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Programmable Logic
Controller Systems
Electronic Monitoring Equipment
Electronic Timers

PITRONIK P2
Technical Manual

17709

03/87 Printed in West-Germany

Programmable Logic Controller System PITRONIK P2

Economical:
Programming instead of hard-wired logic saves time and offers flexibility

Intelligent:
Word instructions for times, counters and sequence control

Expandable:
Up to 120 I/Os with P8-system modules

Compact Unit P2

The better solution for small and intermediate size machine control.

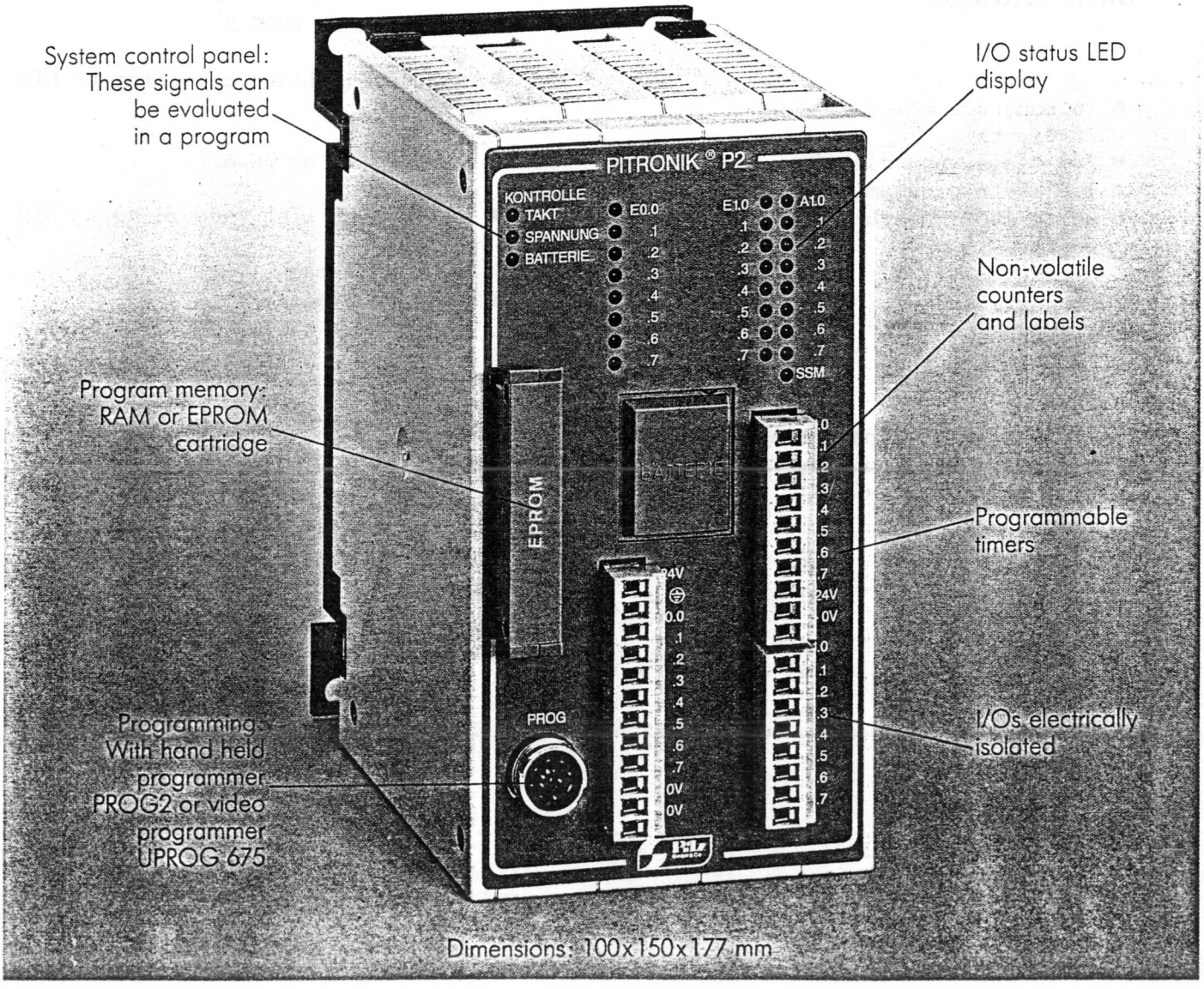
16 inputs, 24 VDC,
10 ms settling time

8 outputs, 24 VDC/400 mA
(electronic protection against electric noise, inclusively inductivities).

Power Supply:
24 VDC with polarity protection

Programmable, as determined by DIN 19239

Signal level, as determined by VDI 2880, pg. 2



System description

Basic hardware

The hardware of the basic P2 unit consists of

- CPU
- program memory
- 16 inputs
- 8 outputs
- system control panel
- data back up battery
- connectors for power, I/Os and programmer

compacted into a small rail mounted housing.

