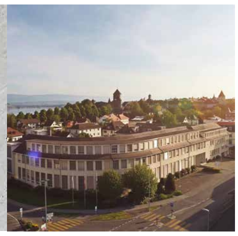


PCD3.W380

Universal analogue input module, 8 channels, 13 bits (12 bits+sign), selectable by software

This module PCD3.W380 is a universal analogue input module with innovative embedded features. It offers many advantages for all involved parties (project manager, programmer, panel builder and end user).

The 8 analogue inputs with 13 bit resolution can be individually configured by software for the various sensor types. Opening the module case and plugging jumpers is no longer necessary. There are 2 connection terminals for each input. Additional external distribution terminals are not required. In addition to 0 … 10 V, ± 10V, 0(4) … 20 mA, Pt/Ni 1000 also NTC10k/NTC20k temperature sensors are supported.

Thanks to the numerous measuring ranges spare parts handling and service become easier, more flexible and less expensive. The precision of the inputs is 0.3 % or better (based on the full range).

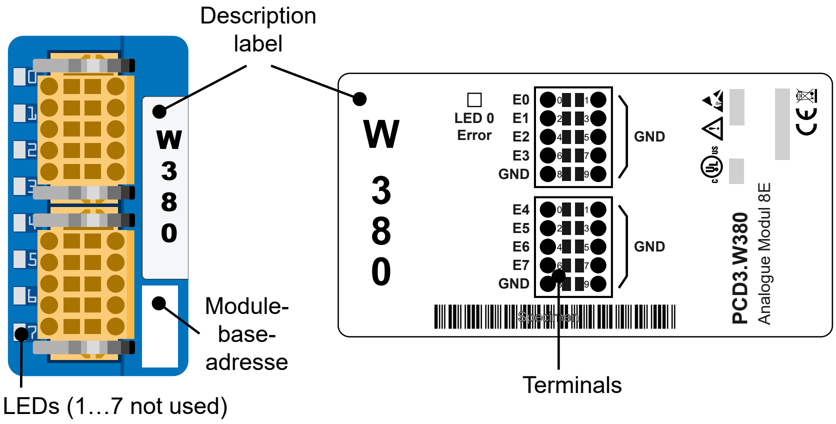
This module can also be used in applications where the data acquisition speed is important. Each channel value is updated in internal buffer every 680 µs that means each input value is refreshed at 1.5 kHz. Digital filters can be configured individually for all inputs.

An LED on the housing indicates module errors, which can also be evaluated in the user program. The inputs are also protected against configuration errors by the user.

PCD3.W380

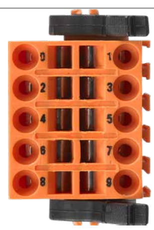
!	I/O modules and I/O terminal blocks may only be plugged or unplugged when the CPU is de-energized. An external power supply at their connections must also be switched off.

Indicators and connections

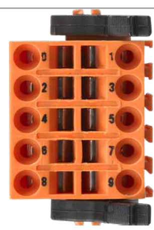


LED	Funktion
0	Error
…	not used
7	not used

X0

0: CH0		1: GND
2: CH1		3: GND
4: CH2		5: GND
6: CH3		7: GND
8: GND		9: GND

X1

0: CH4		1: GND
2: CH5		3: GND
4: CH6		5: GND
6: CH7		7: GND
8: GND		9: GND

Good to know

- 2 connections per channel (signal and ground). All the ground pins are internally connected together.
- 4 channels per connector.
- Wires up to 1 mm².
- In supplement, 2 ground connections per connector (pins 8 and 9). One of this pin should be used for a protective ground connection.

LED 0 - Error

The LED 0 is enabled when an error occurs on the module.

