ANALOG TRANSMITTER

PD 1610

Manual

GB

April 1986

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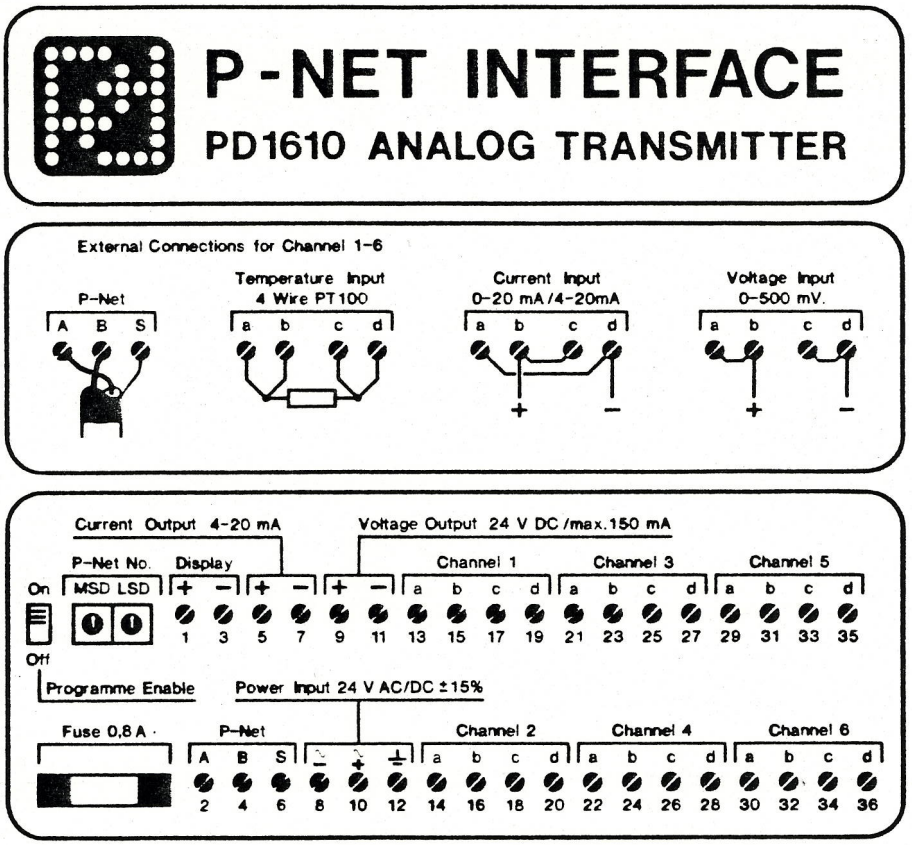
Connections:



made in Denmark by PROCES-DATA SILKEBORG ApS

1. General information.

The PD 1610 analog transmitter is part of **Proces-Data**`s module series 1000. The PD 1610 module has been developed for storing and processing of up to 6 analog measurment signals.

1.1. Functions.

* Connection of analog measurment signals on 6 different channels. The measurment signals could be voltage (0-500 mV), current (0-20 or 4-20 mA) or output from temperature detec- tor Pt-100.

* Conversion of measured results to the desired measurement units e.g. °C or bar.

* Direct connection of the display module PD 220. Using the display module it is possible e.g. to display the 6 different results of measurement as well as selecting various functions.

* Connection to **Proces-Data**`s local area network - the P-net. The same functions may be carried out via the P-net as via the display module.

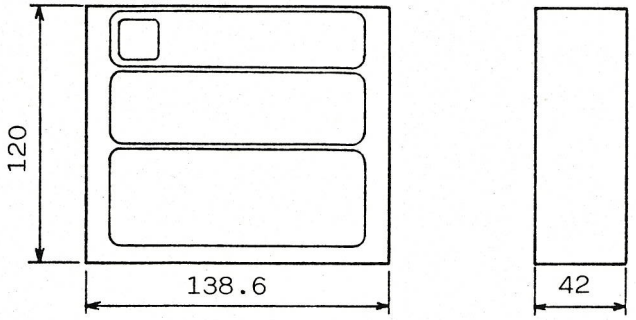
* Analog current output 4-20 mA used for instance for displaying one of the 6 results of measurement on an indicating meter.

* Internal PID-regulator, used for regulating purposes via the analog output.

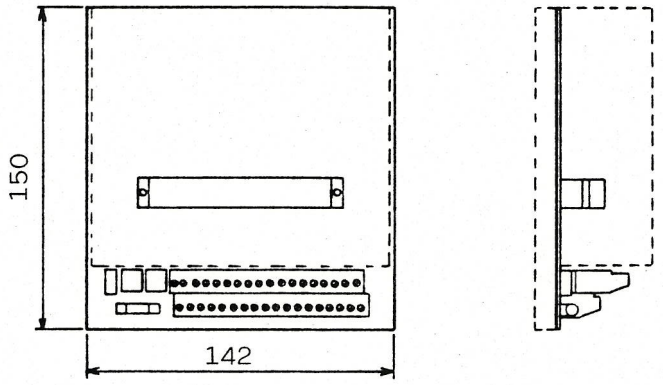
* Voltage output 24 V DC max. 150 mA, e.g. for supply of 2-wire transducers.

1.2. Structure, mechanical.

The PD 1610 module consists of 2 circuit boards incorporated in an aluminium box. The size of the box is 138.6 x 120 x 42 mm.



The module is designed for mounting on a terminal board, PD 1080, where the terminals are located. The terminal board is identical for all modules in **Proces-Data`** s module series 1000, its size being 142 x 150 mm.



Modules are connected to the terminal board with a plug allowing modules to be changed without disconnecting the supply lines.

The terminal board is supplied with 2 rotary switches used when selecting the module`s address in the P-net.

The module, including the terminal board, is designed for installation in a mounting box, panel etc.

1.3. Structure, electrical.

The PD 1610 module consists, among other things, of a micro-computer controlling and supervising all the functions of the transmitter.

