Technical specifications

A

A.1 General Technical Specifications

Standards compliance

The S7-1200 automation system design conforms with the following standards and test specifications. The test criteria for the S7-1200 automation system are based on these standards and test specifications.

Note that not all S7-1200 models may be certified to these standards, and certification status may change without notification. It is the user's responsibility to determine applicable certifications by referring to the ratings marked on the product. Consult your local Siemens representative if you need additional information related to the latest listing of exact approvals by part number.

CE approval

CE

The S7-1200 Automation System satisfies requirements and safety related objectives according to the EC directives listed below, and conforms to the harmonized European standards (EN) for the programmable controllers listed in the Official Journals of the European Community.

- EC Directive 2006/95/EC (Low Voltage Directive) "Electrical Equipment Designed for Use within Certain Voltage Limits"
  - EN 61131-2:2007 Programmable controllers - Equipment requirements and tests
- EC Directive 2004/108/EC (EMC Directive) "Electromagnetic Compatibility"
  - Emission standard
    EN 61000-6-4:2007: Industrial Environment
  - Immunity standard
    EN 61000-6-2:2005: Industrial Environment
- EC Directive 94/9/EC (ATEX) "Equipment and Protective Systems Intended for Use in Potentially Explosive Atmosphere"
  - EN 60079-15:2005: Type of Protection 'n'

The CE Declaration of Conformity is held on file available to competent authorities at:

Siemens AG
IA AS RD ST PLC Amberg
Werner-von-Siemens-Str. 50
D92224 Amberg
Germany

cULus approval

Underwriters Laboratories Inc. complying with:

- Underwriters Laboratories, Inc.: UL 508 Listed (Industrial Control Equipment)
- Canadian Standards Association: CSA C22.2 Number 142 (Process Control Equipment)

NOTICE
The SIMATIC S7-1200 series meets the CSA standard. The cULus logo indicates that the S7-1200 has been examined and certified by Underwriters Laboratories (UL) to standards UL 508 and CSA 22.2 No. 142.

FM approval

Factory Mutual Research (FM)
Approval Standard Class Number 3600 and 3611
Approved for use in:
Class I, Division 2, Gas Group A, B, C, D, Temperature Class T3C Ta = 60° C
Class I, Zone 2, IIC, Temperature Class T3 Ta = 60° C
Canadian Class I, Zone 2 Installation per CEC 18-150

IMPORTANT EXCEPTION: See Technical Specifications for the number of inputs or outputs allowed on simultaneously. Some models are de-rated for Ta = 60° C.

⚠ WARNING
Substitution of components may impair the suitability for Class I, Division 2 and Zone 2. Repair of units should only be performed by an authorized Siemens Service Center.

ATEX approval

ATEX approval applies to DC models only. ATEX approval does not apply to AC and Relay models.

EN 60079-0:2006: Explosive Atmospheres - General Requirements

EN 60079-15:2005: Electrical Apparatus for Potentially Explosive Atmospheres;
Type of protection 'nA'
II 3 G Ex nA II T3

IMPORTANT EXCEPTION: See Technical Specifications for the number of inputs or outputs allowed on simultaneously. Some models are de-rated for Ta = 60° C.

Install modules in a suitable enclosure providing a minimum degree of protection of IP54 according to EN 60529 and take into account the environmental conditions under which the equipment will be used.

When the temperature under rated conditions exceed 70° C at the cable entry point, or 80° C at the branching point of the conductors, the temperature specification of the selected cable should be in compliance with the actual measured temperature.

Provisions should be made to prevent the rated voltage from being exceeded by transient disturbances of more than 40%.

C-Tick approval

The S7-1200 automation system satisfies requirements of standards to AS/NZS 2064 (Class A).

Korea Certification

The S7-1200 automation system satisfies the requirements of the Korean Certification (KC Mark). It has been defined as Class A Equipment and is intended for industrial applications and has not been considered for home use.

Maritime approval

The S7-1200 products are periodically submitted for special agency approvals related to specific markets and applications. Consult your local Siemens representative if you need additional information related to the latest listing of exact approvals by part number.

Classification societies:

- ABS (American Bureau of Shipping)
- BV (Bureau Veritas)
- DNV (Det Norske Veritas)
- GL (Germanischer Lloyd)
- LRS (Lloyds Register of Shipping)
- Class NK (Nippon Kaiji Kyokai)

Industrial environments

The S7-1200 automation system is designed for use in industrial environments.

Table A- 1 Industrial environments

Application field	Noise emission requirements	Noise immunity requirements
Industrial	EN 61000-6-4:2007	EN 61000-6-2:2005

Electromagnetic compatibility

Electromagnetic Compatibility (EMC) is the ability of an electrical device to operate as intended in an electromagnetic environment and to operate without emitting levels of electromagnetic interference (EMI) that may disturb other electrical devices in the vicinity.

Table A- 2 Immunity per EN 61000-6-2

Electromagnetic compatibility - Immunity per EN 61000-6-2	
EN 61000-4-2 Electrostatic discharge	8 kV air discharge to all surfaces 6 kV contact discharge to exposed conductive surfaces
EN 61000-4-3 Radiated, radio-frequency, electromagnetic field immunity test	80 to 1000 MHz, 10 V/m, 80% AM at 1 kHz 1.4 to 2.0 GHz, 3 V/m, 80% AM at 1 kHz 2.0 to 2.7 GHz, 1 V/m, 80% AM at 1 kHz
EN 61000-4-4 Fast transient bursts	2 kV, 5 kHz with coupling network to AC and DC system power 2 kV, 5 kHz with coupling clamp to I/O
EN 6100-4-5 Surge immunity	AC systems - 2 kV common mode, 1kV differential mode DC systems - 2 kV common mode, 1kV differential mode For DC systems (I/O signals, DC power systems) external protection is required.
EN 61000-4-6 Conducted disturbances	150 kHz to 80 MHz, 10 V RMS, 80% AM at 1kHz
EN 61000-4-11 Voltage dips	AC systems 0% for 1 cycle, 40% for 12 cycles and 70% for 30 cycles at 60 Hz

Table A- 3 Conducted and radiated emissions per EN 61000-6-4

Electromagnetic compatibility - Conducted and radiated emissions per EN 61000-6-4		
Conducted Emissions EN 55011, Class A, Group 1	0.15 MHz to 0.5 MHz	<79dB (µV) quasi-peak; <66 dB (µV) average
	0.5 MHz to 5 MHz	<73dB (µV) quasi-peak; <60 dB (µV) average
	5 MHz to 30 MHz	<73dB (µV) quasi-peak; <60 dB (µV) average
Radiated Emissions EN 55011, Class A, Group 1	30 MHz to 230 MHz	<40dB (µV/m) quasi-peak; measured at 10m
	230 MHz to 1 GHz	<47dB (µV/m) quasi-peak; measured at 10m

Environmental conditions

Table A- 4 Transport and storage

Environmental conditions - Transport and storage	
EN 60068-2-2, Test Bb, Dry heat and EN 60068-2-1, Test Ab, Cold	-40° C to +70° C
EN 60068-2-30, Test Db, Damp heat	25° C to 55° C, 95% humidity
EN 60068-2-14, Test Na, temperature shock	-40° C to +70° C, dwell time 3 hours, 5 cycles
EN 60068-2-32, Free fall	0.3 m, 5 times, product packaging
Atmospheric pressure	1080 to 660h Pa (corresponding to an altitude of -1000 to 3500m)

Table A- 5 Operating conditions

Environmental conditions - Operating	
Ambient temperature range (Inlet Air 25 mm below unit)	-20° C to 60° C horizontal mounting -20° C to 50° C vertical mounting 95% non-condensing humidity Unless otherwise specified
Atmospheric pressure	1080 to 795 hPa (corresponding to an altitude of -1000 to 2000m)
Concentration of contaminants	SO_2: < 0.5 ppm; H_2S: < 0.1 ppm; RH < 60% non-condensing
EN 60068-2-14, Test Nb, temperature change	5° C to 55° C, 3° C/minute
EN 60068-2-27 Mechanical shock	15 G, 11 ms pulse, 6 shocks in each of 3 axis
EN 60068-2-6 Sinusoidal vibration	DIN rail mount: 3.5 mm from 5-9 Hz, 1G from 9 - 150 Hz Panel Mount: 7.0 mm from 5-9 Hz, 2G from 9 to 150 Hz 10 sweeps each axis, 1 octave per minute

NOTICE
For systems that must start up in the range of -20° C to 0° C, the user program should delay energizing outputs for 10 seconds following startup.

Table A- 6 High potential isolation test

High potential isolation test	
24 V/5 V nominal circuits	520 VDC (type test of optical isolation boundaries)
115/230 V circuits to ground	1500 VAC
115/230 V circuits to 115/230 V circuits	1500 VAC
115 V/230V circuits to 24 V/5 V circuits	1500 VAC (3000 VAC / 4242 VDC type test)
Ethernet port to 24V/5V circuits and ground[1]	1500 VAC (type test only)

[1] Ethernet port isolation is designed to limit hazard during short term network faults to hazardous voltages. It does not conform to safety requirements for routine AC line voltage isolation.

Protection class

- Protection Class II according to EN 61131-2 (Protective conductor not required)

Degree of protection

- IP20 Mechanical Protection, EN 60529
- Protects against finger contact with high voltage as tested by standard probe. External protection required for dust, dirt, water and foreign objects of < 12.5mm in diameter.

Rated voltages

Table A- 7 Rated voltages

Rated voltage	Tolerance
24 VDC	20.4 VDC to 28.8 VDC 22.0 VDC to 28.8 VDC for ambient temperature -20° C to 0° C
120/230 VAC	85 VAC to 264 VAC, 47 to 63 Hz

NOTICE

When a mechanical contact turns on output power to the S7-1200 CPU, or any digital signal module, it sends a "1" signal to the digital outputs for approximately 50 microseconds. This could cause unexpected machine or process operation which could result in death or serious injury to personnel and/or damage to equipment. You must plan for this, especially if you are using devices which respond to short duration pulses.

Reverse voltage protection

Reverse voltage protection circuitry is provided on each terminal pair of +24 VDC power or user input power for CPUs, signal modules (SMs), and signal boards (SBs). It is still possible to damage the system by wiring different terminal pairs in opposite polarities.

Some of the 24 VDC power input ports in the S7-1200 system are interconnected, with a common logic circuit connecting multiple M terminals. For example, the following circuits are interconnected when designated as "not isolated" in the data sheets: the 24 VDC power supply of the CPU, the power input for the relay coil of an SM, or the power supply for a non-isolated analog input. All non-isolated M terminals must connect to the same external reference potential.

⚠ WARNING

Connecting non-isolated M terminals to different reference potentials will cause unintended current flows that may cause damage or unpredictable operation in the PLC and any connected equipment.

Failure to comply with these guidelines could cause damage or unpredictable operation which could result in death or serve personal injury and/or property damage.

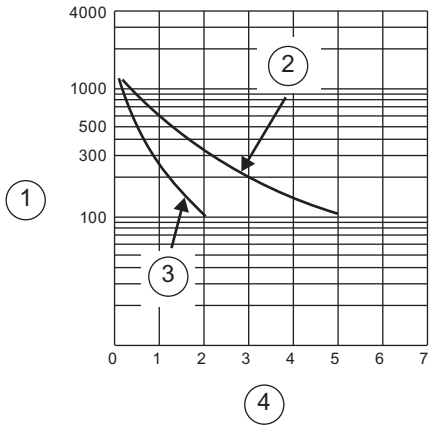
Always ensure that all non-isolated M terminals in an S7-1200 system are connected to the same reference potential.

DC Outputs

Short circuit protection circuitry is not provided for DC outputs on CPUs, signal modules (SMs) and signal boards (SBs).

Relay electrical service life

The typical performance data supplied by relay vendors is shown below. Actual performance may vary depending upon your specific application. An external protection circuit that is adapted to the load will enhance the service life of the contacts.



① Service life (x 10^3 operations)

② 250 VAC resistive load
30 VDC resistive load

③ 250 VAC inductive load (p.f=0.4)
30 VDC inductive load (L/R=7ms)

④ Rated Operating Current (A)

A.2 CPU 1211C

A.2.1 General specifications and features

Table A- 8 General specifications

Technical data	CPU 1211C AC/DC/Relay	CPU 1211C DC/DC/Relay	CPU 1211C DC/DC/DC
Order number	6ES7 211-1BE31-0XB0	6ES7 211-1HE31-0XB0	6ES7 211-1AE31-0XB0
Dimensions W x H x D (mm)	90 x 100 x 75	90 x 100 x 75	90 x 100 x 75
Shipping weight	420 grams	380 grams	370 grams
Power dissipation	10 W	8 W	8 W
Current available (CM bus)	750 mA max. (5 VDC)	750 mA max. (5 VDC)	750 mA max. (5 VDC)
Current available (24 VDC)	300 mA max. (sensor power)	300 mA max. (sensor power)	300 mA max. (sensor power)
Digital input current consumption (24VDC)	4 mA/input used	4 mA/input used	4 mA/input used

Table A- 9 CPU features

Technical data		Description
User memory[1]	Work	30 Kbytes
	Load	1 Mbyte internal, expandable up to SD card size
	Retentive	10 Kbytes
On-board digital I/O		6 inputs/4 outputs
On-board analog I/O		2 inputs
Process image size		1024 bytes of inputs (I) /1024 bytes of outputs (Q)
Bit memory (M)		4096 bytes
Temporary (local) memory		• 16 Kbytes for startup and program cycle (including associated FBs and FCs) • 4 Kbytes for standard interrupt events including FBs and FCs • 4 Kbytes for error interrupt events including FBs and FCs
Signal modules expansion		none
SB, CB, BB expansion		1 max.
Communication module expansion		3 CMs max.
High-speed counters		3 built-in I/O, 5 with signal board, refer to table, HSC input assignments for CPU 1211C (Page 339) • Single phase: 3 at 100 kHz, SB: 2 at 30 kHz • Quadrature phase: 3 at 80 kHz, SB: 2 at 20 kHz
Pulse outputs [2]		4
Pulse catch inputs		6
Time delay / cyclic interrupts		4 total with 1 ms resolution
Edge interrupts		6 rising and 6 falling (10 and 10 with optional signal board)
Memory card		SIMATIC Memory Card (optional)
Real time clock accuracy		+/- 60 seconds/month
Real time clock retention time		20 days typ./12 days min. at 40°C (maintenance-free Super Capacitor)

[1] The size of the user program, data, and configuration is limited by the available load memory and work memory in the CPU. There is no specific limit to the number of OB, FC, FB and DB blocks supported or to the size of a particular block; the only limit is due to overall memory size.

[2] For CPU models with relay outputs, you must install a digital signal board (SB) to use the pulse outputs.

