

OFFICIAL DOCUMENT PACKAGE

Manufacturer's Manual

Amikon cover with selected official Siemens technical pages

SIEMENS S7-200 SMART G2

6ES7288-3AT08-0AA1

EM AT08 THERMOCOUPLE INPUT MODULE

Selected official pages retain the original technical tables, ratings, notes and pagination.

OFFICIAL SOURCE

Siemens S7-200 SMART G2, 03/2026, A5E55110929-AB

Original pages 83-86, 97, 1168-1171

This technical extract does not replace the complete equipment and system manuals. Check the installed hardware and project before use.

Installation

4.1 Guidelines for installing S7-200 SMART G2 devices

The S7-200 SMART G2 devices are designed to be easy to install. The S7-200 SMART G2 can be installed horizontally or vertically on a standard DIN rail. The small size of the S7-200 SMART G2 allows you to make efficient use of space.

WARNING

Safety requirements for installing S7-200 SMART G2 PLCs

S7-200 SMART PLCs are Open Type Controllers. You must install the PLC in a housing, cabinet, or electric control room. Open Type Controllers must be installed within an enclosure which protects you from hazards, including mechanical hazards, electrical shock and spread of fire. Limit entry to the housing, cabinet, or electric control room to authorized personnel.

Failure to follow these installation requirements could result in death or serious injury to personnel, and/or damage to equipment.

Always follow these requirements when installing the PLC.

The installation should provide a dry environment for the S7-200 SMART G2. SELV/PELV circuits are considered to provide protection against electric shock in dry locations.

The installation should provide the appropriate mechanical strength, flammability protection, and stability protection that is approved for open equipment in your particular location category according to applicable electrical and building codes.

Conductive contamination due to dust, moisture, and airborne pollution can cause operational and electrical faults in the PLC.

If you locate the PLC in an area where conductive contamination may be present, the PLC must be protected by an enclosure with appropriate protection rating. IP54 is one rating that is generally used for electronic equipment enclosures in dirty environments and may be appropriate for your application.

WARNING

Improper installation of the S7-200 SMART G2 can result in electrical faults or unexpected operation of machinery.

Electrical faults or unexpected machine operation can result in death, severe personal injury, and/or property damage.

All instructions for installation and maintenance of a proper operating environment must be followed to ensure the equipment operates safely.

Secure connection

In applications with significant environmental vibration or during vertical installation, it is recommended to install DIN rail end caps (8WA1 805) on both sides of the system to ensure the modules remain securely connected.

Separate the devices from heat, high voltage, and electrical noise

As a general rule for laying out the devices of your system, always separate the devices that generate high voltage and high electrical noise from the low-voltage, logic-type devices such as the PLC.

When configuring the layout of the PLC inside your panel, consider the heat-generating devices and locate the electronic-type devices in the cooler areas of your cabinet. Reducing the exposure to a high-temperature environment will extend the operating life of any electronic device.

Consider also the routing of the wiring for the devices in the panel. Avoid placing low-voltage signal wires and communications cables in the same tray with AC power wiring and high-energy, rapidly-switched DC wiring.

Allow sufficient space for heat dissipation and wiring

The S7-200 SMART G2 devices are designed for natural convection cooling. For proper cooling, you must provide a clearance of at least 25 mm above and below the devices. Also, allow at least 25 mm of depth between the front of the modules and the inside of the enclosure.