Basic features

- 16 counters
- 16 timers
- 248 flags, nonvolatile
- 1.6 kbyte program memory space
- up to 1600 instructions

Expansions

The P2 system is expandable by P8 system modules and mounting rails with various numbers of slots:

- max. 6 module slots
- I/O modules with max. 120 I/Os
- timer modules

Programming

The P2 is programmable with

- PILZ hand-held Programmer PROG 2
- PILZ UPROG 675
- SIEMENS PG 675

Programming languages

With programmer PROG 2:

- Instruction List (according to DIN 19239)

With UPROG 675 or PG 675:

- Instruction List (according to DIN 19239)
- Ladder Diagram
- Booleans Diagram

P2 versions

The P2 basic unit is available in two versions:

- 1.6 k RAM
- 1.6 k RAM with data backup (through capacitor, typ. 24 h)
- 1.6 k EPROM

P2 system expansion

The P2 system can be expanded by various modules of the Pilz PLC system P8:

module functions & features	type
4 inputs, 4 outputs	EA4
8 inputs, 24 VDC, settling time 10 ms	E
8 inputs, 24 VDC, settling time 1 ms	ES
8 inputs, 42 VAC, settling time 50 ms	E42
8 inputs, for proximity switches	NA
8 analog adjustable timers	ZT
8 replay outputs, 2 A, max. 240 VAC / 100 VDC	A-REL
	A-REL 05
8 outputs, 24 VDC / 2 A cont. duty	A20S
8 outputs, 24 VDC / 0.4 A, electr. protected	A4
8 outputs, 24 VDC / 0.1 A, push-pull	A1
8 outputs, TTL, for 3 TTL loads each	A-TTL

Mounting rails

number of modules	mounting rail type
P2 basic unit only	BA 0
1	BA 1
2	BA 2
3	BA 3
4	BA 4
5	BA 5
6	BA 6
6 + 6 E-type and A-type, not EA 4!	BA 12

P2 power supply C-P2-NT

The power supply C-P2-NT

- is powered by 110/220 VAC
- supplies 24 VDC/2 A to the
  - basic unit
  - mounting rail
  - modules

Locking latches mounting construction

The illustration demonstrates the removal of a module.

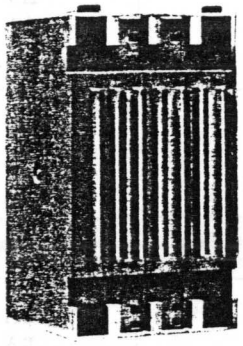
1. The modules have an unsymmetric mechanical profile to secure correct installation. On the backside are 4 locking latches. In the illustration they are shown in the locked position.

2. The modules are fitted to the rail and secured by the latches.

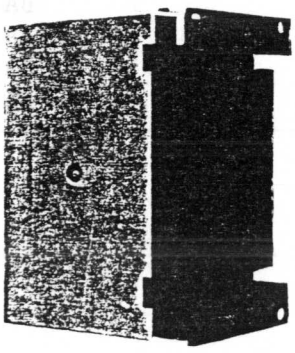
3. With a screwdriver lever the latches out.

4. The module can now be extracted without effort.

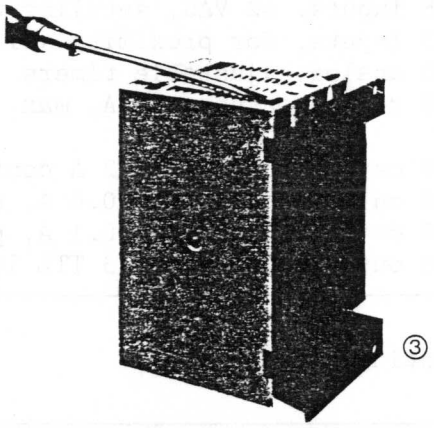




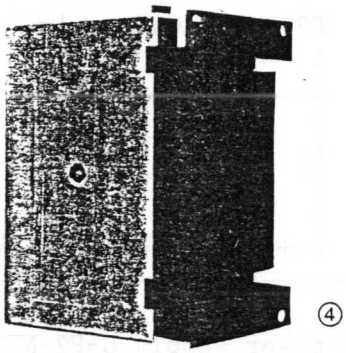
①



②



③



④

Timer module C-P8-ZT

The timer module features individual time ranges. The timers are adjustable with potentiometer. Internally the time ranges are processed digitally.

The basic function of the timers is delay on energisation. Other types of delay, like delay-off or impulse forms are programmable by software.

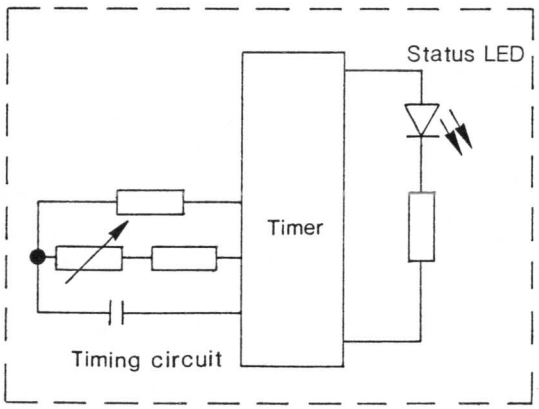
Address 0 and 1 of the timer module are adjustable to 1, 3 or 10 secs., address 6 and 7 to 10, 30, or 100 secs. Addresses 2 - 5 are permanently adjusted to 10 secs.

The standard delivery configuration is

- address 0 with 1 sec.
- address 1 with 3 secs.
- address 2 - 5 with 10 secs.
- address 6 with 30 secs. and
- address 7 with 100 secs.

The time adjustment range is 1 : 20. The repetition accuracy is 1 %. During the countdown the status of a time range is signalled by LED.

- Status display by LED
- Multiple exploitation by software
- 8 individual time ranges, adjustable by potentiometer
- Adjustment range 1 : 20
- Adjustment facility protected by a removable transparent cover



Block diagramm of timer module ZT

Technical data

Time end range	address 0 = 1 s adjustable to 1, 3 or 10 s
	address 1 = 3 s adjustable to 1, 3 or 10 s
	addresses 2 - 5 = 10 s
	address 6 = 30 s adjustable to 10, 30 or 100 s
	address 7 = 100 s adjustable to 10, 30 or 100 s
Adjustment range	1 : 20
Repetition accuracy	1 %
Countdown status display	by LED
Temperature drift	0.1 %/x C



Input-output module C-P8-EA4

Inputs

The EA4 module features 8 inputs and 8 outputs.