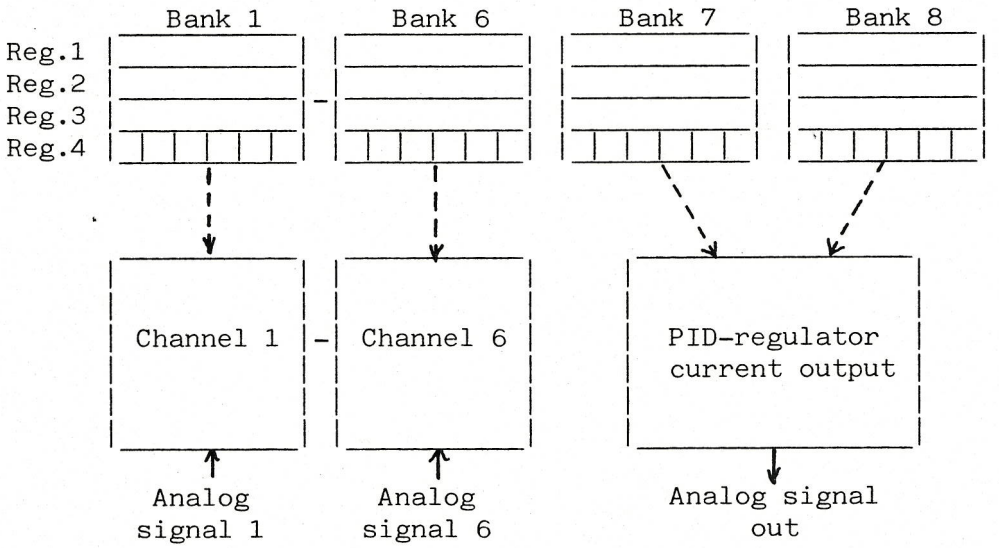
The power supply for the transmitter is 24 V AC or DC, +/- 15%.

The supply voltage, voltage output, current output and micro-processor with associated electronics, are all galvanically separated.

1.4. Selection of functions.

The PD 1610 module is equiped with a EEPROM, where the function codes of the transmitter are stored. The EEPROM is divided into 8 register banks, each containing 4 registers.

Register bank no. 1 defines the signal on channel 1, bank 2 defines the signal on channel 2 and so on. Bank 7 and 8 define the functions of the current output and the PID-regulator.

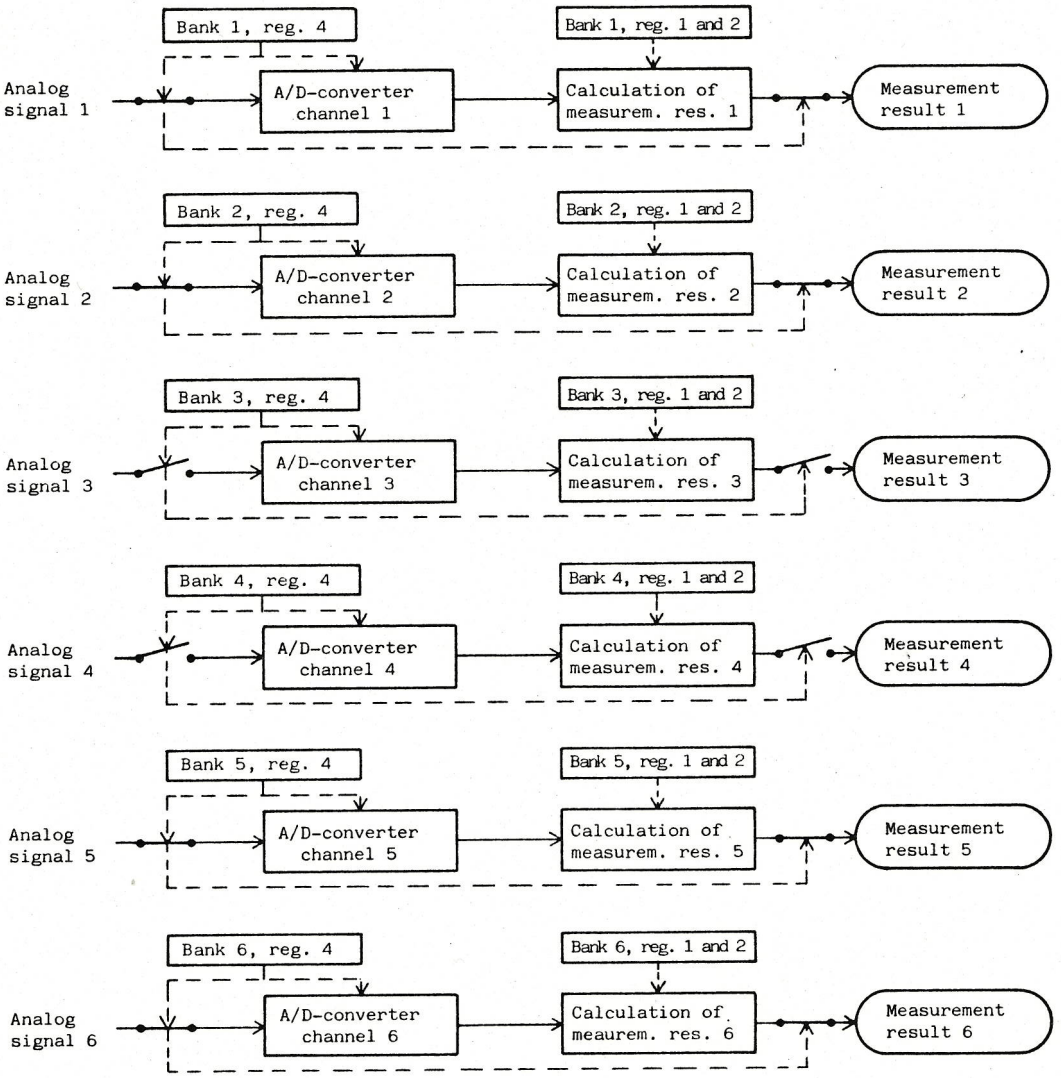


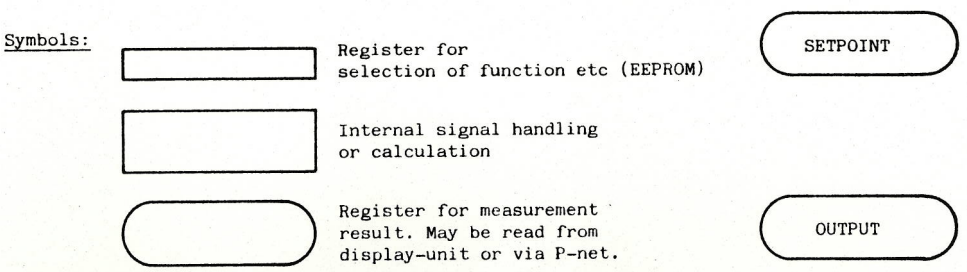
The contents of the EEPROM are preserved even when the transmitter is not connected.