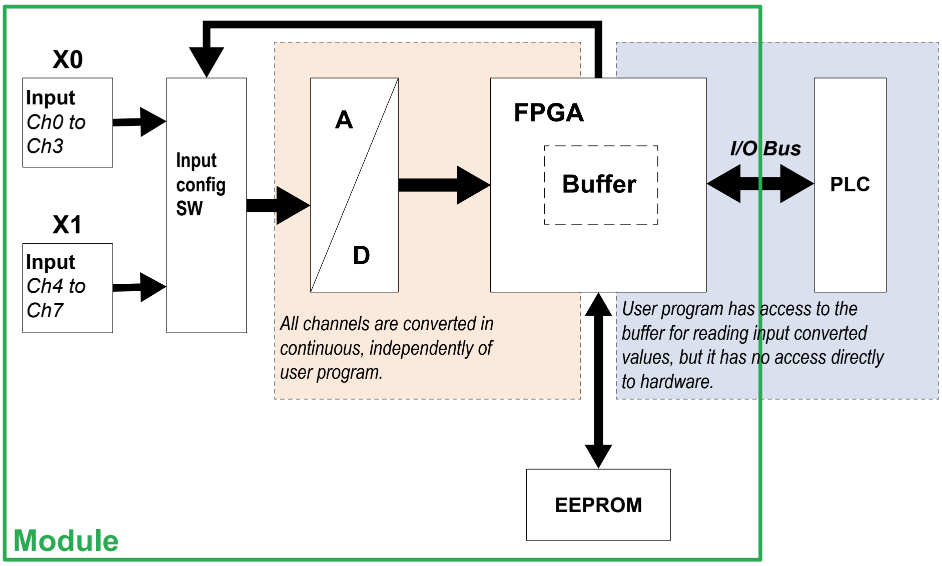
The signaled errors are ..	Description
Configuration error	The desired inputs configuration is not applied correctly.
A/D-Error	A/D converter doesn't respond.
Calibration error	Module not calibrated.
Calibration error	An input channel has been automatically put in protection mode, because the module detects a situation which can cause important damages to hardware.

!	This is a general indication and the details of the error must be read in the specific register of the module.

Block diagram

The PLC communicates with the module through the I/O Bus.

The data acquisition is independent of the rest. The input values are continuously updated into the internal buffer. One value is stored per channel. The values are sent to the PLC when the user program sends a defined request to the module.



The configuration of the module is done in PG5 Device Configurator. The user program can read the input values or input configurations by specific registers.

Technical data (general)

Compatibility	PCD3 (PCD1 and PCD2 in combination with PCD3.Cxxx)			
Power				
Module power supply voltage	+5 V and V+ IOBUS			
Current consumption	25 mA on +5 V and 25 mA on V+			
Galvanic separation	No			
Inputs				
Number of inputs	8			
Input ranges of each mode		Minimum	…	Maximum
	Voltage	−10 V	…	+10 V
	Current	−20 mA	…	+20 mA
	Resistance	0 Ω	…	2'500 Ω
		0 Ω	…	300 kΩ
	Diode	0 V	…	5 V
	Pt1000	−50 °C	…	+400 °C
	Ni1000	−50 °C	…	+200 °C
	Ni1000L&S	−30 °C	…	+130 °C
	NTC10k	used in range 0	…	300 kΩ
	NTC20k	used in range 0	…	300 kΩ
Absolute maximum input voltage	±20 V (independent of the inputs configuration)			
Temperature error (0 °C … +55 °C)	±0,2 %			
Inputs configuration	Each input can be configured individually in 5 modes (ranges above)			
Configuration method	Software (PG5, Device Configurator)			
User connector	Per channel: 1 pin for input 1 pin for ground. 2 pins for protective ground 2 pins for ground in supplement			
Inputs wiring	Up to 1 mm²			
Timing				
Refresh of each channel	680 µs (all channels are updated during this time)			
Hardware input filter time constant	Voltage			τ = 2,5 ms
	Current			τ = 2,5 ms
	Resistance	(<2'500 Ω) * (typ. for R <300 kΩ) **		τ < 4,4 ms τ ≈ 8 ms
	Diode	(typ. for U <5 V)		τ ≈ 4,4 ms
Digital input filter available	No Filter	Ein Wert pro Zyklus		τ = 680 µs
	Filter 1	Mittelwert von 4 Zyklen		τ = 2,72 ms
	Filter 2	Mittelwert von 8 Zyklen		τ = 5,44 ms
	Filter 3***	Mittelwer von 16 Zyklen		τ = 10,88 ms
Min. number of I/O Bus accesses to read one channel				28 (~28 µs)

* Temperature sensors Pt1000, Ni1000 and Ni1000L&S.
** Temperature sensors NTC10k and NTC20k.
*** Recommended filter, configured by default in Device Configurator.

