 * ; Chip select
  53   16   SEI     0
  54   01   STH  1400
  55   10   OUT     0 * ; Data
  56   19   SEA     0
  57   11   SEO     6 * ; Clock
  58   12   REO     6 * ; Clock
  59   27   INI    59
4060   21   JIO     0
  61   00    00  4054
4062   12   REO     7 * ; Chip select

4063   20   JMP    00
4064   00    00  4063
```

1.	2.	3.	4.	Control bit
400	401	402	403	Flag
1	1	1	(0)	
Whole date-time contents			Set	

Transfer the contents of the flags M400...M459 to the hardware date-time

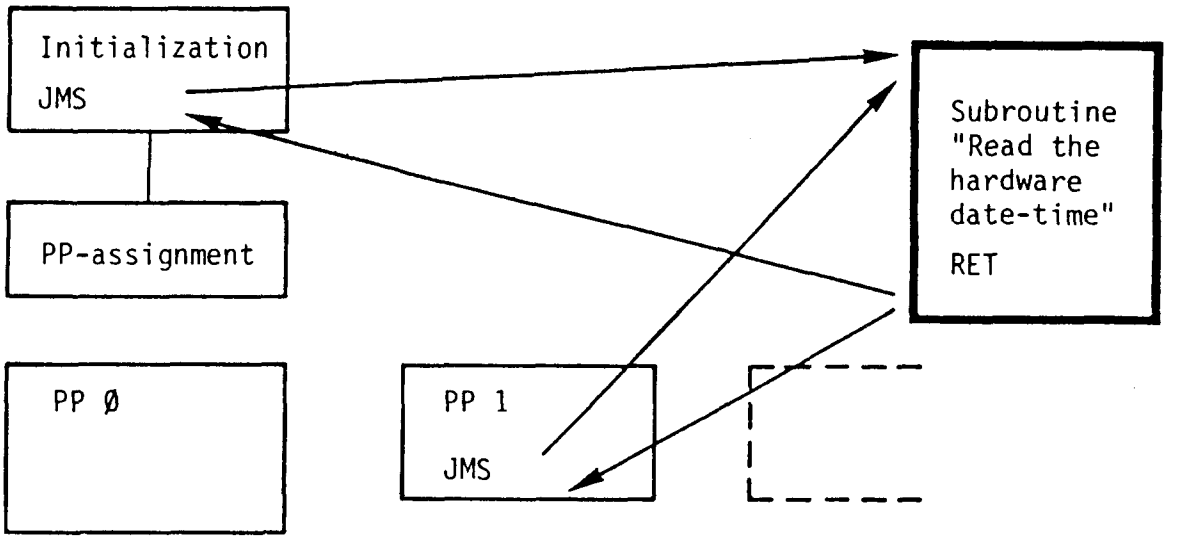
---

*) These addresses do not depend on the plug-in location of the module (example for addr. 0...7).

2. Reading the hardware date-time (whole contents)

The routine "Reading the hardware date-time" must be executed after each voltage failure upon switching on the PLC again. It can also be called in the main program depending on internal or external conditions, ensuring that the software date-time does never deviate much from the hardware date-time. It is of advantage to write the program "Reading the hardware date-time" as a subroutine.

Program structure



Subroutine: Read the whole contents

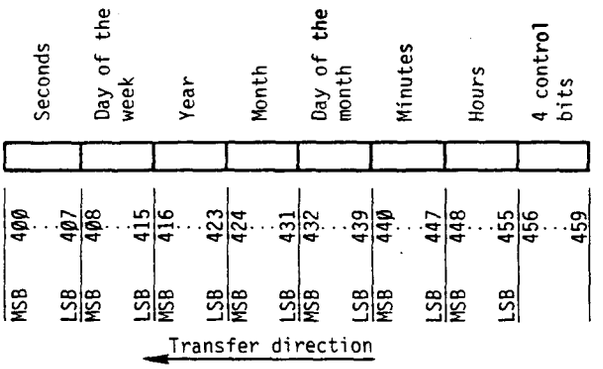
1.	2.	3.	4.	Control bit
459	458	457	456	Flag
1	1	1	(1)	
Whole date-time contents			Read	

```
⇒ 56  11  SEO   459
  57  11  SEO   458      } Control bits for
  58  11  SEO   457      } hardware date-time
  59  11  SEO  (456)     }

  60  11  SEO     7 * ;  Chip select
  61  16  SEI    59
→ 62  01  STH  1400
  63  10  OUT     0 * ;  Data
  64  19  SEA     0
  65  11  SEO     6 * ;  Clock
  66  12  REO     6 * ;  Clock
  67  28  DEI    56
  68  21  JIO     0
  69  00  00     62
  70  16  SEI    55

→ 71  01  STH     0 * ;  Data
  72  10  OUT  1400
  73  19  SEA     0
  74  11  SEO     6 * ;  Clock
  75  12  REO     6 * ;  Clock
  76  28  DEI     0
  77  21  JI0     0
  78  00  00     71
  79  12  REO     7 * ;  Chip select

  80  15  SCR   260      } Day of the week
  81  16   16   415      }
  82  29  PAS    50      }
  83  01   01   260      }

  84  15  SCR   260      } Year
  85  16   16   423      }
  86  29  PAS    50      }
  87  02   02   260      }

  88  15  SCR   260      } Month
  89  16   16   431      }
  90  29  PAS    50      }
  91  03   03   260      }

  92  15  SCR   260      } Day of the month
  93  16   16   439      }
  94  29  PAS    50      }
  95  04   04   260      }

  96  15  SCR   260      } Minutes
  97  16   16   447      }
  98  29  PAS    50      }
  99  06   06   260      }

 100  15  SCR   260      } Hours
 101  16   16   455      }
 102  29  PAS    50      }
 103  05   05   260      }

 104  15  SCR   260      } Seconds
 105  16   16   407      }
 106  29  PAS    50      }
 107  07   07   260      }
 108  24  RET     0
```

Control bits (M459...M456) to hardware date-time (control command)

Transfer date from hardware date-time to flags M455...M400

Transfer contents of flags M400...M455 to software date-time



Hardware date-time ⟶ Flags

*) These addresses depend on the plug-in location of the module.

3. Transferring the seconds from the hardware date-time (to software date-time)

As is well known, it is also possible to transfer only single values of the date-time. If the software date-time is regularly synchronized with the hardware date-time, it may be sufficient to transfer only the seconds (accuracy of the software date-time: <3s/day).

Subroutine: Read the seconds

```
⇒ 501   12   REO   411
  502   12   REO   410
  503   12   REO   409
  504   11   SEO   (408)

  505   11   SEO     7 * ;  Chip select
  506   16   SEI    11
  507   01   STH  1400
  508   10   OUT     0 * ;  Data
  509   19   SEA     0
  510   11   SEO     6 * ;  Clock
  511   12   REO     6 * ;  Clock
  512   28   DEI     8
  513   21   JIO     0
  514   00    00   507

  515   16   SEI     7

  516   01   STH     0 * ;  Data
  517   10   OUT  1400
  518   19   SEA     0
  519   11   SEO     6 * ;  Clock
  520   12   REO     6 * ;  Clock
  521   28   DEI     0
  522   21   JIO     0
  523   00    00   516
  524   12   REO     7 * ;  Chip select

  525   15   SCR   260
  526   16    16   407
  527   29   PAS    50
  528   07    07   260

  529   24   RET     0
```

Control bits for hardware date-time

1.	2.	3.	4.	Control bit
411	410	409	408	Flag
0	0	0	①	
Seconds			Read	

Control bits (M411...M408) to hardware date-time (control instruction)

Seconds

400	401	402	403	404	405	406	407
MSB							LSB

Transfer seconds from hardware date-time to flags M407...M400

Transfer seconds to software date-time

*) These addresses depend on the plug-in location of the module.

B 1.1.13 Type PCA1.W1.. Analog I/O module with 8- or 7-bit resolution

Technical data

Inputs:

Number of channels	6, electrically connected
Voltage range	Ø...5V= 1)
Resolution	8 bits (1/256 ≙ Ø.4%)
Accuracy (absolute deviation)	1 1/2 bits ≙ Ø.6%)
Input impedance	≥ 1MΩ 1)
Time constant of input filter	Ø.2ms
A/D conversion time	< 1ØØµs

All inputs are protected against positive and negative overvoltages.

Outputs:

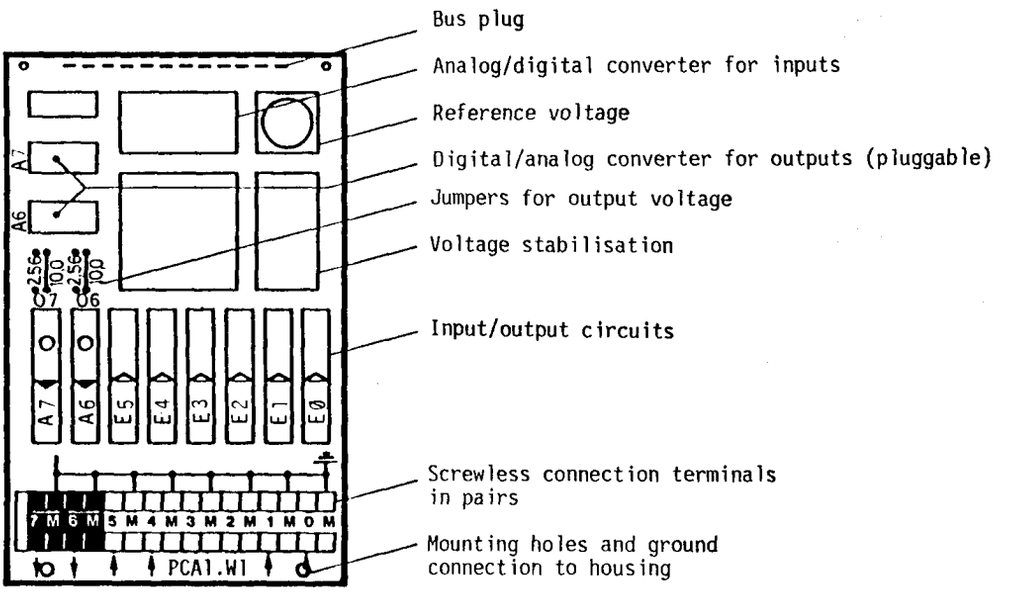
Number of channels	Ø, 1 or 2 2)
Voltage range	Ø...1ØV, can be changed to Ø...2.56V
Resolution	7 bits (1/128 ≙ Ø.8%)
Accuracy	1 1/2 bits ≙ 1.Ø%
Load impedance	≥ 1KΩ
Power consumption (5V)	3Ø...4ØmA
(24V)	25mA

---

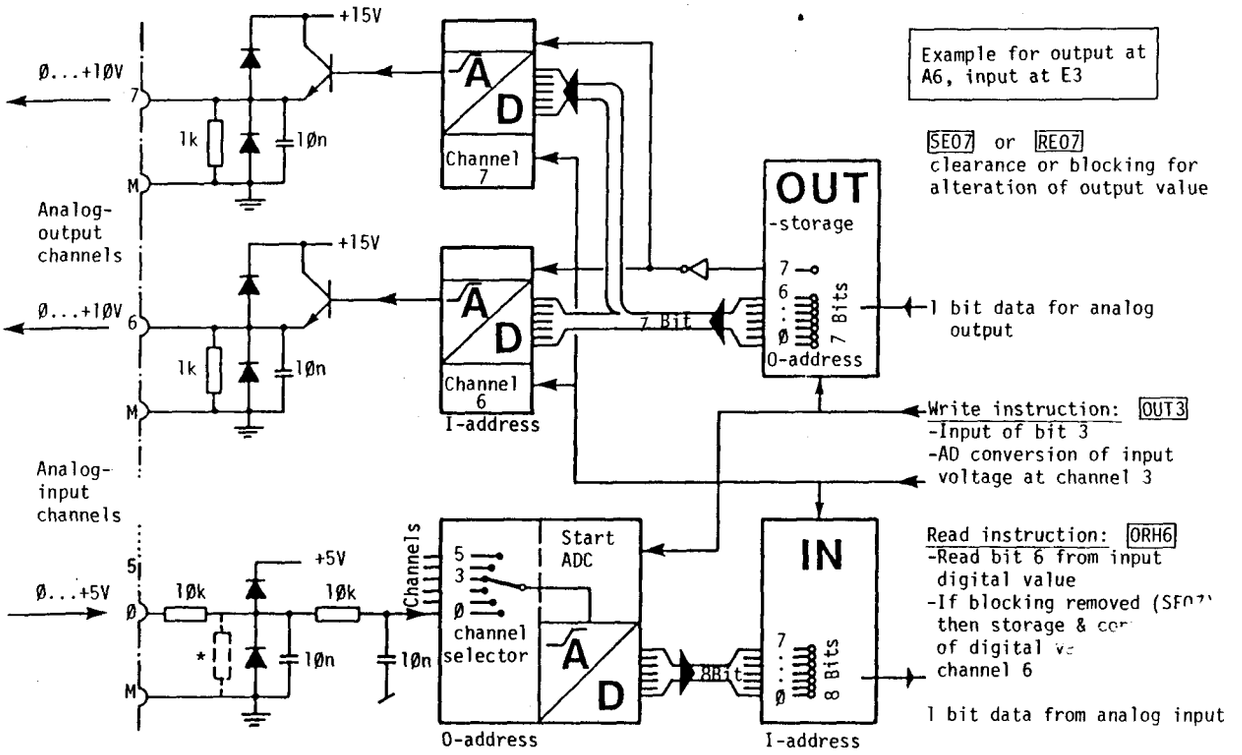
1) Special variants
PCA1.W1.. ZØ9: Ø...2ØmA input impedance 296Ω
PCA1.W1.. Z1Ø: Ø...1ØV input impedance 2ØkΩ

2) Number of analog outputs
without output: PCA1.W1Ø
with 1 output: PCA1.W11 (A7)
with 2 outputs: PCA1.W12 (A7 and A6)

Presentation



Input/output circuit and block circuit diagram



*) Only required at 1ØV or 2ØmA

Programming example for address location Ø...7

Read analog input voltage present on channel 3 (ADDR 3).
The corresponding binary value is to be transferred to counter 26Ø.

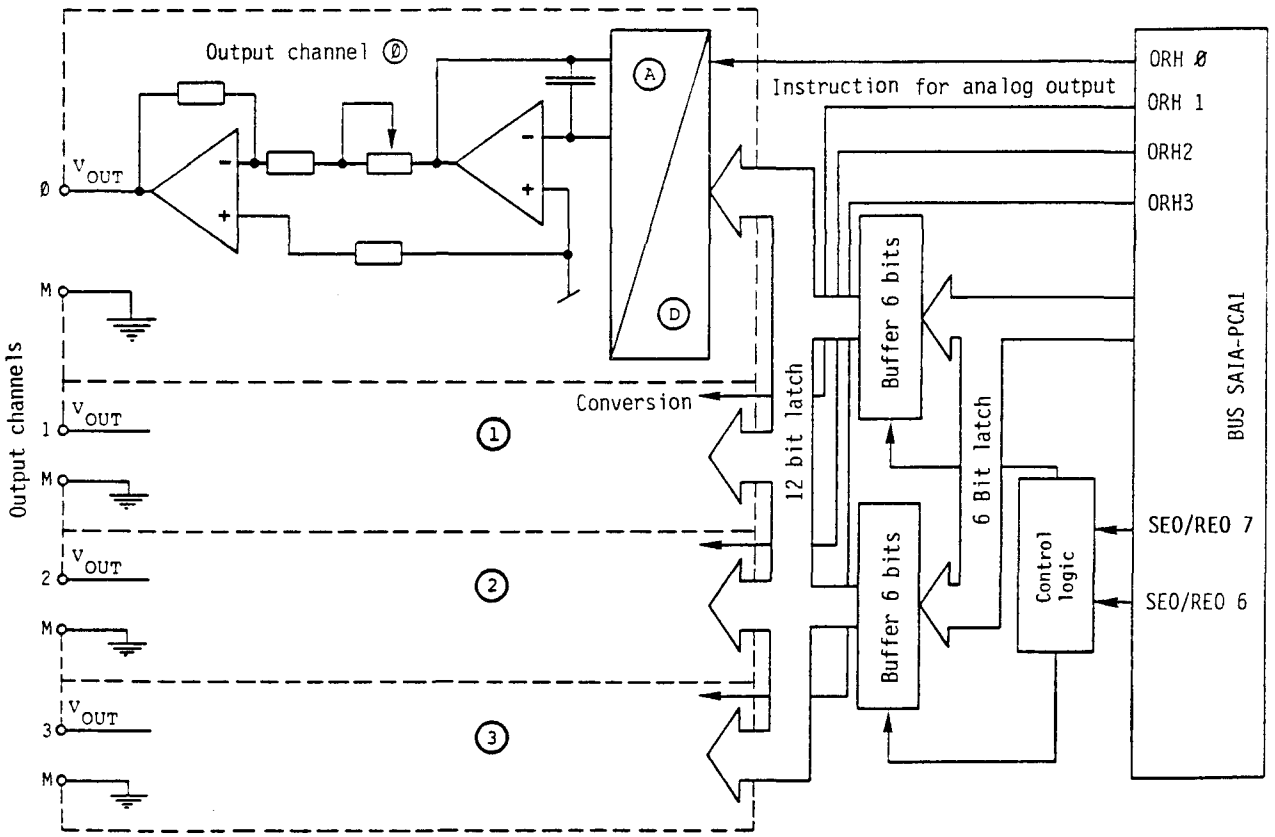
```
1ØØ OUT     3²)     ; Select I-channel 3 and trigger A/D conversion
1Ø1 SCR 26Ø         ; Transmit binary value (8 bits) to counter 26Ø
1Ø2  24   7²)
```

Transfer an analog value to O-channel 6 (ADDR 6).
The numerical value (Ø...255) is stored in counter 31Ø.

```
2ØØ SCR 31Ø         ; Transmit value Ø...255 from counter
2Ø1  21   7¹)²)     ;  to D/A converter
2Ø2 SEO   7²)       ; Clearance for altering the output value
2Ø3 ORH   6²)       ; Storage of binary value, conversion
                    ;  and output to output channel 5
2Ø4 REO   7²)       ; Blocking of output value
```

1) The counter value of Ø...255 corresponds to an output voltage of Ø...1ØV. The resolution, however, is only 7 bits.
2) If this module uses, for example, the addresses 24 to 31, it must be noted that the highest address of the card is 31. This means that input channel 3 corresponds to address 27, the output channel corresponds to address 3Ø and the block or clear command is assigned to address 31.

Block circuit diagram PCA1.W2

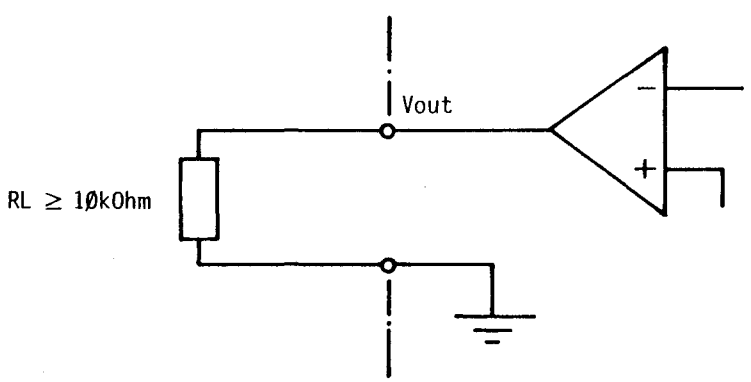


Connection to the process

A voltage output is made up of the plug-in D/A-converter and the two soldered-in amplifiers.

The standard output voltage is Ø...1ØV. For special applications, appropriate precision resistors are soldered in.

The signals are always measured potential to ground.



Software

Output analog value

The 12-bit digital value to be output must be applied at the inputs of the D/A-converters. By means of an instruction (ORH Ø...3) this value is stored and output as analog value by the D/A-converter.

The unchanged analog values of all 4 outputs are available to the process as long as they are not redefined by means of a new instruction.

Procedure

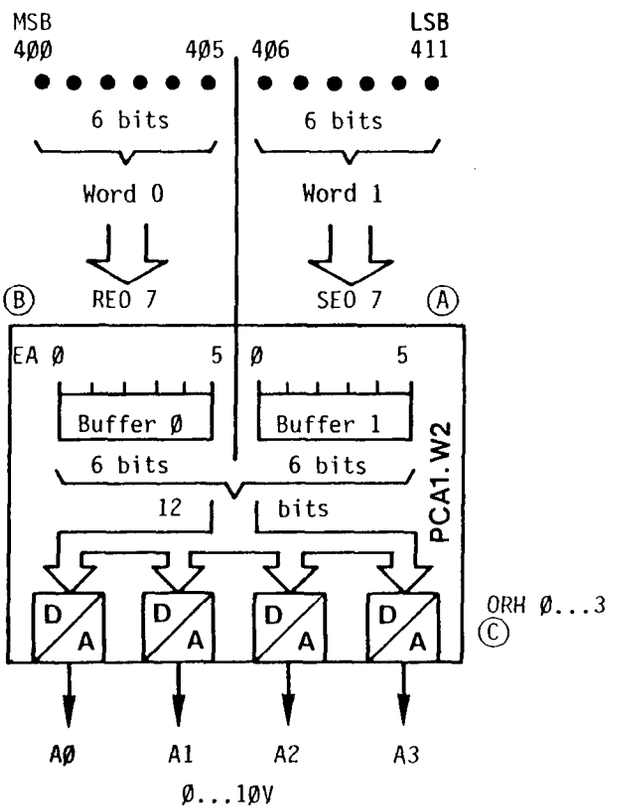
With the series PCA1 only 8 element addresses are available per I/O-module. In order to process the 12-bit data, they are split up into two words consisting of 6 bits each and processed one after the other.

The following steps must be distinguished:

A) Transfer the first 6 bits (starting with LSB) to buffer 1 (SEO 7)

B) Transfer the second 6 bits (up to MSB) to buffer Ø (REO 7)

C) Select the output channel with ORH Ø...3 and trigger D/A-conversion at the same time.



Program for EA Ø...7

```
(SEA    Ø)
SEO     7  *    Word 1
STH   411)
OUT     5 *
STH   41Ø)
OUT     4 *     Transfer 6 bits   (A)
 .      .       to buffer 1
 .      .
STH   4Ø6)
OUT     Ø *
```

```
SEA     Ø
REO     7  *    Word Ø
STH   4Ø5)
OUT     5 *     Transfer 6 bits   (B)
 .      .       to buffer Ø
 .      .
STH   4ØØ)
OUT     Ø *
SEO     6       Select output     (C)
ORH   Ø..3 *    channel Ø...3
REO     6 *     and output
                analog value
```

*) If the module is placed to a position other than Ø, the corresponding basic address must be added.

Analog value output in the form of subroutines

The following versions a to c are distinguished by their software levels, program lengths, execution times and the number of program changes. Due to the standard execution time of 2.13 ms the PP-change is blocked and the serial interface is no longer operated for this period. If the interface is to function with a baud rate of 48ØØ or 96ØØ baud simultaneously, either version a or b can be used or version c with the commands NOP 1111 (operation of the data interface) given in brackets.

Subroutine version	Number of program lines	Execution time PCA14/15	Number of program changes (incl. RET) PCA14/15
a	31	3.Ø9 ms	11
b	15	4.31 ms	13
c	18	2.13 ms	1

a

```
6ØØ (SEA   Ø)
    SEO  23 *
    STH  411
    OUT   21 *
    STH  41Ø
    OUT   2Ø *
    STH  4Ø9
    OUT   19 *
    STH  4Ø8
    OUT   18 *
    STH  4Ø7
    OUT   17 *
    STH  4Ø6
    OUT   16 *
    SEA   Ø
    REO  23 *
    STH  4Ø5
    OUT   21 *
     .    .
     .    .
    STH  4ØØ
    OUT   16 *
    SEA   Ø
    SEO  22 *
    ORH  17 *
    REO  22 *
    RET   Ø
```

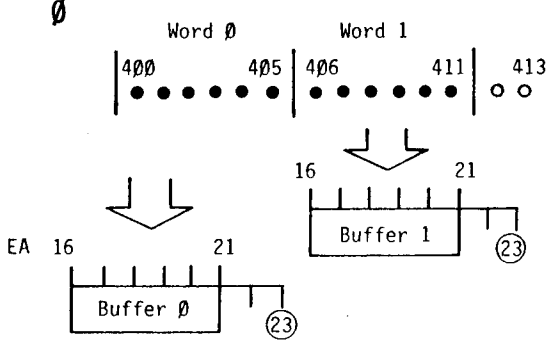
All routines for EA 16...23

b

```
65Ø (SEA   Ø)
    SEO  23 *
    SEI   Ø
┌─► STH 14Ø6
│   OUT 1Ø16 *
│   INI   5
└── JIO
    REO  23 *
┌─► STH 14ØØ
│   OUT 1Ø16 *
│   DEI   Ø
└── JIO
    SEO  22 *
    ORH  17 *
    REO  22 *
    RET   Ø
```

c (software level (1H))