2. Input signals.

Up to 6 analog input signals may be connected to the PD 1610, being current (0-20 or 4-20 mA), voltage (0-500 mV) or a Pt-100 temperature detector. Signal type etc. is selected separately for each channel by means of register bank 1-6.

Fig. 2.a.: Diagram to show signal processing to achieve measurement results.





2.1. Programming, bank 1-6.

Reg. 1: Result at MAX signal.

When the signal types are current and voltage, MAX is the result of measurement wanted at overall signal from the transducer. If the transducer is a Pt-100 temperature detector, MAX is not used.

Example: Pressure transducer 4-20 mA and 5-10 bar: MAX = 10.

Reg. 2: Result at MIN signal.

When the signal types are current and voltage, MIN is the result of measurement wanted at minimum signal from the transducer. If the transducer is a Pt-100 temperature detector, MIN is used for offset-adjusting of the temperature.

Example: Prseeure transducer 4-20 mA and 5-10 bar: MIN = 5.

Reg. 3: Available.

Reg. 3 is available in all 8 registerbanks and can be used for instance for inserting the unit of measurement for the signal on the actual channel.

Reg. 4: Code.

Digit no.	1	2	3	4	5	6

The code has 6 digits with individual significance.

	1	2	3	4	5	6
1. digit: Not used	0					
2. digit: Not used		0				
3. digit: 3 mA alarm limit			0-1			

0: No 3 mA alarm
1: 3 mA alarm limit

NOTE: The alarm can only be used when the signal type is current 4-20 mA.

	1	2	3	4	5	6
4. digit: TEST-mode				0-1		

0: Normal mode
1: TEST-mode (result of measurement is not calculated)

5. digit: Signal type

| | | | | 0-4 | |

0: Channel not in use
1: Temperature detector Pt-100
2: Current 0-20 mA
3: Current 4-20 mA
4: Voltage 0-500 mV

If a channel is not in use, the register for the result of measurement is at the user's disposal. (See paragraph 3.3.: Output current with PID-regulator

6. digit: Number of digits after decimal point on display by readout of result of measurement.

| | | | | | 0-6 |

2.2. Connection of input signals, general.

Each of the 6 analog inputs for the transmitter has a set of four terminals named "A-B-C-D".

NOTE: The 6 sets of terminals are **not** galvanically separated. The 6 terminals marked with a "D" are mutually connected inside the module. Make sure that the reference voltages are the same for all inputs.

All connections on the transmitter are protected against overload so that no damage will occur to the module if the inputs are improperly connected.

2.3. Temperature measurment.

Temperature detectors of the Pt-100 type may be connected to the PD 1610.

The detector is connected to one of the 6 sets of terminals marked "A-B-C-D" as shown in fig. 2.3.a.

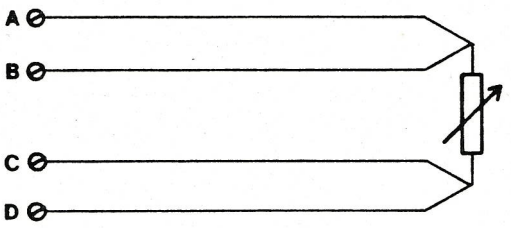


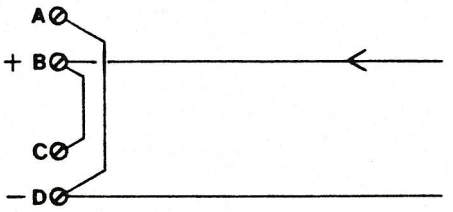
Fig. 2.3.a.

Error:	Less than +/- 0.9 °C using Pt-100 detector following DIN 43760.
Resolution:	0.05 °C
Repeatability:	0.1 °C
Temperature range:	From -30 °C to +400 °C
Detector power dissipation:	Max. 0.1 mW

2.4. Current measurment, 0-20 or 4-20 mA.

Analog current inputs, 0-20 mA or 4-20 mA may be connected to the PD 1610 module.

The signal is connected to one of the 6 sets of terminals marked "A-B-C-D" as shown in fig. 2.4.a.



To source-signal (transducer)

Fig. 2.4.a.

Error:	Less than +/- 0.3%, equivalent to +/- 0.06 mA
Resolution:	0.01%, equivalent to 0.002 mA
Repeatability:	0.02%, equivalent to 0.004 mA
Input impedance:	Max. 100 ohm
Voltage drop:	Max. 2 V at 20 mA

Example: Connection of more 2-wire transducers supplied with power from the voltage output on the module. See fig. 2.4.b.

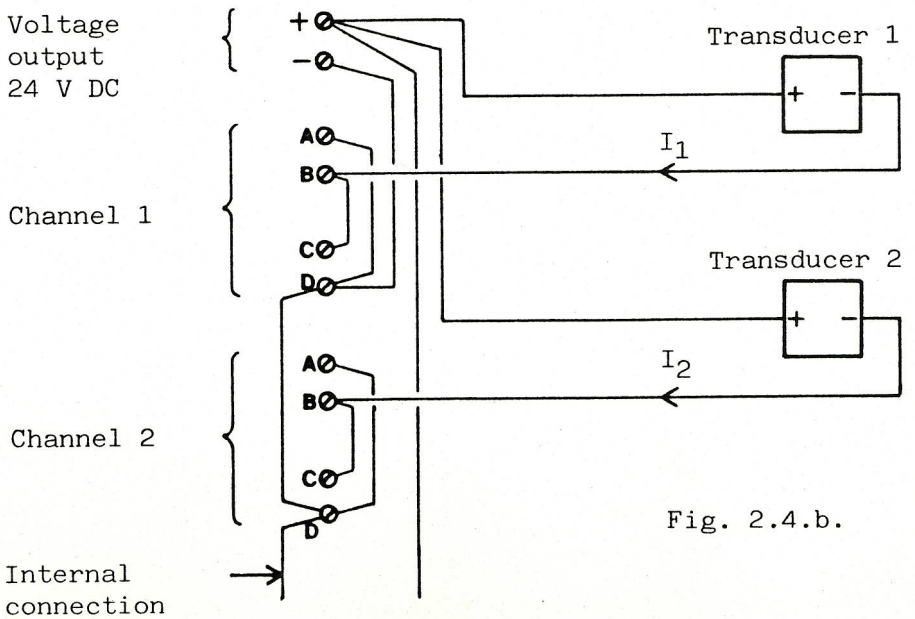


Fig. 2.4.b.