Technical data of input

Each channel can be configured with the following modes:

Input specifications for each mode				
Mode	**Resolution (Bit)**	**Resolution [measure]**	**Accuracy (@ $T_{Ambient}$ = 25 °C)**	**Display**
Voltage -10…+10 V	12 Bit + Sign	2,44 mV (linear) *R_{IN} = 330 kΩ*	0,2 % of measured value ±10 mV	-10'000…+10'000
Current -20…+20 mA	12 Bit + Sign	5,39 µA (linear) *R_{SHUNT} = 225 kΩ*	0,2 % of measured value ±20 mV	-20'000…+20'000
Resistance 0…2'500 Ω	12 Bit	0,50…0,80 Ω *Measuring current 1,0…1,3 mA*	0,2 % of measured value ±3 Ω	0…25'000
Resistance 0…300 kΩ	13 Bit	0 … 10 kΩ : 1 … 10 Ω 10 k … 40 kΩ : 10 … 40 Ω 40 k … 70 kΩ : 40 … 100 Ω 70 k … 100 kΩ : 100 … 200 Ω 100 k … 300 kΩ : 0,2 … 1,5 kΩ *Messstrom* 30 µA… *1,3 mA*	0,2 % of measured value ±40 Ω 0,2 % of measured value ±160 Ω 0,5 % of measured value ±400 Ω 1,0 % of measured value ±800 Ω 2,5 % of measured value ±5,0 Ω	0…300'000
Pt 1000	12 Bit	−50…+400 °C : 0,15…0,25 °C *Measuring current 1,0…1,3 mA*	0,2 % of measured value ±0,5 °C	−500…4000
Ni 1000	12 Bit	−50…+200 °C : 0,09…0,11 °C *Measuring current 1,0…1,3 mA*	0,2 % of measured value ±0,5 °C	−500…2000
Ni 1000 L&S	12 Bit	−30…+130 °C : 0,12…0,15 °C *Measuring current 1,0…1,3 mA*	0,2 % of measured value ±0,5 °C	−300…1300
Diode 0…5'000 mV	12 Bit	1,22 mV (linear) *Measuring current* 0,7… *1,3 mA*	0,2 % of measured value ±10 mV	0…5'000

The measuring current was chosen to be the best compromise between the resolution and the sensors self-heating effect, which is negligible for most of the sensors and applications. Even in bad measuring conditions with Pt/Ni1000 sensors with a low thermal coupling as 4 mW/K, the maximal error produced by the sensors self-heating is lower than 0.3 °C.

NTC-Temperatursensoren

The module offers the possibility to use NTC temperature sensors. The corresponding input must be configured in mode “Resistance 0…300 kΩ“.

Specifications of the channels for NTC10k and NTC20k				
Mode "Widerstand 0…300 kΩ"	**Resolution (Bit)**	**Resolution [measure]**	**Accuracy (@ $T_{Ambient}$ = 25 °C)**	**Display**
NTC10 k[1]	13 Bit	−40…+120 °C 0,05…0,1 °C	−20 … +60 °C : ±0,6 °C −30 … +80 °C : ±1,0 °C −40 … +120 °C : ±2,8 °C	−400…1200 [2]
NTC20 k[3]	13 Bit	−10… +80 °C 0,02…0,05 °C −20…+150 °C <0,15 °C	−15 … +75 °C : ±0,6 °C −20 … +95 °C : ±1,0 °C +95 … +120 °C : ±2,5 °C +120 … +150 °C : ±5,8 °C	−200…1500 [4]

[1] The temperature curves for the NTC10k are not standardized and may be different for each manufacturer. For this reason, the curves can be loaded by the user program using the linearization FBox. The curve of the NTC10k from Produal is available in a CSV file and can be downloaded from the Support Website.
[2] This is the output value of the FBox for linearization. The module gives a resistance 0…300'000 Ω.
[3] For the same reason of NTC10k, the curve of the NTC20k from Honeywell can be downloaded from the Support Website.
[4] This is the output value of the FBox for linearization. The module gives a resistance 0…300'000 Ω.

For an example of the utilization of a NTC sensor, please see the chapter „Example of linearization“.

Temperature sensors with integrated circuits

With an input configured in “Diode 0…5000 mV”, it is possible to use integrated circuit temperature sensors operating as a 2-terminal zener. A typical sensor for this measurement is the LM235 for example.

