

6.6 Analog input module SM 331; AI 8 x 13 Bit; (6ES7331-1KF02-0AB0)

Order number

6ES7331-1KF02-0AB0

Properties

- 8 inputs in 8 channel groups
- Programmable resolution at each channel group (12 bits + sign)
- Programmable measurement type per channel group:
 - Voltage
 - Current
 - Resistance
 - Temperature
- Any measuring range per channel
- Motor protection / temperature monitoring with PTC in accordance with IEC 60034-11-2 type A
- Temperatures detected via KTY83/110, KTY84/130 silicon temperature sensors

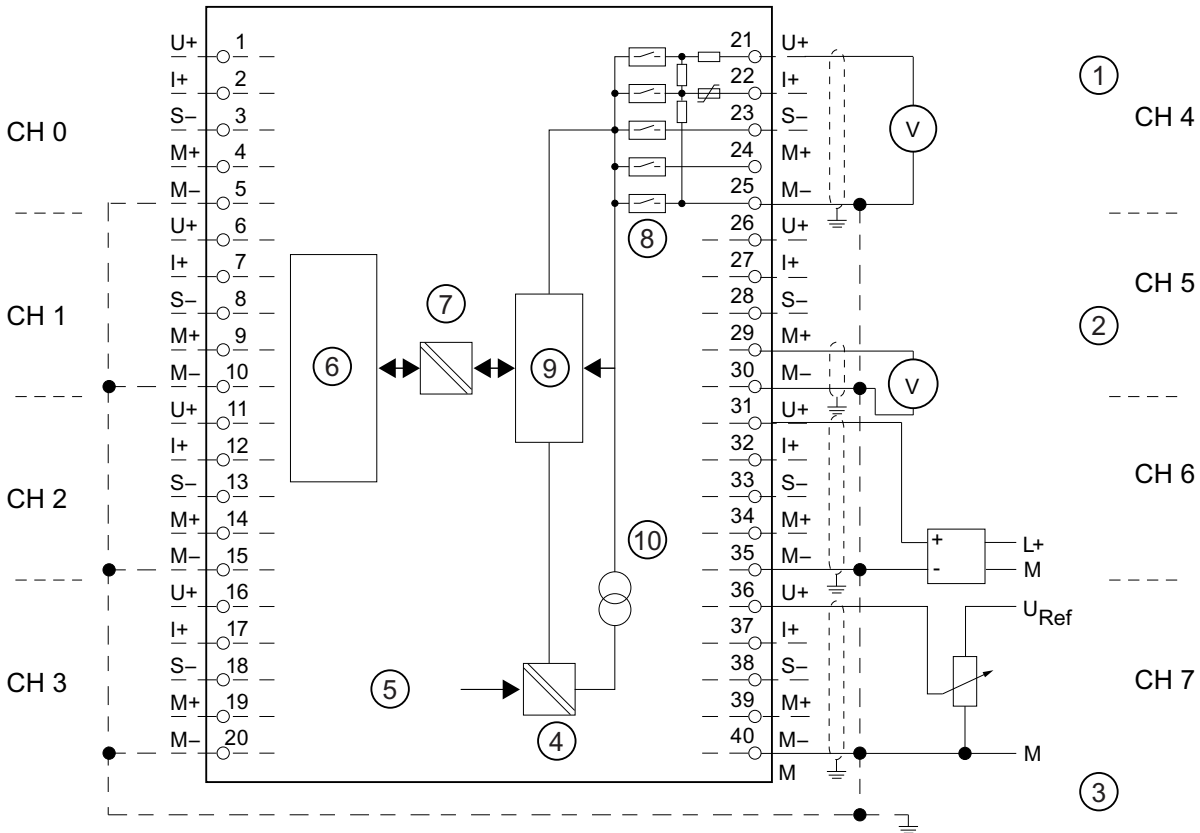
Terminal assignment

The diagrams below show various wiring options. These examples apply to all channels (channel 0 to 7).

Note

When connecting voltage and current transducers, make sure that the maximum permitted common-mode voltage C_{MV} of 2 V is not exceeded between the inputs. Prevent measuring errors by interconnecting the corresponding M- terminals.

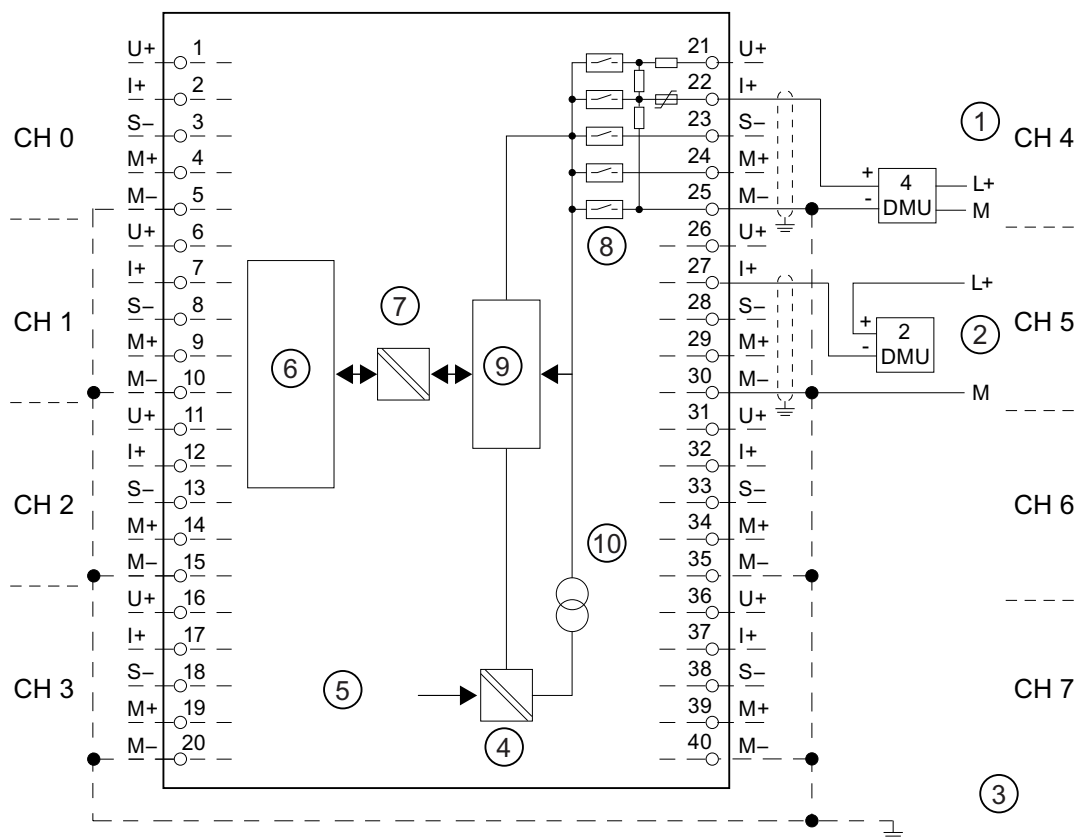
Wiring: Voltage measurement



- ① Voltage measurement ($\pm 5\text{ V}$, $\pm 10\text{ V}$, 1 V to 5 V , 0 V to 10 V)
- ② Voltage measurement ($\pm 50\text{ mV}$, $\pm 500\text{ mV}$, $\pm 1\text{ V}$) (note the input resistance defined in the technical data)
- ③ Equipotential bonding
- ④ Internal supply
- ⑤ + 5 V from backplane bus
- ⑥ Logic and backplane bus interface
- ⑦ Electrical isolation
- ⑧ Multiplexer
- ⑨ Analog digital converter (ADC)
- ⑩ Current source