Table A- 10 Performance

Type of instruction	Execution speed
Boolean	0.08 µs/instruction
Move Word	1.7 µs/instruction
Real math	2.3 µs/instruction

A.2.2 Timers, counters and code blocks supported by CPU 1211C

Table A- 11 Blocks, timers and counters supported by CPU 1211C

Element		Description
Blocks	Type	OB, FB, FC, DB
	Size	30 Kbytes
	Quantity	Up to 1024 blocks total (OBs + FBs + FCs + DBs)
	Address range for FBs, FCs, and DBs	1 to 65535 (such as FB 1 to FB 65535)
	Nesting depth	16 from the program cycle or start up OB; 4 from the time delay interrupt, time-of-day interrupt, cyclic interrupt, hardware interrupt, time error interrupt, or diagnostic error interrupt OB
	Monitoring	Status of 2 code blocks can be monitored simultaneously
OBs	Program cycle	Multiple: OB 1, OB 200 to OB 65535
	Startup	Multiple: OB 100, OB 200 to OB 65535
	Time-delay interrupts and cyclic interrupts	4[1] (1 per event): OB 200 to OB 65535
	Hardware interrupts (edges and HSC)	50 (1 per event): OB 200 to OB 65535
	Time error interrupts	1: OB 80
	Diagnostic error interrupts	1: OB 82
Timers	Type	IEC
	Quantity	Limited only by memory size
	Storage	Structure in DB, 16 bytes per timer
Counters	Type	IEC
	Quantity	Limited only by memory size
	Storage	Structure in DB, size dependent upon count type • SInt, USInt: 3 bytes • Int, UInt: 6 bytes • DInt, UDInt: 12 bytes

[1] Time-delay and cyclic interrupts use the same resources in the CPU. You can have only a total of 4 of these interrupts (time-delay plus cyclic interrupts). You cannot have 4 time-delay interrupts and 4 cyclic interrupts.

Table A- 12 Communication

Technical data	Description
Number of ports	1
Type	Ethernet
HMI device[1]	3
Programming device (PG)	1

Technical data	Description
Connections	• 8 for Open User Communication (active or passive): TSEND_C, TRCV_C, TCON, TDISCON, TSEND, and TRCV • 3 for server GET/PUT (CPU-to-CPU) S7 communication • 8 for client GET/PUT (CPU-to-CPU) S7 communication
Data rates	10/100 Mb/s
Isolation (external signal to PLC logic)	Transformer isolated, 1500 VAC, for short term event safety only
Cable type	CAT5e shielded

[1] The CPU provides dedicated HMI connections to support up to 3 HMI devices. (You can have up to 2 SIMATIC Comfort panels.) The total number of HMI is affected by the types of HMI panels in your configuration. For example, you could have up to three SIMATIC Basic panels connected to your CPU, or you could have up to two SIMATIC Comfort panels with one additional Basic panel.

Table A- 13 Power supply

Technical data		CPU 1211C AC/DC/Relay	CPU 1211C DC/DC/Relay	CPU 1211C DC/DC/DC
Voltage range		85 to 264 VAC	20.4 VDC to 28.8 VDC 22.0 VDC to 28.8 VDC for ambient temperature -20° C to 0° C	
Line frequency		47 to 63 Hz	--	--
Input current	CPU only at max. load	60 mA at 120 VAC 30 mA at 240 VAC	300 mA at 24 VDC	300 mA at 24 VDC
	CPU with all expansion accessories at max. load	180 mA at 120 VAC 90 mA at 240 VAC	900 mA at 24 VDC	900 mA at 24 VDC
Inrush current (max.)		20 A at 264 VAC	12 A at 28.8 VDC	12 A at 28.8 VDC
Isolation (input power to logic)		1500 VAC	Not isolated	Not isolated
Ground leakage, AC line to functional earth		0.5 mA max.	--	--
Hold up time (loss of power)		20 ms at 120 VAC 80 ms at 240 VAC	10 ms at 24 VDC	10 ms at 24 VDC
Internal fuse, not user replaceable		3 A, 250 V, slow blow	3 A, 250 V, slow blow	3 A, 250 V, slow blow

Table A- 14 Sensor power

Technical data	CPU 1211C AC/DC/Relay	CPU 1211C DC/DC/Relay	CPU 1211C DC/DC/DC
Voltage range	20.4 to 28.8 VDC	L+ minus 4 VDC min. L+ minus 5 VDC min. for ambient temperature -20° C to 0° C	
Output current rating (max.)	300 mA (short circuit protected)	300 mA (short circuit protected)	300 mA (short circuit protected)
Maximum ripple noise (<10 MHz)	< 1 V peak to peak	Same as input line	Same as input line
Isolation (CPU logic to sensor power)	Not isolated	Not isolated	Not isolated

A.2.3 Digital inputs and outputs

Table A- 15 Digital inputs

Technical data	CPU 1211C AC/DC/Relay, CPU 1211C DC/DC/Relay, and CPU 1211C DC/DC/DC
Number of inputs	6
Type	Sink/Source (IEC Type 1 sink)
Rated voltage	24 VDC at 4 mA, nominal
Continuous permissible voltage	30 VDC, max.
Surge voltage	35 VDC for 0.5 sec.
Logic 1 signal (min.)	15 VDC at 2.5 mA
Logic 0 signal (max.)	5 VDC at 1 mA
Isolation (field side to logic)	500 VAC for 1 minute
Isolation groups	1
Filter times	0.2, 0.4, 0.8, 1.6, 3.2, 6.4, and 12.8 ms (selectable in groups of 4)
HSC clock input rates (max.) (Logic 1 Level = 15 to 26 VDC)	Single phase: 100 KHz Quadrature phase: 80 KHz
Number of inputs on simultaneously	6 at 60° C horizontal, 50° C vertical
Cable length (meters)	500 m shielded, 300 m unshielded, 50 m shielded for HSC inputs

Table A- 16 Digital outputs

Technical data	CPU 1211C AC/DC/Relay and CPU 1211C DC/DC/Relay	CPU 1211C DC/DC/DC
Number of outputs	4	4
Type	Relay, dry contact	Solid state - MOSFET (sourcing)
Voltage range	5 to 30 VDC or 5 to 250 VAC	20.4 to 28.8 VDC
Logic 1 signal at max. current	--	20 VDC min.
Logic 0 signal with 10 KΩ load	--	0.1 VDC max.
Current (max.)	2.0 A	0.5 A
Lamp load	30 W DC / 200 W AC	5 W
ON state resistance	0.2 Ω max. when new	0.6 Ω max.
Leakage current per point	--	10 µA max.
Surge current	7 A with contacts closed	8 A for 100 ms max.
Overload protection	No	No
Isolation (field side to logic)	1500 VAC for 1 minute (coil to contact) None (coil to logic)	500 VAC for 1 minute
Isolation resistance	100 MΩ min. when new	--
Isolation between open contacts	750 VAC for 1 minute	--
Isolation groups	1	1
Inductive clamp voltage	--	L+ minus 48 VDC, 1 W dissipation

Technical data	CPU 1211C AC/DC/Relay and CPU 1211C DC/DC/Relay	CPU 1211C DC/DC/DC
Maximum relay switching frequency	1 Hz	--
Switching delay (Qa.0 to Qa.3)	10 ms max.	1.0 µs max., off to on 3.0 µs max., on to off
Pulse Train Output rate (Qa.0 and Qa.2)	Not recommended [1]	100 KHz max., 2 Hz min.[2]
Lifetime mechanical (no load)	10,000,000 open/close cycles	--
Lifetime contacts at rated load	100,000 open/close cycles	--
Behavior on RUN to STOP	Last value or substitute value (default value 0)	Last value or substitute value (default value 0)
Number of outputs on simultaneously	4 at 60° C horizontal, 50° C vertical	
Cable length (meters)	500 m shielded, 150 m unshielded	500 m shielded, 150 m unshielded

1 For CPU models with relay outputs, you must install a digital signal board (SB) to use the pulse outputs.

2 Depending on your pulse receiver and cable, an additional load resistor (at least 10% of rated current) may improve pulse signal quality and noise immunity.

A.2.4 Analog inputs

Table A- 17 Analog inputs

Technical data	Description
Number of inputs	2
Type	Voltage (single-ended)
Full-scale range	0 to 10 V
Full-scale range (data word)	0 to 27648
Overshoot range	10.001 to 11.759 V
Overshoot range (data word)	27,649 to 32,511
Overflow range	11.760 to 11.852 V
Overflow range (data word)	32,512 to 32,767
Resolution	10 bits
Maximum withstand voltage	35 VDC
Smoothing	None, Weak, Medium, or Strong See the table for step response (ms) for the analog inputs of the CPU (Page 711).
Noise rejection	10, 50, or 60 Hz
Impedance	≥100 KΩ
Isolation (field side to logic)	None
Accuracy (25°C / -20 to 60°C)	3.0% / 3.5% of full-scale
Cable length (meters)	100 m, shielded twisted pair

A.2.4.1 Step response of the built-in analog inputs of the CPU

Table A- 18 Step Response (ms), 0V to 10V measured at 95%

Smoothing selection (sample averaging)	Rejection frequency (Integration time)		
	60 Hz	50 Hz	10 Hz
None (1 cycle): No averaging	50 ms	50 ms	100 ms
Weak (4 cycles): 4 samples	60ms	70 ms	200 ms
Medium (16 cycles): 16 samples	200 ms	240 ms	1150 ms
Strong (32 cycles): 32 samples	400 ms	480 ms	2300 ms
Sample time	**4.17 ms**	**5 ms**	**25 ms**

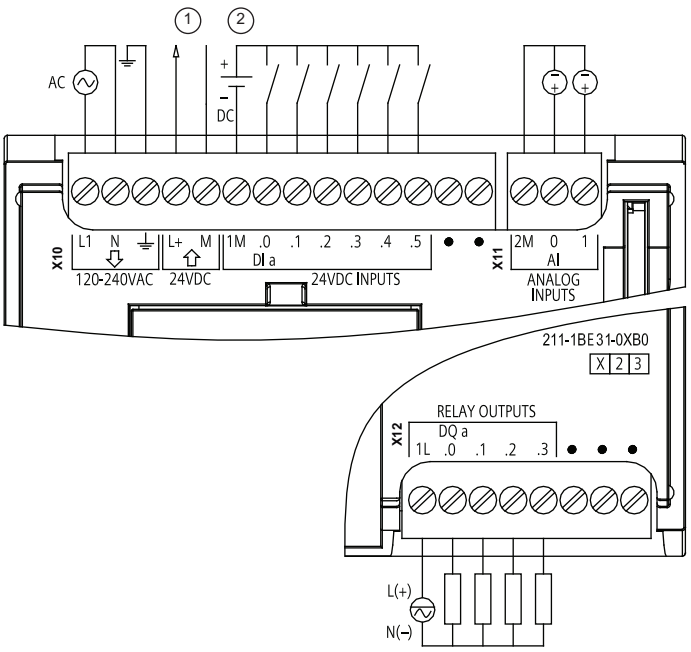
A.2.4.2 Sample time for the built-in analog ports of the CPU

Table A- 19 Sample time for built-in analog inputs of the CPU

Rejection frequency (Integration time selection)	Sample time
60 Hz (16.6 ms)	4.17 ms
50 Hz (20 ms)	5 ms
10 Hz (100 ms)	25 ms

A.2.5 CPU 1211C Wiring diagrams

Table A- 20 CPU 1211C AC/DC/Relay (6ES7 211-1BE31-0XB0)



① 24 VDC Sensor Power Out
For additional noise immunity, connect "M" to chassis ground even if not using sensor supply.

② For sinking inputs, connect "-" to "M" (shown).

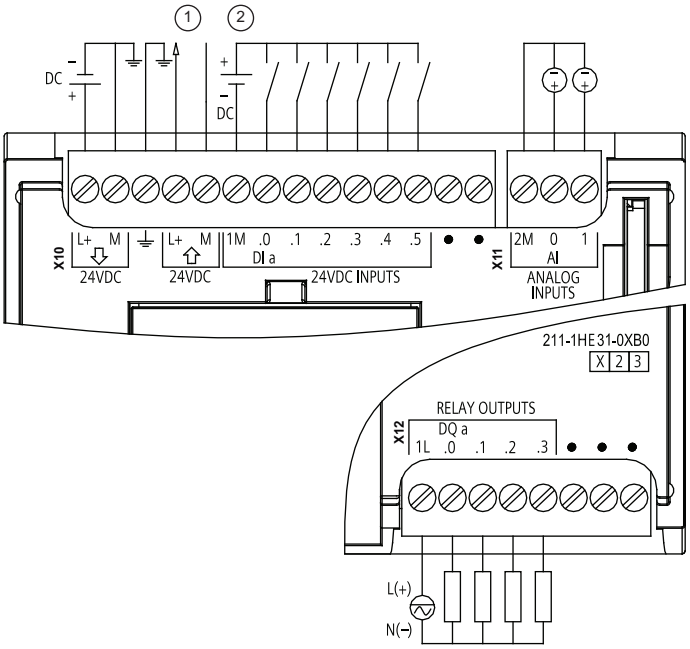
For sourcing inputs, connect "+" to "M".

Note: X11 connectors must be gold. See Appendix C, Spare Parts for order number.

Table A- 21 Connector pin locations for CPU 1211C AC/DC/Relay (6ES7 211-1BE31-0XB0)

Pin	X10	X11 (gold)	X12
1	L1 / 120-240 VAC	2 M	1L
2	N / 120-240 VAC	AI 0	DQ a.0
3	Functional Earth	AI 1	DQ a.1
4	L+ / 24VDC Sensor Out	--	DQ a.2
5	M / 24VDC Sensor Out	--	DQ a.3
6	1M	--	No connection
7	DI a.0	--	No connection
8	DI a.1	--	No connection
9	DI a.2	--	--
10	DI a.3	--	--
11	DI a.4	--	--
12	DI a.5	--	--
13	No connection	--	--
14	No connection	--	--

Table A- 22 CPU 1211C DC/DC/Relay (6ES7 211-1HE31-0XB0)



① 24 VDC Sensor Power Out

For additional noise immunity, connect "M" to chassis ground even if not using sensor supply.

② For sinking inputs, connect "-" to "M" (shown).

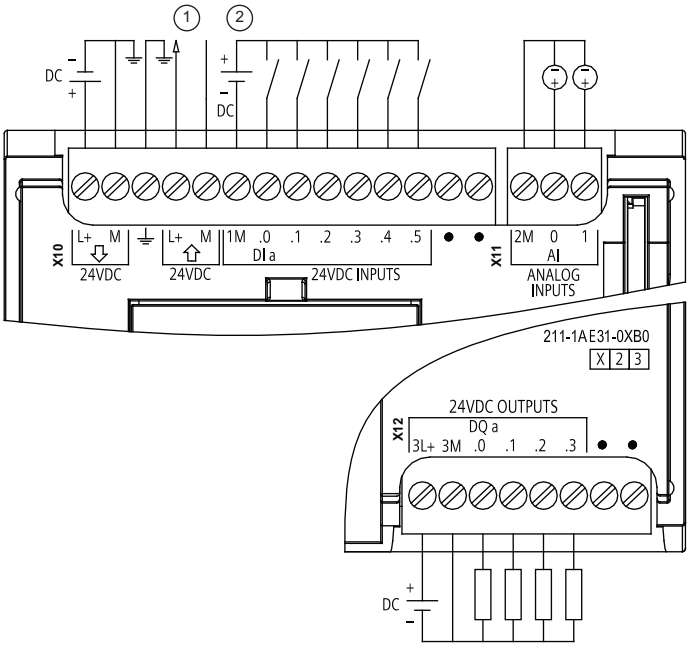
For sourcing inputs, connect "+" to "M".

Note: X11 connectors must be gold. See Appendix C, Spare Parts for order number.

Table A- 23 Connector pin locations for CPU 1211C DC/DC/Relay (6ES7 211-1HE31-0XB0)

Pin	X10	X11 (gold)	X12
1	L+ / 24VDC	2 M	1L
2	M / 24VDC	AI 0	DQ a.0
3	Functional Earth	AI 1	DQ a.1
4	L+ / 24VDC Sensor Out	--	DQ a.2
5	M / 24VDC Sensor Out	--	DQ a.3
6	1M	--	No connection
7	DI a.0	--	No connection
8	DI a.1	--	No connection
9	DI a.2	--	--
10	DI a.3	--	--
11	DI a.4	--	--
12	DI a.5	--	--
13	No connection	--	--
14	No connection	--	--

Table A- 24 CPU 1211C DC/DC/DC (6ES7 211-1AE31-0XB0)



① 24 VDC Sensor Power Out

For additional noise immunity, connect "M" to chassis ground even if not using sensor supply.