Specifications of the channels for LM235				
Mode "Widerstand 0…300 kΩ"	**Resolution (Bit)**	**Resolution [measure]**	**Accuracy (@ $T_{Ambient}$ = 25 °C)**	**Display**
LM235	12 Bit	−40…+125 °C : 0,12 °C	0,2 % des gemessenen Wertes ±0,5 °C	−400…1250 [1]

[1] This is the output value of the FBox for linearization. The module gives a voltage 0 … 5'000 mV.

For an example of the utilization of a LM235 sensor, please see the chapter „Example of linearization“.

Connection circuit

The module is connected to the PCD3 by the I/O bus connector. It can be plugged into all PCD3 versions. The module is fully powered via the PCD bus. An external power supply is not required.

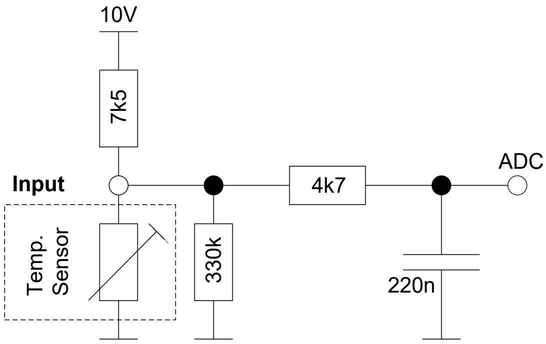
The inputs are connected with the module by two 10-pins connectors for cables up to 1 mm². These connectors are very reliable and providing 2 pins per channel, one for the input and the other connected to the ground. In each connector, 2 pins are connected to the ground and can be used by user. In each connector, one of these pins should be used as protective ground connection to avoid immunity problems against external perturbations. A wire with a section of 1 mm² and a maximum length of 20 cm is recommended for a good PGND connection. (see **Connection concept (Example)**).

Every measurement mode has an equivalent input stage.

Temperature and resistance measurements

For resistance measurements (temperature sensors), 10 V are provided through a 7,5 kΩ resistor to the input.

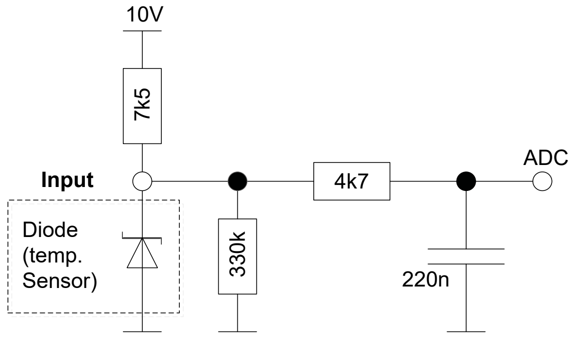
Equivalent schematic of input in temperature and resistance mode.



Diode mode

In “Diode” mode, the module measures voltages in an “active” way. The schematic is the same as the mode for resistance measurements. The output values are given in [mV]. This mode is useful for temperature sensors as LM235.

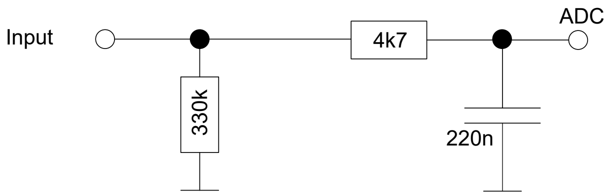
Equivalent schematic of input in "diode" mode



Voltage measurements

In voltage measurements, the input is “directly” connected to the ADC.

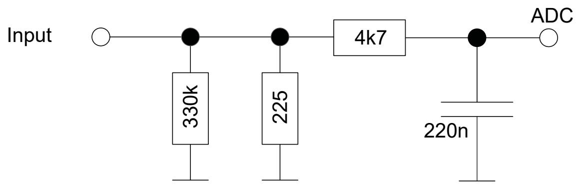
Equivalent schematic of input in "voltage" mode



Current measurements

For current measurements, a shunt of 225 Ω is connected to the ground.