```
7ØØ (SEA   Ø)
    SCR  3Ø1   } Value from C3Ø1
     22  411   } to flag 4ØØ...411
    REO  412
    SEO  413   ──► SEO 23: word 1
    SCR  3ØØ     Word 1 (8 bits)
     24  413     to C3ØØ
(NOP 1111**)
    SCR  3ØØ   } Word 1 (8 bits) to
     21   23 * } buffer 1 (SEO 23)
    REO  4Ø6
    REO  4Ø7 *   ──► REO 23: word Ø
    SCR  3ØØ   } Word Ø (8 bits)
     24  4Ø7   } to C3ØØ
(NOP 1111**)
    SCR  3ØØ   } Word Ø (8 bits) to
     21   23 * } buffer Ø (REO 23)
    SEO  22 *  } Output analog
    ORH  17 *  } value via
    REO  22 *  } channel 17
    RET   Ø
```



For versions a and b flags 4ØØ...411 are used. Version c uses counter C3Ø1 as an output register. 14 flags 4ØØ...413 are used in version c to load the buffers.

* For basic address 16.
** PCA14 as of version V6.Ø34 for a baud rate of 96ØØ bauds.

B 1.1.15 Type PCA1.W3.. 12-bit analog input and output module

Technical data

Inputs:

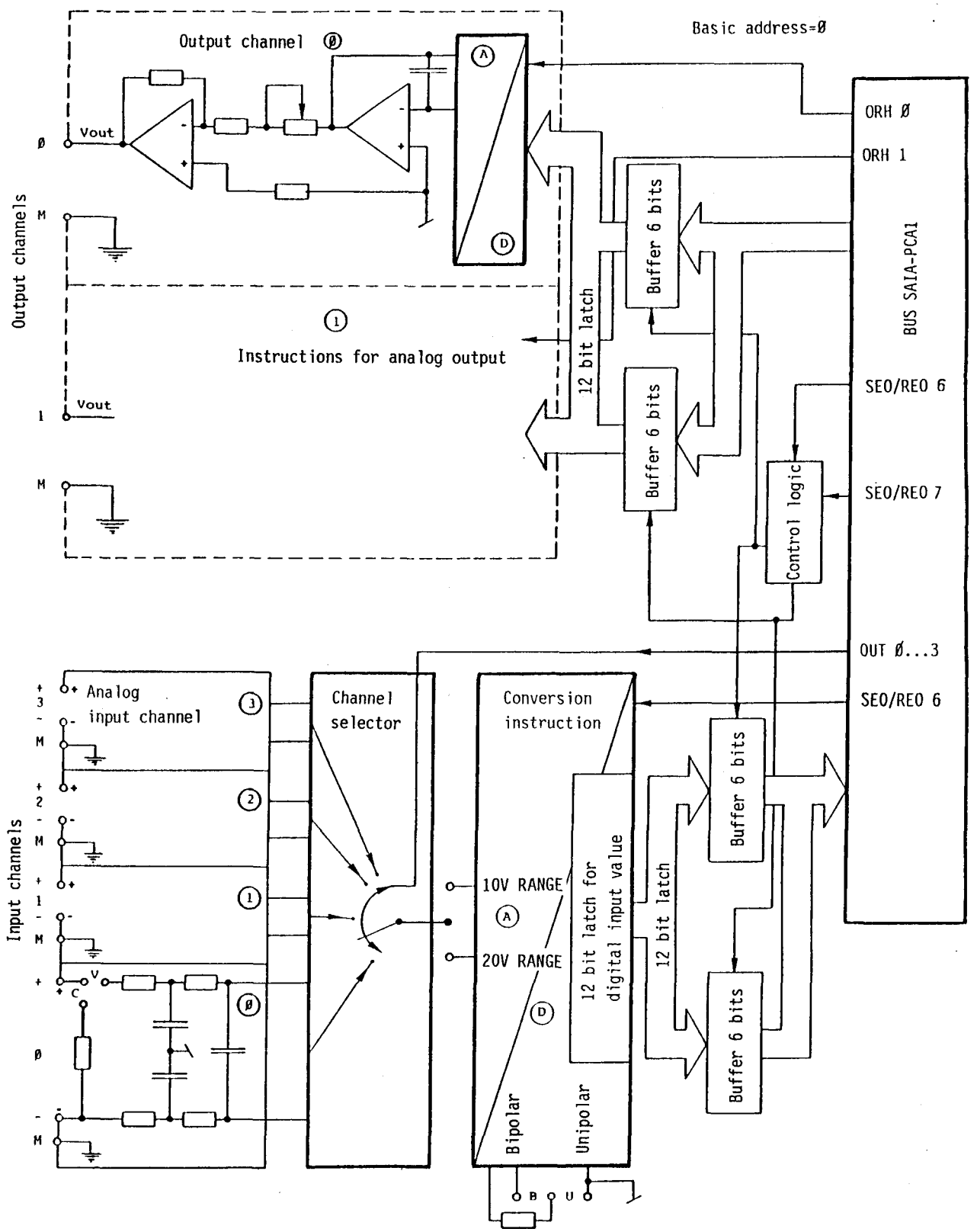
Number of input channels	4
Input circuit	Differential with filter
Signal ranges: - voltage	1) ØV...+1ØV 2) - 5V...+ 5V 3) -1ØV...+1ØV } Selectable for each module by means of a plug
- current	1) Ø ...+2ØmA 2) -1Ø ...+1ØmA 3) -2Ø ...+2ØmA } Alternatively pluggable as current loop. Current range acc. to voltage range selected above
Resolution	12 bits = 1/4Ø96
Accuracy (measured value)	typ. Ø.4% (max. Ø.8% during bipolar operation)
Repeatability	± 2 LSB*
Input impedance - voltage	≥ 1 MΩ
- current	499 Ω
Time constant of the input filter	Ø.1ms
A/D-conversion time	≤ 3Øµs
Max. admissible voltage	±15V

Outputs:

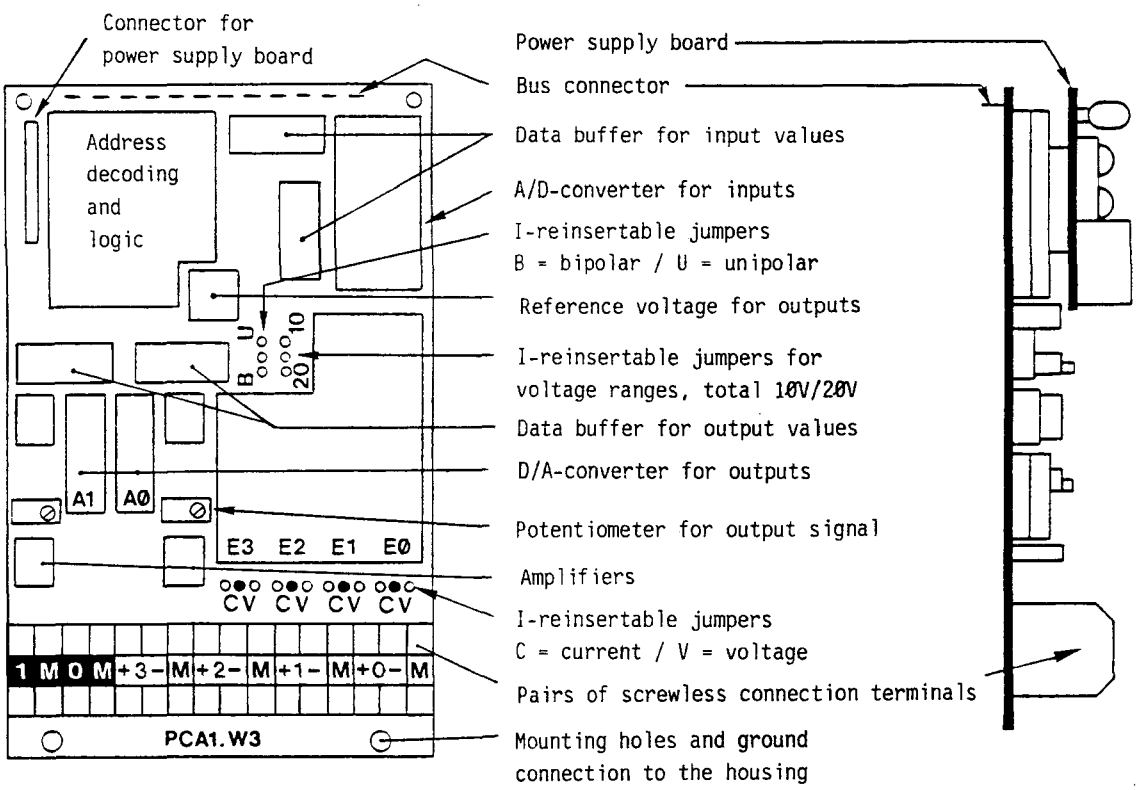
Number of output channels	max. 2
Resolution	12 bits = 1/4Ø96
D/A-conversion	≤ 2Øµs
Signal ranges: - voltage	Standard: ØV...+1ØV Spezial { ØV...+ 5V - 5V...+ 5V -1ØV...+1ØV
Accuracy (actual value) in range Ø...5V or Ø...1ØV	typ. Ø.4% ± 3ØmV**; max. 1% ± 3ØmV**
Load impedance	≥ 1ØkΩ
Current consumption 5V	1ØØ...12ØmA
25V	6Ø...1ØØmA

*) LSB: Least Significant Bit; e.g. 1ØV divided by 4Ø96: approx. 2.5mV
**) Max. constant offset value

Block circuit diagram PCA1.W3..



Presentation



Versions, order specifications

Type PCA1.W3Ø with 4 I-channels, without output channel
Type PCA1.W32 with 4 I-channels + 2 output channels (AØ +A1)

Signal ranges for inputs : selectable by jumpers
Signal ranges for outputs: Ø...1ØV (other ranges of values on request)

Connection to the process

Connection of the input channels

The common-mode voltage range of all input channels is ±1ØV, i.e., both potentials of each input channel must be within ±1ØV with respect to the ground. Under this condition correct registration of the measured data is ensured.

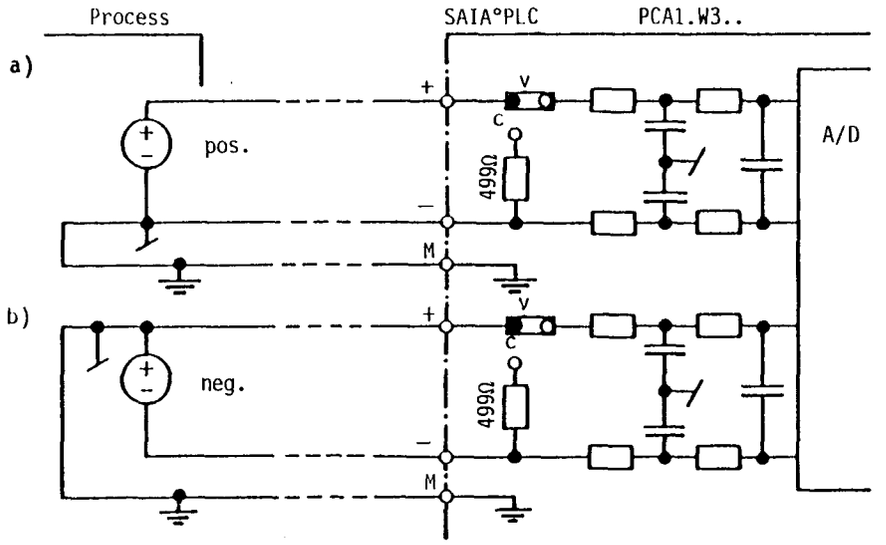
Preselection of the I-ranges:

- The process ground or measuring amplifier ground must be connected to the user ground of the PLC.
- The input voltage range of 1Ø/2ØV is preselected jointly for all inputs of a module via the connector.
- Whether bipolar voltages (±V) or unipolar voltages are to be registrated, is preselected jointly for all inputs of a module via the connector B/U.
- Operation with current can be selected for each input individually via the plug (C = current, V = voltage). If the connector is plugged into C, a precision resistance of 499Ω is switched into this input circuit, the voltage of which is evaluated. The current range depends on the selected voltage range (1ØV ≙ 2ØmA).

The following table shows the three basic ranges with respect to the corresponding digital value:

Digital value	Unipolar U operation (connector 1ØV)	Bipolar operation B	
		(connector 1ØV)	(connector 2ØV)
4Ø95	+1ØV (+2ØmA)	+5V (+1ØmA)	+1ØV (+2ØmA)
2Ø48	+5V (+1ØmA)	ØV (ØmA)	ØV (ØmA)
Ø	ØV (ØmA)	-5V (-1ØmA)	-1ØV (-2ØmA)

In case of unipolar operation the positive potential is applied to the plus-terminal. Figures a and b show the connection scheme for the measurement of positive or negative voltages respectively.



Software

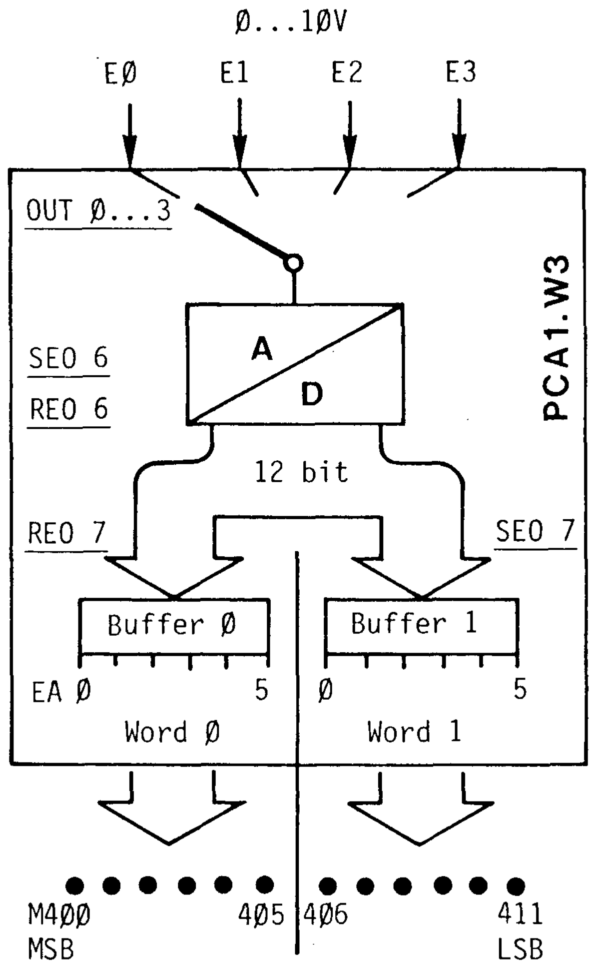
With the version PCA1 only 8 element addresses are available per I/O-module. In order to process the 12-bit data, they are split up into two words consisting of 6 bits each and processed one after the other.

Word Ø: contains the high-order 6 bits including MSB
Word 1: contains the low-order 6 bits including LSB

Read analog value (input channels)

For reading an analog value the following 3 steps are necessary:

A) Select input channel (OUT Ø...3)
B) Initiate actual A/D-conversion (SEO 6, REO 6)
C) Select the 6-bit word group Ø or 1 (REO/SEO 7)



Program for EA Ø...7

```
(SEA     Ø)
 OUT  Ø...3 *   Select input
                channel Ø...3
 SEO      7 *   Word 1
 SEO      6 * }
 REO      6 * } *A/D-conversion
 STH      5 *
 OUT    411
 STH      4 *   Transfer 6 bits from
 OUT    41Ø     buffer 1 to flags
  .       .     411...4Ø6
  .       .
 STH      Ø *
 OUT    4Ø6
-----------------------------------
 SEA      Ø
 REO      7 *   Word Ø
 STH      5 *
 OUT    4Ø5     Transfer 6 bits from
  .       .     buffer Ø to flags
  .       .     4Ø5...4ØØ
 STH      Ø *
 OUT    4ØØ
```

*) If the module is placed to a position other than Ø, the corresponding basic address must be added.

Read the analog value in the form of a subroutine (input channel)

The following versions a to c are distinguished by their software levels, program lengths, execution times and the number of program changes. Version c results in the shortest execution time. With the standard execution time of 2.Ø3 ms, however, the PP-change is blocked and the serial interface is no longer operated for this period. If the serial interface is to function with a baud rate of 48ØØ or 96ØØ bauds simultaneously, either version a or b can be used or version c with the commands NOP 1111 (operation of the data interface) given in brackets.

Subroutine version	Number of program lines	Execution time PCA14/15	Number of program changes (incl. RET) PCA14/15
a	3Ø	3.1Ø ms	11
b	15	4.35 ms	13
c	17	2.Ø3 ms	1

a

```
4ØØ (SEA    Ø)
    OUT   17 *
    SEO   23 *
    SEO   22 *
    REO   22 *
    STH   21 *
    OUT  411
    STH   2Ø *
    OUT  41Ø
    STH   19 *
    OUT  4Ø9
    STH   18 *
    OUT  4Ø8
    STH   17 *
    OUT  4Ø7
    STH   16 *
    OUT  4Ø6
    SEA   Ø
    REO   23 *
    STH   21 *
    OUT  4Ø5
     .     .
     .     .
    STH   16 *
    OUT  4ØØ
    RET   Ø
```

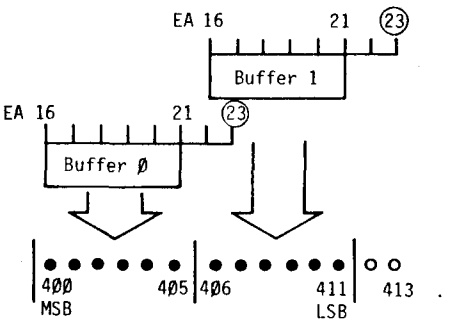
All routines for EA 16...23

b

```
45Ø (SEA    Ø)
    OUT   17 *
    SEO   23 *
    SEO   22 *
    REO   22 *
    SEI    Ø
┌─► STH 1Ø16 *
│   OUT 1416
│   INI    5
└── JIO
    REO   23 *
┌─► STH 1Ø16 *
│   OUT 14ØØ
│   DEI    Ø
└── JIO
    RET    Ø
```

c (software level (1H))

```
5ØØ (SEA    Ø)
    OUT   17        Selection of I-channel
    SEO   23 *
    SEO   22 *      A/D-conversion
    REO   22 *
    REO   23 *      Word Ø
    SCR  3ØØ  }     Value (8 bits) from buffer
     24   23 *  }   Ø into counter 3ØØ
(NOP 1111**)
    SCR  3ØØ  }     Transfer to flags
     21  4Ø7  }     4Ø7...4ØØ
    SEO   23 *      Word 1
    SCR  3ØØ  }     Value of buffer 1
     24   23  }     into counter 3ØØ
(NOP 1111**)
    SCR  3ØØ  }     Transfer to flags
     21  413  }     413...4Ø6
    SCR  3ØØ  }     Load value of 12 bits
     25  411  }     into counter 3ØØ
    RET    Ø
```



With all three versions the analog value is available as 12-bit binary value in the flag area 4ØØ...411. With version c the flags 412 and 413 are also used (because of the transfer of 8 bits instead of 6 bits). The routine c finally transfers the value to counter C3ØØ.

* For basic address 16.
** PCA14 as of version V6.Ø34 for a baud rate of 96ØØ bauds.

Output analog value (output channels)

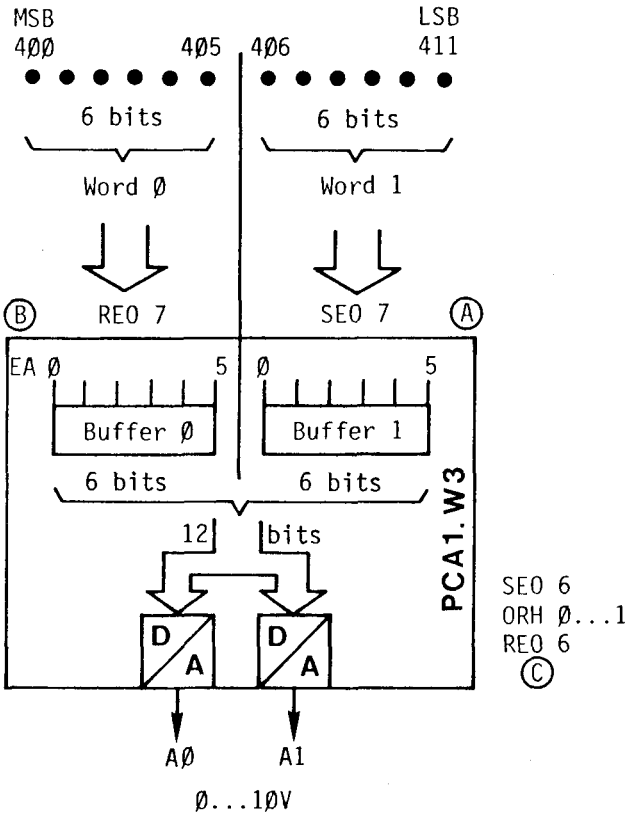
The 12-bit digital value to be output must be applied at the inputs of the digital/analog converters. This value is stored by means of an instruction (ORH Ø or 1) and output as analog value by the D/A-converter. The unchanged analog values of the 2 outputs are available to the process as long as they are not redefined by another instruction.

In order to output an analog value from a bit pattern in the flag area, 3 steps are necessary:

A) Transfer the first 6 bits (starting with LSB) to buffer 1 (SEO 7)

B) Transfer the second 6 bits (up to MSB) to buffer Ø (REO 7)
Release of the D/A-conversion (SEO 6)

C) Select the output channel with ORH Ø...1 and trigger the D/A-conversion at the same time. Block D/A-conversion again (REO 6).



SEO 6
ORH Ø...1
REO 6
C

Program for EA Ø...7

```
(SEA      Ø)
SEO       7 *    Word 1
STH     411
OUT       5 *
STH     41Ø
OUT       4 *    Transfer 6 bits to buffer 1   (A)
 .        .
 .        .
STH     4Ø6
OUT       Ø *

SEA       Ø
REO       7 *    Word Ø
STH     4Ø5
OUT       5 *
 .        .      Transfer 6 bits to buffer Ø   (B)
 .        .
STH     4ØØ
OUT       Ø *
SEA       Ø
SEO       6 *    Release and blocking of the D/A-conversion   (C)

ORH     Ø...1 *  Select output channel Ø...1 and output
REO       6 *
```

*) If the module is placed to an address other than Ø, the corresponding basic address must be added.

Analog value output in the form of subroutines (output channels)

The following versions a to c are distinguished by their software levels, program lengths, execution times and the number of program changes. Version c results in the shortest execution time. Due to the standard execution time of 2.13 ms, however, the PP-change is blocked and the serial interface is no longer operated for this period. If the serial interface is to function simultaneously with a baud rate of 4800 or 9600 bauds, either version a or b can be used or version c with the commands NOP 1111 (operation of the data interface) given in brackets.

Subroutine version	Number of program lines	Execution time PCA14/15	Number of program changes (incl. RET) PCA14/15
a	31	3.09 ms	11
b	15	4.31 ms	13
c	18	2.13 ms	1

a

```
600 (SEA    0)
    SEO   23 *
    STH  411
    OUT   21 *
    STH  410
    OUT   20 *
    STH  409
    OUT   19 *
    STH  408
    OUT   18 *
    STH  407
    OUT   17 *
    STH  406
    OUT   16 *
    SEA    0
    REO   23 *
    STH  405
    OUT   21 *
     .     .
     .     .
    STH  400
    OUT   16 *
    SEA    0
    SEO   22 *
    ORH   17 *
    REO   22 *
    RET    0
```

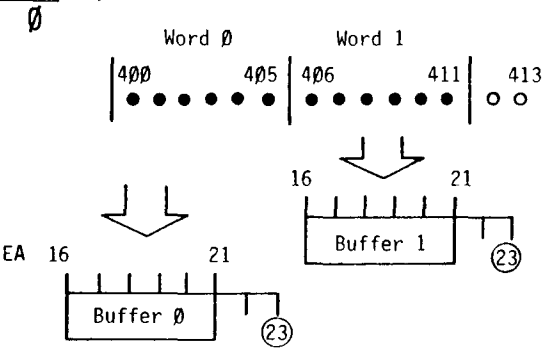
All routines for EA 16...23

b

```
650 (SEA    0)
    SEO   23 *
    SEI    0
    STH 1406
    OUT 1016 *
    INI    5
    JIO
    REO   23 *
    STH 1400
    OUT 1016 *
    DEI    0
    JIO
    SEO   22 *
    ORH   17 *
    REO   22 *
    RET    0
```

c (software level (1H))

