

1 AI8 (ANALOG INPUT UNIT)

**AI8C D201134,
AI8V D201135**

1.1 USE

The AI8 units are eight-channel analog input units used to measure analog current and voltage signals.

The AI8C D201134 unit is intended for measuring 0/4...20 mA current signals and the AI8V D201135 unit for measuring 0/2...10 V voltage signals.

Each channel of the unit AI8C has an independent power supply for the transmitter. The supply is current-limited and the supply voltage is monitored.

The AI8V unit does not have power supplies for the transmitter and it is only suited for active transmitter connection.

The measuring range can be selected and normalized by software. Analog RF low-pass filtering and software digital filtering are carried out on the incoming signals.

The AI8 units monitor short-circuits and breaks in the field circuit as well as exceeding of the high or low limit of the measuring range.



1.2 TECHNICAL SPECIFICATIONS

1.2.1 Structure

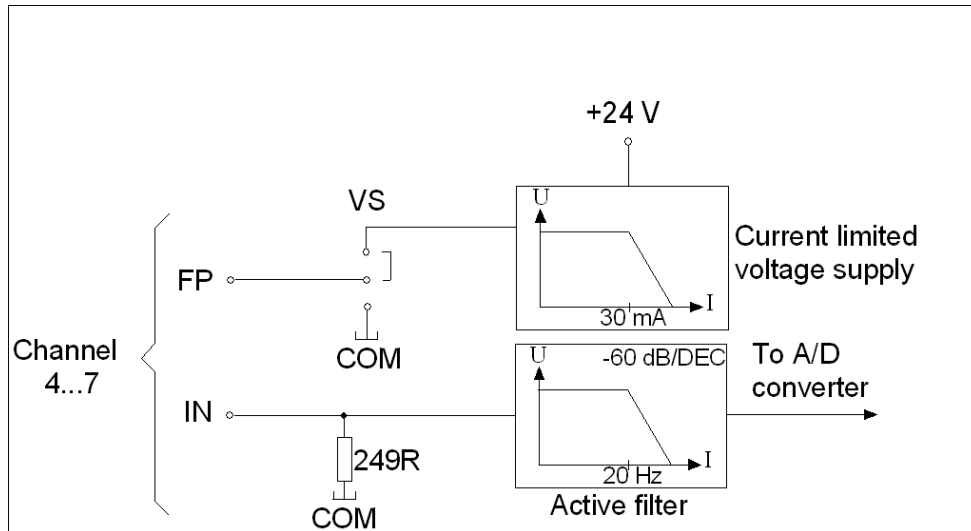
- the size of the casing: 95 mm x 24 mm x 95 mm [H x W x D]
- weight: 90 g

1.2.2 Field interfaces

Inputs	AI8C D201134	AI8V D201135
Number of channels	8	
Measuring range	0...20 mA or 4...20 mA	0...10 V or 2...10 V
Input impedance	249 Ω	> 1 M Ω
Channel-specific current limit	30 mA	–
Voltage supplies for transmitters [VS]	U _{NOM} = 24 VDC, U _{MIN} = 21 VDC	–
Accuracy relative to the measuring range	0.1 % @ 25 °C + 0.05 %/10 °C	
AD resolution	16 bit	
Filtering	–3 dB, 20 Hz	
Parameterizable filtering by software	35 ms...81 s	
Measuring interval	4.4 ms	
Field circuit current supply	Operating voltage	

1.3 INPUT CIRCUIT

1.3.1 AI8C



* FP is fixed to VS on channels 0...3. FP is selectable as VS or COM on channels 4...7.

