SAIA-Burgess Electronics

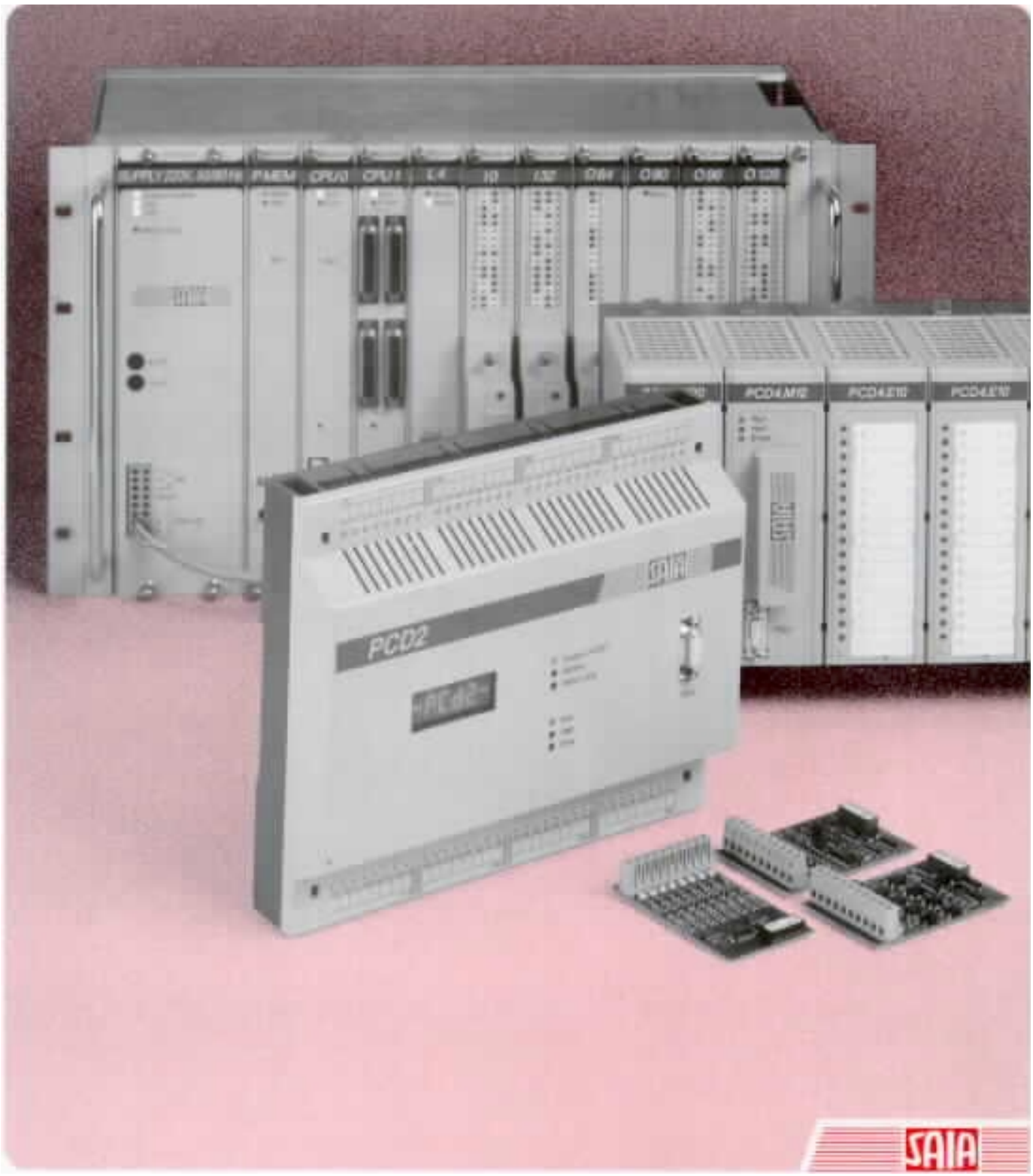
SWITCHES - MOTORS - CONTROLLERS

SAIA® PCD

Process Control Devices

PCD4.W500
PCD4.W600

Intelligent analogue modules



English edition 26/747 E1

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SAIA® Process Control Devices

Intelligent analogue modules

PCD4.W500 and PCD4.W600

Supplement to "PCD4 Series - Hardware Manual" 26/734 E

Edition 26/747 E1 - 08.1998

Subject to technical changes

Updates

Manual : Intelligent analogue modules PCD4.W500 and PCD4.W600 - Edition E1

Date	Chapter	Page	Description

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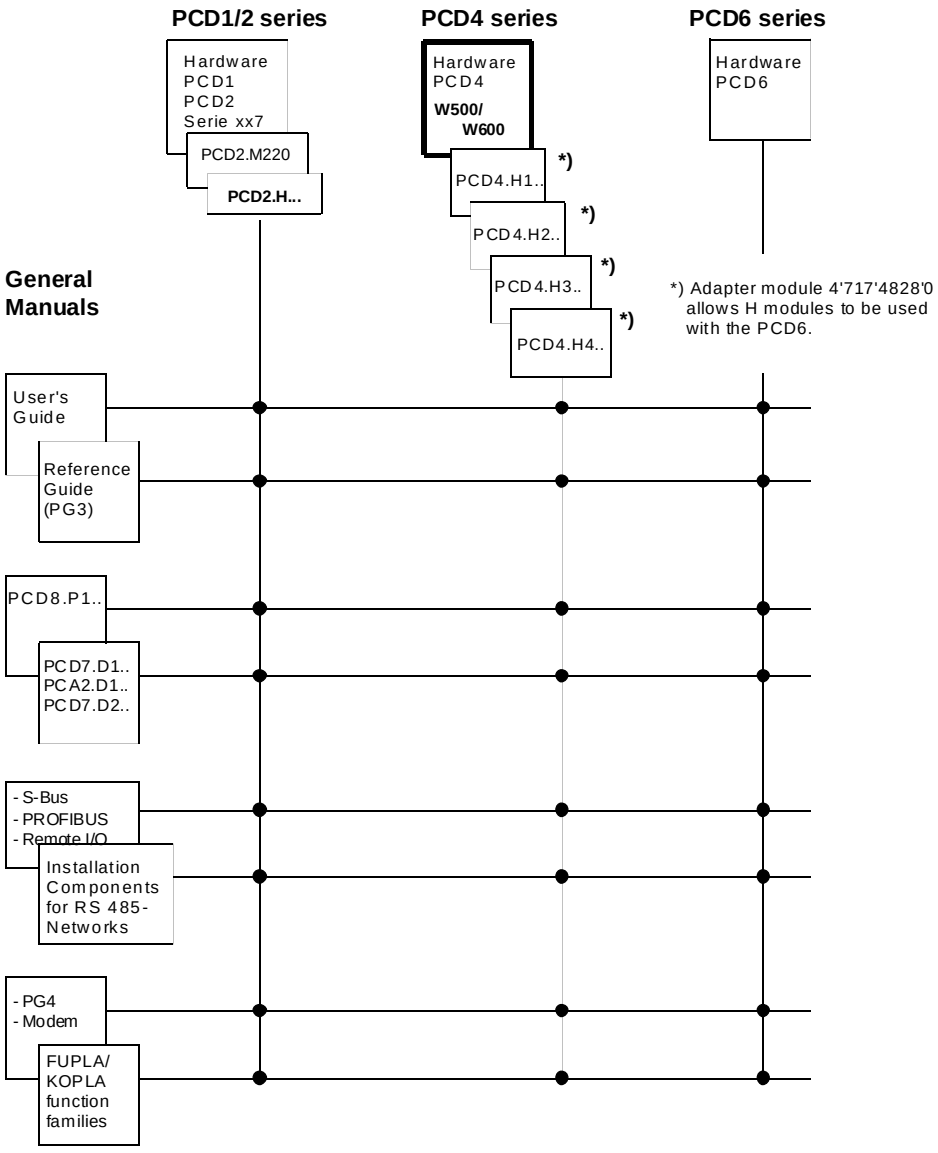
Please note :

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

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

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

Summary



Reliability and safety of electronic controllers

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

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

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

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

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

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

1. PCD4.W500 Galvanically isolated, analogue input module, 12/15-bit resolution

Intelligent analogue input module with galvanic isolation, 12/15-bit resolution and A/D conversion time of 100 µs (single shot). As a range module it is used with PCD7.Wlxx modules. The following connections are therefore possible:

- 8 inputs for voltages 0..+10 V
- 8 inputs for currents 0..20 mA
- 8 inputs for Pt/Ni 1000 resistance thermometers, 2 wire
- 4 inputs for Pt 100/1000 or Ni 100/1000 resistance thermometers, 4 wire

A microcontroller enables intelligent functions to be executed locally without burdening the central processor module:

- single-shot - continuous measurement
- formats: - 12 bit (single shot) - 12/15 bit (continuous),
  - proportional to input size
  - user definable scaling
- comparator function with two limiting values per input and adjustable hysteresis
- linearization and conversion to °C when standard temperature sensors are used
- connection of resistance thermometers (Pt 100/1000, Ni 100/100)
- status information, such as wire break, short-circuit or error

1.1 Hardware and technical data

1.1.1 Module overview

Base module:

PCD4.W500 containing the galvanically isolated DC/DC converter to supply the plug-in range modules, the input multiplexer, A/D converter, programmable current source, optocoupler for galvanic isolation from the PCD processor, microcontroller with its peripheral components, such as the I/O bus interface.

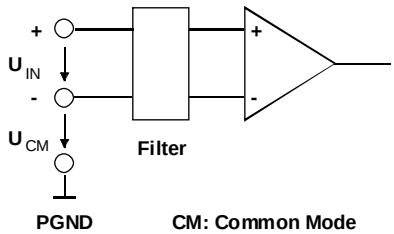
Range modules:

PCD7.W100	4 channels, ranges 0..10 V / ±10 V
PCD7.W101	4 channels, ranges 0..1 V / ±1 V (4 wire Ni/Pt 100/1000)
PCD7.W103	4 channels, range 0..20 mA (4..20 mA)
PCD7.W104	4 channels, range 4 .. 20 mA for 2 wire measuring transducer
PCD7.W110	4 channels for Pt 1000, range -50 .. +150°C, 2-wire measurement
PCD7.W111	4 channels for Ni 1000, range -50 .. +150°C, 2-wire measurement
PCD7.W120	4 channels for Pt/Ni 100/1000 constant current outputs

The input filter time constant is 1 ms

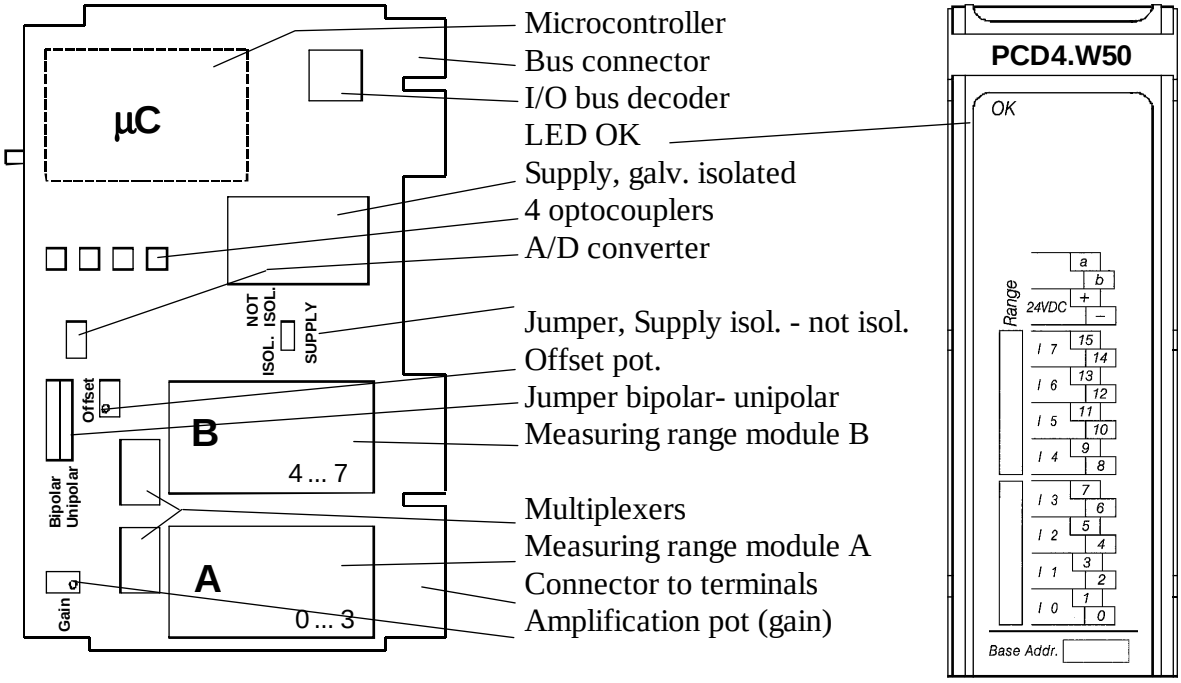
1.1.2 **Technical data** (base module)

Total inputs per module	8 voltage or current inputs or 8/4 inputs for resistance thermometers (Pt 100/1000 or Ni 100/1000)
Potential isolation	Yes, between PCD-GND and module GND 500 VDC, 1 min
Input measurement principle	Differential
Signal range	See range modules
Digital display (resolution)	12 bit (0 .. 4095), single-shot mode
A/D conversion time	max. 100 µs single shot max. 65 µs continous
Admissible over-voltage at analogue inputs	60 VDC
Accuracy regarding range end value	± 0.25% ± 2 LSB
Repeating accuracy	± 2 LSB
Temperature error	± 0.02% /°C
Current outputs	0 .. 10 mA constant current for resistance sensors (for use with PCD7.W120 range module only). Standard value 2 mA. Resolution: 8 bit
Resistance to interference (burst)	2 kV in capacitive coupling with screening
Common-mode behaviour	$U_{IN} + U_{CM} \leq \pm 10$ V CMR > 75 dB



External supply 24 VDC	as PCD4.N21 (transformer 19 V, bridge rectifier)
Current consumption	internal from PCD4 bus +5 V: 150 mA external for current output +24 V: 100 mA

1.1.3 Layout



The following functional blocks can be seen:

- Basic card with bus interface, address decoding, microcontroller system, optocouplers, multiplexers and two spaces for insertion of range modules.
- Space A for insertion of range module with addresses 0 .. 3 and space B for insertion of range module with addresses 4 .. 7.

The "Offset" and "Gain" potentiometers are pre-set in the factory and should not be adjusted.

1.1.4 Insertion of range modules

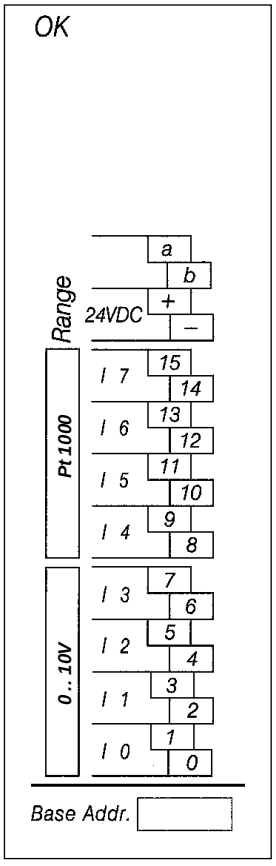
To plug on a range module, the printed circuit board must be removed from the module's housing. This is done by pressing in the snap-latches either side of the front cover. The screw fastening for the card, located on the left side of the module at the top, should then be unscrewed, allowing the printed circuit board to be pulled out of the housing.

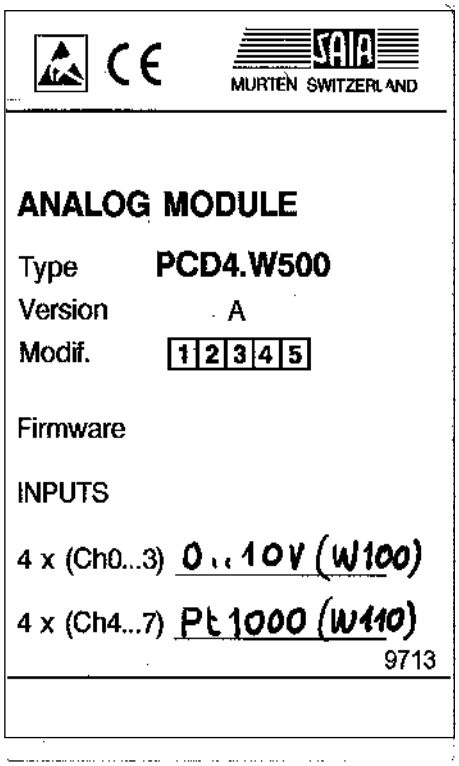
In space A, the lower position, a range module can be inserted for 4 channels with addresses 0 ... 3. Space B, the upper position, is intended for the 4 channels with addresses 4 ... 7, or for the special module PCD7.W120 (resistance thermometers, etc.).

After inserting the range modules, the housing should be closed again and the screw fastening for the card replaced.

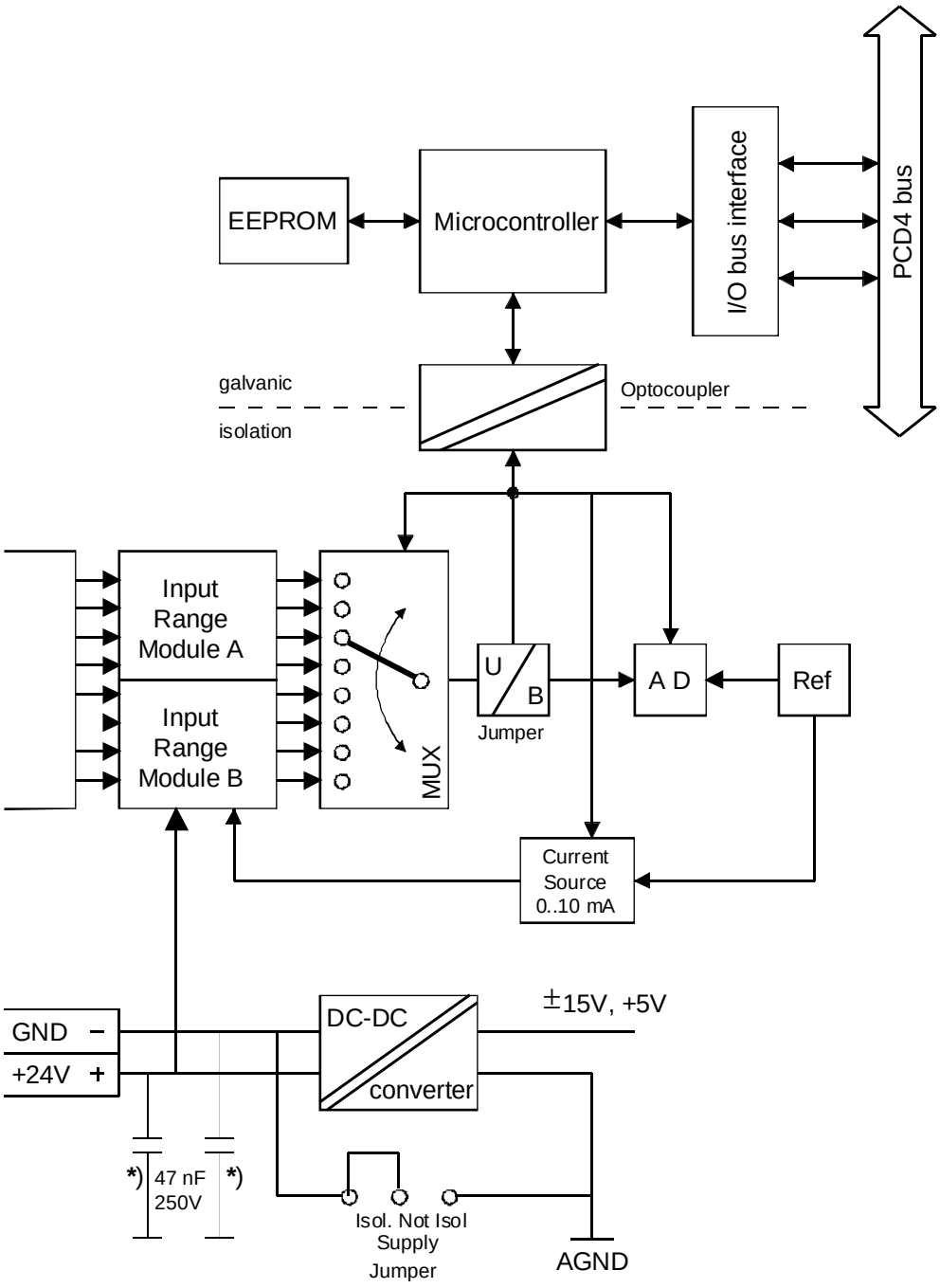
Caution: The basic card and range modules all contain components which are sensitive to electrostatic discharges.

Various range modules can be inserted in spaces A and B. In order that this equipment can be identified externally at any time, remember to enter details on the front and side panel plates.





1.1.5 Block diagram



*) To carry out an isolation test (500 VDC) on the installation, the screening components on the PCD4.C2.. must be removed.