```
700 (SEA    0)
    SCR  301    } Value from C301
     22  411    } to flags 400...411
    REO  412
    SEO  413    ——→ SEO 23: Word 1
    SCR  300    Word 1 (8 bits)
     24  413    to C300
(NOP 1111**)
    SCR  300    } Word 1 (8 bits) to
     21   23 *  } buffer 1 (SEO 23)
    REO  406
    REO  407 *  ——→ REO 23: word 0
    SCR  300    } Word 0 (8 bits)
     24  407    } to C300
(NOP 1111**)
    SCR  300    } Word 0 (8 bits) to
     21   23 *  } buffer 0 (REO 23)
    SEO   22 *  } Output analog
    ORH   17 *  } value via
    REO   22 *  } channel 17
    RET    0
```



For versions a and b flags 400...411 are used. Version c uses counter C301 as an output register. 14 flags 400...413 are used in version c to load the buffers.

* For basic address 16.
** PCA14 from version V6.034 onwards for a baud rate of 9600 bauds.

B 1.1.16 Type PCA1.W4Ø Analog input module for temperature sensor PT 1ØØ

Technical data

Number of inputs	6, electrically connected 2-, 3- or 4-wire technology, independent of each other
Temperature sensor	PT 1ØØ
Measuring ranges	-2Ø°C to 15Ø°C or Ø° to 4ØØ°C [1]
Resolution	8 bits (1/256 ≙ Ø,4%)
Accuracy (absolute deviation)	3 bits (≙ 1.2%)
Power supply per sensor	2mA
Time constant	dependent on the sensor response time
Internal power requirement 5V	4ØmA
24V	4ØmA

---

1) Measuring range selectable by jumpers:

Measuring range	Jumpers
-2Ø°C to 15Ø°C	A ; D (factory setting)
Ø°C to 4ØØ°C	B ; C

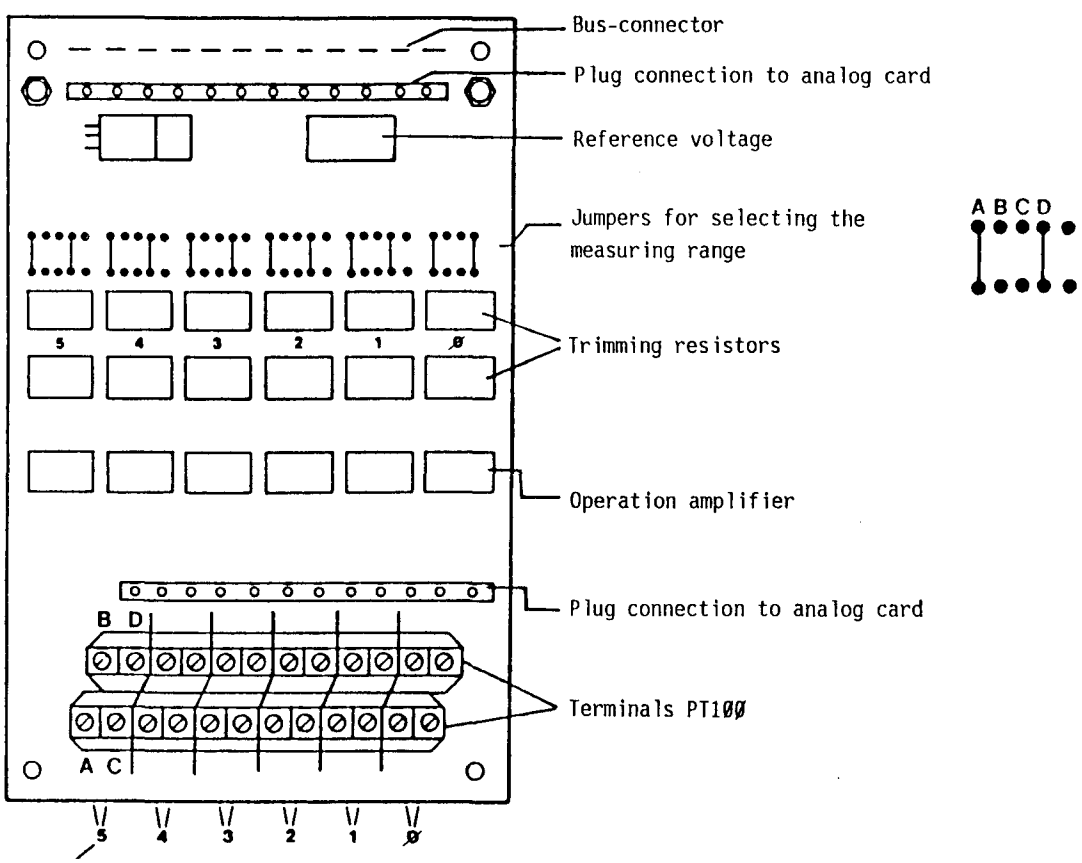
Resistance table PT 1ØØ/binary value PCA1.W4Ø

Sensor temp. °C	Sensor res. R Ω	Binary value	
		Meas. range -2Ø°C - 15Ø°C	Meas. range Ø°C - 4ØØ°C
-2Ø	92.2	Ø	(Ø)
Ø	1ØØ.Ø	3Ø	Ø
65	125.15	128	42
15Ø	157.28	255	96
2ØØ	175.76	(255)	128
4ØØ	246.6Ø	(255)	255

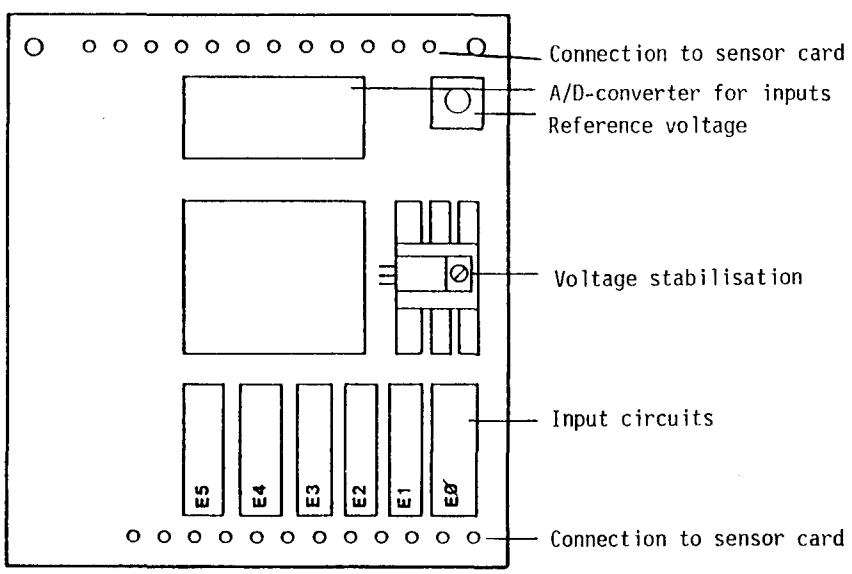
Presentation

The analog module for the PT 1ØØ temperature sensor consists of two pc-boards arranged on top of one another.

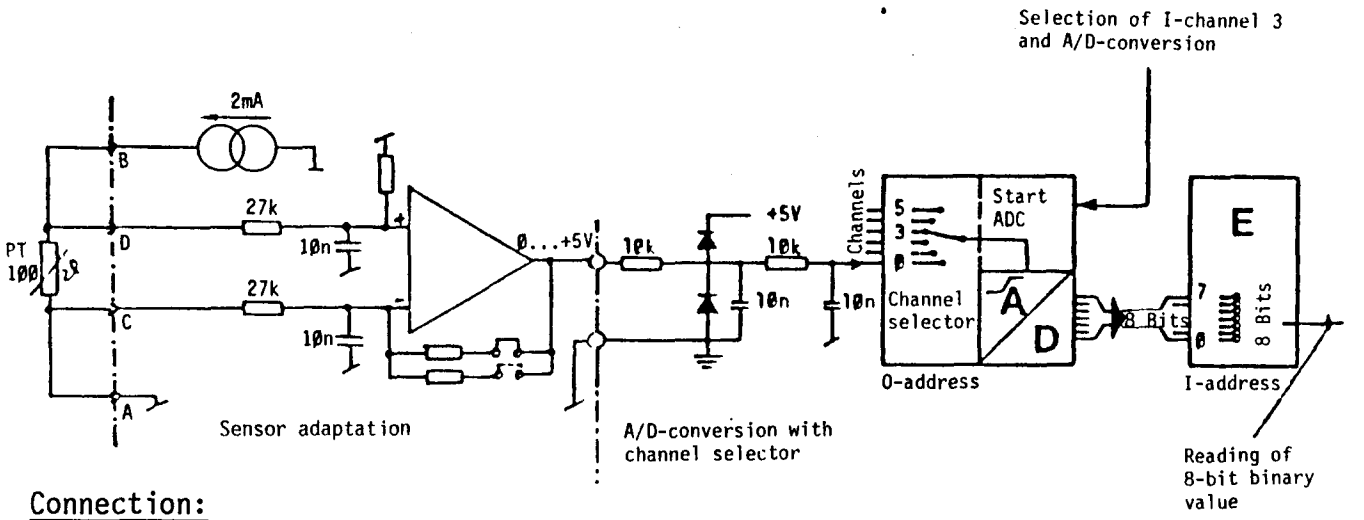
Sensor adapter card (lower)



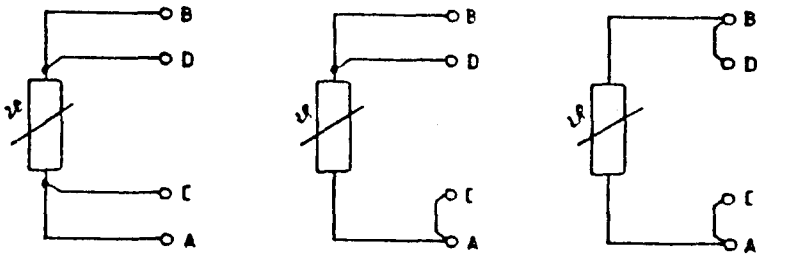
Analog/digital card (upper)



Input/output circuit and block circuit diagram



Connection:



Programming example for address range Ø...7

Reading in the analog input value at channel 3 (ADDR 3). The corresponding binary value is to be transferred to counter C26Ø.

```
1ØØ  OUT    3¹)    Select I-channel 3 and start A/D-conversion
1Ø1  SCR  26Ø      Read binary value of 8 bits to counter C26Ø
1Ø2   24    7¹)
```

Please note the basic address, i.e. on which location the module is mounted.

Example with basic address 24:

```
OUT   3 ⟶ OUT  27 (24+3)

SCR 26Ø ⟶ SCR 26Ø
 24   7 ⟶  24  31 (24+7)
```

B 1.1.17 Type PCA1.F11/F12 Preselector module for entering numerical values

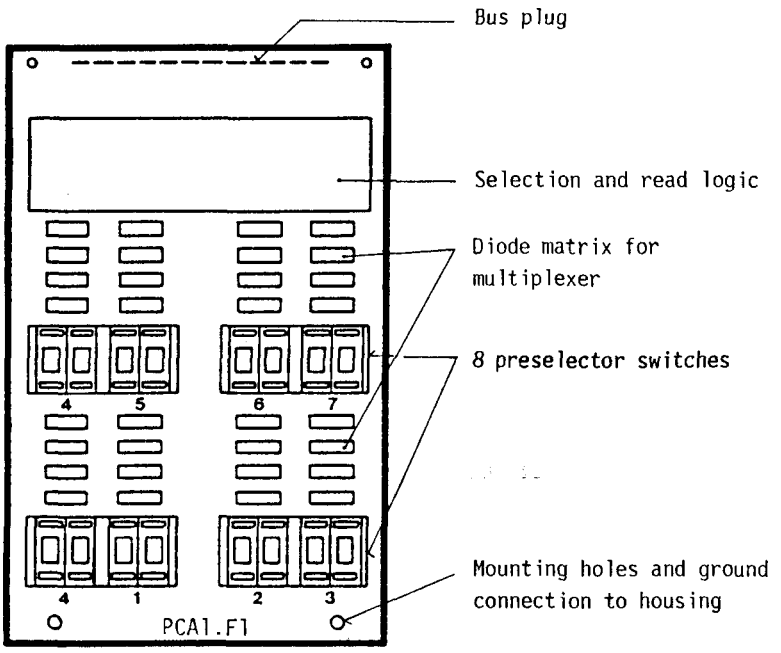
Application

With the preselector module numerical values can directly be entered without external wiring. If they are transmitted to the non-retentive flags or to counter registers, these values can be used as times, counter states or preselections of analog values.

Technical data

Number of input circuits	8
Range of digital values	ØØ...99
Input mode	Multiplex
Internal power consumption of the module (5V)	3ØmA

Presentation and switch allocation

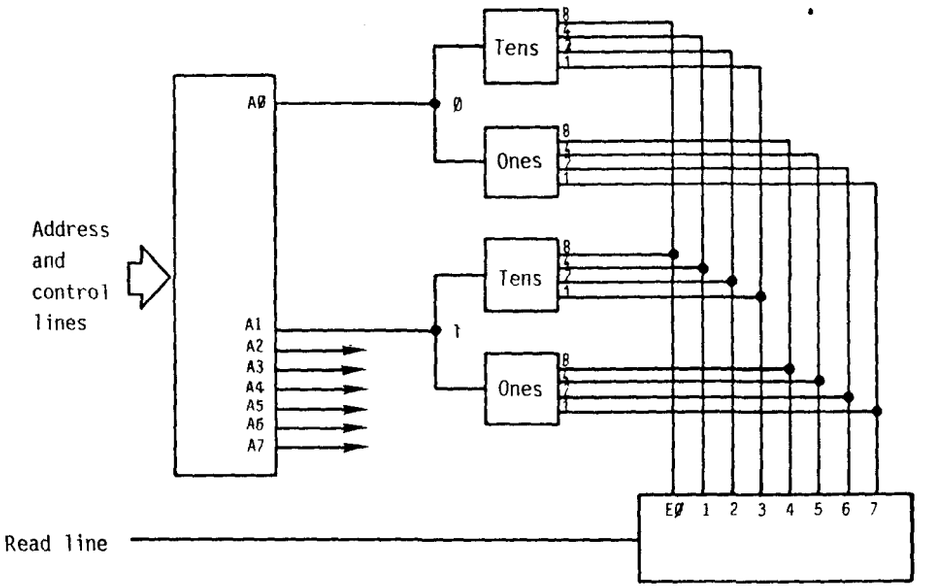


The following versions are available:

- PCA1.F11 with 4 pairs of preselectors, addresses Ø...3
- PCA1.F12 with 8 pairs of preselectors, addresses Ø...7

Due to removable BCD switches on sockets, every desired combination is feasible.

Principle scheme



The allocated pair of preselector switches (ones and tens) is activated by setting of output A0...A7. The preselected value can be read from the 8 address elements E0...E7 and afterwards be written on a non-retentive flag or be loaded into the desired register by a set timer or set counter operation. The activated outputs have to be reset afterwards.

Programming example:

The preselector module uses the address range 24...31.

a) The 2-digit value selected by preselector 2 shall now be read and loaded into counter register 262.