Figure 6-10 Block diagram and terminal diagram

Wiring: 2-wire and 4-wire transducers for current measurement

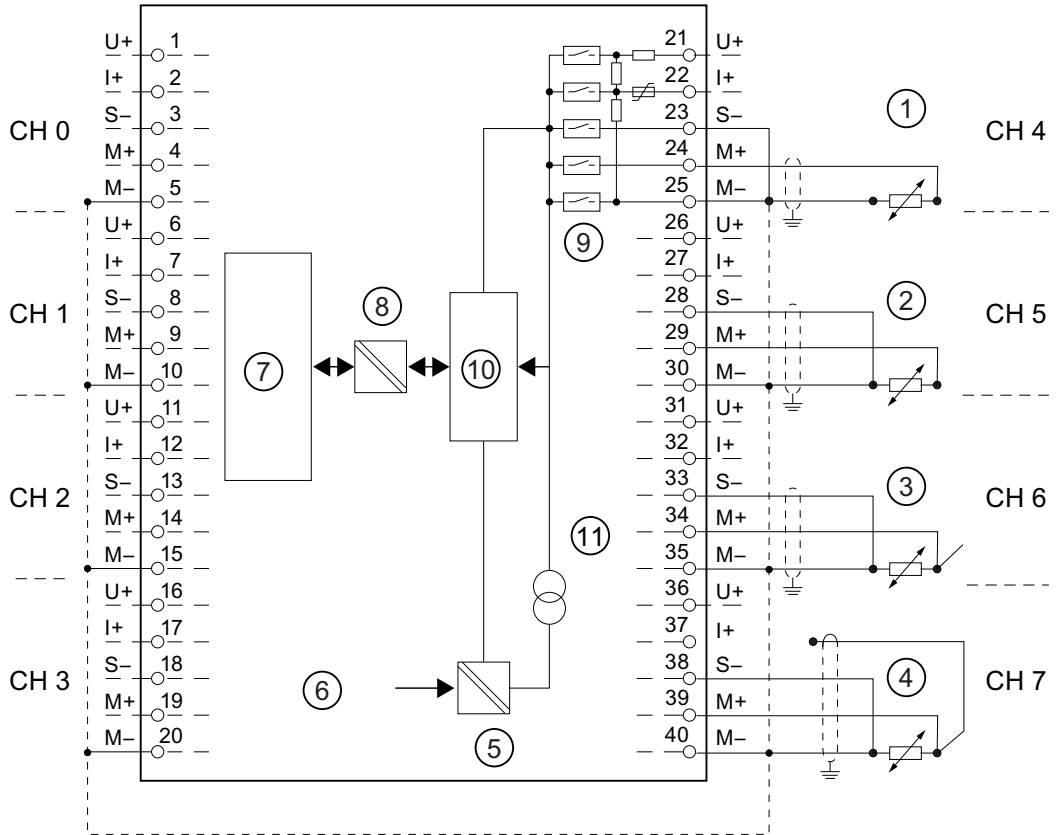


- ① 4-wire transducer (0/4 mA to 20 mA or ± 20 mA)
- ② 2-wire transducer (4 mA to 20 mA)
- ③ Equipotential bonding
- ④ Internal supply
- ⑤ + 5 V from backplane bus
- ⑥ Logic and backplane bus interface
- ⑦ Electrical isolation
- ⑧ Multiplexer
- ⑨ Analog to Digital Converter (ADC)
- ⑩ Current source

Figure 6-11 Block diagram and terminal diagram

Wiring: Resistance measurement with 2-, 3- and 4-wire connection

The following connection possibilities also apply to silicon temperature sensors and PTCs.



- ① 2-wire connection. Insert a bridge between M and S (no line resistance compensation).
- ② 3-wire connection
- ③ 4-wire connection. The fourth line may not be wired (remains unused)
- ④ 4-wire connection. The fourth line is routed to the terminal strip in the cabinet but is not wired.
- ⑤ Internal supply
- ⑥ + 5 V from backplane bus
- ⑦ Logic and backplane bus interface
- ⑧ Electrical isolation
- ⑨ Multiplexer
- ⑩ Analog to Digital Converter (ADC)
- ⑪ Current source

Figure 6-12 Block diagram and terminal diagram

Note

It is not necessary to interconnect the M- terminals when measuring using resistors, resistance thermometers, PTCs, or silicon temperature sensors. However, interconnection of the M- terminals may enhance interference immunity.

Technical specifications

Technical specifications		
Dimensions and weight		
Dimensions W x H x D (mm)	40 x 125 x 117	
Weight	ca. 250 g	
Module-specific data		
Supports isochronous mode	no	
Number of inputs	8	
• with resistive transducers	8	
Cable length	max. 200 m	
• shielded	max. 50 m at 50 mV	
Voltages, currents, electrical potentials		
Constant current for resistive transducers	0.83 mA (pulsed)	
• Resistance thermometer and resistance measurements 0 Ω to 600 Ω	0.83 mA (pulsed)	
• Resistance measurement 0 to 6 k Ω , PTC, silicon temperature sensors	0.25 mA (pulsed)	
Electrical isolation	yes	
• between channels and the backplane bus	yes	
• between channels	no	
Maximum potential difference	2.0 VDC	
• between inputs (CMV)	2.0 VDC	
• Between the inputs and M _{internal} (V _{iso})	75 VDC / 60 VAC	
Isolation test voltage	500 VDC	
Current consumption	max. 90 mA	
• from the backplane bus	max. 90 mA	
Power loss of the module	typ. 0.4 W	
Generation of analog values		
Measuring principle	Integrating	
Integration/conversion time/resolution (per channel)		
• programmable	yes	
• Interference frequency suppression at interference frequency f ₁ in Hz	50	60
• Integration time in ms	60	50
• Basic conversion time, including the integration time in ms	66	55
Additional conversion time for resistance measurements in ms	66	55
• Resolution in bits (including overshoot range)	13 bits	13 bits
Interference frequency suppression, error limits		
Interference frequency suppression at $f = n (f_1 \pm 1 \%)$, ($f_1 =$ interference frequency) $n=1.2$		
• Common mode interference (V _{CM} < 2 V)	> 86 dB	
• Seriesmode interference (peak value < rated input range)	> 40 dB	