1.1.6 Meaning of the 16 addresses

I/O address:	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15

Write (outputs)

Channel address	C0	C1	C2	C3	C4	C5	C6	C7	Conv	Status	Write	O0	O1	O2	O3	Data '0'
Data address	D0	D1	D2	D3	D4	D5	D6	D7	D8	D9	D10	D11	D12	D13	D14	Data '1'

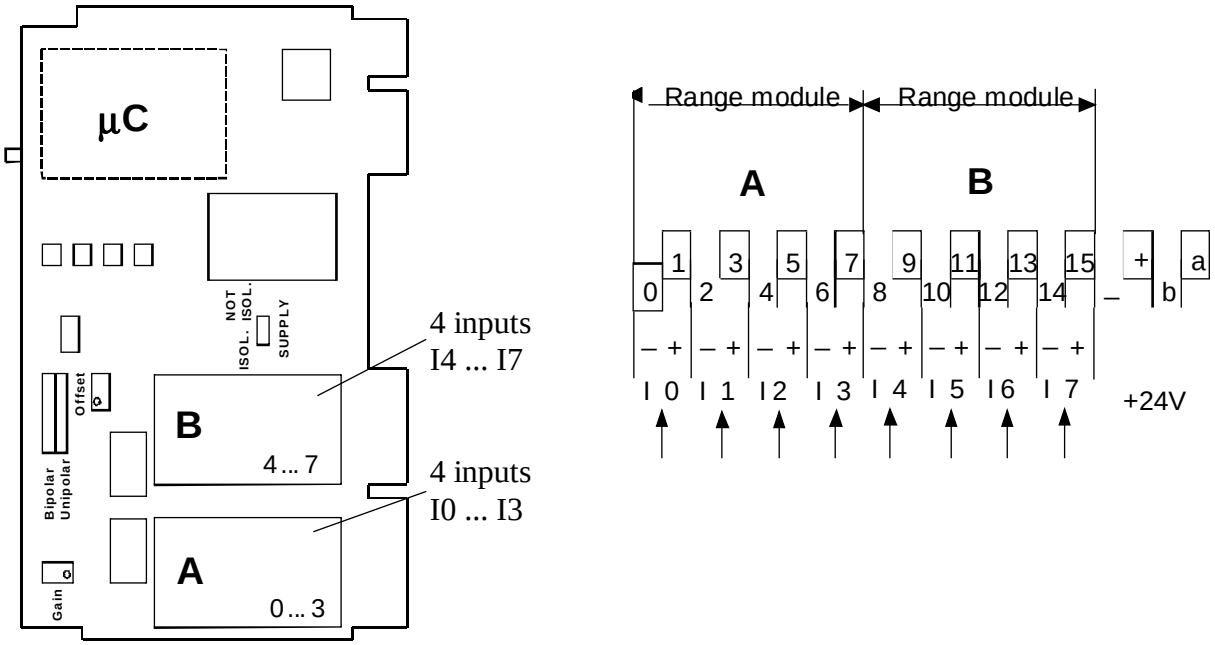
Read (inputs)

	D0	D1	D2	D3	D4	D5	D6	D7	D8	D9	D10	D11	D12	D13	D14	Busy

C0 .. C7:	Channel selection SET O Kx
Conv:	SET/RES O 8 starts conversion (data input/output) *)
Status:	SET/RES O 9 gives the status register at D0 .. D14 *)
Write:	Write/read
O0..3:	4-bit address
Data:	Selects data or channel address
D0..D14:	15-bit data → Conv Status register → Status
*)	Busy "Input" = H

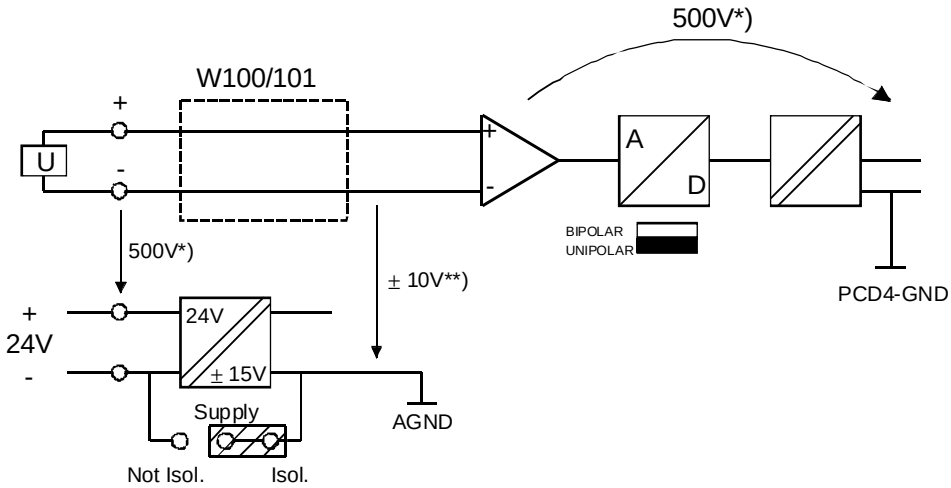
1.1.7 Module connections, taking into consideration the signal transmitter used

Voltage inputs for ranges 0..10 V / ±10 V, 0..1 V / ±1 V



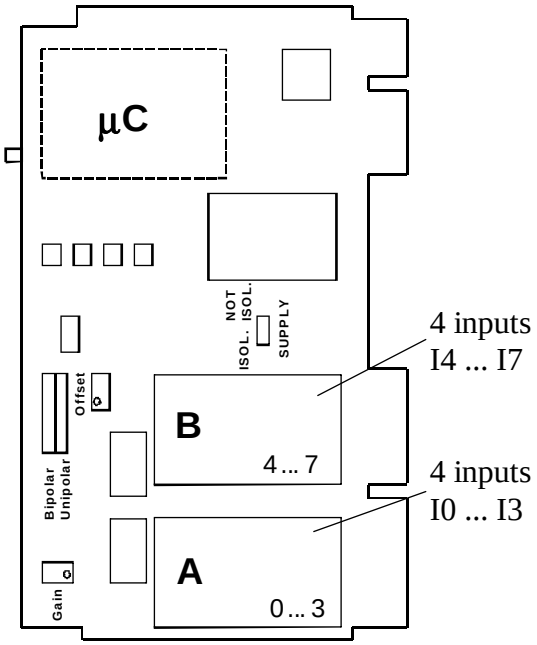
Range module	PCD7.W100	0..10 V → 0..4095:	unipolar
		± 10 V → 0..4095:	bipolar
Range module	PCD7.W101:	0..1 V → 0..4095:	unipolar
		± 1 V → 0..4095:	bipolar

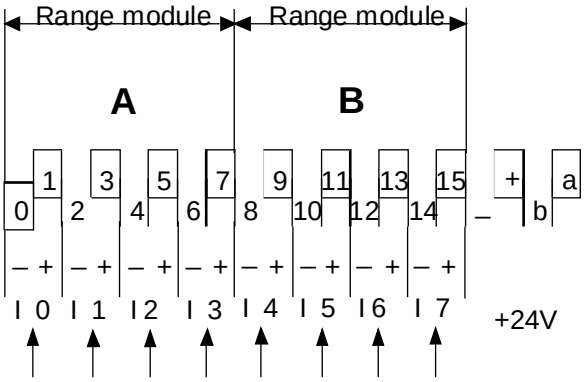
Module spaces A and B can be equipped with different range modules.



*) Isolation voltage of galvanic isolation
**) Common mode voltage

Current inputs for ranges 0..20 mA and 4 ... 20 mA



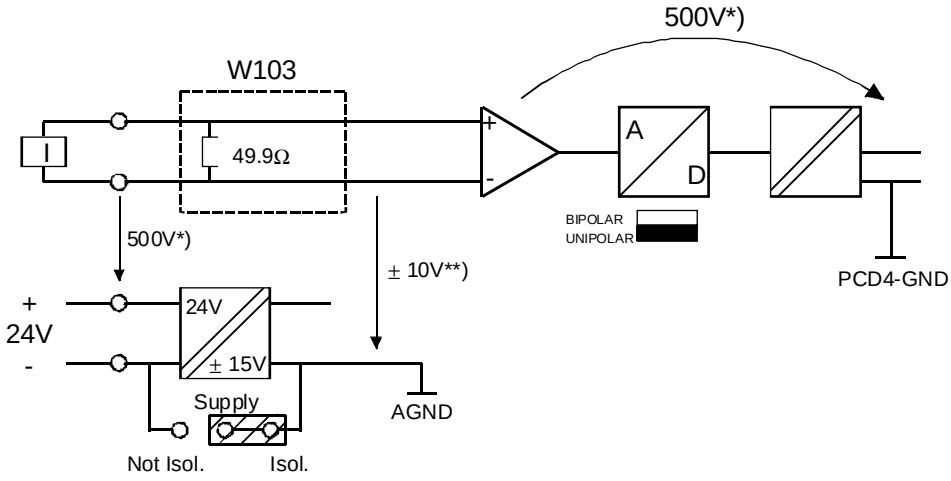


Range module PCD7.W103: measuring range 0..20 mA → 0..4095

For range 4 ... 20 mA, the same range module is used. Current limits are monitored with the user program. The jumper should be in the UNIPOLAR position.

4 mA	=	819	digital measurement
20 mA	=	4095	digital measurement

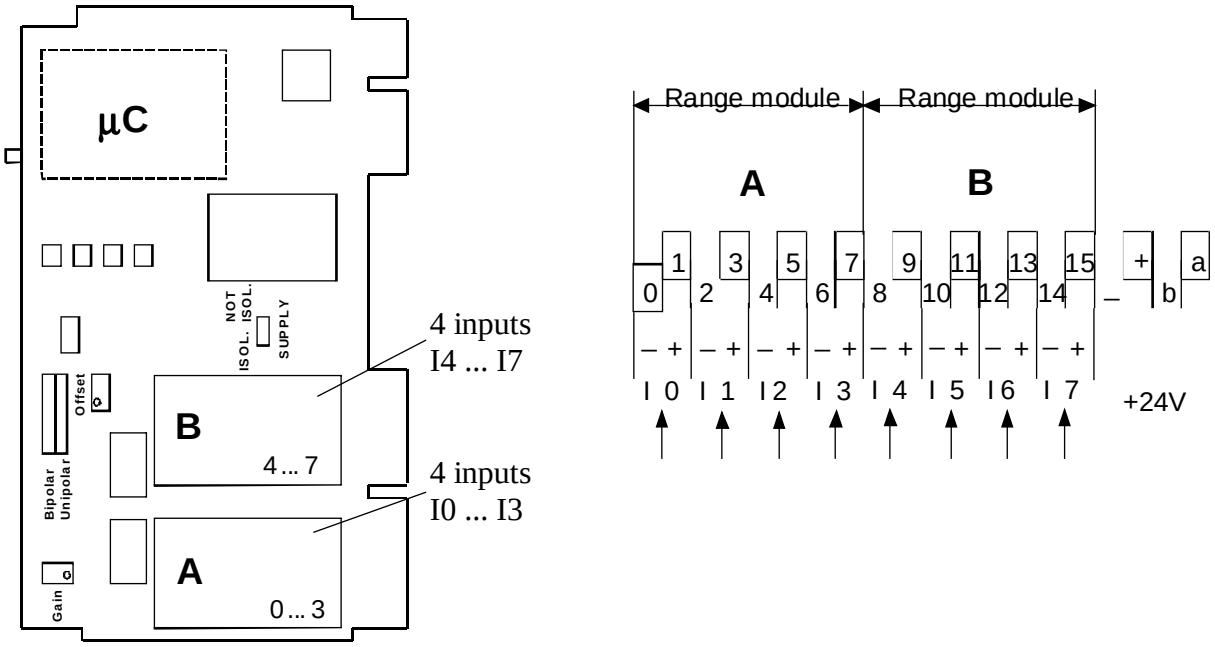
Module spaces A and B can be equipped with different range modules (e.g. A: 0..20 mA, B: ±10 V).



*) Isolation voltage of galvanic isolation
**) Common mode voltage

Current inputs for 4 ... 20 mA from two-wire measuring transducer

Two-wire measuring transducers need a 24 VDC supply on the instrument line, as shown in the diagram below.

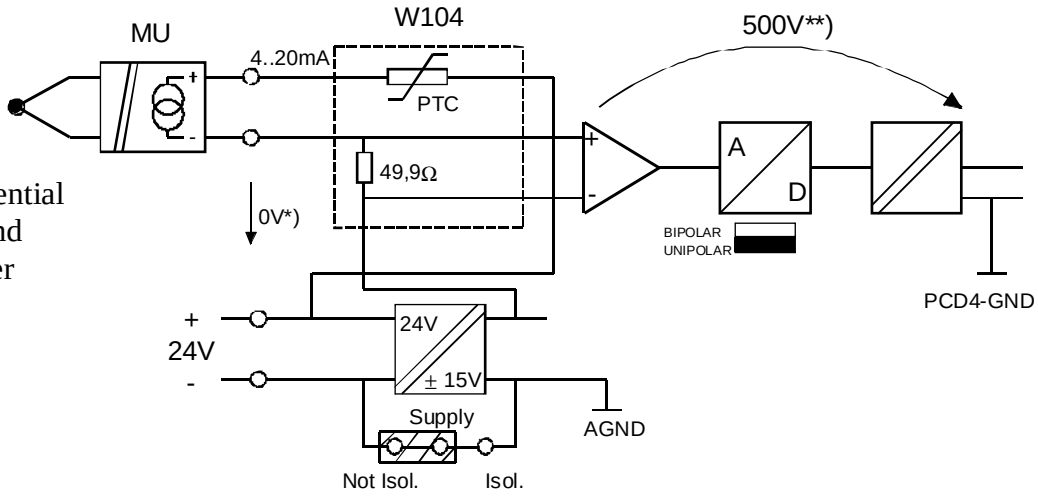


Range module PCD7.W104: measuring range 4 ... 20 mA
4 mA = 819 digital measurement
20 mA = 4095 digital measurement

The SUPPLY jumper must be set to NOT ISOL.

A voltage of + 24 VDC must be applied at the + terminal to supply the measuring transducer. The demands on this voltage are the same as for the PCD4.N2.. power supply module, or as specified by the transducer manufacturer. Maximum current requirement 0.2 A when 8 measuring transducers are connected.

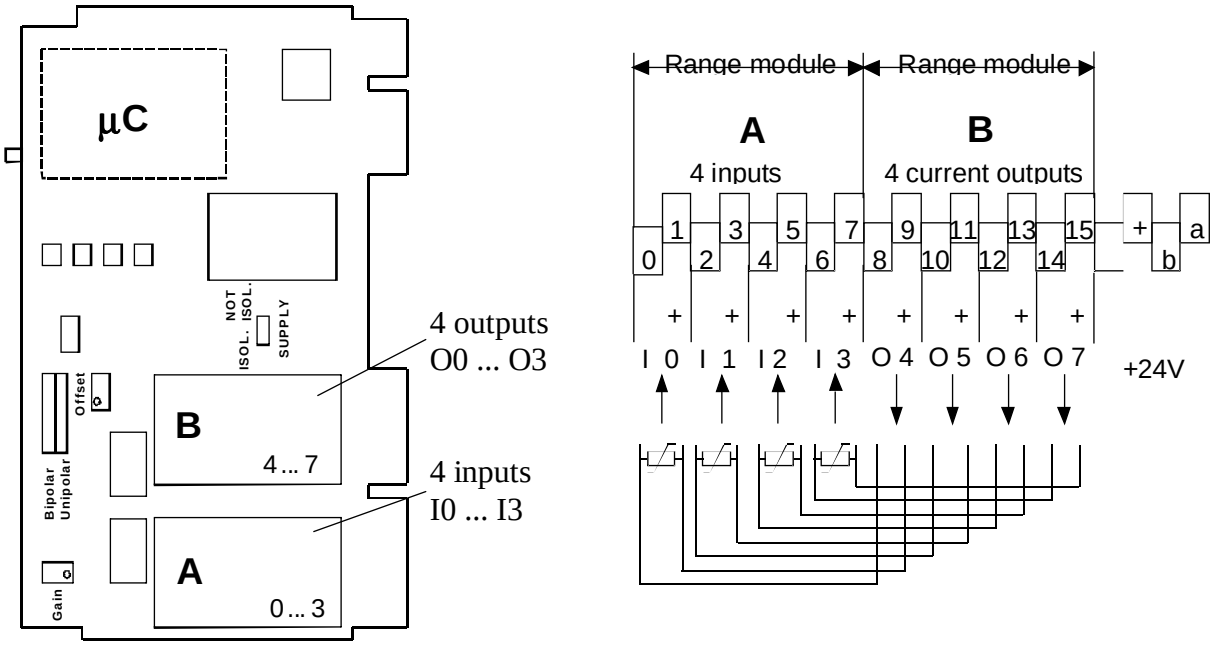
Module spaces A and B can be equipped with different range modules (e.g. A: 4 ... 20 mA, B: ±10 V).



*) Same potential of 24V and transducer

**) Isolation voltage of galvanic isolation

Connection of 4 x Pt 100/1000 or Ni 100/1000 resistance thermometers (4-wire measurement)



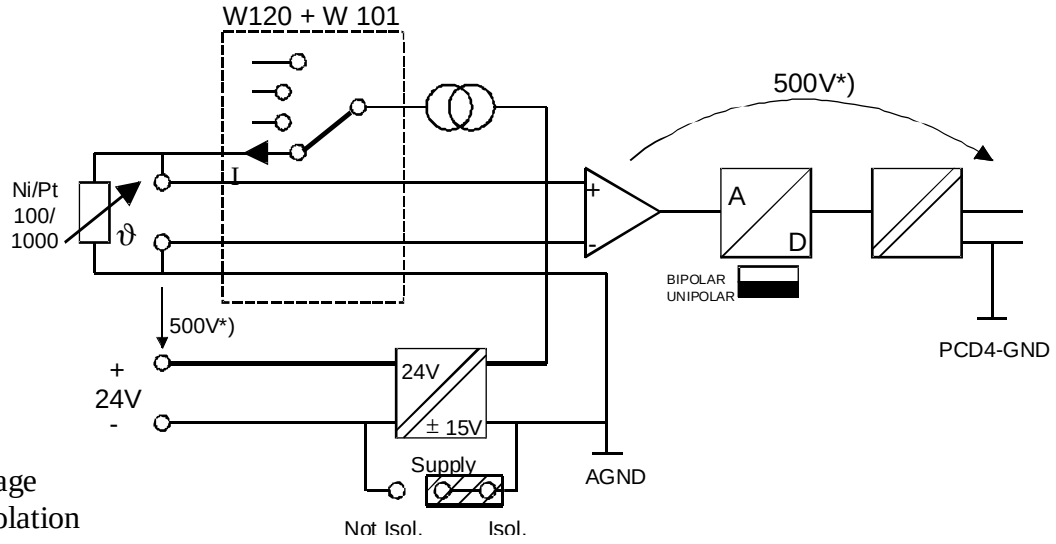
Range module space A:
PCD7.W101 (0..1 V)

Range module space B:
PCD7.W120 for 4 constant current outputs 0..10 mA

The jumper must be set to the UNIPOLAR position.

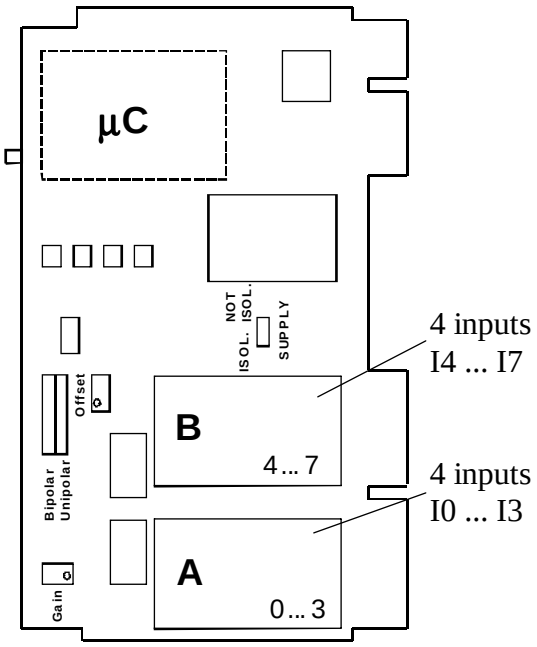
The module in space B provides a constant current of 0..10 mA, 8 bit.
The potential drop at resistance thermometers is channelled to the voltage range module in space A.

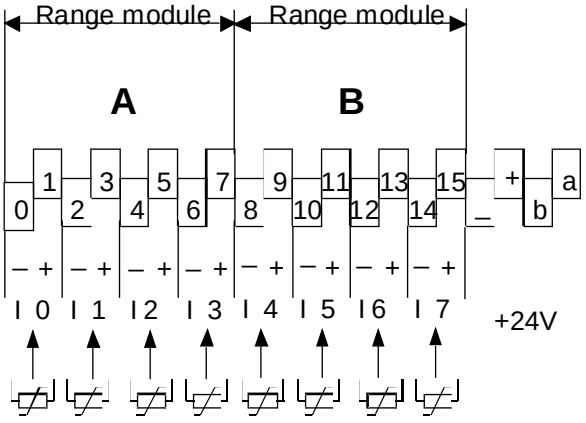
Important: unused current outputs must be short-circuited.



*) Isolation voltage
of galvanic isolation

Module connection of 8 x Pt 1000, Ni 1000 resistance thermometers
(2-wire measurement) for temperature range -50 ... +150°C



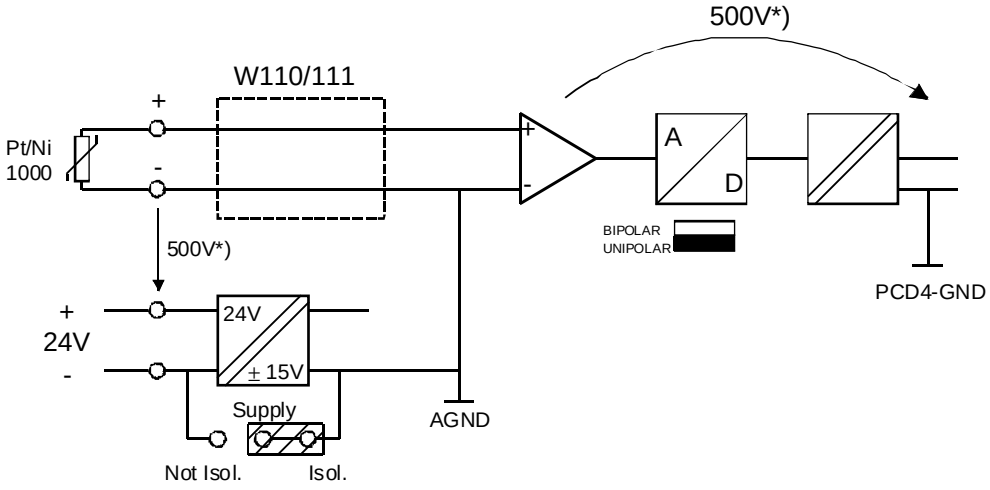


Range module PCD7.W110 for 4 x Pt 1000 (-50 .. +150°C)
PCD7.W111 for 4 x Ni 1000 (-50 .. +150°C)

At each of these modules, 4 x Pt/Ni 1000 resistance thermometers can be connected. Supply voltages for the resistance thermometers provide a stabilized internal supply for the module. Modules have been adjusted in the factory and are independent of the PCD4.W500 base module, i.e. modules are interchangeable.