The flat cable connectors on the MB2 and MB8 mounting bases are connected according to the following table:

FP = VS or COM, IN = Input, CH = channel

CH	0	1	2	3	4	5	6	7
Pin	2	4	6	8	10	12	14	16
	IN	IN	IN	IN	IN	IN	IN	IN
Pin	1	3	5	7	9	11	13	15
	VS	VS	VS	VS	FP	FP	FP	FP

The connecting order for the cable connector signals of CXS, CXW and CXR cross connection boards is as follows:

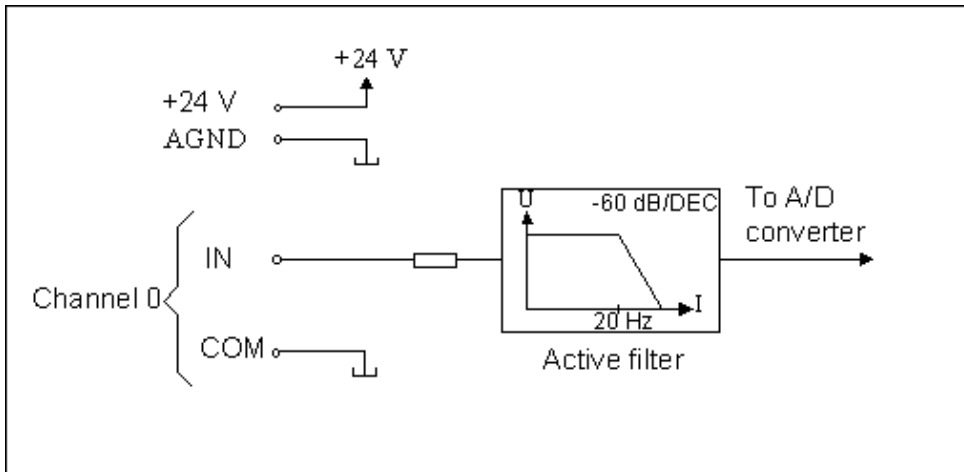
CH	7	7	6	6	5	5	4	4	3	3	2	2	1	1	0	0
AI8C	IN	FP	IN	FP	IN	FP	IN	FP	IN	VS	IN	VS	IN	VS	IN	VS
CXx	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1

There are two versions of the connection units for the MB2 and MB8 mounting bases. With the FCx units, FCS S446105 and FCR S446106, the connection order is as listed in the table below:

Pin	Signal	Pin	Signal	Pin	Signal	Pin	Signal
13	Ch6 FP	14	Ch6 IN	15	Ch7 FP	16	Ch7 IN
9	Ch4 FP	10	Ch4 IN	11	Ch5 FP	12	Ch5 IN
5	Ch2 VS	6	Ch2 IN	7	Ch3 VS	8	Ch3 IN
1	Ch0 VS	2	Ch0 IN	3	Ch1 VS	4	Ch1 IN

FP is either VS or COM depending on the switch settings on the AI8C unit.

1.3.2 AI8V



The flat cable connectors on the MB2 and MB8 mounting bases are connected according to the following table:

C = COM, IN = Input, CH = channel

CH	0	1	2	3	4	5	6	7
Pin	2 IN	4 IN	6 IN	8 IN	10 IN	12 IN	14 IN	16 IN
Pin	1 C	3 C	5 C	7 C	9 C	11 C	13 C	15 C

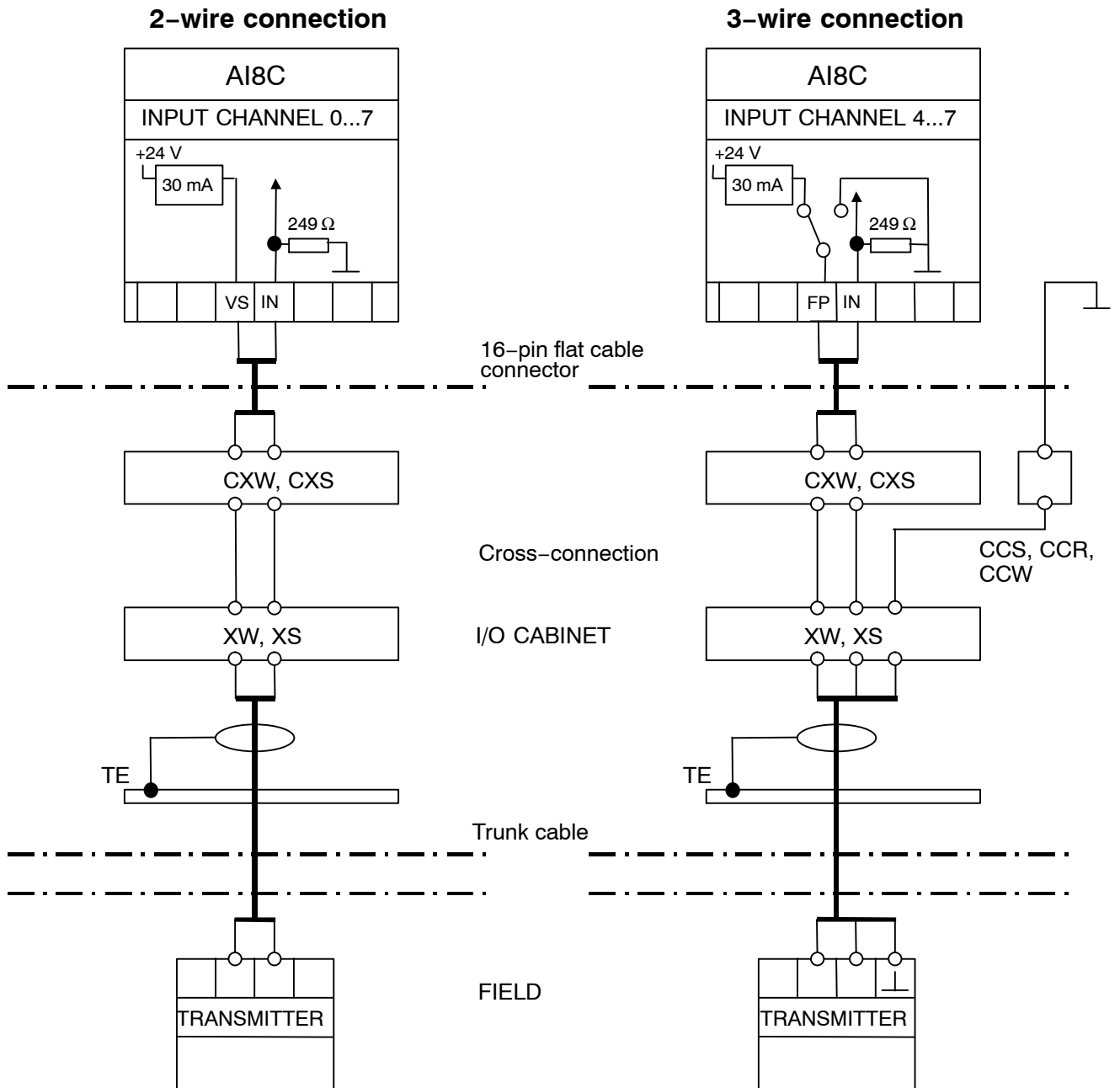
The connecting order for the cable connector signals of CXS, CXW and CXR cross connection boards is as follows:

CH	7	7	6	6	5	5	4	4	3	3	2	2	1	1	0	0
AI8V	IN	C	IN	C	IN	C	IN	C	IN	C	IN	C	IN	C	IN	C
CXx	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1