② For sinking inputs, connect "-" to "M" (shown).

For sourcing inputs, connect "+" to "M".

Note: X11 connectors must be gold. See Appendix C, Spare Parts for order number.

Table A- 25 Connector pin locations for CPU 1211C DC/DC/DC (6ES7 211-1AE31-0XB0)

Pin	X10	X11 (gold)	X12
1	L+ / 24VDC	2 M	3L+
2	M / 24VDC	AI 0	3M
3	Functional Earth	AI 1	DQ a.0
4	L+ / 24VDC Sensor Out	--	DQ a.1
5	M / 24VDC Sensor Out	--	DQ a.2
6	1M	--	DQ a.3
7	DI a.0	--	No connection
8	DI a.1	--	No connection
9	DI a.2	--	--
10	DI a.3	--	--
11	DI a.4	--	--
12	DI a.5	--	--
13	No connection	--	--
14	No connection	--	--

Note

Unused analog inputs should be shorted.

A.3 CPU 1212C

A.3.1 General specifications and features

Table A- 26 General

Technical data	CPU 1212C AC/DC/Relay	CPU 1212C DC/DC/Relay	CPU 1212C DC/DC/DC
Order number	6ES7 212-1BE31-0XB0	6ES7 212-1HE31-0XB0	6ES7 212-1AE31-0XB0
Dimensions W x H x D (mm)	90 x 100 x 75	90 x 100 x 75	90 x 100 x 75
Shipping weight	425 grams	385 grams	370 grams
Power dissipation	11 W	9 W	9 W
Current available (SM and CM bus)	1000 mA max. (5 VDC)	1000 mA max. (5 VDC)	1000 mA max. (5 VDC)
Current available (24 VDC)	300 mA max. (sensor power)	300 mA max. (sensor power)	300 mA max. (sensor power)
Digital input current consumption (24 VDC)	4 mA/input used	4 mA/input used	4 mA/input used

Table A- 27 CPU features

Technical data		Description
User memory[1]	Work	50 Kbytes
	Load	1 Mbyte internal, expandable up to SD card size
	Retentive	10 Kbytes
On-board digital I/O		8 inputs/6 outputs
On-board analog I/O		2 inputs
Process image size		1024 bytes of inputs (I)/1024 bytes of outputs (Q)
Bit memory (M)		4096 bytes
Temporary (local) memory		• 16 Kbytes for startup and program cycle (including associated FBs and FCs) • 4 Kbytes for standard interrupt events including FBs and FCs • 4 Kbytes for error interrupt events including FBs and FCs
Signal modules expansion		2 SMs max.
SB, CB, BB expansion		1 max.
Communication module expansion		3 CMs max.
High-speed counters		5 built in I/O, 6 with signal board, see table, HSC input assignments for CPU 1212C (Page 339) • Single phase: 3 at 100 kHz and 1 at 30 kHz clock rate, SB: 2 at 30 kHz • Quadrature phase: 3 at 80 kHz and 1 at 20 kHz clock rate, SB: 2 at 20 kHz
Pulse outputs [2]		4
Pulse catch inputs		8

Technical data	Description
Time delay / cyclic interrupts	4 total with 1 ms resolution
Edge interrupts	8 rising and 8 falling (12 and 12 with optional signal board)
Memory card	SIMATIC Memory Card (optional)
Real time clock accuracy	+/- 60 seconds/month
Real time clock retention time	20 days typ./12 days min. at 40°C (maintenance-free Super Capacitor)

1 The size of the user program, data, and configuration is limited by the available load memory and work memory in the CPU. There is no specific limit to the number of OB, FC, FB and DB blocks supported or to the size of a particular block; the only limit is due to overall memory size.

2 For CPU models with relay outputs, you must install a digital signal board (SB) to use the pulse outputs.

Table A- 28 Performance

Type of instruction	Execution speed
Boolean	0.08 µs/instruction
Move Word	1.7 µs/instruction
Real math	2.3 µs/instruction

A.3.2 Timers, counters and code blocks supported by CPU 1212C

Table A- 29 Blocks, timers and counters supported by CPU 1212C

Element		Description
Blocks	Type	OB, FB, FC, DB
	Size	50 Kbytes
	Quantity	Up to 1024 blocks total (OBs + FBs + FCs + DBs)
	Address range for FBs, FCs, and DBs	1 to 65535 (such as FB 1 to FB 65535)
	Nesting depth	16 from the program cycle or start up OB; 4 from the time delay interrupt, time-of-day interrupt, cyclic interrupt, hardware interrupt, time error interrupt, or diagnostic error interrupt OB
	Monitoring	Status of 2 code blocks can be monitored simultaneously
OBs	Program cycle	Multiple: OB 1, OB 200 to OB 65535
	Startup	Multiple: OB 100, OB 200 to OB 65535
	Time-delay interrupts and cyclic interrupts	4[1] (1 per event): OB 200 to OB 65535
	Hardware interrupts (edges and HSC)	50 (1 per event): OB 200 to OB 65535
	Time error interrupts	1: OB 80
	Diagnostic error interrupts	1: OB 82
Timers	Type	IEC
	Quantity	Limited only by memory size
	Storage	Structure in DB, 16 bytes per timer

Element		Description
Counters	Type	IEC
	Quantity	Limited only by memory size
	Storage	Structure in DB, size dependent upon count type • SInt, USInt: 3 bytes • Int, UInt: 6 bytes • DInt, UDInt: 12 bytes

1 Time-delay and cyclic interrupts use the same resources in the CPU. You can have only a total of 4 of these interrupts (time-delay plus cyclic interrupts). You cannot have 4 time-delay interrupts and 4 cyclic interrupts.

Table A- 30 Communication

Technical data	Description
Number of ports	1
Type	Ethernet
HMI device[1]	3
Programming device (PG)	1
Connections	• 8 for Open User Communication (active or passive): TSEND_C, TRCV_C, TCON, TDISCON, TSEND, and TRCV • 3 for server GET/PUT (CPU-to-CPU) S7 communication • 8 for client GET/PUT (CPU-to-CPU) S7 communication
Data rates	10/100 Mb/s
Isolation (external signal to PLC logic)	Transformer isolated, 1500 VAC, for short term event safety only
Cable type	CAT5e shielded

1 The CPU provides dedicated HMI connections to support up to 3 HMI devices. (You can have up to 2 SIMATIC Comfort panels.) The total number of HMI is affected by the types of HMI panels in your configuration. For example, you could have up to three SIMATIC Basic panels connected to your CPU, or you could have up to two SIMATIC Comfort panels with one additional Basic panel.

Table A- 31 Power supply

Technical data		CPU 1212C AC/DC/Relay	CPU 1212C DC/DC/Relay	CPU 1212C DC/DC/DC
Voltage range		85 to 264 VAC	20.4 VDC to 28.8 VDC 22.0 VDC to 28.8 VDC for ambient temperature -20° to 0° C	
Line frequency		47 to 63 Hz	--	--
Input current (max. load)	CPU only	80 mA at 120 VAC 40 mA at 240 VAC	400 mA at 24 VDC	400 mA at 24 VDC
	CPU with all expansion accessories	240 mA at 120 VAC 120 mA at 240 VAC	1200 mA at 24 VDC	1200 mA at 24 VDC
Inrush current (max.)		20 A at 264 VAC	12 A at 28.8 VDC	12 A at 28.8 VDC
Isolation (input power to logic)		1500 VAC	Not isolated	Not isolated
Ground leakage, AC line to functional earth		0.5 mA max.	--	--

Technical data	CPU 1212C AC/DC/Relay	CPU 1212C DC/DC/Relay	CPU 1212C DC/DC/DC
Hold up time (loss of power)	20 ms at 120 VAC 80 ms at 240 VAC	10 ms at 24 VDC	10 ms at 24 VDC
Internal fuse, not user replaceable	3 A, 250 V, slow blow	3 A, 250 V, slow blow	3 A, 250 V, slow blow

Table A- 32 Sensor power

Technical data	CPU 1212C AC/DC/Relay	CPU 1212C DC/DC/Relay	CPU 1212C DC/DC/DC
Voltage range	20.4 to 28.8 VDC	L+ minus 4 VDC min. L+ minus 5 VDC min. for ambient temperature -20° C to 0° C	
Output current rating (max.)	300 mA (short circuit protected)	300 mA (short circuit protected)	300 mA (short circuit protected)
Maximum ripple noise (<10 MHz)	< 1 V peak to peak	Same as input line	Same as input line
Isolation (CPU logic to sensor power)	Not isolated	Not isolated	Not isolated

A.3.3 Digital inputs and outputs

Table A- 33 Digital inputs

Technical data	CPU 1212C AC/DC/Relay, DC/DC/Relay, and DC/DC/DC
Number of inputs	8
Type	Sink/Source (IEC Type 1 sink)
Rated voltage	24 VDC at 4 mA, nominal
Continuous permissible voltage	30 VDC, max.
Surge voltage	35 VDC for 0.5 sec.
Logic 1 signal (min.)	15 VDC at 2.5 mA
Logic 0 signal (max.)	5 VDC at 1 mA
Isolation (field side to logic)	500 VAC for 1 minute
Isolation groups	1
Filter times	0.2, 0.4, 0.8, 1.6, 3.2, 6.4, and 12.8 ms (selectable in groups of 4)
HSC clock input rates (max.) (Logic 1 Level = 15 to 26 VDC)	Single phase: 100 KHz (Ia.0 to Ia.5) and 30 KHz (Ia.6 to Ia.7) Quadrature phase: 80 KHz (Ia.0 to Ia.5) and 20 KHz (Ia.6 to Ia.7)
Number of inputs on simultaneously	8 at 60°C horizontal, 50°C vertical
Cable length (meters)	500 m shielded, 300 m unshielded, 50 m shielded for HSC inputs

Table A- 34 Digital outputs

Technical data	CPU 1212C AC/DC/Relay and DC/DC/Relay	CPU 1212C DC/DC/DC
Number of outputs	6	6
Type	Relay, dry contact	Solid state - MOSFET (sourcing)
Voltage range	5 to 30 VDC or 5 to 250 VAC	20.4 to 28.8 VDC
Logic 1 signal at max. current	--	20 VDC min.
Logic 0 signal with 10 KΩ load	--	0.1 VDC max.
Current (max.)	2.0 A	0.5 A
Lamp load	30 W DC / 200 W AC	5 W
ON state resistance	0.2 Ω max. when new	0.6 Ω max.
Leakage current per point	--	10 µA max.
Surge current	7 A with contacts closed	8 A for 100 ms max.
Overload protection	No	No
Isolation (field side to logic)	1500 VAC for 1 minute (coil to contact) None (coil to logic)	500 VAC for 1 minute
Isolation resistance	100 MΩ min. when new	--
Isolation between open contacts	750 VAC for 1 minute	--
Isolation groups	2	1
Inductive clamp voltage	--	L+ minus 48 VDC, 1 W dissipation
Switching delay (Qa.0 to Qa.3)	10 ms max.	1.0 µs max., off to on 3.0 µs max., on to off
Switching delay (Qa.4 to Qa.5)	10 ms max.	50 µs max., off to on 200 µs max., on to off
Maximum relay switching frequency	1 Hz	--
Pulse Train Output rate (Qa.0 and Qa.2)	Not recommended [1]	100 KHz max., 2 Hz min.[2]
Lifetime mechanical (no load)	10,000,000 open/close cycles	--
Lifetime contacts at rated load	100,000 open/close cycles	--
Behavior on RUN to STOP	Last value or substitute value (default value 0)	Last value or substitute value (default value 0)
Number of outputs on simultaneously	6 up to 60°C horizontal, 50°C vertical	
Cable length (meters)	500 m shielded, 150 m unshielded	500 m shielded, 150 m unshielded

1 For CPU models with relay outputs, you must install a digital signal board (SB) to use the pulse outputs.

2 Depending on your pulse receiver and cable, an additional load resistor (at least 10% of rated current) may improve pulse signal quality and noise immunity.

A.3.4 Analog inputs

Table A- 35 Analog inputs

Technical data	Description
Number of inputs	2
Type	Voltage (single-ended)
Full-scale range	0 to 10 V
Full-scale range (data word)	0 to 27648
Overshoot range	10.001 to 11.759 V
Overshoot range (data word)	27,649 to 32,511
Overflow range	11.760 to 11.852 V
Overflow range (data word)	32,512 to 32,767
Resolution	10 bits
Maximum withstand voltage	35 VDC
Smoothing	None, Weak, Medium, or Strong See the table for step response (ms) for the analog inputs of the CPU (Page 720).
Noise rejection	10, 50, or 60 Hz
Impedance	≥100 KΩ
Isolation (field side to logic)	None
Accuracy (25°C / -20 to 60°C)	3.0% / 3.5% of full-scale
Cable length (meters)	100 m, shielded twisted pair

A.3.4.1 Step response of the built-in analog inputs of the CPU

Table A- 36 Step Response (ms), 0V to 10V measured at 95%

Smoothing selection (sample averaging)	Rejection frequency (Integration time)		
	60 Hz	50 Hz	10 Hz
None (1 cycle): No averaging	50 ms	50 ms	100 ms
Weak (4 cycles): 4 samples	60ms	70 ms	200 ms
Medium (16 cycles): 16 samples	200 ms	240 ms	1150 ms
Strong (32 cycles): 32 samples	400 ms	480 ms	2300 ms
Sample time	**4.17 ms**	**5 ms**	**25 ms**

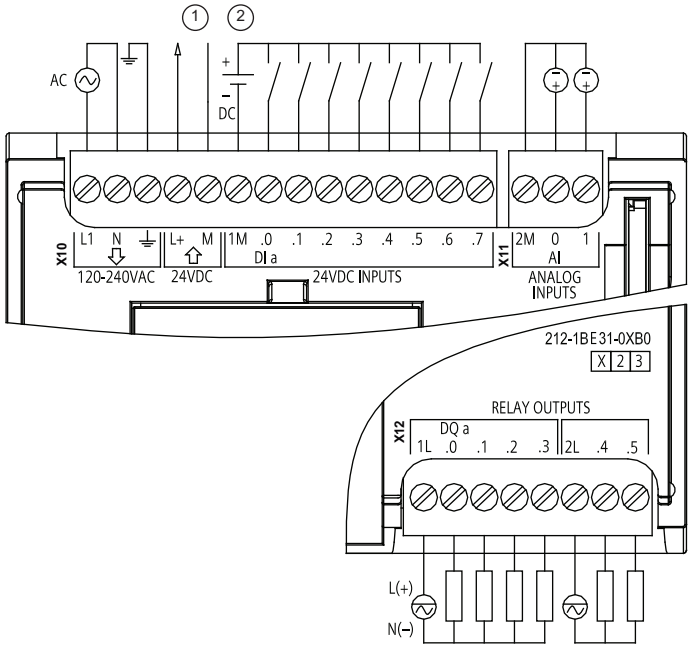
A.3.4.2 Sample time for the built-in analog ports of the CPU

Table A- 37 Sample time for built-in analog inputs of the CPU

Rejection frequency (Integration time selection)	Sample time
60 Hz (16.6 ms)	4.17 ms
50 Hz (20 ms)	5 ms
10 Hz (100 ms)	25 ms

A.3.5 CPU 1212C Wiring diagrams

Table A- 38 CPU 1212C AC/DC/Relay (6ES7 212-1BE31-0XB0)



① 24 VDC Sensor Power Out

For additional noise immunity, connect "M" to chassis ground even if not using sensor supply.