Adjustment to compensate for cable length can be made for each channel by means of the potentiometers on the module itself. To maintain inter-changeability, however, it is preferable to compensate in the user program.

Important: Unused inputs must be short-circuited.



*) Isolation voltage of galvanic isolation

1.2 Standard mode

1.2.1 Software

If the microcontroller (µC) is left unconfigured, the PCD4.W500 module is treated like the PCD4.W300. However, the module (µC) can be configured in such a way that measured results are directly available in °C. See the following chapters 1.3 and 1.4 "Extended modes".

Important note:

If the module has been used previously in 'continuous' mode, this configuration is stored in the EEPROM. On the next startup, this configuration is taken again and the 'single shot' mode will therefore no longer work. The EEPROM must be reconfigured first.

Solution:
Programming with FBoxes: A simple user program with the FBox 'PCD4W500' with all channels set as 'disabled' is to create and to run.
Programming with FB's: In the Config-DB column 'Conf', for all channels the code 0000H is to fill in, then the user program is to run. Program example 1, 'example1.src' can be used, see chapter 1.3.5).

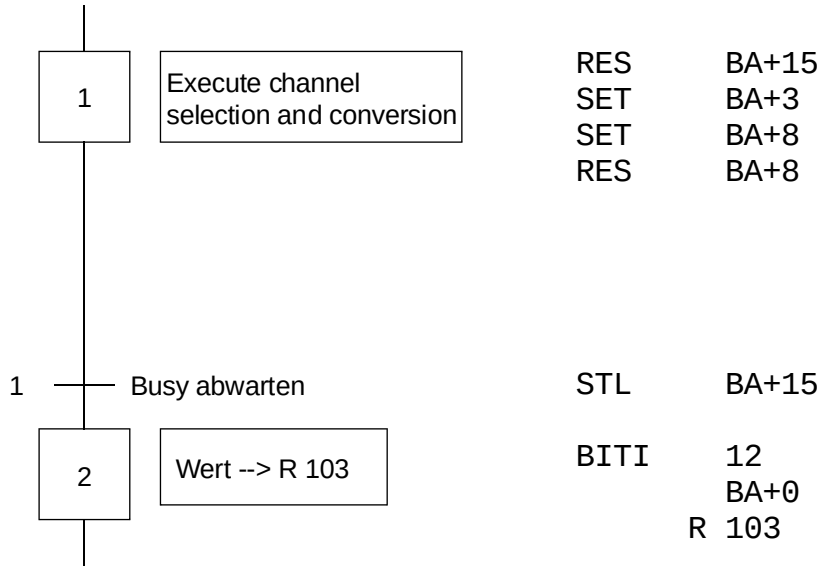
1.2.2 **User program** for single-shot inquiry

Example in IL (Instruction List) to demonstrate principle, with wait loop to await "Busy".

Convert the analogue value at input 3 (channel 3) and save it in register R 103. The module has base address 32.

```
        BA EQU O 32

      (ACC   H)           ; The ACCU must be high
       RES       BA+15    ; Output 15 must be low
       SET       BA+3     ; Selection of channel 3
      (RES       BA+8)
       SET       BA+8     ; Start A/D conversion by switching
       RES       BA+8     ;  output 8 on and off.

busy:  STH       BA+15    ; Busy is high when conversion run-
ning.
       JR    H   busy     ; Wait for as long as busy is high.

       BITI      12       ; Read the 12 bits from
                 BA+0     ;  address 0
             R   103      ;  and write to register R 103
```

Since the reading of an analogue value is a sequential process, it is preferable to write the user program in GRAFTEC (no program jumps, no wait loops).



1.3 Extended mode with FB library

1.3.1 Description of integrated functions

Standard / Single Shot mode
(Factory configuration without additional programming)

Value in 12-bit format (0..4095)
Converted each time the value is queried.
Conversion time: 100 µs

Continuous mode (voltage , current, temperature resistance mode)

In this mode, inputs are converted continuously in a cycle and the value is stored in memory. When the value is queried, the current value is read directly from memory.

Conversion time : 65 µs (time taken for value to be ready for reading)

Currency of values:	voltage, current:	- low resolution: 2 ms - high resolution: 160 ms *)
	temperature	- 2 wire connection: 160 ms *) - 4 wire connection: 100 ms per channel *) (max. 400 ms with 4 channels)

*) 50/60 Hz suppression

Voltage, current mode
The following formats can be selected for measurement of voltage and current:

- Bit format:
  Digital representation 12 bit 0..4095 (low resolution)
  or 15 bit 0..32767 (high resolution)

- Proportional format:
  Digitale representation in physical values

  Voltage range:

  10 V → 1 bit = 1 mV, representation 0..10000 / ±10000
  1 V → 1 bit = 100 µV, representation 0..10000 / ±10000

  Current range:

  20 mA → 1 bit = 1 µA, representation 0..20000
  Resolution:
  at low resolution, steps of 10/5: 0, 10, 20,… (current 0, 5, 10,…)
  at high resolution, single steps 0, 1, 2..

- User Scaling
  In addition, a user definable scaling can be selected. By means of two 15-bit values, the range and offset of the scale are specified for each channel.
  Range: 0..32767 (15 bit unsigned)
  Offset: -16384..+16383 (15 bit signed, 2's complement)

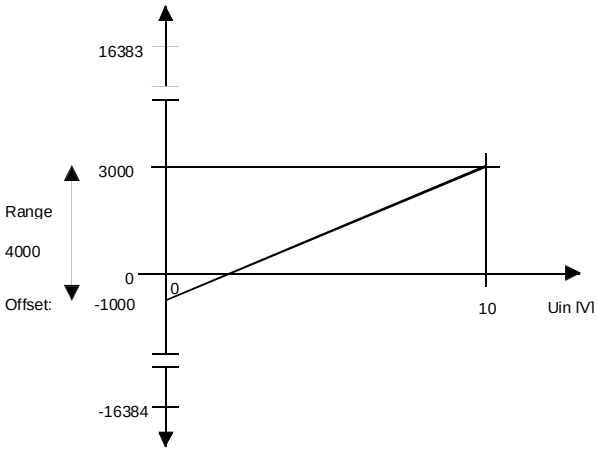
  Example: voltage input 0..10 V:
  Range: 4000
  Offset: -1000 (does not need to be symmetrical)

Remark:

a) **Offset ≥ 0**: The total of offset+range must always be within 0..32767 (15 bit unsigned format). If not, the scaling error flag is set in the status register. The value is read with FB "RdValUpW5".

b) **Offset < 0**: The total of offset+range must always be within -16384..+16383 (15 bit signed format). If not, the scaling error flag is set in the status register. The value is read with FB "RdValBpW5".

e.g.: Offset < 0



Temperature resistance mode

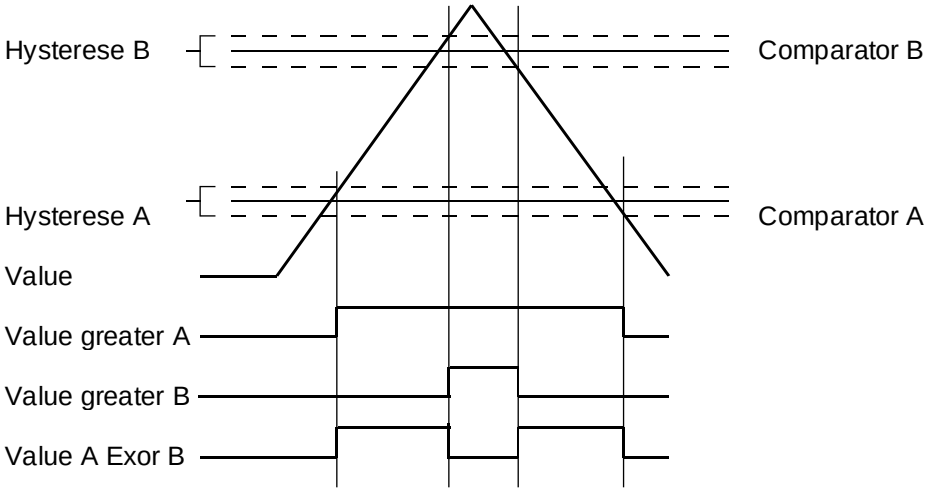
For temperature measurement, the linearisation and conversion to 0,1°C is pre-programmed for Ni/Pt 100/1000 temperature resistors.

Digital representation : - range -50..150°C: -500..1500
- range 0..600°C: 0..6000

Comparator

For each channel, two x 15-bit limiting values with adjustable hysteresis (8 bit / 0..255) can be entered.

The value read back corresponds to several status bits, which show whether the actual value lies within these limits. This relieves the PCD of CMP commands with constants or registers. The analogue input functions as an adjustable threshold value switch. Setting 2 limiting values produces a window comparator.



Note: A hysteresis of 100 produces a comparator value of ± 50. Values can be read from the status register.

The comparator limits must always be within the format range.

1.3.2 Programming model

Mapping PCD4 adresses

I/O	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15

For writing (Outputs)

Channel/ Address	C0	C1	C2	C3	C4	C5	C6	C7	Conv *	Status *	Write	A0	A1	A2	A3	Data *'0'*
Data	D0	D1	D2	D3	D4	D5	D6	D7	D8	D9	D10	D11	D12	D13	D14	Data *'1'*

For reading (Inputs)

D0	D1	D2	D3	D4	D5	D6	D7	D8	D9	D10	D11	D12	D13	D14	Busy

C0..C7:	Channel selection SET O Cx	
Conv:	SET/RES O 8 starts conversion (Data input/output)*	Interrupt 0
Status:	SET/RES O 9 gives the status register at D0..D14*	Interrupt 1
Write:	Write / read	
A0..3:	4-bit address	
Data:	Selects data or channel/address	
D0..D14:	15-bit data → Conv	
	Status register → Status	

- The busy input is =1
- Written data are evaluated by the microcontroller

See chapter 1.2.2 for program example in IL and GRAFTEC.

Status register

Channel spec. status

Global status

Data	Function
D0	0: Value not greater than A 1: Value greater than A
D1	0: Value not greater than B 1: Value greater than B
D2	Logical result of A EXOR B
D3	Scaling error
D4, D5	not used
D6	Wiring error
D7	Channel error
D8 - D10	Internal Error 3 bits : 000: everything ok 001: CPU or internal RAM error 010: external RAM error 011: EPROM checksum error 100: EEPROM checksum error 101: EEPROM initi. or test error 110: AD - converter error 111: Watch dog error
D11	not used
D12	Suppression : 0: 50 Hz 1: 60 Hz
D13	Switch position : 0: unipolar 1: bipolar
D14	General error

Explanation of error flags:

Scaling error: Scaling is not possible.

Wiring error: A short-circuit or wire break was detected during temperature measurement.

Channel error: Set when the scaling or wiring error flag is set.

Internal error: Controller system or peripheral device error.

General error: Set if one of the above error flags is set.

The easiest way to read the status register is using FB "RdStatus".

1.3.3 Programming integrated functions

Individual parameters can be selected by their addresses:

Address	Meaning	No. of bits
01	Channel specific configuration	15 bit
02	Value comparator A	15 bit
03	Hysteresis comparator A	8 bit
04	Value comparator B	15 bit
05	Hysteresis comparator B	8 bit
06	Current source value	8 bit
07	User range scaling value	15 bit
08	User range offset value	15 bit

Table 1:Meaning of addresses

Channel-specific configuration (address = 01)

The programming default is single shot mode (FW default)

Single shot mode

Mode	Range module	Range	Format	Digital representation	Configuration value Comparator off	on
Single shot	-	-	-	-	0000H	-

Table 2: Channel-specific configuration - single shot mode

Single shot mode is programmed in the factory.

Important: Not used channels must be configured as "single shot".

Continuous mode

a) low resolution

Mode	Equipped module	Range	Format	Digital representation	Configuration value Comparator off	Configuration value Comparator on
Voltage	PCD7.W100	10 V	Bitformat	0..4095	0001H	0041H
			Proportional	0/-10000*/**..10000	0009H	0049H
			user scaling	see user scaling**	0019H	0059H
	PCD7.W101	1 V	Bitformat	0..4095	0081H	00C1H
			Proportional	0/-10000*/**..10000	0089H	00C9H
			user scaling	see user scaling**	0099H	00D9H
Current	PCD7.W103	20 mA	Bitformat	0..4095	0002H	0042H
			Proportional	0..20000	000AH	004AH
			user scaling	see user scaling**	001AH	005AH
	PCD7.W104	4..20 mA	Bitformat	0..4095	0082H	00C2H
			Proportional	0..20000	008AH	00CAH
			user scaling	see user scaling**	009AH	00DAH

Tabelle 3: Channel-specific configuration - low resolution

b) high resolution with 50/60 Hz suppression

Mode	Equipped module	Range	Format	Digital representation	Configuration value Comparator off	Configuration value Comparator on
Voltage	PCD7.W100	10 V	Bitformat	0..32767	0021H	0061H
			Proportional	0/-10000*/**..10000	0029H	0069H
			user scaling	see user scaling**	0039H	0079H
	PCD7.W101	1 V	Bitformat	0..32767	00A1H	00E1H
			Proportional	0/-10000*/**..10000	00A9H	00E9H
			user scaling	see user scaling**	00B9H	00F9H
Current	PCD7.W103	20 mA	Bitformat	0..32767	0022H	0062H
			Proportional	0..20000	002AH	006AH
			user scaling	see user scaling**	003AH	007AH
	PCD7.W104	4..20 mA	Bitformat	0..32767	00A2H	00E2H
			Proportional	0..20000	00AAH	00EAH
			user scaling	see user scaling**	00BAH	00FAH
Temperature 2 - wire connection	PCD7.W110	Pt 1000	-50..150°C	-500.1500**	082BH	086BH
	PCD7.W111	Ni 1000	-50..150°C	-500.1500**	0C2BH	0C6BH
3 - wire connection	PCD7.W101	Pt 100	-50..150°C	-500.1500**	012BH	016BH
	+ PCD7.W12x (in preparation)	Pt 100	0..600°C	0..6000	212BH	216BH
		Pt 1000	-50..150°C	-500.1500**	092BH	096BH
		Pt 1000	0..600°C	0..6000	292BH	296BH
		Ni 100	-50..150°C	-500.1500**	052BH	056BH
		Ni 1000	-50..150°C	-500.1500**	0D2BH	0D6BH
4 - wire connection	PCD7.W101	Pt 100	-50..150°C	-500.1500**	00ABH	00EBH
	+ PCD7.W120	Pt 100	0..600°C	0..6000	20ABH	20EBH
		Pt 1000	-50..150°C	-500.1500**	08ABH	08EBH
		Pt 1000	0..600°C	0..6000	28ABH	28EBH
		Ni 100	-50..150°C	-500.1500**	04ABH	04EBH
		Ni 1000	-50..150°C	-500.1500**	0CABH	0CEBH

Tabelle 4: Channel-specific configuration high resolution

*) Jumper at bipolar
**) Read value using "FB RdValBp"

Important: Not used channels must be configured as "single shot".

Configuration process

It is preferable for configuration to be done from the cold-start routine XOB 16.

Structure chart of configuration (and process of "Config" FB's)

<table>
<tr><td colspan="2">Read EEPROM checksum</td></tr>
<tr><td colspan="2">Check if EEPROM checksum has the same value as the stored one and checksum ≠ 0
Yes / No</td></tr>
<tr><td rowspan="6">Do nothing *)</td><td>Stop W500</td></tr>
<tr><td>Write all configuration values
+ suppression to W500</td></tr>
<tr><td>Initialize W500 with new configuration</td></tr>
<tr><td>Save configuration to EEPROM</td></tr>
<tr><td>Run W500</td></tr>
<tr><td>Read new EEPROM checksum and store it</td></tr>
</table>

*) At W500 start-up, the configuration stored in it's EEPROM is adopted automatically. Reconfiguration is therefore unnecessary.

Important: If configuration data is modified, the checksum stored in the DB must be set to zero otherwise configuration will not be done.

→ **Note that programming is simpler using FB "Config" or the PG4's FBox.**

1.3.4 FB description

The following FBs are available for the PCD4.W500 module:

- **FBs for cyclic reading of information (in COB)**

RdValUp	Read input value in unipolar mode
RdValBp	Read input value in bipolar mode
RdStatus	Read status register

- **FBs for configuration or for writing information**

Config	Configure the W500
WrCData	Write channel-specific configuration
RdCData	Read channel-specific configuration
Control	Monitor the W500 card
RdInfo	Read W500 information

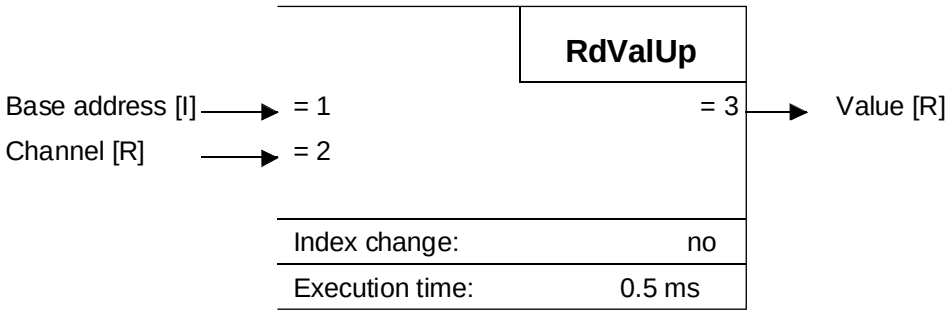
The configuration FBs are slow and should only be used for configuration or to read information. If used in a COB they can delay the program and the W500 module for quite a long time, depending on the FB.

FB global status flags:

Timeout:	All Read-FBs wait until the W500 card has completed the command. If not completed by the end of the timeout period (PCD4.M120 ≈ 15 ms), the FB is exited and this flag is set. Flags for FB "RdStatus": see FB description.
Caution:	Global symbols are common to all W500 Modules! (including status flags of the FB RdStatus)

FB processing times were measured with a PCD4.M120.

RdValUp **Function:** Read Value Unipolar **RdValUp**



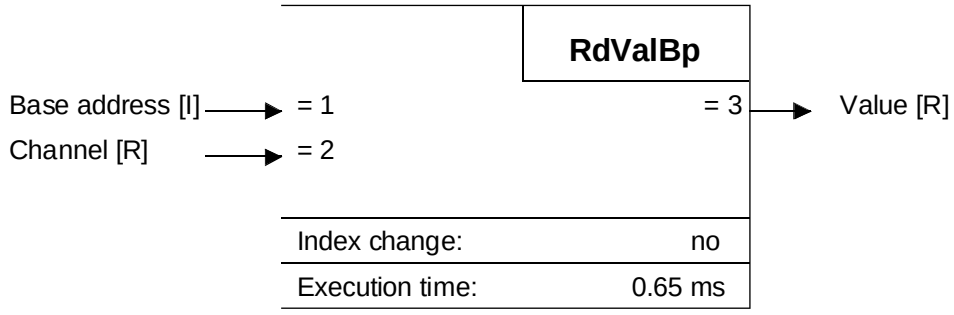
Functional description:

Reads an input using positive values only (e.g. current 20mA → 0..20000). The first parameter is the base address of the W500 module. The second parameter is a register containing the channel number. The third parameter is the register to hold the returned value.

```
$group W500
LD      Channel_Nb   ; Register = channel 2
        2
CFB     RdValUp
      I 16           ; Base address of module
        Channel_Nb   ; Reg. containing channel number
        AD_Value; Register for result
$endgroup
```

Note: The 'Timeout' flag is set if the W500 does not react to the command (Busy remains high) within ≈ 15 ms.

RdValBp **Function:** Read Value Bipolar RdValBp



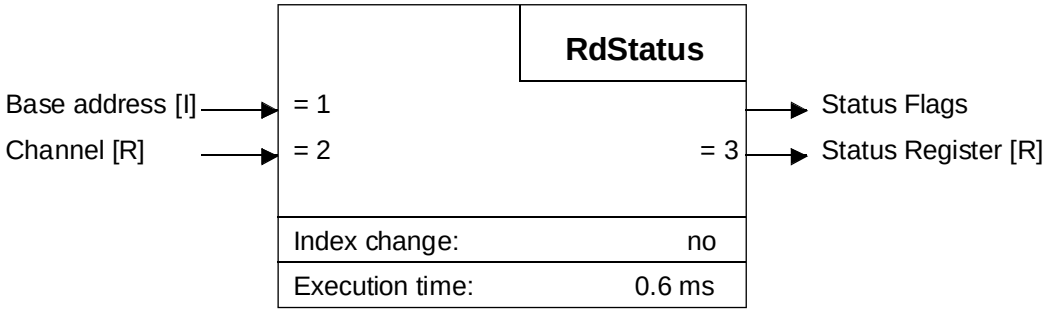
Reads a signed input value (e.g. temperature Pt100 -50..150°C → -500..1500). The first parameter is the base address of the module, the second parameter is a register containing the channel number. The value is returned in the register defined by the third parameter.

```
$group W500
LD      Channel_Nb   ; Register = channel 2
        2
CFB     RdValBp
      I 16           ; Base address of module
        Channel_Nb   ; Reg. containing channel number
        AD_Value; Register for result
$endgoup
```

Note: The 'Timeout' flag is set if the W500 does not react to the command (Busy remains high) within ≈ 15 ms.