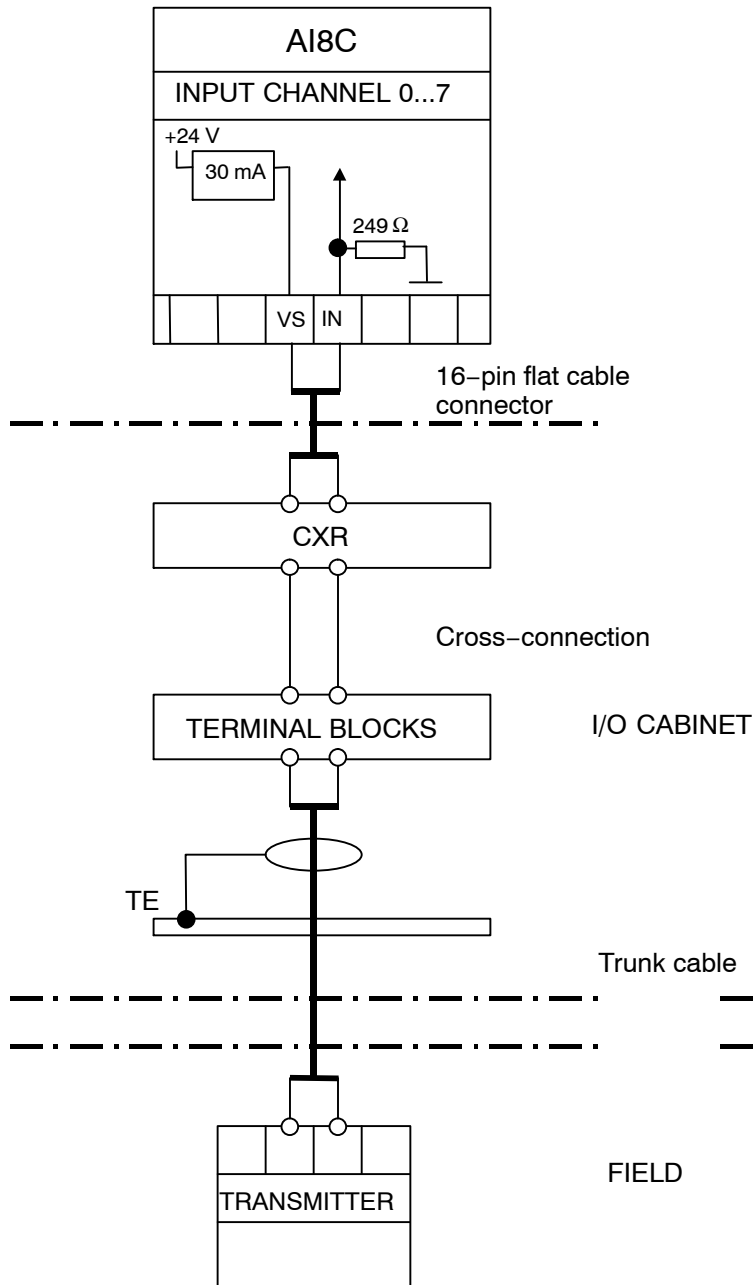
There are two versions of the connection units for the MB2 and MB8 mounting bases. With the FCx units, FCS S446105 and FCR S446106, the connection order is as listed in the table below:

Pin	Signal	Pin	Signal	Pin	Signal	Pin	Signal
13	Ch6 COM	14	Ch6 IN	15	Ch7 COM	16	Ch7 IN
9	Ch4 COM	10	Ch4 IN	11	Ch5 COM	12	Ch5 IN
5	Ch2 COM	6	Ch2 IN	7	Ch3 COM	8	Ch3 IN
1	Ch0 COM	2	Ch0 IN	3	Ch1 COM	4	Ch1 IN

