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WEIGHT TRANSMITTER

PD 1431

Manual

GB

November 1990

Contents

1. General.

The PD 1431 Weight transmitter is a MODULE in Proces-Data's module series 1000. The PD 1431 module is intended for the collection and processing of signals from a weighing element. However, the module can also be used for the collection and processing of various digital signals, as well as controlling valves, relays etc. from the measurement results collected.

1.1. Functions.

* Connection of signals from weighing elements, with the option of belt weighing functions in conjunction with a digital input.

* An analog current output 4-20 mA, which among other things can be used to indicate various measured results on a display instrument.

* Internal PID-regulator, which via the analog output or a digital output can be used for control purposes.

* Internal limit switch/dosage channel for use as alarm detector, or dosing using a measurement and a setpoint.

* 2 digital input channels, useful, for example, when controlling external equipment. Furthermore, these input channels can also be used as counters for registering pulses (max 250 Hz). The digital inputs can also be used for measuring frequency or period (max 250 Hz).

* 2 digital output channels for controlling relays, valves etc.

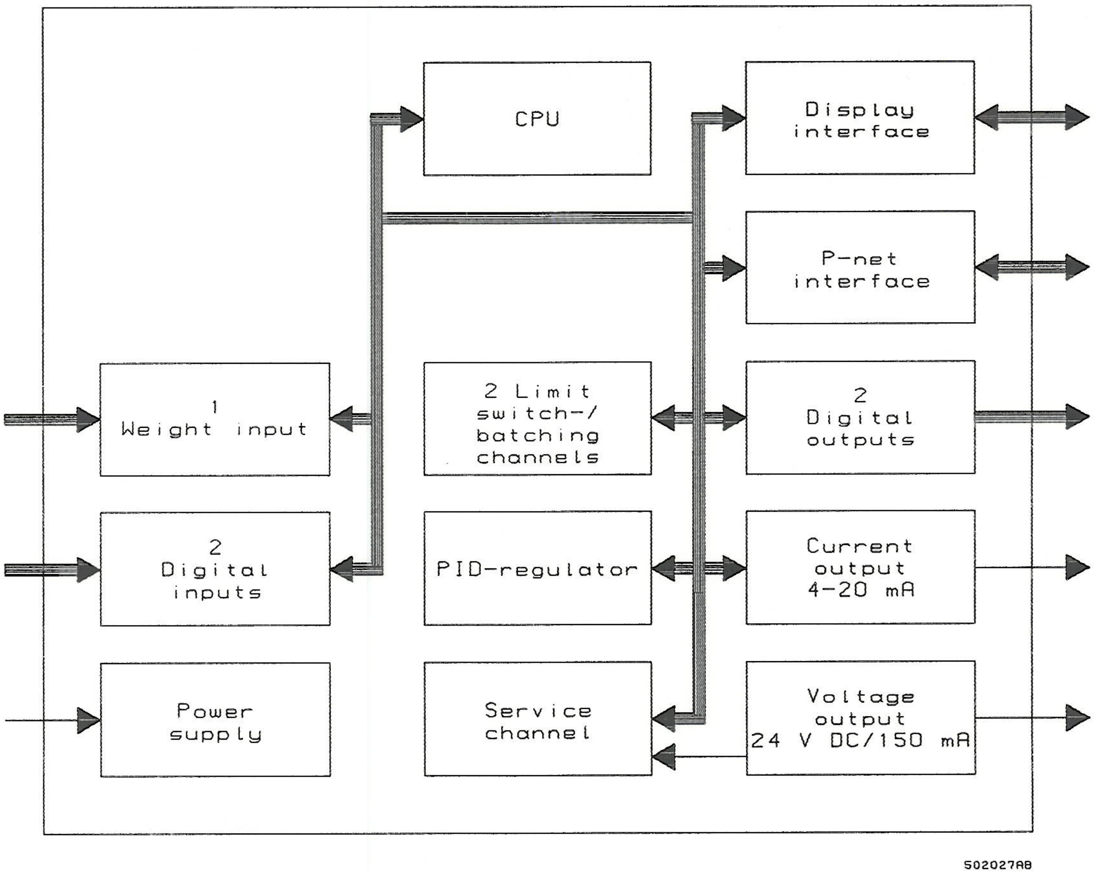
* Direct connection of the PD 230 display. Using the display unit it is possible to select various measurement results as well as setting the module for various functions.

* Connection to PD's local network, the P-net. Using the P- net, it is possible to carry out the same functions (as the display unit) from a central computer.

* Voltage output 24 V DC max. 150 mA.

* Advanced self testing facility which can be monitored using the display unit or through the P-net.

1.2. Block diagram of PD 1431.



1.3. Connection to P-NET.

The PD 1431 module can be connected to Proces-Data's local area network P-Net, which is a local area network intended for process control and collection of data.

The PD 1431 module is controlled via the P-Net. Setting the module for the functions required, and communication between the module and a control computer is also carried out via the P-Net.

A typical application of the P-Net is that of transmitting measurements from one or more modules to a central computer and displaying the results on a screen. Furthermore, it is possible to control the outputs (digital as well as analog) via the computer and to check modules for internal & external errors.

More information about the operation and structure of P-Net can be obtained by writing to Proces-Data.

1.4. Channels/registers.

PD 1431 Module contains:-

1 Service channel	channel 0)	2 Digital inputs	(channel 6-7)
1 Weight channel	(channel 1)	2 Digital outputs	(channel 8-9)
1 Current output	(channel 2)	1 Display channel	(channel A)
1 PID regulator	(channel 3)	1 Special channel	Cchannel B)
1 Dosing channels	(channel 4-5)		

A set of 16 registers numbered from 0 - F, is associated with each channel (see diagram below). For addressing a register within a particular channel, a symbolic address of 2 hexadecimal digits is used.

```
Example: Register 4 on channel 8 needs to be addressed.
         The symbolic address will then look like this:   |8|4|

                          Channel number  ------------------┘ |
                          Register number --------------------┘
```

If attempting to read a non-defined register, the module will not respond. This will be indicated as an error in the P-net transmission.

A set of registers is shown in the fig. below. As an example, the registers associated with channel 0 are defined.

Throughout the manual the register sets will be visualized in a table. The example below concerns the register sets belonging to channel 0.

The register names are standard identifiers defined in Process-Pascal.

Reg.no.	Register name	Write	Storage medium	Number of bytes	Read out
0					
1	DeviceType		P	2	Decimal
2	PrgVers		P	2	Decimal
3	Error3	X	R	1	Hexadec.
4					
5					
6					
7	WDTimer	X	R	2	Decimal
8	WDPreset	X	E	2	Decimal
9	Code9	X	E	4	Hexadec.
A					
B					
C					
D					
E					
F	ErrorF		R	1	Hexadec.

Storage media: R;RAM, E;EEPROM, P;PROM, BR;BATTERY RAM

Data stored in EEPROM is retained after a reset, or after a power failure. If this data needs to be modified, the "Program Enable" switch must be ON.

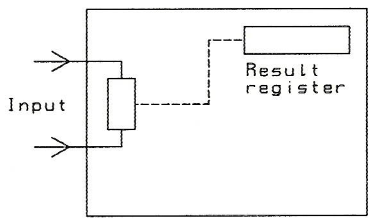
Data stored in Battery RAM is retained after a reset or a power failure.

Types of channel

The module consists of several channels which each have their own function. These channels can be combined to suit the needs of the user. The module contains channels of the following three types:

Input channel:

Direct electrical connection to input device. Input data is stored in a register of its own channel. Typically, it's possible to use scaling.



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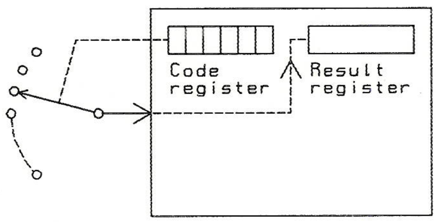
Internal channel:

Channel without electrical connection. The channel takes input data from other channels, or the contents of registers which have been set by the display unit or P-net.
Input data is selected using a code register. The resultant data is stored in a associated output channel register.



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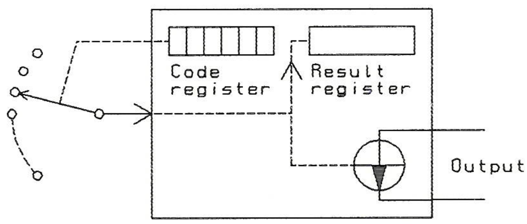
Output channel:

Direct electrical connection to output device. The channel takes data from other channels or from registers which have been set via the display-unit or P-net.
Input data is selected using a code register. Output data is stored in a register which directly controls the output device.



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1.5. Combining Channels.

If, for example, the current output is required to be controlled by a measured weight on the weight input channel, it can be done by pointing to the measured value on the weight channel using a code reg, in the current output channel (see fig.1.5.a.).

As soon as a measured value is pointed to by the code register, the module will create an indirect register, where the measured value can be read. This means that the measurement can be read both in the result register in the analog input channel, and in the indirect register in the current output channel.

When pointing at address 00 by means of a code register, it is possible to write directly in the indirect register.

Note: It is not possible to point to an indirect register using a code register, as this will result in an error on that channel. The indirect registers are marked with an asterisk in the definition of registers for the various channels.

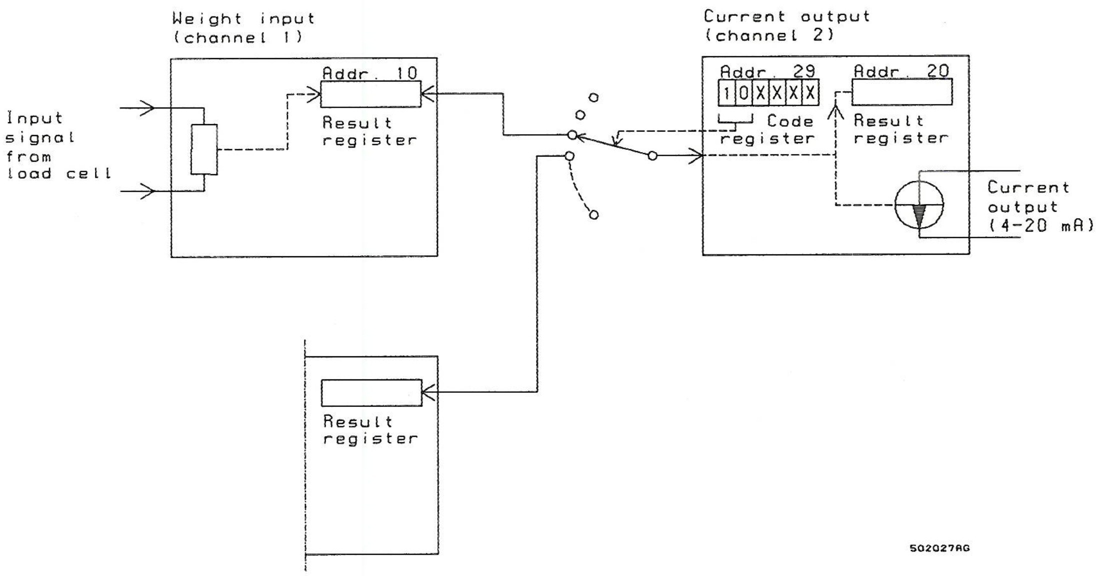


Fig. 1.5.a.

2. Weight Input Channel.

The PD 1431 module has an input channel (channel 1) used when measuring weight.

A maximum of 8 Strain gate load cells can be connected to the weight channel in parallel. It is, however, possible to connect 3 load cells to separate inputs, these being connected in parallel inside the module.

The input sensitivity of the weight channel is 2 mV/V.

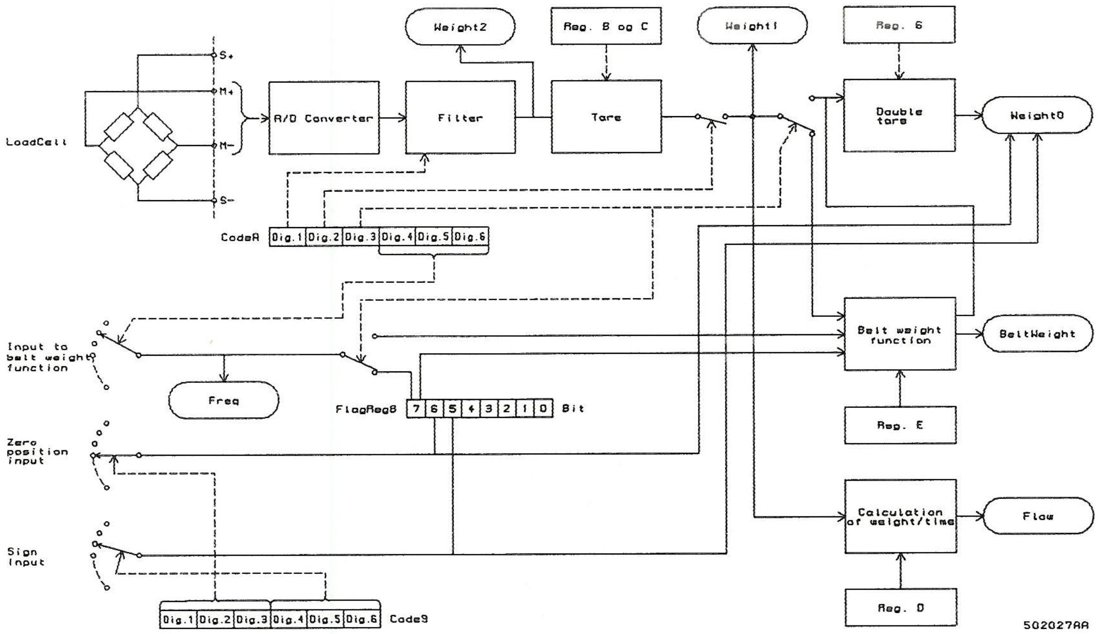
To smooth out possible variation in the measured value, a fourth order filter can be inserted, in which the user can choose between nine time constants.

It is possible to carry out a single and a double taring of the value measured.

Moreover, the flow (weight/time) can be read.

A belt weight providing either a pulse signal or an active signal can be connected to the weight channel.

2.1. Block diagram of Weight Input Channel.



Registers on weight channel (channel 1).

Reg.no.	Contents	Write	Storage medium	Number of bytes	Read out
0	Weight0		R	4	Decimal
1	Weight1		R	4	Decimal
2	Weight2		R	4	Decimal
3	Flow		R	4	Decimal
4	BeltWeight		R	4	Decimal
5	Freq *		BR	4	Decimal
6	Tare	X	BR	4	Decimal
7					
8	FlagReg8	X	R	1	Hexadec.
9	Code9	X	E	4	Hexadec.
A	CodeA	X	E	4	Hexadec.
B	FullScale	X	E	4	Decimal
C	ZeroPoint	X	E	4	Decimal
D	FlowScale	X	E	4	Decimal
E	BeltScale	X	E	4	Decimal
F	CHError		R	1	Hexadec.

* Indirect register

Reg. 0: Weight0.

This register contains the double-tared weight i.e. both the Tare value (Reg. 6) and the ZeroPoint value (Reg. C) are deducted from the value measured .

$$Weight0 = (Weight1 - Tara) * \pm 1$$

By multiplying by +1 or -1, respectively, the sign for the value measured can be changed. This is effected by pointing at a bit on another channel (bit = 1 will give the Weight0 value negative sign).

When writing 0 in this register, the Tare value will be calculated automatically. Also when input for zero adjusting has been activated.

Reg. 1: Weight1.

This result of measurement has only been tared once. It is calculated as follows:

$$Weight1 = Weight2 - ZeroPoint$$

When writing 0 in this register, the ZeroPoint value will be calculated automatically.

The FullScale value can also be adjusted automatically by loading the cell with for example 100 kg. Then insert 100 in Weight1 and the FullScale value will be calculated.

These values can only be calculated automatically when the Programme Enable switch on the terminal board is in position ON.

Reg. 2: Weight2.

This register shows the load of the cell without any kind of taring.

$$Weight2 = Input * FullScale$$

Reg. 3: Flow.

This register shows the increment per time unit, for instance weight per minute. (The time unit may be determined by the user by means of FlowScale).

$$Flow = (new\ Weight1 - previous\ Weight1) * FlowScale$$

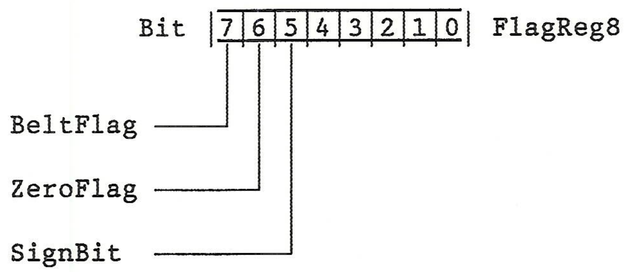
Reg. 6: Tare.

This value is a Tare value for the Weight0 value (for instance the mass of a box placed on the cell.

When writing 0 in Weight0 the Tare value will automatically be calculated.

Reg. 8: FlagReg8.

The Flag register is used to show the bits on other channels which have been pointed at in one of the two code registers of the other channels.



Bit 7:

When the belt weight is running time dosing, the belt weight function is controlled by a bit, indicating if the belt is active. This bit can be read in FlagReg8 (bit 7) and it is pointed to by means of a code register (Reg. A). When the belt is running, bit 7 is set.

If the code register points at address 00 when running a time batch, bit 7 can be controlled directly from the P-net.

Bit 6:

The double tared weight (Reg. 0) may be zero adjusted by a bit on another channel, selected by means of a code register (Reg. 9).

If the code register points at address 00, the function can be controlled directly in the flag register via P-net.

Bit 5:

The sign for the double-tared weight can be controlled by means of a bit on another channel, which is selected by means of a code register (Reg. 9).

If the code register points at address 00, the function can be controlled directly in the flag register via P-net.

Reg. 9: Code9.

Dig.1	Dig.2	Dig.3	Dig.4	Dig.5	Dig.6

Zero adjusting of Weight0
Bit no., channel no, register no.

Sign control on Weight0
Bit no., channel no., register no.

Reg. A: CodeA.

CodeA

Dig.1	Dig.2	Dig.3	Dig.4	Dig.5	Dig.6

Filter constants
0: Time constant = 0.15 sec.
1: - = 0.2 sec.
2: - = 0.35 sec.
3: - = 0.5 sec.
4: - = 0.75 sec.
5: - = 1.5 sec.
6: - = 3.0 sec.
7: - = 6.0 sec.
8: - = 12.0 sec.

0: Normal function
1: TEST-MODE

0: Channel not in use
1: Weight function
2: Belt weight (time)
3: Belt weight (freq)

Input for belt weight function
Bit no., channel no.
register no.

When pointing at address 00 i digit 5 and 6 in the code register (Reg. A) when the belt weight (frequency) function is chosen, one can write directly in the indirect register.

Note: It is not possible to point to an indirect register using a code register.

By means of digit 1 in the code register (Reg. A) a fourth order filter can be inserted, in which the user can choose between nine time constants. The filter is a fourth order filter which can be used when it is necessary to smooth out variation in the measured value. The filter has time constants between 0.15 and 12 seconds.

When the channel is in TEST-mode, the user can insert any value in Weight1 (see the Block Diagram). The weight will still be measured but only the total load (Weight2) can be read out.

Note: When the module is in TEST-mode there is no automatic adjustment of FullScale and ZeroPoint.

Insert "0" in digit 3 if the channel is not in use. Otherwise errors may occur.

By means of digit3 normal weight function or belt weight function is selected. The belt weight function can work by means of a pulse signal (frequency) or a active "Hi" signal (time), indicating that the belt is working.

When the function is belt weight (frequency), it is only necessary to point at a channel no. and a register no. (digit 4 is not in use).

Reg. B: FullScale.

The desired result of measurement at maximum signal from the load cell is inserted in FullScale. The following values are relevant:

Max load (kg)
Sensitivity (mV/V)
Number of cells

$$\textit{FullScale} = (\textit{Max.load} * \textit{Number of cells}) * \frac{2}{\textit{Sensitivity}}$$

The resolution is given in % of FullScale.

The FullScale value can also be adjusted automatically by loading the cell with 100 kg. Then insert 100 in Weight1 and the FullScale value will be calculated.