.

RdStatus **Function:** Read Status Flags RdStatus



Reads a W500 status register. The first parameter is the base address of the module, the second holds the channel number. The result can either be read from the register defined by the third parameter or from the pre-defined status flags.

	Flag	Designation
Channel spec. status	VGrA	0: Value not greater than A 1: Value greater than A
	VGrB	0: Value not greater than B 1: Value greater than B
	AExorB	Logical result of A EXOR B
	ScalErr	Voltage / Scaling error
	WirErr	Wiring error
	ChErr	Channel Error
Global status	IntError	Internal Error 3 bits: 000: everything ok 001: CPU or internal RAM error 010: external RAM error 011: EPROM checksum error 100: EEPROM checksum error 101: EEPROM initi. And test error 110: AD - converter error 111: Watch dog error
	Suppress	Suppression : 0: 50 Hz 1: 60 Hz
	SwPos	Switch position : 0: unipolar 1: bipolar
	GenError	General error

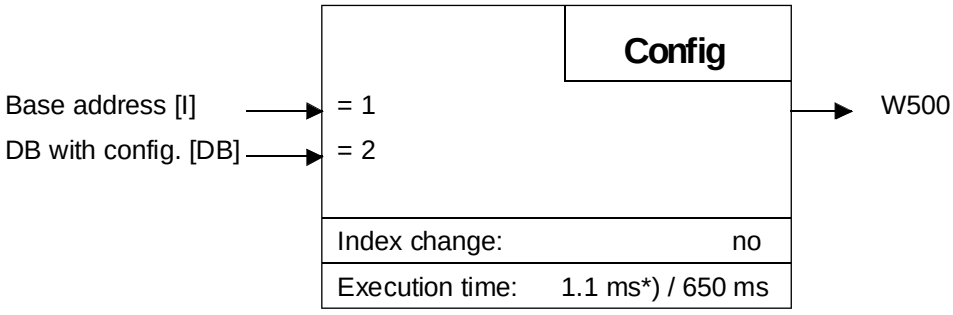
Caution: These symbols are common to all W500 modules!

Example:

```
$group W500
LD      Channel_Nb    ; Register = channel 2
        2
CFB     RdStatus
      I 32            ; Base address of module
        Channel_Nb    ; Reg. containing channel number
        StReg_2       ; Destination reg. for status
STH     VGrA          ; Check if value is grater than
                      ;   comparator value A
$endgroup
```

Note: The 'Timeout' flag is set if the W500 does not react to the command (Busy remains high) within ≈ 15 ms.

Config **Function:** Configurate Config



*) without reconfiguring (i.e. if checksum is the same)

Writes configuration data to the W500. The first parameter is the base address of the module, the second parameter is the data block (DB) containing the configuration data to be written. The configuration data is automatically stored in EEPROM.

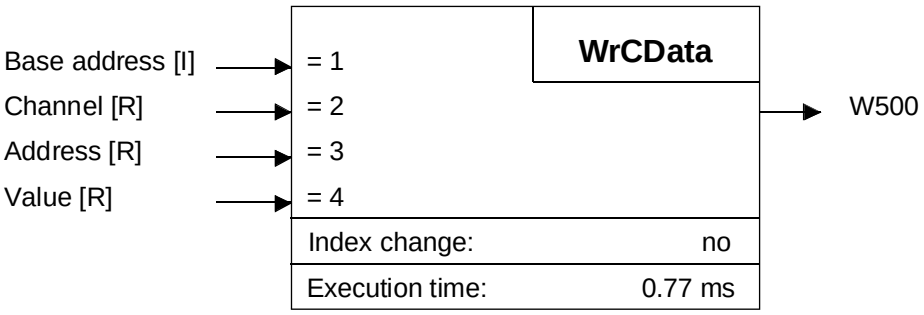
Note regarding the configuration DB:
If the PCD's program memory is writeable RAM, the W500 is always configured the first time a program is run after downloading, and the FB ConfigW5 writes the DB's checksum into the DB. If the PCD's program memory is read-only EPROM or Flash EPROM, the checksum cannot be written to the DB and the W500 is configured on every start-up because the checksum is always zero. To use the same mechanism as applies to writeable RAM memory, the DB must be in extension memory (DB 4000..7999) which is always RAM.

Example see next page.

Example: - Configure channel 0..3 as voltage input, low resolution, proportional, comparator off
- Configure channel 4..7 as current input, high resolution, user scaling, comparator off

```
$group W500

;Configuration  DB-----------------------------------------------------
  DB W5Conf [58]  0               ; reserved for checksum
                  2               ; suppression ( 1 = 60Hz suppression, 2 = 50Hz suppression)
;                 Conf,       KompA,  HyA,    KonpB, HyB,    UsSv,    UsOv,
                  0009H,      0,      0,      0,     0,      0,       0,      ; channel 0
                  0009H,      0,      0,      0,     00,     0,       0,      ; channel 1
                  0009H,      0,      0,      0,     0,      0,       0,      ; channel 2
                  0009H,      0,      0,      0,     0,      0,       0,      ; channel 3
                  003AH,      0,      0,      0,     0,      7000,    -1000,  ; channel 4
                  003AH,      0,      0,      0,     0,      4000,    -2000,  ; channel 5
                  003AH,      0,      0,      0,     0,      6000,    -3000,  ; channel 6
                  003AH,      0,      0,      0,     0,      8000,    -4000,  ; channel 7
  ;               Conf:       Configuration value
  ;               CompA:      Comparator value A
  ;               HyA:        Hysterese value for comparator A
  ;               CompB:      Comparator value B
  ;               HyB:        Hysterese value for Komparator B
  ;               UsSv:       User scaling: Range value
  ;               UsOv:       User scaling: Offset value


                  ; Configuration of W500

                  XOB         16          ; Start-up XOB

                  CFB         Config      ; configurate W500 module
                            I 16
                              W5Conf      ; using data in this DB
                              EXOB
                  $endgroup
```

WrCData **Function:** Write Configuration Data WrCData



Writes a W500 configuration value. The first parameter is the base address of the module, the second parameter holds the channel number. The third parameter holds the destination address in the W500, and the fourth holds the configuration value to be written.

Meaning of addresses:

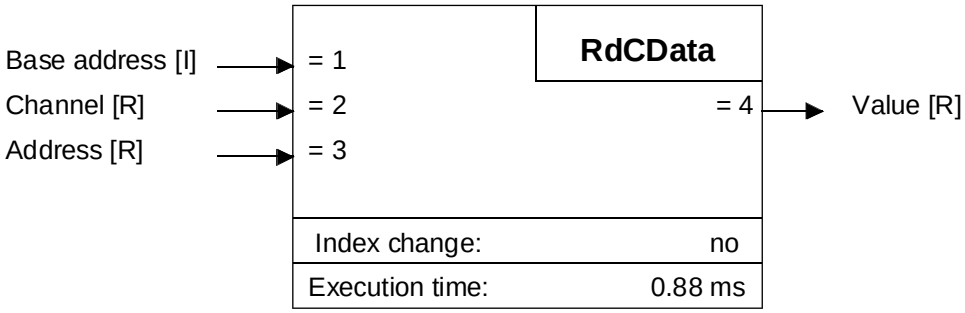
Address	Meaning	
01	Channel specific configuration	15 bit
02	Value comparator A	15 bit
03	Hysteresis comparator A	8 bit
04	Value comparator B	15 bit
05	Hysteresis comparator B	8 bit
06	Current source value	8 bit
07	User range scaling value	15 bit
08	User range offset value	15 bit

Example: To configure channel 3 as Pt 100, 4-wire, -50..150°C, comparator off

```
$group W500
LD      Channel_Nb   ; Register = channel 3
        3
LD      Conf_Val; Config. value reg. = 0ABH
        0ABH
LD      AddressNbr   ; Address to be written to
        01
CFB     WrCData
      I 16           ; Base address of module
        Channel_Nb   ; Reg. containing channel number
        AddressNbr   ; Reg. containing dest. address
        Conf_Val; Reg. cont. val. to be written
$endgroup
```

Note: The 'Timeout' flag is set if the W500 does not react to the command (Busy remains high) within ≈ 15ms.
When the FB 'WrCData' is used, data are only modified in the W500.

RdCData **Function:** Read Configuration Data RdCData



Reads a W500 configuration data value. The first parameter is the base address of the module, the second parameter holds the channel number. The third parameter holds source address, and the fourth is the destination for the configuration value.

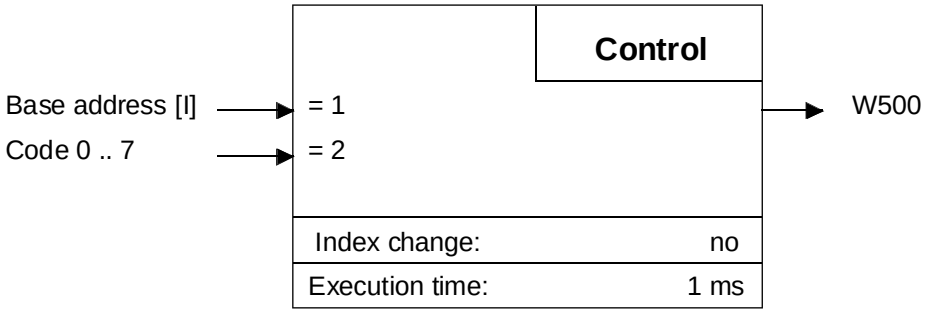
For meaning of addresses see FB 'WrCData'.

Example:

```
$group W500
LD      Channel_Nb   ; Register = channel 3
        3
LD      AddressNbr   ; Address to be read
        01
CFB     RdCData
      I 16           ; Base address of module
        Channel_Nb   ; Reg. containing channel number
        AddressNbr   ; Reg. cont. addr. to be read
        Conf_Val; Reg. for value when read
$endgroup
```

Note: The 'Timeout' flag is set if the W500 does not react to the command (Busy remains high) within ≈ 15 ms.

Control **Function:** Write Control Flag Control



Writes an command to the W500. The first parameter is the base address of the module, the second parameter is the command code.

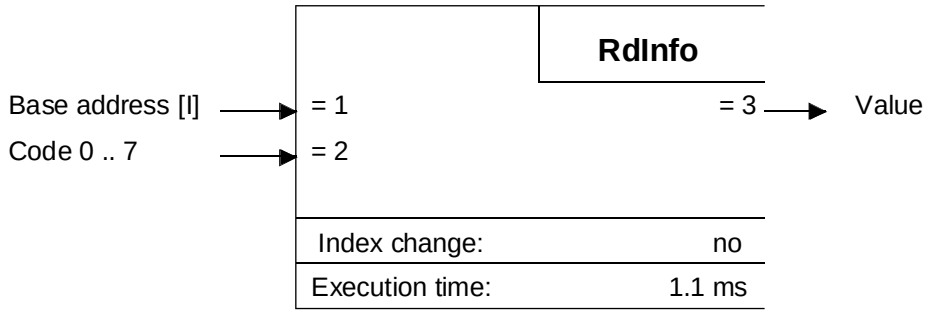
				Busy = H after execute
Code	0	=	60 Hz suppression in high resolution	0.3 ms
	1	=	50 Hz suppression in high resolution	0.3 ms
	2	=	Status of all channels are set to 0	1.6 ms
	3	=	Save configuration to EEPROM	140 ms
	4	=	Initialize the module with the new configuration	18 ms
	5	=	Conversion Control Stop (Can not longer read value)	0.1 ms
	6	=	Conversion Control Run (Can read value again)	0.6 ms
	7	=	Restart warm (Initialization with the configuration stored in EEPROM)	1000 ms
	8	=	Restart cold (Initialization with FW default, single-shot mode)	1000 ms
	9	=	Execute BIST *) (W500 self-test)	830 ms

*) BIST = Building Integrated Self Test

```
$group W500
CFB     Control
      I 16          ; Base address of module
        7           ; Restart warm
$endgroup
```

Note: The 'Timeout' flag is set if the W500 does not react to the command (Busy remains high) within ≈ 15 ms.

RdInfo **Function:** Read Information RdInfo



Reads specific information from the W500. The first parameter is the base address of the module, the second parameter is a 4-bit information code. The value is returned in the register defined by the third parameter.

Code:	0	=	EEPROM Checksum of configuration
	1	=	Modul Identification (W500)
	2	=	Hardware version
	3	=	Modification number
	4	=	Firmware version
	5	=	Firmware checksum
	6	=	Fabrication year
	7	=	Fabrication week

```
$group W500
CFB     RdInfo
      I 16            ; Base address of module
        0             ; EEPROM Checksum
        Reg_Chksum    ; Destination register
$endgroup
```

Note: The 'Timeout' flag is set if the W500 does not react to the command (Busy remains high) within ≈ 15 ms.

1.3.5 User program / Examples

Fundamentals

Example of the order of the files and the procedure during the preparation of an user program. The project to be created should have project name "TEST-W5" and the actual user program module should be entitled "example1.src". The files are arranged like this:

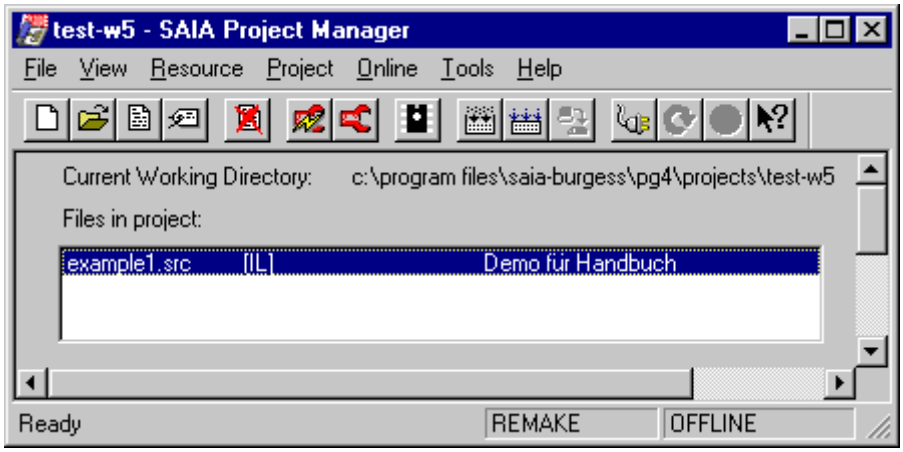
C:\PG4	\FB	\D4W500_b.equ	(depending of
		\D4W500_b.src	installation)
		\...	
	\FBOX	\...	
	\GALEP3	\...	
	\PROJECTS	\FUP_E	(Demo example PG4)
		\GRAF_E	(Demo example PG4)
		\TEST-W5 \example1.src	

The user program for the W500 part is structured as follows:

```
$include C:\PG4\FB\D4W500_b.equ
$group w500

XOB     16


PCD-Code


ecob
$endgroup
```

If the program is written in GRAFTEC, the assembler directives '$include' and '$group' are placed in the first step (ST), normally the initial step (IST). '$endgroup' comes at the end of the last transition (TR).

If everything has been correctly installed, the user program edited and all parameters defined, the program can be processed and downloaded to the PCD with the 'Project' - 'Make' command



Programming examples:

Programming example1 with voltage input module

Program name: example1.src

Range module: 2 x PCD7.W100; Jumper at unipolar

Input 0, 1: voltage, bitformat, low resolution, comparator off,
code as table: 0001H
Input 2, 3: voltage, proportional, low resolution, comparator off,
code as table: 0009H
Input 4, 5: voltage, bitformat, high resolution, comparator off,
code as table: 0021H
Input 6, 7: voltage, proportional, high resolution, comparator off,
code as table: 0029H

Read procedure:
Cyclic: at each COB 0, one analogue value.

User program:

```
$Include C:\PG4\Fb\D4W500_B.EQU
;-------------------------------------------------------------------------
; Resource definitions for PCD4.W500
;-------------------------------------------------------------------------
$group W500

BAW500_0        EQU I 0         ; Base Address of W500

rChannel_0      EQU R 0         ; Channel number counter
rValue_0        EQU R 1         ; Analog value
;Database Value Registers  of Input channels W500
rValueCh0       EQU R 2         ; Analog value Channel 0
rValueCh1       EQU R 3         ; Analog value Channel 1
rValueCh2       EQU R 4         ; Analog value Channel 2
rValueCh3       EQU R 5         ; Analog value Channel 3
rValueCh4       EQU R 6         ; Analog value Channel 4
rValueCh5       EQU R 7         ; Analog value Channel 5
rValueCh6       EQU R 8         ; Analog value Channel 6
rValueCh7       EQU R 9         ; Analog value Channel 7

;DBs
W5Conf_0        EQU DB 0        ; DB for Configurate W500

;Configuration  DB-----------------------------------------------------
;Remark: The Configuration DB is normally a RAM DB, because the checksum
;       will be stored as first parameter in it. This is to guarantee, that after the
;       download of the user program, the configuration will be done at the first
;       startup (because of the 0 ), but then only if the checksum is not equal. If
;       the DB is in a EPROM/Flash memory, the configuration will be executed at
;       every startup or it must be stored in the extension memory (DB 4000-7999).
```

```
;
;           Conf, KompA    HyA     KonpB, HyB,     UrSv,    UrOv,
DB W5Conf_0 [58]  0, ; reserved for checksum
             2, ; suppression   ( 1=60Hz suppression, 2=50Hz suppression)
           0001H, 0,       0,       0,       0,       0,       0,       ; channel 0
           0001H, 0,       0,       0,       0,       0,       0,       ; channel 1
           0021H, 0,       0,       0,       0,       0,       0,       ; channel 2
           0021H, 0,       0,       0,       0,       0,       0,       ; channel 3
           0009H, 0,       0,       0,       0,       0,       0,       ; channel 4
           0009H, 0,       0,       0,       0,       0,       0,       ; channel 5
           0029H, 0,       0,       0,       0,       0,       0,       ; channel 6
           0029H, 0,       0,       0,       0,       0,       0        ; channel 7

$endgroup
;-------------------------------------------------------------------------
           XOB     16
$group W500
           CFB     Config          ; Configurate W500 card
                   BAW500_0
                   W5Conf_0
           LD      rChannel_0      ; Init channel number counter
                   7
$endgroup
           EXOB
;-------------------------------------------------------------------------
;
           COB     0
                   0


$group W500
;       Read each cycle one channel of W500
           SEI     rChannel_0
           CFB     RdValUp         ; Read the analog value unipolar
                   BAW500_0        ; Base address of W500
                   rChannel_0      ; channel number (R)
                   rValue_0        ; analog value (R)
           PUTX    rValue_0        ; put value to Data Base indexed
                   rValueCh0
  DEC      rChannel_0      ; decrement channel number
           JR      P Cont          ; If Channel 0 is done set to 7
           LD      rChannel_0
                   7
Cont:
$endgroup

                    ECOB
```

Programming example 2 with Pt100/1000 temperature sensors

Program name: example2.src

Range module: PCD7.W101 + PCD7.W120; Jumper at unipolar

Input 0, 1: Temp. element Pt 100 0..600°C, comparator on, code as table: 20EBH
Input 2, 3: Temp. element Pt 1000 -50..150°C, comparator on, code as table: 08EBH
Input 4-7: used as current source outputs (must be configure with code 0)

Comparator values:

- I 0: comp A = 100°C, B = 500°C hysteresis every 10°C
- I 1: comp A = 200°C, B = 300°C hysteresis every 10°C
- I 2: comp A = 18°C, B = 22°C hysteresis every 1°C
- I 3: comp A = 0°C, B = 25°C hysteresis every 2°C

Read procedure:

Cyclic: at each COB 0, one analogue value and status per channel.