2.5. Voltage measurment, 0-500 mV.

Analog voltage inputs, 0-500 mV may be connected to the PD 1610 module.

The signal is connected to one of the 6 sets of terminals marked "A-B-C-D" as shown in fig. 2.5.a.

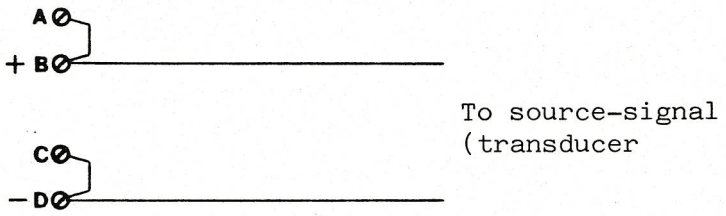


Fig. 2.5.a.

Error:	Less than +/- 0.3%, equivalent to 1.5 mV
Resolution:	0.01%, equivalent to 0.05 mV
Repeatability:	0.02%, equivalent to 0.1 mV
Input impedance:	Greater than 1 Mohm

The input impedance is so high, that common voltage dividing by means of 2 resistors can be used if the signal to be measured is greater than 0-500 mV.

Example: Input signal 0-5 V, see fig. 2.5.b.

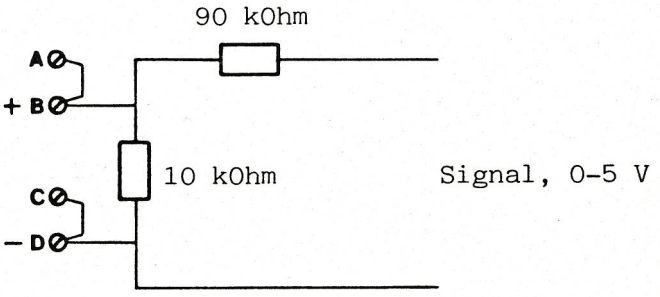


Fig. 2.5.b.

3. Current output and PID-regulator.

The PD 1610 module has a current output, 4-20 mA, used for displaying any one of the 6 measuring results or a SETPOINT via the P-net.

The results of measurement do not neccessarily have to come from the module´s A/D-converter. They can also be inserted via the display unit or via the P-net if the actual channel is not in use (see the paragraph "Input signals").

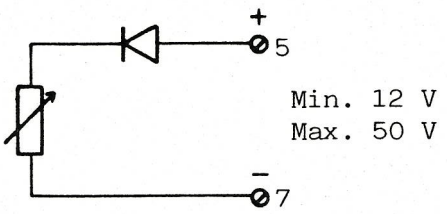
The current output may represent the output from an internal PID-regulator and this output may be used for control purposes.

The signal on the current output may be read from the display unit or P-net as a value between 0 and 100%.

3.1. Current output, electrical.

The current output is configured as an **inactive** current generator and **must be power supplied from an external circuit** (or the built-in voltage output of the module).

Fig. 3.1.a.: Current output, schematic.



The current output is galvanically separated from the rest of the electronics by means of an optocoupler. Furthermore the output is protected against overload by means of a zener diode and a current-limiting resistor. The resistor is designed to operate at a current of approx. 35 mA. The output may be loaded again when the current has been switched off for a few seconds.

The output circuit must be designed so that the voltage on the current output (terminal 5 and 7 on the terminal board) is always min. 12 V, as this voltage is the power supply for the current regulation circuit.

Fig. 3.1.b.: Current output.

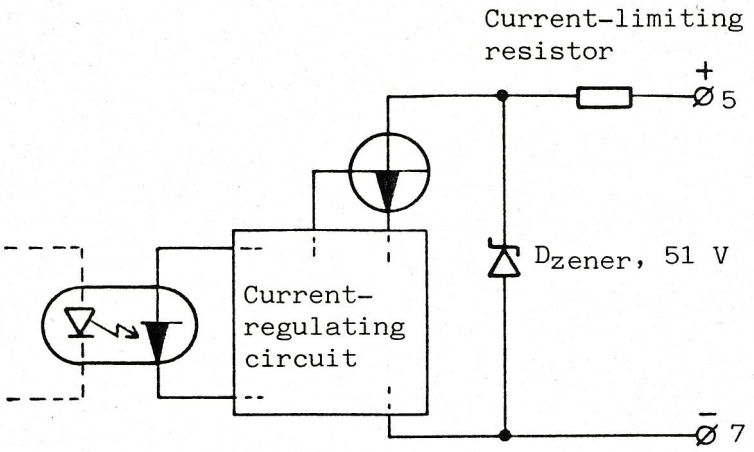


Fig. 3.1.c.: Connection of current output with power supply from the module`s internal voltage supply.