Reg. C: ZeroPoint.

The ZeroPoint value is the basis tare value for the weighing system (e.g. the basis weight of the weight container is inserted in ZeroPoint.

When writing 0 in Weight1, the ZeroPoint value will automatically be calculated.

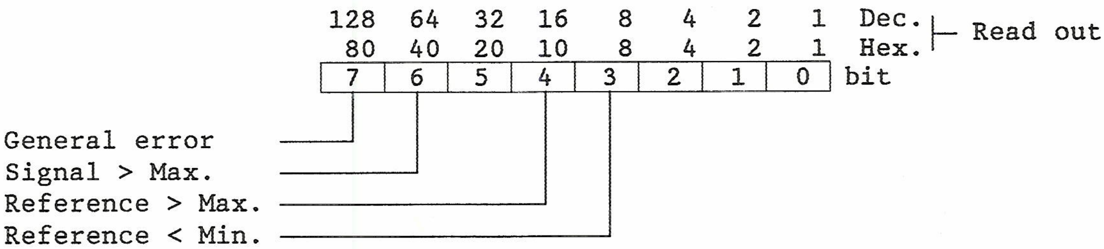
Reg. D: FlowScale.

This factor selects the time unit of the Flow value.

To read out the flow per minute in register 3, set FlowScale to 600.

Reg. F: CHError.

The CHError register indicates whether there is a local error on the channel, or whether there is a general error in the module, resulting in the channel being faulty.



If bit 7 (General error) is set, the other bit are of no importance because the general error may generate any error code on the individual channels (see "Service channel").

Bit 6 (Signal > max.) is set when the input signal is bigger than 110% or smaller than -110% of the FlowScale value. This error may occur if the load cell is not connected correctly.

Bit 4 (Reference > min.) is set when the internal reference is too small. This error may occur due to an error on the module.

Bit 3 (Reference < min) is set when the internal reference is too small. This error may occur if the weight input is improperly connected or if there is an error on the module.

2.2. Belt Weight, function.

When the weight transmitter is measuring by means of a belt weight, the following registers may be used:

Reg. 0: Weight0.

When the channel is programmed as belt weight, this register contains the tared weight of register 4.

$$Weight0 = (BeltWeight - Tara) * \pm 1$$

When multiplying by +1 or -1 it possible to change the sign of the Weight1 value. This is done by pointing to a bit on another channel (bit = 1 will give the Weight0 value negative sign.

By inserting 0 in this register the Tare value will be calculated automatically. Also when input for zero adjustment is activated.

Reg. 4: BeltWeight.

BeltWeight shows the summing up of register 1. The belt weight function can be based either on a frequency or a bit. Therefore there are two formulae for calculation of belt weight value, depending on the choice of function.

Belt weight function based on frequency:

$$BeltWeight = \sum Weight1 * Freq * BeltScale$$

Belt weight function based on bit:

$$BeltWeight \quad \sum (Weight1 * BeltScale) * Bit\ 7 \quad (0/1)$$

Bit 7 indicated if the belt is active. BeltWeight is 0 when the belt is inactive.

Reg. 5: Freq.

When the channel is programmed for belt weight based on frequency, the frequency pointed at in the code register (Reg. A) can be read in this indirect register.

If the code register points at address 00 when belt weight (frequency) is chosen, the frequency can be controlled directly in this register.

Reg. E: BeltScale.

The pulse factor is a constant inserted by the user. The constant is independent of the number of pulses from the belt, and it is calculated using the following values:

X: Length of belt over load cell (meter)
Y: Number of pulses per meter (pulses/meter)
Z: Speed (meter/sec)

The belt weight function can run based on a frequency or a bit. The BeltScale value depends on the chosen function

Belt weight function based on frequency:

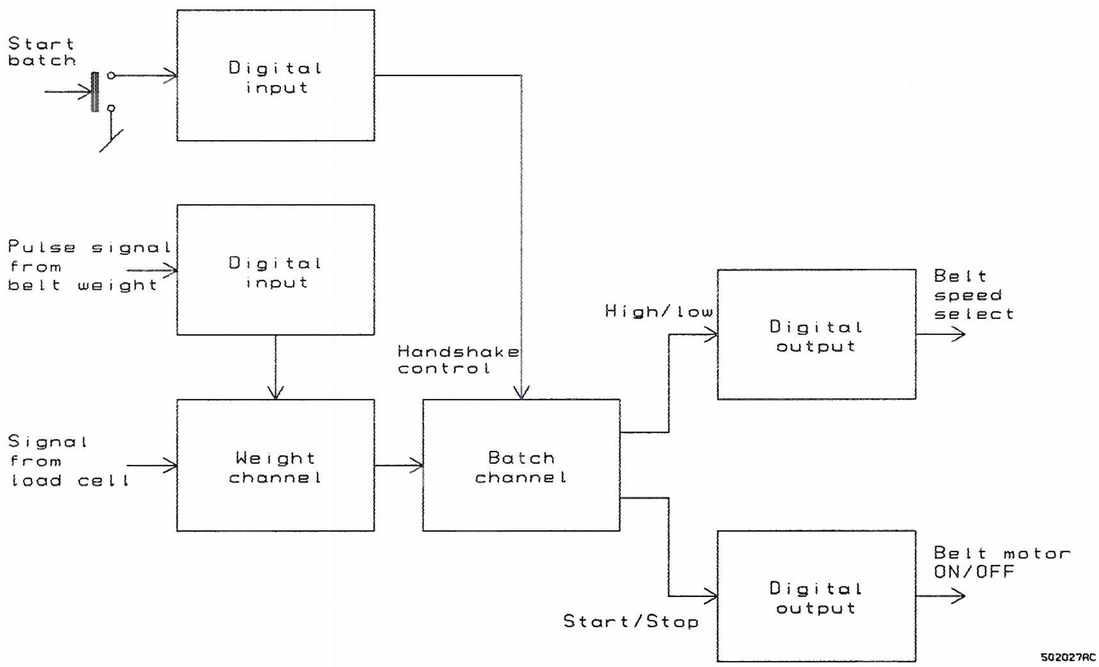
$$BeltScale = \frac{1}{X * Y}$$

Belt weight function based on a bit:

$$BeltScale = \frac{Z}{X}$$

2.3. Example of Belt Weight dosing.

Dosing by means of a belt weight is also possible by means of the weight transmitter. The figure below shows how to connect the individual channels in the module to run a batch.



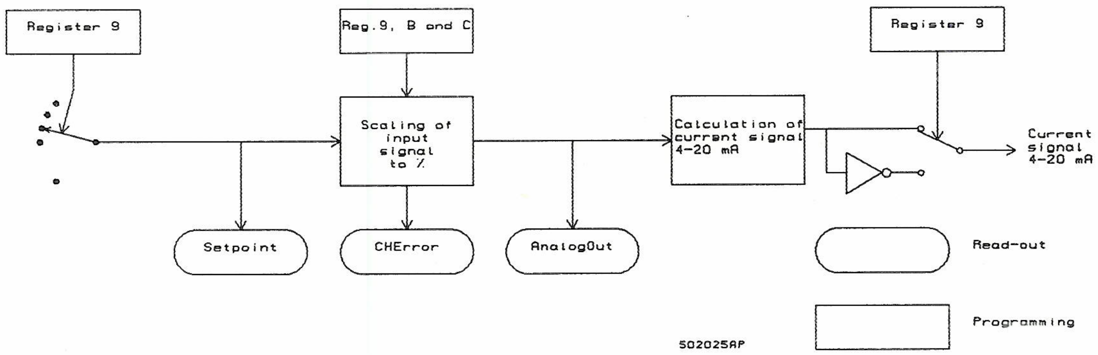
3. Current Output.

The PD 1431 module has a current output (4-20mA) which is an output channel (channel 2). The current output can be the result of a measurement, or a value set by the display unit PD 230, or the P-net.

The current output can also represent the output signal from an internal PID Regulator and can be used for control purposes.

The signal on the current output can be read via display-unit or P-net as a number between 0-100%.

Block diagram of current output function:



Registers in the current output channel (channel 2).

Reg.no.	Register name	Write	Storage medium	Number of bytes	Read out
0	AnalogOut		R	4	Decimal
1					
2					
3					
4					
5					
6					
7	Setpoint *	X	BR	4	Decimal
8					
9	Code9	X	E	4	Hexadec.
A					
B	FullScale	X	E	4	Decimal
C	ZeroPoint	X	E	4	Decimal
D					
E					
F	CHError		R	1	Hexadec.

* Indirect register.

<u>Reg. 0: Analog Out</u>

Using this register the output signal can be displayed as a number between 0-100%.

<u>Reg. 7: Setpoint *</u>

The value which the current output is required to attain (if settled) can be seen in this register.

Reg. 9: Code

Code register for the current output channel (Reg. 9)

```
Code register on                  |Dig.1|Dig.2|Dig.3|Dig.4|Dig.5|Dig.6|
current output channel (Reg. 9)      |_____|     |     |     |     |
                                        |        |     |     |     |
                                        |        |     |     |     |
Channel and                        |    |        |     |     |     |
   register no. for SetPoint       |----         |     |     |     |
                                                 |     |     |     |
   0: Current output disabled      |             |     |     |     |
   1: Current output enabled       |-------------      |     |     |
                                                       |     |     |
   0: 0-100%    4-20 mA            |                   |     |     |
** 1: 0-100%    20-4 mA            |-------------------      |     |
                                                             |     |
   0: Alarm disabled               |                         |     |
   1: Overflow/underflow alarm     |-------------------------      |
                                                                   |
      Not in use                    -------------------------------
```

** Inverting the current output.

The first two digits of the code register must not be used for pointing to an indirect register.

The current output can be inhibited with digit 3 (current output disable).

Digit 4 is used to define whether 100% should equal 20mA or 4mA.

The two alarms "Overflow" and "Underflow" in register F, can be inhibited using digit 5.

Reg. B: Fullscale

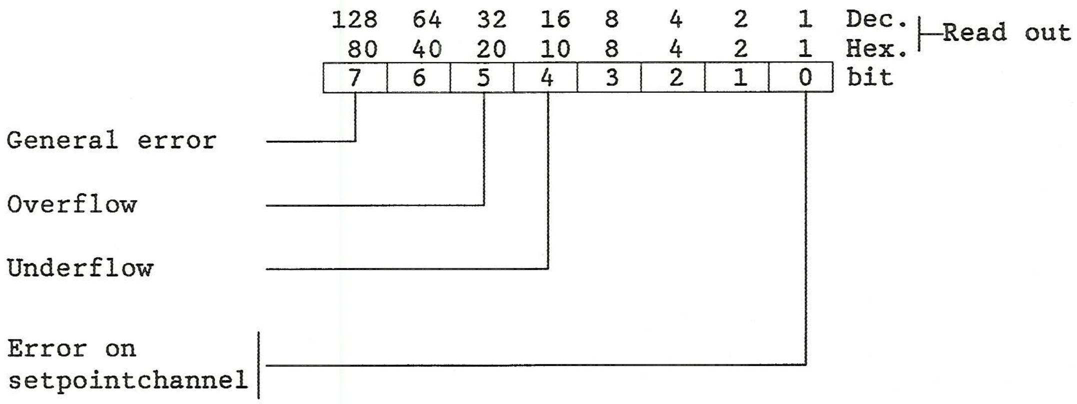
Fullscale is the value for which the max.output signal (100%) is required on the current output.

Reg.C: Zero Point

Zeropoint is the value for which the min.output signal (0%) is required on the current output.

Reg. F: CHError

The CHError register indicates whether there is a local error on the channel, or whether there is a general error in the module, resulting in the channel being faulty.



If bit 7 (general error) is set, then the other bits are insignificant, as the general error can cause additional errors on the channels (see for example "service channel" part 8).

Bit 5 (overflow) is set if the output is more than the fullscale value (Reg. B).

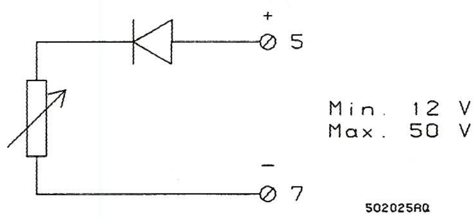
Bit 4 (underflow) is set, if the output is lower than the zeropoint value (Reg. C).

If Bit 0 is set, the module has found an error in the channel from where the output is derived.

3.1. Current Output, Electrical.

The current output is designed as a passive current generator and the voltage must therefore be applied from an external circuit (or perhaps from the built in voltage output in the module).

Fig. 3.1.a. Current output, schematic.



The current output is galvanically separated from the other part of the electronics by an opto-coupler. Furthermore, the output is protected against wrong polarization by a zenerdiode and a current limiting resistor as shown in the figure below. This resistance is rated so that limitation occurs at a current of approximately 35mA. Before the output can be used again, the output must be disconnected totally for a few seconds.

The external control equipment must be rated such that the voltage over the current output range (terminal point 5 and 7 on the base circuit board) is always is min.12.v., the internal control circuitry, being supplied by this voltage.

Fig. 3.1.b.: Current Output.

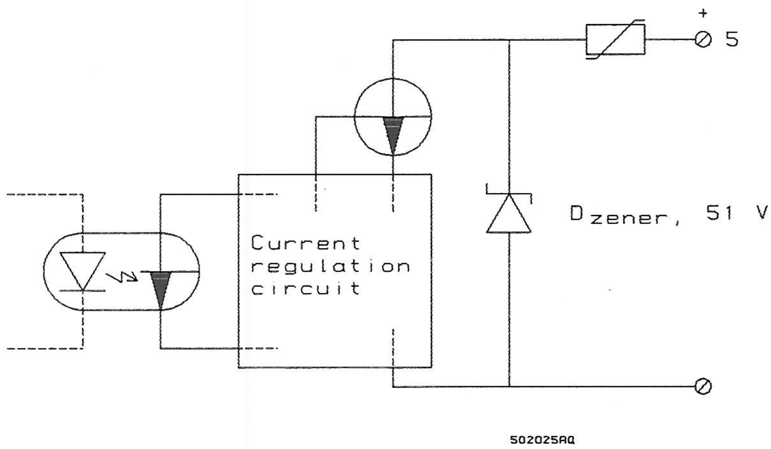


Fig. 3.1.c: Connection of current output with supply from the internal voltage output of the module.

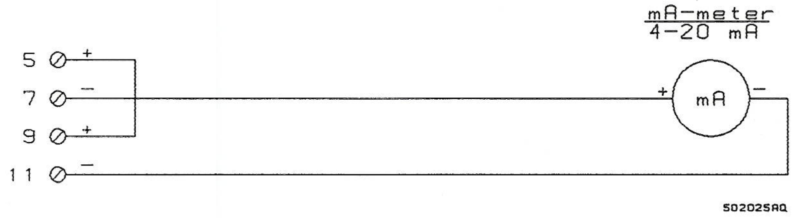
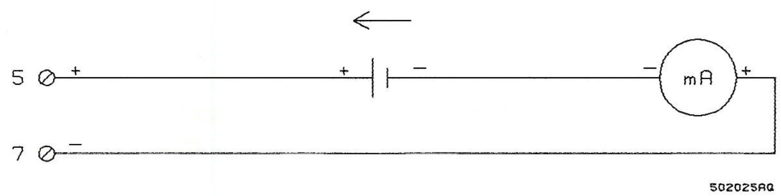


Fig. 3.1.d: Connection of current output with external supply.



4. PID Regulator.

The PD 1431 module is equipped with an internal PID regulator (channel 3), which can be used for various control purposes.

The PID regulator can be used both to control a current signal (4- 20,mA) or a cyclic signal (ie.a digital signal with a set frequency but variable on-time). This is done through other channels in the module.

The regulator is set with the P, I and D parameters and a code, which defines the input signals to the regulator.

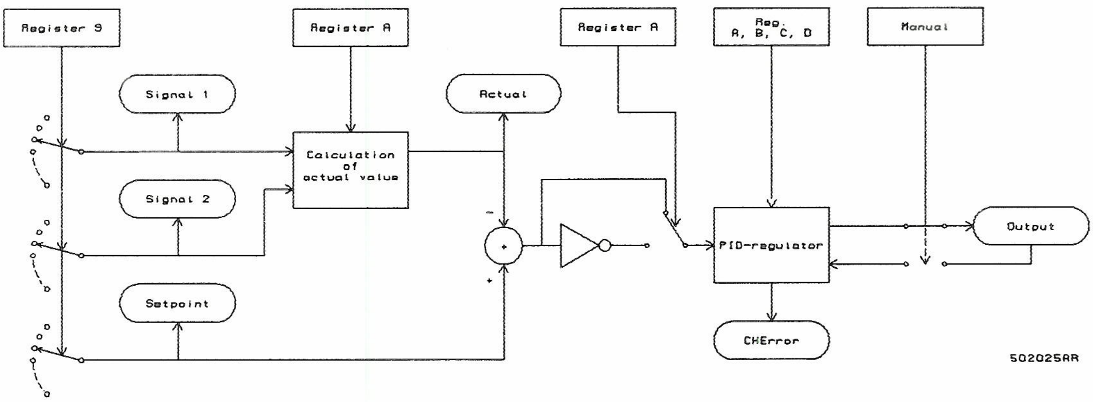
It is possible to define three different signals to the regulator, 1,2 and setpoint.

The input signals can either come from the input channels of the module, or be input via display unit or P-net.

The signals 1 and 2 can be added, subtracted, multiplied, or divided with each other. Thus it is possible to set the module, for example, for proportional regulation between 2 measured values.

Using the display unit or the P-net, the regulator can be set to "Manual".

Block diagram of PID regulator:



Registers for PID Regulator (channel 3)

Reg.no.	Register name	Write	Storage medium	Number of bytes	Read out
0	Output		R	4	Decimal
1	Signal1 *	X	BR	4	Decimal
2	Signal2 *	X	BR	4	Decimal
3	Actual		R	4	Decimal
4					
5					
6					
7	Setpoint *	X	BR	4	Decimal
8	FagReg8	X	R	1	Binary
9	Code9	X	E	4	Hexadec.
A	CodeA	X	E	4	Hexadec.
B	Xp	X	E	4	Decimal
C	Ti	X	E	4	Decimal
D	Td	X	E	4	Decimal
E					
F	CHError		R	1	Hexadec.

* Indirect Registers.

<u>Reg. 1: Signal1 *</u>

The selected input value for signal 1 can be seen in this register.

<u>Reg. 2: Signal2 *</u>

The selected input value for signal 2 can be seen in this register.

<u>Reg. 3: Actual</u>

The result of the calculation using the two input values (signal 1 and signal 2) is stored in this register. See Section 4.1.

<u>Reg. 7: Setpoint *</u>

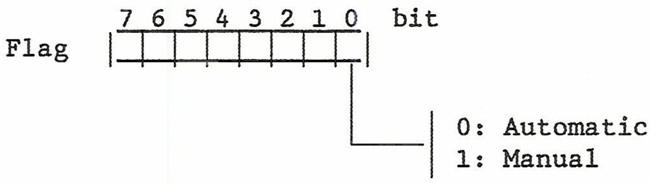
The setpoint, which is used for PID regulator control, can be read from this register.

Reg. 0: Output

The output signal from the PID-regulator can be read from this register as a number between 0 and 100%. If the output should exceed 100%, then the output register will statisize at 100%. Also the module will generate an error code (see register F). This also occurs if the output signal drops below 0%.

Reg. 8: FlagReg.8

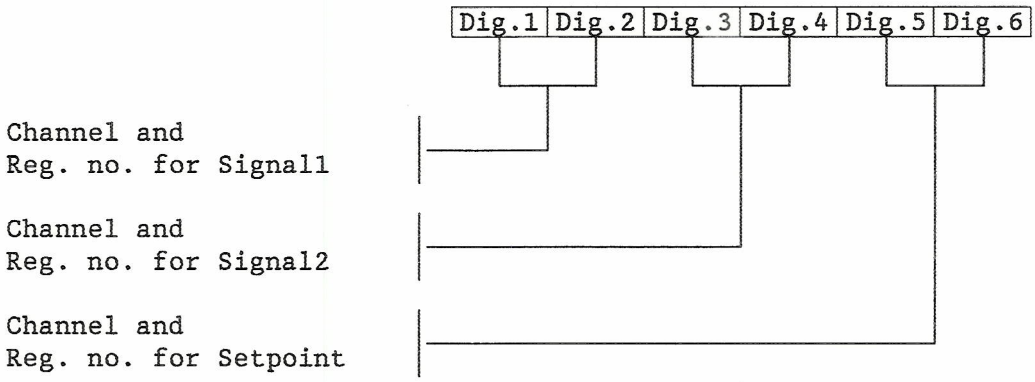
This flag register can be used for switching between automatic & manual control. That is done by writing a 0 or 1 into the register, as shown below:



When the regulator is in "Manual" it is possible to preset an output value, using the display unit or P-net. When the regulator is reset to automatic, the control will continue from the set output signal. This facility is called "Bump-less transfer" and can be used, for example, for avoiding overshoots at start-up when using a very slow control-loop.