User program:

```
$Include C:\PG4\Fb\D4W500_B.EQU
;-------------------------------------------------------------------------
; Resource definitions for PCD4.W500
;-------------------------------------------------------------------------
$group W500

BAW500_0        EQU I 0         ; Base Address of W500

rChannel_0      EQU R 0         ; Channel number counter
rValue_0        EQU R 1         ; Analog value
rStatus_0       EQU R 2         ; Status register
;Database Value Registers  of Input channels W500
rValueCh0       EQU R 3         ; Analog value Channel 0
rValueCh1       EQU R 4         ; Analog value Channel 1
rValueCh2       EQU R 5         ; Analog value Channel 2
rValueCh3       EQU R 6         ; Analog value Channel 3
rValueCh4       EQU R 7         ; Analog value Channel 4
rValueCh5       EQU R 8         ; Analog value Channel 5
rValueCh6       EQU R 9         ; Analog value Channel 6
rValueCh7       EQU R 10        ; Analog value Channel 7
;Database Status Registers of Input channels W500
rStatusCh0      EQU R 11        ; Status register Channel 0
rStatusCh1      EQU R 12        ; Status register Channel 1
rStatusCh2      EQU R 13        ; Status register Channel 2
rStatusCh3      EQU R 14        ; Status register Channel 3
rStatusCh4      EQU R 15        ; Status register Channel 4
rStatusCh5      EQU R 16        ; Status register Channel 5
rStatusCh6      EQU R 17        ; Status register Channel 6
rStatusCh7      EQU R 18        ; Status register Channel 7
;DBs
W5Conf_0        EQU DB 0        ; DB for Configurate W500
```

```
;Configuration  DB----------------------------------------------------------
;Remark: The Configuration DB is normally a RAM DB, because the checksum
;       will be stored as first parameter in it. This is to guarantee, that after the
;       download of the user program, the configuration will be done at the first
;       startup (because of the 0 ), but then only if the checksum is not equal. If
;       the DB is in a EPROM/Flash memory, the configuration will be executed at
;       every startup or it must be stored in the extension memory (DB 4000-7999).
;
;           Conf,   KompA HyA     KonpB, HyB,    UrSv,   UrOv,
DB W5Conf_0 [58]  0, ; reserved for checksum
            2, ; suppression   ( 1=60Hz suppression, 2=50Hz suppression)
            20EBH, 1000,   100,    5000,   1000,   0,      0,      ; channel 0
            20EBH, 2000,   100,    3000,   100,    0,      0,      ; channel 1
            08EBH, 180,    10,     220,    10,     0,      0,      ; channel 2
            08EBH, 0,      20,     250,    20,     0,      0,      ; channel 3
            0000H, 0,      0,      0,      0,      0,      0,      ; channel 4
            0000H, 0,      0,      0,      0,      0,      0,      ; channel 5
            0000H, 0,      0,      0,      0,      0,      0,      ; channel 6
            0000H, 0,      0,      0,      0,      0,      0       ; channel 7
$endgroup
;---------------------------------------------------------------------------
            XOB    16
$group W500
            CFB    Config          ; Configurate W500 card
                   BAW500_0
                   W5Conf_0
            LD     rChannel_0      ; Init channel number counter
                   3
$endgroup
            EXOB
;---------------------------------------------------------------------------
;
            COB    0
                   0

$group W500
;       Read each cycle one channel of W500
            SEI    rChannel_0
            CFB    RdValBp         ; Read the analog value bipolar
                   BAW500_0        ; Base address of W500
                   rChannel_0      ; channel number (R)
                   rValue_0        ; analog value (R)
            PUTX   rValue_0        ; put value to Data Base indexed
                   rValueCh0
            CFB    RdStatus        ; Read status
                   BAW500_0        ; Base address of W500
                   rChannel_0      ; channel number (R)
                   rStatus_0       ; status Register (R)
            PUTX   rStatus_0       ; put Status to Data Base indexed
                   rStatusCh0
            DEC    rChannel_0      ; decrement channel number
            JR     P Cont          ; If Channel 0 is done set to 7
            LD     rChannel_0
                   3
Cont:
$endgroup

                    ECOB
```

Programming example 3 with 2-wire measuring transducer

Program name: example3.src

Range module: PCD7.W104, Jumper at unipolar

Input 0..7: 2-wire measuring transducer,user scaling, high resolution, comparator on
code as table: 00FAH

The measuring transducer for thermometer type K has a temperature range of -100 .. +800°C (proportional to 4 .. 20mA).

User scaling of -1000 to 8000 is selected (offset = -1000, range = 9000).

Comparator values:

- I 0, 1: comp A = 100°C, B = 500°C hysteresis every 10°C
- I 2, 3: comp A = 200°C, B = 300°C hysteresis every 10°C
- I 4, 5: comp A = 500°C, B = 550°C hysteresis every 10°C
- I 6, 7: comp A = 0°C, B = 100°C hysteresis every 5°C

Read procedure: Cyclic: at each COB 0, one analogue value per channel and the status of all channels (comparator)

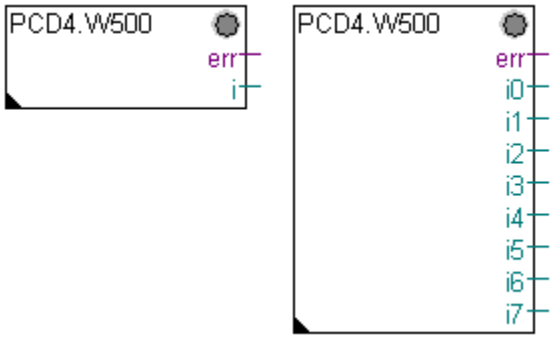
User program:

```
$Include C:\PG4\Fb\D4W500_B.EQU
;-------------------------------------------------------------------------
; Resource definitions for PCD4.W500
;-------------------------------------------------------------------------
$group W500

BAW500_0        EQU I 0         ; Base Address of W500

rChannel_0      EQU R 0         ; Channel number counter
rChannel2_0     EQU R 1         ; Channel number counter
rValue_0        EQU R 2         ; Analog value
rStatus_0       EQU R 3         ; Status register
;Database Value Registers  of Input channels W500
rValueCh0       EQU R 4         ; Analog value Channel 0
rValueCh1       EQU R 5         ; Analog value Channel 1
rValueCh2       EQU R 6         ; Analog value Channel 2
rValueCh3       EQU R 7         ; Analog value Channel 3
rValueCh4       EQU R 8         ; Analog value Channel 4
rValueCh5       EQU R 9         ; Analog value Channel 5
rValueCh6       EQU R 10        ; Analog value Channel 6
rValueCh7       EQU R 11        ; Analog value Channel 7
;Database Status Registers of Input channels W500
rStatusCh0      EQU R 12        ; Status register Channel 0
rStatusCh1      EQU R 13        ; Status register Channel 1
rStatusCh2      EQU R 14        ; Status register Channel 2
rStatusCh3      EQU R 15        ; Status register Channel 3
rStatusCh4      EQU R 16        ; Status register Channel 4
rStatusCh5      EQU R 17        ; Status register Channel 5
rStatusCh6      EQU R 18        ; Status register Channel 6
rStatusCh7      EQU R 19        ; Status register Channel 7

;DBs
W5Conf_0        EQU DB 0        ; DB for Configurate W500

;Configuration  DB-------------------------------------------------------
;Remark: The Configuration DB is normally a RAM DB, because the checksum
;       will be stored as first parameter in it. This is to guarantee, that after the
;       download of the user program, the configuration will be done at the first
;       startup (because of the 0 ), but then only if the checksum is not equal. If
;       the DB is in a EPROM/Flash memory, the configuration will be executed at
;       every startup or it must be stored in the extension memory (DB 4000-7999).
;
;           Conf,   KompA HyA     KonpB, HyB,    UrSv,   UrOv,
DB W5Conf_0 [58]  0, ; reserved for checksum
             2, ; suppression   ( 1=60Hz suppression, 2=50Hz suppression)
           00FAH, 1000,   100,    5000,   100,    9000,   -1000,  ; channel0
           00FAH, 1000,   100,    5000,   100,    9000,   -1000,  ; channel 1
           00FAH, 2000,   100,    3000,   100,    9000,   -1000,  ; channel 2
           00FAH, 2000,   100,    3000,   100,    9000,   -1000,  ; channel 3
           00FAH, 5000,   100,    5500,   100,    9000,   -1000,  ; channel 4
           00FAH, 5000,   100,    5500,   100,    9000,   -1000,  ; channel 5
           00FAH, 0,      50,     1000,   50,     9000,   -1000,  ; channel 6
           00FAH, 0,      50,     1000,   50,     9000,   -1000   ; channel 7
$endgroup
;-------------------------------------------------------------------------
```

```
        XOB   16
$group W500
        CFB   Config          ; Configurate W500 card
              BAW500_0
              W5Conf_0
        LD    rChannel_0      ; Init channel number counter
              7
$endgroup
        EXOB
;-------------------------------------------------------------------------
;
        COB   0
              0


$group W500
;     Read each cycle one channel of W500
        SEI   rChannel_0
        CFB   RdValBp         ; Read the analog value bipolar
              BAW500_0        ; Base address of W500
              rChannel_0      ; channel number (R)
              rValue_0        ; analog value (R)
        PUTX  rValue_0        ; put value to Data Base indexed
              rValueCh0
  DEC   rChannel_0      ; decrement channel number
        JR    P Cont          ; If Channel 0 is done set to 7
        LD    rChannel_0
              7
Cont:
         LD   rChannel2_0     ; Start at channel 7
              7
LOOP:   CFB   RdStatus        ; Read status
              BAW500_0        ; Base address of W500
              rChannel2_0     ; channel number (R)
              rStatus_0       ; status Register (R)
        PUTX  rStatus_0       ; put Status to Data Base indexed
              rStatusCh0
        DEC   rChannel2_0     ; Decrement channel number
        JR    P LOOP          ; Loop until all channels are read
$endgroup

                ECOB
```

1.4 Extended mode with FBoxes in FUPLA

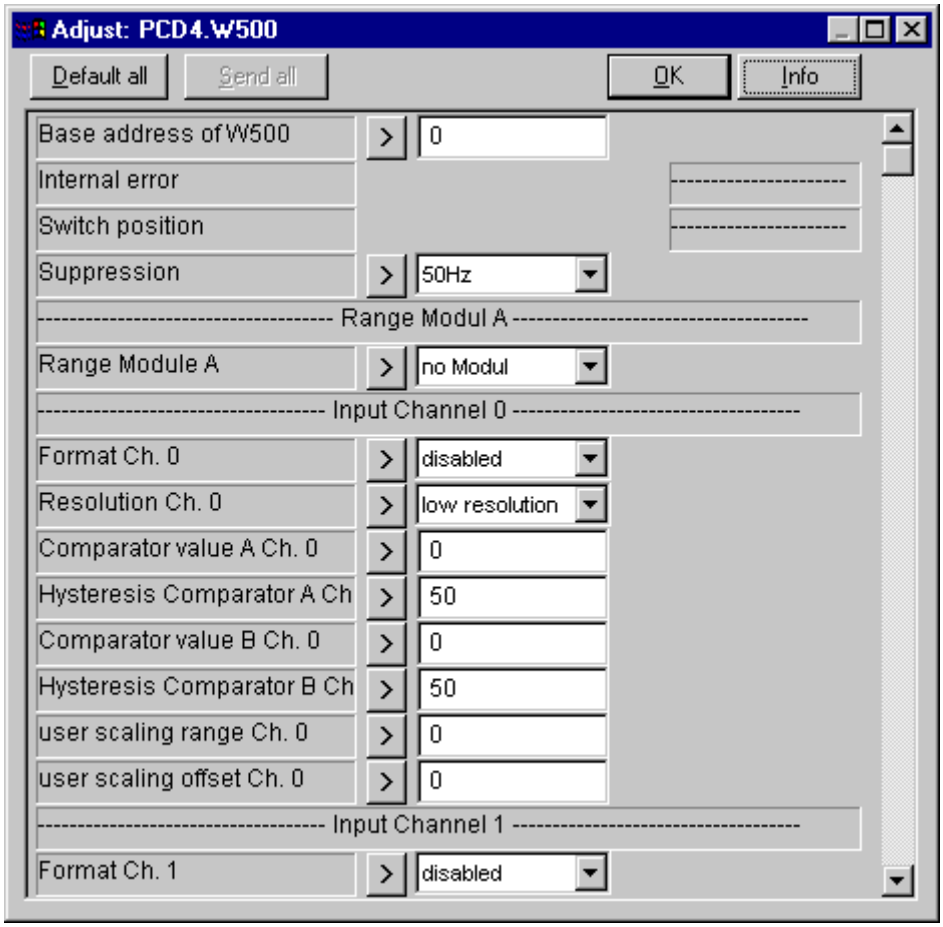
1.4.1 The FBox 'PCD4.W500'



This FBox configurates and reads the values of the PCD4.W500 modules for voltage, current or 2-wire temperature measurement.

Each channel has an output value from type integer. The values of the not used channels are 0.

The adjust window



Base address of W500:
The base address defines the location of the module in the PCD. The number must be the start address of the module (0, 16, 32, …).
Important: do not use the base addresses 240 and 496 (conflict with watch dog).

Internal error:
The internal error shows if there is an error on the controller system of the W500 module.
If an internal error is occurred the LED change to red and the "err" output goes to high.

Switch position:
Shows the switch position of the unipolar/bipolar switch.

Suppression:
You can set 50 or 60 Hz suppression (standard 50 Hz). The suppression is only active in high resolution.

Range Module A and B:
In this adjustment the equipped range module is to be selected.
Important: if there is no module equipped, select "no module".

List of Range Modules:

PCD7.W100	4 channels, voltage range 10 V, input resistance 200 kΩ / 0.2%
PCD7.W101	4 channels, voltage range 1 V, input resistance >10 MΩ
PCD7.W103	4 channels, current range 20 mA (4..20 mA), input resistance 49.9 Ω / 0.1%
PCD7.W104	4 channels, current range 20 mA (4..20 mA) for two-wire converter, input resistance 49.9 Ω / 0.1%
PCD7.W110	4 channels, temperature resistance Pt 1000, temperature range -50..150°C
PCD7.W111	4 channels, temperature resistance Ni 1000, temperature range -50..150°C

Format channel 0..7
Three different formats for each channel can be selected:

- Bit format: digital representation 0..4095 low resolution / 0..32767 high resolution

- Proportional format: proportional to the input:

- Voltage 10 V:	0..10000 or -10000..10000 (bipolar)
- Voltage 1 V:	0..10000 or -10000..10000 (bipolar)
- Current 20 mA:	0/4000..20000 (only unipolar possible)
- Temperature	-50..150°C: -500..1500

- user scaling: a user definable scaling

    - The offset and the range of the scale can be specified

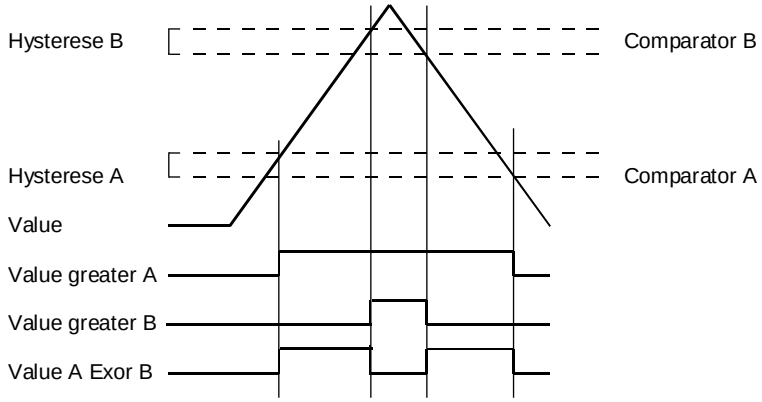
Important: if the input channel is not used, select disabled to disable the conversion.

Comparator value A and B for channels 0..7.
Two comparators for each channel can be defined. The comparator values refer to the output format of the channel.
The comparator values must be within of the corresponding format:

(min. format < comparator value - hysteresis / 2)
(max. format > comparator value + hysteresis / 2)

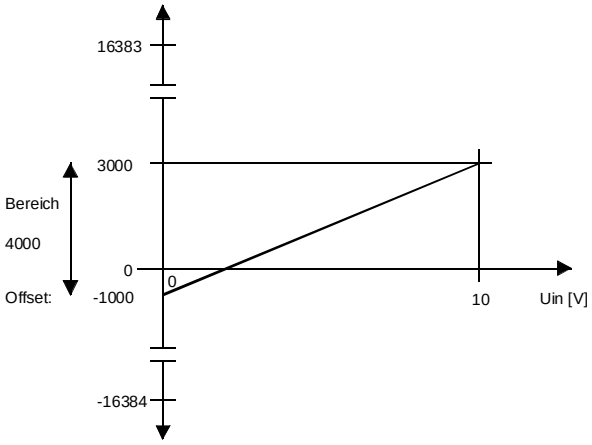
Remarks: If both comparator values are 0 then the comparator is disabled

Hysteresis comparator A and B for channels 0..7.
For each channel a hysteresis can be defined. Possible values 0..255.



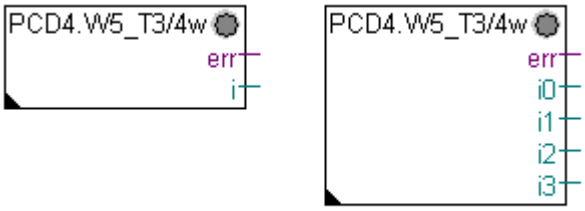
User scaling range & offset for channels 0..7
The offset and range for the user scale can be declared.
To use the user scaling, select the user scaling format.
There are signed or non signed ranges possible:
- Offset < 0 => scale is signed -16384 … 16383
- Offset > 0 => scale is non signed 0 … 32767

ex. signed user scaling



Remarks: All adjustments are mode 'offline'. The program must be re-compiled after changing a parameter.

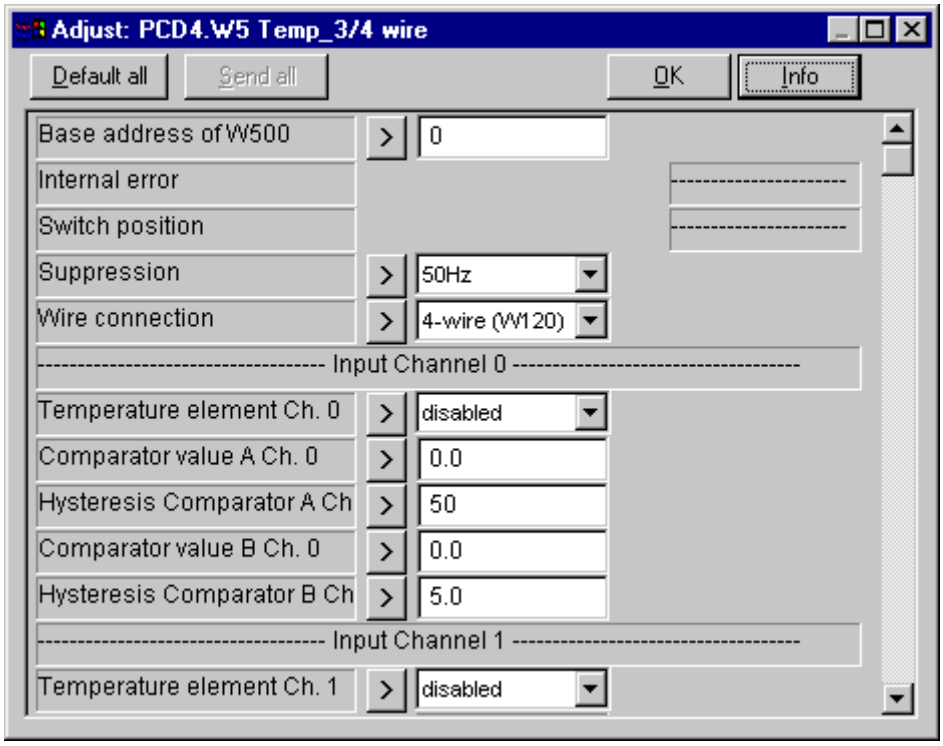
1.4.2 The FBox 'PCD4.W5 Temp_3/4 wire'



This FBox configurates and reads the values if the PCD4.W500 are used as 3 or 4 - wire temperature measurement module.

Each channel has an output value from type integer. The values of the not used channels are 0.

The adjust window



Base address of W500:
The base address defines the location of the module in the PCD. The number must be the start address of the card (0, 16, 32, …).
Important: Do not use the base addresses 240 and 496 (conflict with watch dog).

Internal error:
The internal error shows if there is an error on the controller system of the W500 module. If an internal error is occurred the LED change to red and the "err" output goes to high.

Switch position:
Shows the switch position of the unipolar/bipolar switch.

Suppression:
50 or 60 Hz suppression can be set (standard 50 Hz).

Wire connection:
3 or the 4 wire connection can be choosen.
(3 wire connection is in preparation).

List of Range Modules
connector B:

PCD7.W120	4 channels, for Pt/Ni 100 or Pt/Ni 1000 temperature resistance, 4 constant current outputs for 4 wire connection
PCD7.W121	4 channels, for Pt/Ni 100 or Pt/Ni 1000 temperature resistance, 4 constant current outputs and 4 voltage inputs for 3 wire connection (in preparation)

connector A:

PCD7.W101	4 channels, voltage range 1 V, for Pt/Ni 100 or Pt/Ni 1000 temperature resistance, input resistance >10 MΩ

Temperature element channel 0..7
The following thermometers can be used:

- Pt 1000 temperature range -50..150°C
- Pt 1000 temperature range 0..600°C
- Ni 1000 temperature range -50..150°C
- Pt 100 temperature range -50..150°C
- Pt 100 temperature range 0..600°C
- Ni 100 temperature range -50..150°C

The digital representation is always -500..1500 /0..6000 and the resolution 0.1°C.

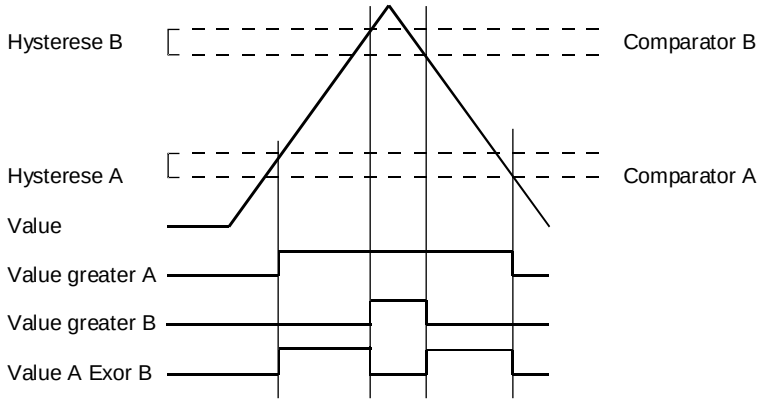
Important: if the output channel is not used, 'disabled' is to select for the conversion.

Comparator value A and B channel 0..3.

Two comparators can be defined for each channel. The comparator values refer to the output format of the channel (1°C => 1.0).

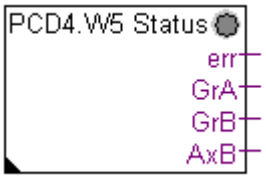
Remarks: If both comparator values are 0 then the comparator is disabled.

Hysteresis comparator A and B channel 0..7
For each channel you can define a hysteresis.