```
  .        .
  .        .
 (SEA      0)
  SEO     26 ; Setting the pair of preselector switches (addr. 24+2)
  SCR    262 ; Setting the counter with
  16      31 ; BCD-input x 1
  REO     26 ; Resetting the pair of preselector switches
  .        .
  .        .
```

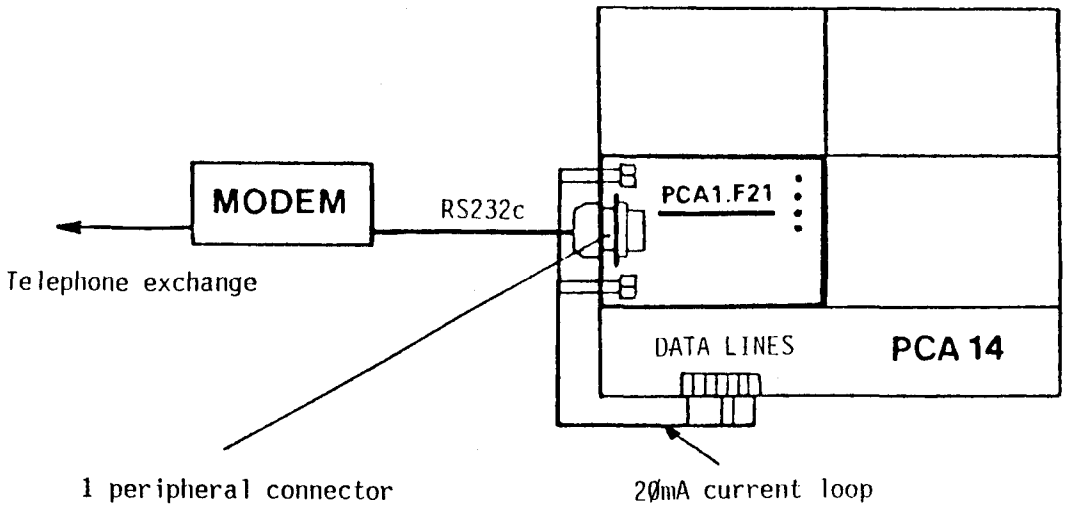
b) The value of pair 6 of the preselector switches shall be loaded into non-retentive flags 424...431.

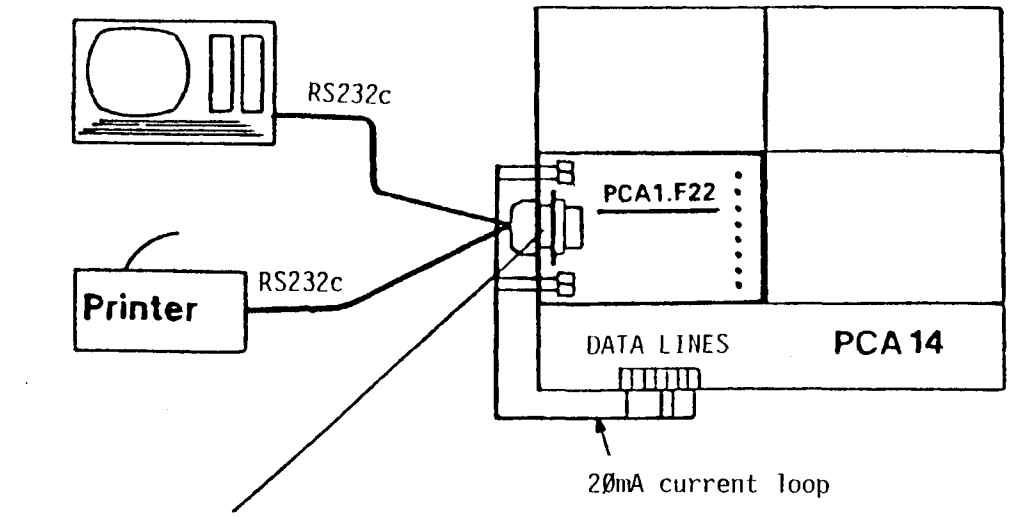
```
  .        .
  .        .
 (SEA      0)
  SEO     30 ; Setting the pair of preselector switches (addr. 24+6)
  SEI      0 ┐
┌►STH   1024 │
|  OUT   1424 } Transmission of value (8 bits)
|  INI      7 │
└─ JIO      -- ┘
  REO     30 ; Resetting the pair of preselector switches
```

B 1.1.18 Type PCA1.F21/PCA1.F22 Data line switching module (only PCA14)

Application

The module PCA1.F21 is fitted with one, the module PCA1.F22 with two serial interfaces of the type RS 232c. Via the DATA LINES of the CPU PCA1.M4.. data can be transferred between the SAIA°PLC and the peripheral units connected to the PCA1.F2. The module PCA1.F21 is particularly suitable for connection to a modem.





Technical data

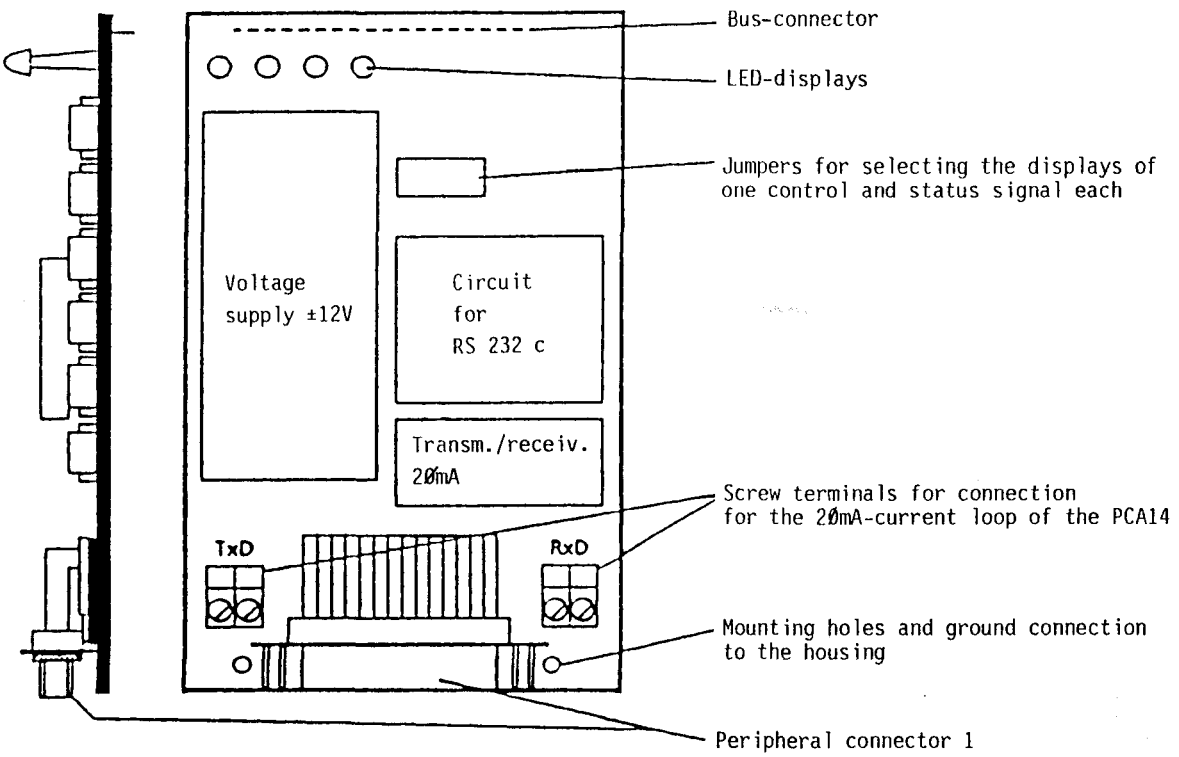
	PCA1.F21	PCA1.F22
Number of peripheral interfaces	1	2
Type of interface	RS 232c	RS 232c
Used addresses	8	8
Data transfer	The data transfer is performed between the CPU PCA1.M4.. via PCA1.F21/F22 and the connected peripheral units.	
Management of the peri-peral interfaces	By means of the user program with the corresponding control and status signals	
Number of control and status signals per peripheral interface	Total 6 CTS, DSR, DCD } Readable signals (status signals) RTS, DTR, ADC } Settable signals (control signals)	
Transmission speed	11Ø to max. 96ØØ bauds*, defined in the software by the PAS 1ØØ instruction	
Signal level of the data lines (according to standard RS 232c)	"L" : + 12V "H" : - 12V	
Level of control and status signals (acc. to standard RS 232c)	"L" : - 12V "H" : + 12V	
Connector for RS 232c	25-pole miniature connector, female (for details refer to section "Pin assignment")	
Power consumption (internal)		

	F21	F22
5V	125 mA	23Ø mA
24V	26 mA	43 mA

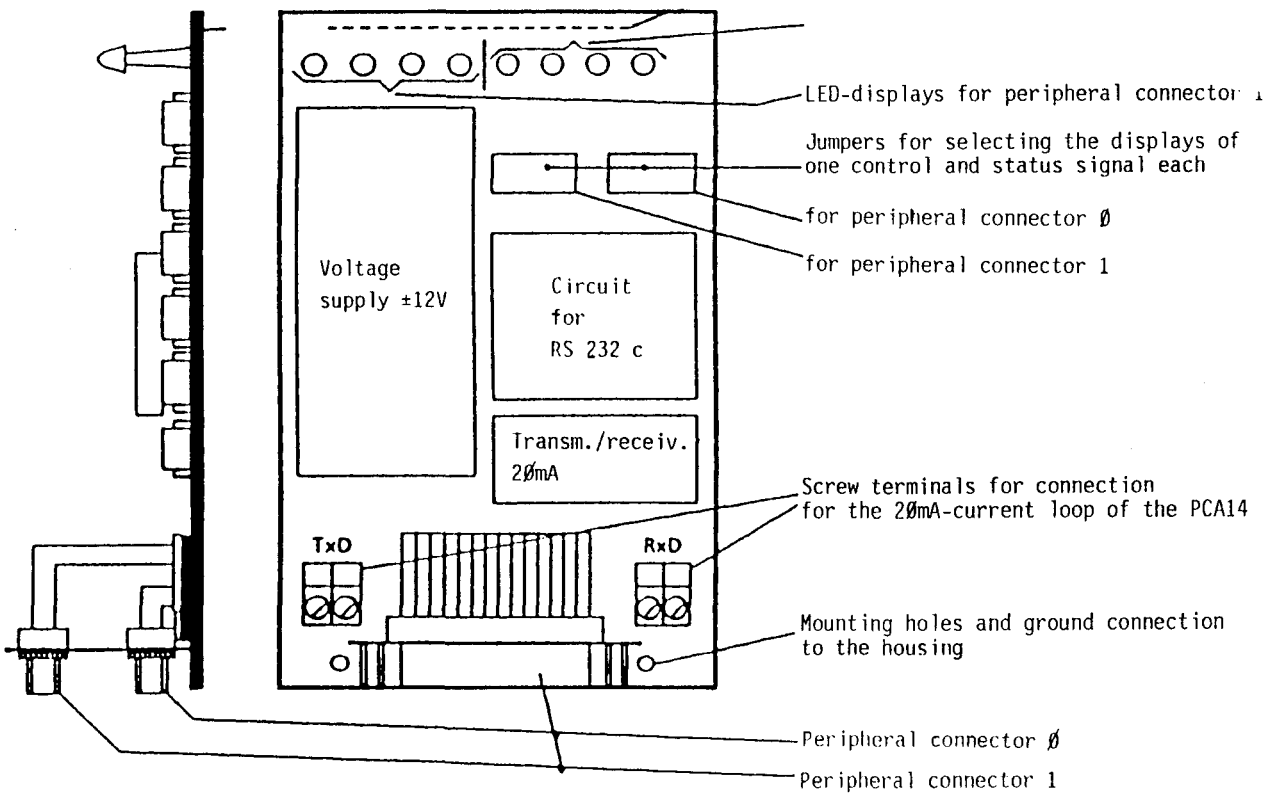
*) High baud rates depend on the program structure.

Presentation

PCA1.F21



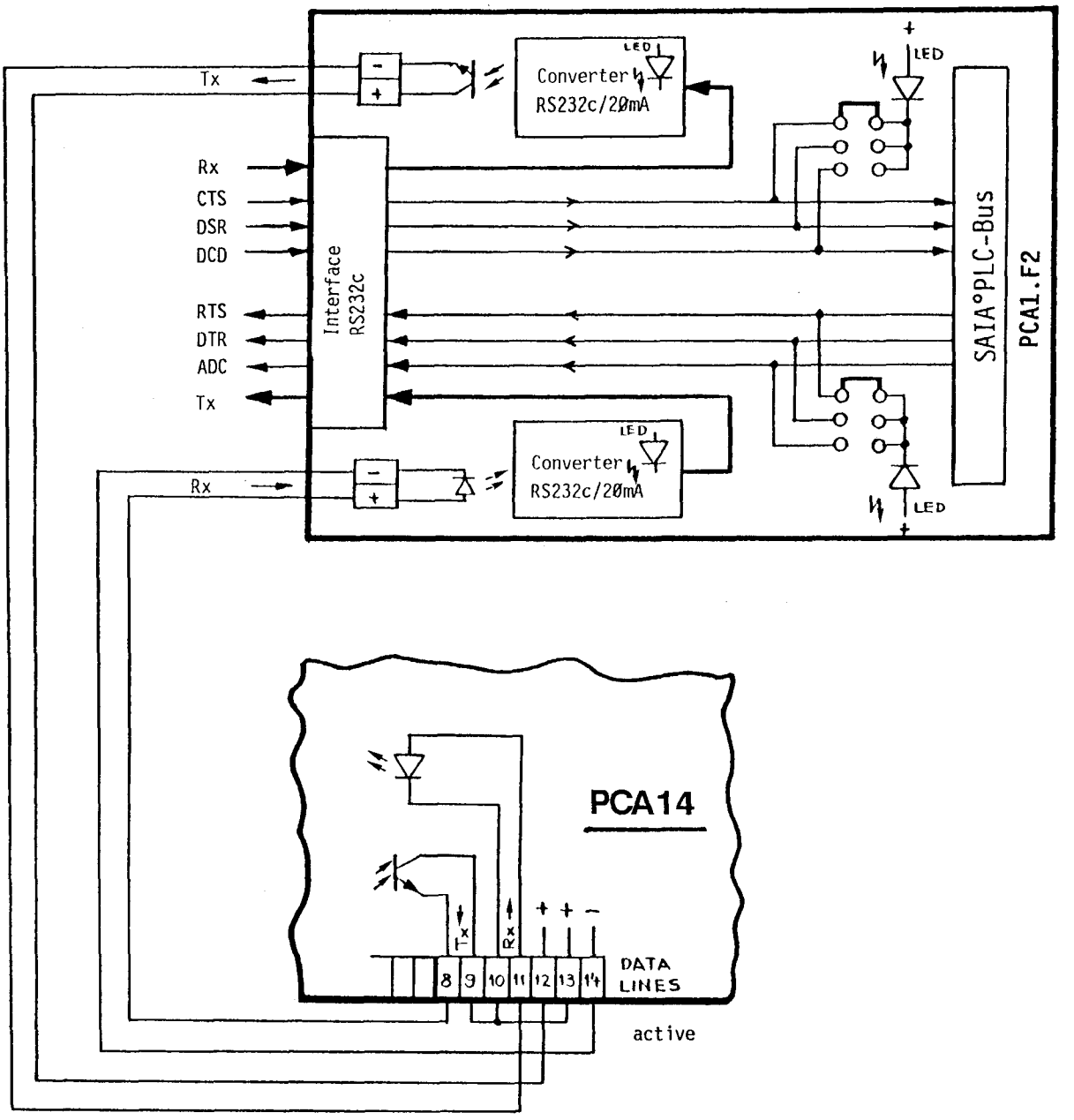
PCA1.F22



DATA LINES connection between PCA1.F2 and PCA14

Like an I/O-module, the module PCA1.F2 can be plugged into any location on the PCA14. Wiring must be effected in such a way that the 20mA-current loop of the PCA14 is active.

The external connection CPU ---> F2 is performed observing the same rules which apply to the cable layout of a 20mA-current loop. Two PCA1.F2-modules can be connected in series resulting in an increase of the number of interfaces to max. 4.



Address assignment and function of the signals

The peripheral interface of the PCA1.F21 or the two interfaces of the PCA1.F22 respectively must be managed by the user program. In order to make this possible, 3 status and 3 control signals each which can be set or read in the user program are available for each connector.

Address assignment

	Address *	Abbreviation	Treatment
Connector Ø (PCA1.F22 only)	Ø	SEL Ø	Settable and readable
	1	DTR DSR	Only settable Only readable
	2	RTS CTS	Only settable Only readable
	3	ADC DCD	Only settable Only readable
Connector 1	4	SEL 1	Settable and readable
	5	DTR DSR	Only settable Only readable
	6	RTS CTS	Only settable Only readable
	7	ADC DCD	Only settable Only readable

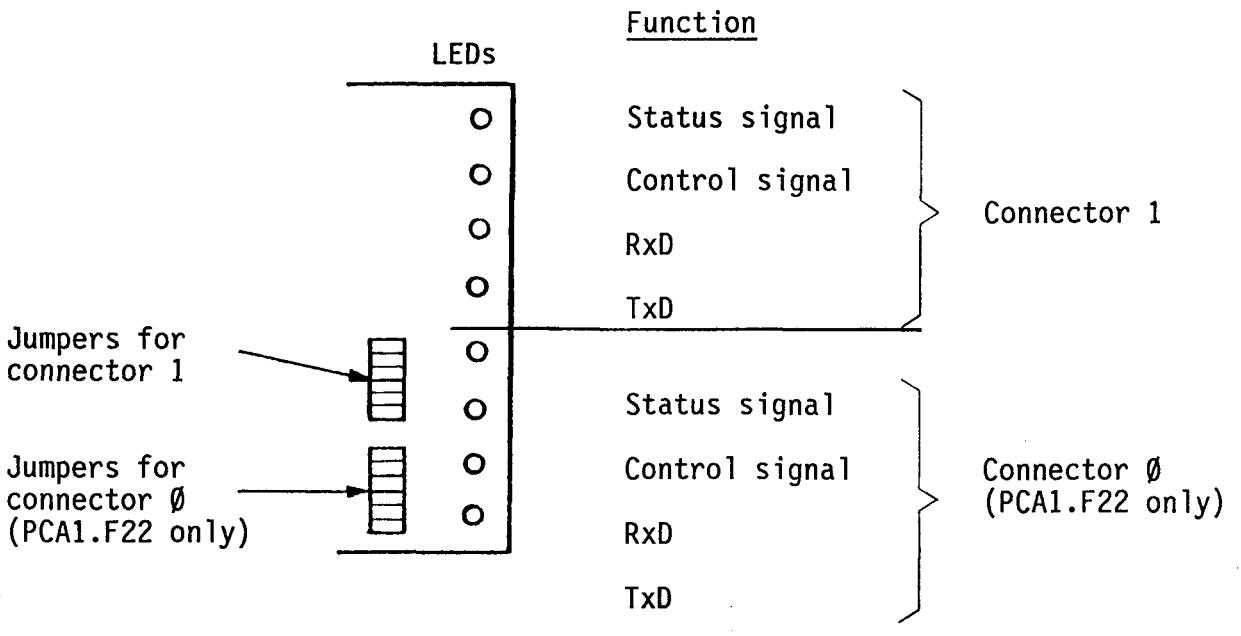
*) The addresses are valid for the mounting location Ø. The respective basic address must be added for other locations.

Function of the control signals

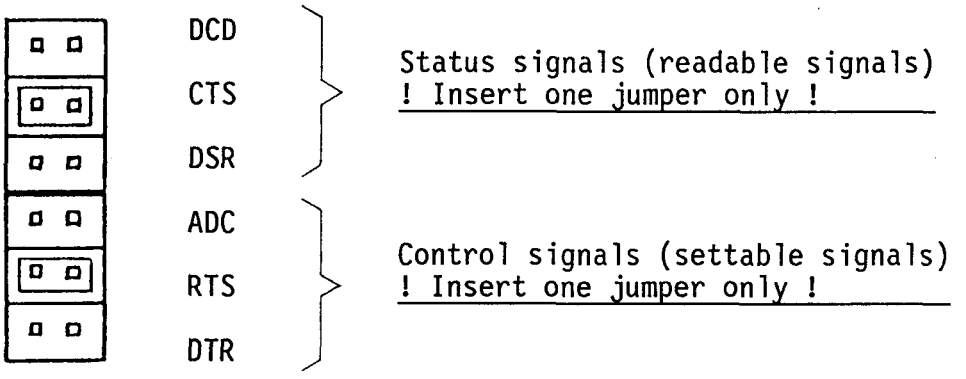
SEL Ø, 1 (Select)		With the instruction SEO SEL Ø, 1 the data lines (TxD, RxD) of the respective peripheral connector Ø or 1 are connected to the DATA LINES of the PCA14. With the read commands (e.g. STH SEL Ø, 1) it can be determined which peripheral connector was connected to the DATA LINES.
DTR (Data Terminal Ready) RTS (Request to Send) ADC (Auto Dialer Control)	1)	These three signals are control signals as described in the standard RS 232c. They can be set in the user program, thus supplying certain instructions or states to the connected peripheral unit. The signals can be interpreted in different ways depending on the peripheral unit.
DSR (Data Set Ready) CTS (Clear to Send) DCD (Data Carrier Detect)	1)	These three signals are status signals as described in the standard RS 232c. They can be read in the user program. The individual signals are interpreted depending on the peripheral unit and must be processed correspondingly in the user program.

1) Similar to the input/output module PCA1.B9Ø two signals each use the same address. (DTR/DSR, RTS/CTS, ADC/DCD). Consequently, one signal can only be set, the other one can only be read (see also "Address assignment").

Meaning of the LEDs



Jumpers for status and control signals:



For each connector 1 status signal and 1 control signal each can be displayed on the corresponding LED. The jumpers can be reinserted during operation, which permits checking the function of the connected peripheral unit.

If no jumper is inserted for the status or control signals, the corresponding LED is permanently illuminated.

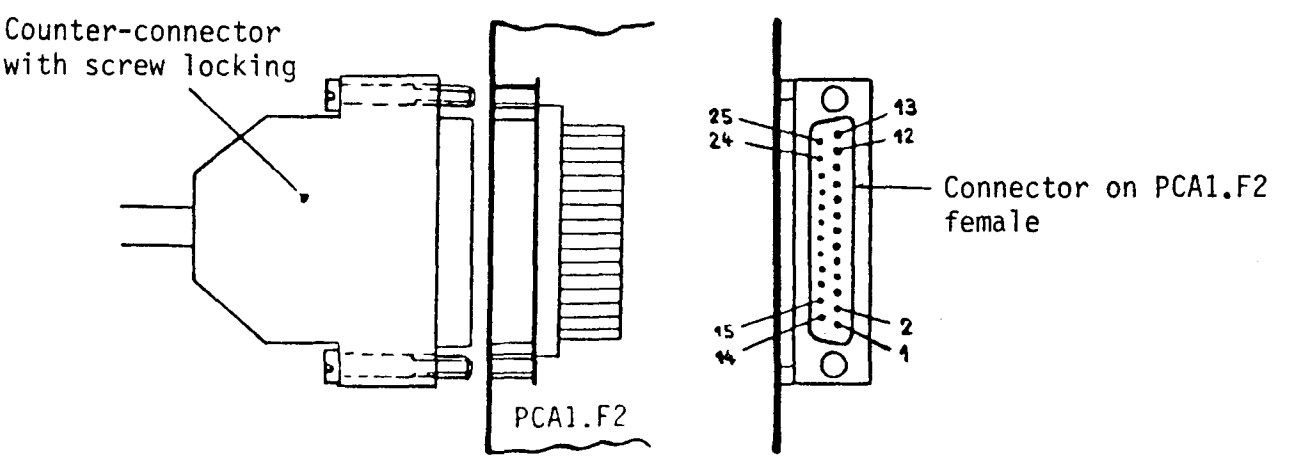
The LEDs "TxD" and "RxD" light up, if data is being transmitted or received. Depending on the baud rate and telegram length only a short flash or a long flickering is recognized.

RS 232c interface cable

The standardized guidelines hold true for laying the signal cable of the RS 232c, i.e. screened cable with a max. length of 15m (if possible not in the same cable duct as the power cables).

Pin assignment (according to RS 232c)

Pin no.	Abbreviation	Signal name	Direction of signal Periph. / PLC
1	PGN	Protective Ground	
2	TxD	Transmitted Data	←
3	RxD	Received Data	→
4	RTS	Request to Send	←
5	CTS	Clear to Send	→
6	DSR	Data Set Ready	→
7	SGN	Signal Ground	
8	DCD	Data Carrier Detect	→
9	ADC	Auto Dialer Control	←
2Ø	DTR	Data Terminal Ready	←
18	- 12V	Imax: 5mA	
21	+ 12V	Imax: 5mA	

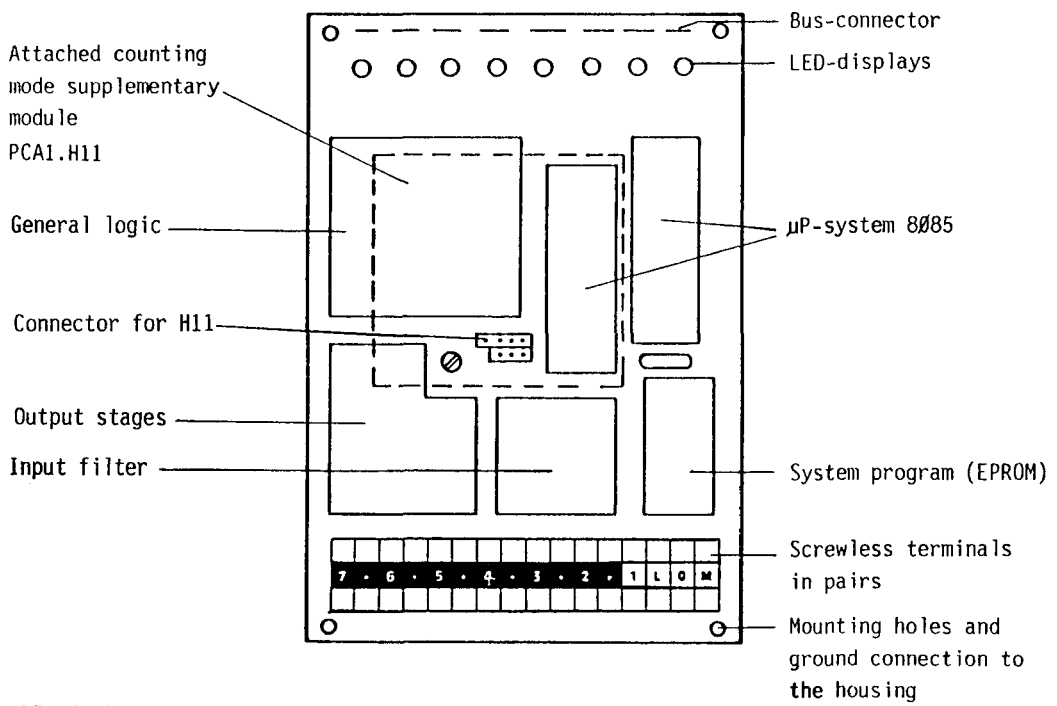


B 1.1.19 Type PCA1.H1.. Rapid counter or pulse generator up to 1ØkHz, 6 decades

Applications

- Counting of pulses up to a frequency of 1ØkHz: For example, from pulse generators, which are used for the determination of angles of rotation, throughput quantities, number of items or digital lengths.
- Recognition of the sense of rotation with 2-channel incremental shaft encoders: For example, for positioning with DC-current motors and connected pulse generators.
- Output of control pulses (2-fold): This allows positioning of x-y-tables, palletizing devices, handling robots with an appropriate stepping motor control.
- Measuring of frequencies, period lengths or pulse lengths, e.g. for determining the speed, number of revolutions, flow, synchronization, frequency, etc.
- Output of register contents to display modules PCA2.D12 (4 decades) or PCA2.D14 (2 x 6 decades).

Presentation



Detailed documentation and software modules

The detailed manual is available in German and English and consists of about 1ØØ pages.
It also includes software modules and practical examples of application. The software modules may also be used as macros for the SAIA°PCA ASSEMBLER.

Please contact our selling agencies.

Technical data

Counter module PCA1.HIØ

Number of counting systems	1
Counting frequency	max. 1ØkHz
Counting capacity	max. 999'999 (6 decades)
Counting direction	up and down
Data memory	volatile (data can be saved via CPU-registers)
Counter state display	with 2 display modules PCA2.D12
Inputs	- clock for counting pulses - up/down for counting direction Display of the logic states by 2 LEDs 24VDC/1ØmA, source or sink operation input delay 5Øµs
Outputs	Direct coincidence outputs - COOR: Low if Z = R - COOØ: Low if Z = Ø High by setting in the user program Outputs comparator or display mode - Z > R - Z = R - Z < R - Z = Ø Display mode selectable via user program Display of the logic states by 6 LEDs 5...32VDC/5ØØmA, positive switching load resistance min. 48Ω for 5...24V
Connection	Pairs of screwless terminals

Counting mode supplementary module PCA1.H11

(can be plugged onto counter module)

Counting modes	phase decoder (M1) or up/down mode (M2), can be selected by plug-in jumpers
Phase decoder (M1)	2-phase at inputs A and B, type of pulse processing (x1, x2, x4) selectable with plug-in jumpers
Up/down mode (M2)	Pulses at input A counting up, Pulses at input B counting down
Inputs A and B	24VDC/1ØmA, source or sink operation input delay 5Øµs
Counting frequency	max. 1ØkHz

Counter module PCA1.HIØ as pulse generator

(the same module functions either as counter or pulse generator)

Number of channels	2
Frequency	max. 1ØkHz
Frequency selection	via user program divisible into steps of approx. 5%
Stability	better than Ø.1% above the temperature range
Signal	symmetrical square-wave signal
Start generator	via the user program
Stop generator	after output of the programmed number of pulses or via inputs stop
Single pulse	via user program pulse length according to the programmed frequency
Outputs	- FØ1: Generator 1 - FØ2: Generator 2 Supply voltage 5...32VDC/5ØØmA, positive switching

Counter module PCA1.HIØ as measuring module

(identical hardware)

Number of channels	2
Measuring frequency	max. 5kHz
Accuracy	1%o (25°C)
Modes (software)	- Frequency measurement - Period length measurement - Pulse measurement
Frequency measurement	Duration 6-digit in ms
Period length	Number of periods to be measured, 6-digit
Pulse length	Number of pulses to be measured, 6-digit
Inputs	E1 signal input
Outputs	A7 duration of measurement A6 overflow

Available versions

PCA1.HIØ Counter module for deries PCA1
(alternatively usable as pulse generator)
PCA1.H11 Counting mode supplementary module (delivered separately)