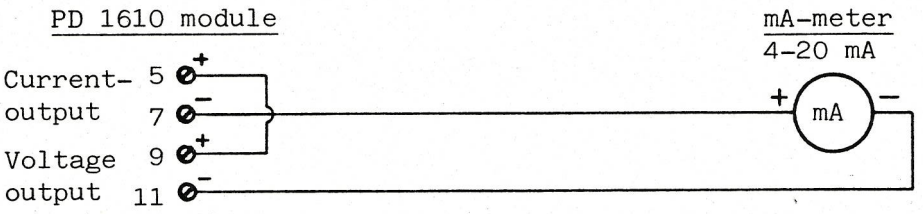
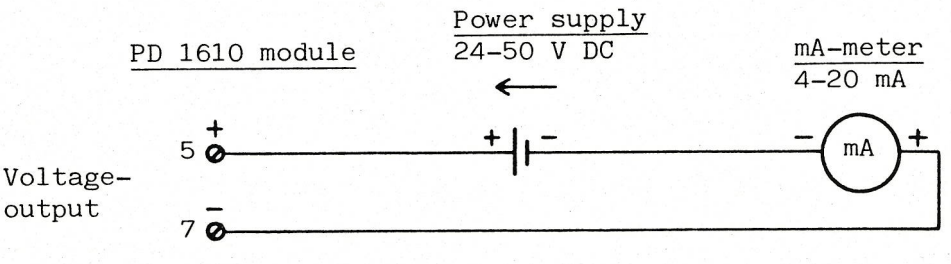
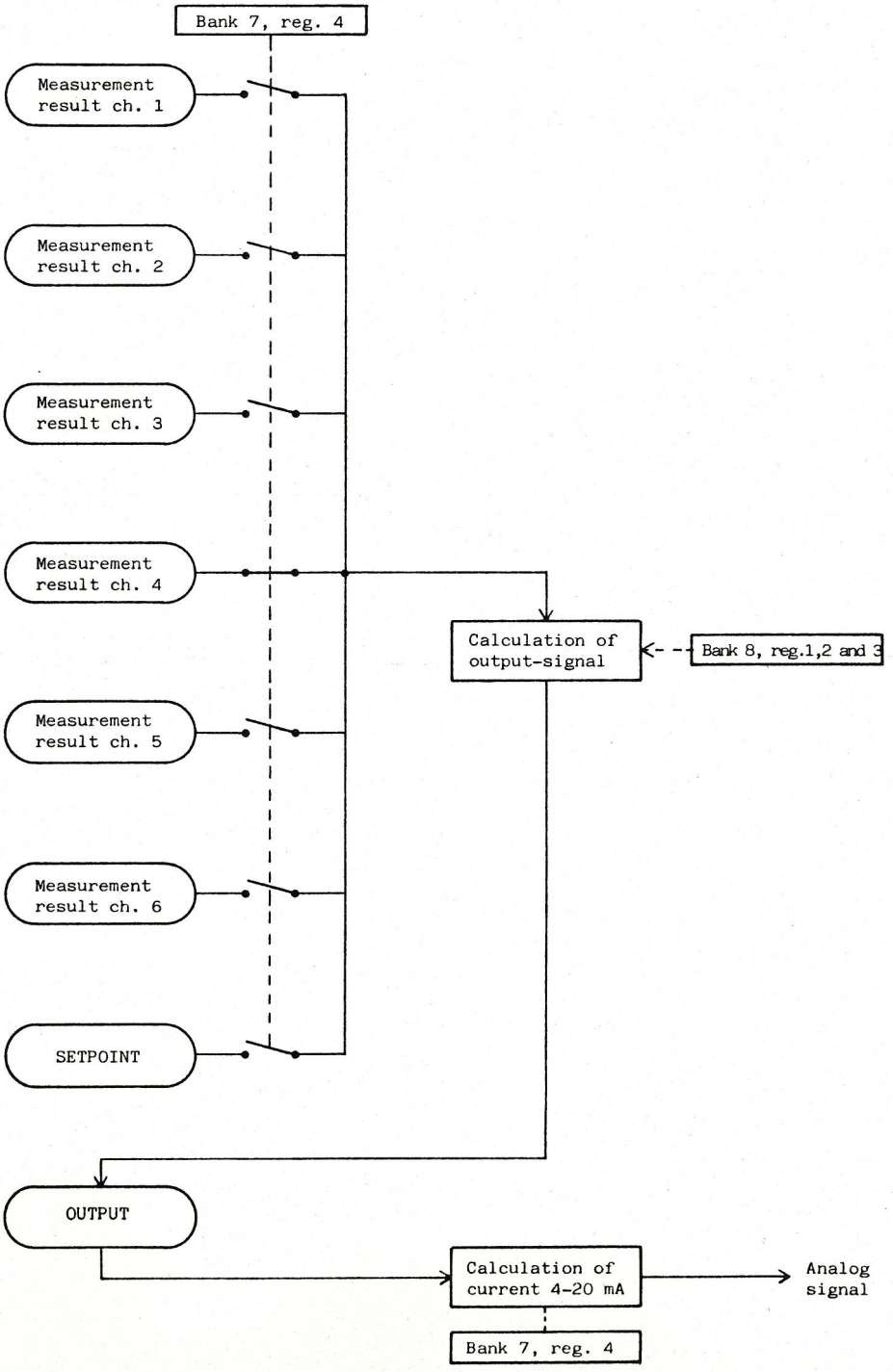


Fig. 3.1.d.: Connection of current output with external power supply.



3.2. Current output without PID-regulator.

Fig. 3.2.a.: Diagram illustrating current output without a regulator.



The functions on the current output are chosen by means of register bank no. 7 and 8.

Register bank no. 7.

Reg. 1: Input signal at MAX input/output signal.

MAX is a number which represents the maximum signal (100%) on the current output. MAX is given directly in the measuring unit in which the result of measurement is defined (e.g. °C).

Reg. 2: Input signal at MIN input/output signal.

MIN is a number which represents the minimum signal (0%) on the current output. MIN is given directly in the measuring unit in which the result of measurement is defined (e.g. °C)

Reg. 3: Available.

Reg. 3 is available in all 8 register banks and may be used for instance for inserting the unit of measurement for the signal on the actual channel.

Reg. 4: Code.

Digit no.	1	2	3	4	5	6

The code has 6 digits with individual significance.

	1	2	3	4	5	6
1. digit: Not used	0					
2. digit: Not used		0				
3. digit: Signal for current output			0-7			

0: No signal
1: Channel 1
2: Channel 2
3: Channel 3
4: Channel 4
5: Channel 5
6: Channel 6
7: SETPOINT

4. digit: Inverting of input.

| | | | | 0-1 | | |

0: 0-100%, equivalent to 4-20 mA
1: 0-100%, equivalent to 20-4 mA

5. digit: Overflow/underflow alarm.

| | | | | | 0-1 | |

0: Alarm off
1: Alarm 02 for input more than MAX or less than MIN

6. digit: Number of digits after decimal point by SETPOINT read-out on display unit

| | | | | | | 0-6 |

Registerbank no. 8.

Registerbank no. 8 is hardly used for any other purposes than setting the PID-regulator. Only the sixth digit of register 4 is of any significance if the regulator is not used.

Reg. 4: Code

Digit no.	1	2	3	4	5	6

6. digit: Number of digits after decimal point by read-out of current output via display unit.

| | | | | | | 0-6 |

3.3. Current output with PID-regulator.

The current output in the PD 1610 module may represent the output from a PID-regulator inside the module.

The function of the regulator is selected by means of the P, I and D parameters and a code defining what input signals are to be used by the regulator.

3 different signals A, B and C may be defined for the regulator - A and B being the inputs and C the SET-POINT-value.

The signals may come from the internal A/D-converter of the module, or (if the actual channel is not in use - see paragraph 2.1.: Programming, bank 1-6) they may be inserted via display unit or P-net.