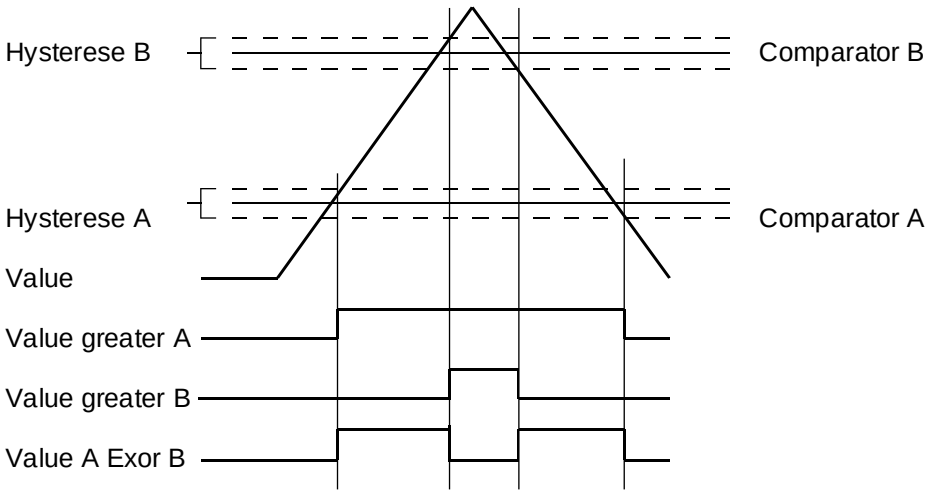
Remarks: All adjusts are mode offline. The program must be recompiled after changing a parameter.

1.4.3 The FBox 'PCD4.W5 Channel Status'

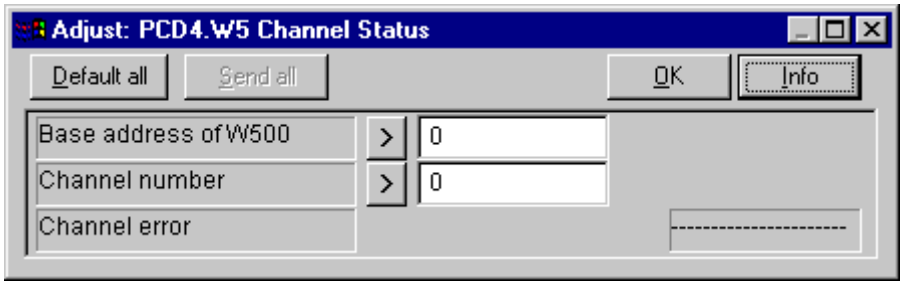


This FBox reads the channel status and the comparator values of the PCD4.W500.

Outputs:
There are 4 output Flags on this FBox:
- err: Error
- GrA: value is greater than comparator A
- GrB: value is greater than comparator B
- AxB: value is between comparator A and B (Exor)



The adjust window



Base address of W500:
The base address defines the location of the module in the PCD. The number must be the start address of the card (0, 16, 32, …).
Important: do not use the base addresses 240 and 496 (conflict with watch dog).

Channel number:
It defines the channel of the W500. Accepted values are 0..7.

Channel error:
The channel error shows if there is an error on the selected channel.
If a channel error is occurred the LED change to red and the "err" output goes to high.

Notes:

Appendix: Resistance values for Pt100/Pt1000 / Ni100/Ni1000

T [°C]	RT Pt100	RT Pt1000	RT Ni 100	RT Ni 1000
-50	80.31	803.07	74.26	742.55
-40	84.27	842.71	79.13	791.31
-30	88.22	882.22	84.15	841.46
-20	92.16	921.60	89.30	892.96
-10	96.09	960.86	94.58	945.82
0	100.00	1000.00	100.00	1000.00
10	103.90	1039.02	105.55	1055.52
20	107.79	1077.93	111.24	1112.36
30	111.67	1116.72	117.06	1170.56
40	115.54	1155.39	123.01	1230.11
50	119.40	1193.95	129.11	1291.05
60	123.24	1232.39	135.34	1353.40
70	127.07	1270.72	141.72	1417.21
80	130.89	1308.93	148.25	1482.50
90	134.70	1347.02	154.93	1549.34
100	138.50	1385.00	161.78	1617.79
110	142.29	1422.86	168.79	1687.89
120	146.06	1460.61	175.97	1759.72
130	149.82	1498.24	183.33	1833.35
140	153.58	1535.75	190.89	1908.87
150	157.31	1573.15	198.63	1986.35
160	161.04	1610.43	206.59	2065.89
170	164.76	1647.60	214.76	2147.58
180	168.46	1684.65	223.15	2231.53
190	172.16	1721.58	231.78	2317.83
200	175.84	1758.40	240.66	2406.60
210	179.51	1795.10	249.80	2497.95
220	183.17	1831.68	259.20	2592.00
230	186.82	1868.15	268.89	2688.87
240	190.45	1904.51	278.87	2788.68
250	194.07	1940.74	289.16	2891.56
260	197.69	1976.86		
270	201.29	2012.87		
280	204.88	2048.76		
290	208.45	2084.53		

T [°C]	RT Pt100	RT Pt1000
300	212.02	2120.19
310	215.57	2155.73
320	219.12	2191.15
330	222.65	2226.46
340	226.17	2261.66
350	229.67	2296.73
360	233.17	2331.69
370	236.65	2366.54
380	240.13	2401.27
390	243.59	2435.88
400	247.04	2470.38
410	250.48	2504.76
420	253.90	2539.02
430	257.32	2573.17
440	260.72	2607.20
450	264.11	2641.12
460	267.49	2674.92
470	270.86	2708.60
480	274.22	2742.17
490	277.56	2775.62
500	280.90	2808.96
510	284.22	2842.18
520	287.53	2875.28
530	290.83	2908.27
540	294.11	2941.14
550	297.39	2973.90
560	300.65	3006.54
570	303.91	3039.06
580	307.15	3071.47
590	310.38	3103.76
600	313.59	3135.94

Formulas:

Pt 100 (-50..0°C) :	100*(1+3.90802E-3*T-0.5802E-6*T^2-0.42735E-11*(T-100)*T^3)
Pt 100 (0..600°C) :	100*(1+3.90802E-3*T-0.5802E-6*T^2)
Pt 1000 (-50..0°C):	1000*(1+3.90802E-3*T-0.5802E-6*T^2-0.42735E-11*(T-1000)*T^3)
Pt 1000 (0..600°C) :	1000*(1+3.90802E-3*T-0.5802E-6*T^2)
Ni 100 (-50..250°C) :	100*(1+0.5485E-2*T+0.665E-5*T^2+2.805E-11*T^4-2E-17*T^6)
Ni 1000 (-50..250°C) :	1000*(1+0.5485E-2*T+0.665E-5*T^2+2.805E-11*T^4-2E-17*T^6)

Notes

2. PCD4.W600 Galvanically isolated analogue output module, 12-bit resolution

Intelligent analogue output module with galvanic isolation, 12-bit resolution and 8 outputs for voltages 0..10 V and ±10 V or currents 0..20 mA and 4..20 mA.

A microcontroller enables intelligent functions to be executed locally without burdening the PCD's CPU:

- single output or synchronous updating
- conversion of digital value to a range-proportional format
- user definable scaling for range and offset
- identification of the module in user program and identification of range modules

2.1 Hardware and technical data

2.1.1 Module overview

Base module:

PCD4.W600 containing the galvanically isolated DC/DC converter to supply the plug-in range modules, the microcontroller with its peripheral components, and the I/O bus interface.

Range modules:

These contain the optocoupler for galvanic isolation from the PCD processor, the D/A converter and the output stages.

PCD7.W300 2 channels, range 0..10 V

PCD7.W302 2 channels, range ±10 V

PCD7.W304 2 channels, range 0..20 mA

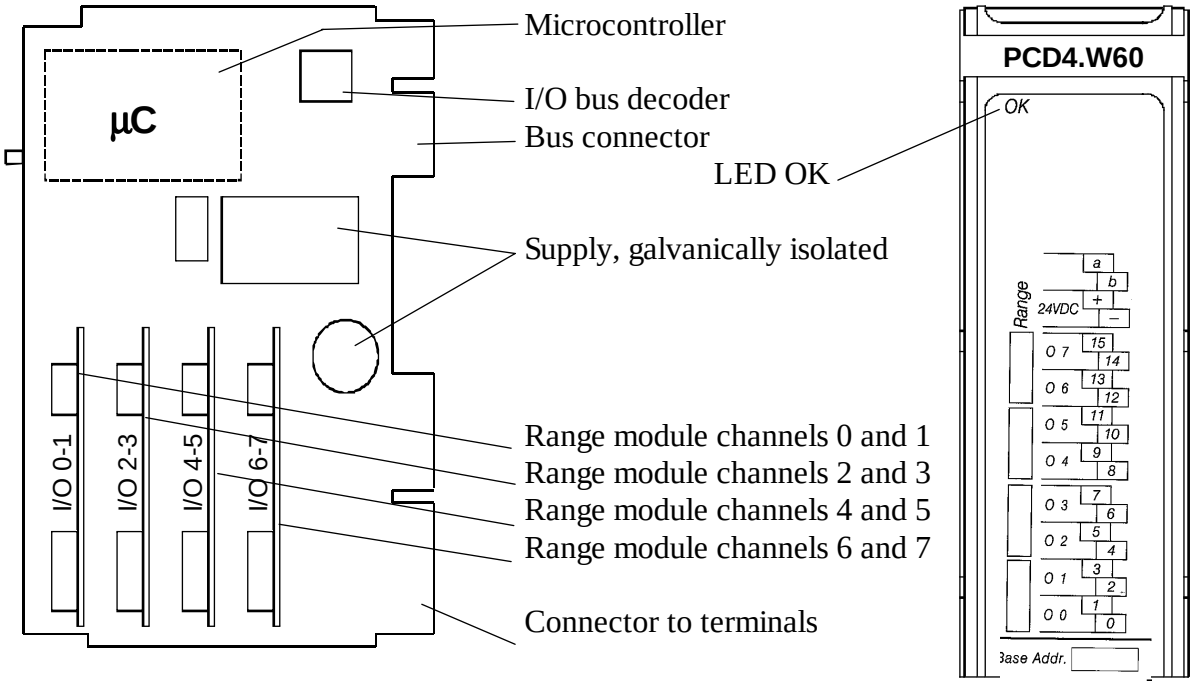
PCD7.W305 2 channels, range 4..20 mA

2.1.2 **Technical data** (base module)

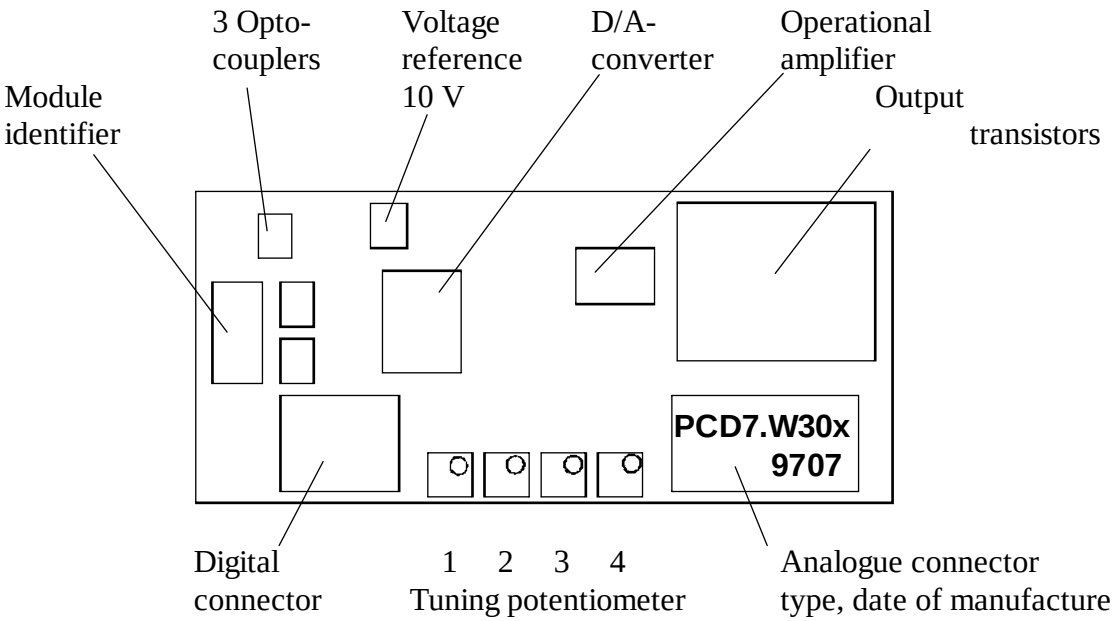
Total outputs per module	8 voltage or current outputs (in 4 groups), short-circuit proof
Potential isolation	Yes, between PCD-GND and module GND 500 VDC, 1 min
Signal ranges	See range modules
Digital display (resolution)	12 bit (0 .. 4095)
Conversion time	0.1 ms for voltage (with resistive load) 0.8 ms for voltage (with capacitive load) 0.3 ms for current
Load impedance	Voltage: ≥ 3 kΩ Current: 0 .. 500 Ω capacitive load < 1 µF inductive load < 1 mH
Accuracy regarding range end value	Voltage: ± 0.15% ± 5 mV Current: ± 0.2% ± 20 µA 4 mA: ± 20 µA
Temperature error	± 0.02% /°C
Linearity error	Voltage: ± 0.05% Current: ± 0.1%
Repeating accuracy	± 0.05%
Residual ripple	Voltage: ± 0,05% Current: ± 0.1%
Current consumption	Internal from PCD4-Bus +5 V: 200 mA External +24 V *): 100 mA +20 mA per current output

*) Requirement as PCD4.N2..

2.1.3 Layout of the main module



Layout of a range module



1: Amp. channel A
2: Offset channel A
3: Amp. channel B
4: Offset channel B

These potentiometers are factory set and should not be adjusted by the user.

2.1.4 Insertion of range modules

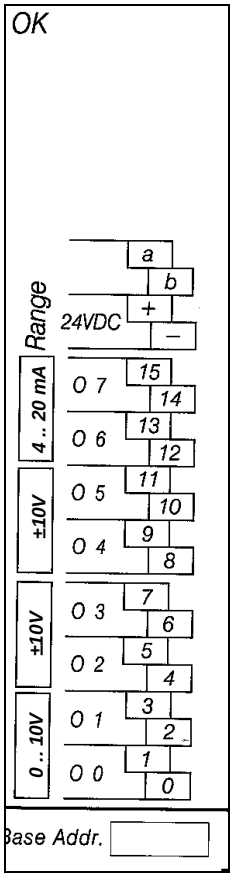
To plug on a range module, the printed circuit board must be removed from the module's housing. This is done by pressing in the snap-latches either side of the front cover. The screw fastening for the card, located on the left side of the module at the top, should then be unscrewed, allowing the printed circuit board to be pulled out of the housing.

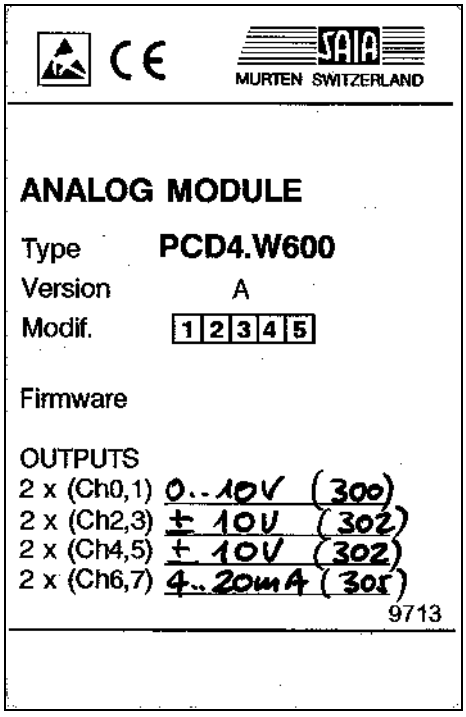
Four range modules, each with 2 channels, can be attached. When fitting them, ensure that the top and bottom of each module latches in.

After inserting the range modules, the housing should be closed again and the screw fastening for the card replaced.

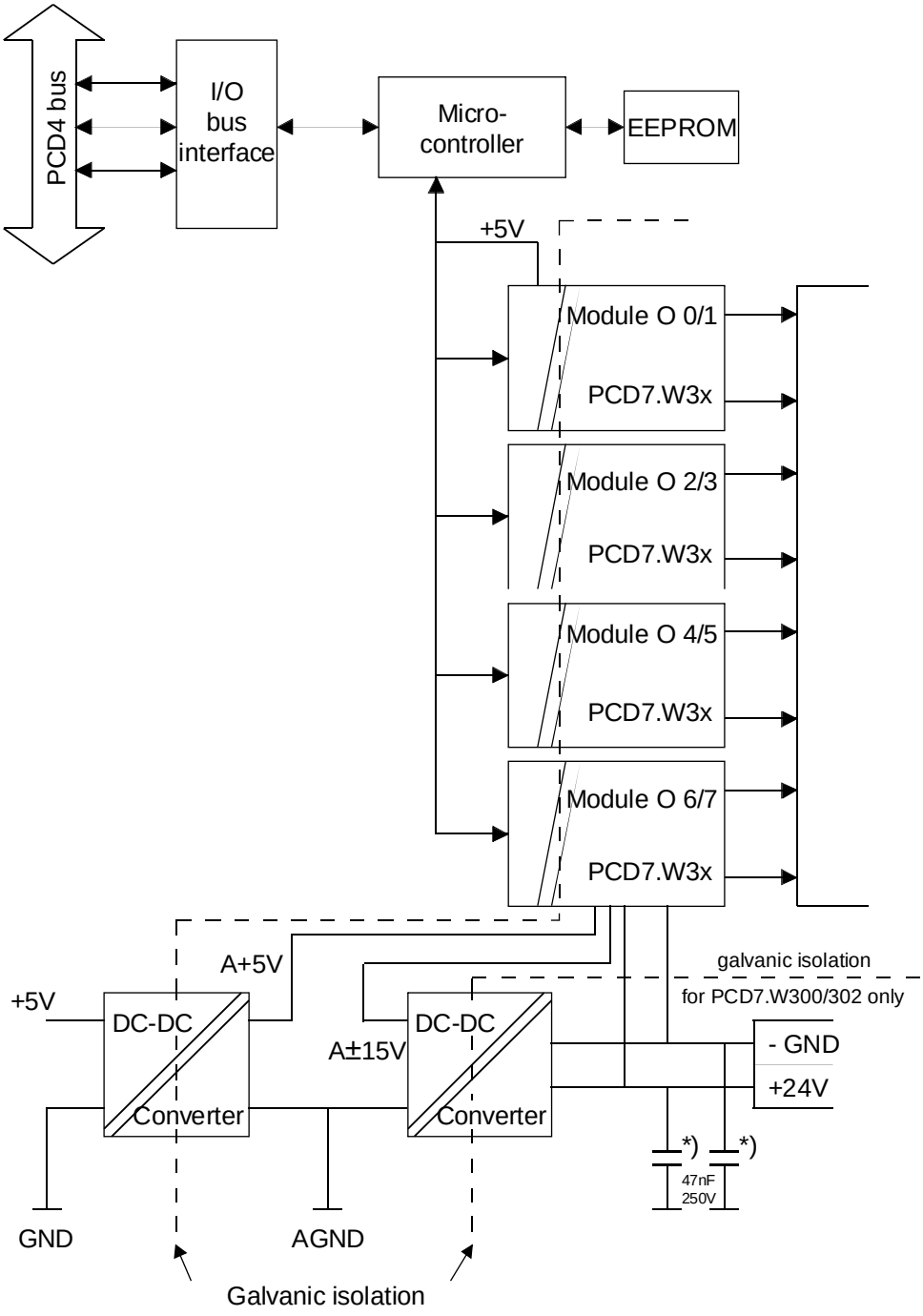
Caution: The basic card and range modules all contain components which are sensitive to electrostatic discharges.

Various types of range modules can be inserted in the 4 spaces. Remember to enter details of which range modules are fitted on the front and side panel plates, so that the equipment can be identified. (The range modules can also be identified via the software.)





2.1.5 Block diagram



*) To carry out an isolation test (500 VDC) on the installation, the screening components on the PCD4.C2.. must be removed.