② For sinking inputs, connect "-" to "M" (shown).

For sourcing inputs, connect "+" to "M".

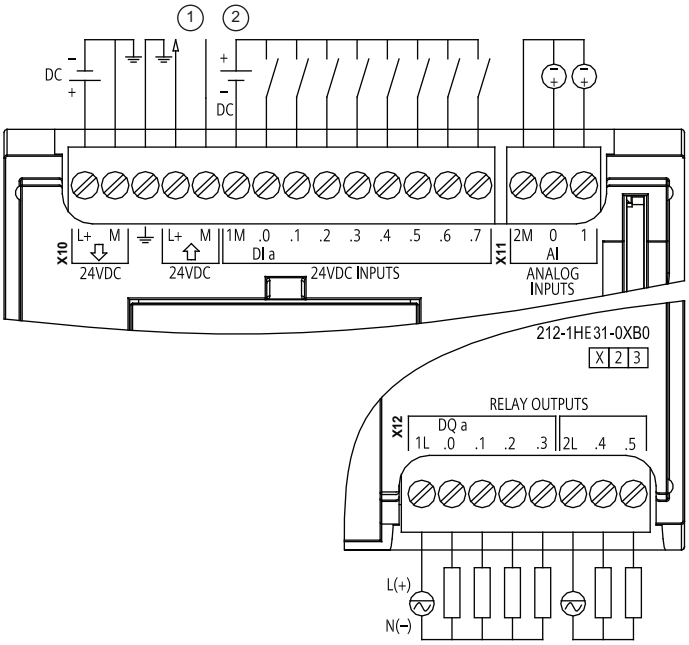
Note: X11 connectors must be gold. See Appendix C, Spare Parts for order number.

Table A- 39 Connector pin locations for CPU 1212C AC/DC/Relay (6ES7 212-1BE31-0XB0)

Pin	X10	X11 (gold)	X12
1	L1 / 120-240 VAC	2 M	1L
2	N / 120-240 VAC	AI 0	DQ a.0
3	Functional Earth	AI 1	DQ a.1
4	L+ / 24VDC Sensor Out	--	DQ a.2
5	M / 24VDC Sensor Out	--	DQ a.3
6	1M	--	2L
7	DI a.0	--	DQ a.4
8	DI a.1	--	DQ a.5

Pin	X10	X11 (gold)	X12
9	DI a.2	--	--
10	DI a.3	--	--
11	DI a.4	--	--
12	DI a.5	--	--
13	DI a.6	--	--
14	DI a.7	--	--

Table A- 40 CPU 1212C DC/DC/Relay (6ES7 212-1HE31-0XB0)



① 24 VDC Sensor Power Out

For additional noise immunity, connect "M" to chassis ground even if not using sensor supply.

② For sinking inputs, connect "-" to "M" (shown).

For sourcing inputs, connect "+" to "M".

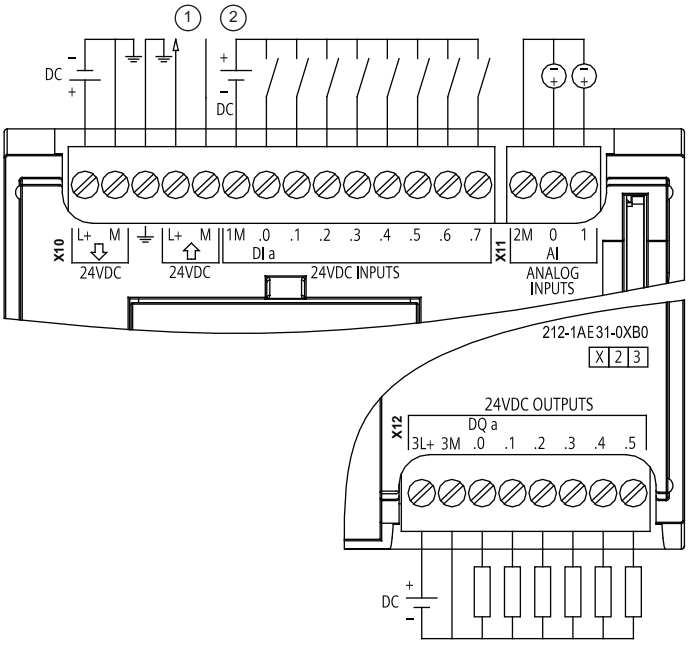
Note: X11 connectors must be gold. See Appendix C, Spare Parts for order number.

Table A- 41 Connector pin locations for CPU 1212C DC/DC/Relay (6ES7 212-1HE31-0XB0)

Pin	X10	X11 (gold)	X12
1	L+ / 24VDC	2 M	1L
2	M / 24VDC	AI 0	DQ a.0
3	Functional Earth	AI 1	DQ a.1
4	L+ / 24VDC Sensor Out	--	DQ a.2
5	M / 24VDC Sensor Out	--	DQ a.3
6	1M	--	2L
7	DI a.0	--	DQ a.4
8	DI a.1	--	DQ a.5
9	DI a.2	--	--
10	DI a.3	--	--

Pin	X10	X11 (gold)	X12
11	DI a.4	--	--
12	DI a.5	--	--
13	DI a.6	--	--
14	DI a.7	--	--

Table A- 42 CPU 1212C DC/DC/DC (6ES7-212-1AE31-0XB0)



① 24 VDC Sensor Power Out

For additional noise immunity, connect "M" to chassis ground even if not using sensor supply.

② For sinking inputs, connect "-" to "M" (shown).

For sourcing inputs, connect "+" to "M".

Note: X11 connectors must be gold. See Appendix C, Spare Parts for order number.

Table A- 43 Connector pin locations for CPU 1212C DC/DC/DC (6ES7 212-1AE31-0XB0)

Pin	X10	X11 (gold)	X12
1	L+ / 24VDC	2 M	3L+
2	M / 24VDC	AI 0	3M
3	Functional Earth	AI 1	DQ a.0
4	L+ / 24VDC Sensor Out	--	DQ a.1
5	M / 24VDC Sensor Out	--	DQ a.2
6	1M	--	DQ a.3
7	DI a.0	--	DQ a.4
8	DI a.1	--	DQ a.5
9	DI a.2	--	--
10	DI a.3	--	--
11	DI a.4	--	--
12	DI a.5	--	--

Pin	X10	X11 (gold)	X12
13	DI a.6	--	--
14	DI a.7	--	--

Note

Unused analog inputs should be shorted.

A.4 CPU 1214C

A.4.1 General specifications and features

Table A- 44 General

Technical data	CPU 1214C AC/DC/Relay	CPU 1214C DC/DC/Relay	CPU 1214C DC/DC/DC
Order number	6ES7 214-1BG31-0XB0	6ES7 214-1HG31-0XB0	6ES7 214-1AG31-0XB0
Dimensions W x H x D (mm)	110 x 100 x 75	110 x 100 x 75	110 x 100 x 75
Shipping weight	475 grams	435 grams	415 grams
Power dissipation	14 W	12 W	12 W
Current available (SM and CM bus)	1600 mA max. (5 VDC)	1600 mA max. (5 VDC)	1600 mA max. (5 VDC)
Current available (24 VDC)	400 mA max. (sensor power)	400 mA max. (sensor power)	400 mA max. (sensor power)
Digital input current consumption (24VDC)	4 mA/input used	4 mA/input used	4 mA/input used

Table A- 45 CPU features

Technical data		Description
User memory[1]	Work	75 Kbytes
	Load	4 Mbytes internal, expandable up to SD card size
	Retentive	10 Kbytes
On-board digital I/O		14 inputs/10 outputs
On-board analog I/O		2 inputs
Process image size		1024 bytes of inputs (I)/1024 bytes of outputs (Q)
Bit memory (M)		8192 bytes

Technical data	Description
Temporary (local) memory	• 16 Kbytes for startup and program cycle (including associated FBs and FCs) • 4 Kbytes for standard interrupt events including FBs and FCs • 4 Kbytes for error interrupt events including FBs and FCs
Signal modules expansion	8 SMs max.
SB, CB, BB expansion	1 max.
Communication module expansion	3 CMs max.
High-speed counters	6 total, see table Operation of the high-speed counter (Page 339) • Single phase: 3 at 100 kHz and 3 at 30 kHz clock rate, • Quadrature phase: 3 at 80 kHz and 3 at 20 kHz clock rate
Pulse outputs [2]	4
Pulse catch inputs	14
Time delay / cyclic interrupts	4 total with 1 ms resolution
Edge interrupts	12 rising and 12 falling (14 and 14 with optional signal board)
Memory card	SIMATIC Memory Card (optional)
Real time clock accuracy	+/- 60 seconds/month
Real time clock retention time	20 days typ./12 days min. at 40°C (maintenance-free Super Capacitor)

1 The size of the user program, data, and configuration is limited by the available load memory and work memory in the CPU. There is no specific limit to the number of OB, FC, FB and DB blocks supported or to the size of a particular block; the only limit is due to overall memory size.

2 For CPU models with relay outputs, you must install a digital signal board (SB) to use the pulse outputs.

Table A- 46 Performance

Type of instruction	Execution speed
Boolean	0.08 µs/instruction
Move Word	1.7 µs/instruction
Real math	2.3 µs/instruction

A.4.2 Timers, counters and code blocks supported by CPU 1214C

Table A- 47 Blocks, timers and counters supported by CPU 1214C

Element		Description
Blocks	Type	OB, FB, FC, DB
	Size	64 Kbytes
	Quantity	Up to 1024 blocks total (OBs + FBs + FCs + DBs)
	Address range for FBs, FCs, and DBs	1 to 65535 (such as FB 1 to FB 65535)
	Nesting depth	16 from the program cycle or start up OB; 4 from the time delay interrupt, time-of-day interrupt, cyclic interrupt, hardware interrupt, time error interrupt, or diagnostic error interrupt OB

Element		Description
	Monitoring	Status of 2 code blocks can be monitored simultaneously
OBs	Program cycle	Multiple: OB 1, OB 200 to OB 65535
	Startup	Multiple: OB 100, OB 200 to OB 65535
	Time-delay interrupts and cyclic interrupts	4[1] (1 per event): OB 200 to OB 65535
	Hardware interrupts (edges and HSC)	50 (1 per event): OB 200 to OB 65535
	Time error interrupts	1: OB 80
	Diagnostic error interrupts	1: OB 82
Timers	Type	IEC
	Quantity	Limited only by memory size
	Storage	Structure in DB, 16 bytes per timer
Counters	Type	IEC
	Quantity	Limited only by memory size
	Storage	Structure in DB, size dependent upon count type • SInt, USInt: 3 bytes • Int, UInt: 6 bytes • DInt, UDInt: 12 bytes

[1] Time-delay and cyclic interrupts use the same resources in the CPU. You can have only a total of 4 of these interrupts (time-delay plus cyclic interrupts). You cannot have 4 time-delay interrupts and 4 cyclic interrupts.

Table A- 48 Communication

Technical data	Description
Number of ports	1
Type	Ethernet
HMI device[1]	3
Programming device (PG)	1
Connections	• 8 for Open User Communication (active or passive): TSEND_C, TRCV_C, TCON, TDISCON, TSEND, and TRCV • 3 for server GET/PUT (CPU-to-CPU) S7 communication • 8 for client GET/PUT (CPU-to-CPU) S7 communication
Data rates	10/100 Mb/s
Isolation (external signal to PLC logic)	Transformer isolated, 1500 VAC, for short term event safety only
Cable type	CAT5e shielded

[1] The CPU provides dedicated HMI connections to support up to 3 HMI devices. (You can have up to 2 SIMATIC Comfort panels.) The total number of HMI is affected by the types of HMI panels in your configuration. For example, you could have up to three SIMATIC Basic panels connected to your CPU, or you could have up to two SIMATIC Comfort panels with one additional Basic panel.

Table A- 49 Power supply

Technical data		CPU 1214C AC/DC/Relay	CPU 1214C DC/DC/Relay	CPU 1214C DC/DC/DC
Voltage range		85 to 264 VAC	20.4 VDC to 28.8 VDC 22.0 VDC to 28.8 VDC for ambient temperature -20° C to 0° C	
Line frequency		47 to 63 Hz	--	
Input current (max. load)	CPU only	100 mA at 120 VAC 50 mA at 240 VAC	500 mA at 24 VDC	
	CPU with all expansion accessories	300 mA at 120 VAC 150 mA at 240 VAC	1500 mA at 24 VDC	
Inrush current (max.)		20 A at 264 VAC	12 A at 28.8 VDC	
Isolation (input power to logic)		1500 VAC	Not isolated	
Ground leakage, AC line to functional earth		0.5 mA max.	-	
Hold up time (loss of power)		20 ms at 120 VAC 80 ms at 240 VAC	10 ms at 24 VDC	
Internal fuse, not user replaceable		3 A, 250 V, slow blow		

Table A- 50 Sensor power

Technical data	CPU 1214C AC/DC/Relay	CPU 1214C DC/DC/Relay	CPU 1214C DC/DC/DC
Voltage range	20.4 to 28.8 VDC	L+ minus 4 VDC min. L+ minus 5 VDC min. for ambient temperature -20° C to 0° C	
Output current rating (max.)	400 mA (short circuit protected)		
Maximum ripple noise (<10 MHz)	< 1 V peak to peak	Same as input line	
Isolation (CPU logic to sensor power)	Not isolated		

A.4.3 Digital inputs and outputs

Table A- 51 Digital inputs

Technical data	CPU 1214C AC/DC/Relay	CPU 1214C DC/DC/Relay	CPU 1214C DC/DC/DC
Number of inputs	14		
Type	Sink/Source (IEC Type 1 sink)		
Rated voltage	24 VDC at 4 mA, nominal		
Continuous permissible voltage	30 VDC, max.		
Surge voltage	35 VDC for 0.5 sec.		
Logic 1 signal (min.)	15 VDC at 2.5 mA		
Logic 0 signal (max.)	5 VDC at 1 mA		

Technical data	CPU 1214C AC/DC/Relay	CPU 1214C DC/DC/Relay	CPU 1214C DC/DC/DC
Isolation (field side to logic)	500 VAC for 1 minute		
Isolation groups	1		
Filter times	0.2, 0.4, 0.8, 1.6, 3.2, 6.4, and 12.8 ms (selectable in groups of 4)		
HSC clock input rates (max.) (Logic 1 Level = 15 to 26 VDC)	Single phase: 100 KHz (Ia.0 to Ia.5) and 30 KHz (Ia.6 to Ib.5) Quadrature phase: 80 KHz (Ia.0 to Ia.5) and 20 KHz (Ia.6 to Ib.5)		
Number of inputs on simultaneously	• 7 (no adjacent points) at 60° C horizontal or 50° C vertical • 14 at 55° C horizontal or 45° C vertical		
Cable length (meters)	500 m shielded, 300 m unshielded, 50 m shielded for HSC inputs		

Table A- 52 Digital outputs

Technical data	CPU 1214C AC/DC/Relay and DC/DC/Relay	CPU 1214C DC/DC/DC
Number of outputs	10	10
Type	Relay, dry contact	Solid state - MOSFET (sourcing)
Voltage range	5 to 30 VDC or 5 to 250 VAC	20.4 to 28.8 VDC
Logic 1 signal at max. current	--	20 VDC min.
Logic 0 signal with 10 KΩ load	--	0.1 VDC max.
Current (max.)	2.0 A	0.5 A
Lamp load	30 W DC / 200 W AC	5 W
ON state resistance	0.2 Ω max. when new	0.6 Ω max.
Leakage current per point	--	10 µA max.
Surge current	7 A with contacts closed	8 A for 100 ms max.
Overload protection	No	No
Isolation (field side to logic)	1500 VAC for 1 minute (coil to contact) None (coil to logic)	500 VAC for 1 minute
Isolation resistance	100 MΩ min. when new	--
Isolation between open contacts	750 VAC for 1 minute	--
Isolation groups	2	1
Inductive clamp voltage	--	L+ minus 48 VDC, 1 W dissipation
Switching delay (Qa.0 to Qa.3)	10 ms max.	1.0 µs max., off to on 3.0 µs max., on to off
Switching delay (Qa.4 to Qb.1)	10 ms max.	50 µs max., off to on 200 µs max., on to off
Maximum relay switching frequency	1 Hz	--
Pulse Train Output rate (Qa.0 and Qa.2)	Not recommended [1]	100 KHz max., 2 Hz min. [2]
Lifetime mechanical (no load)	10,000,000 open/close cycles	--
Lifetime contacts at rated load	100,000 open/close cycles	--
Behavior on RUN to STOP	Last value or substitute value (default value 0)	

Technical data	CPU 1214C AC/DC/Relay and DC/DC/Relay	CPU 1214C DC/DC/DC
Number of outputs on simultaneously	• 5 (no adjacent points) at 60° C horizontal or 50° C vertical • 10 at 55° C horizontal or 45° C vertical	
Cable length (meters)	500 m shielded, 150 m unshielded	

1 For CPU models with relay outputs, you must install a digital signal board (SB) to use the pulse outputs.

2 Depending on your pulse receiver and cable, an additional load resistor (at least 10% of rated current) may improve pulse signal quality and noise immunity.