Technical specifications		
Crosstalk between inputs	> 50 dB	
Operational limit (across entire temperature range, relative to full-scale value in the input range)		
• Voltage input	± 5 V	± 0.6%
	± 10 V	± 0.5%
	1 V to 5 V	
	0 V to 10 V	
	± 50 mV	
	± 500 mV	
± 1 V		
• Current input	± 20 mA	± 0.5%
	0 mA to 20 mA	
	4 mA to 20 mA	
• Resistor/PTC	0 kΩ to 6 kΩ	± 0.5%
	0 Ω to 600 Ω	± 0.5%
	PTC	± 0.5%
• Resistance thermometer/silicon temperature sensors	Pt 100	± 1.2 K
	Ni 100	
	Standard	
	Pt 100	± 1 K
	Ni 100	
	Klima	
Ni 1000,	± 1 K	
LG-Ni 1000		
Standard		
Ni 1000	± 1 K	
LG-Ni 1000		
Klima		
KTY83/110	± 3.5 K	
KTY84/130	± 4.5 K	
Basic error limit (operational limit at 25 °C, relative to full-scale value in the input range)		
• Voltage input	± 5 V	± 0.4%
	± 10 V	± 0.3%
	1 V to 5 V	
	0 V to 10 V	
	± 50 mV	
	± 500 mV	
± 1 V		
• Current input	± 20 mA	± 0.3%
	0 mA to 20 mA	
	4 mA to 20 mA	
• Resistor/PTC	0 kΩ to 6 kΩ	± 0.3%
	0 Ω to 600 Ω	± 0.3%
	PTC	± 0.3%

Technical specifications		
• Resistance thermometer/silicon temperature sensors	Pt 100 Ni 100 Standard	± 1 K
	Pt 100 Ni 100 Klima	± 0.8 K
	Ni 1000 LG-Ni 1000 Standard	± 0.8 K
	Ni 1000 LG-Ni 1000 Klima	± 0.8 K
	KTY83/110 KTY84/130	± 2 K ± 2.7 K
Temperature error (relative to input range)	± 0.006 %/K / 0.006 K/K	
Linearity error (relative to input range)	± 0.1 % / 0.1 K	
Repeat accuracy (in transient state at 25 °C, relative to input range)	± 0.1 % / ± 0.1 K	
Status, interrupts, diagnostics		
Interrupts	none	
Diagnostic functions	none	
Sensor selection data		
Input ranges (rated values) / input impedance		
• Voltage	± 50 mV	100 kΩ
	± 500 mV	
	± 1 V	
	± 5 V	
	± 10 V	
	1 V to 5 V 0 V to 10 V	
• Current	± 20 mA	100 Ω
	0 mA to 20 mA	
	4 mA to 20 mA	
• Resistor/PTC	0 kΩ to 6 kΩ	100 MΩ
	0 Ω to 600 Ω	
	PTC	

Technical specifications		
<ul style="list-style-type: none"> Resistance thermometer/silicon temperature sensors 	Pt 100 Ni 100 Ni 1000 LG-Ni 1000 Standard / Klima KTY83/110 KTY84/130	100 MΩ
Maximum voltage at voltage input U+ (destruction limit)	max. 30 V, continuous	
Maximum voltage at voltage inputs M+, M-, S- (destruction limit)	max. 12 V continuous; 30 V for a duration of max. 1 s	
Maximum current at current input I+ (destruction limit)	40 mA	
Wiring of the signal sensors	using a 40pin front connector	
<ul style="list-style-type: none"> for voltage measurement for current measurement <ul style="list-style-type: none"> – as 2-wire transducer – as 4-wire transducer 	supported supported, with external supply supported	
<ul style="list-style-type: none"> for resistance measurement with 2-wire connection with 3-wire connection with 4-wire connection	supported supported supported	
Characteristics linearization	programmable	
<ul style="list-style-type: none"> for resistance thermometers 	Pt 100 Standard / Klima Ni 100 Standard / Klima Ni 1000 Standard / Klima LG-Ni 1000 Standard / Klima	
<ul style="list-style-type: none"> Technical unit of temperature measurement 	Degrees Centigrade, degrees Fahrenheit, Kelvin	

6.6.1 Measurement types and ranges

Introduction

The measurement type and range is configured at the "measuring range" parameter in *STEP 7*.

Selected type of measurement	Measuring range
Voltage V:	± 50 mV ± 500 mV ± 1 V ± 5 V 1 V to 5 V 0 V to 10 V ± 10 V
Current I	0 mA to 20 mA 4 mA to 20 mA ± 20 mA
resistance (4-wire connection) R-4L	6 kΩ 600 Ω PTC
Thermal resistance RTD-4L (linear, 4-wire connection) (temperature measurement) Silicon temperature sensors	Pt 100 Klima / Standard Ni 100 Klima / Standard Ni 1000 Klima / Standard LG-Ni 1000 Klima / Standard KTY83/110 KTY84/130

6.6.2 Programmable parameters

Introduction

You will find a description of the general procedure for assigning parameters to analog modules in section Programming analog modules (Page 251).

Parameters

Table 6- 17 Overview of the parameters of SM 331; AI 8 x 13 Bit

Parameters	Range of values	Default	Parameter type	Scope
Measurement				
• Measurement type	disabled Voltage V Current I Resistance R, PTC Thermal resistance RTD, silicon temperature sensors	V	dynamic	Channel
• Measuring range	Voltage ± 50 mV; ± 500 mV; ± 1 V; 1 V to 5 V ± 5 V; 0 V to 10 V; ± 10 V	± 10 V		
	Current 0 mA to 20 mA; 4 mA to 20 mA; ± 20 mA	± 20 mA		
	Resistance 0 Ω to 600 Ω; 0 kΩ to 6 kΩ; PTC	600 Ω		
	Thermoelectric resistance (linear) Pt 100 Klima / Standard Ni 100 Klima / Standard Ni 1000 Klima / Standard LG-Ni 1000 Klima / Standard KTY83/110 KTY84/130	Pt 100 Standard		
• Temperature coefficient	Pt 100 0.003850 Ω/Ω/ °C (IST-90) Ni 100 / Ni 1000 0.006180 Ω/Ω/ °C LG-Ni 1000 0.005000 Ω/Ω/ °C	0.003850		
• Interference frequency suppression	50 Hz; 60 Hz	50 Hz		Module
• Temperature unit	Degrees Centigrade, degrees Fahrenheit, Kelvin*	degrees Centigrade		
* only Pt 100 Standard, Ni 100 Standard, Ni 1000 Standard, LG-Ni 1000 Standard				

6.6.3 Additional information on SM 331; AI 8 x 13 Bit

Using the module

The spare parts of the SM 331-1KF02 are compatible with the SM 331-1KF01 and are configured with HSP 2067. HSP 2067 can be installed for STEP7 V5.4, SP5 and higher and is included for STEP7 V5.4, SP6 and higher.