In order to diminish the internal power consumption (at 5V) from 35ØmA to 19ØmA, a special version using CMOS technology was developed. It is referred to as PCA1.HIØ Z16. This is now the standard version.

B 1.2 Internal power requirement of the PCA1 modules

The internal power supply for 5V and 24VDC is provided by the power supply unit in the basic module or extension module respectively. The total current required for CPU, I/O-modules and programming or display module must not exceed the nominal power handling capacity.

Nominal power handling capacity of the internal power supply and constant loads of CPU, D11, D13, P1Ø and PØ5.

Nominal power handling capacity of the power supplies of PCA1.M4.., M5.., C45	5V side mA 1'7ØØ	24V side mA ØØØ
Power requirement CPU M4..	6ØØ	Ø
CPU M5..	45Ø	Ø
Extension C45 *	9Ø	Ø
Power requirement D11	1ØØ	Ø
D13	1Ø	Ø
(D12)	Ø	external
(P1Ø)	(2ØØ)	Ø
(PØ5)	(15Ø)	Ø

*) It must be noted that the ..C45 extension is able to supply about 5ØØmA more current than the M4/M5 modules, because of the removal of the CPU on the 5V side.

Power requirement of the PCA1 I/O-modules

Series PCA1	I at 5V (A) H (max.)	I at 5V (A) L (min.)	I at 25V (A) H (max.)	I at 25V (A) L (min.)
E1Ø/E11	68	11	Ø	Ø
E2Ø	7Ø	1Ø	Ø	Ø
E4Ø	7Ø	15	Ø	Ø
E5Ø	68	11	Ø	Ø
A1Ø	146	86	7	18
A21	9Ø	34	14Ø	Ø
A3Ø	1ØØ	26	7	7
A5Ø	9Ø	35	3Ø	Ø
B1Ø	112	54	4	9
B8Ø	12Ø	3Ø	Ø	Ø
B9Ø	1Ø5	5Ø	5Ø	5Ø
F12	3Ø	3Ø	Ø	Ø
F21	125	125	25	25
F22	23Ø	23Ø	45	45
W12	4Ø	3Ø	25	25
W24	7Ø	6Ø	7Ø	4Ø
W32	12Ø	1ØØ	1ØØ	6Ø
W4Ø	appr. 4Ø	appr. 4Ø	appr. 4Ø	appr. 4Ø
H1Ø Z16	19Ø	19Ø	55	55
H1Ø	35Ø	35Ø	55	55
H11	22	22	--	--
R2Ø	85	85	--	--
R2Ø + R25	95	95	--	--

H: all LED are on or max.
L: all LED are off or min.

Example:

	5Ø% I/O = H 5V/mA	5Ø% I/O = H 24V/mA
PCA1.M47	6ØØ	Ø
4 x B9Ø	21Ø + 1ØØ	1ØØ + 1ØØ
2 x A1Ø	146 + 86	7 + 18
2 x A21	9Ø + 34	14Ø
1 x P1Ø	2ØØ	Ø
TOTAL	1466 mA	365 mA
	(< 17ØØ mA)	(< 8ØØ mA)

B 2 Programming units, additional units and accessories

Additional units used for programming (simulation, starting-up, documentation)

PØ5	Hand-held programming unit	PCA2.PØ5
PØ1	Programming interface	PCAØ.PØ1
S1Ø	Input simulation unit	PCA2.S1Ø
K8Ø	Cable	PCA1.K8Ø
SØ5	Input simulation unit	PCA2.SØ5
P18	Programming unit	PCA2.P18
PCASS	SAIA°PCA ASSEMBLER	PCASS
P16	EPROM-Kopiergerät	PCA2.P16

Memory modules

R95	Memory module 4K, non-volatile	PCA1.R95
R96	Memory module 4K, non-volatile	PCA1.R96
R2Ø	Text memory extension module	PCA1.R2Ø
R25	Data memory extension module	PCA1.R25

Display modules

D11	Display module, 4-digit	PCA1.D11
D12	Display module (remote display), 4-digit	PCA2.D12
D13	Display interface for D12	PCA1.D13
D14	Display module (remote display), 2x6-digit	PCA2.D14

External interface module, type KOM

KOM 111B Dual-input interface, 22Ø VAC, type D4, output 24VDC/4ØmA pulsating per input

KOM 111B Dual-input interface, 11Ø VAC, type C8, output 24VDC/4ØmA pulsating per input

KOM 121B Dual-relay output interface, type M4

Switching power AC1 : 6A, 25Ø VAC (per output)
AC11: 1A, 25Ø VAC (per output)

B 2.1 Programming units

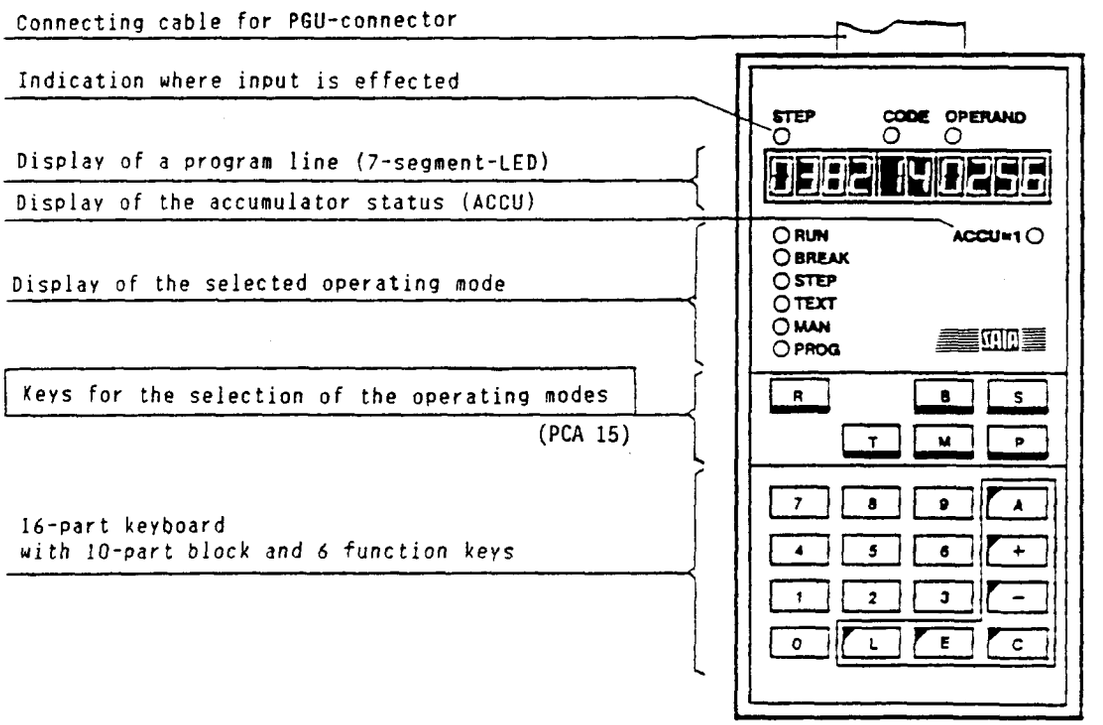
B 2.1.1 Hand-held programming unit PCA2.PØ5

This compact programming unit was developed in particular for the series PCAØ, but it can also be used for the series PCA1 and PCA2.

All operating modes can be selected with keys. Programming is performed in the "PROG"-operating mode by means of a 1Ø-part keyboard in simple numerical code. All elements (inputs, outputs, flags, timers, counters) can be queried or set in the "MAN"-operating mode.

All timer and counter values can be indicated in the RUN-mode. In the operating mode "STEP" a jump can be effected to any program line (= step address) of the user memory. Finally, "BREAK" permits the program processing up to a set breakpoint and continuation in step-by-step operation. For details refer to chapter C "Operating modes".

It must be noted that the keys for selecting the operating modes must be pressed at least Ø.5s for safety reasons. The selected mode is displayed by the corresponding LED.
In the case of PCA14, the operating modes are selected with the sliding switch on the basic module.

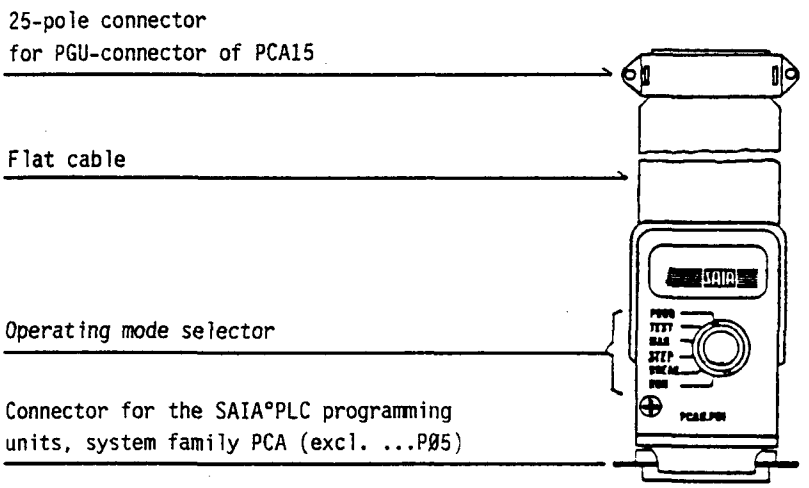


B 2.1.2 Programming interface PCAØ.PØ1 for PCA15

This interface allows connection of the following SAIA°PLC programming units to the series PCA15:

PCA2.P18 - Hand-held computer with a wide range of possibilities
(from software version V18-Ø4 onwards)
PCASS - IBM-PC with SAIA°PCA-ASSEMBLER

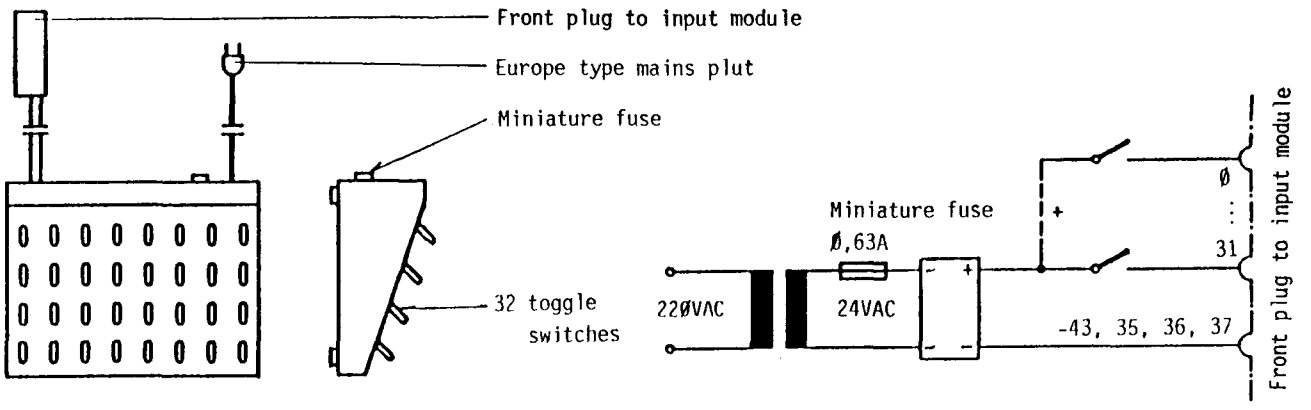
As a result, all upwards compatible tools of the SAIA°PLC, system family PCA, are available also for the PCA15.



B 2.1.3 PCA2.S1Ø 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 from which are fed to the PLC inputs via a system cable and plug.

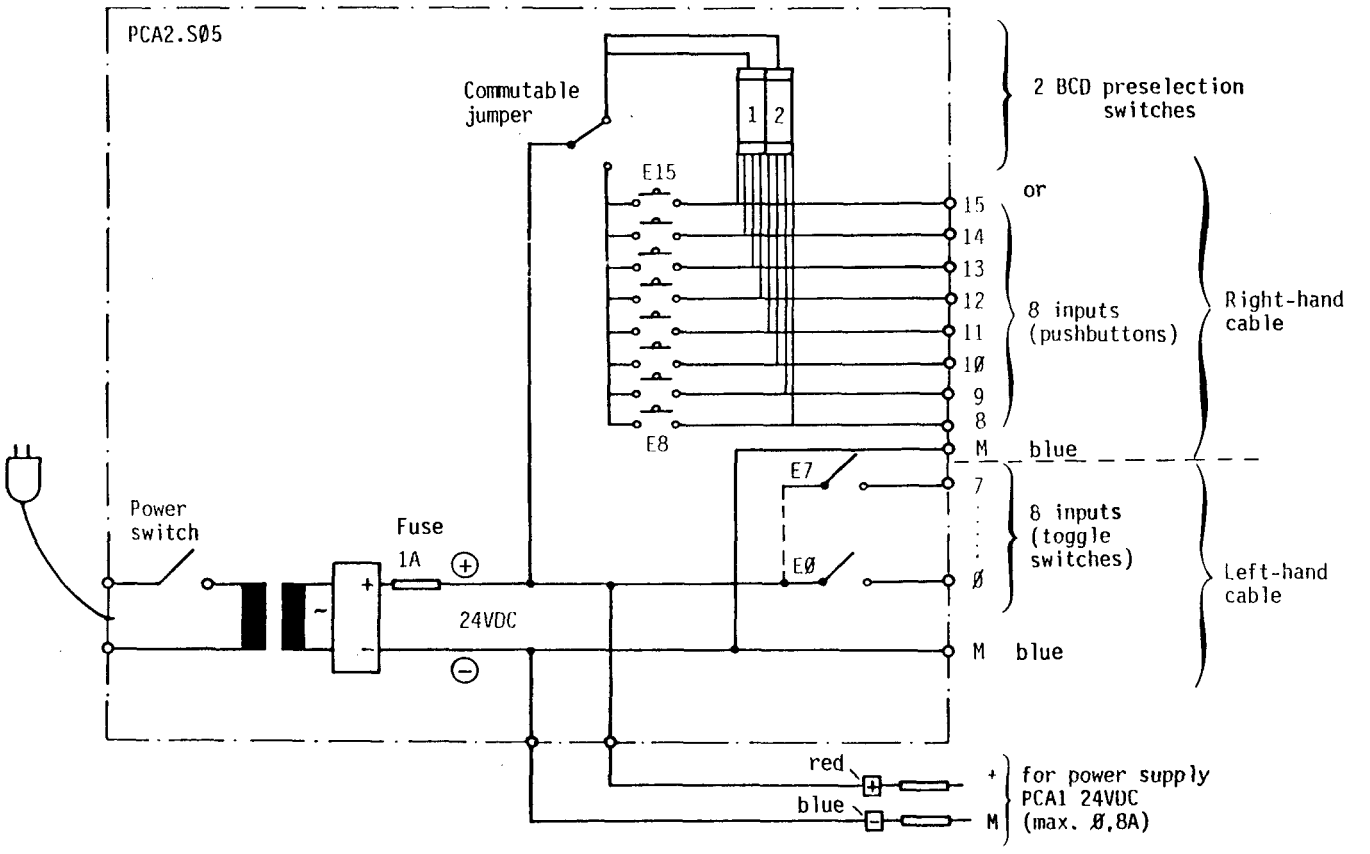
Ordering designation for connection to 22ØVAC: PCA2.S1Ø D4



B 2.1.4 PCA2.SØ5 Input simulation and supply module

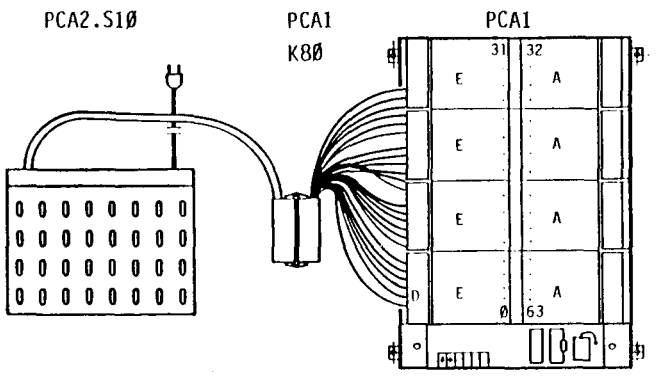
Ordering designation for connection to 22ØVAC: PCA2.SØ5 D4

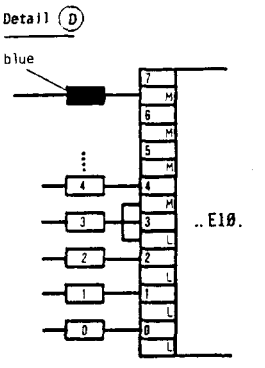
The housing is identical to that of the S1Ø, except that it has an integrated supply of 24VDC and a pair of BCD-switches for entering numerical values. A reversing switch also allows using the pulse keys. Direct connection of cables to inputs (see also dimensional diagram, chapter B 2.4).



Intermediate cable type PCA1.K8Ø for PCA2.S1Ø

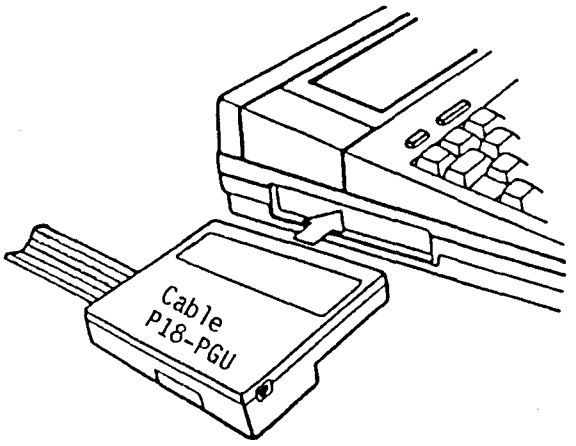
The cable K8Ø is connected to the connector of the S1Ø-device and led out via 33 pins with the aid of hardened steel pins. Each of these pins can be plugged into the I-terminals and removed without tools.
The K8Ø-cable can be used for all input modules (E1Ø, E11, E2Ø, E4Ø und B1Ø, B8Ø, B9Ø). However, the respective bridge circuit of the minus (M, L or -) must be observed.

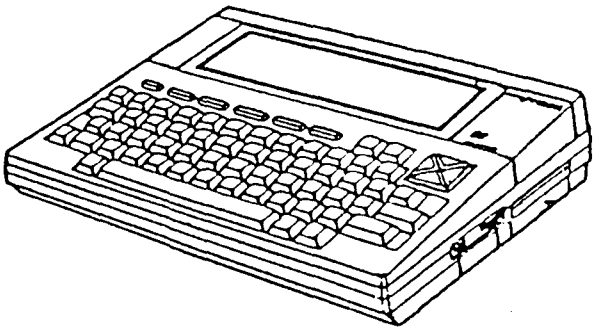




Connection of I-modules

B 2.1.5 Programming unit PCA2.P18





Brief description

The programming unit PCA2.P18 is a compact and versatile means which can be used for programming all SAIA°PLC as well as for servicing.

The P18 uses the commercial hand-held computer, type NEC 82Ø1A, as hardware. Compactness combined with a high degree of intelligence, an efficient firmware and a variety of peripherals form an ideal portable programming unit, be it on your desk or out in the field.

With the SAIA°PLC connected (via PGU-connector), the P18 makes programming very easy. Moreover, SAIA°PLC texts can be edited or all PLC-registers can be accessed on-line for servicing purposes via the 2ØmA-data line of the PCA14 and PCA15.

In short, the following functions are possible:

- Programming in numerical or mnemonic code
- Display of program sections and texts
- Search functions
- Storage and loading of user programs and texts
- Printing of programs (on an external printer)
- Editing and output of SAIA°PLC texts
- Acces to data and registers of the SAIA°PLC while user program is running.

Thanks to the permanently stored BASIC-interpreter and the text processing program, the P18 can also be used as a portable personal computer. Numerous additional interfaces and the corresponding software support communication with peripheral units such as printer, modem, tape unit, disk drive unit and bar code reader.

A detailed description is supplied with each unit.

B 2.1.6 SAIA°PCA ASSEMBLER

The software package SAIA°PCA ASSEMBLER for comfortable programming, documentation and starting-up

The PCA-ASSEMBLER makes programming of the PCA-family of controllers very easy. The user is efficiently supported in his work by practical menus and the appropriate auxiliary pages which means that he virtually does not require a manual or a knowledge of MS-DOS.

The user program is written in the so-called "Editor" using a conventional text processing program (e.g. Personal Editor or Wordstar). It is possible to use practice-oriented designations for the operands to mark jumps in the form of symbols and labels which are then converted to a PCA-program by the actual "Assembler" and "Linker". Macros with parameters can be implemented for frequently used routines and comments can be used for clearly documenting the new program.

Further possibilities of the new PCA assembler include the modular and global documentation, presentation as flow-charts, an efficient cross-reference list and it is also possible to load the program directly into the RAM-memory of the PCA.

Its advantages become obvious particularly when the controller is started up. In RUN-mode the "Online Debugger" allows the actual states of elements such as inputs, outputs, flags, timers, counters, registers and the date-time to be displayed and also modified. The programs "P1Ø" and "CI" permit direct access to the RAM user memory of all PCAs. By selecting the submenu "Program eproms", tested user programs can be directly loaded into the EPROM programming units PCA2.P16 or ERTEC PGS49.

The software package SAIA°PCA ASSEMBLER can be run on all IBM-PC/XT/AT or PS/2 or compatible units which fulfil the following conditions:

- 512 Kbyte main memory
- 2 floppy disk drives of 36ØK or even better 1 floppy disk drive and a hard disk
- 1 or even better 2 bidirectional, parallel interfaces for controlling a printer and for connection to the PGU-connector of the PCA
- Monochrome or colour VDU (with MCGA, CGA, EGA, VGA or Hercules cards)
- Keyboard as desired
- Operating system MS-DOS 3.Ø or a higher version
- Cable PCA2.K43 for connection to the PGU-connector of the PCA
- Text processing program as desired (Personal Editor and Wordstar are recommended)

A detailed description is available for every software package.

Screen

Main menu of PCA-ASSEMBLER

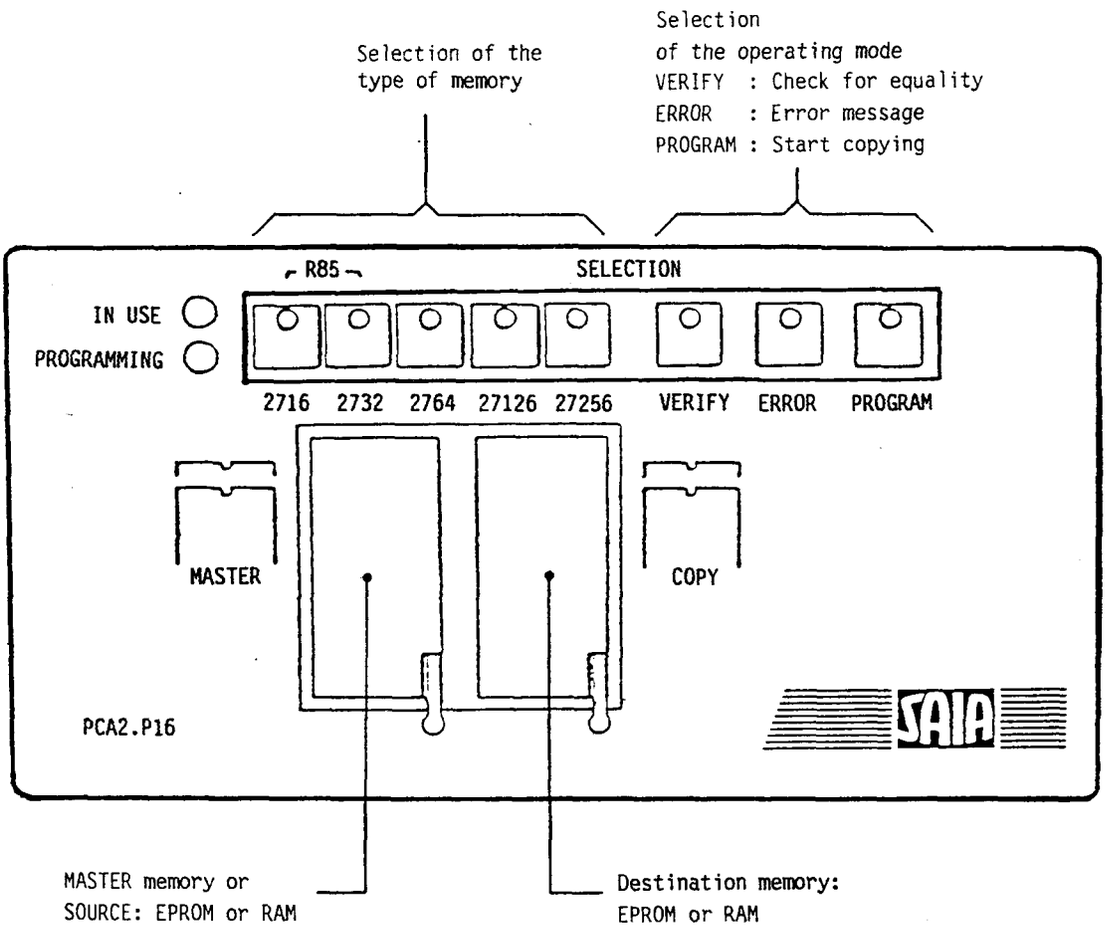
```
SAIA PCA ASSEMBLER V1.1                                    MAIN MENU
        xxxxx  SAIA AG   Marktbereich CH   3280 Murten  xxxxx
Directory: C:\PCASS                                  16.12.88 13.30

