Thermocouple and RTD Expansion Modules Specifications

Table A-24 Thermocouple and RTD Modules Order Numbers

Order Number	Expansion Model	EM Inputs	EM Outputs	Removable Connector
6ES7 231-7PD22-0XA0	EM 231 Analog Input Thermocouple, 4 Inputs	4 Thermocouple	-	No
6ES7 231-7PF22-0XA0	EM 231 Analog Input Thermocouple, 8 Inputs	8 Thermocouple	-	No
6ES7 231-7PB22-0XA0	EM 231 Analog Input RTD, 2 Inputs	2 RTD	-	No
6ES7 231-7PC22-0XA0	EM 231 Analog Input RTD, 4 Inputs	4 RTD	-	No

Table A-25 Thermocouple and RTD Modules General Specifications

Order Number	Module Name and Description	Dimensions (mm) (W x H x D)	Weight	Dissipation	VDC Requirements +5 VDC	VDC Requirements +24 VDC
6ES7 231-7PD22-0XA0	EM 231 Analog Input Thermocouple, 4 Inputs	71.2 x 80 x 62	210 g	1.8 W	87 mA	60 mA
6ES7 231-7PF22-0XA0	EM 231 Analog Input Thermocouple, 8 Inputs	71.2 x 80 x 62	210 g	1.8 W	87 mA	60 mA
6ES7 231-7PB22-0XA0	EM 231 Analog Input RTD, 2 Inputs	71.2 x 80 x 62	210 g	1.8 W	87 mA	60 mA
6ES7 231-7PC22-0XA0	EM 231 Analog Input RTD, 4 Inputs	71.2 x 80 x 62	210 g	1.8 W	87 mA	60 mA

Table A-26 Thermocouple and RTD Modules Specifications

General	6ES7 231-7PD22-0XA0 Thermocouple, 4 Inputs	6ES7 231-7PF22-0XA0 Thermocouple, 8 Inputs	6ES7 231-7PB22-0XA0 RTD, 2 Inputs	6ES7 231-7PC22-0XA0 RTD, 4 Inputs
Isolation				
Field to logic	500 VAC		500 VAC	
Field to 24 VDC	500 VAC		500 VAC	
24 VDC to logic	500 VAC		500 VAC	
Common mode input range (input channel to input channel)	120 VAC		0	
Common mode rejection	> 120 dB at 120 VAC		> 120 dB at 120 VAC	
Input type	Floating TC		Module ground referenced RTD (2, 3, or 4 wire connections)	
Input ranges[1]	TC types (select one per module) S, T, R, E, N, K, J Voltage range : +/- 80 mV		RTD types (select one per module): platinum (Pt), copper (Cu), nickel (Ni), or Resistance See Table A-31 or A-32 for available RTD types.	
Input resolution				
Temperature	0.1° C / 0.1° F		0.1° C / 0.1° F	
Voltage	15 bits plus sign		-	
Resistance	-		15 bits plus sign resistive	
Measuring Principle	Sigma-delta		Sigma-delta	
Module update time: All channels	405 ms	810 ms	405 ms (700 ms for Pt10000)	810 ms (1400 ms for Pt10000)
Wire length	100 meters to sensor max.		100 meters to sensor max.	
Wire loop resistance	100Ω max.		20Ω, 2.7Ω for Cu max.	20Ω, 2.7Ω for 10Ω RTDs
Suppression of interference	85 dB at 50 Hz/60 Hz/ 400 Hz		85 dB at 50 Hz/60 Hz/400 Hz	
Data word format	Voltage: -27648 to + 27648		Resistance: 0 to +27648	
Maximum sensor dissipation	-		1m W	
Input impedance	≥1 MΩ		≥ 10 MΩ	
Maximum input voltage	30 VDC		30 VDC (sense), 5 VDC (source)	30 VDC
Input filter attenuation	-3 db at 21 kHz		-3 db at 3.6 kHz	-3 db at 21 kHz
Basic error	0.1% FS (voltage)		0.1% FS (resistance)	
Repeatability	0.05% FS		0.05% FS	
Cold junction error	±1.5 ° C		-	
LED indicator	2 (External 24 VDC present and System Fail)			
24 VDC supply voltage range	20.4 to 28.8 VDC (Class 2, Limited Power, or sensor power from PLC)			

[1] The input range selection (temperature, voltage on resistance) applies to all channels on the module.