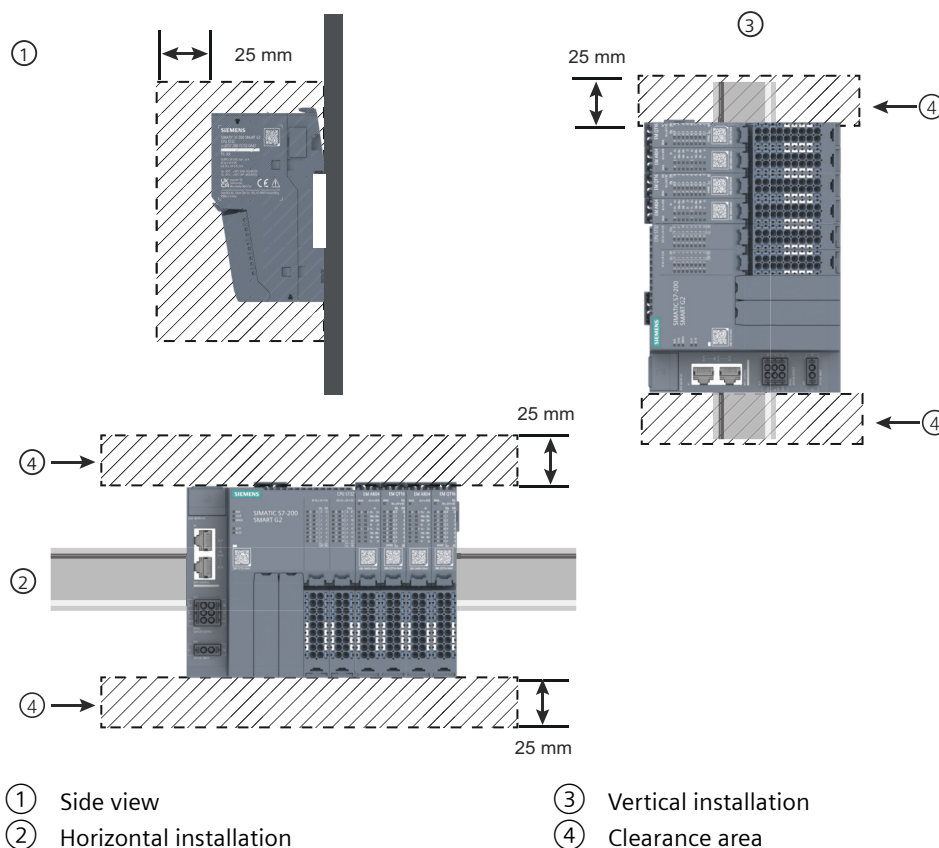


CAUTION

Temperature considerations

For vertical mounting, the maximum allowable ambient temperature is reduced by 10 degrees C. Operating with large temperature fluctuations outdoors could result in erratic process operation and could result in minor personal injury.

If your installation includes expansion modules, it is recommended to mount the CPU below them as shown in the following figure. Follow the prescribed guidelines for mounting modules to ensure proper cooling.



When planning your layout for the PLC, allow enough clearance for the wiring and communications cable connections.

Installation rules for reducing thermal load

The following rules help reduce the thermal stress on the S7-200 SMART G2 system within the control cabinet.

- Horizontal installation should be prioritized
- During vertical installation, high-power consumption modules should be inserted at the top, and low-power consumption modules at the bottom
- Install CPU stations with high-power consumption modules in the lower section of the control cabinet
- In multi-layer configurations, high-power consumption modules should be inserted on both sides to allow waste heat to dissipate upward unobstructed

4.1 Guidelines for installing S7-200 SMART G2 devices

Before you install or remove any electrical device, ensure that the power to that equipment has been turned off. Also, ensure that the power to any related equipment has been turned off.



WARNING

There is a risk of electric shock when installing or removing the equipment

Performing live installation or wiring work on the S7-200 SMART G2 or related equipment may result in electric shock or unintended activation of the device.

Always follow appropriate safety precautions and ensure the power to the S7-200 SMART G2 or related equipment is disconnected before installing or removing any devices.

Failure to disable all power during installation or removal of the S7-200 SMART G2 or related equipment can result in death, severe personal injury and/or property damage due to electric shock or unexpected equipment operation.

Always ensure that whenever you replace or install an S7-200 SMART G2 device you use the correct module or equivalent device.

Always follow the grounding guidelines (Page 97).



WARNING

Risks associated with replacing S7-200 SMART G2 device

Improper installation of the S7-200 SMART G2 module may cause abnormal operation of the program in the S7-200 SMART G2.

When replacing S7-200 SMART G2 equipment, use the same model, orientation, and sequence.

Otherwise, unintended operation of the equipment may occur, resulting in death, serious personal injury, and/or property damage.



WARNING

Installing or removing equipment in a flammable or combustible environment

Disconnecting equipment in a flammable or combustible environment may cause a fire or explosion.

Do not disconnect equipment in a flammable or combustible environment; when working in such environments, follow appropriate safety precautions.