The "Manual" facility can also be used for a quick zero-setting of the output signal, for example in an alarm situation.

Register 9: Code 9



Register A: Code A

Dig.1	Not in use
Dig.2	Regulator type: 0: No Integration (I) 1: Integration (I)
Dig.3	0: PID-regulator disable 1: PID-regulator enable
Dig.4	0: (1) - Setpoint 1: (1 + 2) - Setpoint 2: (1 - 2) - Setpoint 3: (1 x 2) - Setpoint 4: (1 : 2) - Setpoint 5: Setpoint - (1) 6: Setpoint - (1 + 2) 7: Setpoint - (1 - 2) 8: Setpoint - (1 x 2) 9: Setpoint - (1 : 2)
Dig.5	Overflow/underflow alarm: 0: Alarm disabled 1: Alarm enabled
Dig.6	Not in use

Using digit 2 of the code register (Reg.A) the regulator's integration time (I) can be disabled.

Digit 3 is used for enabling/disabling the PID regulator. If the regulator is not required, then digit 3 must be set to a 0, to avoid possible errors in the channel.

Digit 4 is used to select how the regulator should calculate the output value (as described above).

Digit 5 is used to select whether the overflow/underflow alarm is enabled/disabled (see Reg. F).

Reg. B: Xp

Xp is the PID regulator's proportional band. The proportional band for a regulator is the change required in the input signal to give a change from 0 to 100% in the output signal (without I and D). Xp is defined in the same units, as the input signal to the regulator.

Reg. C: Ti

Ti is the integration time constant for the regulator, which is the time it takes for the I-component of the regulator to give the same change in the output signal as that made by the P- component, following a permanent change of the input signal.

The I-effect in the regulator is minimised by setting Ti to a very high value. Ti is defined in seconds.

Reg. D: Td

Td is the regulator's differentiation time. The differentiation time for a regulator, is the time a constantly rising input signal must take to rise from 0-100% (equivalent to Xp) in order to give a constant output signal of - 100% (without P and I).

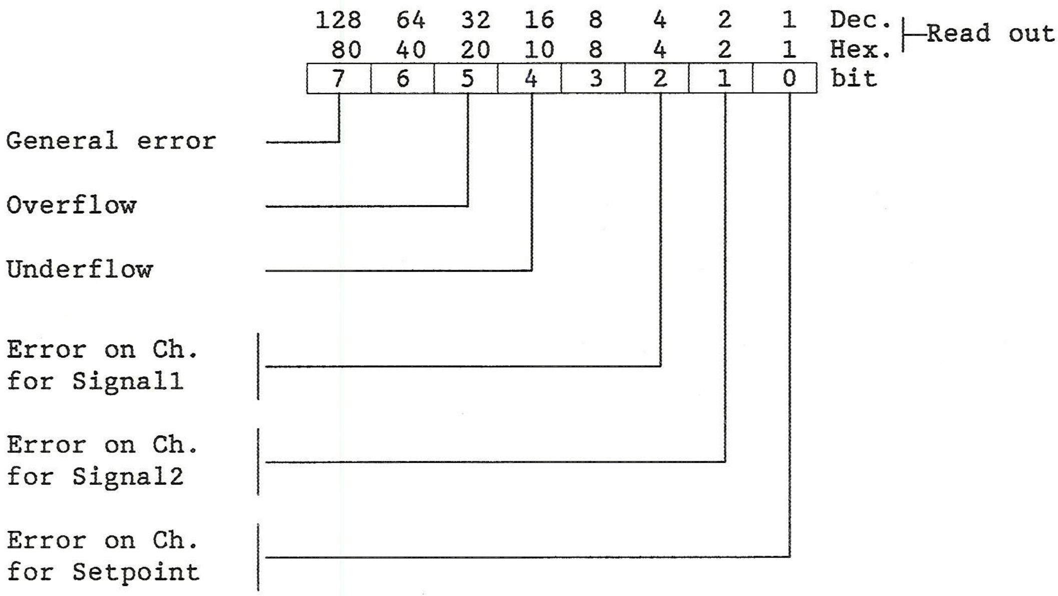
As the signal from the D-component in the regulator is negative when the input signal is rising, the component will act as a "brake" on the output signal.

The D-component in the regulator can be totally disabled by setting Td to 0. Td is defined in seconds.

If problems arise in setting the three parameters P, I and D, please refer to technical literature on the subject.

Reg. F: CHError

The CHError register indicates whether there are any current errors on the channel, or if there is a general error on the module, which could result in the channel being faulty.



If bit 7 (general error) is set then the other bits are insignificant, as the general error can lead to other errors on the channels (see Service Channel in section 8).

Bit 5 (overflow) is set when a result is above 100%.

Bit 4 (underflow) is set if a result falls below 0%.

Bit 0-2 indicates whether there is an error on the channel from where Setpoint, signal 2 and signal 1 respectively, have been taken.

4.1. Calculation of Actual Value.

As previously mentioned, Signal 1 and Signal 2 can be added, subtracted, multiplied or divided with each other. It is therefore possible to choose various forms of control. The result of the chosen calculation will be stored in the Actual register (reg.3).

As an alternative, one can store signal 1 directly in the Actual register.

To select the input signals to the PID regulator (signal 1 and signal 2), the code register must be programmed as shown in the example below.

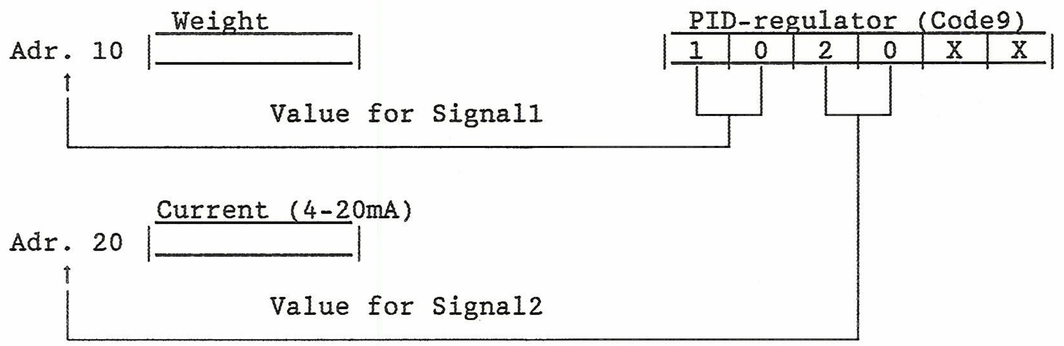
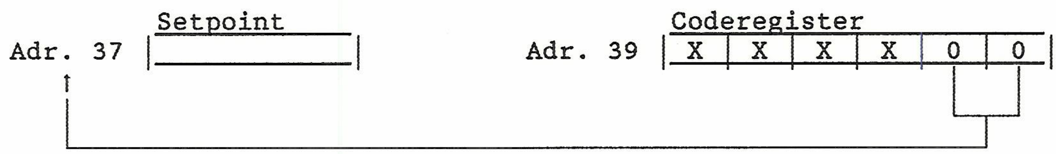


Fig. 4.1.a.

By means of another code register (reg.A) one can select whether signal 1 and signal 2 should be added, subtracted, etc.

The regulator utilises values from the Actual register and a selected value in the Setpoint register.

The address from which the Setpoint collects data, is selected through the code register (reg.9) as shown in the example below.



When a difference occurs between the Actual value and Setpoint, it can be corrected by making the output value rise or fall. This choice is made using an inverter, selected by a code register change.
Using digit 4 in the code register (reg.A), signal 1 and signal 2 can be added, subtracted, multiplied or divided, and defines whether inversion should be used.

```
             Coderegister
      CodeA | 1 | 2 | 3 | 4 | 5 | 6 |digit

0: (Signal1) - Setpoint
1: (Signal1 + Signal2) - Setpoint
2: (Signal1 - Signal2) - Setpoint     **
3: (Signal1 x Signal2) - Setpoint
4: (Signal1 : Signal2) - Setpoint

5: Setpoint - (Signal1)
6: Setpoint - (Signal1 + Signal2)
7: Setpoint - (Signal1 - Signal2)     ***
8: Setpoint - (Signal1 x Signal2)
9: Setpoint - (Signal1 : Signal2)
```

The result of the expression in the brackets will be stored in the Actual register.

If the Actual value is greater than the Setpoint value, the following is true:-

** These 5 functions will result in a falling output value (eg.Reheating), i.e. the inverter is connected.

*** These 5 functions will result in a rising output value (e.g. cooling), i.e. the invertor is disconnected.

4.2. Example of simple scaling.

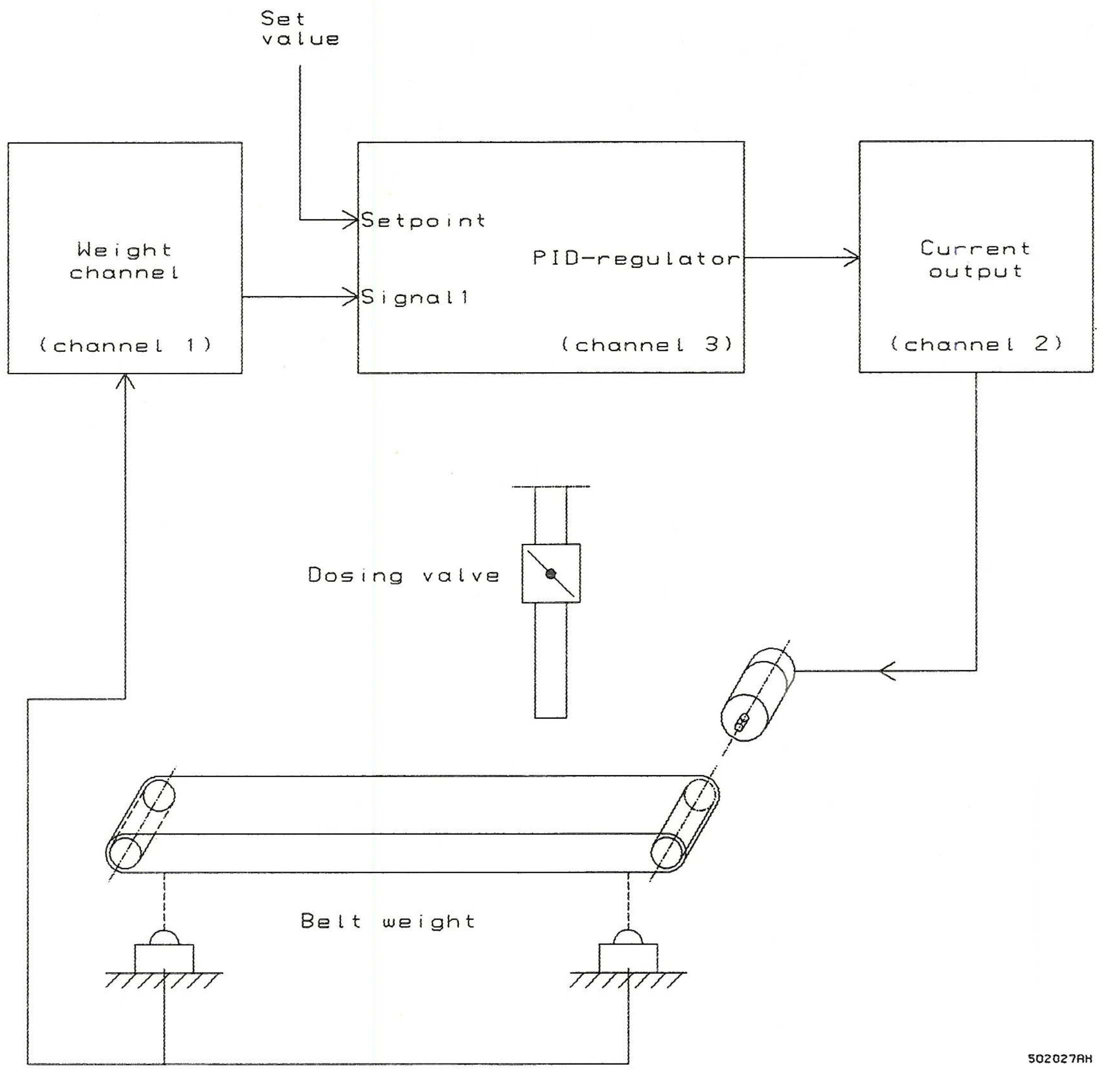
This type of scaling can be used when controlling the speed of a belt weight.

The PID-regulator, the current output and the weight channel is used.

The current output controls the speed of the belt.

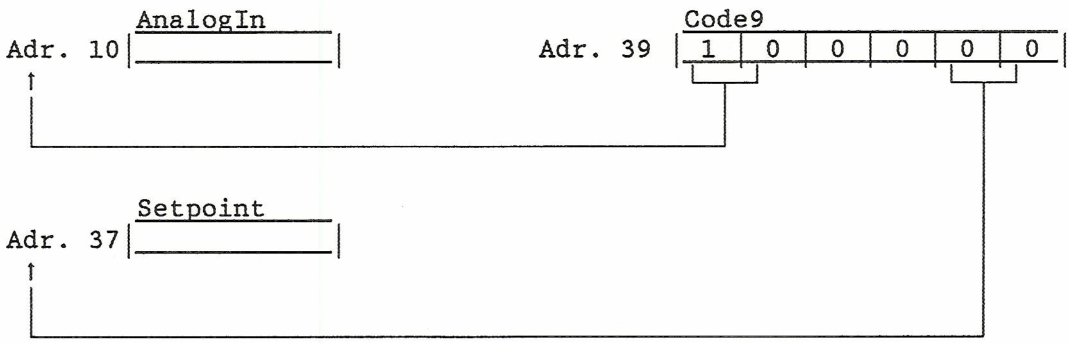
The weight channel measures the load of the belt weight.

The dosing valve may be controlled by one of the two internal dosing channels which are able to batch by means of a digital output.

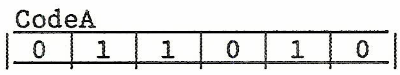


Setting of coderegister.

The result of the weight measuring will be placed on address 10, from where the PID-regulator gets its input signal. The regulator also needs a fixed setpoint value which is inserted in the SetPoint register. These two input signals are pointed at in a coderegister programmed as follows:



The other code on the PID-regulator channel can be programmed as follows:

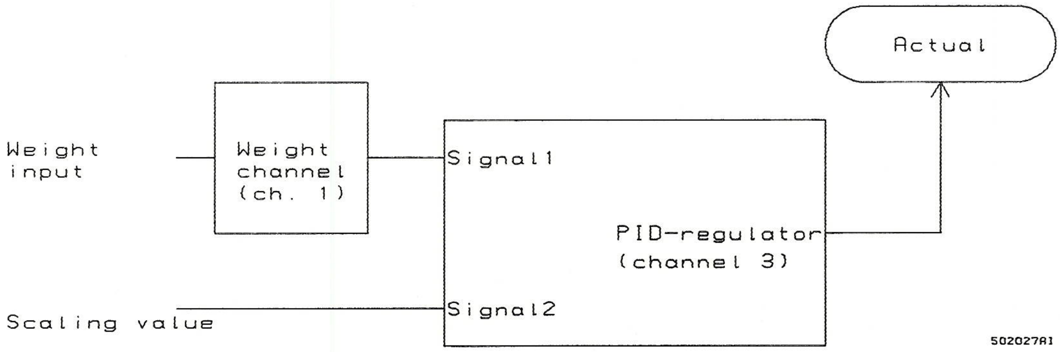


Now the three parameters P, I and D (Tp, Ti and Td) must be inserted.

The output value of the PID-regulator will be placed in the output register (Reg. 0) which means that the current output must be programmed to follow this value.

4.3. Example of scaling using the PID regulator.

If it is required to scale a measured value, it can be done with the PID regulator. For example, to multiply a frequency reading with a set scaling value.



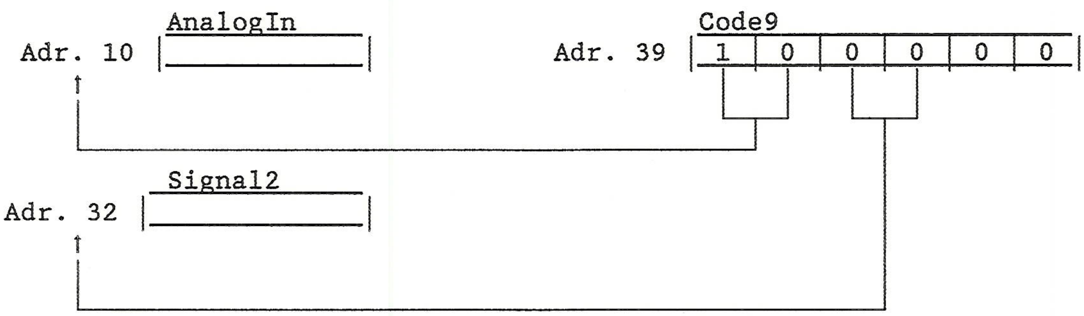
Actual = Weight x scaling value

Fig. 4.3.a.

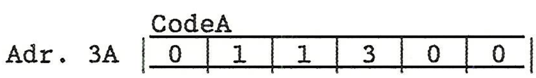
Setting Code Registers

Program the digital input (channel 5) to measure frequency.

The result of the flow measurement will be stored in address 10, from where the PID regulator can take one of its input signals. Apart from the weight input signal, the regulator needs a set scaling value, which is written to the Signal2 register. These two input signals to the regulator are selected by a code register (reg.9), which is programmed as follows:-



The other code register on the PID-regulator can be programmed as follows:-



The final value after scaling can be read in the Actual register (reg. 3).

4.4. Example of Ratio Control.

This type of control can be used for example, in processes where it is required to control a flow to a defined ratio.

In addition to the PID-regulator, the current output of the module is used.

The measured results from the two flow transmitters are transferred by a computer via the P-net.

The current output controls a valve which governs the flow through the pipework.