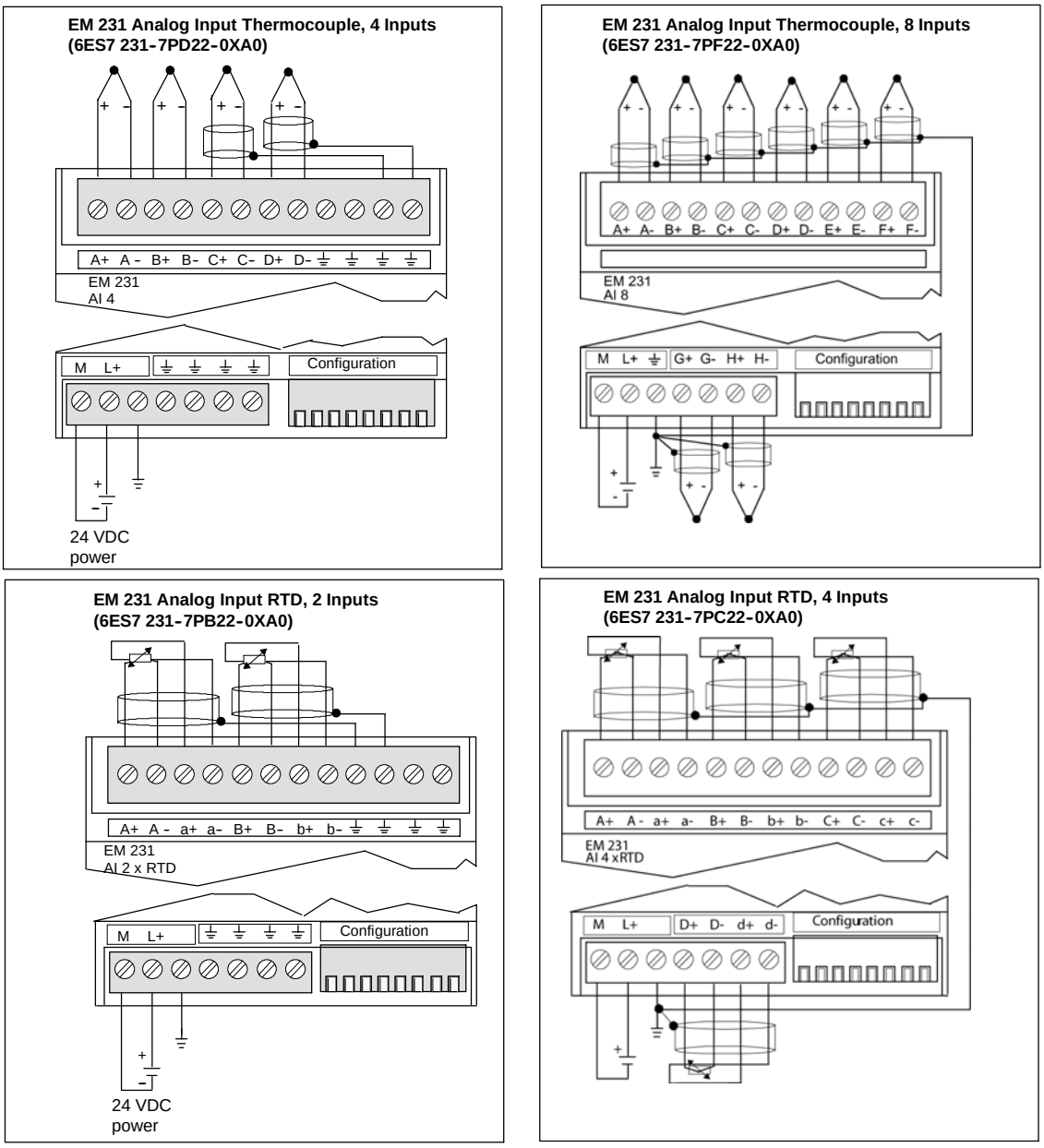


Figure A-23 Connector Terminal Identification for EM 231 Thermocouple and EM 231 RTD Modules