Equivalent schematic of input in "current" mode



Configurable digital filters

Each channel can be configured with a digital filter. Four possibilities are available:

Disabled	Each channel value is updated in buffer every 680 µs (f = 1,47 kHz)
3 ms	Mean of 4 cycles, value updated every 2,72 ms (f = 367 Hz)
6 ms	Mean of 8 cycles, value updated every 5,44 ms (f = 184 Hz)
12 ms	Mean of 16 cycles, value updated every 10,88 ms (f = 92 Hz)

Input values acquisition

The module is able to acquire and convert the each channel one by one, with a total cycle time of 680 µs:

CH0 → CH1 → CH2 → CH3 → CH4 → CH5 → CH6 → CH7 → CH0 → ...

680 µs

Out of range indication

The module has an out of range indication. This information can be read in the registers “OutOfRange” (1 bit per input). The table on the right shows the values setting the bits “Out Of Range.

Limit values for overrange and underrange

	“Out of range” bit set ..	
Modus	**Limit min**	**Limit max**
Voltage −10 … +10 V	N/A	N/A
Current −20 … +20 mA	−20'002 µA	+20'002 µA
Resistance 0 … 2'500 Ω	N/A	2'518,7 Ω
Resistance 0 … 300 kΩ	N/A	302'010 Ω
Pt 1000	−50,0 °C	+408,7 °C
Ni 1000	−50,0 °C	+210,3 °C
Ni 1000 L&G	−30,0 °C	+130 °C
Diode 0 … 5'000 mV	N/A	4'999 mV

N/A = means not available.

Input protections

The design supports an input voltage between −20 V to +20 V in all the modes of measurement. It can be considered a passive protection. Higher values can damage the module. For voltages higher than ±13 V a current passes through the circuit. It can be calculated approximately:

$I_{overvoltage}$ = (Vin – 13 V) / 225 Ω.

In this situation, the values measured on the other channels can be falsified.

For some measuring ranges active protection circuits are also available. As soon as a protection circuit is triggered by too high a signal, the corresponding bit in the "Module Error" register is set.

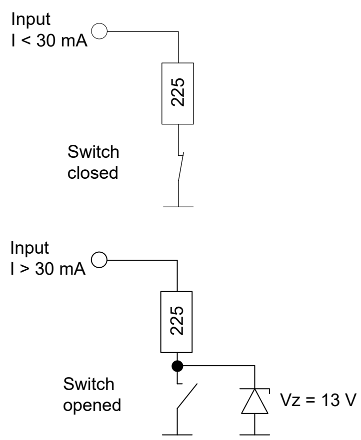
Current measuring range

If current mode is chosen the measuring shunt is connected to ground through the switch as shown in the picture on the left.

In case the current is higher than 30 mA* the switch opens to protect the measuring shunt. For voltage lower than ±13 V on the opened input the current will be kept lower than 1 mA. If the voltage on the opened input rises above ±13 V the current can be approximately calculated using the formula:

$I_{overvoltage}$ = (Vin – 13 V) / 225 Ω

Care should be taken to keep input voltage below ±20 V.



* HW version ‘A’ and ‘A1’: Limit = ±24 mA

Protection mode

The input stage configuration (switch) is automatically modified when the module enters in protection mode. The input values of the others channels could be out of the specified tolerances when a channel is in protection mode.