Unused channels

Set the "disabled" value at the "measurement type" parameter for unused channels. This setting reduces module cycle times.

Interconnect the M- terminals of unused channels.

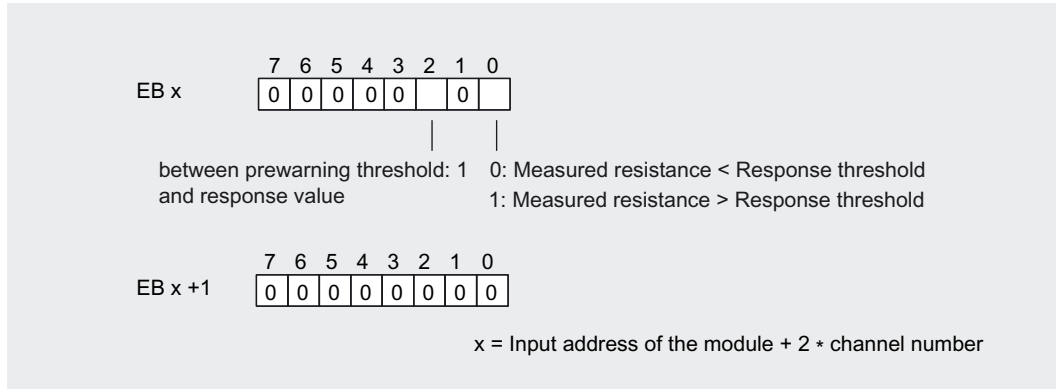
Using PTC resistors

PTCs are suitable for monitoring the temperature of or providing thermal protection for complex drives and transformer windings. The module has no analog values when PTC resistances are used. Status information on fixed temperature ranges are displayed instead of analog values.

- When setting the parameters, select measurement type R "Resistance" and measuring range "PTC".
- Connect the PTC (see "Terminal diagram for resistance measurement").
- Use PTC resistors that comply with IEC 60034-11-2 (previously, PTC thermistors that complied with DIN/VDE 0660, Part 302).
- Sensor data for the PTC resistor:

Property	Technical specifications	Comment
Switching points	Response to rising temperature	
	< 550 Ω	Normal range: Bit 0 = "0", bit 2 = "0" (in the PII)
	550 Ω to 1650 Ω	Advance warning range: Bit 0 = "0", bit 2 = "1" (in the PII)
	> 1650 Ω	Actuating range: Bit 0 = "1", bit 2 = "0" (in the PII)
	Response to falling temperature	
	> 750 Ω	Actuating range: Bit 0 = "1", bit 2 = "0" (in the PII)
	750 Ω to 540 Ω	Advance warning range: Bit 0 = "0", bit 2 = "1" (in the PII)
< 540 Ω	Normal range: Bit 0 = "0", bit 2 = "0" (in the PII)	
(RRT-5) °C (RRT+5) °C (RRT+15) °C Measurement voltage Voltage at PTC	Max. 550 Ω Min. 1,330 Ω Min. 4,000 Ω Max. 7.5 V	RRT = Rated response temperature

- Assignment in the process image input (PII)



- Notes on programming

NOTICE

Only bits 0 and 2 in the process image input are relevant for evaluation. You can use bits 0 and 2 to monitor the temperature of a motor, for example.

Bits 0 and 2 in the process image input cannot be saved. When assigning parameters, make sure that the motor, for example, starts up in a controlled manner (by means of an acknowledgment).

Bits 0 and 2 can never be set at the same time; they are set one after the other.

Using silicon temperature sensors

Silicon temperature sensors are commonly used to detect temperatures in motors.

- When assigning the parameters, select measurement type "thermoresistor" and measuring range "KTY83/110" or "KTY84/130".
- Connect the temperature sensor (see "Terminal diagram for resistance measurement").

Use temperature sensors which comply with the Product Specifications published by Philips Semiconductors.

- KTY83 series (KTY83/110)
- KTY84 series (KTY84/130)

Also take note of the accuracy of the temperature sensors.

The temperature is specified in 0.1 degrees C, 0.1 degrees K, and/or 0.1 degrees F, see section Representation of the analog values of analog input channels (Page 220).

6.7 Analog input module SM 331; AI 8 x 12 bit; (6ES7 331-7KF02-0AB0)

Order number

6ES7331-7KF02-0AB0

Properties

- 8 inputs in 4 channel groups
- Programmable measurement type at each channel group
 - Voltage
 - Current
 - Resistance
 - Temperature
- Programmable resolution at each channel group (9/12/14 bits + sign)
- Any measuring range selection per channel group
- Programmable diagnostics and diagnostic interrupt
- Programmable limit value monitoring for 2 channels
- Programmable hardware interrupt when limit is exceeded
- Electrically isolated to CPU and load voltage (not for 2-wire transducers)

Resolution

The measured value resolution is directly proportional to the selected integration time, that is, the measured value resolution increases in proportion to length of the integration time at the analog input channel.

Diagnostics

For information on diagnostics messages consolidated in the "group diagnostics" parameter, refer to the table *Diagnostic messages of analog input modules*.

Hardware interrupts

Hardware interrupts for channel groups 0 and 1 can be programmed in *STEP 7*. However, set a hardware interrupt only for the first channel of a channel group, that is, either at channel 0, or at channel 2

Terminal assignment

The diagrams below show various wiring options. The input impedance depends on the setting of the measuring range module, see table *Measurement types and ranges*.