Compatibility

The RTD and Thermocouple modules are designed to work with the CPU 222, CPU 224, CPU 224XP and CPU 226.

EM 231 RTD Module

The EM 231 RTD module provides a convenient interface for the S7-200 family to several different RTDs. It also allows the S7-200 to measure three different resistance ranges. All RTDs attached to the module must be of the same type.

Configuring the EM 231 RTD Module

DIP switches enable you to select RTD type, wiring configuration, temperature scale, and burnout direction. The DIP switches are located on the bottom of the module as shown in Figure A-24. For the DIP switch settings to take effect, you need to power cycle the PLC and/or the user 24V power supply.

Select RTD type by setting DIP switches 1, 2, 3, 4, 5 and 6 to correspond to the RTD as shown in Table A-31 and Table A-32. Refer to Table A-33 for other DIP switch settings.

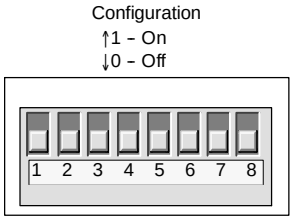


Figure A-24 DIP Switches for the EM 231 RTD Module

Table A-31 Selecting the RTD Type: DIP Switches 1 to 6 for the EM 231 Analog Input RTD 4 Inputs

RTD Type and Alpha[1]	SW1	SW2	SW3	SW4	SW5	SW6	RTD Type and Alpha[1]	SW1	SW2	SW3	SW4	SW5	SW6
100Ω Pt 0.003850 (Default)	0	0	0	0	0	0	100Ω Pt 0.003902	1	0	0	0	0	0
200Ω Pt 0.003850	0	0	0	0	1	0	200Ω Pt 0.003902	1	0	0	0	1	0
500Ω Pt 0.003850	0	0	0	1	0	0	500Ω Pt 0.003902	1	0	0	1	0	0
1000Ω Pt 0.003850	0	0	0	1	1	0	1000Ω Pt 0.003902	1	0	0	1	1	0
100Ω Pt 0.003920	0	0	1	0	0	0	SPARE	1	0	1	0	0	0
200Ω Pt 0.003920	0	0	1	0	1	0	100Ω Ni 0.00672	1	0	1	0	1	0
500Ω Pt 0.003920	0	0	1	1	0	0	120Ω Ni 0.00672	1	0	1	1	0	0
1000Ω Pt 0.003920	0	0	1	1	1	0	1000Ω Ni 0.00672	1	0	1	1	1	0
100Ω Pt 0.00385055	0	1	0	0	0	0	100Ω Ni 0.006178	1	1	0	0	0	0
200Ω Pt 0.00385055	0	1	0	0	1	0	120Ω Ni 0.006178	1	1	0	0	1	0
500Ω Pt 0.00385055	0	1	0	1	0	0	1000Ω Ni 0.006178	1	1	0	1	0	0
1000Ω Pt 0.00385055	0	1	0	1	1	0	10000Ω Pt 0.003850	1	1	0	1	1	0
100Ω Pt 0.003916	0	1	1	0	0	0	10Ω Cu 0.004270	1	1	1	0	0	0
200Ω Pt 0.003916	0	1	1	0	1	0	150Ω FS Resistance	1	1	1	0	1	0
500Ω Pt 0.003916	0	1	1	1	0	0	300Ω FS Resistance	1	1	1	1	0	0
1000Ω Pt 0.003916	0	1	1	1	1	0	600Ω FS Resistance	1	1	1	1	1	0
GOST 50Ω Pt 0.00385055	0	0	0	0	1	1	GOST Cu 50Ω 0.00426	0	1	0	1	1	1
GOST 100Ω Pt 0.00385055	0	0	0	1	0	1	GOST Cu 100Ω 0.00426	0	1	1	0	0	1
GOST 500Ω Pt 0.00385055	0	0	0	1	1	1	GOST Cu 500Ω 0.00426	0	1	1	0	1	1
GOST 10Ω Pt 0.003910	0	0	1	0	0	1	GOST Cu 10Ω 0.00428	0	1	1	1	0	1
GOST 500Ω Pt 0.003910	0	0	1	0	1	1	GOST Cu 50Ω 0.00428	0	1	1	1	1	1
GOST 100Ω Pt 0.003910	0	0	1	1	0	1	GOST Cu 100Ω 0.00428	1	0	0	0	0	1
GOST 500Ω Pt 0.003910	0	0	1	1	1	1	GOST Cu 500Ω 0.00428	1	0	0	0	1	1