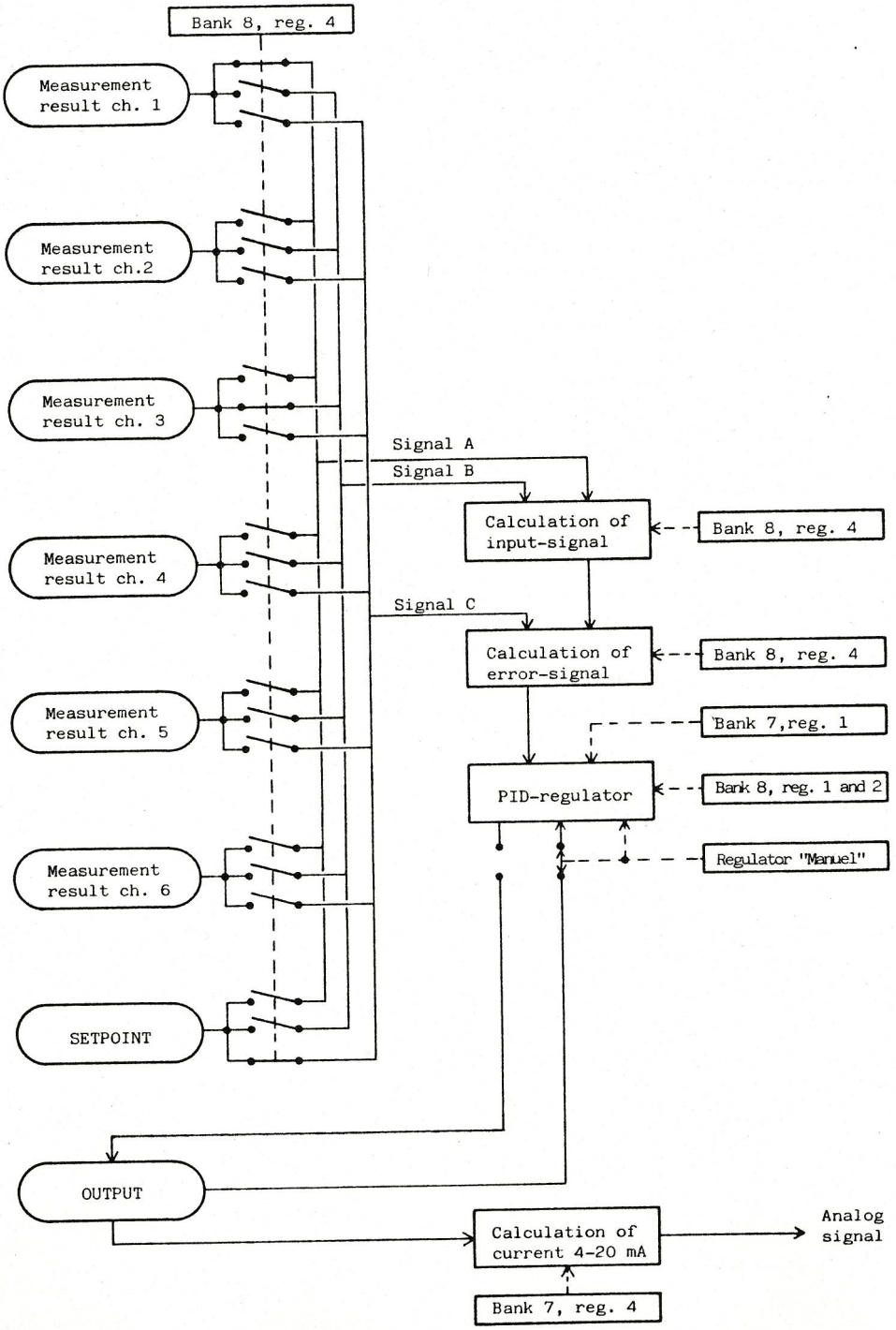
The signals A and B may be added, subtracted, multiplied or divided by each other. In this way it is possible to select the module for proportional regulation between 2 measured values.

By means of display unit or P-net the regulator may be put to "Manual" position (for further information see the paragraphs "Display" unit and "P-net connection").

When the regulator is in "Manual", the output from the regulator may be defined via the display unit or via P-net. When the regulator is put back to "Auto", regulation continues with reference to the defined output. This facility is called "Bump-less transfer" and may be used e.g. to avoid over-shoot when a very slow feed-back control system is started.

The "Manual" facility may also be used for a quick zero setting of the output e.g. in case of alarm.

Fig. 3.3.a.: Diagram illustrating current output with regulator.



The functions of the current output and regulator are selected by means of register bank no. 7 and 8.

Register bank no. 7.

Reg. 1: Xp

Xp is the proportional band of the PID-regulator. The proportional band for a regulator is the change in input giving a change from 0-100% in output (without I and D). Xp is given in the same units of measurement as input for the regulator (e.g. °C).

Reg. 2: Not used.

Reg. 2 is only used for current output without regulator.

Reg. 3: Available.

Reg. 3 is available in all 8 registerbanks and may be used for instance for inserting the unit of measurement for the signal on the actual channel.

Reg. 4: Code

Digit no.	1	2	3	4	5	6

The code has 6 digits with individual significance.

	1	2	3	4	5	6
1. digit: Not used	0					
2. digit: Not used		0				
3. digit: Signal for current output			8			
4. digit: Inverting of output				0-1		

8: Signal from regulator

0: 0-100% equivalent to 4-20 mA
1: 0-100% equivalent to 20-4 mA

5. digit: Overflow/ underflow alarm

| | | | | 0-1 | |

0: Alarm off
1: Alarm for overflow/underflow on regulator

6. digit: Number of digits after decimal point by read out of SETPOINT via display unit

| | | | | | 0-6 |

Register bank no. 8.

Reg. 1: "Ti"

| |

"Ti" is the integration time of the regulator. The integration time for a regulator is the time taken for the I-component of in the regulator to make the same change in output as the P-component after a lasting change in input.

By adjusting "Ti" to a very high level the I-effect in the regulator is reduced to a minimum.

"Ti" is indicated in seconds.

Reg. 2: "Td"

| |

"Td" is the differentiation time of the regulator. The differentiation time for a regulator is the time it must take for a continuously increasing input to go up from 0 to 100% (equivalent to Xp), in order to give a steady output of -100% (without P and I).

As the signal from the D-component of the regulator is negative by increasing input, this component will influence on the output as a "brake".

The D-component is cut off by setting Td to 0.

Td is given in seconds.

Reg. 3: Available

| |

Reg. 4: Code

Digit no.	1	2	3	4	5	6

The code has 6 digits with individual significance.