Wiring: Voltage measurement

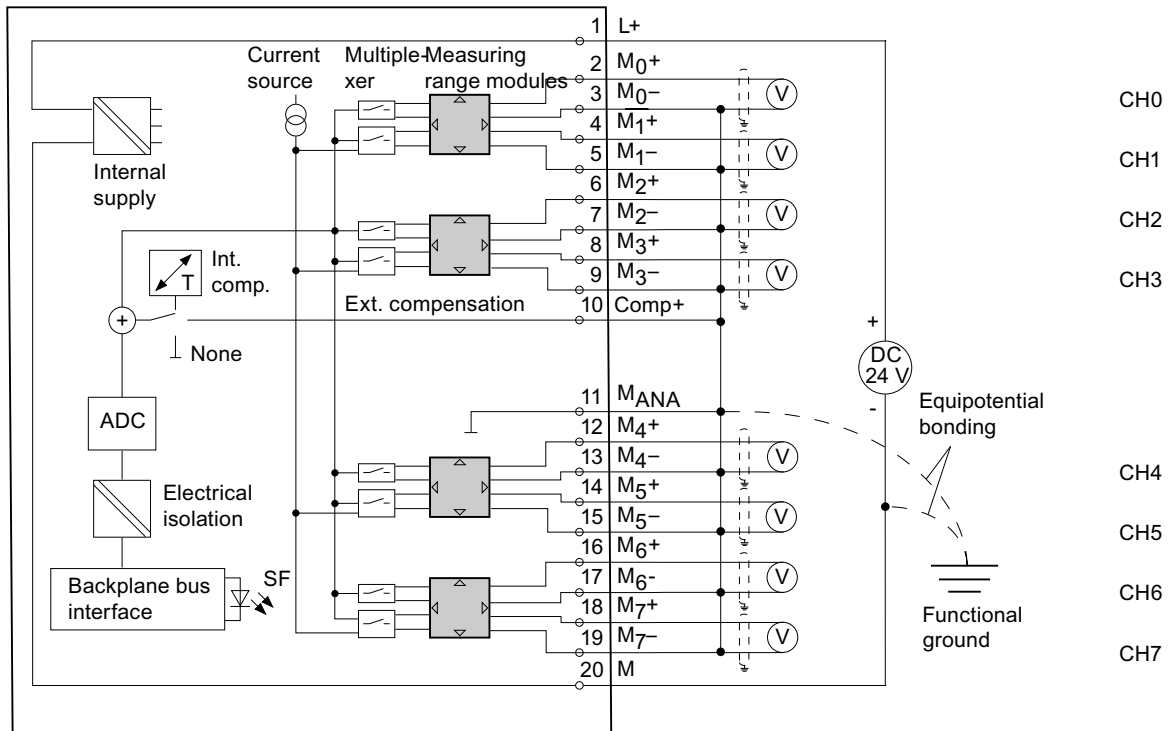


Figure 6-13 Block diagram and wiring diagram

Measuring range module settings

Measuring range	Measuring range module setting
± 80 mV	A
± 250 mV	
± 500 mV	
± 1,000 mV	
± 2.5 V	B
± 5 V	
1 V to 5 V	
± 10 V	

Wiring: 2-wire and 4-wire transducers for current measurement

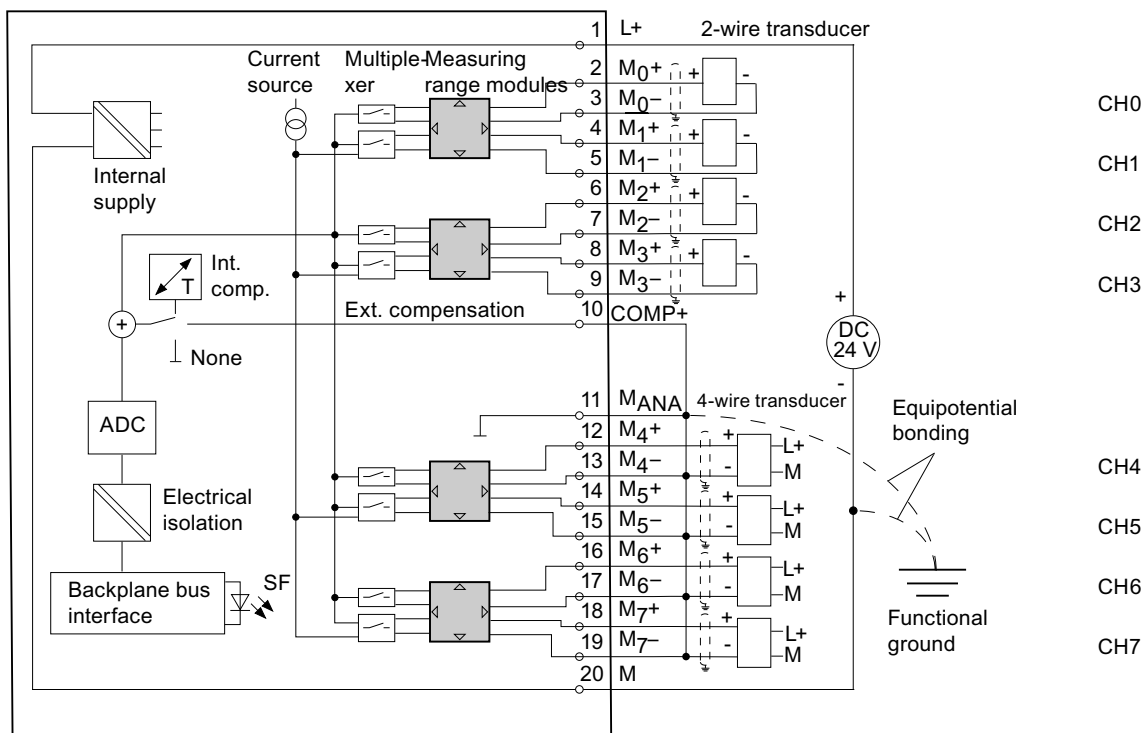


Figure 6-14 Block diagram and wiring diagram

Note

The interconnection between M_{ANA} and M- (terminals 11, 13, 15, 17, 19) is not required when using grounded 4-wire transducers with non-isolated supply.