EM 231 RTD Status Indicators

The RTD module provides the PLC with data words that indicate temperatures or error conditions. Status bits indicate range error and user supply/module failure. LEDs indicate the status of the module. Your program should have logic to detect error conditions and respond appropriately for the application. Table A-34 shows the status indicators provided by the EM 231 RTD module.



Tip

The channel data format is twos complement, 16-bit words. Temperature is presented in 0.1 degree units. (For example, if the measured temperature is 100.2 degrees, the reported data is 1002.) Resistance data are scaled to 27648. For example, 75% of full scale resistance is reported as 20736.

(225Ω / 300Ω * 27648 = 20736)

Table A-34 EM 231 RTD Status Indicators

Error Condition	Channel Data	SF LED Red	24 V LED Green	Range Status Bit[1]	24 VDC User Power Bad[2]
No errors	Conversion data	OFF	ON	0	0
24 V missing	32766	OFF	OFF	0	1
SW detects open wire	–32768/32767	BLINK	ON	1	0
Out of range input	–32768/32767	BLINK	ON	1	0
Diagnostic error[3]	0000	ON	OFF	0	note[3]

1 Range status bit is bit 3 in module error register byte (SMB9 for Module 1, SMB11 for Module 2, etc.)
2 User Power Bad status bit is bit 2 in module error register byte (such as SMB 9, SMB 11, refer to Appendix D.)
3 Diagnostic errors cause a module configuration error. The User Power Bad status bit may or may not be set before the module configuration error.

If the PLC has read the data:

- ❏ All 4 channels in the EM 231 Analog Input RTD 2 Inputs are updated every 405 milliseconds.
- ❏ All channels in the EM 231 Analog Input RTD 4 Inputs are updated every 810 milliseconds.

If the PLC does not read the data within one update time, the module reports old data until the next module update after the PLC read. To keep channel data current, it is recommended that the PLC program read data at least as often as the module update rate.



Tip

When you are using the RTD module, be sure to disable analog filtering in the PLC. Analog filtering can prevent error conditions from being detected in a timely manner.

Open wire detection is performed by software internal to the RTD module. Out of range inputs and detected open wire conditions are signaled by setting the range status bit in the SMB and by setting the channel data up or down scale per the switch settings. Open wire detection takes a minimum of three module scan cycles and can take longer, depending on which wire(s) are open. Open Source+ and/or Source– wires are detected in the minimum time. Open Sense+ and/or Sense– wires can take 5 seconds or more to detect. Open sense lines can randomly present valid data, with open wire detected intermittently, especially in electrically noisy environments. Electrical noise can also extend the time it takes to detect the open wire condition. It is recommended that open wire/out of range indications be latched in the application program after valid data has been reported.



Tip

If you have an unused channel, you can wire the that channel with a resistor in place of the RTD to prevent open wire detection from causing the SF LED to blink. The resistor must be the nominal value of the RTD. For example, use 100 ohms for PT100 RTD .