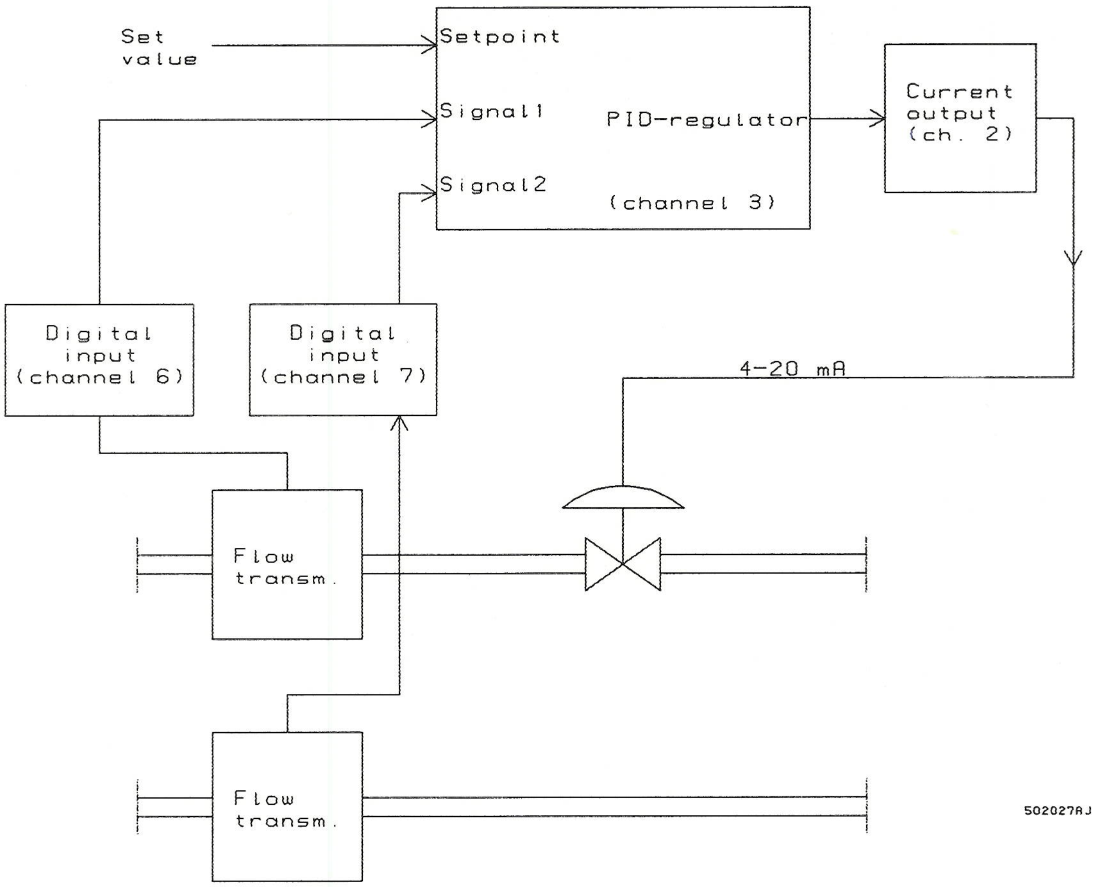
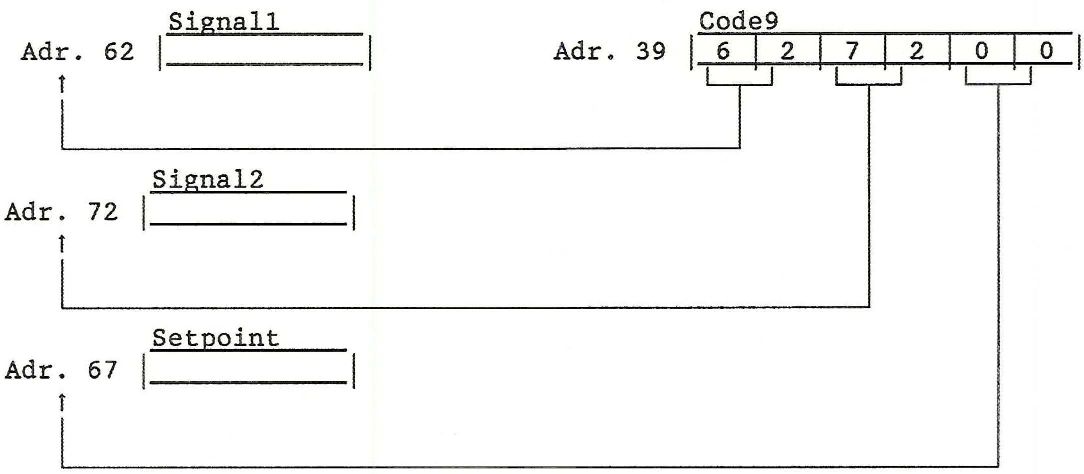


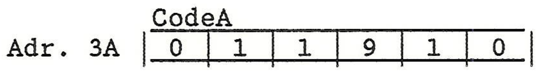
Fig.4.4.a.

Setting the module

The two frequency measurement results are stored in address 62 and 72, from where the PID-regulator can retrieve its input signals. In addition, the regulator needs a fixed Setpoint value, which is stored in the SetPoint register. These three input signals are selected by a code register (reg.9) which is programmed as follows:-



The other code register on the PID-regulator channel can be programmed as follows:-



The three parameters, P, I and D (Tp, Ti and Td) can now be set.

The output result from the PID regulator is stored in the output register (reg.0), i.e. the current output must be programmed to select this value.

5. Limit Switch / Dosage Channel.

The module has two internal limit switch / dosage channels (channel 4 and 5). The channels can be used e.g. as alarm detectors based on two measuring results (Actual1 and Actual7). Both values may be defined by the user. Each of the two channels can control two flags, each with a offset value.

Block diagram showing Limit Switch / Dosage Channel:

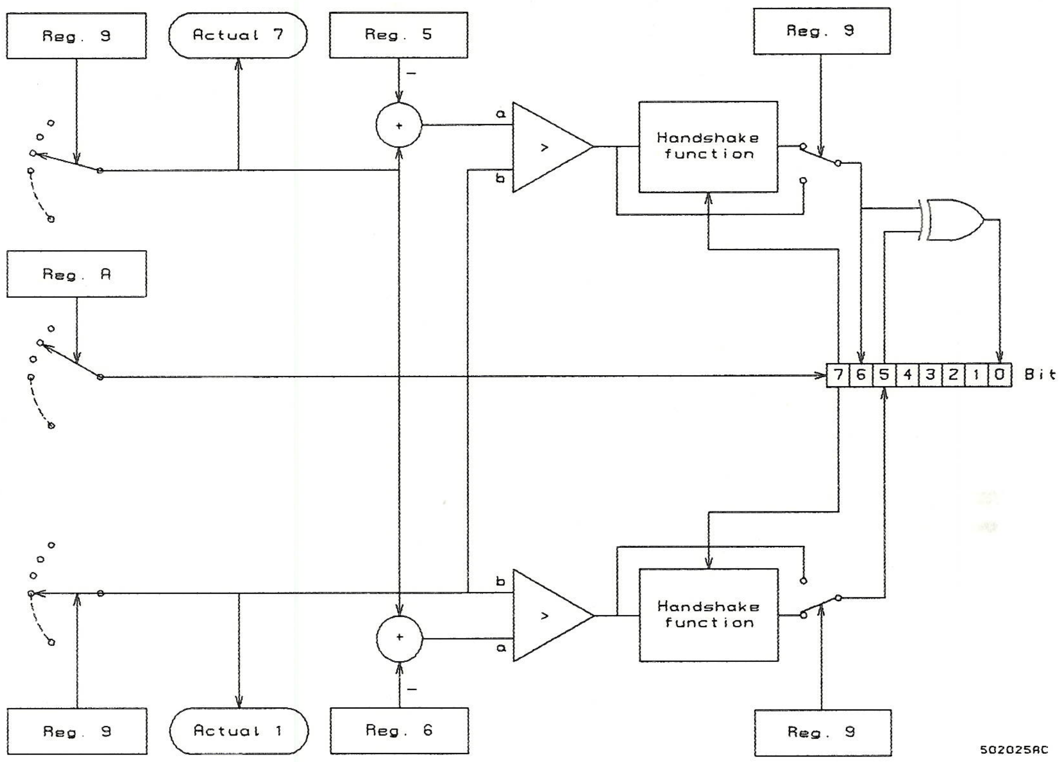


Fig. 5.a.

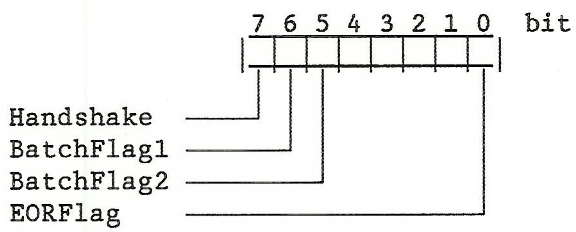
Registers on Limit Switch / Dosage Channel (channel 4-5)

Reg.no.	Register name	Write	Storage medium	Number of bytes	Read out
0	FlagReg	X	R	1	Binary
1	Actual1 *	X	BR	4	Decimal
2					
3					
4					
5	ActOffset1	X	BR	4	Decimal
6	ActOffset2	X	BR	4	Decimal
7	Actual7 *	X	BR	4	Decimal
8					
9	Code9	X	E	4	Hexadec.
A	CodeA	X	E	4	Hexadec.
B					
C					
D					
E					
F	CHError		R	1	Hexadec.

* Indirect register

Reg. 0: FlagReg.

The flag register contains BatchFlag1 and BatchFlag2, which are controlled automatically. These two flags work as output value for the channel e.g. a digital output can follow one of this flags. An Exclusive Or function is automatically executed on the two batch flags and placed in bit 0. A Handshake bit is used for starting a batch.



Reg. 1: Actual1. *

In this register one can read the Actual1 value pointed out by means of the code.

If the coderegister points at address 00, it is possible to write in the register.

Reg. 5: ActOffset1.

The offset value for BatchFlag1 must be inserted in this register.

Reg. 6: ActOffset2.

The offset value for BatchFlag2 must be inserted in this register.

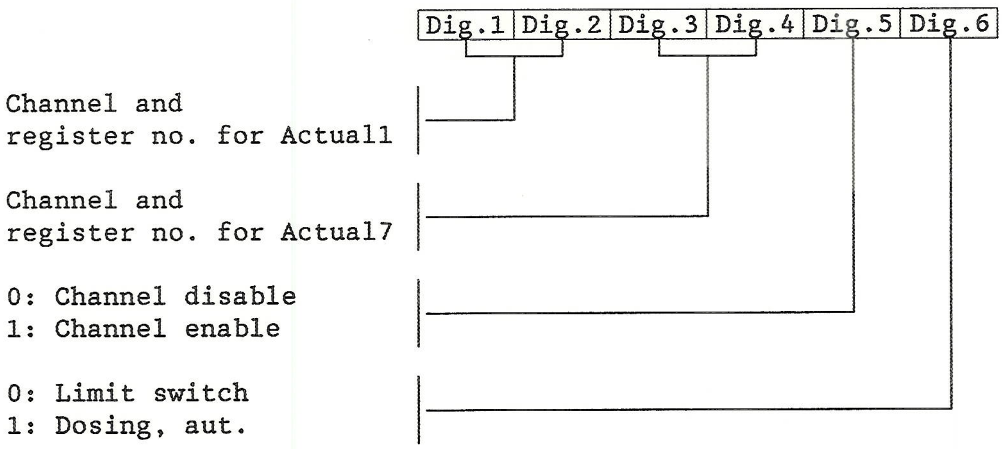
Reg. 7: Actual7.

The Actual7 value chosen by means of the code (Reg. 9) may be read in this register.

If the coderegister points at address 00, it is possible to write in the register.

Reg. 9:Code9.

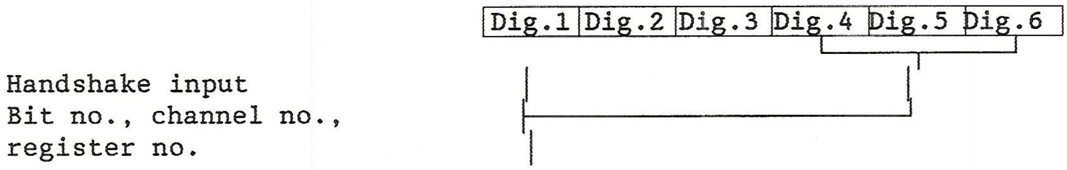
Coderegister for limit switch / dosage channel (Reg. 9)



It is not allowed to point at a register by means of the first four digits in the code. Doing so may course errors. The channel can be disabled by means of digit 5. If the channel is not in use, a "0" should be inserted in digit 5 to prevent errors. By means of digit 5 the channel is set to limit switch or dosing.

When pointing to address 00 by means of digit 1-4, it is possible to write in the indirect register.

Reg. A: CodeA.

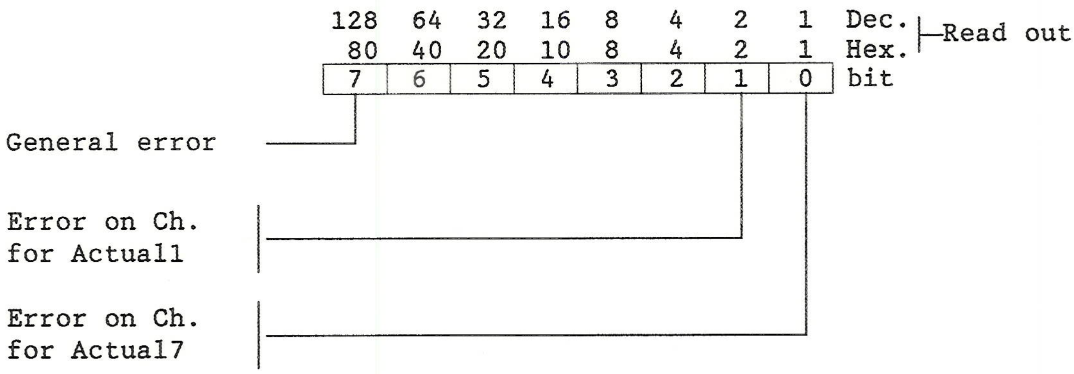


It is possible to control the Handshake flag by means of another bit (a input flag on a digital input) by pointing at the bit. Bit no., channel no. and register no. must be known. If this function is not in use, a "0" must be inserted in digit 4, 5 and 6 which allows control of the Handshake flag directly in FlagReg. (Reg. 0).

Note: When the Handshake flag is following an input, the input must only be activated for a short while (at least 250 ms. Otherwise the dosing will never start.

Reg. F: CHError.

The CHError register indicates whether there is a local error on the channel, or whether there is a general error in the module, resulting in the channel being faulty.



If bit 7 (General error) is set, the other bit are of no importance as the general error may cause any error on the individual channels (see "Service channel").

Bit 1 is set if there is an error on the channel where the Actual1 value is stored.

Bit 0 is set if there is an error on the channel where the Actual7 value is stored.

5.1. Limit Switch, function.

The channel can be used for supervision of a pulsating signal.

5.1.1. Limit Switch, example.

An example on use of the limit switch function is shown in fig. 5.1.1.a.

By means of the code register (Reg. 9) the Actual7 value is given as the fluctuation input signal. Actual1 is defined as a fixed setpoint; this is done by pointing to address 00, and writing directly in the Actual1 register. Furthermore a tolerance around the setpoint value can be set by means of the two offset values, because ActOffset1 is made negative and ActOffset2 positive. Thus each of the two batch flags corresponds to an offset value.

BatchFlag will be OFF until Actual7 exceeds Actual1 + ActOffset1. Likewise, BatchFlag2 will be OFF until Actual7 exceeds Actual1 + ActOffset2. The two offset values are thus used to determine how a time must elapse from when the Actual7 value reaches the setpoint (Actual1) until the BatchFlag must change; so by making one offset value negative, one can determine how long a time must elapse from when the BatchFlag changes, until the Actual7 value reaches the setpoint (Actual1).

If one wishes to test whether the Actual1 value lies within or outside the limits, one can use the EORFlag. The EORFlag is set when the Actual1 value lies within the limits. If the opposite function is desired, this can be done by means of the digital output channel, as it is possible to connect an invertor before the digital output, ie, the digital output goes ON, when the EORFlag is OFF.

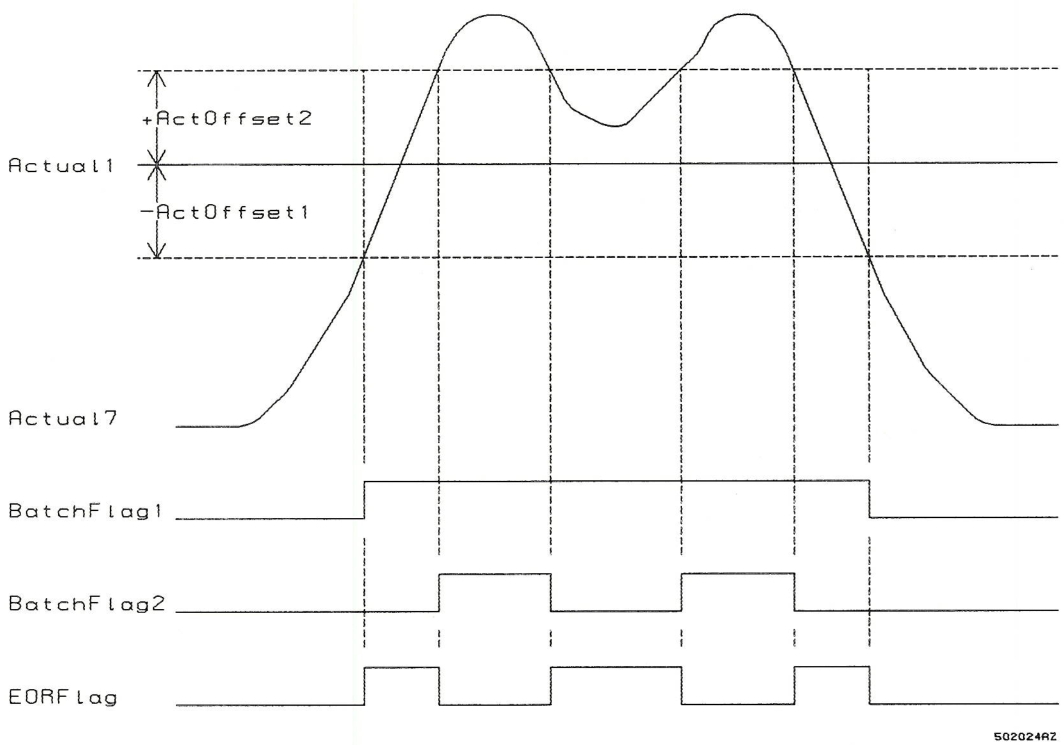


Fig. 5.1.1.a.

5.1.2. Limit Switch with positive offset, example.

One can also chose to make both offset values positive. See fig. 5.1.2.a.

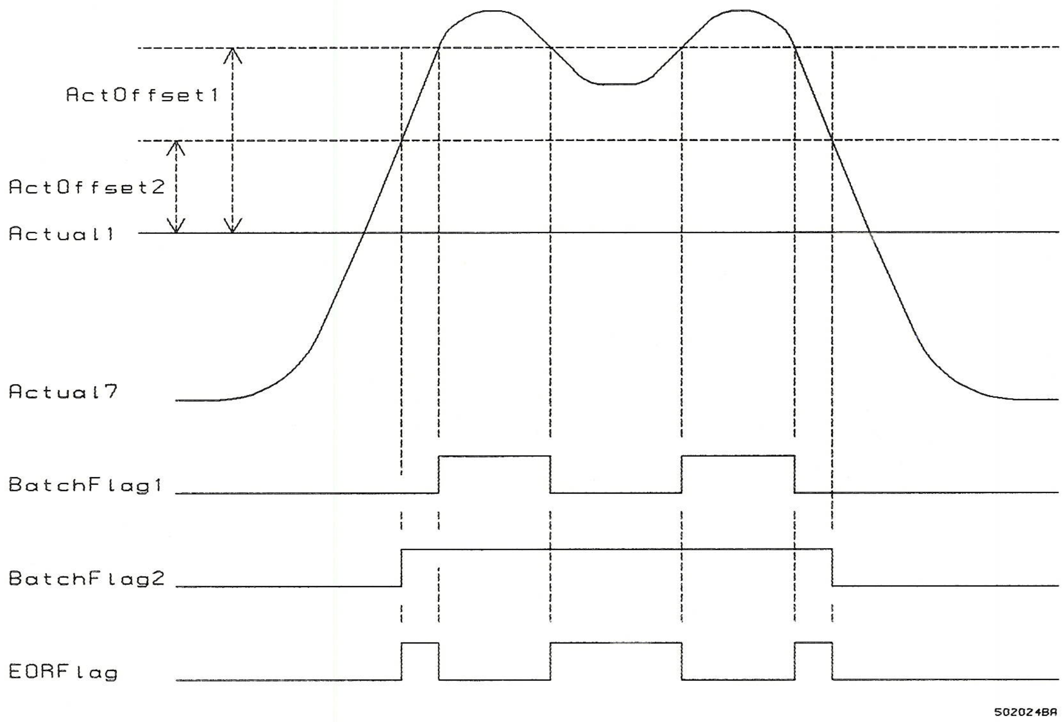


Fig. 5.1.2.a.

5.2. Dosing.

This channel may also be used for batching purposes. Dosing runs until the measured value (Actual1) is equal to the desired value (Actual7). A dosing channel can control two flags (in Reg. 0) based on the same result of measurement and the same setpoint, but with two different offset values (ActOffset1 and 2) - one for each flag. These offset values are used when dosing at two different speeds or when dosing with a slow valve. When the remaining amount equals the offset value, the dosing stops.