2.1.6 Meaning of the 16 addresses

I/O address:	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15

Write (outputs)

Channel address	C0	C1	C2	C3	C4	C5	C6	C7	Conv	Status	Write	O0	O1	O2	O3	Data '0'
Data address	D0	D1	D2	D3	D4	D5	D6	D7	D8	D9	D10	D11	D12	D13	D14	Data '1'

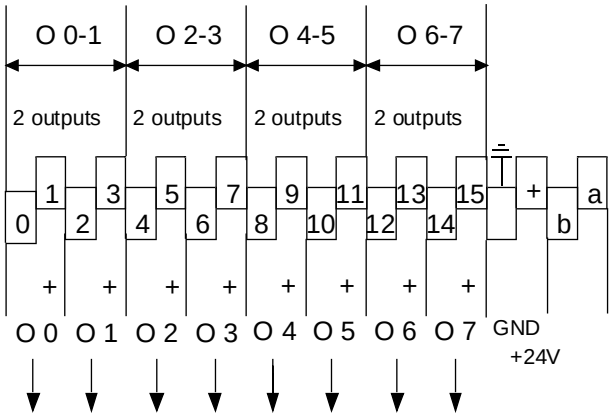
Read (inputs)

	D0	D1	D2	D3	D4	D5	D6	D7	D8	D9	D10	D11	D12	D13	D14	Busy

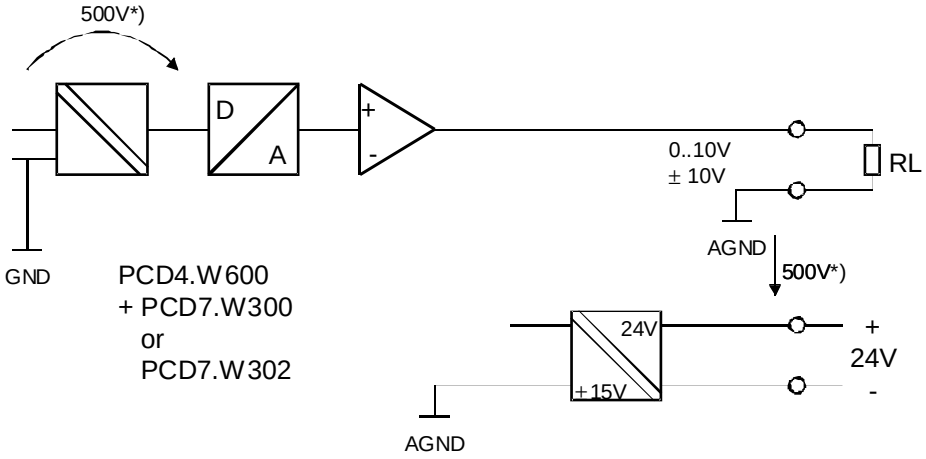
C0 .. C7:	Channel selection SET O Kx
Conv:	SET/RES O 8 starts conversion (data input/output) *)
Status:	SET/RES O 9 gives the status register at D0 .. D14 *)
Write:	Write/read
O0..3:	4-bit address
Data:	Selects data or channel address
D0..D14:	15-bit data → Conv Status register → Status

*) Busy "Input" = H

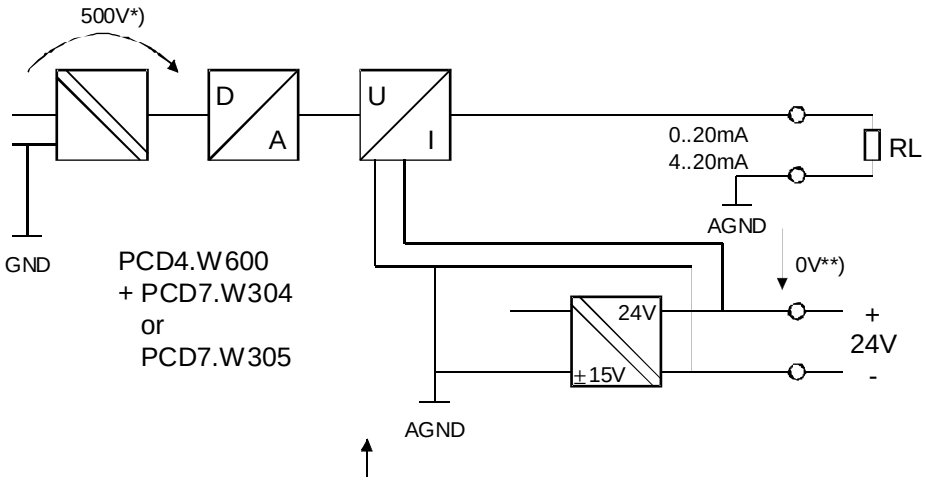
2.1.7 Module connections



Connections for voltage output



Connections for current output



*) Isolation voltage of galvanic isolation
**) Same potential of 24 V and RL (output)

2.2 Standard mode

2.2.1 Software

If the microcontroller (µC) is left unconfigured, the PCD4.W600 module is treated like other analogue output modules. However, the module (µC) can be configured in such a way that a range and an offset are directly taken in consideration. See the following chapters 2.3 and 2.4 "Extended modes".

Important note:

If the module has been used previously in 'synchronous updating' mode, this configuration is stored in the EEPROM. On the next startup, this configuration is taken again and the 'single shot' mode will therefore no longer work. The EEPROM must be reconfigured first.

Solution:
Programming with FBoxes: A simple user program with the FBox 'PCD4W600' with all channels set as 'disabled' is to create and to run.
Programming with FB's: In the Config-DB column 'Conf', for all channels the code 0000H is to fill in, then the user program is to run. Program example 'example1.src' can be used, see chapter 2.3.5).

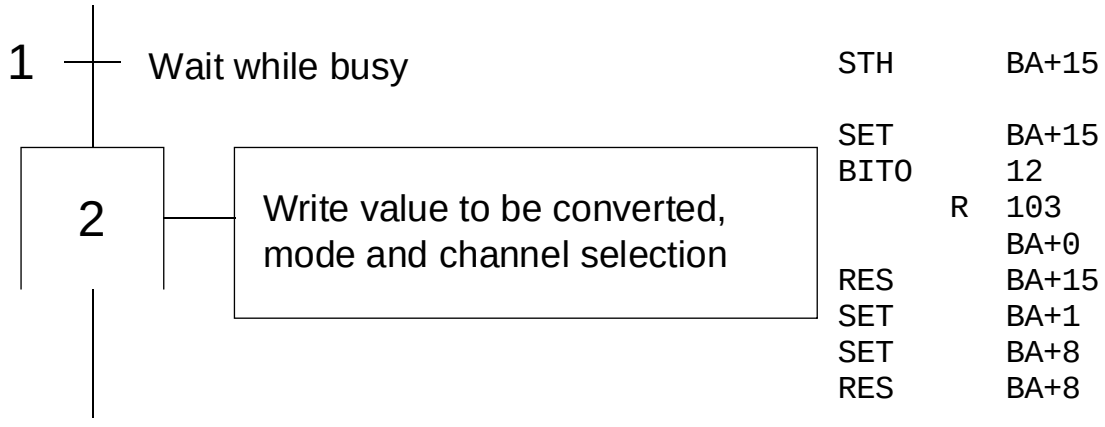
2.2.2 User program to output an analogue value

Example in IL (Instruction List) to demonstrate the principles, using a wait loop while busy.

Output the analogue value from register R103 to channel 1. The module has base address 48.

```
        BA   EQU  O 48

BUSY:   STH       BA+15     ; When high, microcontroller busy
        JR     H  BUSY      ; Wait for as long as busy is high

        ACC    H             ; ACCU  must be high
        SET       BA+15      ; Must be high to write data
        BITO      12         ; Write D/A value, 12 bit
               R  103        ;   from register R 103
                  BA+0       ;   to address 0 (LSB) until 11
        RES       BA+15      ; Must be low to write channel
                             ;   address
        SET       BA+1       ; Channel selection: channel 1
       (RES       BA+8)
        SET       BA+8       ; Trigger A/D conversion
        RES       BA+8       ;   by switching address 8 on/off
```

Since the reading or writing of an analogue value is a sequential process, it is preferable to write the user program in GRAFTEC (no program jumps, no wait loops).



2.3 Extended mode with FB library

2.3.1 Single Shot Mode

12 Bit format
(Factory configuration without further programming)
Value in 12-bit format (0..4095)
Output time: ≈ 150µs (voltage output)

Proportional voltage, current

Digital representation in physical values

Voltage range:

PCD7.W300	10 V	→	Representation 0..10000
PCD7.W302	±10 V	→	Representation ±10000

Current range:

PCD7.W304	0..20 mA	→	Representation 0..20000
PCD7.W305	4..20 mA	→	Representation 4000..20000

Note: The PCD4.W600 module itself recognises which range module is fitted to which socket (plug & play).

However, output module resolution always remains 12 bits.
Output time: ≈ 1ms (voltage output)

User scaling

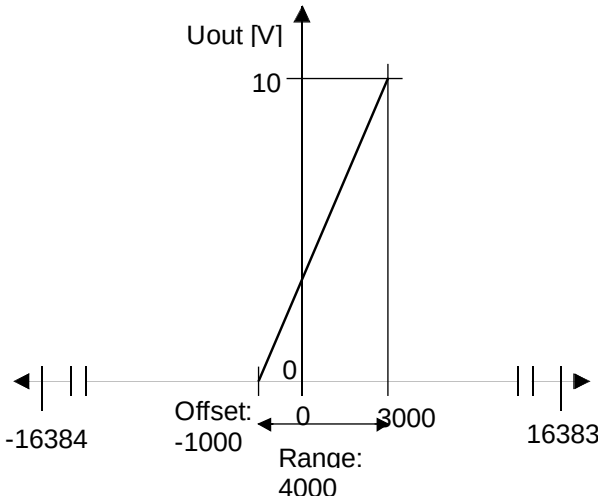
It is also possible to select user definable scaling. The range and offset for the scale are specified by means of two x 15-bit values per channel.

- Bereich: 0..32767 (15 Bit no sign)
- Offset: -16384..+16383 (15 Bit sign 2er Complement)

e.g. Voltage output 0..10 V:
- Range: 4000
- Offset: -1000 (need not be symmetrical)

Offset < 0: The sum of offset + range must always fall within 0..32767 (15 bit, unsigned format). If not, the scaling error flag is set in the status register.

Offset < 0: The sum of offset + range must always fall within -16384..+16383 (15 bit, signed format). If not, the scaling error flag is set in the status register.



When user scaling is selected, the specified range is used, regardless of the range module.
However, output module resolution always remains 12 bits.

Synchronous updating mode

Each output can be preloaded with a value (address 2 / FB 'WrPreVal'). When the command "Sync all channels now" (FB 'Control') is written, the previously loaded values are output by the processor to the W600 card, placing no load on the PCD4 processor. The format is as selectable in single-shot mode.

Delay time between 8 channels : ≈ 75µs

2.3.2 Programming model

Mapping PCD4 addresses

I/O	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15

For writing (Outputs)

channel/ Address	C0	C1	C2	C3	C4	C5	C6	C7	Conv *	Status *	Write	A0	A1	A2	A3	Data *'0'*
Data	D0	D1	D2	D3	D4	D5	D6	D7	D8	D9	D10	D11	D12	D13	D14	Data *'1'*

For reading (Inputs)

D0	D1	D2	D3	D4	D5	D6	D7	D8	D9	D10	D11	D12	D13	D14	Busy

C0..C7: Channel selection SET O Cx
Conv: SET/RES O 8 starts conversion(Data input/output)*) Interrupt 0
Status: SET/RES O 9 gives the status register at D0..D14* Interrupt 1
Write: Write / Read
A0..3: 4-bit address
Data: Selects data or channel/address
D0..D14: 15-bit data → Conv
Status register → Status

*) - theBusy input becomes =1 (H)
- Written data is assessed by the microcontroller

Note If conversion is triggered for an absent range module, the channel error and general error flags are set in the status register.

For program example in IL and GRAFTEC, see chapter 2.2.2.

Statusregister

Channel spec. status

Global status

Data	Function
D0-D2	not used
D3	Scaling error
D4, D5	not used
D6	Range Module not equipped
D7	Channel Error
D8-D10	Internal Error 3 bits : 000: everything ok 001: CPU or internal RAM error 010: external RAM error 011: EPROM checksum error 100: EEPROM checksum error 101: EEPROM initi. and test error 110: DA converter error 111: Watch dog error
D11-D13	not used
D14	General error

Explanation of error flags:

Scaling error: Scaling is not possible.

Range module not fitted:
Conversion was executed for an output without a range module.

Channel error: Set when if the scaling or range module not fitted flag is set.

Internal error: Controller system or peripheral device fault.

General error: Set when one of the above flags is set.

The easiest way to read the status register is using FB "RdStatusW6".

2.3.3 Programming integrated functions

Individual parameters can be selected with addresses:

Address	Meaning	No. of bits
01	Channel specific configuration	15 Bit
02	Preload value for synchronous updating	15 Bit
03	not used	
04	not used	
05	not used	
06	not used	
07	User scaling range value	15 Bit
08	User scaling offset value	15 Bit

Table 1: Meaning of addresses

Channel-specific configuration (address = 01)

Mode	Equipped module	Format	Code
Single shot		12 bit*)	0000H*)
	+	Proportional	0008H
		User Scaling	0018H
Synchronous Updating**)		12 bit	0001H
	+	Proportional	0009H
		User Scaling	0019H

Table 2: Channel-specific configuration

* Default programming (FW default)
\+ The PCD4.W600 module itself recognises which range module is fitted to which socket (plug & play).
** When an output configured in synchronous-updating mode starts up (power-up, restart warm) the preload value stored in EEPROM is output.

Configuration process

It is preferable for configuration to take place in the start-up routine XOB 16.

Structure chart of configuration (and process of FB Config)

<table>
<tr><td colspan="2">Read EEPROM checksum</td></tr>
<tr><td colspan="2">Check if EEPROM checksum has the same value as the stored one and checksum ≠ 0
Yes / No</td></tr>
<tr><td rowspan="6">Do nothing *)</td><td>Stop W600</td></tr>
<tr><td>Write all configuration values
+ suppression to W600</td></tr>
<tr><td>Initialize W600 with new configuration</td></tr>
<tr><td>Save configuration to EEPROM</td></tr>
<tr><td>Run W600</td></tr>
<tr><td>Read new EEPROM checksum and store it</td></tr>
</table>

*) At W600 start-up, the configuration stored in it's EEPROM is adopted automatically. Reconfiguration is therefore unnecessary.

Important: If configuration data is modified, the checksum stored in the DB must be set to zero otherwise configuration will not be done.

→ **Note that programming is simpler using FB "Config" or the PG4's FBox.**

2.3.4 FB description

The following FBs are available for the PCD4.W600 module:

- **FBs for the cyclic reading / writing of information (in COB)**

  - WrVal — Write output value
  - WrPreVal — Write preload value
  - RdStatus — Read status register
  - Control Code 0 — Write Sync command

- **FBs for configuration or for writing information**

  - Config — Configure the W600
  - WrCData — Write channel-specific configuration
  - RdCData — Read channel-specific configuration
  - Control Code 2 .. 8 — Monitor the W600 module (exception: Sync all channels now)
  - RdInfo — Read W600 information

The configuration FBs are slow and should only be used for configuration or to read information. If used in a COB they can delay the program or the W600 module for quite a long time, depending on the FB.

FB global status flags:

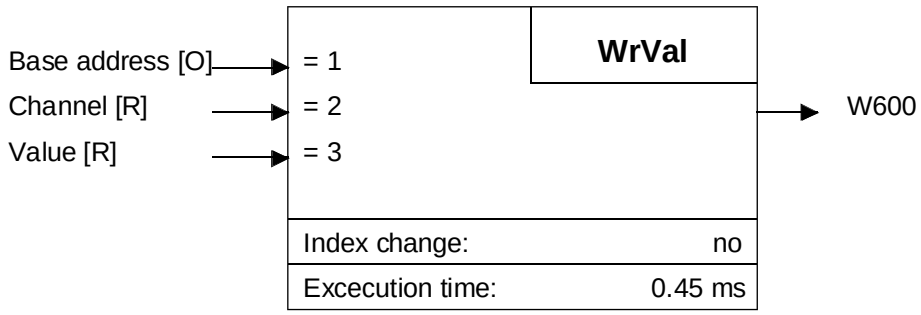
Timeout: All FBs wait until the W600 card has completed the command. If not completed by the end of the time-out period (PCD4.M120 ≈ 15 ms), the FB is exited and this flag is set.

Flags for FB RdStatus: see FB description.

Caution: Global symbols are common to all W600 modules! (including status flags of the FB 'RdStatus')

FB processing times were measured with a PCD4.M120.

WrVal **Function:** - Write Value WrVal



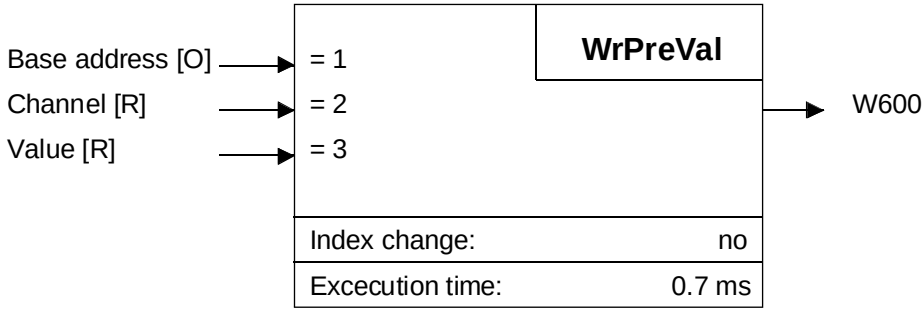
Writes an output value. The first parameter is the base address of the W600 module, the second parameter is a register which holds the channel number. The third parameter is a register containing the output value be written.

```
$group W600
LD      Channel_Nb   ; Register = channel 2
        2
LD      DA_Value; Register = value to output
        1000
CFB     WrVal
      O 16           ; Base address of module
        Channel_Nb   ; Reg. containing channel number
        DA_Value; Reg. containing the value
$endgroup
```

Notes: When the W600 is configured for user scaling or proportional format, the busy input remains high for ≈ 0.5 ms after processing the FB.

The 'Timeout' flag is set if the W600 does not react to the command (Busy remains high) within ≈ 15 ms.

WrPreVal **Function:** - Write Preload Value WrPreVal



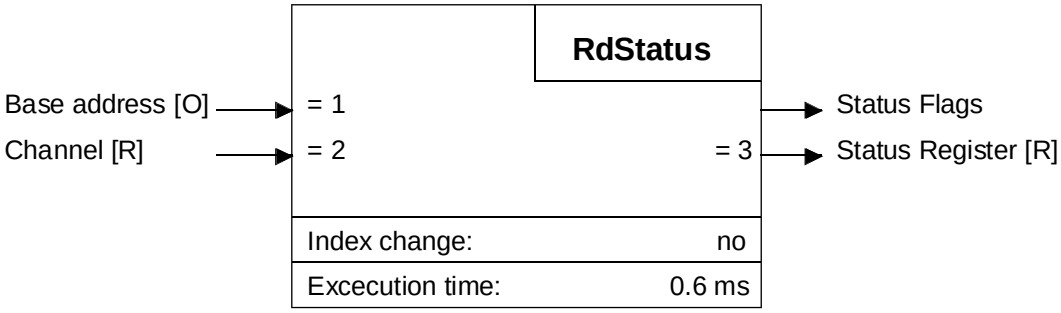
Writes the preload value of an output. The first parameter is the base address of the module, the second parameter holds the channel number, the third parameter holds the preload value.

```
$group W600
LD      Channel_Nb   ; Register = channel 2
        2
LD      DA_Value; Register = value to output
        1000
CFB     WrPreVal
      O 16           ; Base address of module
        Channel_Nb   ; Reg. containing channel number
        DA_Value; Reg. containing the value
$endgroup
```

Notes: When the W600 is configured for user scaling or proportional format, the busy input remains high for ≈ 0.5 ms after processing the FB.

The 'Timeout' flag is set if the W600 does not react to the command (Busy remains high) within ≈ 15 ms.

RdStatus **Function:** - Read Status Flags RdStatus



Reads a channel's status register. The first parameter is the base address, the second parameter holds the channel number. The result can either be read from the register given as the third parameter, or from the predefined flags.

Definition, flag names:

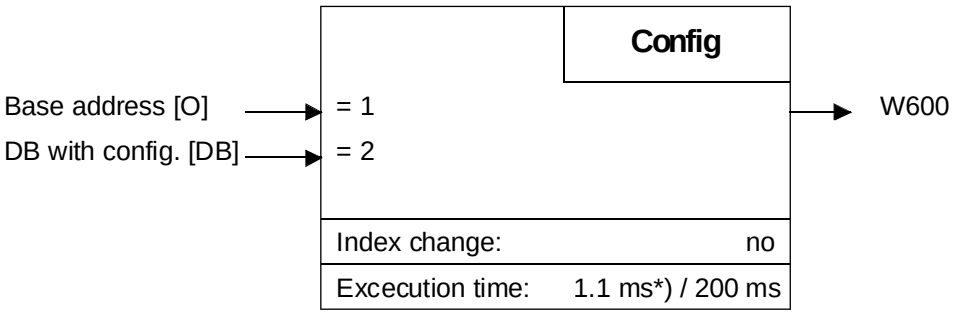
Flag	Bezeichnung	
Global status		
ScalErr	Voltage / Scaling error	
Mnotequ	Module not equippped	
ChError	Channel Error	
Channel spec. status		
IntError	Internal Error 3 bits :	000: everything ok 001: CPU or internal RAM error 010: external RAM error 011: EPROM checksum error 100: EEPROM checksum error 101: EEPROM initi. And test error 110: DA-converter error 111: Watch dog error
GenError	General error	

Caution: Symbols are common to all W600 modules!

```
$group W600
LD      Channel_Nb    ; Register = channel 2
        2
CFB     RdStatus
      O 32            ; Base address of module
        Channel_Nb    ; Reg. holding channel number
        StReg_2       ; Reg. for channel 2 status
STH     Mnotequ       ; Check if modul is present
SET   O 99            ; Set W600 error output if not
$endgroup
```

Note: The 'Timeout' flag is set if the W600 does not react to the command (Busy remains high) within ≈ 15 ms.

Config **Function:** - Configurate Config



*) without reconfiguring (i.e. if checksum is the same)

Configures the W600 using data in a data block (DB). The first parameter is the base address of the module, the second parameter is the number of the DB containing the configuration data. The configuration data is automatically stored in EEPROM on the W600 module.

Note regarding the configuration DB:

If the PCD's program memory is writeable RAM, the W600 is always configured the first time a program is run after downloading, and the FB "ConfigW6" writes the DB's checksum into the DB. If the PCD's program memory is read-only EPROM or Flash EPROM, the checksum cannot be written to the DB and the W600 is configured on every start-up because the checksum is always zero. To use the same mechanism as applies to writeable RAM memory, the DB must be in extension memory (DB 4000..7999) which is always RAM.

e.g. : - Configure channel 0 .. 3 proportional single shot
- Configure channel 4 .. 7 user scaling synchronous updating

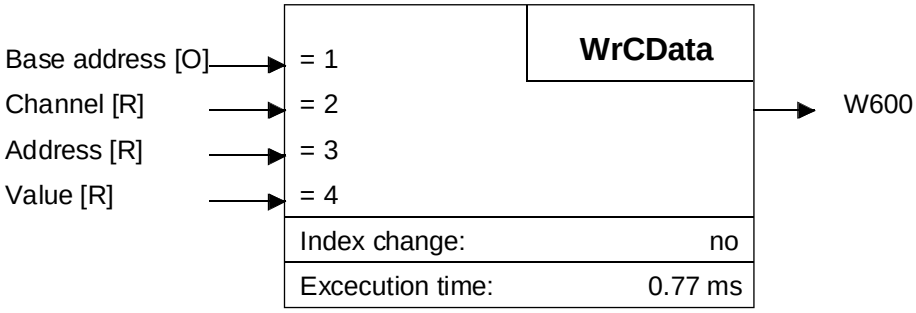
```
$group W600
;Configuration DB----------------------------------------------------------
DB W6Conf [33]  0,                                                  ; Checksum
;               Conf,       StrVal,     UsSv,       UsOv,
                0008H,      0,          0,          0,          ; channel 0
                0008H,      0,          0,          0,          ; channel 1
                0008H,      0,          0,          0,          ; channel 2
                0008H,      0,          0,          0,          ; channel 3
                0019H,      2500,       7000,       -1000,      ; channel 4
                0019H,      0,          4000,       -2000,      ; channel 5
                0019H,      0,          6000,       -3000,      ; channel 6
                0019H,      0,          8000,       -4000       ; channel 7
```

;Conf: Configuration Code
;StrVal: Startup Value for W600 Output (only in Sync mode usable)
;UrSv: User scaling range value
;UrOv: User scaling offset value

```
; Configure W600 module
XOB     16              ; Start-up XOB
CFB     Config          ; Configurate W600 module
      O 16
        W6Conf          ; from this DB
EXOB
$endgroup
```

Note: The 'Timeout' flag is set if the W600 does not react to the command (Busy remains high) within ≈ 15 ms.