EM 231 RTD Module Ranges

EM 231 RTD temperature ranges and accuracy for each type of RTD module are shown in Tables A-35 and A-36.

Table A-35 Temperature Ranges (°C) and Accuracy for the RTD Module

Decimal	Hex	Pt10000	Pt100, Pt200, Pt500, Pt1000, & GOST 0.003850	GOST 0.003910 Pt10, Pt50, Pt100, Pt500	Ni100, Ni120, Ni1000 LG-Ni1000	Ni100 GOST 0.006170	Cu 10 0.00427	GOST 0.00426 Cu 10 Cu 50 Cu 100 Cu 500	GOST 0.00428 Cu 10 Cu 50 Cu 100 Cu 500	
32767	7FFF									↑
32766	7FFE									Over-range
32511	7EFF									
27649	6C01									
27648	6C00									
25000	61A8			↑						
18000	4650			1295.0° C						
15000	3A98									
12950	3296									
11000	2AF8	↑	↑	1100.0°C						
10000	2710	1000.0° C	1000.0°C							
8500	2134		850.0° C							
6000	1770	600.0° C					↑			
3120	0C30				↑		312.0° C			N
2950	0B86				295.0° C					O
2600	0A28						260.0° C			M
2500	09C4				250.0° C			↑	↑	I
2400	960					↑		240.0° C	240.0° C	N
2124	84C					212.4° C				A
2000	7D0							200.0° C	200.0° C	L
1800	708					180.0° C				
1	0001	0.1° C	0.1° C	0.1° C	0.1° C	0.1° C	0.1° C	0.1° C	0.1° C	R
0	0000	0.0° C	0.0° C	0.0° C	0.0° C	0.0° C	0.0° C	0.0° C	0.0° C	A
-1	FFFF	-0.1° C	-0.1° C	-0.1° C	-0.1° C	-0.1° C	-0.1° C	-0.1° C	-0.1° C	N
500	FE0C							-50.0° C		G
-600	FDA8				-60.0° C	-60.0° C		-60.0° C		E
								↓		
-1050	FBE6				-105.0° C	-105.0° C				
					↓	↓				
-2000	F830	-200.0° C	-200.0° C				-200.0° C		-200.0° C	
-2400	F6A0						-240.0° C		-240.0° C	
-2430	F682	-243.0° C	-243.0° C				↓		↓	
-2600	F5D8	↓	↓	-260.0° C						
-273.2	F554			-273.2° C						
-6000	E890									Under-range
-10500	D6FC									↓
-12000	D120									
-32767	8001									
-32768	8000									
ACCURACY OVER FULL SPAN		±0.4%	±0.1%	±0.5%	±0.2%	±0.5%	±0.2%	±0.3%	±0.3%	
ACCURACY IN NOMINAL RANGE		±4° C	±1° C	±1° C[1]	±0.6° C	±42.8° C	±1° C	±1° C	±1° C	

1 OF = Overflow; OR = Over range; NR = Nominal range; UR = Under range; UF = Underflow
↑ or ↓ : All analog values exceeding the limits will report the out of range value, 32767 (0x7FFF).
[1]Accuracy decreases below -250 C to as great as 7 C.

2 Accuracy may deviate up to +/- 1.5% of full-scale when subjected to severe RF interferences such as specified in the generic immunity standard EN 61000-6-2.

S7-200CN Products

A cross-reference of SIMATIC S7-200 products to S7-200CN products is shown in the following table. For wiring and performance specifications, refer to the cross-referenced SIMATIC S7-200 product in Appendix A. Check the markings on the actual S7-200CN product for the specific Agency approvals and Certifications.