A.4.4 Analog inputs

Table A- 53 Analog inputs

Technical data	Description
Number of inputs	2
Type	Voltage (single-ended)
Full-scale range	0 to 10 V
Full-scale range (data word)	0 to 27648
Overshoot range	10.001 to 11.759 V
Overshoot range (data word)	27,649 to 32,511
Overflow range	11.760 to 11.852 V
Overflow range (data word)	32,512 to 32,767
Resolution	10 bits
Maximum withstand voltage	35 VDC
Smoothing	None, Weak, Medium, or Strong See the table for step response (ms) for the analog inputs of the CPU (Page 730).
Noise rejection	10, 50, or 60 Hz
Impedance	≥100 KΩ
Isolation (field side to logic)	None
Accuracy (25°C / -20 to 60°C)	3.0% / 3.5% of full-scale
Cable length (meters)	100 m, shielded twisted pair

A.4.4.1 Step response of the built-in analog inputs of the CPU

Table A- 54 Step Response (ms), 0V to 10V measured at 95%

Smoothing selection (sample averaging)	Rejection frequency (Integration time)		
	60 Hz	**50 Hz**	**10 Hz**
None (1 cycle): No averaging	50 ms	50 ms	100 ms
Weak (4 cycles): 4 samples	60ms	70 ms	200 ms
Medium (16 cycles): 16 samples	200 ms	240 ms	1150 ms
Strong (32 cycles): 32 samples	400 ms	480 ms	2300 ms
Sample time	**4.17 ms**	**5 ms**	**25 ms**

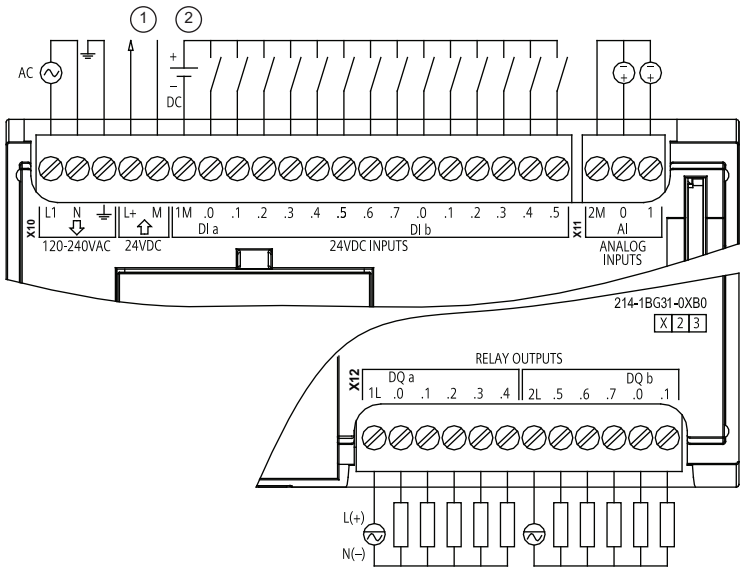
A.4.4.2 Sample time for the built-in analog ports of the CPU

Table A- 55 Sample time for built-in analog inputs of the CPU

Rejection frequency (Integration time selection)	Sample time
60 Hz (16.6 ms)	4.17 ms
50 Hz (20 ms)	5 ms
10 Hz (100 ms)	25 ms

A.4.5 CPU 1214C Wiring Diagrams

Table A- 56 CPU 1214C AC/DC/Relay (6ES7 214-1BG31-0XB0)



① 24 VDC Sensor Power Out

For additional noise immunity, connect "M" to chassis ground even if not using sensor supply.

② For sinking inputs, connect "-" to "M" (shown).

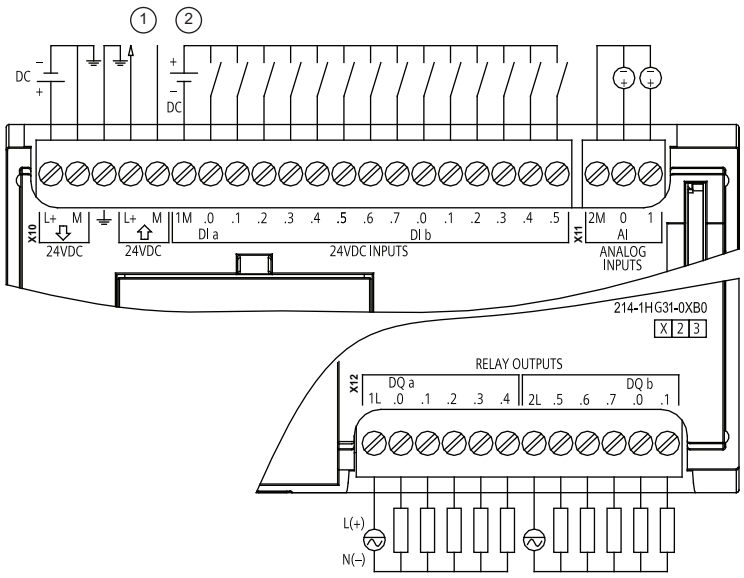
For sourcing inputs, connect "+" to "M".

Note: X11 connectors must be gold. See Appendix C, Spare Parts for order number.

Table A- 57 Connector pin locations for CPU 1214C AC/DC/Relay (6ES7 214-1BG31-0XB0)

Pin	X10	X11 (gold)	X12
1	L1 / 120-240 VAC	2 M	1L
2	N / 120-240 VAC	AI 0	DQ a.0
3	Functional Earth	AI 1	DQ a.1
4	L+ / 24VDC Sensor Out	--	DQ a.2
5	M / 24VDC Sensor Out	--	DQ a.3
6	1M	--	DQ a.4
7	DI a.0	--	2L
8	DI a.1	--	DQ a.5
9	DI a.2	--	DQ a.6
10	DI a.3	--	DQ a.7
11	DI a.4	--	DQ b.0
12	DI a.5	--	DQ b.1
13	DI a.6	--	--
14	DI a.7	--	--
15	DI b.0	--	--
16	DI b.1	--	--
17	DI b.2	--	--
18	DI b.3	--	--
19	DI b.4	--	--
20	DI b.5	--	--

Table A- 58 CPU 1214C DC/DC/Relay (6ES7 214-1HG31-0XB0)



① 24 VDC Sensor Power Out

For additional noise immunity, connect "M" to chassis ground even if not using sensor supply.

② For sinking inputs, connect "-" to "M" (shown).

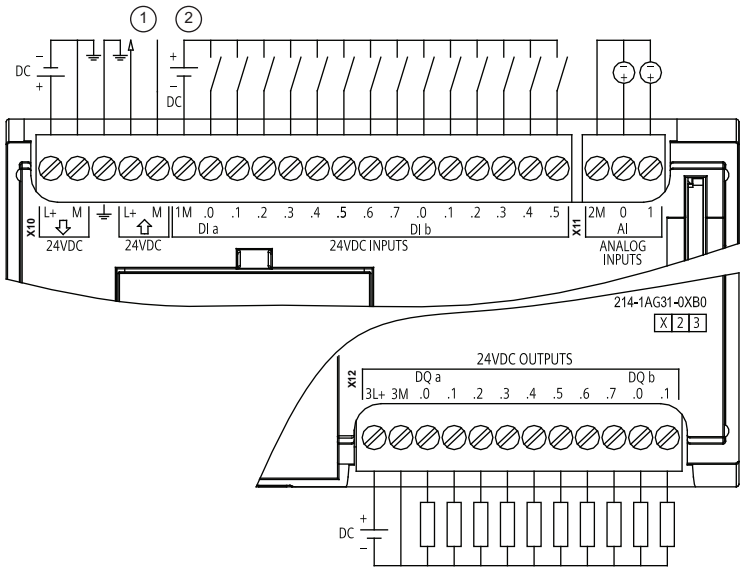
For sourcing inputs, connect "+" to "M".

Note: X11 connectors must be gold. See Appendix C, Spare Parts for order number.

Table A- 59 Connector pin locations for CPU 1214C DC/DC/Relay (6ES7 214-1HG31-0XB0)

Pin	X10	X11 (gold)	X12
1	L+ / 24VDC	2 M	1L
2	M / 24VDC	AI 0	DQ a.0
3	Functional Earth	AI 1	DQ a.1
4	L+ / 24VDC Sensor Out	--	DQ a.2
5	M / 24VDC Sensor Out	--	DQ a.3
6	1M	--	DQ a.4
7	DI a.0	--	2L
8	DI a.1	--	DQ a.5
9	DI a.2	--	DQ a.6
10	DI a.3	--	DQ a.7
11	DI a.4	--	DQ b.0
12	DI a.5	--	DQ b.1
13	DI a.6	--	--
14	DI a.7	--	--
15	DI b.0	--	--
16	DI b.1	--	--
17	DI b.2	--	--
18	DI b.3	--	--
19	DI b.4	--	--
20	DI b.5	--	--

Table A- 60 CPU 1214C DC/DC/DC (6ES7 214-1AG31-0XB0)



① 24 VDC Sensor Power Out

For additional noise immunity, connect "M" to chassis ground even if not using sensor supply.

② For sinking inputs, connect "-" to "M" (shown).

For sourcing inputs, connect "+" to "M".

Note: X11 connectors must be gold. See Appendix C, Spare Parts for order number.

Table A- 61 Connector pin locations for CPU 1214C DC/DC/DC (6ES7 214-1AG31-0XB0)

Pin	X10	X11 (gold)	X12
1	L+ / 24VDC	2 M	3L+
2	M / 24VDC	AI 0	3M
3	Functional Earth	AI 1	DQ a.0
4	L+ / 24VDC Sensor Out	--	DQ a.1
5	M / 24VDC Sensor Out	--	DQ a.2
6	1M	--	DQ a.3
7	DI a.0	--	DQ a.4
8	DI a.1	--	DQ a.5
9	DI a.2	--	DQ a.6
10	DI a.3	--	DQ a.7
11	DI a.4	--	DQ b.0
12	DI a.5	--	DQ b.1
13	DI a.6	--	--
14	DI a.7	--	-
15	DI b.0	--	--
16	DI b.1	--	--
17	DI b.2	--	--
18	DI b.3	--	--

Pin	X10	X11 (gold)	X12
19	DI b.4	--	--
20	DI b.5	--	--

Note

Unused analog inputs should be shorted.

A.5 CPU 1215C

A.5.1 General specifications and features

Table A- 62 General

Technical data	CPU 1215C AC/DC/Relay	CPU 1215C DC/DC/Relay	CPU 1215C DC/DC/DC
Order number	6ES7 215-1BG31-0XB0	6ES7 215-1HG31-0XB0	6ES7 215-1AG31-0XB0
Dimensions W x H x D (mm)	130 x 100 x 75	130 x 100 x 75	130 x 100 x 75
Shipping weight	550 grams	585 grams	520 grams
Power dissipation	14 W	12 W	12 W
Current available (SM and CM bus)	1600 mA max. (5 VDC)	1600 mA max. (5 VDC)	1600 mA max. (5 VDC)
Current available (24 VDC)	400 mA max. (sensor power)	400 mA max. (sensor power)	400 mA max. (sensor power)
Digital input current consumption (24VDC)	4 mA/input used	4 mA/input used	4 mA/input used

Table A- 63 CPU features

Technical data		Description
User memory[1]	Work	100 Kbytes
	Load	4 Mbytes, internal, expandable up to SD card size
	Retentive	10 Kbytes
On-board digital I/O		14 inputs/10 outputs
On-board analog I/O		2 inputs/2 outputs
Process image size		1024 bytes of inputs (I)/1024 bytes of outputs (Q)
Bit memory (M)		8192 bytes

Technical data	Description
Temporary (local) memory	• 16 Kbytes for startup and program cycle (including associated FBs and FCs) • 4 Kbytes for standard interrupt events including FBs and FCs • 4 Kbytes for error interrupt events including FBs and FCs
Signal modules expansion	8 SMs max.
SB, CB, BB expansion	1 max.
Communication module expansion	3 CMs max.
High-speed counters	6 total, see table HSC input assignments for CPU 1215C • Single phase: 3 at 100 kHz and 3 at 30 kHz clock rate • Quadrature phase: 3 at 80 kHz and 3 at 20 kHz clock rate
Pulse outputs [2]	4
Pulse catch inputs	14
Time delay / cyclic interrupts	4 total with 1 ms resolution
Edge interrupts	12 rising and 12 falling (14 and 14 with optional signal board)
Memory card	SIMATIC Memory Card (optional)
Real time clock accuracy	+/- 60 seconds/month
Real time clock retention time	20 days typ./12 days min. at 40°C (maintenance-free Super Capacitor)

1 The size of the user program, data, and configuration is limited by the available load memory and work memory in the CPU. There is no specific limit to the number of OB, FC, FB and DB blocks supported or to the size of a particular block; the only limit is due to overall memory size.

2 For CPU models with relay outputs, you must install a digital signal board (SB) to use the pulse outputs.

Table A- 64 Performance

Type of instruction	Execution speed
Boolean	0.08 µs/instruction
Move Word	1.7 µs/instruction
Real math	2.3 µs/instruction

A.5.2 Timers, counters and code blocks supported by CPU 1215C

Table A- 65 Blocks, timers and counters supported by CPU 1215C

Element		Description
Blocks	Type	OB, FB, FC, DB
	Size	64 Kbytes
	Quantity	Up to 1024 blocks total (OBs + FBs + FCs + DBs)
	Address range for FBs, FCs, and DBs	1 to 65535 (such as FB 1 to FB 65535)
	Nesting depth	16 from the program cycle or start up OB; 4 from the time delay interrupt, time-of-day interrupt, cyclic interrupt, hardware interrupt, time error interrupt, or diagnostic error interrupt OB

Element		Description
	Monitoring	Status of 2 code blocks can be monitored simultaneously
OBs	Program cycle	Multiple: OB 1, OB 200 to OB 65535
	Startup	Multiple: OB 100, OB 200 to OB 65535
	Time-delay interrupts and cyclic interrupts	4[1] (1 per event): OB 200 to OB 65535
	Hardware interrupts (edges and HSC)	50 (1 per event): OB 200 to OB 65535
	Time error interrupts	1: OB 80
	Diagnostic error interrupts	1: OB 82
Timers	Type	IEC
	Quantity	Limited only by memory size
	Storage	Structure in DB, 16 bytes per timer
Counters	Type	IEC
	Quantity	Limited only by memory size
	Storage	Structure in DB, size dependent upon count type • SInt, USInt: 3 bytes • Int, UInt: 6 bytes • DInt, UDInt: 12 bytes

[1] Time-delay and cyclic interrupts use the same resources in the CPU. You can have only a total of 4 of these interrupts (time-delay plus cyclic interrupts). You cannot have 4 time-delay interrupts and 4 cyclic interrupts.