WrCData **Function:** - Write Configuration Data WrCData



Writes a W600 configuration data value. The first parameter is the base address of the module, the second parameter holds the channel number, the third parameter holds the destination address, and the fourth parameter holds the data to be written.

Meaning of the addresses:

Address	Meaning	
01	Channel specific configuration	15 bit
02	Preload value for synchronous updating	15 bit
07	User scaling range value	15 bit
08	User scaling offset value	15 bit

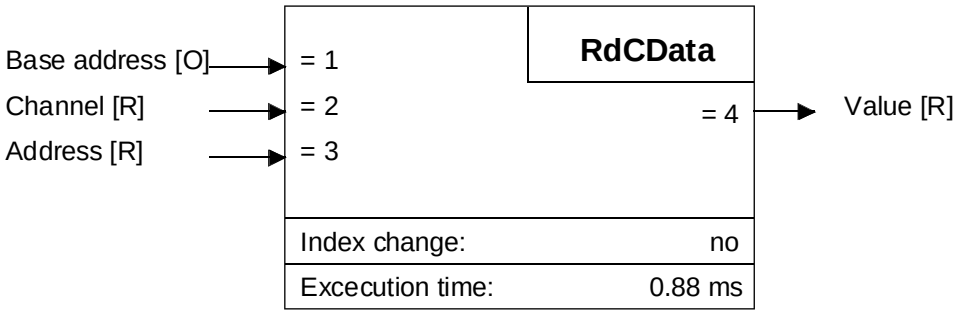
e.g. : - Configure channel 3 Synchronous Updating

```
$group W600
LD      Channel_Nb   ; Register = channel 3
        3
LD      Conf_Val; Synchronous updating 12 bit
        0001H
LD      AddressNbr   ;Destination address
        01           ; (channel specific config)
CFB     WrCData
      O 16           ; Base address of module
        Channel_Nb   ; Reg. containing channel number
        AddressNbr   ; Reg. containing address
        Conf_Val; Register containing value
$endgroup
```

Note: The 'Timeout' flag is set if the W600 does not react to the command (Busy remains high) within ≈ 15 ms.

When using FB 'WrCData', data are only modified in the W600. The DB for FB 'Config' is not updated.

RdCData **Function:** - Read Configuration Data RdCData



Reads a W600 configuration data value. The first parameter is the base address of the module, the second parameter holds the channel number, the third parameter holds the data address, and the fourth parameter is the destination register for the configuration value.

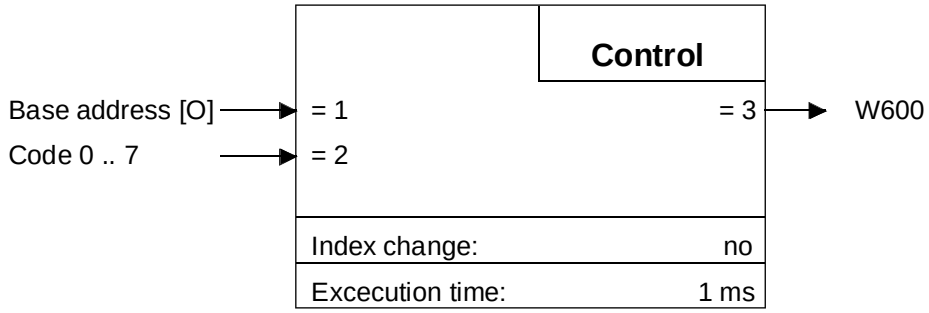
Meaning of addresses see FB "WrCData".

e.g. :

```
$group W600
LD      Channel_Nb   ; Register = channel 3
        3
LD      AddressNbr   ; Source address
        01           ; (channel specific config)
CFB     RdCData
      O 16           ; Base address of module
        Channel_Nb   ; Reg. holding channel number
        AddressNbr   ; Reg. holding source address
        Conf_Val; Register for result
$endgroup
```

Note: The 'Timeout' flag is set if the W600 does not react to the command (Busy remains high) within ≈ 15 ms.

Control **Function:** - Write Control Flag Control



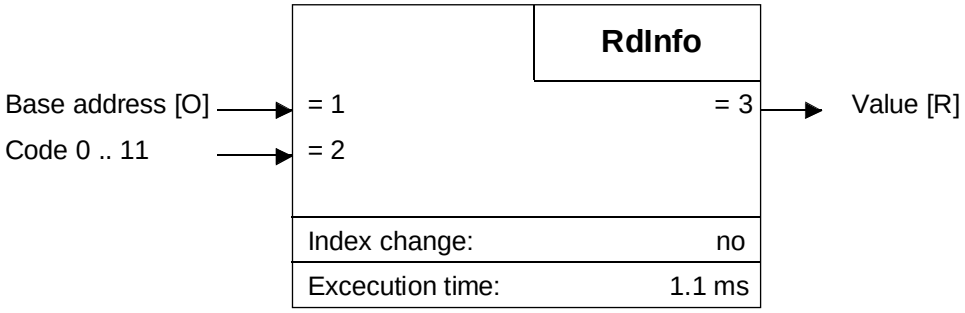
Writes a command to the W600 module. The first parameter is the base address of the module, the second parameter is a command code.

				Busy high after execute
Code:	0	=	Sync all channels now	0.3 ms
	2	=	Status of all channels are set to 0	0.7 ms
	3	=	Save configuration to EEPROM	140 ms
	4	=	Initialize the module with the new config.	11 ms
	5	=	Conversion Control Stop (can not longer output value)	0.1 ms
	6	=	Conversion Control Run (can output value again)	0.6 ms
	7	=	Restart warm (Initialization with the configuration stored in EEPROM)	900 ms
	8	=	Restart cold (Initialzation with FW default, single-shot mode)	1000 ms
	9	=	Execute BIST (W600 self-test)	830 ms

```
$group W600
CFB     Control
      O 16          ; Base address of module
        7           ; Restart warm command
$endgroup
```

Note: The 'Timeout' flag is set if the W600 does not react to the command (Busy remains high) within ≈ 15 ms.

RdInfo **Function:** - Read Information RdInfo



Reads information from the W600 module. The first parameter is the base address of the module, the second parameter is a 4-bit information code. The value is returned in the register defined by the third parameter.

Code:	0	=	EEPROM Checksum of configuration
	1	=	Modul Identification (W600)
	2	=	Hardware - Version
	3	=	Modification number
	4	=	Firmware - Version
	5	=	Firmware - Checksum
	6	=	Fabrication - Year
	7	=	Fabrication - Week
	8	=	Range Module Identifier I/O 0,1 (PCD7.W30x)
	9	=	Range Module Identifier I/O 2,3 (PCD7.W30x)
	10	=	Range Module Identifier I/O 4,5 (PCD7.W30x)
	11	=	Range Module Identifier I/O 6,7 (PCD7.W30x)

Range Module Identifier:

Code	Module	Range
00h	not equipped	-
01h	PCD7.W300	U: 0..10V
02h	PCD7.W302	U: ±10V
04h	PCD7.W304	I: 0..20mA
05h	PCD7.W305	I: 4..20mA

```
$group W600
 CFB    RdInfo
      O 16          ; Base address of module
        11          ; Range module identifier
        Ident_Val   ; Register to hold the result
$endgroup
```

Note: The 'Timeout' flag is set if the W600 does not react to the command (Busy remains high) within ≈ 15 ms.

2.3.5 User program / Example

Fundamentals

Example of the order of the files and the procedure during the preparation of an user program. The project to be created should have project name "TEST-W6" and the actual user program module should be entitled "example1.src". The files are arranged like this:

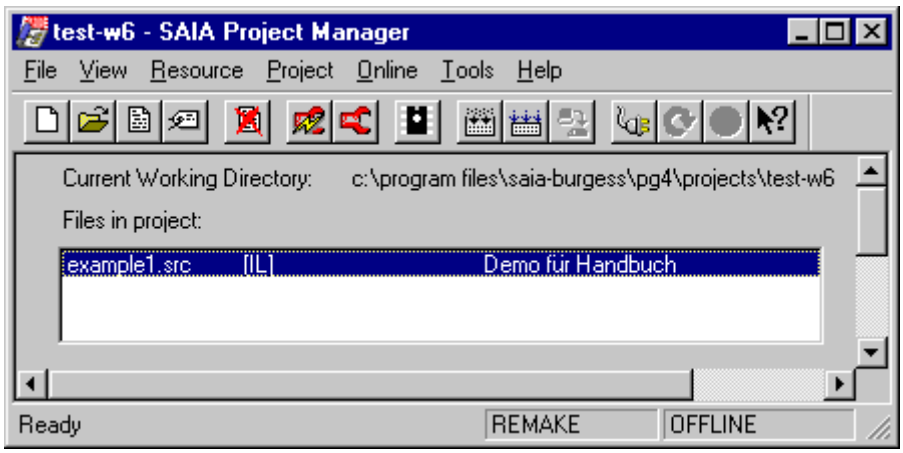
C:\PG4	\FB	\D4W600_b.equ	(depending of
		\D4W600_b.src	installation)
		\...	
	\FBOX	\...	
	\GALEP3	\...	
	\PROJECTS	\FUP_E	(Demo example PG4)
		\GRAF_E	(Demo example PG4)
		\TEST-W6 \example1.src	

The user program for the W600 part is structured as follows:

```
$include C:\PG4\FB\D4W600_b.equ
$group w600

XOB     16


PCD-Code


ecob
$endgroup
```

If the program is written in GRAFTEC, the assembler directives '$include' and '$group' are placed in the first step (ST), normally the initial step (IST). '$endgroup' comes at the end of the last transition (TR).

If everything has been correctly installed, the user program edited and all parameters defined, the program can be processed and downloaded to the PCD with the 'Project' - 'Make' command



Programming examples:

Program name: example1.src

1. Programming with FB 'Config'
2. Cyclical writing of outputs

Format: - O 0-3: Single shot, proportional
Code as table: 0008H
- O 4-7: Synchronous updating, user scaling
Code as table: 0019H

Range module: not relevant for programming
User Scaling Ranges: - Ch 4: 2000..7000 (Start value: 2000)
- Ch 5: -6000..6000 (Start value: 0)
- Ch 6: -500..8000 (Start value: 0)
- Ch 7: -3000..10000 (Start value: 0)

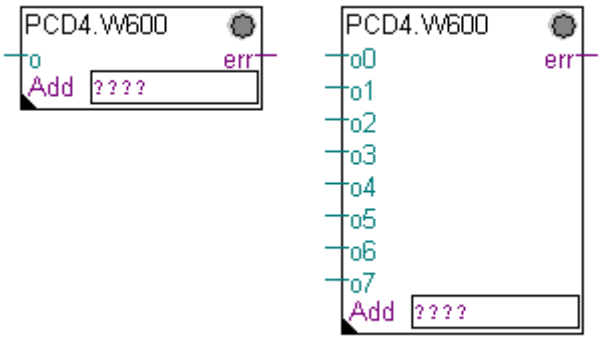
```
$Include D4W600_B.EQU
;-------------------------------------------------------------------------
; Resource definitions for PCD4.W600
;-------------------------------------------------------------------------
$group w600

BAW600_0        EQU I 0         ; Base Address of W600
rChannel_0      EQU R 0         ; Channel number counter
rChannel2_0     EQU R 1         ; Channel number counter
rValue_0        EQU R 2         ; Analog value
;Database Value Registers  of Output channels W600
rValueCh0       EQU R 3         ; Analog value Channel 0
rValueCh1       EQU R 4         ; Analog value Channel 1
rValueCh2       EQU R 5         ; Analog value Channel 2
rValueCh3       EQU R 6         ; Analog value Channel 3
rValueCh4       EQU R 7         ; Analog value Channel 4
rValueCh5       EQU R 8         ; Analog value Channel 5
rValueCh6       EQU R 9         ; Analog value Channel 6
rValueCh7       EQU R 10        ; Analog value Channel 7

;DB
W6Conf_0        EQU DB 0                ; DB for Configurate W600

;Configuration  DB-----------------------------------------------------
;Remark: The Configuration DB is normally a RAM DB, because the checksum
;       will be stored as first parameter in it. This is to guarantee, that after the
;       download of the user program, the configuration will be done at the first
;       startup (because of the 0 ), but then only if the checksum is not equal. If
;       the DB is in a EPROM/Flash memory, the configuration will be executed at
;       every startup or it must be stored in the extension memory (DB 4000-7999).
;
```

```
;           Conf,    StrVal,  UrSv,    UrOv,
DB W6Conf_0 [33]  0, ;Checksum
            0008H,  0,       0,       0,       ; channel 0
            0008H,  0,       0,       0,       ; channel 1
            0008H,  0,       0,       0,       ; channel 2
            0008H,  0,       0,       0,       ; channel 3
            0019H,  2000,    5000,    2000,    ; channel 4
            0019H,  0,       12000,   -6000,   ; channel 5
            0019H,  0,       8500,    -500,    ; channel 6
            0019H,  0,       13000,   -3000    ; channel 7
;
; Conf: Configuration Code
; StrVal: Startup Value for W600 output (only in User scaling mode usable)
; UrSv: User scaling range value
; UrOv: User scaling offset value
;
$endgroup
;*******************************************************************************
            XOB     16      ;coldstart routine
;
;
$group w600
            CFB     Config          ; Configurate W600 card
                    BAW600_0
                    W6Conf_0
            LD      rChannel_0
                    3
;
$endgroup
            EXOB
;
;
```

```
            COB     0
                    0
;
$group w600
;       Write each cycle one of the channels 4..7
            SEI     rChannel_0
            GETX    rValueCh0
                    rValue_0
            CFB     WrVal           ; Write the preload analog value
                    BAW600_0        ; Base address of W600
                    rChannel_0      ; channel number (R)
                    rValue_0        ; analog value (R)
            DEC     rChannel_0      ; decrement channel number
            JR      P Next
            LD      rChannel_0      ; If Channel 0 is done set to 3
                    3
Next:
;       Write each cycle the channels 0..3 with the sync
            LD      rChannel2_0
                    7
LOOP:
            SEI     rChannel2_0
            GETX    rValueCh0
                    rValue_0
            CFB     WrPreVal        ; Write the preload analog value
                    BAW600_0        ; Base address of W600
                    rChannel2_0     ; channel number (R)
                    rValue_0        ; analog value (R)
            DEC     rChannel2_0     ; decrement channel number
            CMP     RChannel2_0
                    K 4
            JR      P LOOP          ; If Channel 0 is done set exit
            CFB     Control         ; Sync all channels now
                    BAW600_0        ; Base address of W600
                    0               ; Code sync
$endgroup

            ECOB
```

2.4 Extended mode with FBoxes in FUPLA

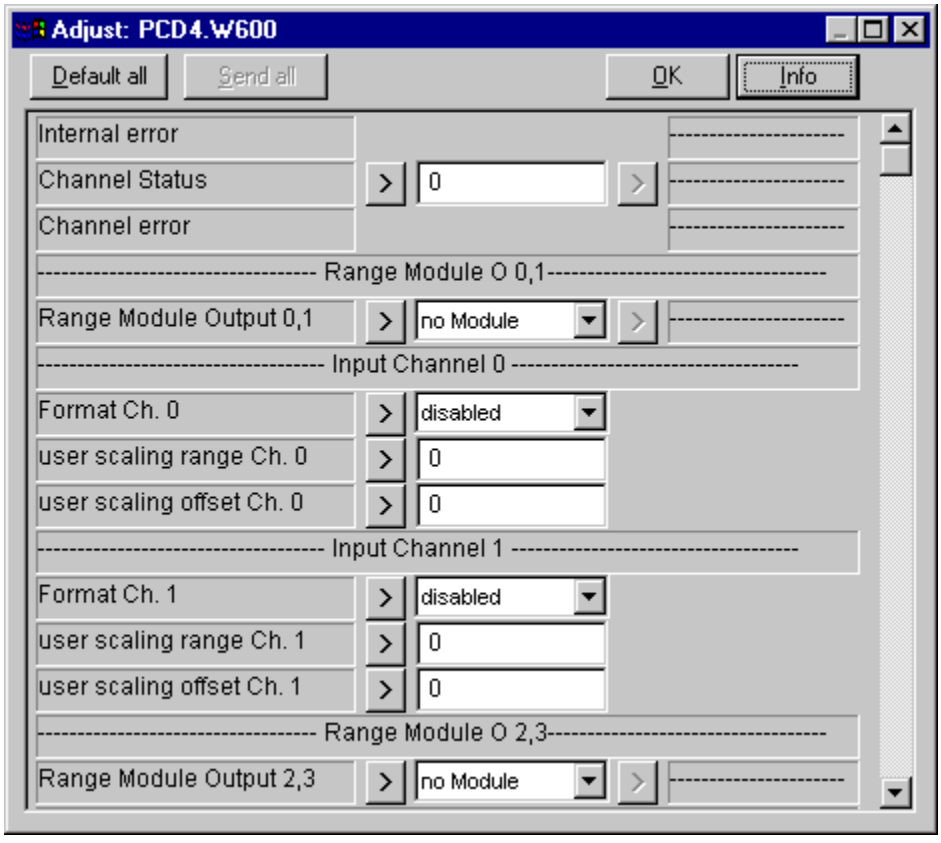
The FBox 'PCD4.W600'



This FBox configurates and reads the values of the PCD4.W600 module.

The base address (Add) defines the location of the module in the PCD. Important: do not use the base addresses 240 and 496 (conflict with watch dog).

The adjust window:



Internal error:
The internal error shows if there is an error on the controller system of the W600 module.
If an internal error is occurred the LED change to red and the “err” output goes to high.

Channel Status
Select the channel for the "channel error"

Channel error
Indicates if there is an error for the selected channel.

Range Module O 0,1; O 2,3; O 4,5; O 6,7:
In this adjustment the equipped module is to be selected. When the PG4 is online with the CPU, the adjust shows the recognized equipped module.
If the selected and the recognized range module is different, then an internal error message will show it.

If there is no Range module equipped 'not used' is to be selected in the Format adjust.

List of Range Modules:

PCD7.W300	2 channels, voltage range 0..10 V, resolution 12 bits, galvanic isolated
PCD7.W302	2 channels, voltage range -10..10 V, resolution 12 bits, galvanic isolated
PCD7.W304	2 channels, current range 0..20 mA, resolution 12 bits, galvanic isolated
PCD7.W305	2 channels, voltage range 4..20 mA, resolution 12 bits, galvanic isolated

Format channel 0..7
Three different formats for each channel can be selected:

- Bit format: digital representation 0..4095 low resolution

- proportional format: proportional to the output:

- PCD7.W300 Voltage	10 V:	0..10000
- PCD7.W302 Voltage	1 V:	-10000..10000
- PCD7.W304 Current	20 mA:	0..20000
- PCD7.W305 Current	20 mA:	4000..20000

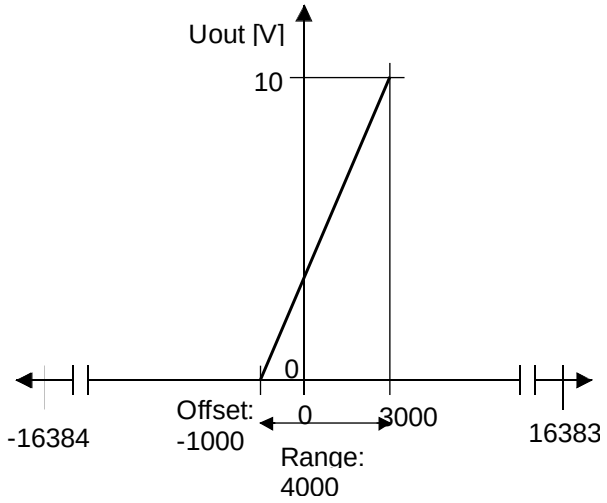
- user scaling: a user definable scaling

- the offset and the range of the scale can be specified.

Important: If the output channel is not used, select disabled to disable the conversion.

User scaling range & offset channel 0..7.
The offset and range for the user scal can be declared
To use the user scaling, the user scaling format is to be selected.
There are signed or non signed ranges possible:
- Offset < 0 → scale is signed -16384 … 16383
- Offset > 0 → scale is non signed 0 … 32767

ex. signed user scaling



Remarks: All adjusts (except Channel Status) are mode offline. The program must be recompiled after changing a parameter.

Notes

From :

Company :
Department :
Name :
Address :

Tel. :

Date :

Send back to :

SAIA-Burgess Electronics Ltd.
Bahnhofstrasse 18
CH-3280 Murten (Switzerland)
http://www.saia-burgess.com

BA : Electronic Controllers

Intelligent analogue modules
PCD4.W500 and PCD4.W600

If you have any suggestions concerning the SAIA® PCD, or have found any errors in this manual, brief details would be appreciated.

Your suggestions :