When Actual1, Actual7, ActOffset1 and ActOffset2 are inserted, dosing can be started by setting the Handshake flag. This flag will be cleared automatically and when this has happened the two batch flags will be steady, which means that they may be read out via P-net.

When the two batch flags have been cleared they can not be set again without starting the dosing again (by setting the Handshake flag).

BatchFlag1 will be ON until Actual1 exceeds Actual7 - ActOffset1. Batchflag2 will be ON until Actual1 exceeds Actual7 - ActOffset2. The two offset values must be positive figures.

Dosing example, time schedule.

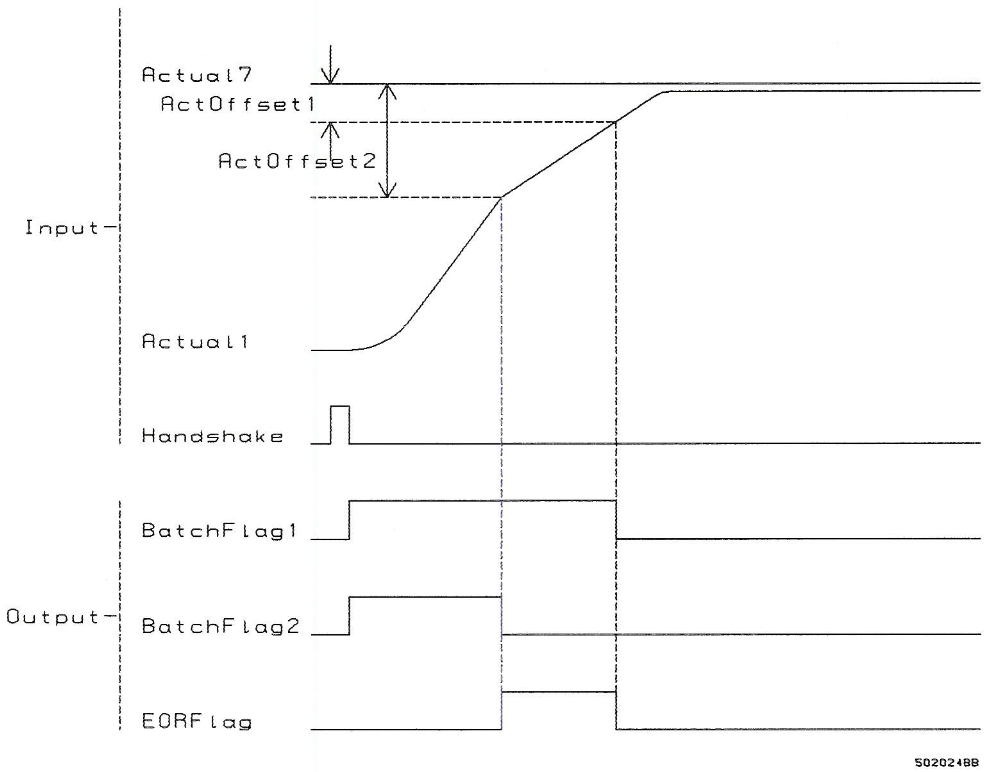
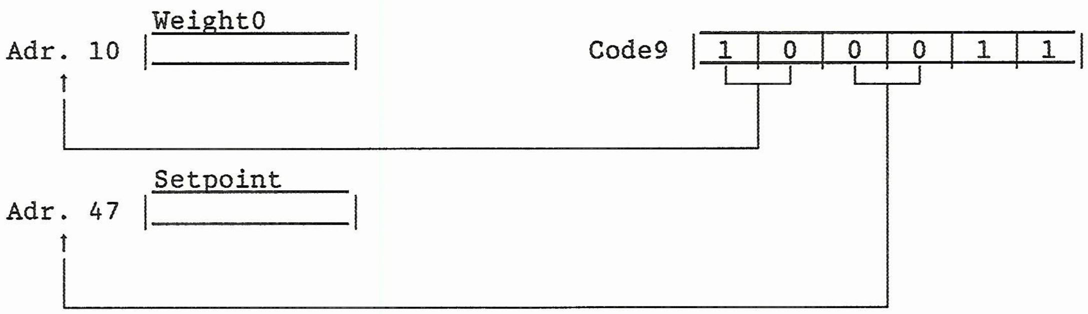


Fig. 5.2.a.

Setting of coderegister.

To define the Actual1 and Actual7 values, one must point at the wanted values by means of a coderegister as shown in the example below.

The Actual1 value could be a weight and the Actual7 value a fixed value.

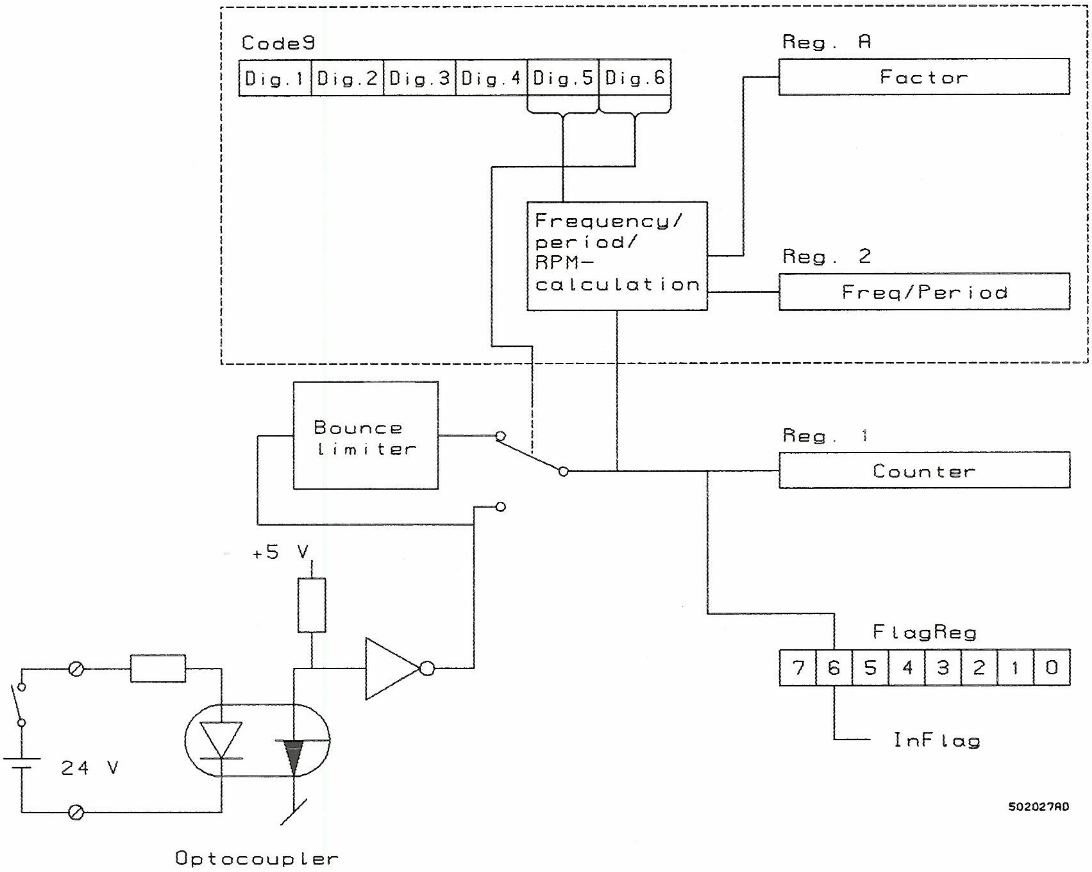


6. Input Channels.

The PD 1431 module is equipped with two input channels (channel 5 and 6).

The two digital input circuits are configured as passive inputs i.e. the input connections must have a voltage applied from an external circuit (or via the internal voltage output of the module). Also, the inputs are galvanically isolated from other parts of the electronics by an optocoupler. The inputs are also protected against overloading due to incorrect polarization.

Block diagram of input channel:

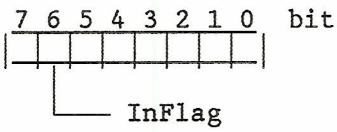


Registers in the Input Channels (channel 6-7)

Reg.no.	Register name	Write	Storage medium	Number of bytes	Read out
0	FlagReg		R	1	Binary
1	Counter	(X)	R	2	Decimal
2	Freq/Period		R	4	Decimal
3					
4					
5					
6					
7					
8					
9	Code9	X	E	4	Hexadec.
A	Scale	X	E	4	Decimal
B					
C					
D					
E					
F	CHError		R	1	Hexadec.

Reg.0: Flag Register

The input flag is set when a voltage is applied to the input terminal, and reset when the voltage is not present.



Reg.1: Counter

The counter totalizes the number of pulses applied at the input. The frequency of counting is a maximum of 250Hz. The counter counts up, and the largest number which can be stored is 65535 (2 bytes).

When the counter exceeds 65535, it is reset and continues again from zero.

There is no automatic preset of the counter. If it is required to preset the counter, this must performed using the P-net or the display unit. The counter increments every time the Flag changes from "1" to "0".

Reg. 2: Freq/Period

The measured result which can be a frequency or a period, can be read in register 2.

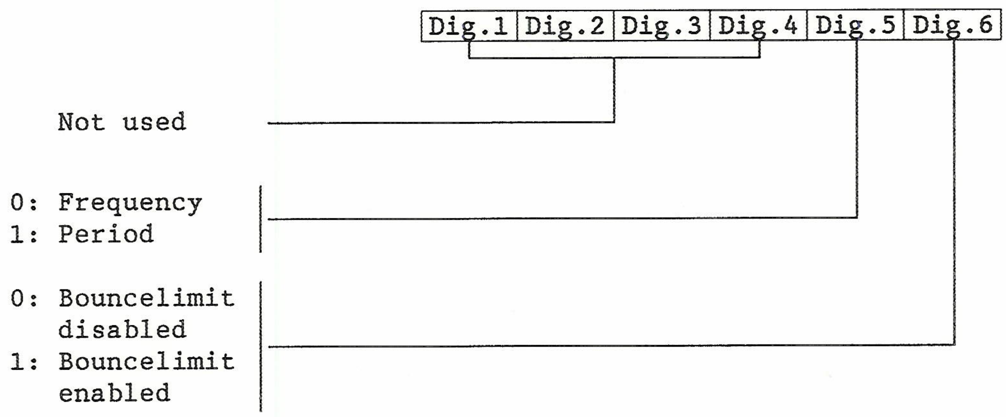
The input pulse frequency must be between 0.1 Hz and 250Hz. If the frequency is below 0.1Hz, register 2 will be set to 0.

New data is processed every two seconds unless the pulse frequency is below 0.5 Hz. In this case the time between pulses is measured, and the frequency is calculated from this.

The accuracy of the reading is within about 0.1%

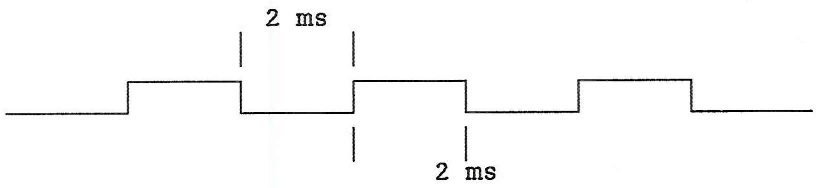
Reg.9: Code 9.

Code register for the digital input channel (reg.5 and 6).

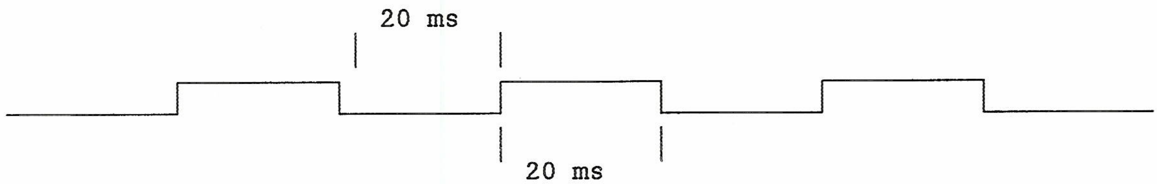


The built-in switch bounce limiter function can be selected by digit 6. The switch bounce on the inputs can have a duration of up to 10 ms. When the function is selected the input frequency must not exceed 25 Hz.

With the bounce limiter de-selected
the minimum on and off time permitted 2 ms.



With the bounce limiter selected, the
minimum on and off time permitted is 20 ms.



Digit 5 is used to select frequency or period.

Reg. A: Scale

This register holds a factor which is always multiplied with the contents of register 2. If it is required to convert frequency to RPM, the factor should be 1/60 = 0.01667 (if the pulsator gives 1 pulse per revolution). If a conversion is not required the factor should be set to 1.

Reg.F: CHError

The error code shows whether there are any current errors in the module as a whole, which could result in this particular channel being faulty. The error code contains 8 bits of which only one is significant.

```
                         7 6 5 4 3 2 1 0  bit
  Bit 7: General error  |X| | | | | | | |
```

6.1. Detection of switch state, e.g. push-buttons, microswitches.

For this activity input channels (5 or 6) are used.

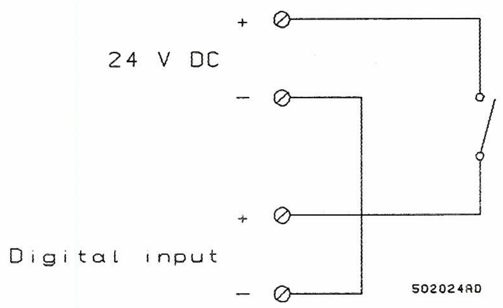
Mode of operation:

The switch state is indicated in the flag register for the selected input channel (reg.0).

When the switch is closed the input flag is set.

When the switch is open the input flag is reset.

Connection to terminal block.

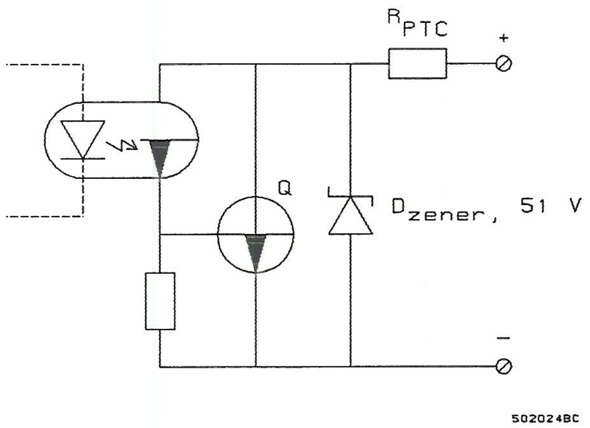


Using this arrangement, the counter (Reg.1) will be incremented each time the switch is opened.

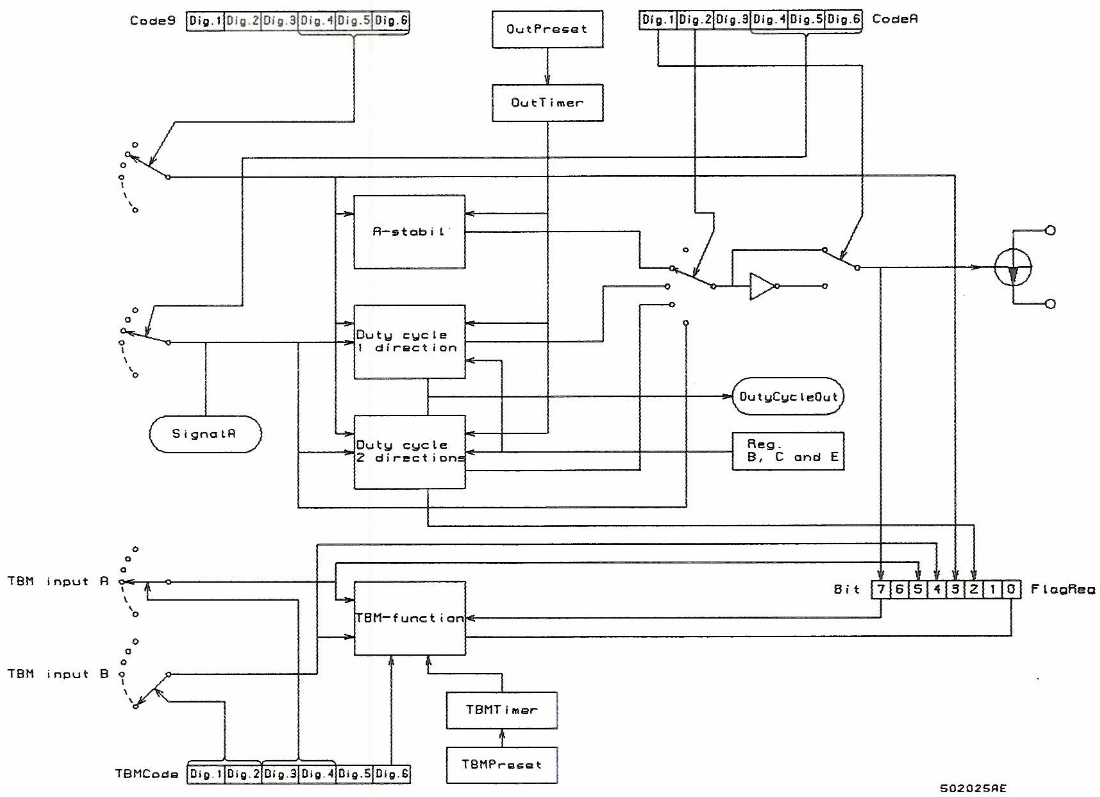
No special setting of the module is required.

7. Digital Output Channels.

The transmitter is equipped with two digital output channels (channel 8 and 9). The two outputs are passive e.g. the output works as a contact. The output is galvanically separated from the rest the electronics by means of a optocoupler.



Blockdiagram of Digital Output

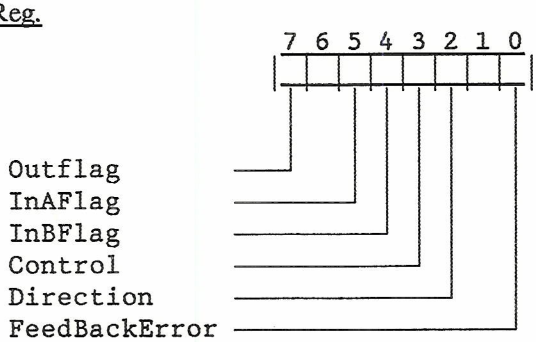


7.1. Registers on Digital Output Channel.

Reg.no.	Register name	Write	Storage medium	Number of bytes	Read out
0	FlagReg	X	R	1	Binary
1	OutTimer	X	R	2	Decimal
2	DutyCycleOut		R	4	Decimal
3					
4					
5	SignalA *	X	BR	4	Decimal
6	TBMTimer	X	R	2	Decimal
7	TBMPreset	X	E	2	Decimal
8	OutPreset	X	E	2	Decimal
9	Code9	X	E	4	Hexadec.
A	CodeA	X	E	4	Hexadec.
B	FullScale	X	E	4	Decimal
C	ZeroPoint	X	E	4	Decimal
D	TBMCode	X	E	4	Hexadec.
E	MinTime	X	E	2	Decimal
F	CHError		R	1	Hexadec.

* Indirect register.

Reg.0: FlagReg.



Bit 7: OutFlag.

The flag controls the output on condition that the watch-dog flag is set or enabled (in coderegister on Service channel).

Flag = "0" = = = > Output OFF
Flag = "1" = = = > Output ON

Bit 5 and 4: InAFlag, InBFlag.

Using feedback control on the output channel, requires one or two input channels.

The InAFlag reflects the input flag on the channel chosen as channel A (by means of coderegister). The InBFlag reflects the input flag on the channel chosen as channel B.

Bit 3: Control.

When the Control flag is set, the automatic functions are ON.

When writing "0" in the Control flag, the OutFlag is reset and the automatic functions are OFF (except the feedback control). The output may now be controlled in the normal way. After a reset the Control flag is reset.

Bit 2: Direction.

When running duty-cycle regulation in two directions, this bit will state the direction.

Positive DutyCycleOut	=>	Direction flag = "0"
Negative DutyCycleOut	=>	Direction flag = "1"

Bit 0: FeedBackError.

If a feedback control is used, this flag will state if a feedback error is detected.

FeedBackError = "1" => error

Note: This feedback error may also be read out from the error code register (Reg. F).