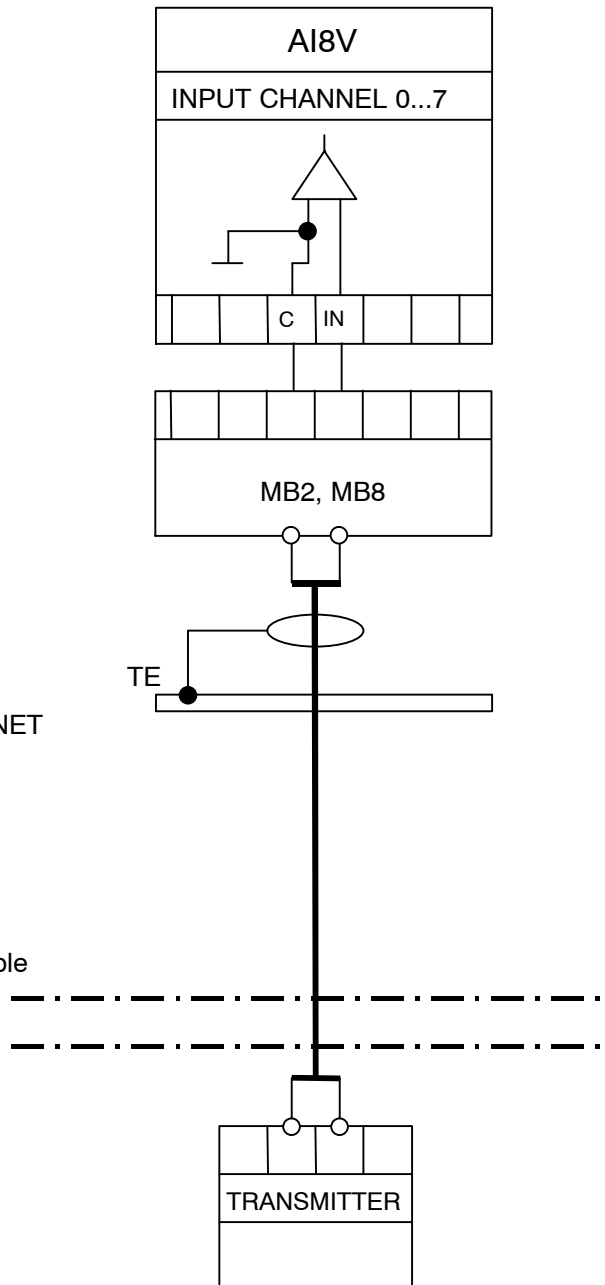
1.3.3 Example connections



Terminal block cross-connection

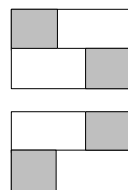


Without cross-connection



1.4 SELECTOR SWITCHES

The AI8C unit has 8 selector switches, with which it is possible to either enable or disable transmitter—specifically the operating voltage supply for channels 4..7, as indicated in the picture below. The card's default factory setting is that the unit supplies operating voltage for each channel. The operating voltage supply is +24 VDC. The selector switches are located on the rear panel of the unit next to the unit connectors. Channels 0..3 are always supplied with operating voltage from the unit. The AI8V unit has no selector switches.



Operating voltage supply to the transmitter enabled

Operating voltage supply to the transmitter disabled

switch no.	channel no.
8	7
7	
6	6
5	
4	5
3	
2	4
1	

1.5 SIGNAL LIGHTS

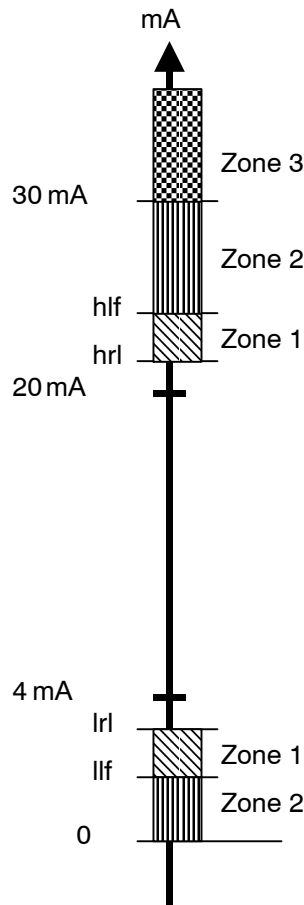
There are eight red signal lights on the unit marked 0...7.

The signal light is lit continuously red, if there is a break or a short-circuit in the field circuit of the channel. The signal light is blinking red at a frequency of 3 Hz when the high or low alarm limit of the channel's measuring range has been exceeded.

The operation of the signal lights can be affected using the configuration parameter "Line fault control" (lfcntrl).



1.6 FAULT BITS



When the measured value is in Zone 1, the default action is to approve the newest measurement read from the I/O unit and add the fault bit 'OVF' to it. The Zone 1 limits are specified using the configuration symbol parameters "Measurement low limit" (lrl), "Line fault low limit" (lfl), "Measurement high limit" (hrl) and "Line fault high limit" (hlf). Measurement processing and the operation of the OVF fault bit can be controlled with the "Line fault control" (lfcntrl) parameter.

When the measured value is in Zone 2, the default action is that the newest measurement read from the I/O unit is not approved, the measurement freezes and fault bits 'EXT' and 'OLD' are added to it. The Zone 2 limits are specified using the configuration symbol parameters "Line fault low limit" (lfl) and "Line fault high limit" (hlf). Measurement processing and the operation of the 'EXT' and 'OLD' fault bits can be controlled by using the "Behavior if 'EXT' is on" (extcntrl) and "Line fault control" (lfcntrl) parameters.