A fire or explosion can result in death, serious injury and/or property damage.

4.4 Wiring guidelines

4.4.1 Prerequisites

Proper grounding and wiring of all electrical equipment is important to help ensure the optimum operation of your system and to provide additional electrical noise protection for your application and the S7-200 SMART G2. For the wiring diagram of the S7-200 SMART G2, please refer to the technical specifications (Page 1146).

Prerequisites

Before grounding or wiring any electrical equipment, ensure that the power to the device is turned off. Also, ensure that the power to all related equipment has been turned off.

WARNING

There is a risk of electric shock when installing or removing the equipment

Performing live installation or wiring work on the S7-200 SMART G2 or related equipment may result in electric shock or unintended activation of the device.

Always follow appropriate safety precautions and ensure the power to the S7-200 SMART G2 or related equipment is disconnected before installing or removing any devices.

Failure to disable all power during installation or removal of the S7-200 SMART G2 or related equipment can result in death, severe personal injury and/or property damage due to electric shock or unexpected equipment operation.

Always take safety into consideration as you design the grounding and wiring for the S7-200 SMART G2 system. Follow all applicable electrical codes when wiring the S7-200 SMART G2 and related equipment. Install and operate all equipment according to all applicable national and local standards. Contact your local authorities to determine which codes and standards apply to your specific case.

WARNING

Risk of unintended equipment operation

Control devices may malfunction under unsafe conditions, leading to unintended equipment operation.

Use an emergency stop function, electromechanical overrides or other redundant safeguards that are independent of the S7-200 SMART G2.

Such unexpected operations could result in death, severe personal injury and/or property damage.

A.5 Thermocouple expansion modules (EMs)

A.5.1 EM AT08 thermocouple specifications

Table A-38 General specifications

Model	EM AT08 AI 8 x 16 bit TC
Part number	6ES7288-3AT08-0AA1
Dimensions W x H x D (mm)	15 x 118 x 74.5
Weight	79 g
Power consumption	0.525 W
Current consumption (SM Bus)	105 mA

Table A-39 Analog inputs

Model	EM AT08 AI 8 x 16 bit TC	
Number of inputs	8	
Range	See Thermocouple selection table.	
Nominal range (data word)		
Overrange/underrange (data word)		
Overflow/underflow (data word)		
Resolution	Temperature	0.1 °C / 0.1 °F
	Voltage	15 bits plus sign
Maximum withstand voltage	± 35 V	
Noise rejection	For the selected filter setting 85 dB (10 Hz/50 Hz/60 Hz/400 Hz)	
Common mode rejection	greater than 120 dB	
Impedance	≥ 10 MΩ	
Isolation	Field side to logic	707 V DC
Channel to channel isolation	120 V AC	
Resolution	See Thermocouple selection table.	
Repeatability	±0.05% FS	
Measuring principle	Integrating	
Module update time	See Filter selection table.	
Cold junction error	±2.5 °C	
Cable length (meters)	100 m to sensor max.	
Wire resistance	100 Ω max.	

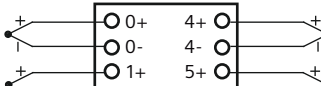
Table A-40 Diagnostics

Model	EM AT08 AI 8 x 16 bit TC
Overflow/underflow ¹	x
Wire break ²	x

- ¹ 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.
- ² When wire break alarm is disabled and an open wire condition exists in the sensor wiring, the module may report random values.

The EM AT08 Thermocouple (TC) analog expansion module measures the value of voltage connected to the module inputs. The temperature measurement type can be either "Thermocouple" or "Voltage".

- "Thermocouple": The value will be reported in degrees multiplied by ten (for example, 25.3 degrees will be reported as decimal 253).
- "Voltage": The nominal range full scale value will be decimal 27648.

EM AT08 RTD thermocouple 8-point 16-bit (6ES7288-3AT08-0AA1)										
	DC input terminal									
	Signals	AI 0+/ TC	AI 0-/T C	AI 1+/T C	AI 1-/T C	AI 2+/T C	AI 2-/T C	AI 3+/T C	AI 3-/T C	
	Pin number	1	3	5	7	9	11	13	15	17
	Pin number	2	4	6	8	10	12	14	16	18
	Signals	AI 4+/ TC	AI 4-/T C	AI 5+/T C	AI 5-/T C	AI 6+/T C	AI 6-/T C	AI 7+/T C	AI 7-/T C	

Note

Unused analog inputs should be shorted.

