SIEMENS

SIMATIC

S7-1200

SM 1231 Thermocouple Signal Module

Product Information

Product Information

New S7-1200 Thermocouple analog signal module available

The SM 1231 Thermocouple analog signal module has been added to the S7-1200 family. The order number for this signal module is shown below.

Signal Module	Order Number
SM 1231 AI4 x TC x 16 bit	6ES7 231-5QD30-0XB0

The SM 1231 Thermocouple (TC) analog signal module measures the value of voltage connected to the module inputs. This value can be either temperature from a TC or volts.

● If voltage, the nominal range full scale value will be decimal 27648.

● If temperature, the value will be reported in degrees multiplied by ten (for example, 25.3 degrees will be reported as decimal 253).

This product information includes details about the characteristics and technical specifications of this signal module. Refer to the SIMATIC S7-1200 Programmable Controller System Manual for more information about the S7-1200 product family.

Additional assistance

For assistance in answering technical questions, for training on these products, or for ordering, contact your Siemens distributor or sales office.

S7-1200 SM 1231 Analog Input Thermocouple

Model	SM 1231 AI4 x TC x16 bit
Order number (MLFB)	6ES7 231-5QD30-0XB0
Dimensions W x H x D (mm)	45 x 100 x 75
Weight	180 grams
Power dissipation	1.5 W
Current consumption (SM Bus)	80 mA
Current consumption (24 VDC)[1]	40 mA
Number of inputs	4
Type	Floating TC and mV
Range	See Thermocouple selection table
Nominal range	See Thermocouple selection table
Overrange/underrange	See Thermocouple selection table
Overflow/underflow (data word)	See Thermocouple selection table
Resolution Temperature Voltage	 0.1° C/0.1° F 15 bits plus sign
Maximum withstand voltage	± 35 V
Noise rejection	85 dB for the selected filter setting (10 Hz, 50 Hz, 60 Hz or 400 Hz)
Common mode rejection	> 120dB at 120 VAC
Impedance	≥ 10 MΩ
Isolation Field to logic Field to 24 VDC 24 VDC to logic Channel to channel	 500 VAC 500 VAC 500 VAC none
Accuracy (25°C / 0 to 55°C)	See Thermocouple selection table
Repeatability	±0.05% FS
Measuring principle	Integrating
Module update time	See Filter selection table
Cold junction error	±1.5°C
Cable length (meters)	100 meters to sensor max.
Wire resistance	100 Ω max.
Diagnostics	
Overflow/underflow[2]	Yes
Wire break[3]	Yes
24 VDC low voltage[2]	Yes

[1] 20.4 to 28.8 VDC (Class 2, Limited Power, or sensor power from PLC)

[2] The overflow, underflow and low voltage diagnostic alarm information will be reported in the analog data values even if the alarms are disabled in the module configuration.

[3] When wire break alarm is disabled and an open wire condition exists in the sensor wiring, the module may report random values.

Thermocouple basics

Thermocouples are formed whenever two dissimilar metals are electrically bonded to each other. A voltage is generated that is proportional to the junction temperature. This voltage is small; one microvolt could represent many degrees. Measuring the voltage from a thermocouple, compensating for extra junctions, and then linearizing the result forms the basis of temperature measurement using thermocouples.

When you connect a thermocouple to the SM 1231 Thermocouple signal module, the two dissimilar metal wires are attached to the module at the module signal connector. The place where the two dissimilar wires are attached to each other forms the sensor thermocouple.

Two more thermocouples are formed where the two dissimilar wires are attached to the signal connector. The connector temperature causes a voltage that adds to the voltage from the sensor thermocouple. If this voltage is not corrected, then the temperature reported will deviate from the sensor temperature.

Cold junction compensation is used to compensate for the connector thermocouple. Thermocouple tables are based on a reference junction temperature, usually zero degrees Celsius. The cold junction compensation compensates the connector to zero degrees Celsius. The cold junction compensation restores the voltage added by the connector thermocouples. The temperature of the module is measured internally, then converted to a value to be added to the sensor conversion. The corrected sensor conversion is then linearized using the thermocouple tables.

For optimum operation of the cold junction compensation, the thermocouple module must be located in a thermally stable environment. Slow variation (less than 0.1° C/minute) in ambient module temperature is correctly compensated within the module specifications. Air movement across the module will also cause cold junction compensation errors.

If better cold junction error compensation is needed, an external iso-thermal terminal block may be used. The thermocouple module provides for use of a 0° C referenced or 50° C referenced terminal block.

SM 1231 Thermocouple selection table

The ranges and accuracy for the different thermocouple types supported by the SM 1231 Thermocouple signal module are shown in the table below.

Thermocouple Type	Under range minimum	Nominal range low limit	Nominal range high limit	Over range maximum	Normal range [1, 2] accuracy @ 25°C	Normal range [1, 2] accuracy 0°C to 55°C
J	-210.0°C	-150.0°C	1200.0°C	1450.0°C	±0.3°C	±0.6°C
K	-270.0°C	-200.0°C	1372.0°C	1622.0°C	±0.4°C	±1.0°C
T	-270.0°C	-200.0°C	400.0°C	540.0°C	±0.5°C	±1.0°C
E	-270.0°C	-200.0°C	1000.0°C	1200.0°C	±0.3°C	±0.6°C
R & S	-50.0°C	+100.0°C	1768.0°C	2019.0°C	±1.0°C	±2.5°C
N	-270.0°C	-200.0°C	1300.0°C	1550.0°C	±1.6°C	±1.0°C
C	0.0°C	100.0°C	2315.0°C	2500.0°C	±0.7°C	±2.7°C
TXK/XK(L)	-200.0°C	-150.0°C	800.0°C	1050.0°C	±0.6°C	±1.2°C
Voltage	-32512 -94.0715mV	-27648 -80mV	27648 80mV	32511 94.071mV	±0.05%	±0.1%

[1]   Internal cold junction error is ±1.5°C for all ranges. This adds to the error in this table. The module requires at least 30 minutes of warmup time to meet this specification.

[2]   In the presence of radiated radio frequency of 970 MHz to 990 MHz, the accuracy may be degraded.

Filter selection table

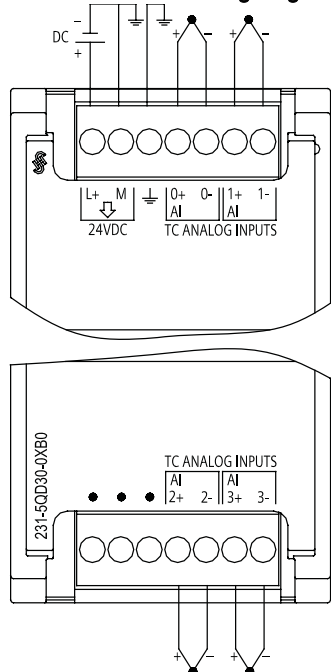| Rejection frequency (Hz)	Integration time (ms)	4 Channel module update time (seconds)
10	100	1.205
50	20	0.245
60	16.67	0.205
400[1]	10	0.125

[1] To maintain module resolution and accuracy when 400 Hz rejection is selected, the integration time is 10 ms. This selection also rejects 100 Hz and 200 Hz noise.

It is recommended for measuring thermocouples that a 100 ms integration time be used. The use of smaller integration times will increase the repeatability error of the temperature readings.

Note

After power is applied to the module, it performs internal calibration for the analog to digital converter. During this time, the module reports a value of 32767 on each channel until valid data is available on that channel. The PLC program may need to allow for this initialization time.

SM 1231 AI4 x TC wiring diagram

6ES7 231-5QD3-0XB0