When the measured value is in Zone 3, the newest measurement read from the I/O unit is not approved, the measurement freezes and fault bits 'EXT' and 'OLD' are added to it.

In fault situations in which the process control server is not able to read a new measurement from the I/O unit, the default action is that the measurement freezes and the fault bit 'OLD' is added to it. Measurement processing and the operation of the 'OLD' fault bit can be controlled by using the "Input fault control" (infcntrl) parameter of the configuration symbol.

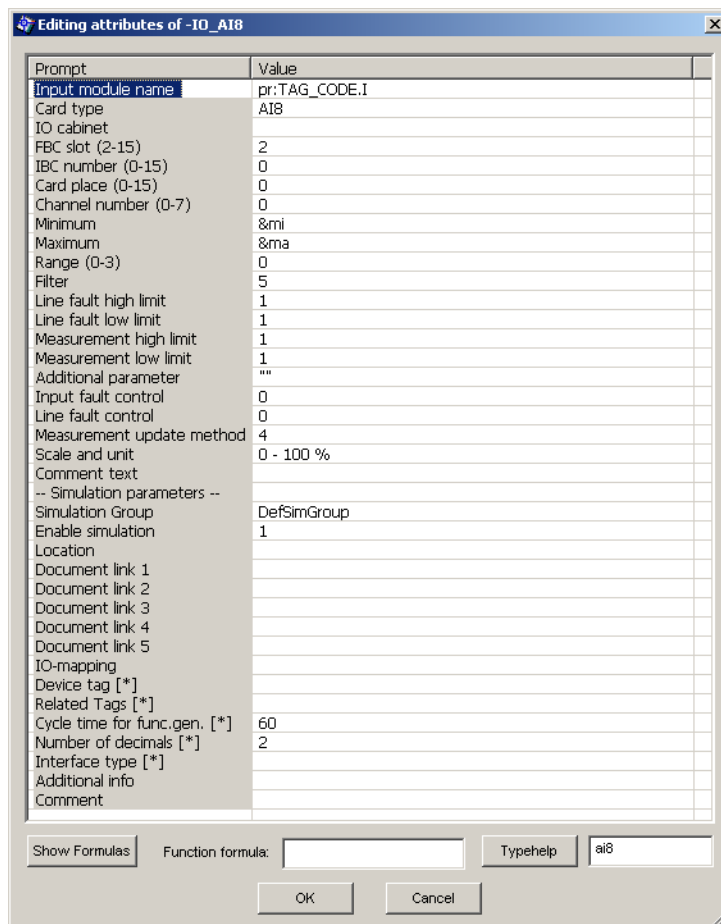
1.7 CONFIGURATION

1.7.1 Symbols

The symbols can be added in the I/O – MIO M80 menu of the FbCAD tool.

MIO	M80	AI8
pr:TAG_CODE.I		
Address	2	0 : 0 : 0
Measurement		:m
Scale and unit	0 - 100 %	

The parameters and default values of the symbol:



1.7.2 Parameters connected to run-time operation

Input module name

I/O function identifier.

Card type

I/O unit's exact type.

IO cabinet

The identifier of the I/O cabinet where the I/O unit is located.

FBC slot (2–15)

FBC slot number.

IBC number (0–15)

IBC Bus Controller number.

Card place (0–15)

I/O unit's place in I/O group.

Channel number (0–7)

I/O channel number.

Minimum (min)

Lower scale limit.

&mi string means that the value is read from the "Scale and unit" parameter's low limit value.

Maximum (max)

Upper scale limit.

&ma string means that the value is read from the "Scale and unit" parameter's high limit value.

Range (0–3) (range)

Input signal range of the I/O's analog input channel, encoded as follows:

Analog input channel of the current range:

0 = 4...20 mA, measurement can be outside of Minimum and Maximum.