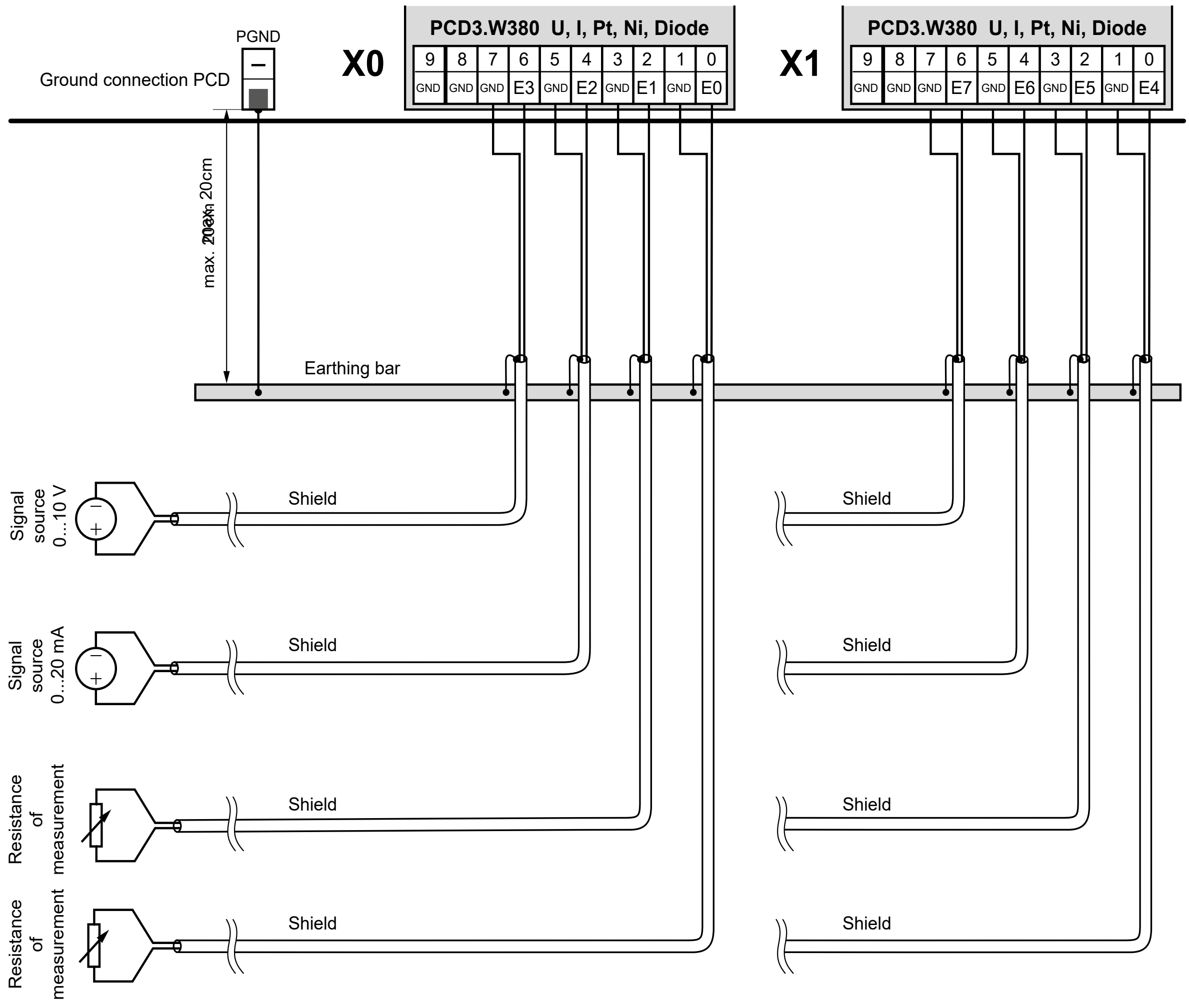
The modules from version ‘A2’ have an automatic reconfiguration mechanism after the active protection has become active. Once triggered, the input will remain for 10 seconds in protection mode. After 10 seconds, the input will switch back to normal operating configuration. If the input is still in overload condition, protection will again be activated. This feature is available only with firmware version greater than 1.24.10.

For Modules with version ‘A’ or ‘A1’ the protection will also be activated when an overload occurs, but to switch back to normal operation mode the PCD has to be restarted.

Connection concept (Example)

The sensors are connected directly to the respective 10-pole terminal blocks. In order to couple as little interference as possible to the module via the lines, the connection should be made according to the principle explained below.

Connection examples (define input type in the Device Configurator)