The input circuits are designed to filter incoming signals, convert them to the internal signal level and to isolate them electrically from the central processor.

Troublefree operation is ensured by "energy acknowledgement". A HIGH-signal at an input must have a certain energy level for a defined periode of time to be recognized as valid data.

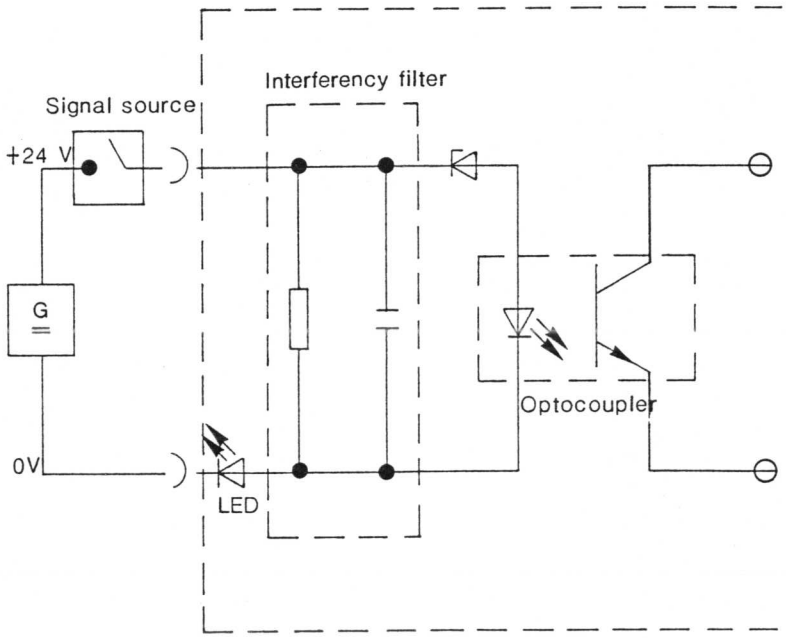
The signal sources are connected to the module by a standard clamp screw connector. The LEDs are marked analog to the inputs and outputs. The input circuit is current drawing.

The module can be mounted in any slot position. The position determines the module's basic address.

Each input is connected to a noise filter. Therefore, the leads don't need to be shielded.

The inputs are electrically isolated by optocoupler.

- Clamp screw connectors, fail-plug proof
- 8 inputs with LED status display
- Electrical isolation by optocoupler
- Write on sticker labels
- "Energy acknowledgement" principle



Block diagram EA4 inputs

Technical data EA4 inputs

Inputs	8
Operating voltage	24 VDC
Voltage range	20.4. - 28.8 VDC
Circuit design	current drawing min. 3.5 mA, max. 11.2 mA
Noise filter settling time	10 ms
LOW signal	0 - 5 V
HIGH signal	18 - 28.8 V
Status display	8 LEDs
Electrical input isolation	by optocoupler
Isolation voltage	1 500 V

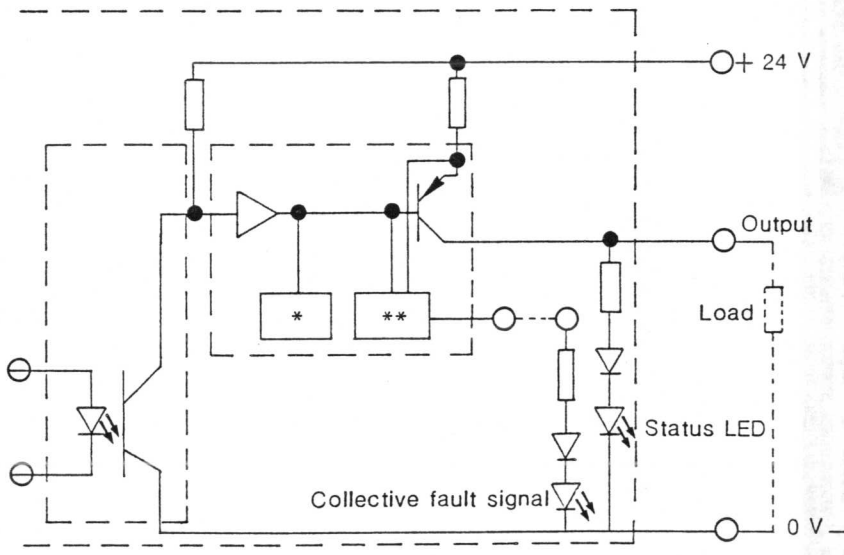


Outputs

The outputs are designed for electrical loads of up to 7 Watts. In their basic function the outputs are status memorizing. They can be programmed to be nonmemorizing. The status can be enquired by the program software.

The current supplying outputs are electronically protected against overload and short circuits. When shorted, the collective fault signal LED on the module illuminates. Each output is protected against voltage spikes (e. g. from inductive loads). Allocated LEDs signal the status of each output and can be enquired by the program software. The outputs memorize a HIGH level. No flag memory is used. The setting or resetting time of an output is 1 ms or less.