Table A- 66 Communication

Technical data	Description
Number of ports	2
Type	Ethernet
HMI device[1]	3
Programming device (PG)	1
Connections	• 8 for Open User Communication (active or passive): TSEND_C, TRCV_C, TCON, TDISCON, TSEND, and TRCV • 3 for server GET/PUT (CPU-to-CPU) S7 communication • 8 for client GET/PUT (CPU-to-CPU) S7 communication
Data rates	10/100 Mb/s
Isolation (external signal to PLC logic)	Transformer isolated, 1500 VAC, for short term event safety only
Cable type	CAT5e shielded

[1] The CPU provides dedicated HMI connections to support up to 3 HMI devices. (You can have up to 2 SIMATIC Comfort panels.) The total number of HMI is affected by the types of HMI panels in your configuration. For example, you could have up to three SIMATIC Basic panels connected to your CPU, or you could have up to two SIMATIC Comfort panels with one additional Basic panel.

Table A- 67 Power supply

Technical data		CPU 1215C AC/DC/Relay	CPU 1215C DC/DC/Relay	CPU 1215C DC/DC/DC
Voltage range		85 to 264 VAC	20.4 VDC to 28.8 VDC 22.0 VDC to 28.8 VDC for ambient temperature -20° C to 0° C	
Line frequency		47 to 63 Hz	--	
Input current (max. load)	CPU only	100 mA at 120 VAC 50 mA at 240 VAC	500 mA at 24 VDC	
	CPU with all expansion accessories	300 mA at 120 VAC 150 mA at 240 VAC	1500 mA at 24 VDC	
Inrush current (max.)		20 A at 264 VAC	12 A at 28.8 VDC	
Isolation (input power to logic)		1500 VAC	Not isolated	
Ground leakage, AC line to functional earth		0.5 mA max.	-	
Hold up time (loss of power)		20 ms at 120 VAC 80 ms at 240 VAC	10 ms at 24 VDC	
Internal fuse, not user replaceable		3 A, 250 V, slow blow		

Table A- 68 Sensor power

Technical data	CPU 1215C AC/DC/Relay	CPU 1215C DC/DC/Relay	CPU 1215C DC/DC/DC
Voltage range	20.4 to 28.8 VDC	L+ minus 4 VDC min. L+ minus 5 VDC min. for ambient temperature -20° C to 0° C	
Output current rating (max.)	400 mA (short circuit protected)		
Maximum ripple noise (<10 MHz)	< 1 V peak to peak	Same as input line	
Isolation (CPU logic to sensor power)	Not isolated		

A.5.3 Digital inputs and outputs

Table A- 69 Digital inputs

Technical data	CPU 1215C AC/DC/Relay	CPU 1215C DC/DC/Relay	CPU 1215C DC/DC/DC
Number of inputs	14		
Type	Sink/Source (IEC Type 1 sink)		
Rated voltage	24 VDC at 4 mA, nominal		
Continuous permissible voltage	30 VDC, max.		
Surge voltage	35 VDC for 0.5 sec.		
Logic 1 signal (min.)	15 VDC at 2.5 mA		
Logic 0 signal (max.)	5 VDC at 1 mA		

Technical data	CPU 1215C AC/DC/Relay	CPU 1215C DC/DC/Relay	CPU 1215C DC/DC/DC
Isolation (field side to logic)	500 VAC for 1 minute		
Isolation groups	1		
Filter times	0.2, 0.4, 0.8, 1.6, 3.2, 6.4, and 12.8 ms (selectable in groups of 4)		
HSC clock input rates (max.) (Logic 1 Level = 15 to 26 VDC)	Single phase: 100 KHz (Ia.0 to Ia.5) and 30 KHz (Ia.6 to Ib.5) Quadrature phase: 80 KHz (Ia.0 to Ia.5) and 20 KHz (Ia.6 to Ib.5)		
Number of inputs on simultaneously	• 7 (no adjacent points) at 60° C horizontal or 50° C vertical • 14 at 55° C horizontal or 45° C vertical		
Cable length (meters)	500 m shielded, 300 m unshielded, 50 m shielded for HSC inputs		

Table A- 70 Digital outputs

Technical data	CPU 1215C AC/DC/Relay and CPU 1215C DC/DC/Relay	CPU 1215C DC/DC/DC
Number of outputs	10	10
Type	Relay, dry contact	Solid state - MOSFET (sourcing)
Voltage range	5 to 30 VDC or 5 to 250 VAC	20.4 to 28.8 VDC
Logic 1 signal at max. current	--	20 VDC min.
Logic 0 signal with 10 KΩ load	--	0.1 VDC max.
Current (max.)	2.0 A	0.5 A
Lamp load	30 W DC / 200 W AC	5 W
ON state resistance	0.2 Ω max. when new	0.6 Ω max.
Leakage current per point	--	10 µA max.
Surge current	7 A with contacts closed	8 A for 100 ms max.
Overload protection	No	No
Isolation (field side to logic)	1500 VAC for 1 minute (coil to contact) None (coil to logic)	500 VAC for 1 minute
Isolation resistance	100 MΩ min. when new	--
Isolation between open contacts	750 VAC for 1 minute	--
Isolation groups	2	1
Inductive clamp voltage	--	L+ minus 48 VDC, 1 W dissipation
Switching delay (Qa.0 to Qa.3)	10 ms max.	1.0 µs max., off to on 3.0 µs max., on to off
Switching delay (Qa.4 to Qb.1)	10 ms max.	50 µs max., off to on 200 µs max., on to off
Maximum relay switching frequency	1 Hz	--
Pulse Train Output rate (Qa.0 and Qa.2)	Not recommended [1]	100 KHz max., 2 Hz min. [2]
Lifetime mechanical (no load)	10,000,000 open/close cycles	--
Lifetime contacts at rated load	100,000 open/close cycles	--
Behavior on RUN to STOP	Last value or substitute value (default value 0)	

Technical data	CPU 1215C AC/DC/Relay and CPU 1215C DC/DC/Relay	CPU 1215C DC/DC/DC
Number of outputs on simultaneously	• 5 (no adjacent points) at 60° C horizontal or 50° C vertical • 10 at 55° C horizontal or 45° C vertical	
Cable length (meters)	500 m shielded, 150 m unshielded	

1 For CPU models with relay outputs, you must install a digital signal board (SB) to use the pulse outputs.

2 Depending on your pulse receiver and cable, an additional load resistor (at least 10% of rated current) may improve pulse signal quality and noise immunity.

A.5.4 Analog inputs and outputs

A.5.4.1 Analog input specifications

Table A- 71 Analog inputs

Technical data	Description
Number of inputs	2
Type	Voltage (single-ended)
Full-scale range	0 to 10 V
Full-scale range (data word)	0 to 27648
Overshoot range	10.001 to 11.759 V
Overshoot range (data word)	27,649 to 32,511
Overflow range	11.760 to 11.852 V
Overflow range (data word)	32,512 to 32,767
Resolution	10 bits
Maximum withstand voltage	35 VDC
Smoothing	None, Weak, Medium, or Strong See the table for step response (ms) for the analog inputs of the CPU.
Noise rejection	10, 50, or 60 Hz
Impedance	≥100 KΩ
Isolation (field side to logic)	None
Accuracy (25°C / -20 to 60°C)	3.0% / 3.5% of full-scale
Cable length (meters)	100 m, shielded twisted pair

A.5.4.2 Step response of built-in analog inputs of the CPU

Table A- 72 Step Response (ms), 0V to 10V measured at 95%

Smoothing selection (sample averaging)	Rejection frequency (Integration time)		
	60 Hz	50 Hz	10 Hz
None (1 cycle): No averaging	50 ms	50 ms	100 ms
Weak (4 cycles): 4 samples	60ms	70 ms	200 ms
Medium (16 cycles): 16 samples	200 ms	240 ms	1150 ms
Strong (32 cycles): 32 samples	400 ms	480 ms	2300 ms
Sample time	**4.17 ms**	**5 ms**	**25 ms**

A.5.4.3 Sample time for the built-in analog ports of the CPU

Table A- 73 Sample time for built-in analog inputs of the CPU

Rejection frequency (Integration time selection)	Sample time
60 Hz (16.6 ms)	4.17 ms
50 Hz (20 ms)	5 ms
10 Hz (100 ms)	25 ms

A.5.4.4 Analog output specifications

Analog outputs

Table A- 74 Analog outputs

Technical data	Description
Number of outputs	2
Type	Current
Full-scale range	0 to 20 mA
Full-scale range (data word)	0 to 27648
Overshoot range	20.01 to 23.52 mA[1]
Overshoot range (data word)	27,649 to 32,511
Overflow range	see footnote [2]
Overflow range data word	32,512 to 32,767
Resolution	10 bits
Output drive impedance	≤500 Ω max.
Isolation (field side to logic)	None
Accuracy (25°C / -20 to 60°C)	3.0% / 3.5% of full-scale

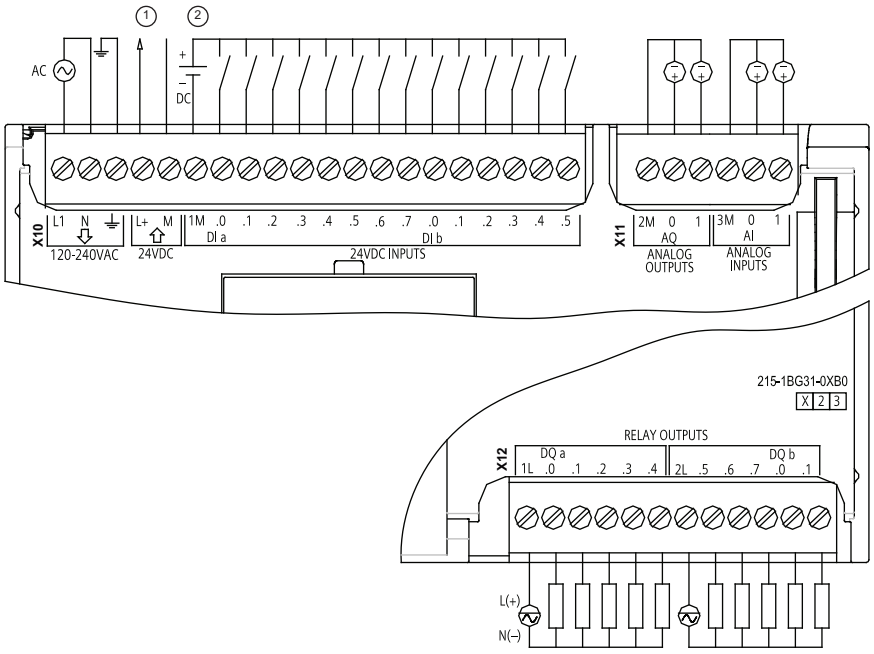
Technical data	Description
Settling time	2 ms
Cable length (meters)	100 m, shielded twisted pair

1 For the CPU 1215C with DC power supply: at supply voltage 20.4 VDC, up to 400 Ω output drive impedance is supported in overshoot range.

2 In an overflow condition, analog outputs will behave according to the device configuration properties settings. In the "Reaction to CPU STOP" parameter, select either: Use substitute value or Keep last value.

A.5.5 CPU 1215C Wiring Diagrams

Table A- 75 CPU 1215C AC/DC/Relay (6ES7 215-1BG31-0XB0)



① 24 VDC Sensor Power Out
For additional noise immunity, connect "M" to chassis ground even if not using sensor supply.

② For sinking inputs, connect "-" to "M" (shown).
For sourcing inputs, connect "+" to "M".

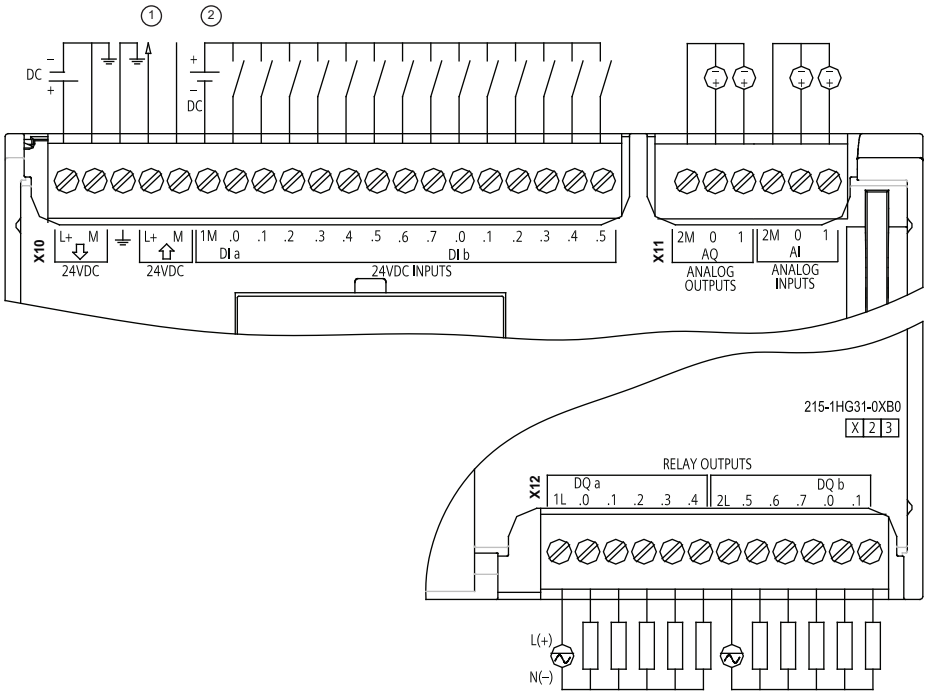
Note: X11 connectors must be gold. See Appendix C, Spare Parts for order number.

Table A- 76 Connector pin locations for CPU 1215C AC/DC/Relay (6ES7 215-1BG31-0XB0)

Pin	X10	X11 (gold)	X12
1	L1 /120-240 VAC	2 M	1L
2	N / 120 - 240 VAC	AQ 0	DQ a.0

Pin	X10	X11 (gold)	X12
3	Functional Earth	AQ 1	DQ a.1
4	L+ / 24VDC Sensor Out	3M	DQ a.2
5	M / 24VDC Sensor Out	AI 0	DQ a.3
6	1M	AI 1	DQ a.4
7	DI a.0	--	2L
8	DI a.1	--	DQ a.5
9	DI a.2	--	DQ a.6
10	DI a.3	--	DQ a.7
11	DI a.4	--	DQ b.0
12	DI a.5	--	DQ b.1
13	DI a.6	--	--
14	DI a.7	--	--
15	DI b.0	--	--
16	DI b.1	--	--
17	DI b.2	--	--
18	DI b.3	--	--
19	DI b.4	--	--
20	DI b.5	--	--

Table A- 77 CPU 1215C DC/DC/Relay (6ES7 215-1HG31-0XB0)



① 24 VDC Sensor Power Out
For additional noise immunity, connect "M" to chassis ground even if not using sensor supply.