Reg. 1: OutTimer.

Each output channel has a timer used for automatic functions. The timer decrements at a frequency of 10 Hz (max. time approx. 1 hour) until it reaches 0.

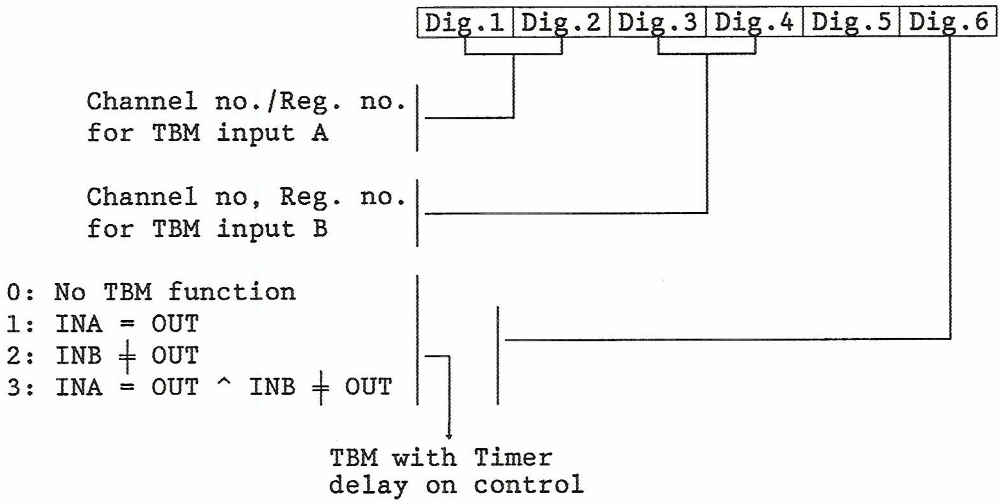
The timer is preset either via the P-net or from the preset register, depending on the function chosen.

Reg. 8: Outpreset.

This register contains a preset value for the timer.

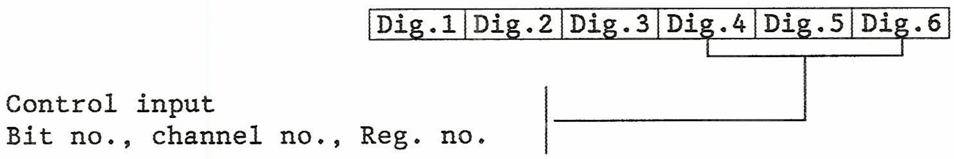
Reg. D: TBMCode.

This code register is used when selecting the feedback function e.g. single or double feedback signal.



Se paragraph 7.5. and 7.6.

Reg. 9: Code9.



To control the Control flag by means of another bit (e.g. an input flag on a digital input), point at the selected bit. (Bit no., Reg. no. and channel no. must be known). If this function is not required, insert "0" in digit 4, 5 and 6.

Reg. A: CodeA.

```
                                   |Dig.1|Dig.2|Dig.3|Dig.4|Dig.5|Dig.6|

   0: Non inverting output          Dig.1
   1: Inverting output

** 0: Output without automatic
   1: Pulse output
   2: Sequence control              Dig.2
   3: Duty cycle (1 direction)
   4: Duty cycle (2 directions)

   SignalA for Duty cycle/
   Sequence control                 Dig.4 - Dig.6
   (Bit no., channel no.
   Reg. no.)
```

The output may be inverted by means of digit 1. The Out-flag though, normally following the output, will not be inverted.

If one of the Duty-cycle functions are chosen, it is only necessary to point at a channel no. and a Reg. no. in the code register.

** These functions are explained in the following paragraphs.

Reg. 5: SignalA. *

SignalA, pointed out by means of the code, may be read in this register.

If the code register points at address 00, one may write in the register.

Reg. 6: TBMTimer.

Each output channel has a TBM-timer.

The timer decrements at a frequency of 10 Hz (max. time approx. 1 hour), until it reaches 0.

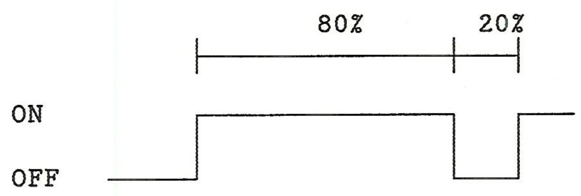
The timer may be preset via P-net or from the timer preset register.

Reg. 7: TBMPreset.

This register contains a preset value for the TBM timer.

Reg. 2: DutyCycleOut.

When the digital output is configured as duty-cycle output a value (0-100%) for the output will automatically be calculated. This value will tell for how long time the output must be ON. Se below.



In this example the output is ON 80% of the time. The value in the DutyCycleOut register is 80. The frequency of the output signal may be changed just by changing the contents of the OutPreset register. (Reg. 8).

Reg. B: FullScale.

The value in FullScale defines the amount of input that will lead to a DutyCycleOut value of 100%.

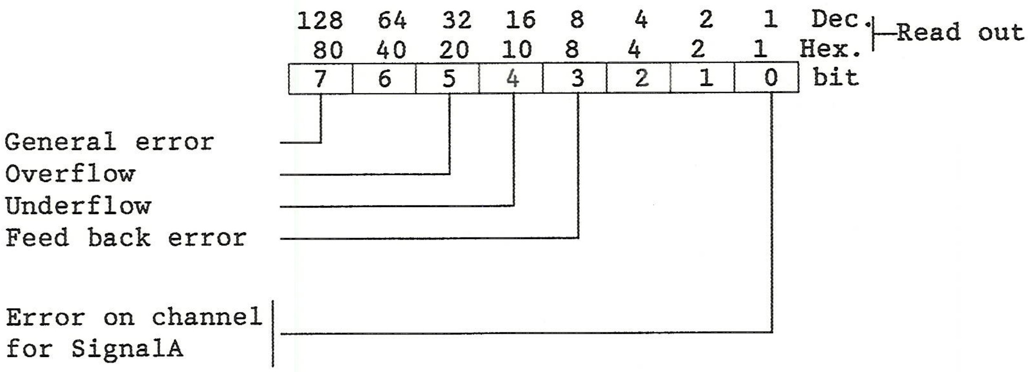
Reg. C: ZeroPoint.

ZeroPoint defines the amount of input that will lead to a DutyCycleOut value of 0%. When running duty-cycle output with two directions, ZeroPoint will define the amount of input that will lead to a DutyCycleOut value of -100%.

Reg. E: MinTime.

In this register one can define the shortest period of time in which the output must be ON. If the time in which the output is ON falls below the contents of the MinTime register, the output will go OFF. The MinTime value is given in the same units as the OutPreset value.

Reg. F: CHError.



If bit (general error) is set, the other bit are without any significance as the general error may lead to any error code on the individual channels (se "Service Channel").

Bit 5 (overflow) is set if the duty-cycle value exceeds 100%.

Bit 4 (underflow) is set if the DutyCycleOut value falls below 0%. When running duty-cycle output with two directions, bit 4 will be set if the DutyCycleOut value falls below
-100%.

Bit 3 is set when a feed-back error occurs. (May also be read in Reg. 0).

If bit 0 is set, the module has an error on the channel from where SignalA is retreived. This error can only occur if the digital output is configured as either limit switch/dosage channel or duty-cycle output.

7.2. Output controlled via P-net.

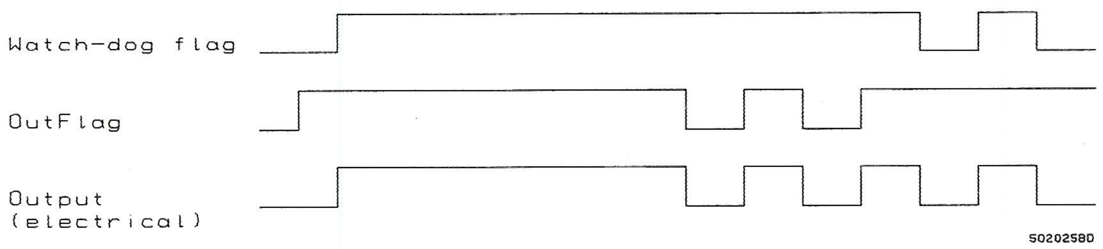
Function:

Output is controlled by means of bit 7 (OutFlag)in the flag register of the output channel (Reg. 0). This flag is set/reset via P-net or display unit PD 230.

Output goes ON if OutputFlag **and** watch-dog flag are set. (If the watch-dog function is not to be used it may be cut off, see "Service Channel").

The output function is independent of the Control-flag. OutputFlag though, will be reset (output goes OFF) if the Control-flag is reset - even if the Control-flag is already reset.

Time schedule:



Note: The Watch-dog flag is an internal flag which can not be read out.

7.3. Output controlled by timer, (pulse output).

Function:

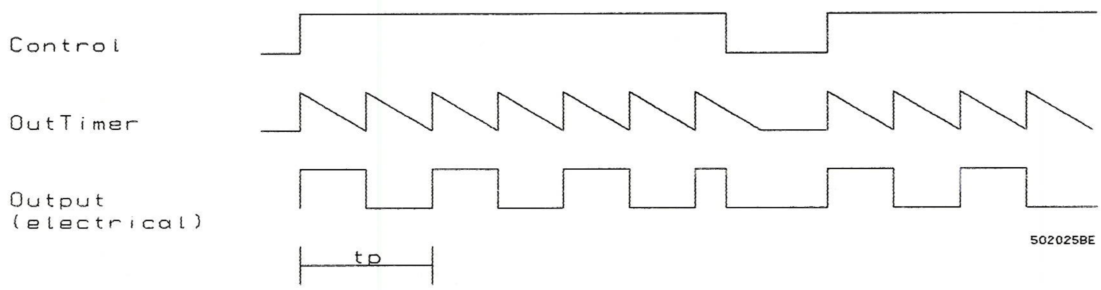
If the Control-flag is set output will shift each time the timer reaches 0.

(The time for a period (tp) is 2 times the contents of the timer-preset register).

When the Control-flag is reset, output is reset and may now be controlled via P-net. The timer (OutTimer) runs even if the Control-flag is reset but it is not reset when reaching 0.

When the Control-flag is set output shifts immediately if the OutTimer has reached 0. If not, output will not shift until it reaches 0. The timer may be set to 0 via P-net before the Control- flag is set.

Time schedule:

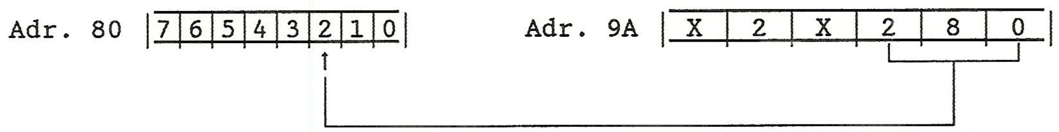


"tp/2" is inserted in tenth of a second in OutPreset for the Output channel (Reg. 8).

7.4. Sequence control.

The two digital outputs can be programmed to follow any bit in a flag register (or a bit in an error code register).

This is done by pointing at the selected bit. (Bit no., Reg. no. and channel no. must be known). This is done as shown in the example below:



In the example bit 2 on channel 8 in register 0 is selected, which means that the digital output (channel 9) is set to follow the Direction flag (bit 2) on the digital output (channel 8).

7.5. Single feed-back signal with adjustable delay.

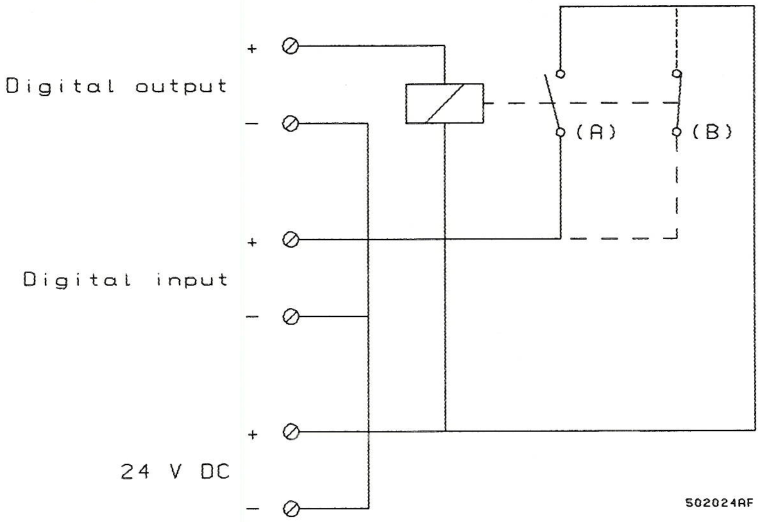
This FB-function requires one input.

Function:

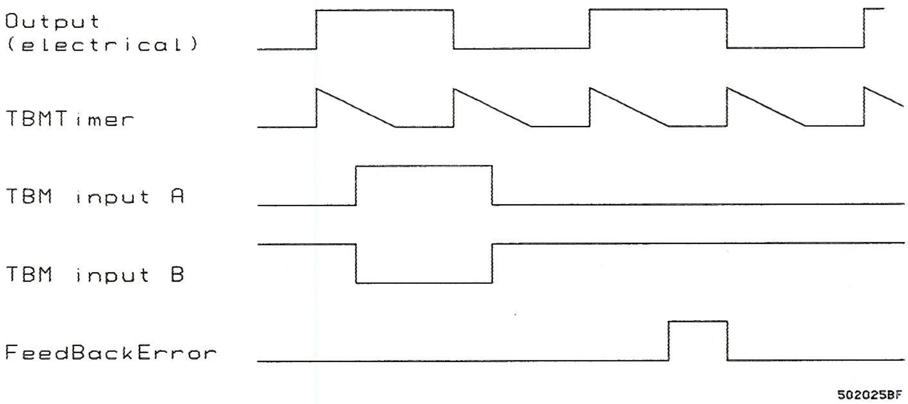
When output shifts, input must shift within the time td max. If this doesn't happen the FeedBackError flag in the flag register of the output-channel (Reg. 0) is set.

The largest tolerated delay of the FB-signal (td max) is inserted in the TBMPreset register of the output-channel (Reg. 7).

Connection to terminal strip:

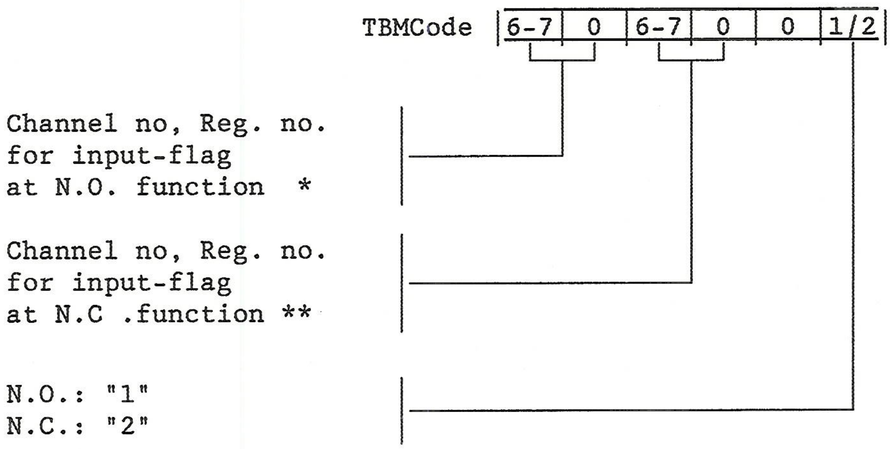


Time schedule:



Settings:

To select single feed-back function the code register (Reg. D) must be set as follows:



*: normally open
**: normally closed

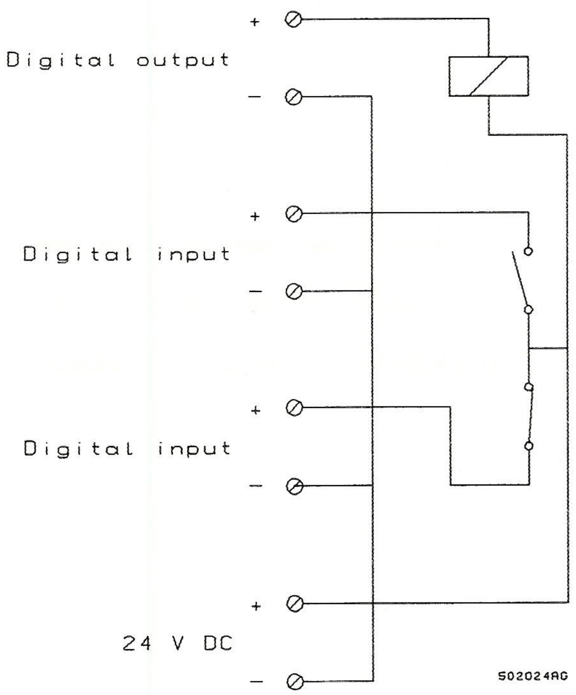
7.6. Double feed-back signal with adjustable delay.

When using double FB-signal it is necessary to use two additional input-channels, channel 6 and channel 7. A normally open contact is connected to channel 6 and a normally closed contact to channel 7.

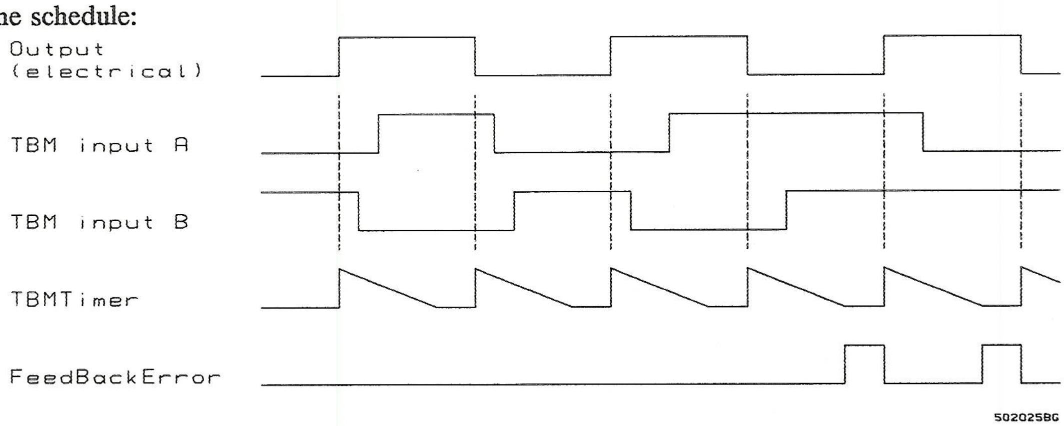
Function:

When output is OFF input 6 must be reset (contact open) and input 7 must be set (contact closed). The largest tolerated delay of the FB-signal (td max) is inserted in the timer-preset register of the output-channel (Reg. 7). When output shifts both input 6 and input 7 must shift within the time td max. If this doesn't happen the FeedBackError-flag in the flag register of the output-channel (Reg. 0) is set.

Connection to terminal strip:



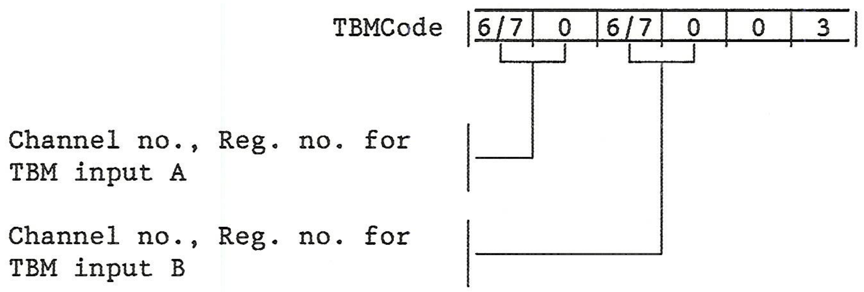
Time schedule:



Settings:

The input channels 6 and 7 are used.

The code register for the output channel is set as follows:



7.7. Feed-back signals.

Single or double feed-back signal (TBM) may be used.

When using one feed-back signal, one additional input is necessary to handel the input signal. When using two feed-back signals, two additional inputs are used.

The maximum delay tolerated in the connected system is adjustable.

The setting of the code register on the output channel is depending on what type of contacts are used.

When using N.O. (normally open) contacts, the channel no. and register no. of the input flag (60 or 70) are inserted in the code register (Reg. D) in digit 1 and 2 (TBM Input A).