1. digit: Signal A

1-7					

1: Channel 1
2: Channel 2
3: Channel 3
4: Channel 4
5: Channel 5
6: Channel 6
7: SETPOINT

2. digit: Activation of I-component

	0-1				

As the I-component can not be completely cut off, even if "Ti" is adjusted to a very high level, this code is introduced to make it possible to remove the I-component completely.

0: Without I
1: With I

3. digit: Signal B

		1-7			

1: Channel 1
2: Channel 2
3: Channel 3
4: Channel 4
5: Channel 5
6: Channel 6
7: SETPOINT

4. digit: Calculation of signal for regulator

			0-9		

0: (A)-C
1: (A+B)-C
2: (A-B)-C
3: (AxB)-C
4: (A÷B)-C
5: C-(A)
6: C-(A+B)
7: C-(A-B)
8: C-(AxB)
9: C-(A÷B)

5, digit: Signal C

| | | | | | 1-7 | |

1: Channel 1
2: Channel 2
3: Channel 3
4: Channel 4
5: Channel 5
6: Channel 6
7: SETPOINT

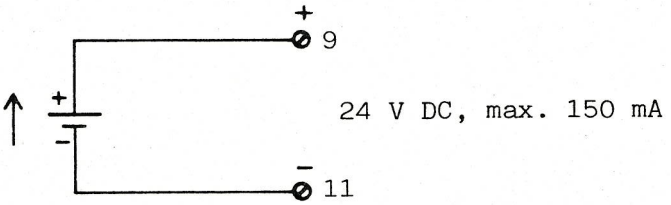
6. digit: Number of digits after the decimal point by read out from regulator via display unit

| | | | | | | 0-6 |

4. Voltage output.

The PD 1610 module is supplied with a voltage output of 24 V DC, maximum 150 mA.

Fig. 4.a.: Voltage output, schematic.



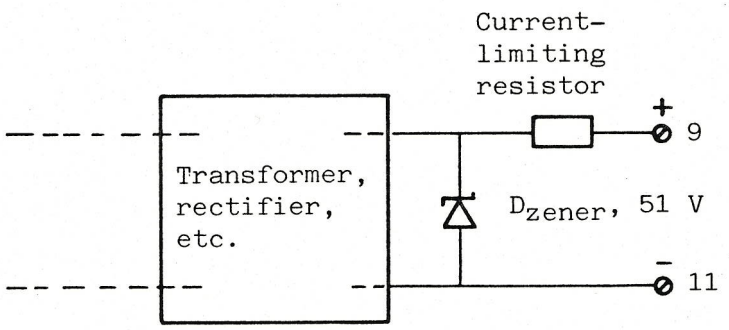
The voltage output may be used for supply e.g. of current output or 2-wire transducers.

The voltage output is galvanically separated from the rest of the electronics by means of a transformer.

The output is protected against overload by means of a zenerdiode and a current-limiting resistor.

After an overload the load must be disconnected before the output can be normally loaded again.

Fig. 4.b.: Voltage output.



5. Display unit.

The display unit PD 220 may be connected directly to the the PD 1610 module. The display unit has 3 functions.

1: Display of measurement results etc. from the module.

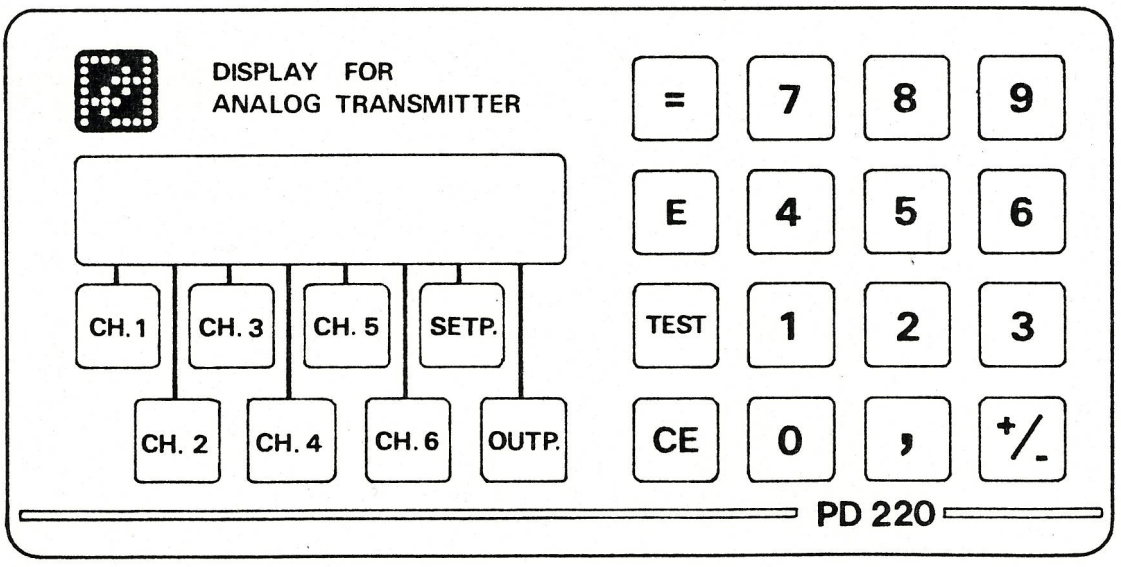
2: Modification of rates in the module e.g. SETPOINT.

3: Selecting functions for the module e.g. selection of signal type on the 6 analog channels.

The display unit is connected to the module with a 2-wire cable. The display-unit is supplied with power via this cable. It also carries the exchange of data between the module and the display-unit. The length of the cable must not exceed 100 m.

The cross-sectional area of the cable must be at least 0.75 mm^2 .

Fig. 5.a.: Display unit for analog transmitter.



5.1. Operation.

5.1.1. Display of measurement results etc.

The 6 results of measurement, SETPOINT and output may be displayed via the display-unit. The desired readout is chosen by pressing one of the 8 keys under the display window. An arrow indicates the last key that was pressed. The display readout is automatically updated approx. once per second.

5.1.2. Changing register contents.

Result registers of channels not in use for measuring analog signals, or put in TEST-mode, may be modified from the display unit. Also the SETPOINT may be keyed in from the display unit. Furthermore the OUTPUT may be keyed in if current output with regulator is used and the regulator is put in "Manual" mode.

The keying in is performed by first displaying the rate as described above, then keying in the desired rate and pressing the "=" key. This procedure will place the desired rate in the register, after which a normal display is obtained.