② For sinking inputs, connect "-" to "M" (shown). For sourcing inputs, connect "+" to "M".

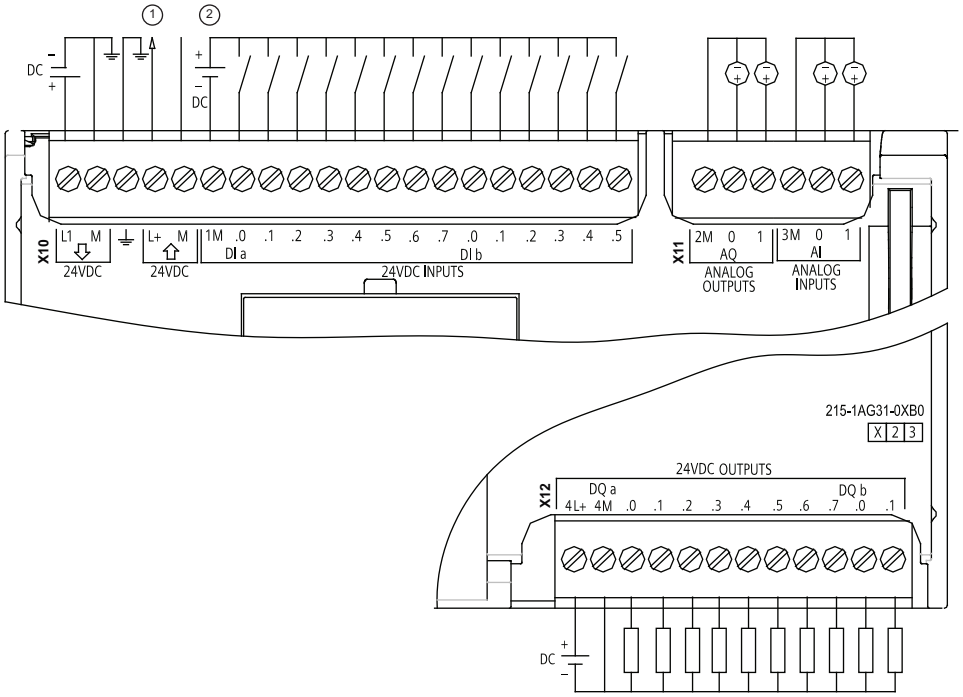
Note: X11 connectors must be gold. See Appendix C, Spare Parts for order number.

Table A- 78 Connector pin locations for CPU 1215C DC/DC/Relay (6ES7 215-1HG31-0XB0)

Pin	X10	X11 (gold)	X12
1	L+ / 24VDC	2 M	1L
2	M / 24VDC	AQ 0	DQ a.0
3	Functional Earth	AQ 1	DQ a.1
4	L+ / 24VDC Sensor Out	2M	DQ a.2
5	M / 24VDC Sensor Out	AI 0	DQ a.3
6	1M	AI 1	DQ a.4
7	DI a.0	--	2L
8	DI a.1	--	DQ a.5
9	DI a.2	--	DQ a.6
10	DI a.3	--	DQ a.7
11	DI a.4	--	DQ b.0
12	DI a.5	--	DQ b.1
13	DI a.6	--	--
14	DI a.7	--	--

Pin	X10	X11 (gold)	X12
15	DI b.0	--	--
16	DI b.1	--	--
17	DI b.2	--	--
18	DI b.3	--	--
19	DI b.4	--	--
20	DI b.5	--	--

Table A- 79 CPU 1215C DC/DC/DC (6ES7 215-1AG31-0XB0)



① 24 VDC Sensor Power Out
For additional noise immunity, connect "M" to chassis ground even if not using sensor supply.

② For sinking inputs, connect "-" to "M" (shown). For sourcing inputs, connect "+" to "M".

Note: X11 connectors must be gold. See Appendix C, Spare Parts for order number.

Table A- 80 Connector pin locations for CPU 1215C DC/DC/DC (6ES7 215-1AG31-0XB0)

Pin	X10	X11 (gold)	X12
1	L1 / 24VDC	2 M	4L+
2	M / 24VDC	AQ 0	4M
3	Functional Earth	AQ 1	DQ a.0
4	L+ / 24VDC Sensor Out	3M	DQ a.1

Pin	X10	X11 (gold)	X12
5	M / 24VDC Sensor Out	AI 0	DQ a.2
6	1M	AI 1	DQ a.3
7	DI a.0	--	DQ a.4
8	DI a.1	--	DQ a.5
9	DI a.2	--	DQ a.6
10	DI a.3	--	DQ a.7
11	DI a.4	--	DQ b.0
12	DI a.5	--	DQ b.1
13	DI a.6	--	--
14	DI a.7	--	--
15	DI b.0	--	--
16	DI b.1	--	--
17	DI b.2	--	--
18	DI b.3	--	--
19	DI b.4	--	--
20	DI b.5	--	--

Note

Unused analog inputs should be shorted.

A.6 Digital signal modules (SMs)

A.6.1 SM 1221 digital input specifications

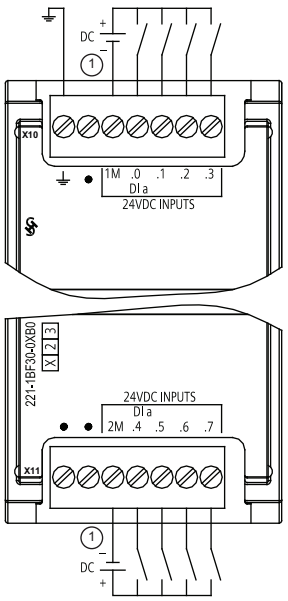
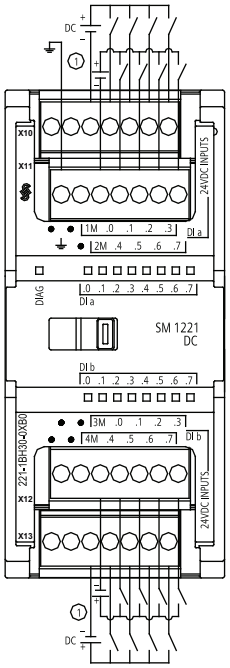
Table A- 81 General specifications

Model	SM 1221 DI 8 x 24 VDC	SM 1221 DI 16 x 24 VDC
Order number	6ES7 221-1BF30-0XB0	6ES7 221-1BH30-0XB0
Dimensions W x H x D (mm)	45 x 100 x 75	45 x 100 x 75
Weight	170 grams	210 grams
Power dissipation	1.5 W	2.5 W
Current consumption (SM Bus)	105 mA	130 mA
Current consumption (24 VDC)	4 mA / input used	4 mA / input used

Table A- 82 Digital inputs

Model	SM 1221 DI 8 x 24 VDC	SM 1221 DI 16 x 24 VDC
Number of inputs	8	16
Type	Sink/Source (IEC Type 1 sink)	Sink/Source (IEC Type 1 sink)
Rated voltage	24 VDC at 4 mA, nominal	24 VDC at 4 mA, nominal
Continuous permissible voltage	30 VDC, max.	30 VDC, max.
Surge voltage	35 VDC for 0.5 sec.	35 VDC for 0.5 sec.
Logic 1 signal (min.)	15 VDC at 2.5 mA	15 VDC at 2.5 mA
Logic 0 signal (max.)	5 VDC at 1 mA	5 VDC at 1 mA
Isolation (field side to logic)	500 VAC for 1 minute	500 VAC for 1 minute
Isolation groups	2	4
Filter times	0.2, 0.4, 0.8, 1.6, 3.2, 6.4, and 12.8 ms (selectable in groups of 4)	0.2, 0.4, 0.8, 1.6, 3.2, 6.4, and 12.8 ms (selectable in groups of 4)
Number of inputs on simultaneously	8	16
Cable length (meters)	500 m shielded, 300 unshielded	500 m shielded, 300 unshielded

Table A- 83 Wiring diagrams for the digital input SMs

SM 1221 DI 8 x 24 VDC (6ES7 221-1BF30-0XB0)	SM 1221 DI 16 x 24 VDC (6ES7 221-1BH30-0XB0)
	

① For sinking inputs, connect "-" to "M" (shown). For sourcing inputs, connect "+" to "M".

Table A- 84 Connector pin locations for SM 1221 DI 8 x 24 VDC (6ES7 221-1BF30-0XB0)

Pin	X10	X11
1	GND	No connection
2	No connection	No connection
3	1M	2M
4	DI a.0	DI a.4
5	DI a.1	DI a.5
6	DI a.2	DI a.6
7	DI a.3	DI a.7

Table A- 85 Connector pin locations for SM 1221 DI 16 x 24 VDC (6ES7 221-1BH30-0XB0)

Pin	X10	X11	X12	X13
1	GND	No connection	No connection	No connection
2	No connection	No connection	No connection	No connection
3	1M	2M	3 M	4 M
4	DI a.0	DI a.4	DI b.0	DI b.4
5	DI a.1	DI a.5	DI b.1	DI b.5
6	DI a.2	DI a.6	DI b.2	DI b.6
7	DI a.3	DI a.7	DI b.3	DI b.7

A.6.2 SM 1222 8-Point Digital Output Specifications

Table A- 86 General specifications

Model	SM 1222 DQ 8 x Relay	SM 1222 DQ8 RLY Changeover	SM 1222 DQ 8 x 24 VDC
Order number	6ES7 222-1HF30-0XB0	6ES7 222-1XF30-0XB0	6ES7 222-1BF30-0XB0
Dimensions W x H x D (mm)	45 x 100 x 75	70 x 100 x 75	45 x 100 x 75
Weight	190 grams	310 grams	180 grams
Power dissipation	4.5 W	5 W	1.5 W
Current consumption (SM Bus)	120 mA	140 mA	120 mA
Current consumption (24 VDC)	11 mA / Relay coil used	16.7 mA/Relay coil used	11 mA / Relay coil used

Table A- 87 Digital outputs

Model	SM 1222 DQ 8 x Relay	SM 1222 DQ8 RLY Changeover	SM 1222 DQ 8 x 24 VDC
Number of outputs	8	8	8
Type	Relay, dry contact	Relay change over contact	Solid state - MOSFET (sourcing)

Model	SM 1222 DQ 8 x Relay	SM 1222 DQ8 RLY Changeover	SM 1222 DQ 8 x 24 VDC
Voltage range	5 to 30 VDC or 5 to 250 VAC	5 to 30 VDC or 5 to 250 VAC	20.4 to 28.8 VDC
Logic 1 signal at max. current	--	--	20 VDC min.
Logic 0 signal with 10K Ω load	--	--	0.1 VDC max
Current (max.)	2.0 A	2.0 A	0.5 A
Lamp load	30 W DC/200 W AC	30 W DC/200 W AC	5W
ON state contact resistance	0.2 Ω max. when new	0.2 Ω max. when new	0.6 Ω max.
Leakage current per point	--	--	10 µA max.
Surge current	7 A with contacts closed	7 A with contacts closed	8 A for 100 ms max.
Overload protection	No	No	No
Isolation (field side to logic)	1500 VAC for 1 minute (coil to contact) None (coil to logic)	1500 VAC for 1 minute (coil to contact)	500 VAC for 1 minute
Isolation resistance	100 MΩ min. when new	100 MΩ min. when new	--
Isolation between open contacts	750 VAC for 1 minute	750 VAC for 1 minute	--
Isolation groups	2	8	1
Current per common (max.)	10 A	2 A	4 A
Inductive clamp voltage	--	--	L+ minus 48 V, 1 W dissipation
Switching delay	10 ms max.	10 ms max	50 µs max. off to on 200 µs max. on to off
Maximum relay switching frequency	1 Hz	1 Hz	--
Lifetime mechanical (no load)	10,000,000 open/close cycles	10,000,000 open/close cycles	--
Lifetime contacts at rated load	100,000 open/close cycles	100,000 open/close cycles	--
Behavior on RUN to STOP	Last value or substitute value (default value 0)	Last value or substitute value (default value 0)	Last value or substitute value (default value 0)
Number of outputs on simultaneously	8	• 4 (no adjacent points) at 60° C horizontal or 50° C vertical • 8 at 55° C horizontal or 45° C vertical	8
Cable length (meters)	500 m shielded, 150 m unshielded	500 m shielded, 150 m unshielded	500 m shielded, 150 m unshielded

A.6.3 SM 1222 16-Point Digital Output Specifications

Table A- 88 General specifications

Model	SM 1222 DQ 16 x Relay	SM 1222 DQ 16 x 24 VDC
Order number	6ES7 222-1HH30-0XB0	6ES7 222-1BH30-0XB0
Dimensions W x H x D (mm)	45 x 100 x 75	45 x 100 x 75
Weight	260 grams	220 grams
Power dissipation	8.5 W	2.5 W
Current consumption (SM Bus)	135 mA	140 mA
Current consumption (24 VDC)	11 mA / Relay coil used	-

Table A- 89 Digital outputs

Model	SM1222 DQ 16 x Relay	SM1222 DQ 16 x 24 VDC
Number of outputs	16	16
Type	Relay, dry contact	Solid state - MOSFET (sourcing)
Voltage range	5 to 30 VDC or 5 to 250 VAC	20.4 to 28.8 VDC
Logic 1 signal at max. current	-	20 VDC min.
Logic 0 signal with 10K Ω load	-	0.1 VDC max.
Current (max.)	2.0 A	0.5 A
Lamp load	30 W DC/200 W AC	5W
ON state contact resistance	0.2 Ω max. when new	0.6 Ω max.
Leakage current per point	--	10 µA max.
Surge current	7 A with contacts closed	8 A for 100 ms max.
Overload protection	No	No
Isolation (field side to logic)	1500 VAC for 1 minute (coil to contact) None (coil to logic)	500 VAC for 1 minute
Isolation resistance	100 MΩ min. when new	-
Isolation between open contacts	750 VAC for 1 minute	-
Isolation groups	4	1
Current per common (max.)	10 A	8 A
Inductive clamp voltage	-	L+ minus 48 V, 1 W dissipation
Switching delay	10 ms max.	50 µs max. off to on 200 µs max. on to off
Maximum relay switching frequency	1 Hz	-
Lifetime mechanical (no load)	10,000,000 open/close cycles	-
Lifetime contacts at rated load	100,000 open/close cycles	-
Behavior on RUN to STOP	Last value or substitute value (default value 0)	Last value or substitute value (default value 0)

Model	SM1222 DQ 16 x Relay	SM1222 DQ 16 x 24 VDC
Number of outputs on simultaneously	• 8 (no adjacent points) at 60° C horizontal or 50° C vertical • 16 at 55° C horizontal or 45° C vertical	16
Cable length (meters)	500 m shielded, 150 m unshielded	500 m shielded, 150 m unshielded

Table A- 90 Wiring diagrams for the 8-point digital output SMs

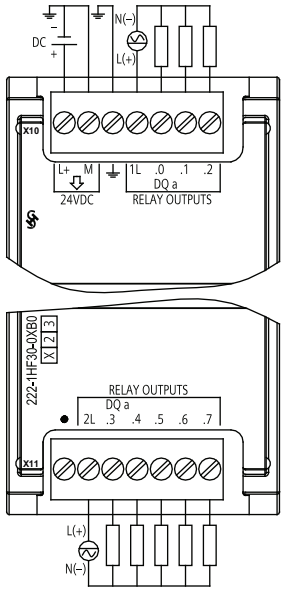
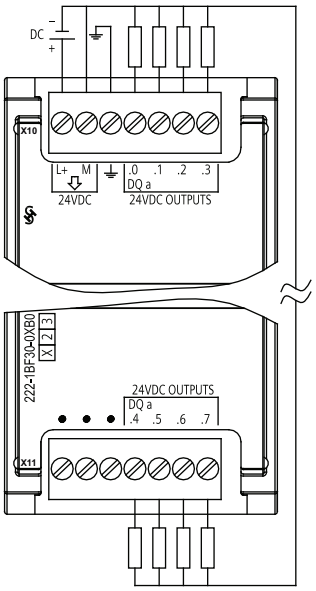
SM 1222 DQ 8 x Relay (6ES7 222-1HF30-0XB0)	SM 1222 DQ 8 x 24 VDC (6ES7 222-1BF30-0XB0)
	