- Electronic shortcircuit protection with collective fault signal LED
- 8 outputs with LED status display
- Electrical isolation by optocoupler
- Current supplying circuit
- Integrated protection against inductive load, overload and short circuit



Block diagram EA4 Outputs

* Thermo protection
** Short circuit protection

Technical data EA4 outputs

Outputs	8
Rated current	400 mA at 50 % duty 200 mA at 100 % duty
Circuit design	current supplying
Output protection against	overloading, short circuiting, inductive voltage spikes
Status display	8 LEDs
Fault signal	collective LED indicator

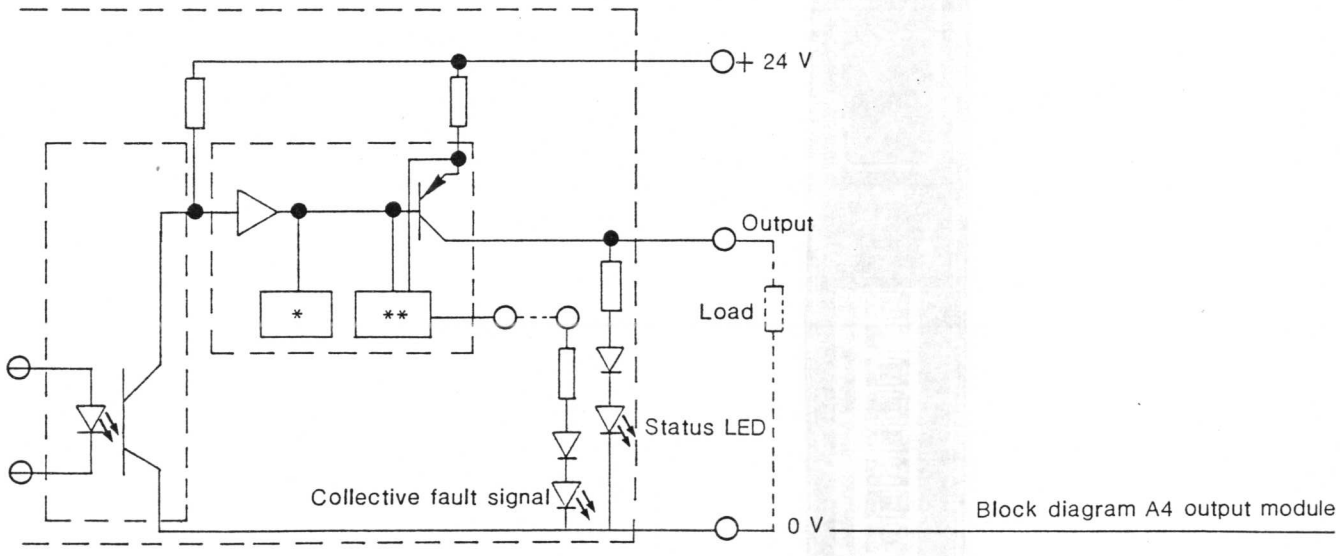


Output module C-P8-A4

In their basic function the outputs are status memorizing. It can be programmed to be nonmemorizing. The status can be enquired by the program software. The 8 opto-isolated outputs are designed for electrical loads of up to 10 Watts.

The current supplying outputs are electronically protected against overload and short circuits. When shorted, the collective fault signal LED on the module illuminates. Each output is protected against voltage spikes (e. g. from inductive loads). Allocated LEDs signal the status of each output an can be enquired by the program software. The outputs memorize a HIGH level. No flag memory is used. The setting or resetting time of an output is 1 ms or less.

- Electronic shortcircuit protection with collective fault signal LED
- 8 outputs with LED status display
- Electrical isolation by optocoupler
- Current supplying circuit
- Integrated protection against inductive load, overload and short circuit

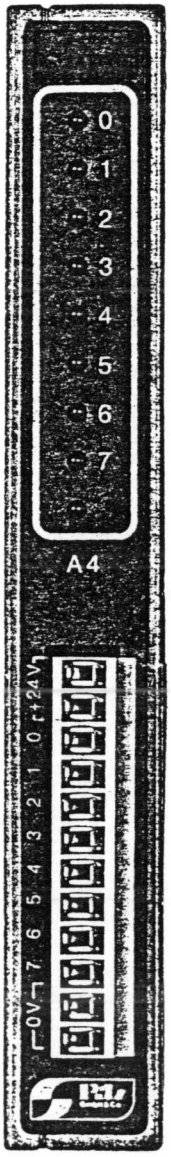


Block diagram A4 output module

* Thermo protection
** Short circuit protection

Technical data

Operating voltage	6 - 24 VDC
Voltage range	6 - 28.8 VDC (incl. residual ripple)
Rated current	400 mA
Output protection against	overloading, short circuiting, inductive voltage spikes
Status display	8 LEDs
Fault signal	collective LED indicator
Status enquiry	by software
Electrical isolation	by optocoupler



Relay output module C-P8-REL

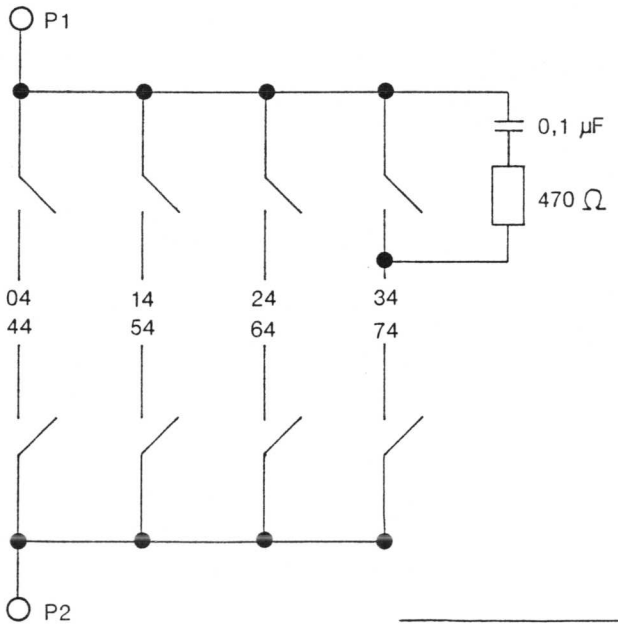
The 8 relay outputs of this module are designed to switch loads of up to 400 VA at 240 VAC.