    Edit                Text assembler          Compare programs
    Assemble            Disassembler            Xref listing
    Link                flow chart              File handling
    Up/download         Runtime analysis        Ms-dos command
    Online debug        Hex converter           Setup
    comms Interface     Program eproms          Quit

<ARROW>, <SPACE> or <Tab> selects operation, <CR> or <Command letter> executes
```

ONLINE DEBUG menu of PCA-ASSEMBLER

```
SAIA PCA ONLINE DEBUG V3.4
 Display
   C260    2090
    e12    0011 0010
   BZ00    EE EF FF 3D 67

    Σ0     1101 0000 0100 0011
   TZ56    2163
 Clock
 wy dw yy mo dm hh mm ss
 88 03 88 12 15 17 05 58
 Program
  A    1    03    2
  A    2    03    7
  A    3    10    12
  A    4    10    21
  A    5    10    13
  A    6    10    24
  A    7    14    256
  A    8    00    500
  A    9    01    256
  A   10    10    25
  A   11    20    0
 Write

 Display  Write  Program  clocK  Save  Load  comms-interface  Reset  Quit
```

B 2.1.7 Type PCA2.P16 EPROM-copying unit

Owing to two high- quality sockets (Texttool) the unit can be used for copying and comparing EPROMs and buffered RAMs independently of other units. The serial interface RS 232c permits connection of any commercial personal computer. A program supporting operation of the P16 from the IBM-PC is part of the PCA-assembler (package no. 3).



The P16 meets especially the requirements of the SAIA°PLC. In addition to the usual EPROM types 2716 to 27256, the buffered RAMs PCA1.R95 and PCA1.R96 can be written to and read.

Technical data

Supply voltage	22Ø VAC 5Ø Hz ± 1Ø%
Power requirement	2Ø VA
Microprocessor	MC 68Ø9
Serial interface	RS 232c (96ØØ, 24ØØ, 12ØØ and 3ØØ bauds)
Dimensions	222 x 47 x 172 mm (W x H x D)
Weight	1.7 kg

With the P16 the following memory modules can be programmed:

Type	Programming voltage:	
2716	25V	
2732	25V	1) 3)
2732A	21V	1)
2764	21V	
27128	21V	
27256	21V	2)
2816		3)
PCA1.R95 (buffered RAM)		
PCA1.R96 (buffered RAM)		

1) For the type 2732A the P16 has been set to a programming voltage of 21V (factory setting).
   For the type 2732 which has a programming voltage of 25V, a jumper needs to be re-soldered on the pc-board EP 8Ø Ø67.
2) For the type 27256, which has a programming voltage of 12.5V, the resistor R3 (3k6) needs to be changed to 2k on the pc-board EP 8Ø Ø66.
3) Do not use with SAIA°PLC.

Copying

During copying, data is read from a master-IC and written to a copying-IC. When working without the Personal Computer, i.e. without using the serial interface, copying can usually be performed only using the same types of EPROM. However, mixed operation is possible using the EPROM 2764 and buffered RAMs PCA2.R95 or PCA2.R96. Only the entire memory contents can be copied from the MASTER socket to the COPY socket.

1. Select the copying EPROM with the appropriate key. The corresponding LED lights up. For the EPROM-emulators R95 and R96 the keys 2716 and 2732 must be pressed simultaneously.

2. Insert the master-IC and the copy-IC in the frames. Take care that the notch or pin 1 respectively is at the top on the left.
   The ICs are retained in the frames by pressing down the levers. In the case of the 24-pole ICs it must be noted that the upper contact openings must not be covered.

3. Press key "PROGRAM". The LED "IN USE" lights up for a short time. During this time a check is performed to determine whether the memory module to be programmed has been erased. Afterwards the LED "PROGRAMMING" also lights up until programming is finished. Any errors which occur during programming, are displayed by the flashing LED "ERROR". Moreover, an LED lights up in the keys indicating the type of error.

   Error messages

   Key 2716 : EPROM cannot be programmed
   Key 2732 : EPROM has not been erased
   Key 2764 : EPROMs are different
   Key 27128: EPROMs are different and copy-IC empty
   Key 27256: 2816 cannot be erased

   The error display is cleared with the key "ERROR".

Comparing

The procedure is similar to copying. However, The LED "PROGRAMMING" does not light up. Proceed as follows:

1. Select copying-EPROM with the appropriate key.

2. Press key 'VERIFY'.

If no error message appears, the contents of the two memory modules are the same. The flashing LED "ERROR" indicates an error (see list of errors).

Erasing the 2816 (EEPROM)

In order to erase the 2816, press the key 'ERROR' and '2716' simultaneously.

Important: The memory module 2816 cannot be used together with the SAIA°PLC.

Serial interface RS 232c

The integrated serial interface offers the experienced user manifold possibilities of programming the P16 from a Personal Computer. See also chapter B.6 of the manual PCA2.P16.

When the PCA2.K46 cable is used, the transfer of data is supported under menu-guidance by the SAIA°PCA ASSEMBLER with the "Program eproms" program.

B 2.1.8 Type PCA1.R95/R96 Buffered RAM chip

RAM-memories are read-/write-memories, which means that the information can be modified at any time with the aid of a programming unit (as data memory in the PCA14 also via the user program).

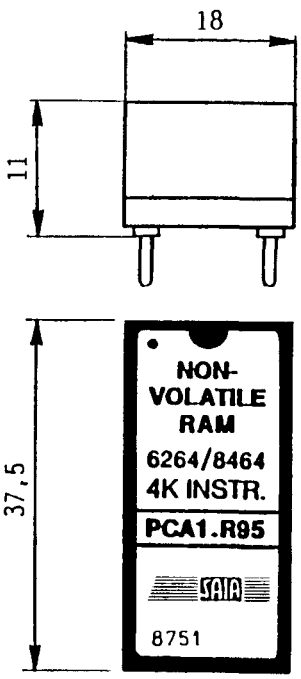
The buffered RAM chip is the ideal memory chip serving as a program and text memory from the programming stage to the start-up. Owing to the incorporated buffer battery and the protective electronic system this memory chip can be detached from the PLC and transported without modifying its contents.

The slightly conductive plastic socket protects the pins against static charges, thus avoiding memory content changes. The internal battery is thereby not discharged.

Memory type	PCA1.R95	PCA1.R96
Storage capacity		
- Program lines	**4K**	4K
- Texts, data	**8K**	8K
Number of pins	**28**	28
Buffer battery life	approx. 8 years	approx. 6 years

Application in PCA14/15, PCAØ and PCA2.

Presentation



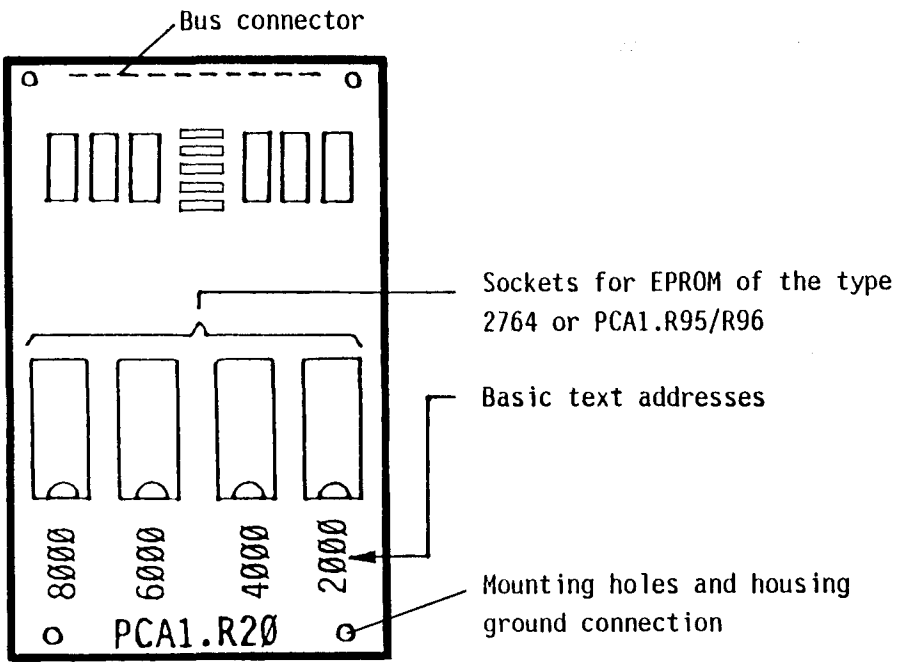
B 2.1.9 Type PCA1.R2Ø Text memory extension module, 32 characters (for PCA14 as of version V6.Ø34)

The text memory card PCA1.R2Ø increases the storage capacity for texts five-fold. In addition, the text memory module offers the possibility of reserving the whole memory mounted in the CPU for user steps or as data memory and of storing all texts on the text module.

Technical data

Text capacity	4 x 8K characters = 32K text characters
Types of memory (sockets)	- for buffered RAM-memory PCA1.R95 or R96 - for EPROM type 2764 (order no. 4'5Ø2'4719'Ø)
Mounting of module	like I/O-module, however, only on socket Ø

Presentation



The module PCA1.R2Ø must always be mounted on socket Ø of the PCA14 (addresses Ø...7)!

Memory structure

Memory socket		TEXT ADDRESSES not indexed	TEXT ADDRESSES indexed	
Right socket on the CPU		0 - 818	1000 - 1818 [1]	as usual
Socket 2000 on R20	Module R20	2000 - 2818	3000 - 3818	
Socket 4000 on R20		4000 - 4818	5000 - 5818	
Socket 6000 on R20		6000 - 6818	7000 - 7818	
Socket 8000 on R20		8000 - 8818 [2]	9000 - 9818	

Compared to the normal text address assignment on the CPU (0...818), the addresses on the R20 module are increased by 2000 to 8000 (depending on the socket). The following footnotes should be read for indexed text output and limit addresses.

---

1) As is known, texts may be output in indexed form. For text subroutines (CPU socket) in the address range 0...818 only 3 figures are available for addressing.
Details see manual "PCA Software level c", chapter "Text output".

2) Starting with text address 8192 the text number can no longer be entered directly in PAS 23, the multiple of 2 K must rather be entered in the code and the remainder in the operand.

	Code	Operand
Example: text no. 8400	PAS	23
	04	0208 ; (4 x 2048) + 208 = 8400

Text input

A text input effected directly on the PCA1.R2Ø card is not provided for. There are two possibilities of entering texts:

1. Using PCA14. Texts are entered into a buffered RAM-memory module (R95 or R96), which is located on the right socket of the CPU. Therefore, the text addresses Ø...818 are used. Upon termination of the input, the memory module is plugged into the corresponding address location on the R2Ø module.

2. Using the text assembler of the SAIA°PCA ASSEMBLER and the PCA2.P16 EPROM copying unit or the programming unit PCA2.P21.
   Proceed as described under 1.

Text output (call text in the user program with PAS 23)

When calling the text, the basic addresses of the text (2ØØØ to 8ØØØ) must be added in the 2nd line of the PAS 23 instruction in accordance with the selected socket. For indexed text calls those basic addresses exceed the basic addresses by 1ØØØ (3ØØØ to 9ØØØ), see description in chapter "Memory structure".

Important notes:

a) Text stored on the PCA1.R2Ø module are addressed using 4 digits. It must be noted for text subroutines that $L must always be followed by 4 digits.

b) A text subroutine which uses the addresses 2ØØØ...8818 cannot be called by a text using the addresses Ø...818. However, a subroutine in the address range Ø...818 can be called by a text in the address range 2ØØØ...8818, whereby the subroutine address must be entered using 4 digits (e.g. $L Ø412).

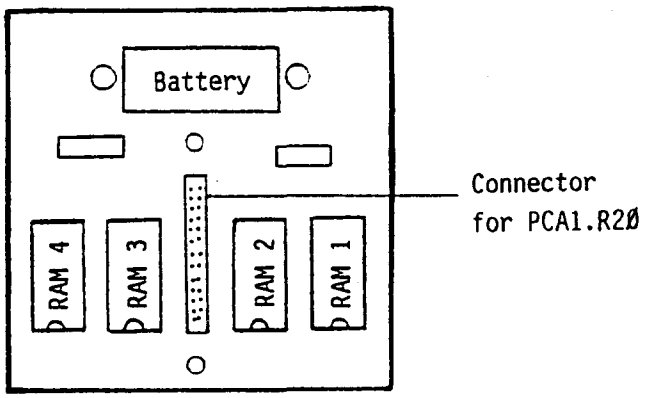
B 2.1.10 Type PCA1.R25 Data memory extension module, 16K words

The PCA1.R25 module serves as an additional module for the text memory extension module PCA1.RØØ. It has a large buffered data memory of 16K words of 16 bits each.

Technical data

Data memory capacity	16K words of 16 bits each
Type of memory	RAM, battery-buffered with PAS 58 instructions, for writing and reading (16 bits)
Firmware version	PCA14 from version V6.Ø36 onwards
Mounting of module	on module RØØ, on socket Ø

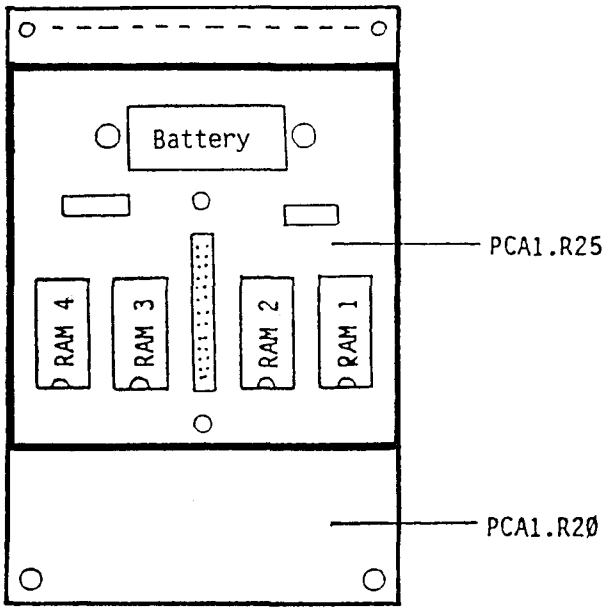
Presentation



Memory organization

	Word address (16 bits)
RAM 1	Ø ... 4Ø95
RAM 2	4Ø96 ... 8191
RAM 3	8192 ... 12287
RAM 4	12288 ... 16383

Mounting on text memory extension module PCA1.R2Ø



The data memory module PCA1.R25 is plugged onto the text memory extension module PCA1.R2Ø and fastened with 2 screws. Due to the module R2Ø + R25, the PCA14 is additionally provided with a text memory of 32K ASCII-characters and a data memory of 16K words or 32K bytes.

Buffer battery

When the PCA14 is switched off, the NiCd battery protects the RAM-memory against data loss for at least 2 months (battery completely charged).

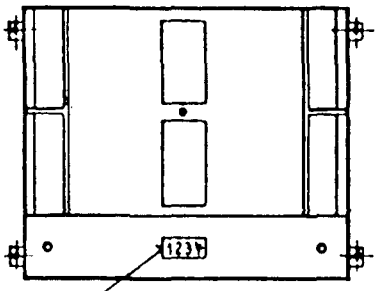
The pluggable battery lasts at least 5 years.
Spare part no. 4'5Ø7'136Ø'Ø.

In order to prevent data loss on the R25 when replacing the battery, proceed as follows:

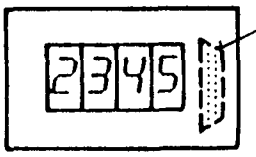
1. Switch off PCA14
2. Remove cover above the inputs/outputs
3. Switch on PCA14
4. Remove old battery
5. Install new battery
6. Check data on R25
7. Leave the PCA14 switched on for several hours (charging of battery!)

B 2.2 Display modules

B 2.2.1 PCA1.D11 Operand display module



Window in the cover of the operating panel



For PGU-connector on the operating panel

PCA1.D11 module, attachable to the operating panel

Description:

With the two instructions

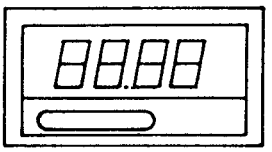
- DTC: Display Timer or Counter
- DOP: Display Operand

4-digit figures can be displayed in the RUN-mode. Thus, counter states (as well as step numbers), timers or, with the DOP-instruction, operands (e.g. as error numbers) can be displayed elegantly without using inputs or outputs.

Depending on the user program the following displays are possible:

- fixed display according to the user software
- various displays selectable by selector switch
- various displays periodically altering

B 2.2.2 PCA2.D12 Display module



General

The PCA2.D12 module is a remote display which can be controlled via SAIA°PLC outputs. It has a 4-digit display and is able to indicate a decimal point. The display can be built in anywhere at a greater distance to the PLC 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 PLC.
In conjunction with the display interface PCA1/2.D13 the D12 can be connected even at a greater distance to the PGU-connector where the comfortable instructions DTC and DOP are available.

Structure, function

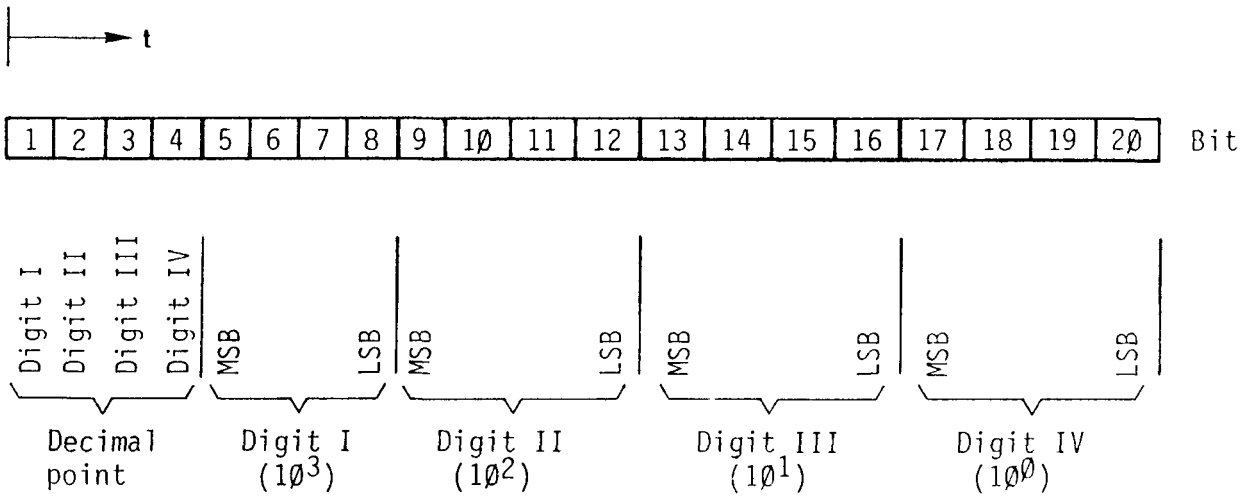
The module is in the same housing as the electronic totalizing counter of the CKG type. It consists of the following main components:

- power supply 24VDC
- 3 inputs for 24VDC
- decoder/driver
- 4-digit, 7-segment display with decimal point

The 3 outputs of the PLC 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, i.e. bit by bit from the SAIA°PLC 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 2Ø clock signals must be generated and 2Ø data bits must be transmitted (4 BCD-values + 4 bits for the decimal point).

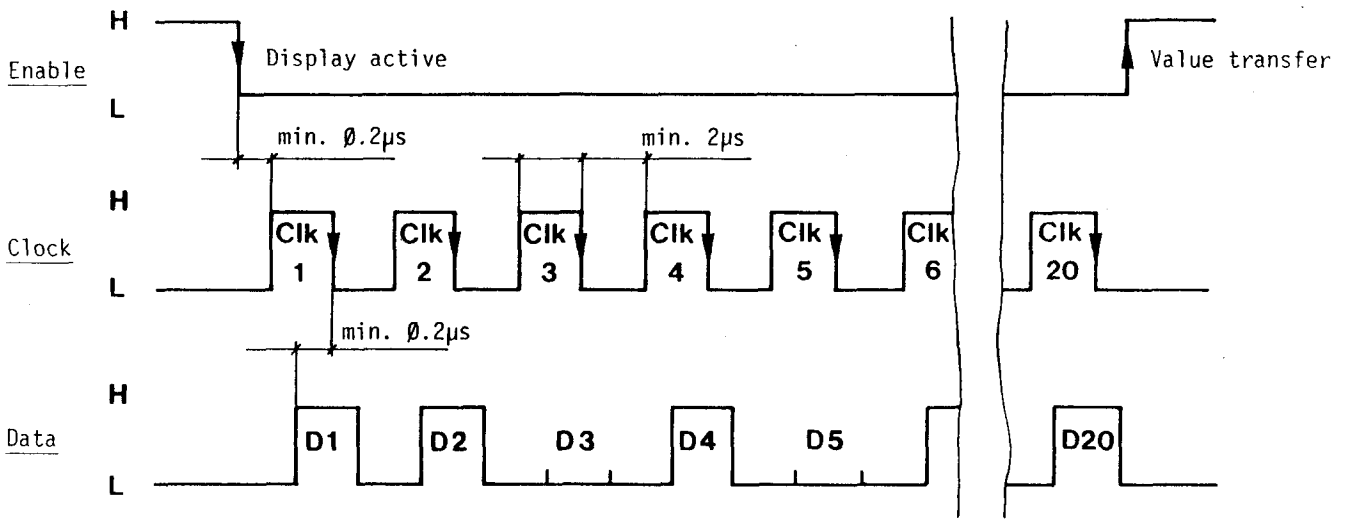
The following sequence of the 2Ø data bits must be adhered to:



The following 16 characters can be presented per segment:

Character	Code	Character	Code
Ø	ØØØØ	⊓	1Ø1Ø
1	ØØØ1	|	1Ø11
2	ØØ1Ø	||	11ØØ
3	ØØ11	⊔	11Ø1
4	Ø1ØØ	-	111Ø
5	Ø1Ø1	"blank"	1111
6	Ø11Ø		
7	Ø111		
8	1ØØØ		
9	1ØØ1		

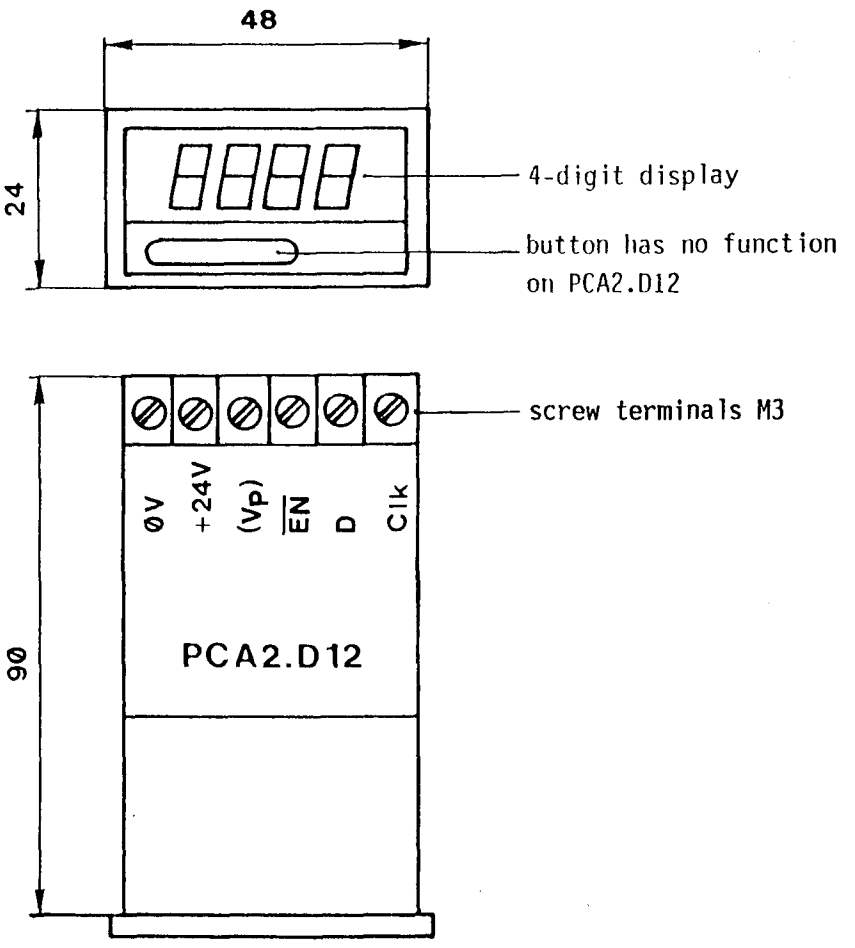
The connection between "Enable", "Clock" and "Data" is illustrated in the time-dependency diagram:



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°PLC can easily be applied directly without waiting for certain periods to elapse.

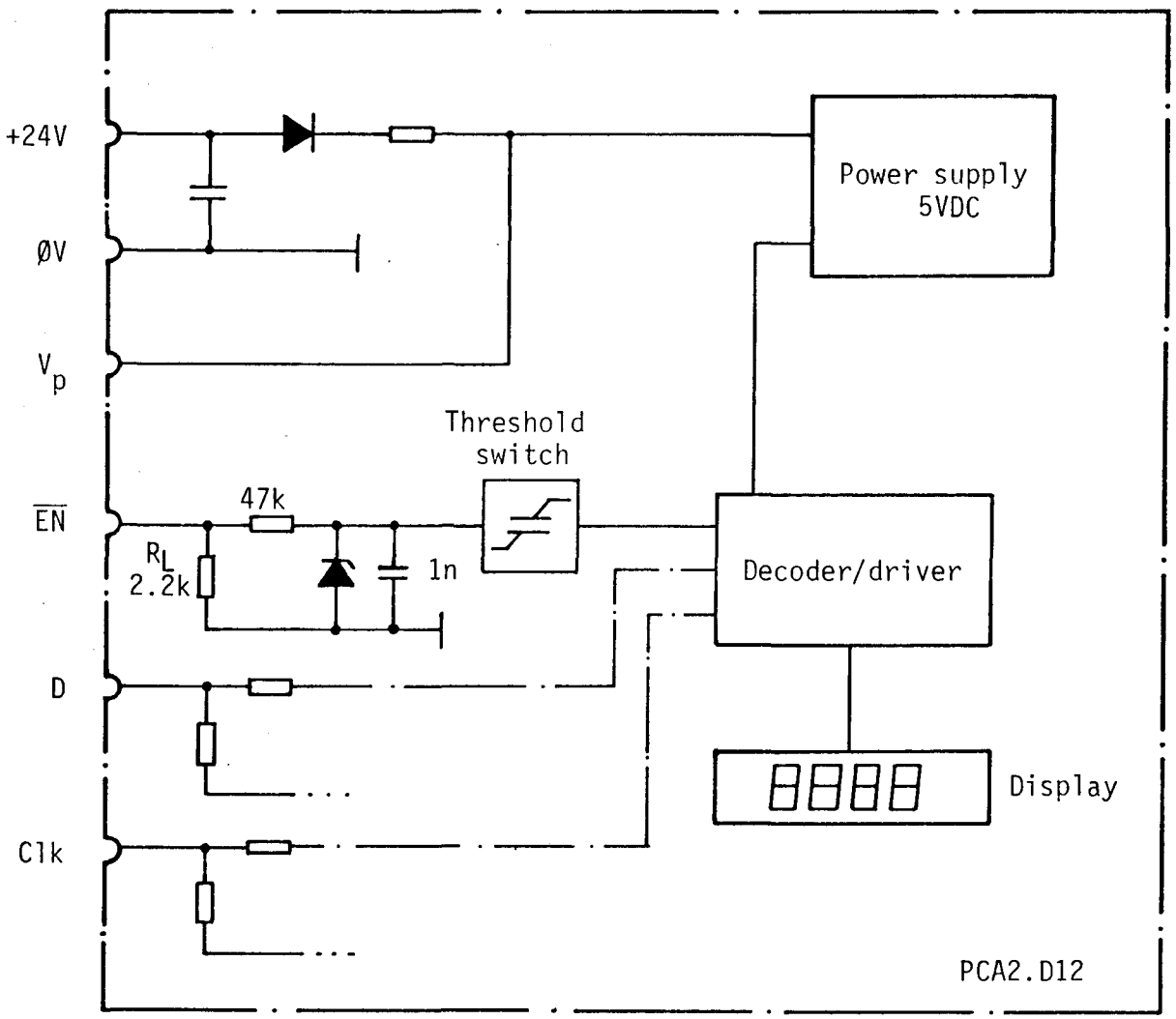
Presentation and terminal arrangement



Technical data:

- Supply voltage:	24VDC ± 2Ø%, two-way rectification is sufficient
- Input voltage for EN, D, CLK:	24VDC, smoothed
- Input current for 24VDC:	1ØmA
- Definition of the input voltages:	"H": 19V...32V "L": ØV... 4V
- Input delay:	< 1ms
- Usable SAIA°PLC output modules:	PCA1.A1Ø, B1Ø, B8Ø, B9Ø PCA2.A4Ø
- Control	serially via 3 PLC-outputs or via interface D13

Input circuit and block circuit diagram



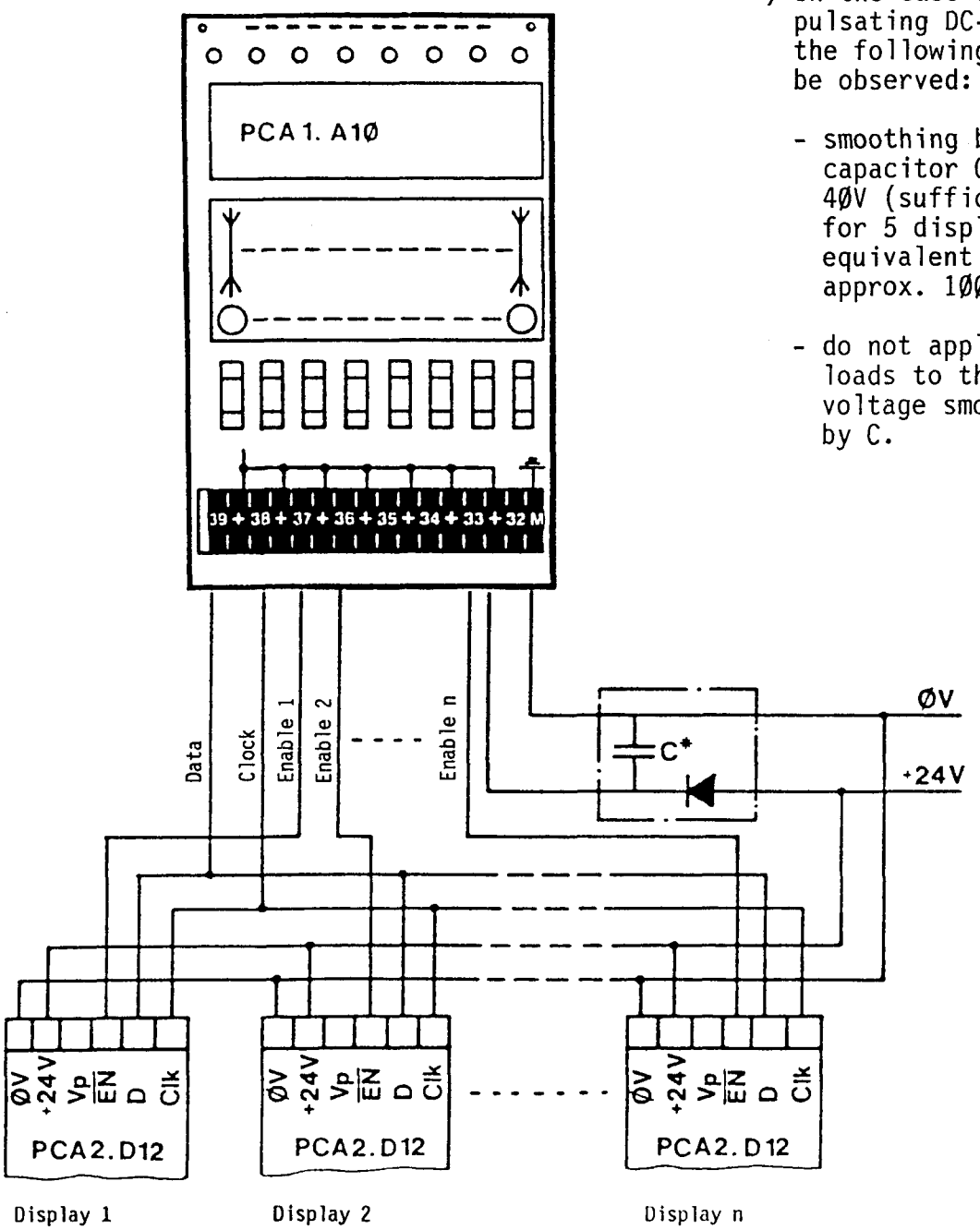
Note:

V_p supplies display interface D13.

Connection of several displays to a PLC

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.

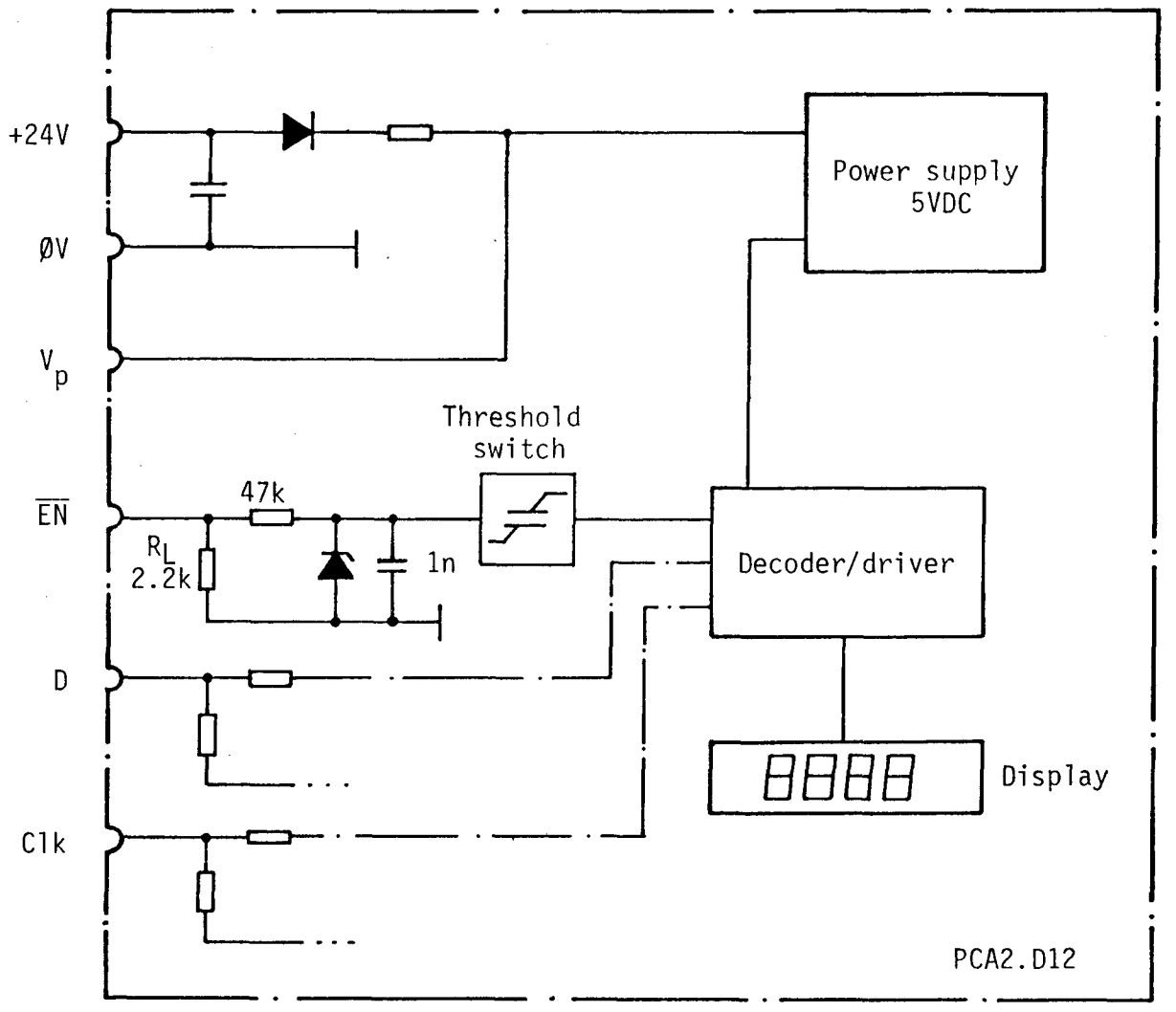
Connection: (e.g. PCA1.A1Ø - PCA2.D12)



*) In the case of a pulsating DC-voltage the following must be observed:

- smoothing by capacitor C1ØØ µF, 4ØV (sufficient for 5 displays is equivalent to I = approx. 1ØØmA)
- do not apply other loads to the voltage smoothed by C.

Input circuit and block circuit diagram



Note:

V_p supplies display interface D13.

Examples

Example 1

Six PCA2.D12 displays are to be connected to one SAIA°PLC. How many outputs are required?

Solution 1

Per display one "Enable" signal	6 outputs
1 "Data" signal (simultaneously to all displays)	1 output
1 "Clock" signal (simultaneously to all displays)	1 output
Total	8 outputs

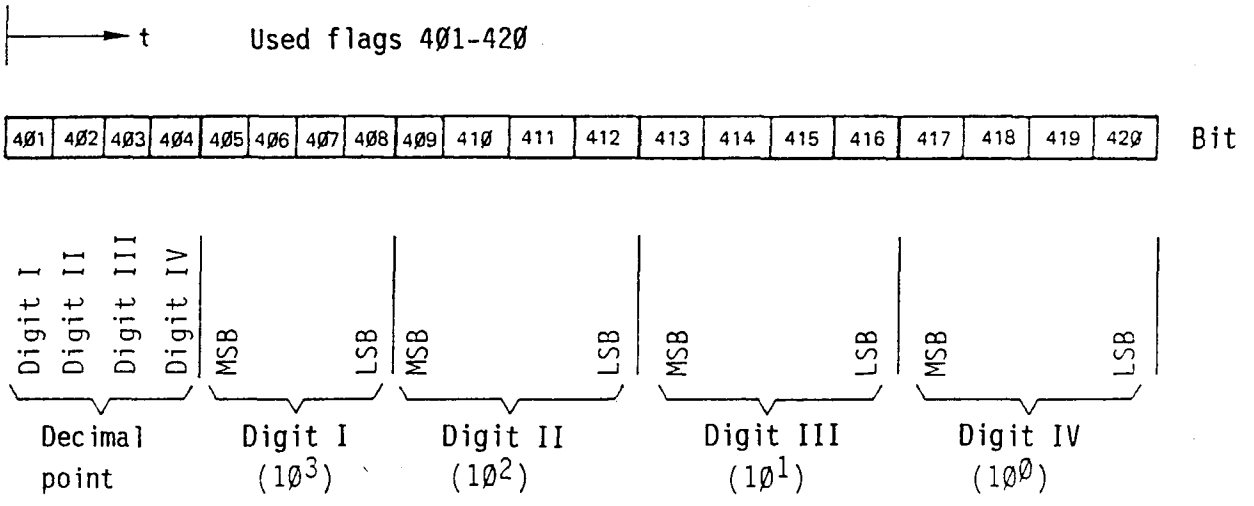
Example 2

Every half second a counter is to be incremented up to the value 9999 and then reset to zero. Its content is to be indicated on the PCA2.D12 display module with a decimal point in the 2nd place.

The following outputs must be assigned for "Enable", "Data" and "Clock":

EN : O2
D : O3
CLK: O4

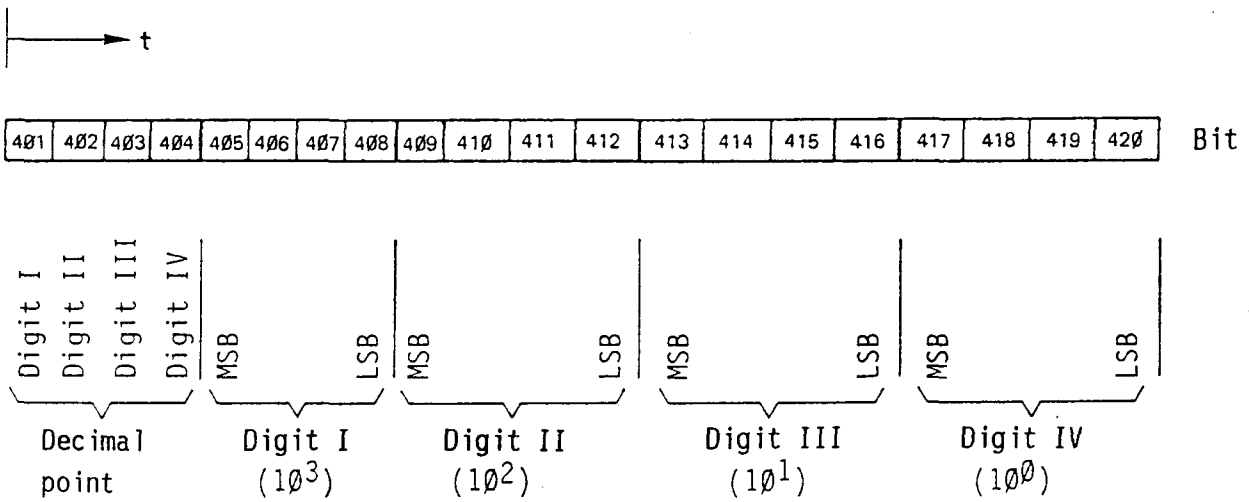
Used counters: C28Ø
C281



Solution 2