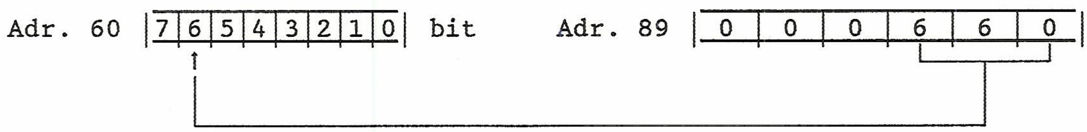
When using N.C. (normally closed) contact, the channel no and register no. of the input flag (60 or 70) are inserted in digit 3 and 4 (TBM Input B).

7.8. Controlling the Controlflag.

The module is equipped with a function that will set/reset the Control-flag automatically. This is done by pointing to a bit in a register. Ie, it is possible to connect or disconnect the digital output and the automatic functions, eg, by means of a digital input. This function will be especially useful if the multifunction module is located in a system in which the user has neither a display unit (PD 230) nor a computer connected. Then it would be possible to stop, for example, a batch by means of a switch, connected to a digital input.

Example:

If it is required to set/reset the Control flag by means of a digital input, this can be done by pointing to the InFlag in the flag register on the digital input channel, as shown below:



If the module is programmed as shown, the control flag will follow the input flag on the digital input channel.

Note: The Control flag can also be set directly in the flag-register (Reg. 0) by means of P-net or display unit (PD 230).

7.9. Dutycycle regulation.

It is possible to control the mark-space ratio of a digital output, for example, by means of a measured result on an analog input.

There are two types of duty cycle regulation, either regulation in one direction or regulation in two directions.

7.9.1. Duty cycle output in one direction.

This type of control can, for example, be used in conjunction with the internal PID-regulator for controlling of ON/OFF valve. This type of control is carried out by varying the ON-time on the output signal, but with a fixed defined frequency. The value which the output follows can be read in the DutyCycleOut register, and the value will be calculate as follows:

$$DutyCycleOut = \frac{Input\ signal - ZeroPoint}{FullScale - ZeroPoint} \times 100$$

- ie the DutyCycleOut value will always be 0-100%.

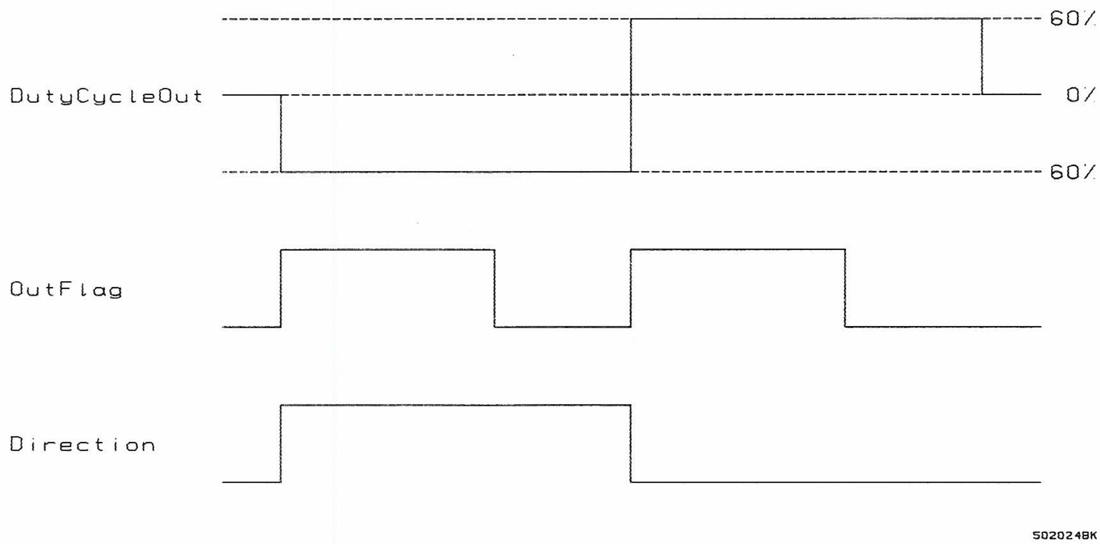
7.9.2. Duty cycle regulation in two directions.

Duty Cycle output in two directions can, for example, be used for controlling a bi-directional motor. The control is carried out by varying the ON-time of the output signal. The value which the output follows, can be read in the DutyCycleOut register, and the value is calculated as follows:

$$(2 * (\frac{SignalA - ZeroPoint}{FullScale - ZeroPoint}) - 0,5)) * 100$$

- ie the DutyCycleOut value will always be in the region of "zero" (DutyCycleOut will be between - 100 - 100%). The Direction flag (Reg. 0) will show the sign.

DutyCycleOut Positive = Direction bit = 0
DutyCycleOut negative = Direction bit = 1



The Duty Cycle output can run with a resolution of 200 mS, the resolution will, however, fall to 400 mS if both digital outputs are programmed as duty cycle output.

8. Service Channel (Channel 0).

The service channel contains registers which are relevant to all other channels. The service channel contains data about the module type and version No. of the program, both types of data being important to the P-net operation. The service channel monitors the microprocessor, collects error codes from other channels, and also controls the monitor facility called a watch- dog.

In the case of external errors, (for example a break in the communication cable, or a loss of supply voltage in the control computer) this would result in the module not being called by the P-net, and the Watch-dog will automatically inhibit all outputs, and cause the current output to decrease to 4 mA.

The user is able to decide how much time there should be between call-ups to the module via P-net. If this time is exceeded the watch-dog facility comes into operation as described above. At the same time, an error will be registered in the general error code register and in the error code registers for the other channels.

Registers in the Service Channel.

Reg.no.	Register name	Write	Storage medium	Number of bytes	Read out
0					
1	DeviceType		P	2	Decimal
2	PrgVers		P	2	Decimal
3	Error3	X	R	1	Hexadec.
4					
5					
6					
7	WDTimer	X	R	2	Decimal
8	WDPreset	X	E	2	Decimal
9	Code9	X	E	4	Hexadec.
A					
B					
C					
D					
E					
F	ErrorF		R	1	Hexadec.

Reg.1: Device Type

This register contains the module type number, e.g. 1431.

Reg.2: PrgVers

This register contains the program version number, e.g. 8601

Reg.3: Error3

This register contains the highest error code detected since the last error code register reading. Even if the error was transitory, the code will be retained until the register is interrogated. The error code meanings are the same for register 3 and register F.

Reg.7: WDTimer

When the module is communicated with via P-net, the timer is automatically set to the value from the preset register (reg.8). If the timer reaches zero before it is set again, the watch-dog flag will be reset, causing the outputs to switch OFF and the current output to revert to 4mA.

Reg.WDPreset

The maximum time allowed between two call-ups to the module, without the watch-dog being activated, is set in this register.

Reg.9: Code9

This register enables the watch-dog facility to be selected.

The register contains 6 digits. Digits 1-5 are not used.

Digit 6 defines whether the watch-dog is selected or not.

Dig.1	Dig.2	Dig.3	Dig.4	Dig.5	Dig.6

Dig.5:

```
0: Normal function
1: Special function
```

Dig.6:

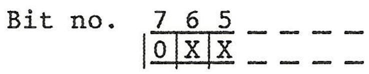
```
0:  Watchdog selected
    (Watchdog flag controlled by WDTimer)
1:  Watchdog for digital output de-selected,
    current output selected
2:  Watchdog for digital output selected,
    current output de-selected
3:  Watchdog inhibited
```

Register F: ErrorF

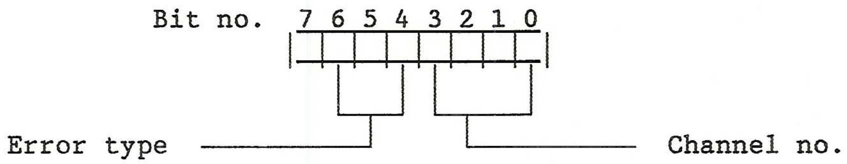
When faults occur, this error code register will contain the last error code while the fault exists, but if the fault disappears the code will not be retained in the register (unlike register 3).

The error code register contains 8 bits which need to be converted to a (hexadecimal) number between 0 and 93.

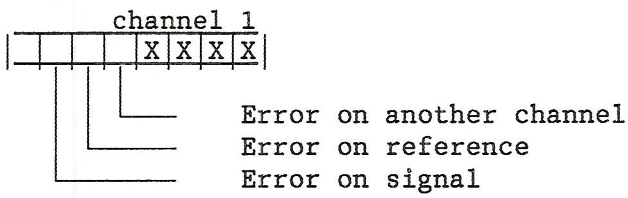
The error codes can be split into two groups. Numbers below 80 pertain to errors on individual channels, and 80-93 apply to errors on the module as a whole.



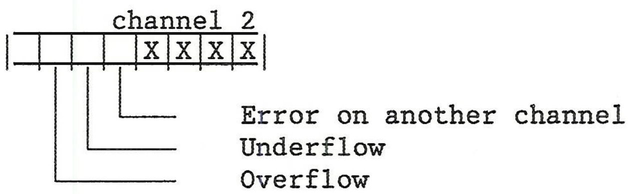
If the most significant bit (bit7) is "0", then an error only applies to a single channel.



Channel 1:



Channel 2:



Channel 3:

```
          channel 3
|_|_|_|_|X|X|X|X|
    | | |
    | | |____      Error on another channel
    | |______      Error on underflow
    |________      Error on overflow
```

Channel 4 and 5:

```
        channel 4/5
|_|_|_|_|X|X|X|X|
        |
        |____      Error on another channel
```

Channel 8 and 9

```
   channel 8 and 9
|_|_|_|_|X|X|X|X|
        |
        |____      Error on another channel
```

If further information on the error is required, register F on the specific channel can be read.

```
Bit no. 7 6 5 _ _ _ _
       |1|X|X _ _ _ _
```

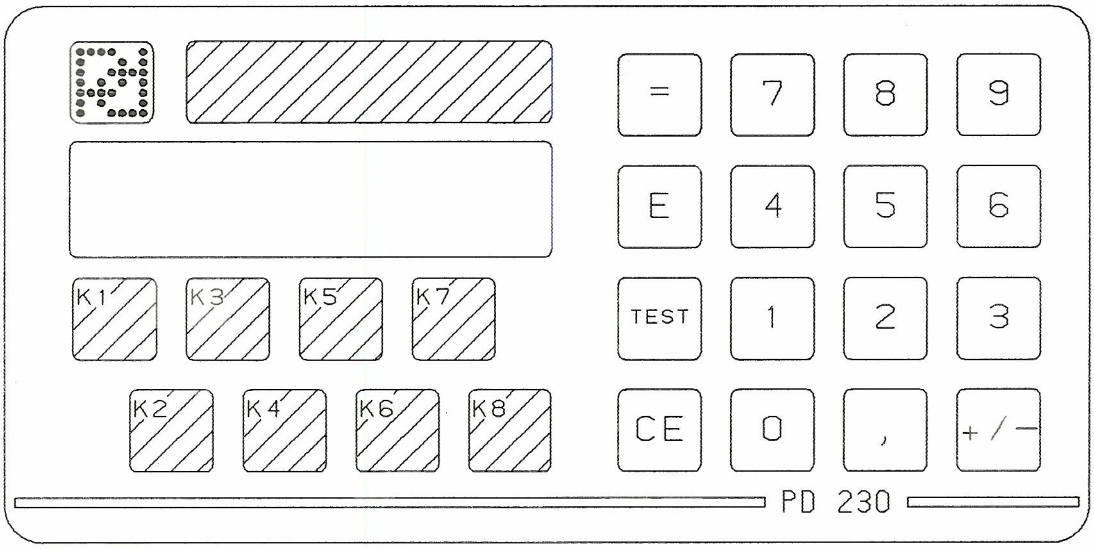
If the most significant bit (bit 7) is "1" then one of the error codes 80-93 applies.

These error codes (read as hexadecimal numbers) have the following meaning:-

Error Codes	Meaning
80	Voltage output overloaded
85	WDTimer time out
89	External data store fault.
90	Program cycle time fault (microprocessor short of time)
91	Write protected data store fault.
92	Internal data store fault.
93	Program store fault.

9. Display Channel (Channel 9).

The display-unit, PD 230, can be directly connected to all of the PROCES-DATA series of modules. Thus it is possible to display or change any register in a module. Moreover, it is possible to both display and modify up to 8 different registers, simply by pressing one of the 8 keys K1 to K8 on the display unit. However, it is important to note that data, except for a code register is displayed in decimal format. Therefore, if it is required to display a flag register this will be displayed in decimal not in hexadecimal format.



SO2024AA

Note: The shaded areas illustrate transparent screens, behind which customised text can be placed.

Reg.no.	Register name	Write	Storage medium	Number of bytes	Read out
0					
1	Code1	X	E	4	Hexadec.
2	Code2	X	E	4	Hexadec.
3	Code3	X	E	4	Hexadec.
4	Code4	X	E	4	Hexadec.
5	Code5	X	E	4	Hexadec.
6	Code6	X	E	4	Hexadec.
7	Code7	X	E	4	Hexadec.
8	Code8	X	E	4	Hexadec.
9					
A					
B					
C					
D					
E					
F					

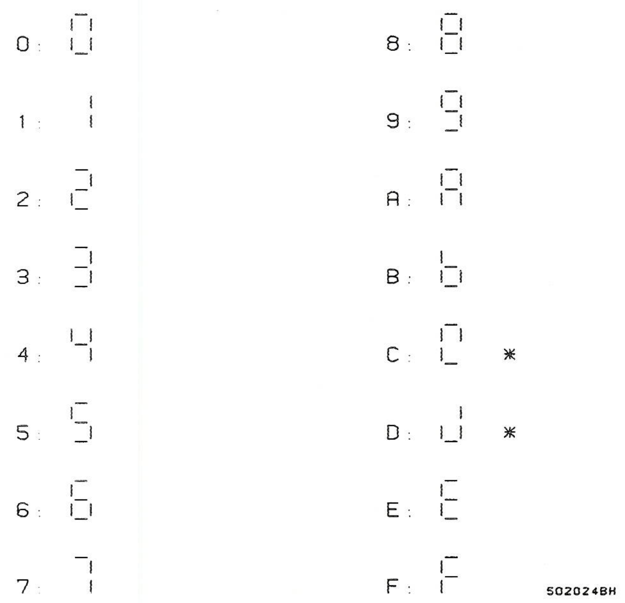
To enable the programming of the PD 1431 module using the display unit, it is possible to modify the code register and other write protected registers (i.e. all registers with an E for storage medium in the register definition). A write-protected register is displayed by keying in E1, followed by the channel and the register number - eg:-

Fullscale on channel 1 needs to be modified:-

Key	Read out	
[E] [1]	0	
[1] [1] [1] [1]	0111	
[=]	1B	Channel no., Reg. no.
[K1]	100,000	FullScale = 100
[2] [0] [0]	200	FullScale is altered from 100 to 200.
[=]	200,000	FullScale is saved in write protected store

Note: The letters A-F are keyed in as numbers. The display unit will then convert them to letters (hexadecimal notation) for display e.g. 12 corresponds to C.

The display unit has the following characters:-



* Note these characters, as they are rather unusual.

9.1. An example of programming to use a display channel on the PD 230 display unit.

Display a percentage from channel 2 by pressing display-channel K2.

Key	Read out	
E 1	0	
1 0 0 2	1002	
=	A2	Channel no., Reg. no.
K1	000000	Display code 2

Now the code may be input by changing one digit at a time.

This is done by pressing the display channel key (KX) directly underneath the digit which is required to be changed.

K3	0	
2	2	0 is altered to 2 in digit 1
=	2	2 = channel no. of read out
K1	200000	Display code 2
K8	0	
3	3	0 is altered to 3 in digit 6
=	3	3 = 3 digits after decimal point
K1	200003	Display code 2
E 1	A2	
0	0	
=	0	Back to read out mode
K2	56,555	Output in % on channel 2.

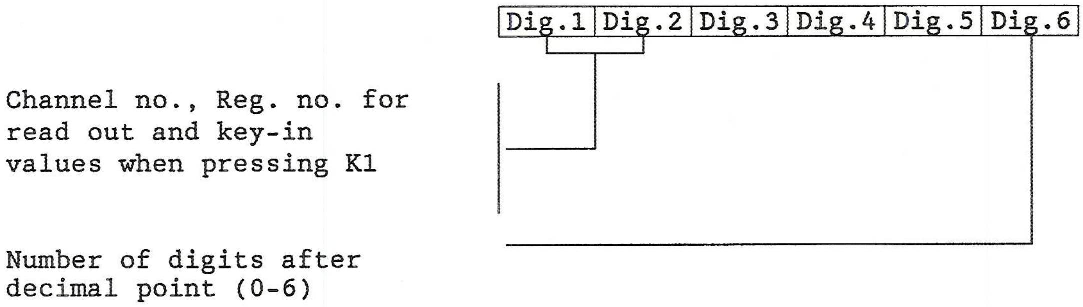
The percentage on channel 2 will now be displayed with 3 digits after the decimal point.

9.2. Programming of the function keys (K1-K8).

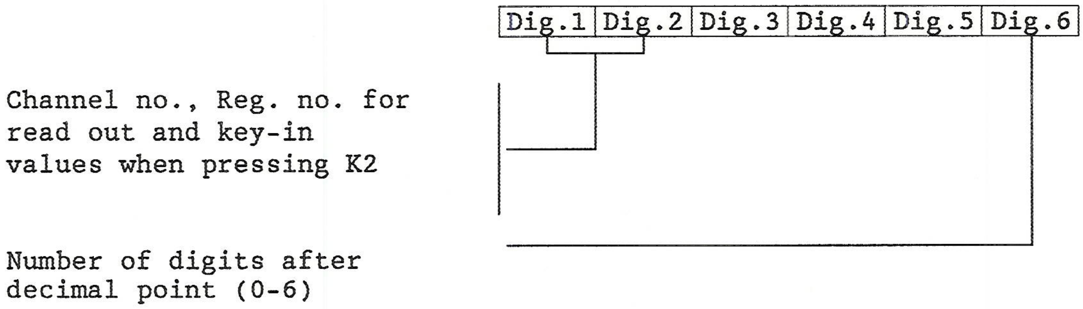
To choose up to 8 registers selected by the keys below the screen (K1-K8), the module must be programmed. This is done by using the eight display-code registers in the display channel. There is a code register for each key below the screen (K1-K8). This means that the user can define a specific register for display associated with each channel (1-8).

Note: The code register cannot be displayed or changed by this method.

Reg.1: Code 1



Reg.2: Code 2



And so on ...

The address of the register required to be displayed or changed is stored in digit 1 and 2.

Digit 6 is used for selecting the number of digits that should follow the decimal point on the displayed value.

Note: If an undefined address is being selected the display unit will show 999999 on the display.

9.3. Displaying error codes.

The PD 1431 is equipped with an extensive self testing system, which can detect faults caused by the module being wrongly used, or within in the module itself.

When the testing routines detect a fault, the user will be advised of this on the display unit, by means of an "A" for Alarm in the first digit of the display. By pressing the TEST key, the display will show an error code of 2 digits, indicating the nature of the fault (see section 8 "Reg.F: Error F").

The test system is designed so that the alarm is statisized even if the fault disappears. The error code on the display is updated **only** by pressing the TEST-Key. If several errors occur at once, only the error code with the highest value is retained.

Note: The display can only present error codes on channel 1-6.