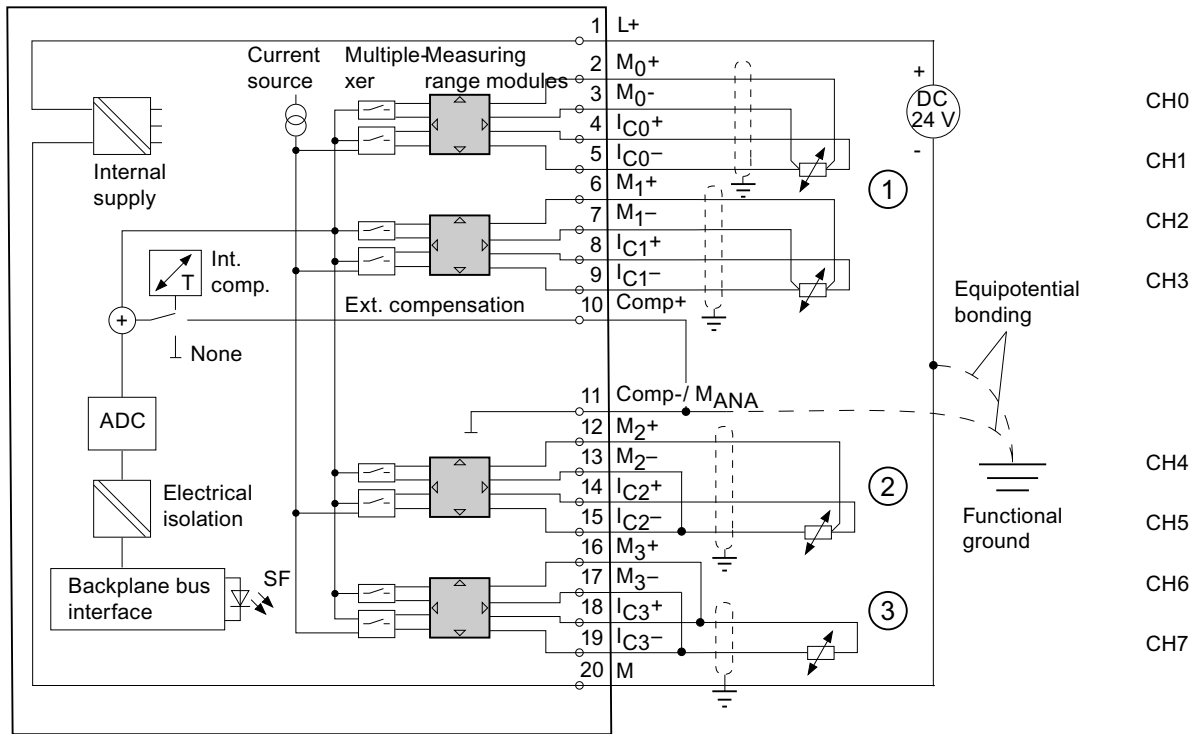
Measuring range module settings

Measuring range		Measuring range module setting
2-wire transducer	4 mA to 20 mA	D
4-wire transducer	± 3.2 mA	C
	± 10 mA	
	0 mA to 20 mA	
	4 mA to 20 mA	
	± 20 mA	

CAUTION

Any voltage measurement will destroy the measuring range module if "current" measuring mode is set.

Wiring: 2-, 3- and 4-wire connection of resistance transducers or thermoresistors



- ① 4-wire connection
- ② 3-wire connection
- ③ 2-wire connection

Figure 6-15 Block diagram and terminal diagram

Measuring range module settings

Measuring range		Measuring range module setting
150 Ω 300 Ω 600 Ω		A
Thermoresistor (linear, 4-wire connection) (temperature measurement) RTD-4L	Pt 100 Klima Ni 100 Klima Pt 100 Standard Ni 100 Standard	A

Note

- "Resistance measurement" is only available at one channel per group. The "2nd" channel of the group is used accordingly for current measuring mode (I_C). The "1st" channel of the group returns the measured value. The "2nd" channel of the group is assigned the default overflow value "7FFF_H."
- There is no compensation for power resistors for "2- and 3-wire connections".

Wiring: Thermocouples with external compensation

Insert a bridge between Comp+ and M_{ANA} when using the internal compensation.

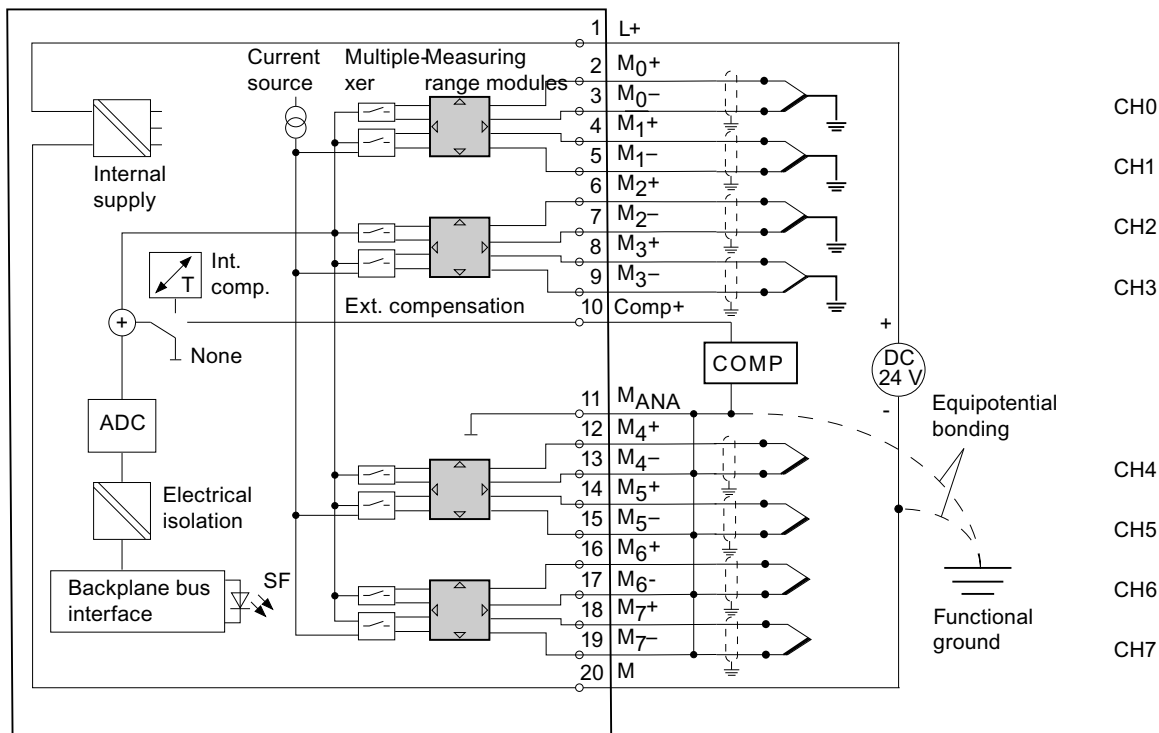


Figure 6-16 Block diagram and wiring diagram

Measuring range module settings

Measuring range		Measuring range module setting
Thermocouple TC-I (internal comparison) (thermal voltage measurement) Linearization is ignored	Type N [NiCrSi-NiSi] Type E [NiCr-CuNi] Type J [Fe-CuNi] Type K [NiCr-Ni] Type L [Fe-CuNi]	A
Thermocouple TC-E (external comparison) (thermovoltage measurement) Linearization is ignored	Type N [NiCrSi-NiSi] Type E [NiCr-CuNi] Type J [Fe-CuNi] Type K [NiCr-Ni] Type L [Fe-CuNi]	A
Thermocouple (linear, internal comparison) (temperature measurement) TC-IL	Type N [NiCrSi-NiSi] Type E [NiCr-CuNi] Type J [Fe-CuNi] Type K [NiCr-Ni] Type L [Fe-CuNi]	A
Thermocouple (linear, external comparison) (temperature measurement) TC-EL	Type N [NiCrSi-NiSi] Type E [NiCr-CuNi] Type J [Fe-CuNi] Type K [NiCr-Ni] Type L [Fe-CuNi]	A