Through the relay contacts the module circuits are electrically isolated. 4 contacts are gathered in one branch.

The outputs are status memorizing. A spark suppression is built in. The output status is displayed by allocated LEDs.

The reaction time is 10 ms. The drop off time is 20 ms.

- Status display by LED
- 8 outputs with neutral contact
- Electrical isolation
- Built in spark suppression

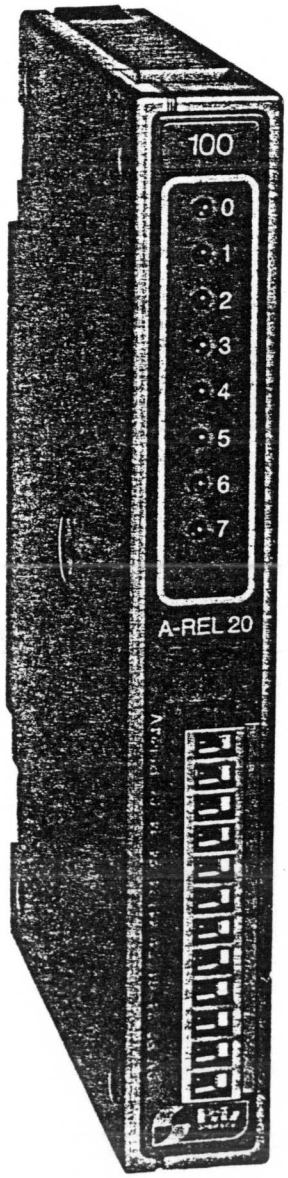


Block diagram relay output module

Technical data

Switching voltage	240 VAC, 100 VDC
Continuous current	2 A/AC per contact
	450 mA/DC per contact
Output load	240 VAC/400 VA
	100 VDC/50 W
Contact material	Ag/Ni/Au-plated
Mechanical life	no load: 20 x 10E6
	2 A/AC: 2.5 x 10E5
Reaction time	10 ms
Drop off time	20 ms
Switching cycle	30 Hz max.
Operating voltage range	24 VDC, 85 - 110 %
Relay coil current	25 mA each
Spark suppression	r-c combination
Minimum contact load	1 V at 10 mA

Observe: At 220 VAC/50 Hz the spark suppression circuit draws max. 10 mA when the relay is off.



Input module C-P8-E and C-P8-ES

The input circuits process binary signals. They convey incoming information from the controlled systems to the processor. The processor treats signals originating from machine or hand operated signal sources with the same priority.

The input circuits are designed to filter incoming signals, convert them to the internal signal level and to isolate them electrically from the central processor.

Troublefree operation is ensured by "energy acknowledgement". A HIGH-signal at an input must have a certain energy level for a defined period of time to be recognized as valid data.

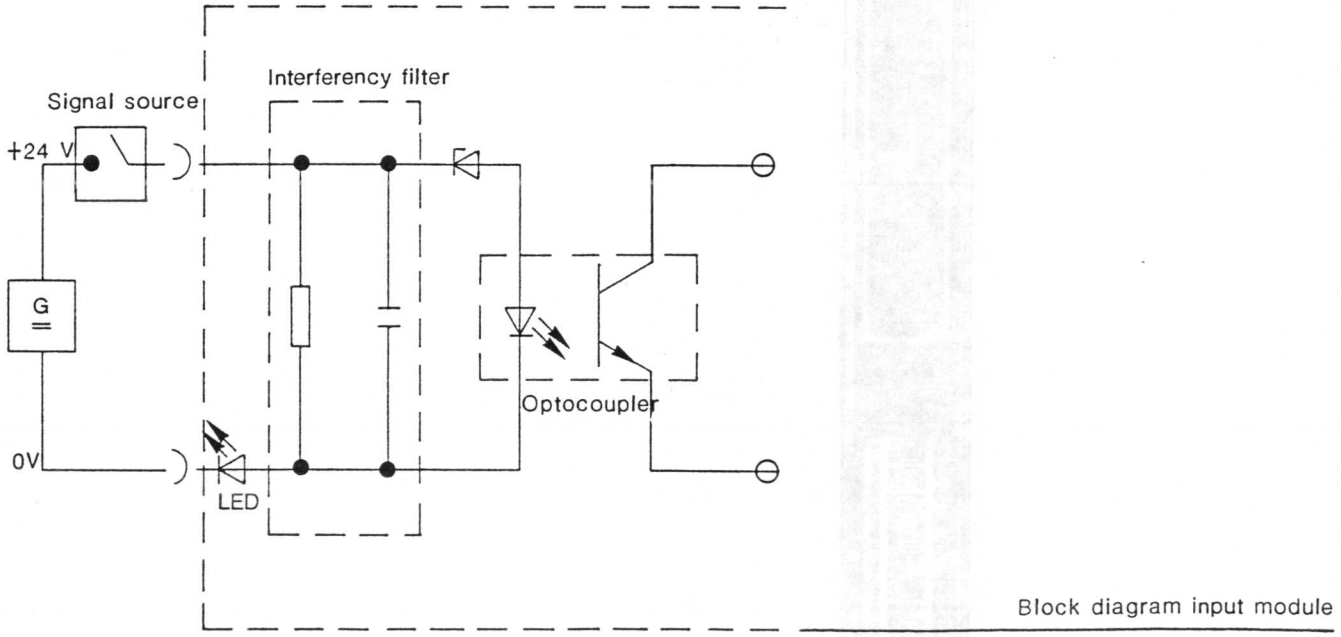
The signal sources are connected to the module by a standard clamp screw connector. The LEDs are marked analog to the inputs and outputs. The input circuit is current drawing.