9.4. Connecting the PD 230.

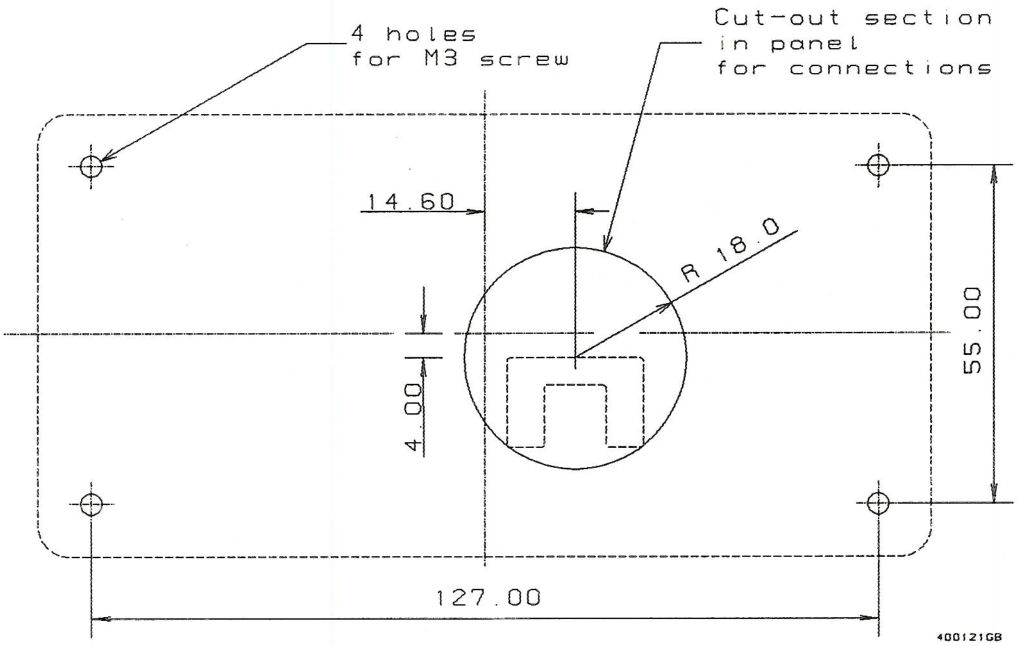
The display unit is connected to the PD 1431 with a single 2 core cable. The display unit is powered through this cable, and exchange of data between PD 1431 and PD 230 also uses this medium. The length of the cable must not exceed 100m and the cross sectioned area must be at least 0.75 sq.mm.

The cable is attached to the two spade connectors on the back of the display unit and to terminals 1 and 3 on the PD 1431's circuit board.

Terminal 1 should be connected to the spade connector marked "+".

9.5. Assembly drawing, PD 230.

The display unit is designed for stationary use e.g. mounted on the front of a panel. Se drawing for cut-out in panel.



The case measures W x H x D = 8 x 144 x 72 mm.

The unit is watertight and tolerates ambient temperatures between -10° C and + 50° C.

10. Special function.

The PD 1431 module has a special batch function which allows batching of three individual components e.g. in a tank mounted on load cells. This function is especially useful for use in small dosing plants as it only requires one Weight transmitter (PD 1431) and one Display unit (PD 230).

The mass of each component is defined by means of a setpoint and a reflow value.

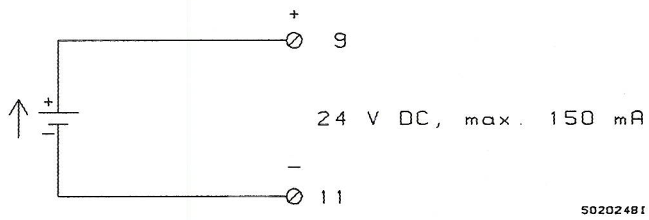
All values may be read in and out via the Display unit PD 230.

Note: When this function is switched on, it is only possible to use the current output (channel 2) and the PID regulator (channel 3), because all the other channels are in use for this function.

More information about this special function can be obtained by writing to Proces-Data.

11. Voltage Output.

The PD 1431 module is equipped with a voltage output which provides 24 V DC, at 150 mA maximum.

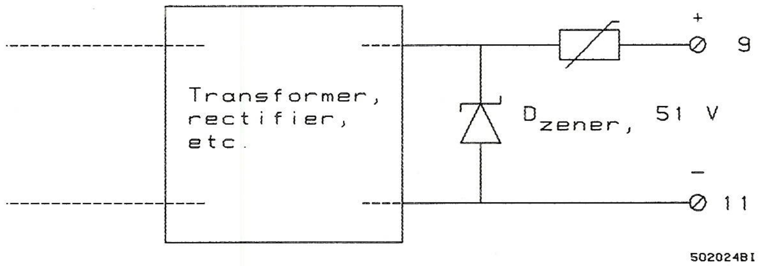


The voltage output can be used to supply external DC-equipment.

The voltage output is protected against overloading by a zenerdiode and a current limiting resistor.

Should an overload occur it will result in an error being stored in the error code register.

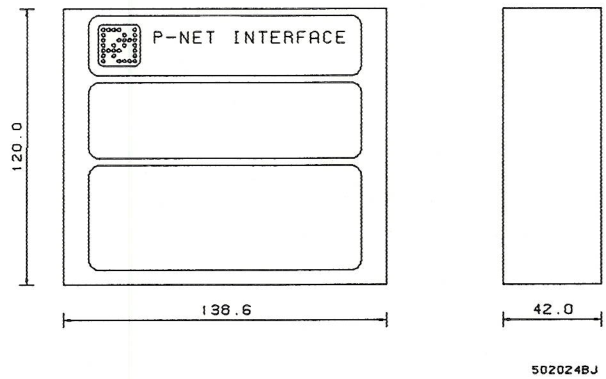
Following an overload the load should be removed before the output can be used again.



12. Construction, Mechanical.

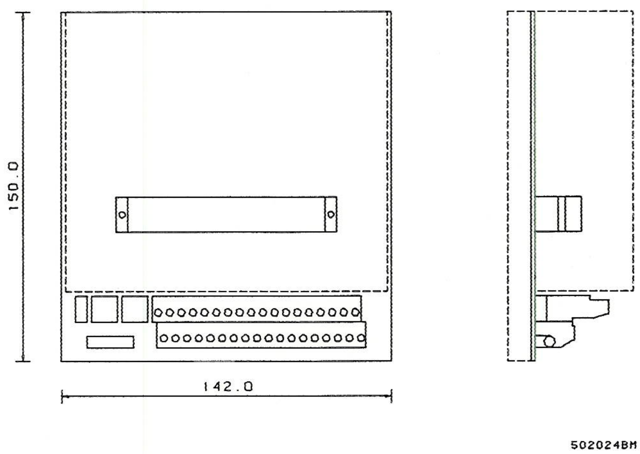
The PD 1431 module consists of two circuit boards housed in an aluminum case. The case measures W x H x D = 138.6 x 120 x 42 mm.

Fig.12.a: Aluminum Case for PD 1431



The module is intended for mounting on a base circuit board, PD 1080 (Fig 12.b) where the interface terminals and the switch "Program Enable" are placed. PD 1080 base circuit board is the same for all the modules in PD's module series and measures W x H = 142 x 150 mm.

Fig 12.b: Base circuit board PD 1080

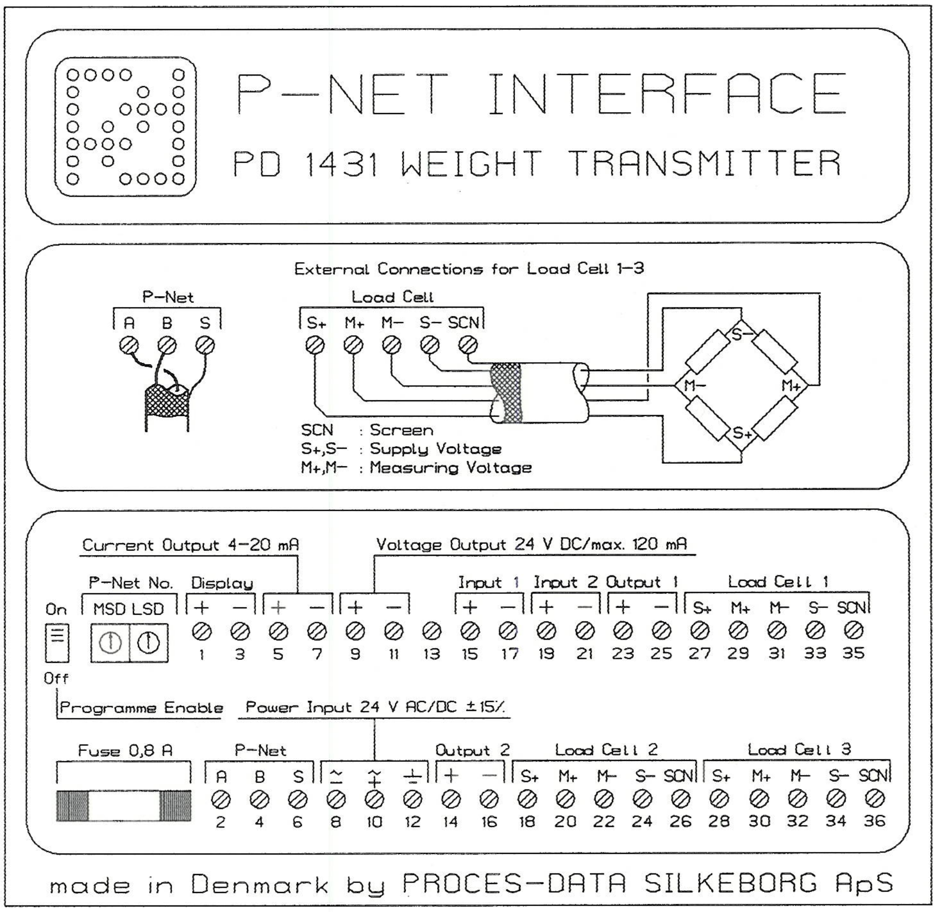


The connection between the module and the base circuit board is performed by plug and socket. The module can thus be changed without the wiring having to be disconnected.

Apart from the terminals and the program enable switch, the base circuit board contains 2 rotary switches, which are used for setting the address of the module for the P-Net. The number applies to the base circuit board, and therefore need not be set again if a module is changed.

The module, with base circuit board, is designed for installing in either a sealed box for wall mounting or for incorporation in a cabinet with other equipment.

12.1. Connections.



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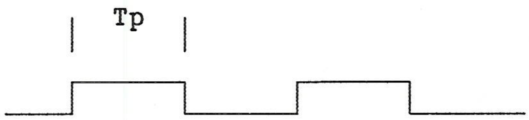
13. Specifications.

	Min.	Typical	Max.	Unit
Power supply	20,4	24	27,6	V AC/DC
Power consumption	2,9		7,8	W
Weight input:				
Sensitivity at FullScale (2 mV/V)	1,996	2	2,004	mV/V
Resolution, % of FullScale (2 mV/V)		0,01		%
Load cell impedance **	75			Ω
Digital input:				
Input voltage at "0"	0		6	V DC
Input voltage at "1"	18		30	V DC
Input current (input voltage = 24 V)			5	mA
Frequency range at 50% duty cycle, without bounce limiter	0		250	Hz
Frequency range at 50% duty cycle, with bounce limiter	0		25	Hz
Deviations at 50% duty cycle			±0,3	%
Pulse time without bounce limiter *	2			ms
Pulse time with bounce limiter *	20			ms
Digital output:				
Voltage drop over output at 10 mA		1,709		V DC
Voltage drop over output at 100 mA		3,85		V DC
Current during load			100	mA
Voltage output:				
Output voltage at 0 mA	24	26	28	V DC
Output voltage at 100 mA	21,5	23,5	25	V DC
Output current			150	mA
Ambient temperature	0		50	°C

* Pulse time = Tp

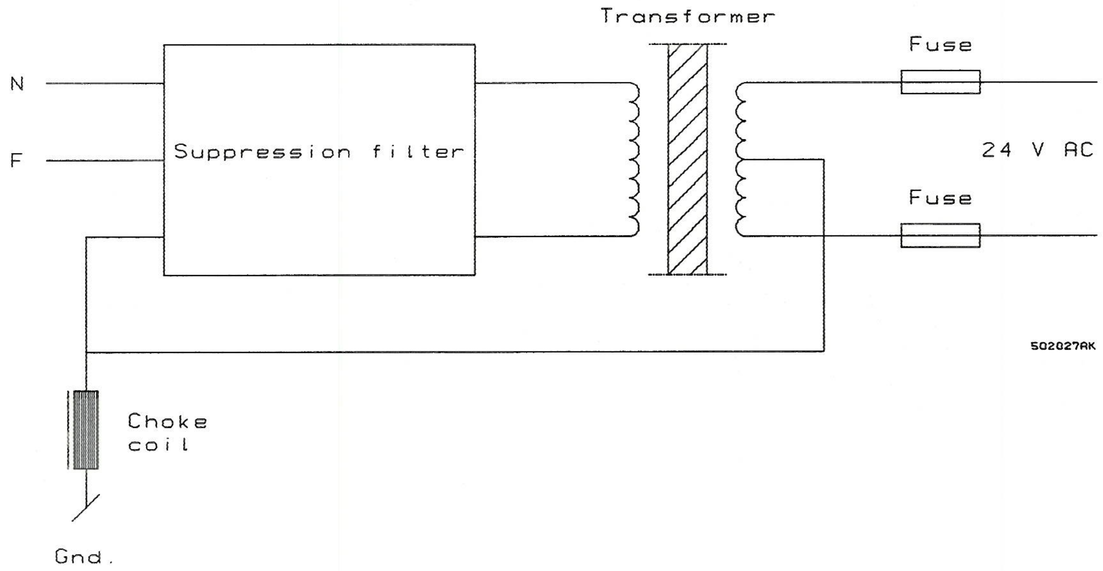


** Load cell impedance

Total impedance for all connected load cells. The impedance of the individual load cells are connected in parallel. E.g. 8 load cells with an impedance of 600 Ω or 4 load cells with an impedance of 300 ohm.

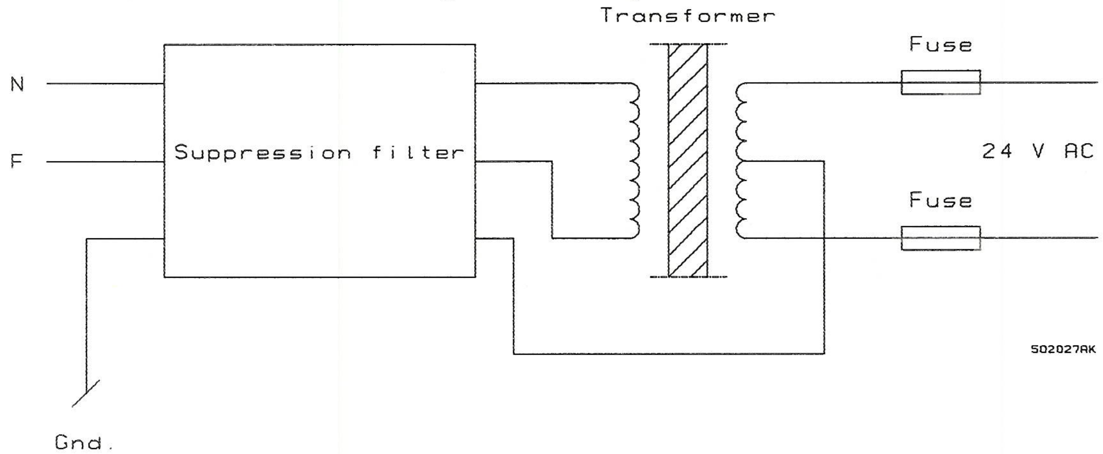
14. Noise limiter.

In environments with a high level of noise it is recommended to insert a hum eliminator before the supply transformer.



The hum eliminator could be a Schaffner FN332-1/05.

Also a hum eliminator with built-in impedance coil may be used.



The hum eliminator could be a Schaffner FN343-1/05.

Because of the centre tap on the transformer, two fuses are necessary. If the + or - terminals are short circuited a large current will be produced, because the voltage is ±12 V relative to ground.

It is recommended to use a two-chamber transformer with the primary winding in one chamber and the secondary winding in the other chamber.

15. Survey of registers in the PD 1431 module.

Reg. no.	Service channel 0	Weight channel 1	Current output 2	PID-regulator 3	Dosing channel 4-5	Digital input 6-7	Digital output 8-9	Display channel A
0		Weight0	AnalogOut	Output	FlagReg	FlagReg	FlagReg	
1	DeviceType	Weight1		Signal1	Actual1	Counter	OutTimer	Code1
2	PrgVers	Weight2		Signal2		Freq/Period	DutyCycle	Code2
3	Error3	Flow		Actual				Code3
4		BeltWeight						Code4
5		Freq			ActOffset1		SignalA	Code5
6		Tare			ActOffset2		TBMTimer	Code6
7	WDTimer		SetPoint	SetPoint	Actual7		TBMPreset	Code7
8	WDPreset	FlagReg8		FlagReg8			OutPreset	Code8
9	Code9	Code9	Code9	Code9	Code9	Code9	Code9	
A		CodeA		CodeA	CodeA	Code9	CodeA	
B		FullScale	FullScale	Xp			FullScale	
C		ZeroPoint	ZeroPoint	Ti			ZeroPoint	
D		FlowScale		Td			TBMCode	
E		BeltScale					MinTime	
F	ErrorF	CHError	CHError	CHError	CHError	CHError	CHError	

16. Survey of standard identifiers in the PD 1431 module for use in Process-Pascal.

Name	Register no.	Number of bytes	Storage medium	Read out	Channel no.
ActOffset1	5	4	BR	Decimal	4-5
ACtOffset2	6	4	BR	Decimal	4-5
Actual	3	4	R	Decimal	3
Actual1	1	4	BR	Decimal	4-5
Actual7	7	4	BR	Decimal	4-5
AnalogOut	0	4	R	Decimal	2
BeltScale	E	4	E	Decimal	1
BeltWeight	4	4	R	Decimal	1
CHError	F	1	R	Hexadec.	1-9
Code1	1	4	E	Hexadec.	A
Code2	2	4	E	Hexadec,	A
Code3	3	4	E	Hexadec.	A
Code4	4	4	E	Hexadec	A
Code5	5	4	E	Hexadec.	A
Code6	6	4	E	Hexadec.	A
Code7	7	4	E	Hexadec.	A
Code8	8	4	E	Hexadec.	A
Code9	9	4	E	Hexadec.	0-9
CodeA	A	4	E	Hexadec.	1,3-5,8-9
Counter	1	2	R	Decimal	6-7
DeviceType	1	2	P	Decimal	0
DutyCycleOut	2	4	R	Decimal	8-9
Error3	3	1	R	Hexadec.	0
ErrorF	F	1	R	Hexadec.	0
FlagReg	0	1	R	Binary	4-9
FlagReg8	8	1	R	Binary	1, 3
Flow	3	4	R	Decimal	1
FlowScale	D	4	E	Decimal	1
Freq	5	4	BR	Decimal	1
Freq/Period	2	4	R	Decimal	6-7
FullScale	B	4	E	Decimal	1-2, 8-9
MinTime	E	2	E	Decimal	8-9
OutPreset	8	2	E	Decimal	8-9
Output	0	4	R	Decimal	3
OutTimer	1	2	R	Decimal	8-9

To be continued....

Name	Register no.	Number of bytes	Storage medium	Read out	Channel no.
PrgVers	2	2	P	Decimal	0
Scale	A	4	E	Decimal	6-7
SetPoint	7	4	BR	Decimal	2-3
SignalA	5	4	BR	Decimal	8-9
Signal1	1	4	BR	Decimal	3
Signal2	2	4	BR	Decimal	3
Tare	6	4	BR	Decimal	1
TBMCode	D	4	E	Hexadec.	8-9
TBMPreset	7	2	E	Decimal	8-9
TBMTimer	6	2	R	Decimal	8-9
Td	D	4	E	Decimal	3
Ti	C	4	E	Decimal	3
WDPreset	8	2	E	Decimal	0
WDTimer	7	2	R	Decimal	0
Weight0	0	4	R	Decimal	1
Weight1	1	4	R	Decimal	1
Weight2	2	4	R	Decimal	1
Xp	B	4	E	Decimal	3
ZeroPoint	C	4	E	Decimal	1-2, 8-9

16.1. Survey of standard identifiers (Bit).

Name	Register no.	Bit no.	Channel no.
BatchFlag1	0	5	4-5
BatchFlag2	0	6	4-5
BeltFlag	8	7	1
Control	0	3	8-9
Direction	0	2	8-9
EORFlag	0	0	4-5
FeedbackError	0	0	8-9
Handshake	0	7	4-5
InAFlag	0	5	8-9
InBFlag	0	4	8-9
InFlag	0	6	6-7
Manual	8	0	3
OutFlag	0	7	8-9
SignBit	8	5	1
ZeroFlag	8	6	1

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