Note

- An interconnection of M- and M_{ANA} is prohibited when using grounded thermocouples. In this case, you must ensure that low-resistance equipotential bonding is in place so that the permitted common-mode voltage is not exceeded.
- Interconnect M- and M_{ANA} when using non-grounded thermocouples

Technical specifications

Technical specifications	
Dimensions and weight	
Dimensions W x H x D (mm)	40 x 125 x 117
Weight	ca. 250 g
Module-specific data	
Supports isochronous mode	no
Number of inputs	8
• with resistive transducers	4
Cable length	max. 200 m
• shielded	max. 50 m at 80 mV and with thermocouples
Voltages, currents, electrical potentials	
Rated electronics supply voltage L +	24 VDC
• Reverse polarity protection	yes
Transducer power supply	
• Supply current	max. 60 mA (per channel)
• short circuit-proof	yes
Constant current for resistive transducers	typ. 1.67 mA (pulsed)
Electrical isolation	
• between channels and the backplane bus	Yes
• between channels and electronics power supply	Yes
– Not for 2-wire transducers	
Maximum potential difference	
• Between inputs and M _{ANA} (CMV)	typ. DC 2.5 V (> DC 2.3V)
– at signal = 0 V	
• between inputs (CMV)	typ. DC 2.5 V (> DC 2.3V)
• between M _{ANA} and M _{internal} (V _{iso})	75 VDC / 60 VAC
Isolation test voltage	500 VDC
Current consumption	
• from the backplane bus	max. 50 mA
• from load voltage L+	max. 30 mA (without 2-wire transducer)
Power loss of the module	typ. 1 W

6.7 Analog input module SM 331; AI 8 x 12 bit; (6ES7 331-7KF02-0AB0)

Technical specifications				
Generation of analog values				
Measuring principle	Integrating			
Integration/conversion time/resolution (per channel)				
• Programmable	Yes			
• Integration time in ms	2.5	16 ² / ₃	20	100
• Basic conversion time, including the integration time in ms	3	17	22	102
Additional conversion time for resistance measurement, in ms or	1	1	1	1
additional conversion time for wire-break monitoring in ms or	10	10	10	10
additional conversion time for resistance measurements and wire-break monitoring in ms	16	16	16	16
• Resolution in bits (including overrange)	9 bits	12 bits	12 bits	14 bits
• Interference frequency suppression at interference frequency f1 in Hz	400	60	50	10
• Basic execution time of the module in ms (all channels enabled)	24	136	176	816
Measured value smoothing	none			
Interference frequency suppression, error limits				
Interference frequency suppression at $F = n (f1 \pm 1 \%)$, ($f1 =$ interference frequency)				
• Common mode interference ($V_{CM} < 2.5 V$)	> 70 dB			
• Seriesmode interference (peak value < rated input range)	> 40 dB			
Crosstalk between inputs	> 50 dB			
Operational limit (across entire temperature range, relative to full-scale value in the input range)				
• Voltage input	80 mV 250 mV to 1,000 mV 2.5 V to 10 V	± 1% ± 0.6% ± 0.8%		
• Current input	3.2 mA to 20 mA	± 0.7%		
• Resistance	150 Ω; 300 Ω; 600 Ω	± 0.7%		
• Thermocouple	Types E, N, J, K, L	± 1.1%		
• Resistance thermometer	Pt 100/Ni 100	± 0.7%		
	Pt 100 climatic	± 0.8%		
Basic error limit (operational limit at 25 °C, relative to full-scale value in the input range)				
• Voltage input	80 mV 250 mV to 1,000 mV 2.5 V to 10 V	± 0.7% ± 0.4% ± 0.6%		
• Current input	3.2 mA to 20 mA	± 0.5%		
• Resistance	150 Ω; 300 Ω; 600 Ω	± 0.5%		
• Thermocouple	Types E, N, J, K, L	± 0.7%		
• Resistance thermometer	Pt 100/Ni 100	± 0.5%		
	Pt 100 climatic	± 0.6%		

Technical specifications		
Temperature error (relative to input range)	± 0.005%/K	
Linearity error (relative to input range)	± 0.05%	
Repeat accuracy (in settled state at 25 °C, relative to input range)	± 0.05%	
Temperature error of internal compensation	± 1%	
Status, interrupts, diagnostics		
Interrupts	programmable	
• Limit interrupt	Channels 0 and 2	
• Diagnostic interrupt	programmable	
Diagnostic functions	programmable	
• Group error display	red LED (SF)	
• Reading diagnostics information	supported	
Sensor selection data		
Input ranges (rated values) / input impedance		
• Voltage	± 80 mV ± 250 mV ± 500 mV ± 1000 mV ± 2.5 V ± 5 V 1 V to 5 V ± 10 V	10 MΩ 10 MΩ 10 MΩ 10 MΩ /100 kΩ 100 kΩ 100 kΩ 100 kΩ
• Current	± 3.2 mA ± 10 mA ± 20 mA 0 mA to 20 mA 4 mA to 20 mA	25 Ω 25 Ω 25 Ω 25 Ω 25 Ω
• Resistance	150 Ω 300 Ω 600 Ω	10 MΩ 10 MΩ 10 MΩ
• Thermocouples	Types E, N, J, K, L	10 MΩ
• Resistance thermometers	Pt 100, Ni 100	10 MΩ
Maximum voltage at voltage input (destruction limit)	max. 20 V, continuous 75 V for the duration of max. 1 s (duty factor 1:20)	
Maximum current at current input (destruction limit)	40 mA	
Wiring of the signal sensors	using a 20-pin front connector	
• for voltage measurement	supported	
• for current measurement		
as 2-wire transducer	supported	
as 4-wire transducer	supported	
• For thermoresistor/resistance measurement with 2-wire connection	Supported, cable resistances are not compensated	

Technical specifications	
with 3-wire connection	Supported, cable resistances are not compensated
with 4-wire connection	Supported, cable resistances are compensated
• Load of the 2-wire transducer	max. 820 Ω
Characteristics linearization	programmable
• for thermocouples	Types E, N, J, K, L
• for resistance thermometers	Pt 100 (Standard and Klima range) Ni 100 (Standard and Klima range)
Temperature compensation	programmable
• Internal temperature compensation	supported
• External temperature compensation with compensating box	supported
• Compensation for 0 °C reference junction temperature	supported
• Technical unit of temperature measurement	degrees Centigrade

6.7.1 Measurement types and ranges

Introduction

Module SM 331; AI 8 x 12 Bit has measuring range modules

The measurement type and range is configured at the "measuring range" parameter in *STEP 7*.