- 1 = 0...20 mA, measurement can be outside of Minimum and Maximum.
- 2 = 4...20 mA, measurement is limited between Minimum and Maximum.
- 3 = 0...20 mA, measurement is limited between Minimum and Maximum.

Analog input channel of the voltage range:

- 0 = 2...10 V, measurement can be outside of Minimum and Maximum.
- 1 = 0...10 V, measurement can be outside of Minimum and Maximum.
- 2 = 2...10 V, measurement is limited between Minimum and Maximum.
- 3 = 0...10 V, measurement is limited between Minimum and Maximum.

Filter (filt)

Software filtering on analog input channel of the I/O (-20 dB/decade); -3 dB cut-off frequency, encoded as follows:

0 =	no software filtering	7 =	0.064 Hz (2.5 s)
1 =	4.7 Hz (34 ms)	8 =	0.031 Hz (5.2 s)
2 =	2.1 Hz (74 ms)	9 =	0.016 Hz (10 s)
3 =	1.0 Hz (160 ms)	10 =	0.0078 Hz (21 s)
4 =	0.50 Hz (320 ms)	11 =	0.0039 Hz (40 s)
5 =	0.25 Hz (630 ms)	12 =	0.0020 Hz (81 s)
6 =	0.12 Hz (1.3 s)		

Line fault high limit (hlf)

Line fault high limit is encoded as follows:

	0/4...20 mA	0/2...10 V
0 =	21.0 mA	10.50 V
1 =	22.0 mA	11.00 V
2 =	23.5 mA	11.75 V
3 =	24.8 mA	12.40 V

Line fault low limit (llf)

Line fault low limit is encoded as follows:

	4...20 mA	2...10 V
0 =	3.0 mA	1.50 V
1 =	2.0 mA	1.00 V
2 =	1.0 mA	0.50 V
3 =	0.2 mA	0.10 V

With a measurement range of 0...20 mA / 0...10 V only the higher limit will be monitored. Monitoring is done from the actual measurement before the software filtering.

Measurement high limit (hrl)

The high limit of measurement range is encoded as follows:

	0/4...20 mA	0/2...10 V
0 =	20.5 mA	10.25 V
1 =	21.0 mA	10.50 V
2 =	22.0 mA	11.00 V
3 =	22.5 mA	11.25 V

Measurement low limit (lrl)

The low limit of measurement range is encoded as follows:

	4...20 mA	2...10 V
0 =	3.8 mA	1.90 V
1 =	3.6 mA	1.80 V
2 =	2.8 mA	1.40 V
3 =	2.0 mA	1.00 V

With a measurement range of 0...20 mA / 0...10 V only the higher limit will be monitored. Monitoring is done from the actual measurement before the software filtering.

Behavior if "EXT" is on (extcntrl)

Behavior of the measurement if line fault "EXT" is on

- 0 = no freezing of measurement
- 1 = measurement will be frozen at the last known good value.

Additional parameter (a_param)

Input fault control (infcntrl)

This parameter specifies the measurement value, which is returned to PCS, when there is no connection to IBC or to I/O unit. This parameter is used when the user wants to control the measurement value in the case of power supply failure, when I/O has no backup power supply.

This parameter determines the value returned to the process control server and the unnecessary alarms generated by the fault bits can be avoided. This parameter has no effect on the OVF fault bit.

Input fault control parameter is encoded as follows:

- 0 Measurement freezes and OLD fault bit is set.
- 1 If connection to IBC but not to I/O unit, both the measurement value and the fault bits remain as they are. If no connection to IBC, measurement freezes and OLD fault bit is set.
- 2 If connection to IBC but not to I/O unit, measurement value is set to 0%, no change to fault bits. If no connection to IBC, measurement freezes and OLD fault bit is set.