The module can be mounted in any slot position. The position determines the module's basic address.

Each input is connected to a noise filter. Therefore, the leads don't need to be shielded.

The inputs are electrically isolated by optocoupler.

- Clamp screw connectors, fail-plug proof
- 8 inputs with LED status display
- Electrical isolation by optocoupler
- Write-on sticker labels
- "Energy acknowledgement" principle



Block diagram input module

Technical data

C-P8-EHS

Inputs	8
Operating voltage	24 VDC
Circuit design	current drawing
	14 mA at 24 V
Noise filter settling time	0.5 ms
LOW signal	-3 V to +5 VDC
HIGH signal	13 to 30.2 VDC
Status display	8 LEDs
Electrical input isolation	by optocoupler
Isolation voltage	1 500 V

C-P8-ES

Inputs	8
Operating voltage	24 VDC
Circuit design	current drawing
	14 mA at 24 V
Noise filter settling time	1 ms
LOW signal	-3 V to +5 VDC
HIGH signal	13 to 30.2 VDC
Status display	8 LEDs
Electrical input isolation	by optocoupler
Isolation voltage	1 500 V
Application	absolute distance measuring systems



P2 programming language

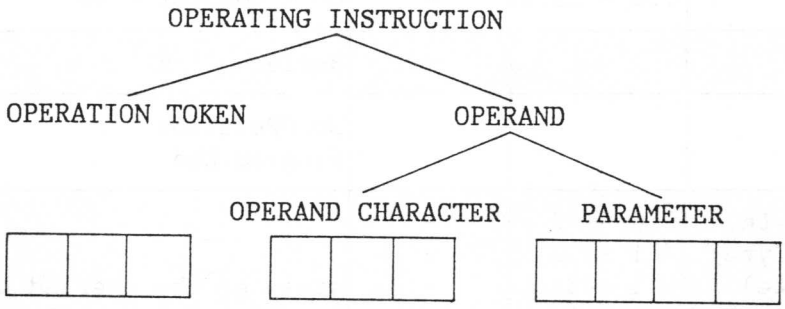
Instruction list

- Binary link instructions
- Short form mnemonics
- As defined an DIN 19239

The application program in the PLC consists of a sequence of operating instructions. An instruction contains

- an operation token with up to 3 characters
- an operand consisting of a token with up to 3 characters and a parameter with up to 4 digits

An instruction can consist of an operational token only.The operand can be characterized by an address.



Examples of Operating Instructions

OPERATION TOKEN	OPERAND CHARACTER	PARAMETER
U (AND)	E (INPUT)	1.5
O (OR)	E	4.2
= (SET)	A (OUTPUT)	4.2

Address reference

Description	Address range	Remark
Input	E 0.0 - E 7.7	octal coded count
Output	A 1.0 - A 7.7	octal coded count
Flag	M 1.0 - M 31.7	octal coded count
	M 0.0	battery alarm
	M 0.1	cycle start
	M 0.2	reserved
	M 0.3	reserved
	M 0.4	reserved
	M 0.5	reserved
	M 0.6	reserved
	M 0.7	reserved