```
10          SCR      280
11                Ø     Ø  ;  Initial value Ø
12          SCR      281
13                Ø4 1807  ;  Maximum value 9999
14
15          SCR      280
16                2Ø  42Ø  ;  Counter contents on flags

17          SEO      4Ø2  ;  Decimal point on 2nd place 4Ø1...42Ø
18
19
2Ø          SEA        Ø
21          REO        2  ;  Enable = "L"
22          SEI        Ø
23          SEO        4  ;  Clock
24          STH     14Ø1     IR: 4Ø1...42Ø
25          OUT        3  ;  Data
26          SEA        Ø
27          REO        4  ;  Clock
28          INI       19
29          JIO       23
3Ø          SEO        2  ;  Enable = "H"
31
32
33          DTC      28Ø  ;  Operand display
34          DEC      281  ;  -1
35          STL      281  ;  Ø ?
36          JIO       1Ø
37
38
39          INC      28Ø  ;  (Ø,1,2,3...9999,Ø,1...)
4Ø          STR      256
41                ØØ    5
42          WIH      256  ;  Wait Ø.5s
43          JMP       15
```

Standard routine for controlling the display



B 2.2.3 PCA1.D13 Display interface

Description

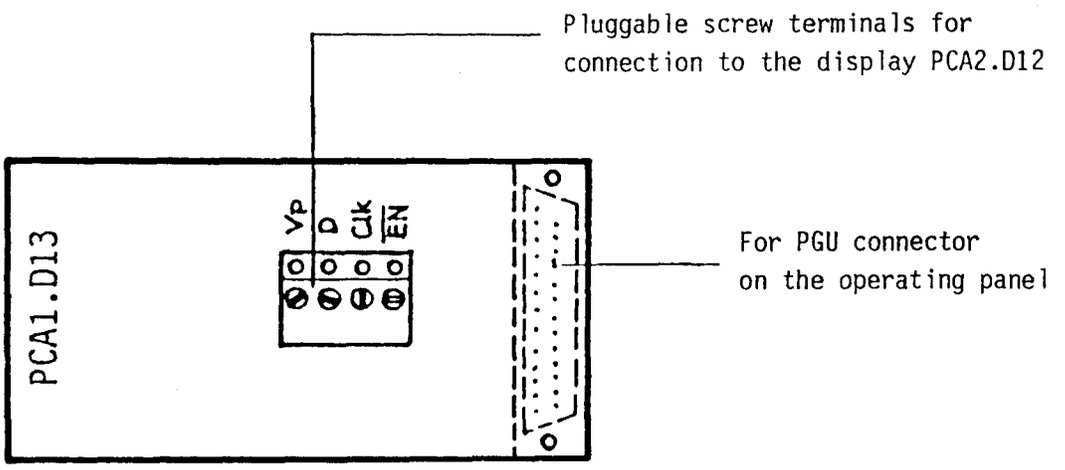
The display interface D13 combines the advantages of the display module PCA1.D11 (simple software handling via the instruction DTC and DOP for 4-digit decimal displays) and those of the display PCA2.D12, which need not be located anywhere near the SAIA°PLC.

The D13 is inserted in the PGU-plug of the SAIA°PLC and connected to the display PCA2.D12 by means of pluggable screw terminals.

Technical data

- Supply voltage Vp: 24VDC, ±2Ø%, full-wave rectified is sufficient (supplied by the display module PCA2.D12)
- 3 opto-isolated outputs for EN, D, CLK
- Connection of 2 displays PCA2.D12 is possible (same display)
- Control by means of the instructions DOP and DTC (see manual Software 1H)
- Concerning the cable layout and type of cable between D12 and D13 no special measures are required. The same general criteria as for the cabling of input and output modules apply (see chapter A 5).

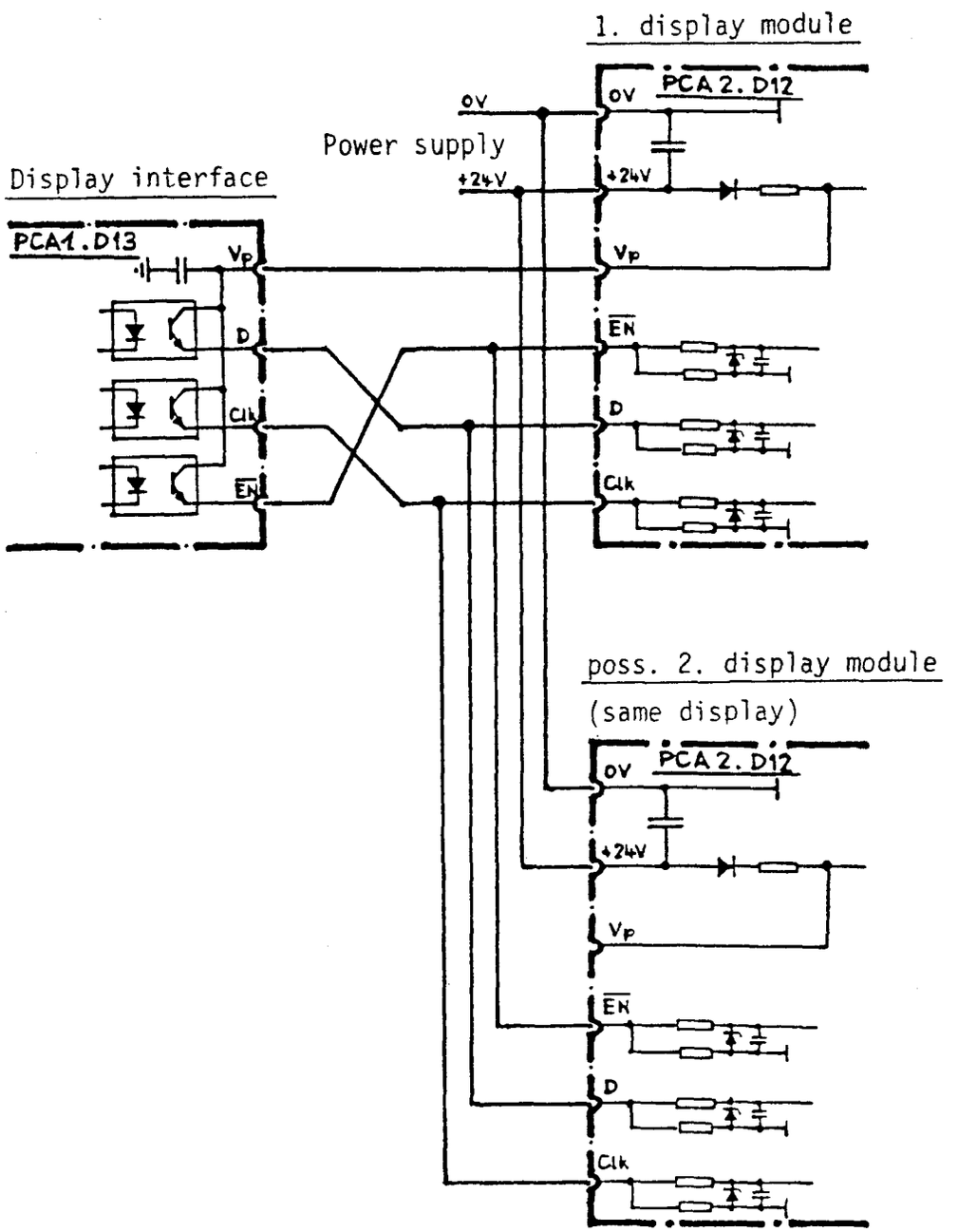
Presentation



The open module PCA1.D13 is plugged into the PGU-connector of the operating panel. The pluggable screw terminals for connecting the display module protrude through the window.

Various screws are supplied for the attachment and the mechanical protection of the module.

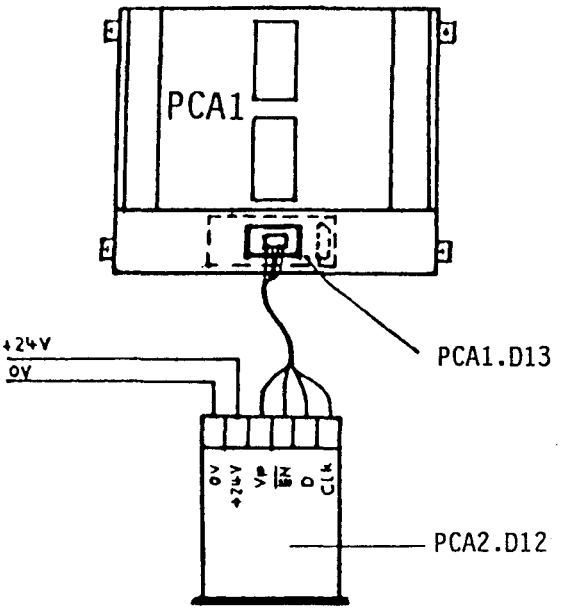
Connection diagram



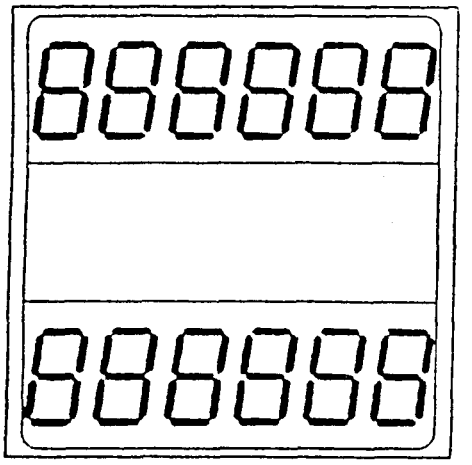
Note:

- Both displays indicate the same data.
- Module D13 is supplied by module D12 at the back via the terminals Vp. This and the use of optocouplers ensure maximum interference protection of the PCA1.

Connection to display module PCA2.D12



B 2.2.4 PCA2.D14 Display module



General

The PCA2.D14 module is a remote display module which is controlled via 3 outputs of the SAIA°PLC. The module has two 6-digit displays. Several PCA2.D14 can be connected in series in case of more than two displays.

Application, control

The module was developed in connection with the fast counter module PCA1.H1Ø. In this application controlling is performed by the counter module alone. The user must only program the appropriate mode in the user program.

When the PCA2.D14 is used without the H1Ø module, the information to be displayed is most easily transmitted serially with a standard program routine from a flag field via 3 SAIA°PLC outputs.

Technical data

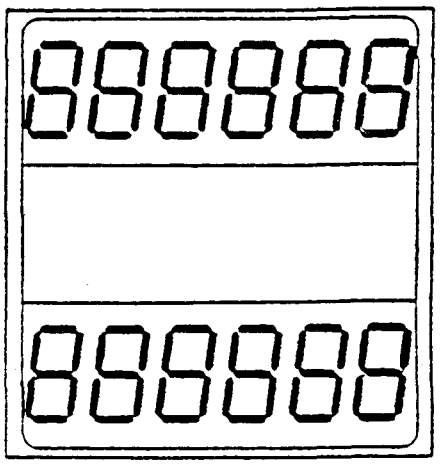
Display	2 times 6 digits, 7-segment LED
Digit height	1Ømm
Supply voltage	24VDC ± 2Ø%, full-wave rectified is sufficient
Input voltage for EN, D, CLK	24VDC smoothed
Input current at 24VDC	1ØmA
Definition of the input level	"H" = +19...+32V "L" = Ø...+ 4V
Input delay	< 1ms
Usable SAIA°PLC output modules	PCA1.A1Ø, B1Ø, B8Ø, B9Ø PCA2.A4Ø
Control	serially via 3 SAIA°PLC outputs irrespective of the number of D14

Structure, 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 Ø.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	ØV	----->	ØV	



Upper display

Lower display

The data for a display of 2 x 6 digits are most easily presented in a complete flag field, e.g. M5ØØ...547 in BCD-notation. If these values are kept in counters, they must be transferred to the flag fields first.

```
  5ØØ                                                    523
M  o o o o o   o 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
   1ØØ'ØØØ     1Ø'ØØØ      1'ØØØ        1ØØ          1Ø          1

  524                                                    547
M  o o o o o   o 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
   1ØØ'ØØØ     1Ø'ØØØ      1'ØØØ        1ØØ          1Ø          1
```

Software routine

Every time the following routine has been executed the current information in the flag field is indicated on the display until the display is updated by a new piece of information after a further run.

Softlevel 1 *

```
(60      SEA    0)
 61      REO    2  ENABLE
 62      SEI    0
 63      SEO    3  DATA
 64      SCR  280  AUX. COUNTER
          00    4
 66      SEO    4  CLOCK
 67      REO    4  CLOCK
 68      DEC  280  AUX. COUNTER
 69      STH  280  AUX. COUNTER
 70      JIO   66
 71      SCR  280  AUX. COUNTER
          00   16
 73      STH 1500  FLAGS
 74      OUT    3  DATA
 75      SEA    0
 76      SEO    4  CLOCK
 77      REO    4  CLOCK
 78      INI   47
 79      JIZ   84
 80      DEC  280  AUX. COUNTER
 81      STH  280  AUX. COUNTER
 82      JIO   73
 83      JMP   63
 84      SEO    2  ENABLE
(85      RET    0)
```

When not used as a subroutine

Used address	
Enable	A2
Data	A3
Clock	A4
Flag	M500...M547
Aux. counter	C280

for M500...547

for 1 D14 upper and lower display **)

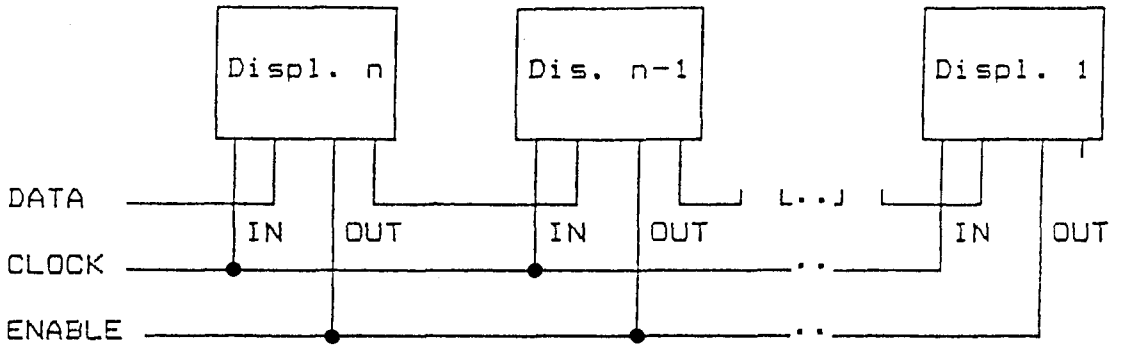
When used as a subroutine

```
  500                                                    523
M  o o o o   o o o o   o o o o   o o o o   o o o o   o o o o
  MSB   LSB                                        MSB   LSB  display
   100'000    10'000    1'000      100        10         1