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 EM AT08 Thermocouple 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, and then converted to a value to be

A.5 Thermocouple expansion modules (EMs)

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.

The ranges and accuracy for the different thermocouple types supported by the EM AT08 Thermocouple expansion module are shown in the table below.

Table A-41 EM AT08 thermocouple selection table

Type	Under range minimum ¹	Nominal range low limit	Nominal range high limit	Over range maximum ²	Normal range ^{3,4} accuracy @ 25 °C	Normal range ^{1,2} accuracy -20 °C to 60 °C
J	-210.0 °C	-150.0 °C	1200.0 °C	1450.0 °C	±0.6 °C	±1.2 °C
K	-270.0 °C	-200.0 °C	1372.0 °C	1622.0 °C	±0.7 °C	±1.5 °C
T	-270.0 °C	-200.0 °C	400.0 °C	540.0 °C	±0.7 °C	±1.5 °C
E	-270.0 °C	-200.0 °C	1000.0 °C	1200.0 °C	±0.6 °C	±1.2 °C
R & S	-50.0 °C	100.0 °C	1768.0 °C	2019.0 °C	±1.0 °C	±2.5 °C
B	0.0 °C	200.0 °C	800.0 °C	--	±2.0 °C	±3.5 °C
	--	800.0 °C	1820.0 °C	1820 °C	±1.0 °C	±2.3 °C
N	-270.0 °C	-200.0 °C	1300.0 °C	1550.0 °C	±1.0 °C	±1.6 °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 °C	±0.6 °C	±1.2 °C
Voltage	-32512	-27648 -80mV	27648 80mV	32511	±0.05%	±0.1%

¹ Thermocouple values below the under-range minimum value are reported as -32768.

² Thermocouple values above the over-range maximum value are reported as 32767.

³ Internal cold junction error is ±2.5 °C for all ranges. This error must be added to the error values in this table. The module requires at least 30 minutes of warm-up time to meet this specification.

Note

Thermocouple channel

Each channel on the Thermocouple expansion module can be configured with a different thermocouple type (selectable in the software during configuration of the module).

Table A-42 Noise reduction and update times for the EM AT08 thermocouple

Rejection frequency selection	Integral time	8 Channel module update time (seconds)
400 Hz (2.5 ms)	10 ms ¹	0.286
60 Hz (16.6 ms)	16.67 ms	0.446

Rejection frequency selection	Integral time	8 Channel module update time (seconds)
50 Hz (20 ms)	20 ms	0.526
10 Hz (100 ms)	100 ms	2.450

- 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, the module 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. Your user program may need to allow for this initialization time. Because the configuration of the module can vary the length of the initialization time, you should verify the behavior of the module in your configuration. If required, you can include logic in your user program to accommodate the initialization time of the module.

Representation of analog values for Thermocouple Type J

A representation of the analog values of thermocouples type J is shown in the table below.

Table A-43 Representation of analog values for Thermocouple Type J

Type J in °C	Function units		Type J in °F	Function units		Range
	dec	Hexadecimal		dec	Hexadecimal	
> 1450.0	32767	7FFF	> 2642.0	32767	7FFF	Overflow
1450.0	14500	38A4	2642.0	26420	6734	High limit violated
:	:	:	:	:	:	
1200.1	12001	2EE1	2192.2	21922	55A2	
1200.0	12000	2EE0	2192.0	21920	55A0	Rated range
:	:	:	:	:	:	
-150.0	-1500	FA24	-238.0	-2380	F6B4	
-150.1	-1501	FA23	-238.2	-2382	F6B2	Low limit violated
:	:	:	:	:	:	
-210.0	-2100	F7CC	-346.0	-3460	F27C	
< -210.0	-32768	8000	< -346.0	-32768	8000	Underflow ¹

¹ Faulty wiring (for example, polarity reversal, or open inputs) or sensor error in the negative range (for example, wrong type of thermocouple) may cause the thermocouple module to signal underflow.