querry only

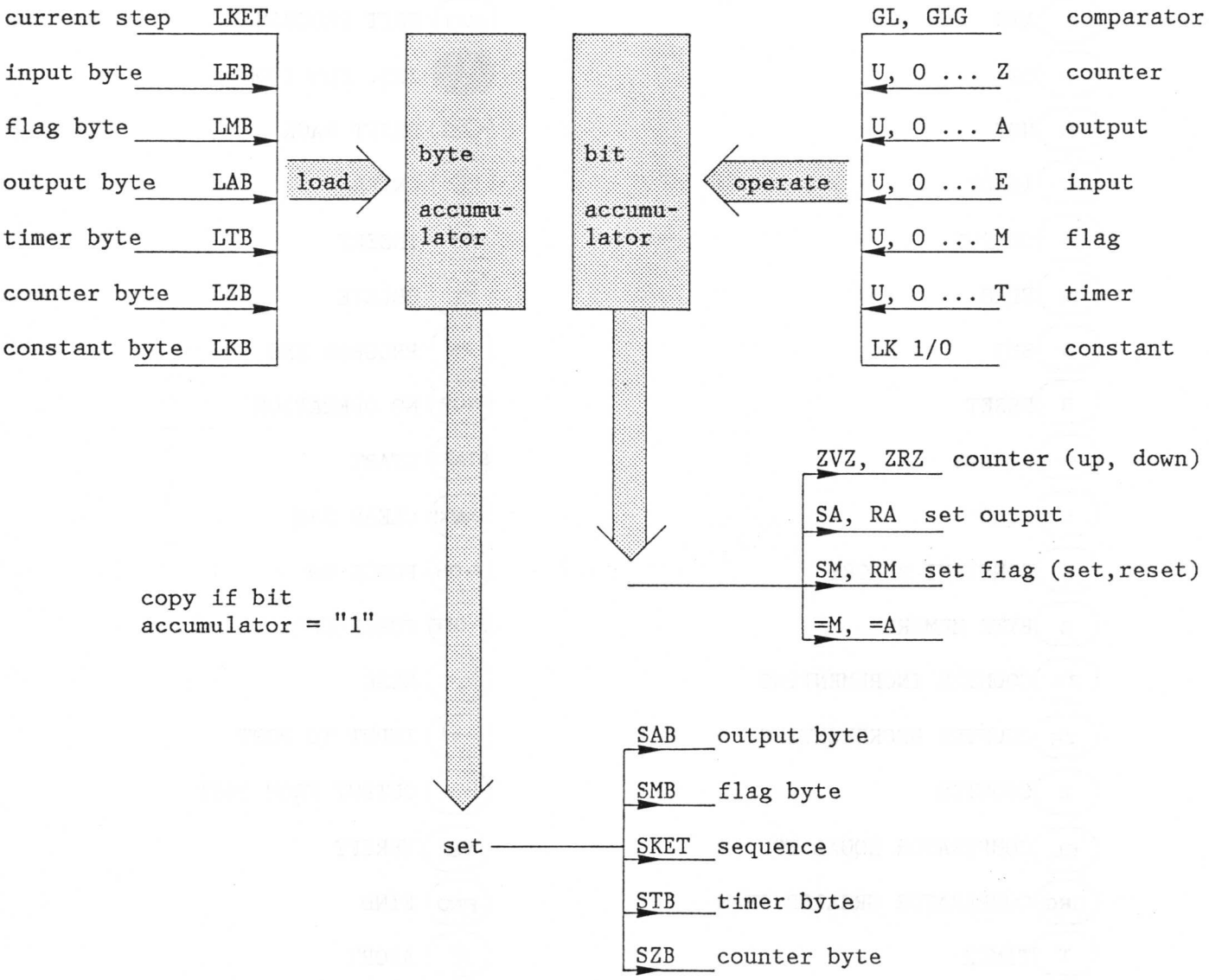
		Value	Addressing
Timer	T 0 - T 7	0.1 - 9.9 s	decimal
Timer	T 8 - T 15	1 - 99 s	"
Counter	Z 0 - Z 15		"
Counter < 0*	Z 0.0 - Z 15.0	counter	"
Counter > 99*	Z 0.9 - Z 15.9	carry over	"

* sweep impulse during one cycle

Instruction set

Operation	Operand	Parameter	Condition	Remarks
L (Load)	K (Constant)	1/0	-	load bit accumulator
L (Load)	KB (Const. Byte)	0 - 99	-	load byte accumulator
U (AND); UN (+NOT) O (OR); ON (Or NOT)	E (Input) A (Output) M (Flag) T (Timer) Z (Counter)	0.0 - 7.7 1.0 - 7.7 0.0 - 31.7 0 - 15 0.0 - 15.9	- - - - -	bit polling (Boolean link) 00 < counter < 99
O (OR)	-	-	-	Boolean link
NOP PE				No OPeration Program End
L (Load)	EB (Input Byte) AB (Output Byte) MB (Flag Byte) TB (Timer Byte) ZB (Counter Byte)	0 - 7 1 - 7 1 - 31 0 - 15 0 - 15	- - - - -	state of the operand byte in the byte accumulator
S (Set)	A (Output) M (Flag)	1.0 - 7.7 1.0 - 31.7	X X	set address if bit accumulator is "1"
	AB (Output Byte) MB (Flag Byte) TB (Timer Byte) ZB (Counter Byte)	1 - 7 1 - 31 0 - 15 0 - 15	X X X X	If bit accumulator is "1" then copy byte accumulator into corresponding operand byte
ZV (Counter Down)	Z (Counter)	0 - 15	X	count "up" if bit accumulator is "1"
ZR (Counter Up)	Z (Counter)	0 - 15	X	count "down" if bit accumulator is "1"
R (Reset)	A (Output) M (Flag) T (Timer)	1.0 - 7.7 1.0 - 31.7 0 - 15	X X X	reset if bit accumulator is "1"
= = N (Not)	A (Output) M (Flag)	1.0 - 7.7 1.0 - 31.7	X X	set if bit accumulator is "1" reset if bit accum. is "0"
KET (Sequence) SCHR (Step) S (Set)	- - KET (Sequence)	0 - 15 1 - 99 0 - 15	 X X	sequence selection step selection if bit accum. is "1" byte accum. sum is the step number within the selected sequence
L (Load)	KET (Sequence)	0 - 15	-	load present step number into the selected sequence
GL (Equal)	Z (Counter)	0 - 15		counter = byte accum. sum? result in bit accum. = "1"
GRG (Greater =)	Z (Counter)	0 - 15		counter ≤ byte accum.? result in bit accum. = "1"
GL (Equal to comparator)	KET (Sequence)	0 - 15		step number = byte accum.? result in bit accum = "1"
GRG (Greater than)	KET (Sequence)			step number ≤ byte accum? result in bit accum. = "1"