5.1.3. PID-regulator "Manual".

The "Manual" mode on the regulator is described in paragraph 3.3.: Current output and PID-regulator. The regulator is in "Auto" mode when the contents of the register E7 is "0", and in "Manual" mode when the contents is "1".

The following sequence will put the regulator to "Manual" mode:
"E" - "7" - "1" - "=".

The following sequence will put the regulator to "Auto" mode:
"E" - "7" - "0" - "=".

The "Program Enable" switch does not have to be in "ON" position to put the regulator into "Manual" or "Auto" modes.

After reset, the regulator is in "Auto" mode.

5.1.4. Display of EEPROM.

The EEPROM in the PD 1610 module contains 32 registers divided into 8 banks, each of 4 registers.

To read a register, first key in "Bank no." in register E8. Then choose register number (1-4).

Example: Read out of Bank 2, reg. 3.
Key in: "E" - "8" - "2" - "=".
Bank number is now chosen.

Key in: "E" - "3".
Register number is now chosen and the contents of the register is shown in the display window. The first digit indicates the register number.

5.1.5. Changing contents of EEPROM.

To insert new rates in the EEPROM first read the actual register as described above. Then key in the new rate and finally press the "=" key.

This procedure will place the desired rate in the register, after which normal readout is obtained.

To change the contents of the EEPROM the "Program Enable" switch must be in "ON" position. This switch is situated on the terminal board next to the terminals.

5.2. Error alarm.

The PD 1610 module is equipped with a comprehensive test system which is able to reveal errors caused by wrong operation of the module or errors in the module itself.

When the test system finds an error, the user is informed via the display unit. An "A" for alarm will appear in the first digit of the display window. When the TEST key is pressed, the display shows an error code of 2 digits giving details about the error. The alarm will not be cancelled until the error code has been shown in the display window - not even if the error that causes the alarm disappears again.

If more than one error occurs at the same time only the error code with the highest number will be saved.

5.2.1. Definition of error codes.

The error codes may be divided into 2 groups:

Group 1 contains error codes not dependant on the type of signal on the input.

Group 2 contains error codes dependant on the type of input signals on the channels.

Group 1:

ERROR CODES	MEANING
93	Program-store fault
92	Data-store fault
91	EEPROM fault
90	Microprocessor fault
72-88	A/D-converter fault
02	Overflow current output/regulator
01	Overflow voltage output

Group 2:

For all error codes in group 2 the most significant digit indicates the channel number on which the error has occured. For instance error code 16 means: Current channel 1 less than 3 mA - and error code 46 means: Current channel 4 less than 3 mA.

Signal type current, 0-20 or 4-20 mA.

ERROR CODES	MEANING	REASON
18,28..68	Overflow A/D-converter	Signal too large Internal fault
17,27..67	Current > 20 mA	Signal too large
16,26..66	Current < 3mA	Signal too small Current circuit fault Internal fault This error can only occur with 4-20 mA signals

Signal type voltage, 0-500 mV.

ERROR CODES	MEANING	REASON
14,24..64	Overflow A/D-converter	Signal too large Measuring circuit fault Internal fault
13,23..63	Voltage > 500 mV	Signal too large

Signal type Pt-100 temperature detector.

ERROR CODES	MEANING	REASON
18,28..68	Overflow A/D-converter	Internal fault
17,27..67	Internal reference > max.	Internal fault
16,26..66	Internal reference < min.	Temperature detector disconnected Internal fault
14,24..64	Overflow A/D-converter	Signal too large Temperature detector fault Internal fault
13,23..63	Temperature > 400 °C	Signal too large
12,22..62	Temperature < -30 °C	Signal too small Temperature detector short-circuited

6. P-net connection.

The PD 1610 module may be connected to the P-net, which is a local area network used for process control and data collection. Using the P-net almost the same values may be read out and altered as via the display unit.

A typical use of the P-net would be - from a central computer - to collect results of measurement from one or more modules and present them on a data screen. Setpoint and parameters in the module´s internal PID-regulator may also be adjusted from the central computer.

All units connected to the P-net must have an address between 01 and 7E. This number is inserted by means of 2 rotary switches placed on the terminal board next to the terminals.

When calling a PD 1610 module via the P-net only 2-byte addresses can be used, and the number of data bytes in a data block must not exceed 4.

Further information about the building up of the P-net may be obtained on request from **Proces-Data**.

When a computer wants to collect data from a module it first sends the address of the module out on the P-net. Then a register address defining which data is to be read out.

The register addresses are defined in the table on the next page. Furthermore the table shows how to read the same data via the display unit.

DISPLAY-ADDRESS	P-NET-ADDRESS	NUMBER OF BYTES	CONTENTS
	0001	2	Type of device (1610)
	0002	2	Program-version (8601)
TEST key	0003	1	Error code
Reg. E7	0004	1	Regulator "Manual" mode
Result, CH 1-key	0011	4	Result, channel 1
Result, CH 2-key	0012	4	Result, channel 2
Result, CH 3-key	0013	4	Result, channel 3
Result, CH 4-key	0014	4	Result, channel 4
Result, CH 5-key	0015	4	Result, cahnnel 5
Result, CH 6-key	0016	4	Result, channel 6
SETPOINT-key	0017	4	Setpoint
Output-key	0018	4	Output %
Bank 1, reg. 1	0020	4	MAX, channel 1
Bank 1, reg. 2	0021	4	MIN, channel 1
Bank 1, reg. 3	0022	4	Available, channel 1
Bank 1, reg. 4*	0023	4	Code, channel 1
Bank 2, reg. 1	0024	4	MAX, channel 2
.	.	.	.
.	.	.	.
.	.	.	.
Bank 6, reg. 4*	0037	4	Code, channel 6
Bank 7, reg. 1	0038	4	MAX/Xp, current outp./regul.
Bank 7, reg. 2	0039	4	MIN, current output
Bank 7, reg. 3	003A	4	Available
Bank 7, reg. 4*	003B	4	Code, current outp./regul.
Bank 8, reg. 1	003C	4	"Ti" regulator
Bank 8, reg. 2	003D	4	"Td" regulator
Bank 8, reg. 3	003E	4	Available
Bank 8, reg. 4*	003F	4	Code, regulator

* In registers containing codes, (consisting of 6 digits of individual significance), the 6 digits must be contained within the 3 most significant bytes, while the contents of the least significant byte is of no importance.