  524                                                    547
M  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
```

*) The display module D14 can thus be controlled from any SAIA°PLC (including PCA13 and PCA21).

**) For connecting several D14 in series see following page.

The following diagram shows several PCA2.D14 connected in series.:
Each D14 displays its own data.



The flag field containing the information to be displayed must be expanded correspondingly:

for 1 PCA2.D14 = 1 x 48 flags
for 2 PCA2.D14 = 2 x 48 flags
for 3 PCA2.D14 = 3 x 48 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.

In other words, INI (n x 48) - 1 with n = number of PCA2.D14.

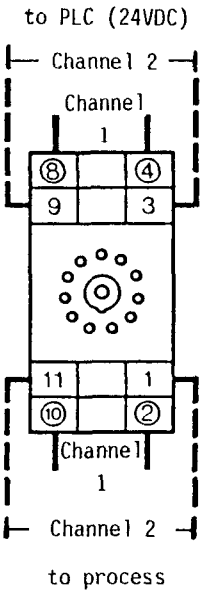
The following 16 characters per segment can be presented:

Character	Code	Character	Code
Ø	ØØØØ	⊓	1Ø1Ø
1	ØØØ1	|	1Ø11
2	ØØ1Ø	||	11ØØ
3	ØØ11	⊔	11Ø1
4	Ø1ØØ	-	111Ø
5	Ø1Ø1	"blank"	1111
6	Ø11Ø		
7	Ø111		
8	1ØØØ		
9	1ØØ1		

For examples refer to the Software manual.

B 2.3 KOM series external interface module

The purpose of the external interfaces is for adapting the I/O levels of the PLC from 24VDC to the process requirements. They are constructed in two-channel form and mounted in plug-in housings for an 11-way round socket. LEDs indicate the logic status ("H" = ON), facilitating the rapid checking of the signal lines as far as the terminals of the process. To render the wiring easy to view, the cables from the process or to the PLC are arranged on the opposite side of the plug holder.



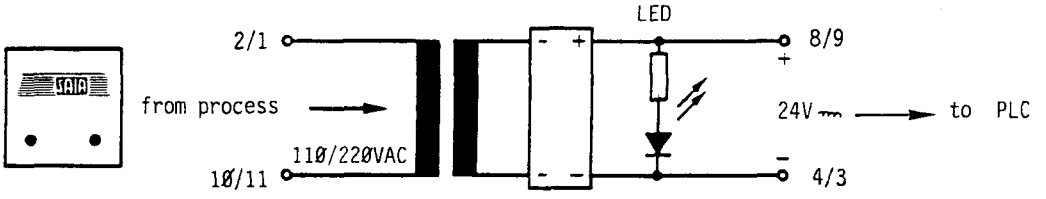
Plug-socket holder
Order no. 4 4Ø8 4817 Ø

B 2.3.1 Type KOM 111B Dual input interface

The purpose of this input interface is for the isolation of the mains control lines from the 24V signal level of the PLC. The isolation is accomplished by means of inductive transmitters; this has the advantage of providing a safeguard against surge voltages.

Front

Switching scheme (per channel)



Technical data

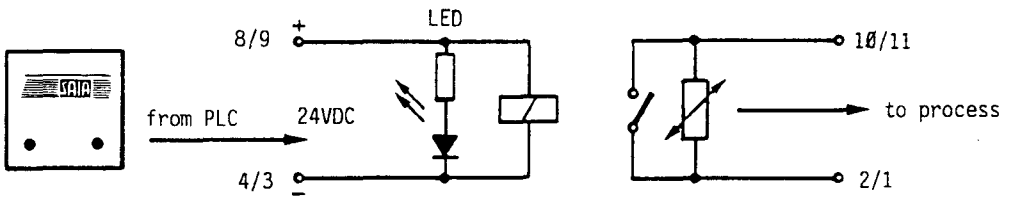
Input voltage	22ØV, 5Ø...6Ø Hz ± 2Ø% type KOM 111B D4 11ØV, 5Ø...6Ø Hz ± 2Ø% type KOM 111B C8
Input current	in each case Ø.5A
Output voltage	24VDC pulsating
Output current	in each case max. 4ØmA
Reaction time	max. 1Øms (acc. to phase length)
Surge voltage on process side	5kV, 1/5Ø µs
Connection	11-way round socket
Order specification	KOM 111B D4 or C8 (see input voltage)

B 2.3.2 Type KOM 121B Dual-relay-output interface

Electric isolation in this interface is achieved by relays, the contacts of which are able to directly switch mains voltages. The normally-open contact to the relay is used corresponding to the PLC output.

Front

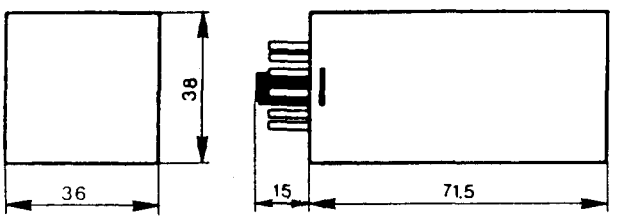
Switching scheme (per channel)



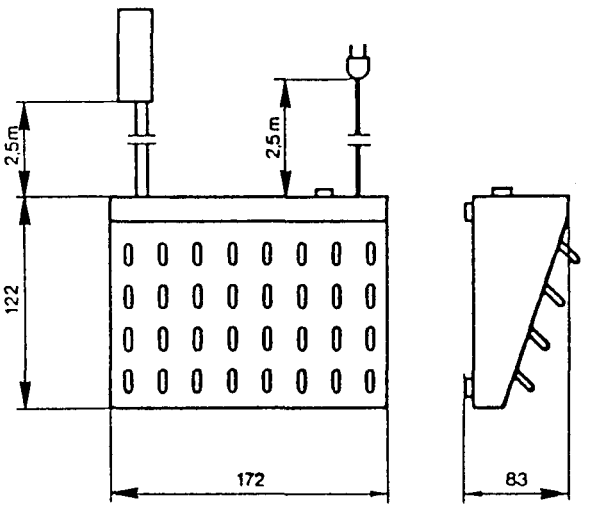
Technical data

Input voltage	24VDC ± 20%, smoothed or pulsating
Input current	in each case 20mA
Relay contact	in each case 1 normally-open contact with hard silver contacts
Switching power	in each case 6A, 250VAC AC1 1A, 250VAC AC11
Contact life (AC1)	3A, 220VAC 0.1 mio. switching cycles 1.5A, 220VAC 0.5 mio. switching cycles 0.3A, 220VAC 5 mio. switching cycles
Order specification	KOM 121B M4

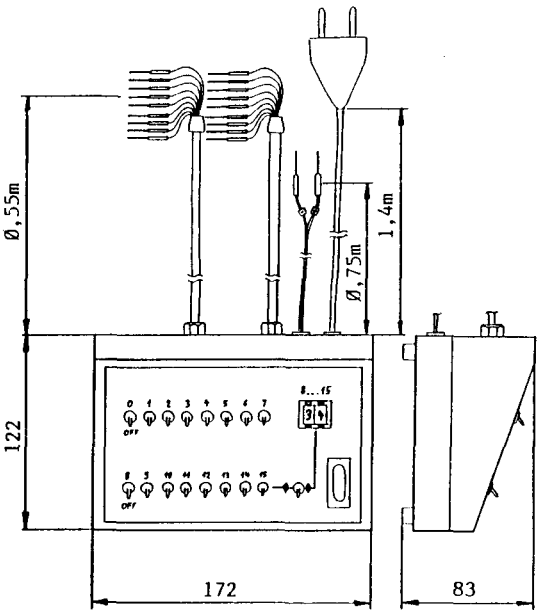
B 2.4 Dimensions of additional units



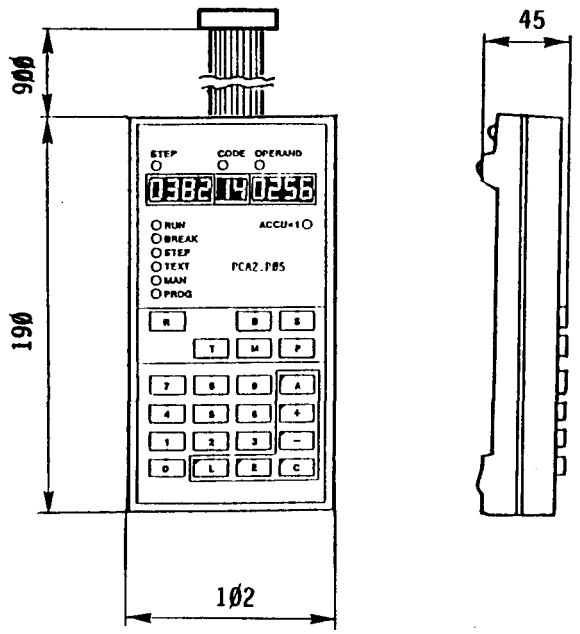
External interfaces
KOM 111B and 121B



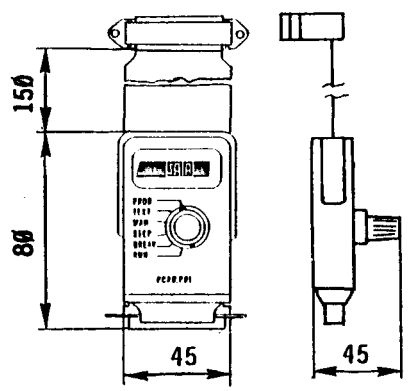
Input simulation unit
PCA2.S1Ø



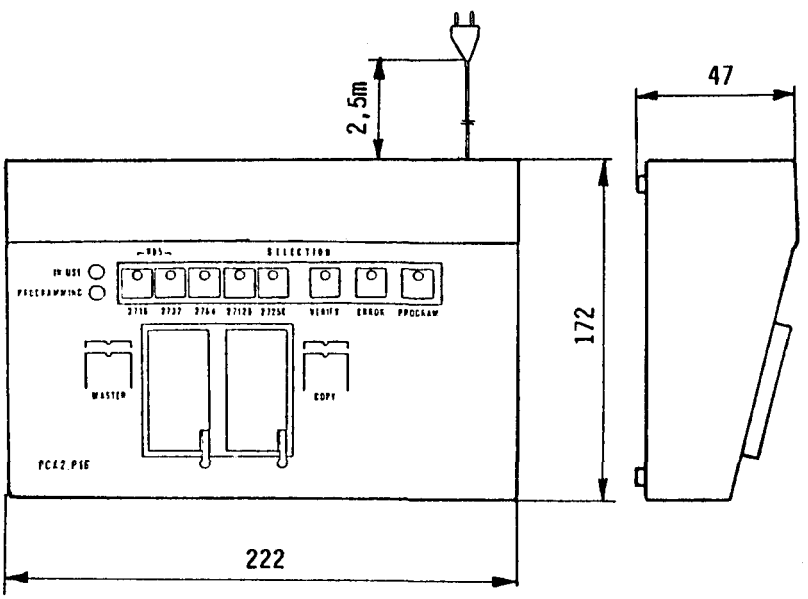
Input simulation unit
PCA2.SØ5



Programming unit
PCA2.P05



Programming interface
PCA0.P01



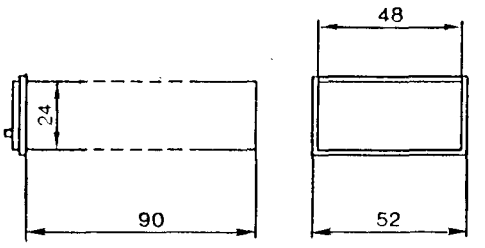
EPROM copying unit
PCA2.P16

B 2.5 Dimensions, assembly and installation of PCA2.D12

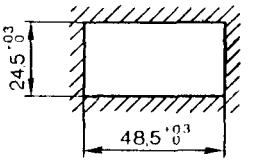
The display can be installed in any position desired anywhere in a control cabinet door or an operating panel.

The display can be fastened in three ways:

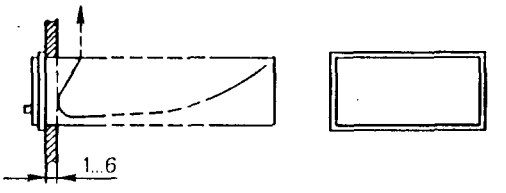
Dimensions



Opening for installation valid for both assembly types



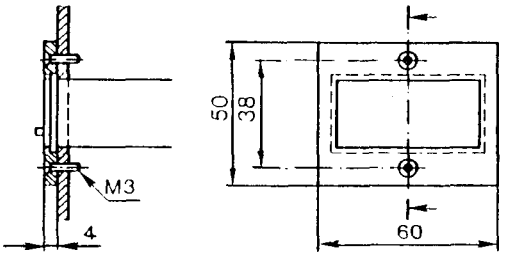
Fastening with clamping spring



Standard version

Fastening with frontal frame and 2 countersunk screws M3/90°. with vertical frontal frame

Assembly type, vertical

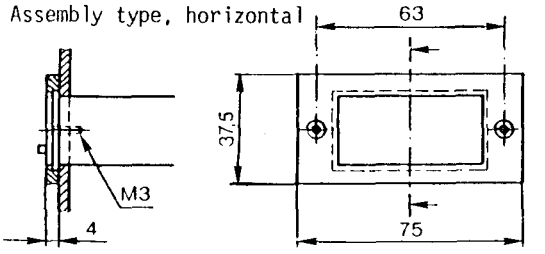


Miscellaneous small parts

Order no. 4 108 3671 0

with horizontal frontal frame

Assembly type, horizontal



Order no. 4 108 3672 0

B 2.6 Dimensions, assembly and installation of PCA2.D14

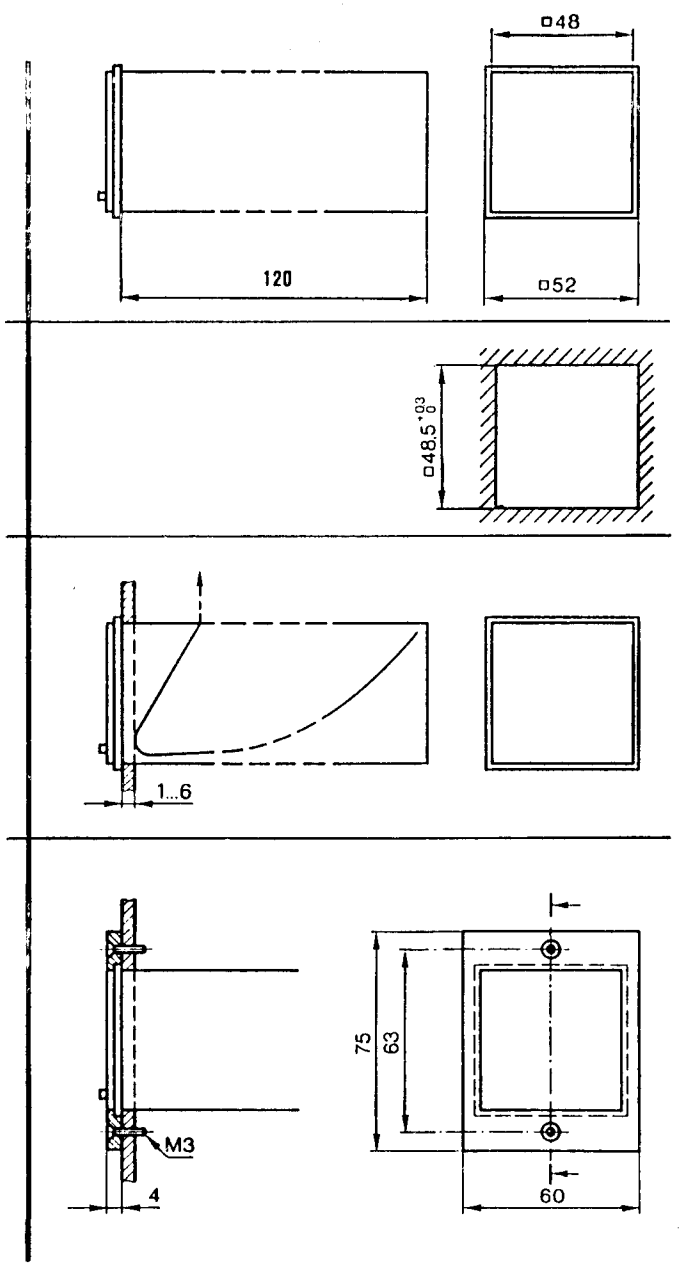
The display module can be installed in any location desired.

It can be fastened in two ways:

- with a clamping spring
- with a frontal frame and screws

(The clamping 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 M3/9Ø°

Notes:

OPERATING MODES

C 1 Selection of operating modes for PCA14 and PCA15

C 1.1 Operating modes, level 1H for PCA15 and PCA14

- RUN
- PROG
- MAN (Bit)
- BREAK
- STEP

C 1.2 Summary of operating modes

C 1.3 Detailed description of operating modes

C 2 Further operating modes (only PCA14)

- MAN with date-time
- TEXT or text memory as data register

Setting of operating modes

A PLC can operate in various operating modes for preparing, testing and editing a program.

PCA14: A sliding switch for selecting the operating modes is provided on the operating panel. This sliding switch is always active.

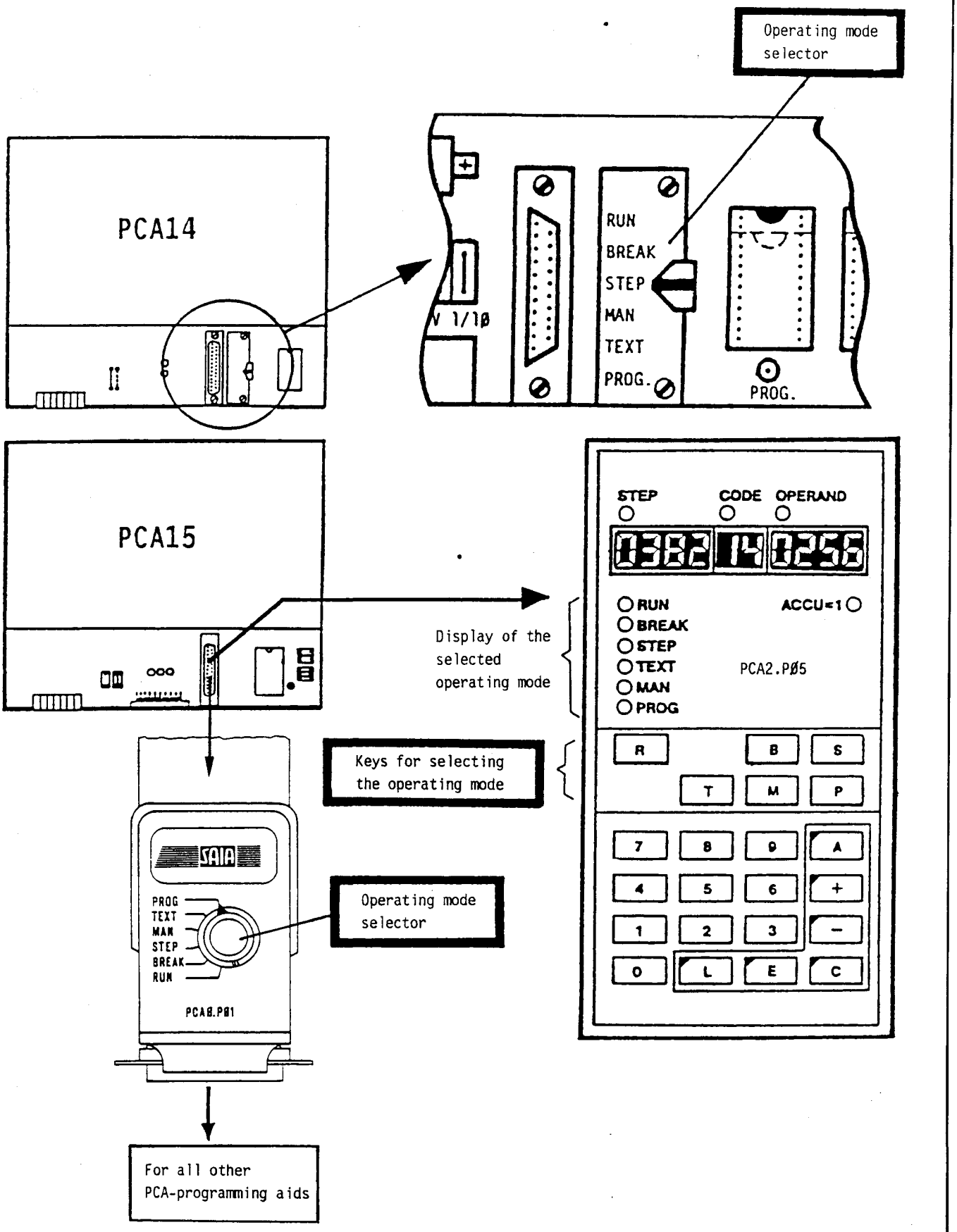
PCA15: The operating modes are preselected outside the PLC. The keys of the programming unit PCA2.PØ5 are used, or in case a different programming aid such as the handheld computer P18 or an IBM-PC is used, to select the operating modes with the programming interface PCAØ.PØ1.

The selected operating mode remains active, when the connection between the programming units and the PCA15 is ended.

The following operating modes are automatically selected when the PCA15 is switched on.

- With programming unit PØ5 connected:	STEP (LED "STEP" lights up, the green LED "RUN" does not light up!)
- Without programming unit:	RUN (LED "RUN" lights up)
- With PØ1 connected:	According to selector switch position

C 1 Selection of operating modes



C 1.1 Operating modes, level 1H for PCA15 and PCA14

[R]	RUN	Normal program processing (lamp RUN on PCA15 lights up)
[P]	PROG	A user program can be loaded into a RAM memory (plugged onto the user plug-in socket of the PCA15).
[M]	MAN	Manual interrogation and setting of elements (inputs, outputs, flags, timers, counters)
[S]	STEP	Jump to a preselected step address (program line) of the user program and step-by-step operation
[B]	BREAK	Program processing up to a set "breakpoint" and subsequent step-by-step operation

C 1.2 Summary of operating modes

[R] RUN — Normal program execution

The PCA1 is automatically in the RUN-mode when switching on if no programming unit is connected.

[P] PROG — Programming

A program can be stored in a RAM-memory (on the user socket of the PCA1) or overwritten (corrected).

	Step	Code	Operand	
[A]	x x x x	[E]	x x	x x x x
		[E]	x x	x x x x or [C] to delete a wrongly entered line
		[+]	Terminates the input	
Test program		[+][+] or [-][-]		

[M] MAN ** — Manual testing or setting of elements

(Elements = inputs, outputs, flags, counters, timers)

Testing: [A] x x x (Step / Element address) ⟶ display of the logic state in the operand (Ø/1)

Setting: [A] x x x [E][1] ⟷ or [Ø] (Element address)

[S] STEP

[+] ⟶ Display showing where the program is.

Jump to the preselected step address of the user program

[A] 139 [+] ⟶ Program jumps to step 139, then

[+][+] ... step-by-step execution of the program with the result of the logic operation being checkable ✷ ACC = 1*. Switching to RUN is always possible.

In case of parallel programs, only the activated parallel program is executed in the STEP-mode.

[B] BREAK — Interruption of the program run and subsequent step-by-step-operation

[+] ⟶ Display showing where the program is

[+][+].... step-by-step execution of the program with the result of the logic operation being checkable ✷ ACC = 1*. Switching to RUN is always possible.

In case of parallel programs, all programs are executed simultaneously (as in the RUN-mode).

Setting of a breakpoint

[A] 82Ø [+] ⟶ Program runs up to step 82Ø, then

[+][+].... step-by-step operation skipping the "criterial" point.

---

*) ACC = accumulator is used to indicate the result of the logic combination. If ACC = 1 (conditions of the logic combination fulfilled = 1), the following switching instructions are executed.

**) If the address of a timer or counter is preceded by a 3 (e.g. 326Ø for counter 26Ø), the value of this register can be read or entered manually with [E] value [+] .

C 1.3 Detailed description of the operating modes

[R] RUN — Normal program processing
The PCA15 is automatically in the RUN-mode when switching on if no programming unit is connected. For PCA14, the sliding switch must be in position RUN.

[P] PROG — Programming
A program can be stored in a RAM memory (on the user plug-in socket of the PCA1) or overwritten (corrected).

	STEP		CODE	OPERAND
[A]	xxxx	[E]	xx	xxxx
		[E]	xx	xxxx
		[C]	Deletes a wrongly entered line	
		[+]	Terminates the input	
		[+][+]	or [-][-]	to display the program

[M] MAN — Manual testing or setting of elements
(Elements = inputs, outputs, flags, counters, timers)

		STEP[1]	OPERAND
Testing:	[A]	xxx	Ø/1 ⟶ display of the logic state
Setting:	[A]	xxx	[E] ⟶ [1] or [Ø]

---

1) STEP = Element address
If the address of a timer or counter is preceded by a 3 (e.g. 326Ø for counter 26Ø), the value of this register can be read or entered manually with:

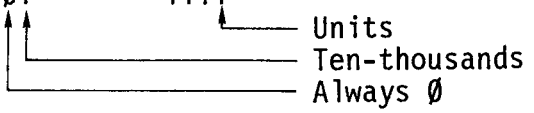
[A] 3xxx [E] value [+], [-], [A], [E]

For an example see following page.

Continued from footnote 1)

Example: Input of values 23419 or 127 into counters 29Ø or 291.

Input:	Display:	STEP	CODE	OPERAND
[A] 329Ø		329Ø	ØY	YYYY



Input:	Display:	STEP	CODE	OPERAND
[A] 329Ø		329Ø	ØY	YYYY
[E] 23419		329Ø	Ø2	3419
[E] 127		3291	Ø1	ØØ27

Correction before storing

[C]		3291	ØØ	ØØØØ
[Ø] 127*		3291	ØØ*	Ø127
[+]				

---

* Values <1Ø'ØØØ have to be preceded by a leading Ø.

[S] STEP [+] ⟶ Display showing where the program is.

Jump to the preselected step address of the user program

[A] 139 [+] ⟶ Program jumps to step 139

[+] [+] ... step-by-step processing of the program with the linkage result being checkable: ✸ ACCU = 1 [2)]

Switching to RUN is always possible.
In case of parallel program, only the activated parallel program is processed in the STEP mode.

[B] BREAK Interruption of the program run and subsequent step-by-step operation

[+] ⟶ Display showing where the program is.

[+] [+] ... step-by-step execution of the program with the linkage result being checkable: ✸ ACCU = 1 [2)]

Switching to RUN is always possible.
In case of parallel programs, all programs are processed simultaneously (as in the RUN-mode).

Setting of a "breakpoint"

[A] 82Ø [+] ⟶ Program runs up to step 82Ø in slow RUN operation

[+] [+] ... step-by-step operation over the "critical" point

---

2) ACCU (= accumulator) is used to indicate the status of the logic combination.
When LED lights up, the ACCU = 1 (conditions of the logic combination fulfilled, linkage result = 1), and the following switching instructions are executed.

C 2 Further operating modes (only PCA14)

[M] "MAN"

Manual access to the software date-time

In case you use the date-time module E40 refer to chapter B 1, where reading and writing to the hardware date-time will be explained (black box routines, Software manual).

All programming units allow direct access to the software date-time (reading and writing).

Contrary to the buffered hardware date-time (PCA1.E40 module), the software date-time works only as long as voltage is applied to the PLC. Therefore, all values have to be introduced each time the PCA14 is started up. The date-time has a max. deviation factor of 3s/day.
The following table shows the signification and the numerical range for the addresses 4000...4007.

Address	Meaning	Numerical range
4000	Week of the year	1...53
4001	Day of the week	1...7
4002	Year (1989=89)	0...99
4003	Month	1...12
4004	Day of the month (Feb = 28)*	1...31
4005	Hours	1...23
4006	Minutes	1...59
4007	Seconds	0...59

*) Contrary to the hardware date-time R27, the software date-time does not take the leap years into account (February = 28 days).

You may enter a maximum of 2 digits which appear in the operand (see examples on the following page).

- Examples: Input for Thursday, June 2nd, 89, 1Øh 12min 45s

Input:	Display:	STEP	CODE	OPERAND
A	4ØØØ	4ØØØ	ØØ	ØØYY
E	22*	4ØØØ	ØØ	ØØ22
E	4*	4ØØ1	ØØ	ØØØ4
E	89	4ØØ2	ØØ	ØØ89
E	6*	4ØØ3	ØØ	ØØØ6
E	2*	4ØØ4	ØØ	ØØØ2
E	1Ø	4ØØ5	ØØ	ØØ1Ø
E	12	4ØØ6	ØØ	ØØ12
E	45	4ØØ7	ØØ	ØØ45
+				

After entering the seconds (4ØØ7), key [+] is depressed, provided that the input corresponds to the actual time. Do not press key [E] again, since otherwise the input of the calendar week is erased.

- Display:

Input:	Display:				
A	4ØØØ	4ØØØ	ØØ	ØØ22	22. week of the year
+		4ØØ1	ØØ	ØØØ4	Thursday
+		4ØØ2	ØØ	ØØ89	1989
+		4ØØ3	ØØ	ØØØ6	June
+		4ØØ4	ØØ	ØØØ2	2
+		4ØØ5	ØØ	ØØ1Ø	1Øh
+		4ØØ6	ØØ	ØØ12	12min
+		4ØØ7	ØØ	ØØ45	45s
					46s
					47s
					..
					..

---

* Calendar week and day of the week must correspond to month and date!

[T] "TEXT" or text memory as data register

Input and reading of texts in the text memory

Input of texts is effected on RAM 6116, 6264 or 8464 or on the buffered RAM modules PCA1.R92/95/96 which are plugged onto the right-hand text socket of the basic module.

The following 2 possibilities are available:

a) Using one of the PCA programming units, connected via the PGU connector.

b) With a peripheral unit with current loop interface, connected to the serial data interface (7 terminals on the right).

For detailed description refer to manual Software level 2.

Manual access to the text memory as data register (PAS 54)
(as of system program version V6.ØØ4)

As mentioned in connection with the instruction PAS 54, the text memory can also be used as data register. In order to understand the monitor function of the system program, the formats which are used for organizing the various registers must be brought to mind:

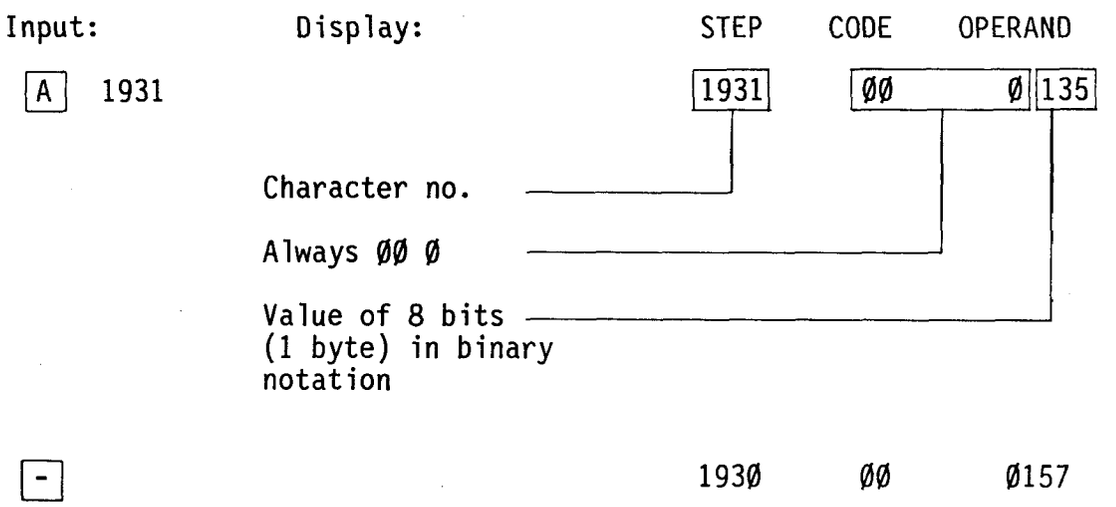
Counter register : binary 16 bits
Text memory : binary 8 bits or 16 bits
(as data register) or BCD 8 bits

For manual access to the text memory as data register the operating mode selector switch must be set to "TEXT".

- Display of the text memory contents

  a) Immediate display of a character value of 8 bits (1 byte) in binary notation

  Upon actuation of key [A] , and subsequent input of the character number to be displayed (Ø...8191), the stored value (Ø...255) is displayed in the operand field in binary notation.



b) Display of the contents of 2 character no. (2 bytes = 16 bits) in binary notation

Actuating the key [C] once has the result that in addition to the selected character number the value of the preceding character can also be combined to form a 16-bit value (2 bytes) in binary notation. Consequently values in the range Ø...65'535 can be displayed in the CODE and OPERAND field.

Input: [C]

Display:

STEP	CODE	OPERAND
1931	E	3 4717

Character no. selected with key [A]

Character for 2 bytes

Value of the 2 characters 193Ø and 1931 (2 bytes) in binary notation

In this way, the contents of transferred counters can be displayed with their total capacity of 16 bits.

c) Display of 1 character no. (1 byte = 8 bits) in BCD-notation

By actuating key [C] (convert) a second time, the bit pattern is displayed in BCD-notation.

Input: [C] [-]

Display:

STEP	CODE	OPERAND
1931	H Ø*	ØØ87
193Ø	H	Ø ØØ 9-

Character no.

Character for BCD-notation

Always Ø ØØ

1 byte in BCD-notation

*) Character in the code applies to PØ5. For P1Ø refer to the table on the following page.

Real BCD-bit patterns are displayed as decimals. If other characters are present as e.g. at character no. 1930, these are no BCD-bit patterns. In order to be able to interpret their values nevertheless, the following 7-segment characters are defined in the OPERAND:

Binary value	7-segment character P10	P05
10		
11		
12		
13		
14		
15	blank	blank

- Manual data inputs into the text memory
  (limited RAM-memory in this area)

  Key [A] : subsequent input of the character no., at which the value is to be stored

  Key [E] : clears the old value and permits new input

  Key [C] : before key [E] means "convert"
  after key [E] means "clear"

  Key [+], [-], [A], [E]: cause storage of the value introduced

  Corresponding to the reading of data, 3 cases are distinguished for the manual input of data:

  a) Input of a binary value of 1 byte (e.g. 48) at a character no. (e.g. 7436)

Input:		Display:	STEP	CODE	OPERAND
[A]	7436		7436	00	0XXX
[E]	48		7436	00	0048
[+]			7437	00	0YYY

b) Input of a binary value of 2 bytes (e.g. 1487) at character no. 7456 and 7457

Input:		Display:	STEP	CODE	OPERAND
[A]	7457 1)		7457	ØØ	ØXXX
[C]	2)		7457	EY*	YYYY
[E]	1487 3)		7457	E1*	Ø487
[C]	Ø1487		7457	EØ*	1487
[+]			7459 4)	EZ*	ZZZZ

1) Always the higher address of a pair of 2 bytes is entered.

2) [C] before [E] results in the conversion to 2 bytes.

3) If values < 1Ø'ØØØ are entered, a Ø must be typed first. Correction with [C].

4) The character no. is automatically increased by 2.

c) Input of a BCD-value (e.g. 3Ø) at character no. 766Ø (in BCD-notation, only values from Ø..99 ≙ 1 byte can be entered)

Input:		Display:	STEP	CODE	OPERAND
[A]	766Ø		766Ø	ØØ	ØXXX
[C]			766Ø	EY*	YYYY
[C]			766Ø	HØ*	ØØZZ
[E]	3Ø		766Ø	HØ*	ØØ3Ø
[+]			7661	HØ*	ØØAB

*) Characters apply to PCA2.PØ5.

List of modules