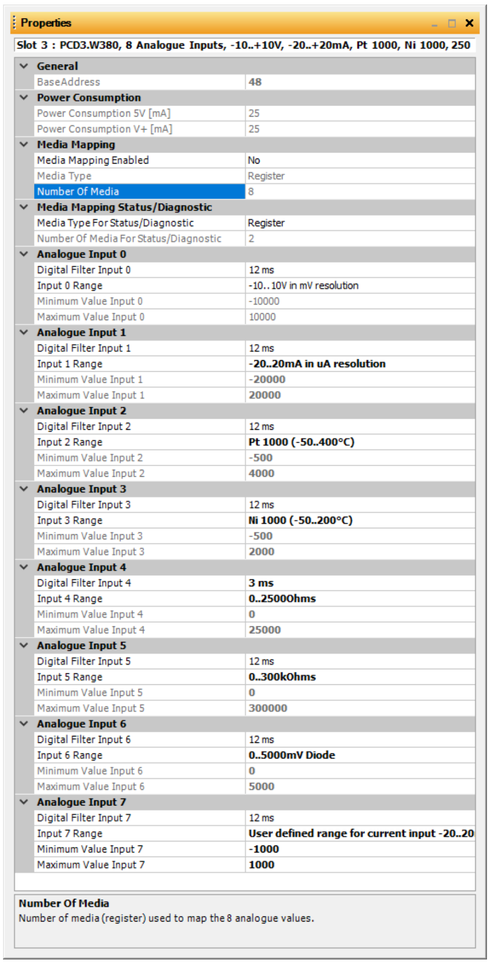


Classic	For programming the modules PCD3.W380, no FBox is available.
Classic	The PCD used for the module PCDx.W380 must be updated with a firmware version 1.22.28 or higher. Please, download the last firmware version from the support website and load it in the PCD with the PG5 Firmware Downloader Tool.
xx7	**xx7 and RIOs** The firmware reads in the values according to the configuration (I/O Builder or network configurator).
!	**Watchdog** This module can be used on all base addresses; there is no interaction with the watchdog on the CPUs.
i	Further information can be found in the Manual on "27-600_ENG I/O-modules for PCD1 / PCD2 and PCD3 series".

Configuration

Saia PG5® Controls Suite

PCD-System	Evaluation
Classic	The evaluation is performed by the firmware. It reads the values according to the configuration (Device Configurator or Network Configurator).



Properties

Slot 3 : PCD3.W380, 8 Analogue Inputs, -10..+10V, -20..+20mA, Pt 1000, Ni 1000, 250

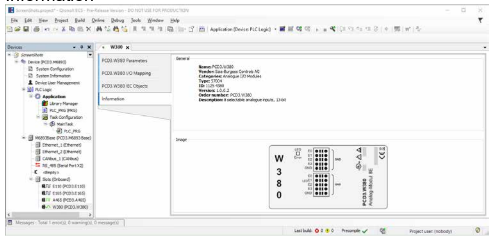
General	
BaseAddress	48
Power Consumption	
Power Consumption 5V [mA]	25
Power Consumption V+ [mA]	25
Media Mapping	
Media Mapping Enabled	No
Media Type	Register
Number Of Media	8
Media Mapping Status/Diagnostic	
Media Type For Status/Diagnostic	Register
Number Of Media For Status/Diagnostic	2
Analogue Input 0	
Digital Filter Input 0	12 ms
Input 0 Range	-10..10V in mV resolution
Minimum Value Input 0	-10000
Maximum Value Input 0	10000
Analogue Input 1	
Digital Filter Input 1	12 ms
Input 1 Range	-20..20mA in uA resolution
Minimum Value Input 1	-20000
Maximum Value Input 1	20000
Analogue Input 2	
Digital Filter Input 2	12 ms
Input 2 Range	Pt 1000 (-50..400°C)
Minimum Value Input 2	-500
Maximum Value Input 2	4000
Analogue Input 3	
Digital Filter Input 3	12 ms
Input 3 Range	Ni 1000 (-50..200°C)
Minimum Value Input 3	-500
Maximum Value Input 3	2000
Analogue Input 4	
Digital Filter Input 4	3 ms
Input 4 Range	0..25000hms
Minimum Value Input 4	0
Maximum Value Input 4	25000
Analogue Input 5	
Digital Filter Input 5	12 ms
Input 5 Range	0..300kOhms
Minimum Value Input 5	0
Maximum Value Input 5	300000
Analogue Input 6	
Digital Filter Input 6	12 ms
Input 6 Range	0..5000mV Diode
Minimum Value Input 6	0
Maximum Value Input 6	5000
Analogue Input 7	
Digital Filter Input 7	12 ms
Input 7 Range	User defined range for current input -20..20
Minimum Value Input 7	-1000
Maximum Value Input 7	1000

Number Of Media
Number of media (register) used to map the 8 analogue values.