Table H-1 Cross Reference for SIMATIC S7-200 Products to S7-200CN Products

Model Name and Description	S7-200 SIMATIC Product	S7-200CN Product
CPU 222 DC/DC/DC, 8 Inputs/6 Outputs	6ES7 212-1AB23-0XB0	6ES7 212-1AB23-0XB8
CPU 222 AC/DC/Relay 8 Inputs/ 6 Relays	6ES7 212-1BB23-0XB0	6ES7 212-1BB23-0XB8
CPU 224 DC/DC/DC 14 Inputs/ 10 Outputs	6ES7 214-1AD23-0XB0	6ES7 214-1AD23-0XB8
CPU 224 AC/DC/Relay14 Inputs/ 10 Relays	6ES7 214-1BD23-0XB0	6ES7 214-1BD23-0XB8
CPU 224XP DC/DC/DC 14 Inputs/10 Outputs	6ES7 214-2AD23-0XB0	6ES7 214-2AD23-0XB8
CPU 224XPsi DC/DC/DC 14 Inputs/10 Outputs	6ES7 214-2AS23-0XB0	6ES7 214-2AS23-0XB8
CPU 224XP AC/DC/Relay 14 Inputs/10 Relays	6ES7 214-2BD23-0XB0	6ES7 214-2BD23-0XB8
CPU 226 DC/DC/DC 24 Inputs/16 Outputs	6ES7 216-2AD23-0XB0	6ES7 216-2AD23-0XB8
CPU 226 AC/DC/Relay 24 Inputs/16 Relays	6ES7 216-2BD23-0XB0	6ES7 216-2BD23-0XB8
EM 221 Digital Input 8 x 24 VDC	6ES7 221-1BF22-0XA0	6ES7 221-1BF22-0XA8
EM 221 Digital Input 16 x 24 VDC	6ES7 221-1BH22-0XA0	6ES7 221-1BH22-0XA8
EM 222 Digital Output 8 x 24 VDC	6ES7 222-1BF22-0XA0	6ES7 222-1BF22-0XA8
EM 222 Digital Output 8 x Relays	6ES7 222-1HF22-0XA0	6ES7 222-1HF22-0XA8
EM 223 24 VDC Digital Comb 4 Inputs/4 Outputs	6ES7 223-1BF22-0XA0	6ES7 223-1BF22-0XA8
EM 223 24 VDC Digital Comb 4 Inputs/4 Relay Outputs	6ES7 223-1HF22-0XA0	6ES7 223-1HF22-0XA8
EM 223 24 VDC Digital Comb 8 Inputs/8 Outputs	6ES7 223-1BH22-0XA0	6ES7 223-1BH22-0XA8
EM 223 24 VDC Digital Comb 8 Inputs/8 Relay Outputs	6ES7 223-1PH22-0XA0	6ES7 223-1PH22-0XA8
EM 223 24 VDC Digital Comb 16 Inputs/16 Outputs	6ES7 223-1BL22-0XA0	6ES7 223-1BL22-0XA8
EM 223 24 VDC Digital Comb 16 Inputs/16 Relay Outputs	6ES7 223-1PL22-0XA0	6ES7 223-1PL22-0XA8
EM 223 24 VDC Digital Comb 32 Inputs/32 Outputs	6ES7 223-1BM22-0XA0	6ES7 223-1BM22-0XA8
EM 223 24 VDC Digital Comb 32 Inputs/32 Relay Outputs	6ES7 223-1PM22-0XA0	6ES7 223-1PM22-0XA8
EM 231 Analog Input, 4 Inputs	6ES7 231-0HC22-0XA0	6ES7 231-0HC22-0XA8
EM 235 Analog Combination 4 Inputs/1 Output	6ES7 235-0KD22-0XA0	6ES7 235-0KD22-0XA8
EM 232 Analog Output, 2 Outputs	6ES7 232-0HB22-0XA0	6ES7 232-0HB22-0XA8
EM 231 Analog Input RTD, 2 Inputs	6ES7 231-7PB22-0XA0	6ES7 231-7PB22-0XA8
EM 231 Analog Input Thermocouple, 4 Inputs	6ES7 231-7PD22-0XA0	6ES7 231-7PD22-0XA8