The default setting of the module is "voltage" measurement with "± 10V" range. You can use these default settings without having to program the SM 331; AI 8 x 12 Bit in *STEP 7*.

Measuring range modules

You may have to change the position of the measuring range modules to suit the measurement type and range (see the chapter *Setting the measuring types and ranges of analog input channels*). The necessary settings are also available on the module's imprint. Mark the position of the measuring range module on the front door (see figure).

Range:

A	B
C	D

Measurement types and ranges

Table 6- 18 Measurement types and ranges

Selected type of measurement	Measuring range (type of sensor)	Measuring range module settings
Voltage V	± 80 mV ± 250 mV ± 500 mV ± 1000 mV	A
	± 2.5 V ± 5 V 1 V to 5 V ± 10 V	B
Thermocouple TC-I (internal comparison) (thermal voltage measurement) Linearization is ignored	Type N [NiCrSi-NiSi] Type E [NiCr-CuNi] Type J [Fe-CuNi] Type K [NiCr-Ni] Type L [Fe-CuNi]	A
Thermocouple TC-E (external comparison) (thermovoltage measurement) Linearization is ignored		
Thermocouple (linear, internal comparison) (temperature measurement) TC-IL	Type N [NiCrSi-NiSi] Type E [NiCr-CuNi]	A

Selected type of measurement	Measuring range (type of sensor)	Measuring range module settings
Thermocouple (linear, external comparison) (temperature measurement) TC-EL	Type J [Fe-CuNi] Type K [NiCr-Ni] Type L [Fe-CuNi]	
Current (2-wire transducer) 2DMU	4 mA to 20 mA	D
Current (4-wire transducer) 4DMU	± 3.2 mA ± 10 mA 0 mA to 20 mA 4 mA to 20 mA ± 20 mA	C
Resistance (4-wire connection) R-4L	150 Ω 300 Ω 600 Ω	A
Thermoresistor (linear, 4-wire connection) (temperature measurement) RTD-4L	Pt 100 Klima Ni 100 Klima Pt 100 Standard Ni 100 Standard	A

Channel groups

The channels of SM 331; AI 8 x 12 Bit are arranged in four groups of two channels. You can assign parameters only to one channel group.

SM 331; AI 8 x 12 Bit is equipped with one measuring range module per channel group.

The table below shows the relevant configuration of channel groups. The channel group number is required to program SFC parameters in the user program.

Table 6- 19 Assignment of SM 331; AI 8x12 bit channels to channel groups

Channelsform one channel group each
Channel 0	Channel group 0
Channel 1	
Channel 2	Channel group 1
Channel 3	
Channel 4	Channel group 2
Channel 5	
Channel 6	Channel group 3
Channel 7	

See also

Programming analog modules (Page 251)

Diagnostics messages of analog input modules (Page 253)

6.7.2 Programmable parameters

Introduction

For information on programming analog modules, refer to the chapter *Programming analog modules*.

Parameters

Table 6- 20 Overview of the parameters for SM 331; AI 8 x 12 Bit

Parameters	Range of values	Default	Parameter type	Scope
Enable <ul style="list-style-type: none"> • Diagnostics interrupt • Process interrupt when limit exceeded 	yes/no yes/no	no no	dynamic	Module
Process interrupt trigger <ul style="list-style-type: none"> • High limit • Low limit 	May be restricted by the measuring range from 32511 to - 32512 from - 32512 to 32511	-	dynamic	Channel
Diagnostics <ul style="list-style-type: none"> • Group diagnostics • with line continuity check 	yes/no yes/no	no no	static	Channel group
Measurement <ul style="list-style-type: none"> • Measurement type 	disabled Voltage V 4DMU current (4-wire transducer) 2DMU current (2-wire transducer) R-4L resistance (4-wire connection) RTD-4L thermoresistor (linear, 4-wire connection) TC-I thermocouple (internal comparison) TC-E thermocouple (external comparison) TC-IL thermocouple (internal comparison) TC-EL thermocouple (linear, external comparison)	V	dynamic	Channel or channel group
<ul style="list-style-type: none"> • Measuring range 	See the table <i>Measurement types and ranges</i>	± 10 V		
<ul style="list-style-type: none"> • Noise suppression 	400 Hz; 60 Hz; 50 Hz; 10 Hz	50 Hz		

6.7.3 Additional information on SM 331; AI 8 x 12 Bit

Unused channels

As certain programmed inputs may remain unused due to the channel group configuration, make allowances for the special features of these inputs outlined below in order to be able to use the diagnostics functions at these used channels:

- **Voltage measurement (except 1 V to 5V)** and for thermocouples: Short-circuit unused channels and connect these with M_{ANA} . This optimizes interference immunity of the analog input module. Set the "disabled" value at the "measurement type" parameter for unused channels. This setting reduces module cycle times. Also short-circuit the COMP input if this is not used.
- **Measuring range 1 V to 5 V:** wire the used and unused inputs of the same channel group in parallel.
- **Current measurement, 2-wire transducer:** There are two options of wiring the channel circuit.
 - a) Open unused input; channel group diagnostics disabled. If you were to enable diagnostics, the analog module would trigger a single diagnostic interrupt, and light up its SF LED.
 - b) Loading the unused input using a 1.5 k Ω to 3.3 k Ω resistor. This allows you to enable diagnostics for this channel group.
- **Current measurement 4 mA to 20 mA, 4-wire transducer:** wire the unused inputs of the same channel group in series.

All channels deactivated

If you disable **all** input channels of the module and enable diagnostics at the parameters of SM 331; AI 8 x 12 Bit, the module does **not** report "external auxiliary voltage missing."

Line continuity check for the 4 mA to 20 mA measuring range

If you configured a measuring range of 4 mA to 20 mA, and **enabled the line continuity check**, the analog input module logs a wire-break event to diagnostics data when the current drops below 3,6 mA.

The module also triggers a diagnostics interrupt if this function is enabled in the program.

A wire break can only be signaled by means of the lit SF LED and the diagnostic bytes must be evaluated in the user program if diagnostics interrupts are disabled.

If you configured a measuring range of 4 mA to 20 mA, **disabled** the line continuity check, and enabled diagnostic interrupts, the module triggers a diagnostic interrupt when the underflow value is reached.

Line continuity check

The line continuity check is designed only for temperature measurements (thermocouples and thermoresistors.)

See also

Representation of the analog values of analog input channels (Page 220)