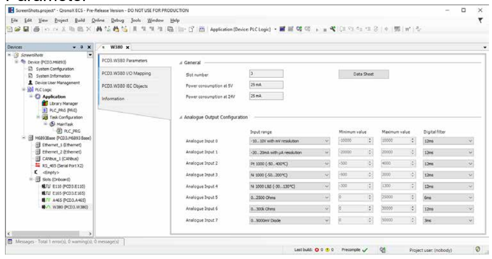
Saia Qronox ECS Engineering and Commisioning Suite

PCD-System	Evaluation
IEC-Controller	The evaluation is performed by the firmware. It reads the values according to the configuration (Device Configurator)

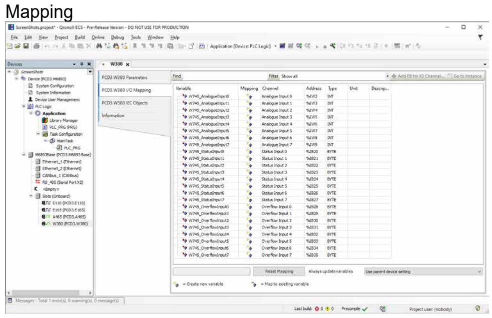
Information



Parameter



Mapping

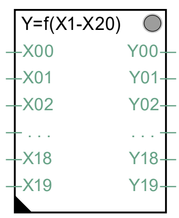


Example of linearization

The choice of NTC sensors is not available in the Device Configurator because these sensors are not standardized. To use a NTC with the module PCD3.W380, please configure the desired channel in mode “0…300 kΩ” and use the linearization FBox available in PG5 environment. This FBox can be used to enter the own tables for the conversion of a resistance value in a temperature value.

A project example can be downloaded from the SBC Support Website at this location:
https://sbc-support.com/en/produkt-index/pcd3/wxxx-analoge-io/w3xx-analoge-inputs

▶ Software Program example for PCD3.W380, linearization of analogue values.



FBox
HLK > General > "Conversion20 points"

This project example can be used for temperature measurements with integrated circuits operating as a 2-terminal zener too. This FBox can be used to enter the own tables for the conversion of a voltage value in a temperature value. The desired channel must be configured in mode „Diode 0…5000 mV“.

ATTENTION

These devices must only be installed by a professional electrician, otherwise there is the risk of fire or the risk of an electric shock.

WARNING

Product is not intended to be 0used in safety critical applications, using it in safety critical applications is unsa-fe.

WARNING - SAFETY

The unit is not suitable for the explosion-proof areas and the areas of use excluded in EN 61010 Part 1.

WARNING - SAFETY

Check compliance with nominal voltage before commissioning the device (see type label). Check that connection cables are free from damage and that, when wiring up the device, they are not connected to voltage.
Do not use a damaged device !

NOTE

In order to avoid moisture in the device due to condensate build-up, acclimatise the device at room temperature for about half an hour before connecting.

CLEANING

The device can be cleaned in dead state with a dry cloth or cloth soaked in soap solution. Do not use caustic or solvent-containing substances for cleaning.

MAINTENANCE

These devices are maintenance-free.
If damaged during, no repairs should be undertaken by the user.

GUARANTEE

Opening the module invalidates the guarantee.

Observe this instructions (data sheet) and keep them in a safe place.
Pass on the instructions (data sheet) to any future user.

WEEE Directive 2012/19/EC Waste Electrical and Electronic Equipment directive
The product should not be disposed of with other household waste. Check for the nearest authorized collection centers or authorized recyclers. The correct disposal of end-of-life equipment will help prevent potential negative consequences for the environment and human health.

EAC Mark of Conformity for Machinery Exports to Russia, Kazakhstan or Belarus.

PCD3.W380

4 405 5048 0

Ordering information

Type	Short description	Description	Weight
PCD3.W380	Analogue input module 8 inputs, 13 bits resolution	Universal analogue input module, 8 channels, 13 bits (12 bits + sign), selectable by software, 0 … 10 V, ± 10V, 0(4) … 20 mA, ± 20 mA, Pt/Ni 1000, 0 … 2500 Ohm, 0 … 300 kOhm (for NTC sensors), Plug-in spring terminal block (2 connectors type K (4 405 5048 0) included).	80 g

Ordering information Accessories

Type	Short description	Description	Weight
4 405 5048 0	connector type K	Plug-in spring terminal block, 2×5 pole up to 1.0 mm^2 (orange block), labelled 0 … 9, connector type "K"	15 g

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