- 3 If connection to IBC but not to I/O unit, measurement value is set to 0%, OLD fault bit is set. If no connection to IBC, measurement freezes and OLD fault bit is set.
- 4 If connection to IBC but not to I/O unit, measurement value is set to 100%, no change to fault bits. If no connection to IBC, measurement freezes and OLD fault bit is set.
- 5 If connection to IBC but not to I/O unit, measurement value is set to 100%, OLD fault bit is set. If no connection to IBC, measurement freezes and OLD fault bit is set.
- 6 If no connection to I/O unit, both the measurement value and the fault bits remain as they are.
- 7 If no connection to I/O unit, measurement value is set to 0%, no change to fault bits.
- 8 If no connection to I/O unit, measurement value is set to 0%, OLD fault bit is set.
- 9 If no connection to I/O unit, measurement value is set to 100%, no change to fault bits.
- 10 If no connection to I/O unit, measurement value is set to 100%, OLD fault bit is set.

Line fault control (lfcntrl)

Line fault control on analog input channel of the I/O is encoded as follows:

- 0 Measurement freezes, EXT and OLD fault bits are set, diagnostic alarm is generated, channel's signal light is lit.
- 1 Measurement freezes, EXT and OLD fault bits are set, diagnostic alarm is not generated, channel's signal light is not lit.
- 2 Measurement, EXT fault bit is set, diagnostic alarm is generated, channel's signal light is lit.
- 3 Measurement, EXT fault bit is set, diagnostic alarm is not generated, channel's signal light is not lit.
- 4 Measurement, EXT fault bit is not set, diagnostic alarm is generated, channel's signal light is lit.
- 5 Measurement, EXT fault bit is not set, diagnostic alarm is not generated, channel's signal light is not lit.
- 6 Measurement value is set to 0%, EXT fault bit is set, diagnostic alarm is generated, channel's signal light is lit.
- 7 Measurement value is set to 0%, EXT fault bit is set, diagnostic alarm is not generated, channel's signal light is not lit.
- 8 Measurement value is set to 0%, EXT fault bit is not set, diagnostic alarm is generated, channel's signal light is lit.
- 9 Measurement value is set to 0%, EXT fault bit is not set, diagnostic alarm is not generated, channel's signal light is not lit.
- 10 Measurement value is set to 100%, EXT fault bit is set, diagnostic alarm is generated, channel's signal light is lit.
- 11 Measurement value is set to 100%, EXT fault bit is set, diagnostic alarm is not generated, channel's signal light is not lit.
- 12 Measurement value is set to 100%, EXT fault bit is not set, diagnostic alarm is generated, channel's signal light is lit.
- 13 Measurement value is set to 100%, EXT fault bit is not set, diagnostic alarm is not generated, channel's signal light is not lit.

NOTE!

In case of current supply overload (>30 mA) the "Line fault control" (lfcntrl) parameter value has no effect. Operation is the same as when the "Line fault control" (lfcntrl) value is 0.

NOTE!

The function of the parameter “Behavior if ”EXT” is on” (extctrl) (parameter of I/O unit) is independent of the function of the parameter “Line fault control” (lfctrl) (parameter of FBC).

Measurement update method (upd)

The update method parameter is used to optimize bus transfers to enable fast measurements (≤ 20 ms control cycles).

0 = every cycle

1 = every 20 ms

2 = every 50 ms

3 = every 100 ms

4 = optimized to control task (CT) speed

If $CT < 200$ ms \rightarrow upd = 0

If $CT \geq 200$ ms \rightarrow upd = 1

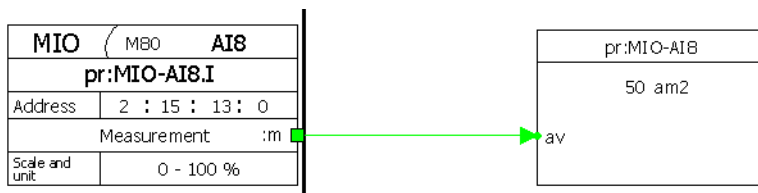
If $CT \geq 500$ ms \rightarrow upd = 2

If $CT \geq 1000$ ms \rightarrow upd = 3

If upd > 0, values from different channels may come from different time points.

Scale and unit

The signal is scaled to these values. The unit is a comment that is visible only in the CAD diagram.

Comment text**1.7.3 Example connection****1.8 EC DECLARATION OF CONFORMITY**

EC Declaration of Conformity is described in section ”EC Declarations of Conformity”.