Function and operation of the individual instructions



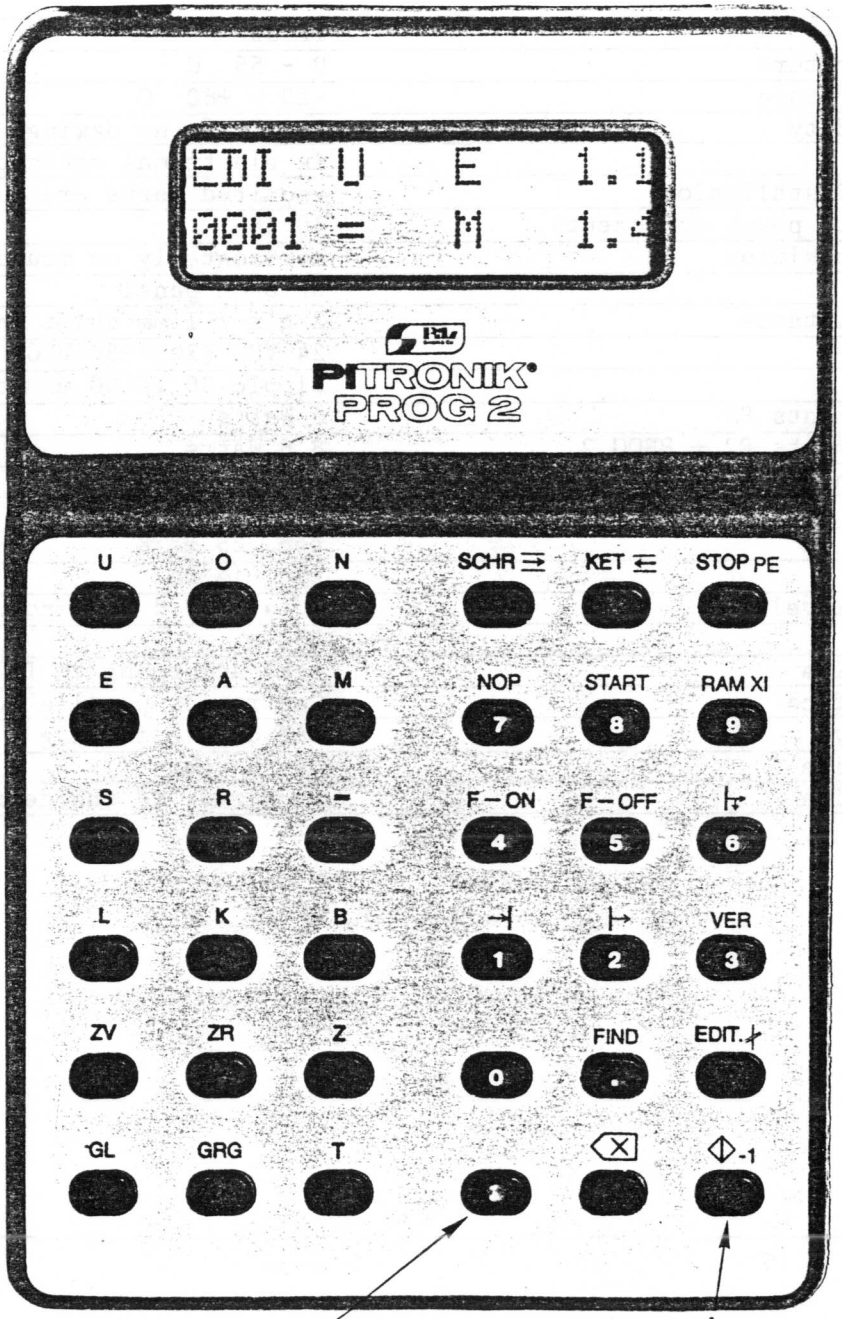
PROG 2 keyboard functions

U AND
O OR
N NOT
E INPUT
A OUTPUT
M FLAG
S SET
R RESET
= EQUALS
L LOAD
K CONSTANT MEMORY
B BYTE MEMORY
ZV COUNTER INCREMENTING
ZR COUNTER DECREMENTING
Z COUNTER
GL COMPARATOR EQUAL TO
GRG COMPARATOR GREATER THAN
T TIMER
SCHR STEP
KET SEQUENCE
STOP STOP

EDIT EDIT PROGRAM
2ND. FUNCTION
SHIFT BACK
ENTER
INSERT
DELETE
PE PROGRAM END
NOP NO OPERATION
START START
RAMXI CLEAR RAM
F-ON FORCE ON
F-OFF FORCE OFF
READ
INPUT TO PORT
OUTPUT FROM PORT
VER VERIFY
FIND FIND
ABORT
-1 ONE INSTRUCTION STEP BACK

Technical data

Protection class	IP 30
Ambient temperature	0 - 55 C
Storage temperature	-20 - +60 C
Relative humidity	0 - 75 %, no dewing permittable
Installation	in electrical cabinet required
- Isolated installation	required parts are supplied
- Distance to power components	10 cm
- Mounting position	horizontally on mounting plate
	or back panel
Vibration resistance	2 g's / 1 mm shift in all planes
Supply voltage	24 VDC (20 - 30 VDC) incl. residual
	ripple 36 V/100 ms accord. to VDI
Power requirements P2	6 Watts
Power requirements P2 + PROG 2	8.6 Watts
Input assy. logical levels	"1" = 13 - 30.2 VDC
	"0" = 0 - 5 VDC
Clock rate	typ. 25 ms/K
Input current	typ. 14 mA
Output assy. level	20.4 - 27.6 VDC incl. residual ripple
Weight	860 g
Electrical noise	1 kV according to IEC 255
Printer interface	Centronics parallel via adapter
Backup battery	RAM data buffering
- Battery life	ca. 5 years
Earth connection	required, to the designated terminal



Pressing the red key changes the function of the keys to 2nd. function.

Press ENTER after each instruction input.

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