Table A- 91 Connector pin locations for SM 1222 DQ 8 x Relay (6ES7 222-1HF30-0XB0)

Pin	X10	X11
1	L+ / 24VDC	No connection
2	M / 24VDC	2L
3	Functional Earth	DQ a.3
4	1L	DQ a.4
5	DQ a.0	DQ a.5
6	DQ a.1	DQ a.6
7	DQ a.2	DQ a.7

Table A- 92 Connector pin locations for SM 1222 DQ 8 x 24 VDC (6ES7 222-1BF30-0XB0)

Pin	X10	X11
1	L+ / 24VDC	No connection
2	M / 24VDC	No connection
3	Functional Earth	No connection
4	DQ a.0	DQ a.4
5	DQ a.1	DQ a.5
6	DQ a.2	DQ a.6
7	DQ a.2	DQ a.7

Table A- 93 Wiring diagram for the 8-point digital output relay changeover SM

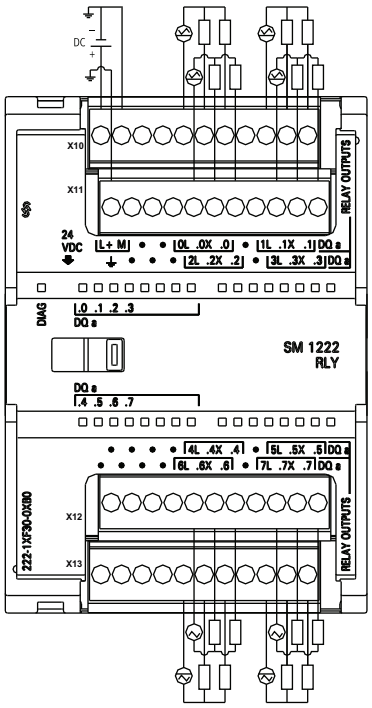
SM 1222 DQ 8 x Relay Changeover (6ES7 222-1XF30-0XB0)	
	

Table A- 94 Connector pin locations for SM 1222 DQ 8 x Relay Changeover (6ES7 222-1XF30-0XB0)

Pin	X10	X11	X12	X13
1	L+ / 24VDC	Functional Earth	No connection	No connection
2	M / 24VDC	No connection	No connection	No connection
3	No connection	No connection	No connection	No connection
4	No connection	No connection	No connection	No connection
5	0L	2L	4L	6L

Pin	X10	X11	X12	X13
6	DQ a.0X	DQ a.2X	DQ a.4X	DQ a.6X
7	DQ a.0	DQ a.2	DQ a.4	DQ a.6
8	No connection	No connection	No connection	No connection
9	1L	3L	5L	7L
10	DQ a.1X	DQ a.3X	DQ a.5X	DQ a.7X
11	DQ a.1	DQ a.3	DQ a.5	DQ a.7

Table A- 95 Wiring diagrams for the 16-point digital output SMs

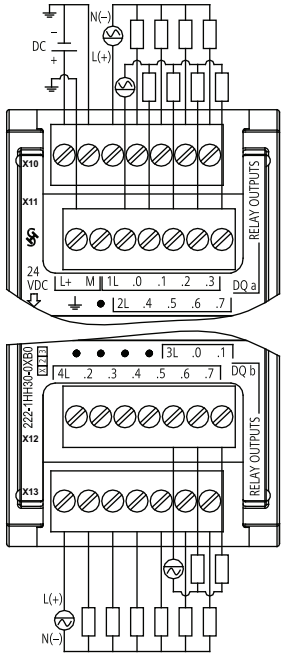
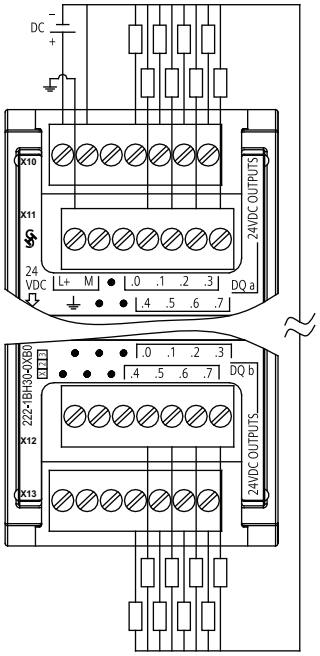
SM 1222 DQ 16 x Relay (6ES7 222-1HH30-0XB0)	SM 1222 DQ 16 x 24 VDC (6ES7 222-1BH30-0XB0)
	

Table A- 96 Connector pin locations for SM 1222 DQ 16 x Relay (6ES7 222-1HH30-0XB0)

Pin	X10	X11	X12	X13
1	L+ / 24VDC	Functional Earth	No connection	4L
2	M / 24VDC	No connection	No connection	DQ b.2
3	1L	2L	No connection	DQ b.3
4	DQ a.0	DQ a.4	No connection	DQ b.4
5	DQ a.1	DQ a.5	3L	DQ b.5
6	DQ a.2	DQ a.6	DQ b.0	DQ b.6
7	DQ a.3	DQ a.7	DQ b.1	DQ b.7

Table A- 97 Connector pin locations for SM 1222 DQ 16 x 24 VDC (6ES7 222-1BH30-0XB0)

Pin	X10	X11	X12	X13
1	L+ / 24VDC	Functional Earth	No connection	No connection
2	M / 24VDC	No connection	No connection	No connection
3	No connection	No connection	No connection	No connection
4	DQ a.0	DQ a.4	DQ b.0	DQ b.4
5	DQ a.1	DQ a.5	DQ b.1	DQ b.5
6	DQ a.2	DQ a.6	DQ b.2	DQ b.6
7	DQ a.3	DQ a.7	DQ b.3	DQ b.7

A.6.4 SM 1223 Digital Input/Output VDC Specifications

Table A- 98 General specifications

Model	SM 1223 DI 8 x 24 VDC, DQ 8 x Relay	SM 1223 DI 16 x 24 VDC, DQ 16 x Relay	SM 1223 DI 8 x 24 VDC, DQ 8 x 24 VDC	SM 1223 DI 16 x 24 VDC, DQ 16 x 24 VDC
Order number	6ES7 223-1PH30-0XB0	6ES7 223-1PL30-0XB0	6ES7 223-1BH30-0XB0	6ES7 223-1BL30-0XB0
Dimensions W x H x D (mm)	45 x 100 x 75	70 x 100 x 75	45 x 100 x 75	70 x 100 x 75
Weight	230 grams	350 grams	210 grams	310 grams
Power dissipation	5.5 W	10 W	2.5 W	4.5 W
Current consumption (SM Bus)	145 mA	180 mA	145 mA	185 mA
Current consumption (24 VDC)	4 mA / Input used 11 mA / Relay coil used		4 mA / Input used	

Table A- 99 Digital inputs

Model	SM 1223 DI 8 x 24 VDC, DQ 8 x Relay	SM 1223 DI 16 x 24 VDC, DQ 16 x Relay	SM 1223 DI 8 x 24 VDC, DQ 8 x 24 VDC	SM 1223 DI 16 x 24 VDC, DQ 16 x 24 VDC
Number of inputs	8	16	8	16
Type	Sink/Source (IEC Type 1 sink)			
Rated voltage	24 VDC at 4 mA, nominal			
Continuous permissible voltage	30 VDC max.			
Surge voltage	35 VDC for 0.5 sec.			
Logic 1 signal (min.)	15 VDC at 2.5 mA			
Logic 0 signal (max.)	5 VDC at 1 mA			
Isolation (field side to logic)	500 VAC for 1 minute			
Isolation groups	2	2	2	2
Filter times	0.2, 0.4, 0.8, 1.6, 3.2, 6.4, and 12.8 ms, selectable in groups of 4			

Model	SM 1223 DI 8 x 24 VDC, DQ 8 x Relay	SM 1223 DI 16 x 24 VDC, DQ 16 x Relay	SM 1223 DI 8 x 24 VDC, DQ 8 x 24 VDC	SM 1223 DI 16 x 24 VDC, DQ 16 x 24 VDC
Number of inputs on simultaneously	8	• 8 (no adjacent points) at 60° C horizontal or 50° C vertical • 16 at 55° C horizontal or 45° C vertical	8	16
Cable length (meters)	500 m shielded, 300 m unshielded			

Table A- 100 Digital outputs

Model	SM 1223 DI 8 x 24 VDC, DQ 8 x Relay	SM 1223 DI 16 x 24 VDC, DQ 16 x Relay	SM 1223 DI 8 x 24 VDC, DQ 8 x 24 VDC	SM 1223 DI 16 x 24 VDC, DQ 16 x 24 VDC
Number of outputs	8	16	8	16
Type	Relay, dry contact		Solid state - MOSFET (sourcing)	
Voltage range	5 to 30 VDC or 5 to 250 VAC		20.4 to 28.8 VDC	
Logic 1 signal at max. current	--		20 VDC, min.	
Logic 0 signal with 10 KΩ load	--		0.1 VDC, max.	
Current (max.)	2.0 A		0.5 A	
Lamp load	30 W DC / 200 W AC		5 W	
ON state contact resistance	0.2 Ω max. when new		0.6 Ω max.	
Leakage current per point	--		10 µA max.	
Surge current	7 A with contacts closed		8 A for 100 ms max.	
Overload protection	No			
Isolation (field side to logic)	1500 VAC for 1 minute (coil to contact) None (coil to logic)		500 VAC for 1 minute	
Isolation resistance	100 MΩ min. when new		--	
Isolation between open contacts	750 VAC for 1 minute		--	
Isolation groups	2	4	1	1
Current per common	10A	8 A	4 A	8 A
Inductive clamp voltage	--		L+ minus 48 V, 1 W dissipation	
Switching delay	10 ms max.		50 µs max. off to on 200 µs max. on to off	
Maximum relay switching frequency	1 Hz		--	
Lifetime mechanical (no load)	10,000,000 open/close cycles		--	
Lifetime contacts at rated load	100,000 open/close cycles		--	
Behavior on RUN to STOP	Last value or substitute value (default value 0)			

Model	SM 1223 DI 8 x 24 VDC, DQ 8 x Relay	SM 1223 DI 16 x 24 VDC, DQ 16 x Relay	SM 1223 DI 8 x 24 VDC, DQ 8 x 24 VDC	SM 1223 DI 16 x 24 VDC, DQ 16 x 24 VDC
Number of outputs on simultaneously	8	• 8 (no adjacent points) at 60° C horizontal or 50° C vertical • 16 at 55° C horizontal or 45° C vertical	8	16
Cable length (meters)	500 m shielded, 150 m unshielded			

Table A- 101 Wiring diagrams for the digital input VDC/output relay SMs

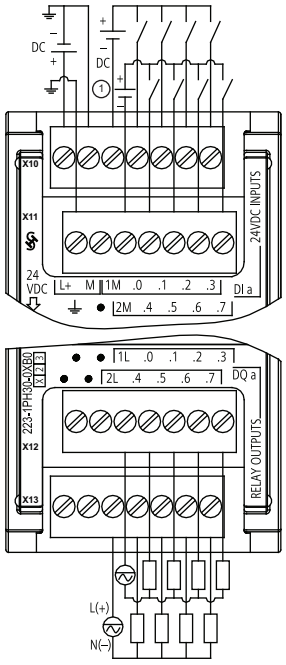
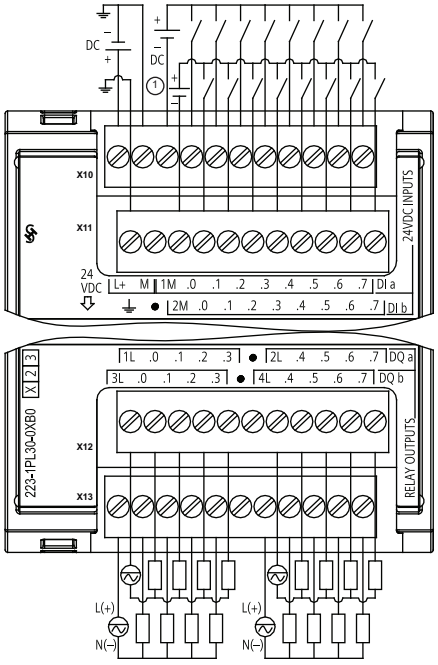
SM 1223 DI 8 x 24 VDC, DQ 8 x Relay (6ES7 223-1PH30-0XB0)	SM 1223 DI 16 x 24 VDC, DQ 16 x Relay (6ES7 223-1PL30-0XB0)	Notes
		① For sinking inputs, connect "-" to "M" (shown). For sourcing inputs, connect "+" to "M".

Table A- 102 Connector Pin Locations for SM 1223 DI 8 x 24 VDC, DQ 8 x Relay (6ES7 223-1PH30-0XB0)

Pin	X10	X11	X12	X13
1	L+ / 24VDC	GND	No connection	No connection
2	M / 24VDC	No connection	No connection	No connection
3	1M	2M	1L	2L
4	DI a.0	DI a.4	DQ a.0	DQ a.4

Pin	X10	X11	X12	X13
5	DI a.1	DI a.5	DQ a.1	DQ a.5
6	DI a.2	DI a.6	DQ a.2	DQ a.6
7	DI a.3	DI a.7	DQ a.3	DQ a.7

Table A- 103 Connector Pin Locations for SM 1223 DI 16 x 24 VDC, DQ 16 x Relay (6ES7 223-1PL30-0XB0)

Pin	X10	X11	X12	X13
1	L+ / 24VDC	GND	1L	3L
2	M / 24VDC	No connection	DQ a.0	DQ b.0
3	1M	2M	DQ a.1	DQ b.1
4	DI a.0	DI b.0	DQ a.2	DQ b.2
5	DI a.1	DI b.1	DQ a.3	DQ b.3
6	DI a.2	DI b.2	No connection	No connection
7	DI a.3	DI b.3	2L	4L
8	DI a.4	DI b.4	DQ a.4	DQ b.4
9	DI a.5	DI b.5	DQ a.5	DQ b.5
10	DI a.6	DI b.6	DQ a.6	DQ b.6
11	DI a.7	DI b.7	DQ a.7	DQ b.7

Table A- 104 Wiring diagrams for the digital input VDC/output SMs

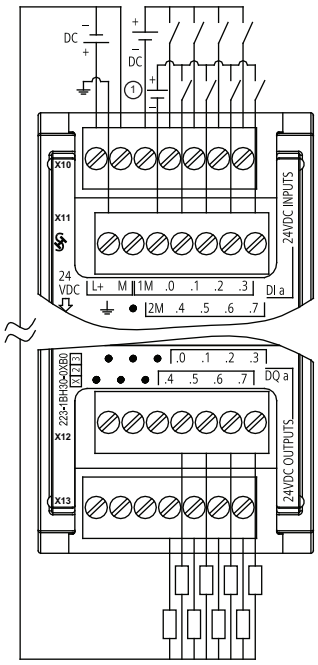
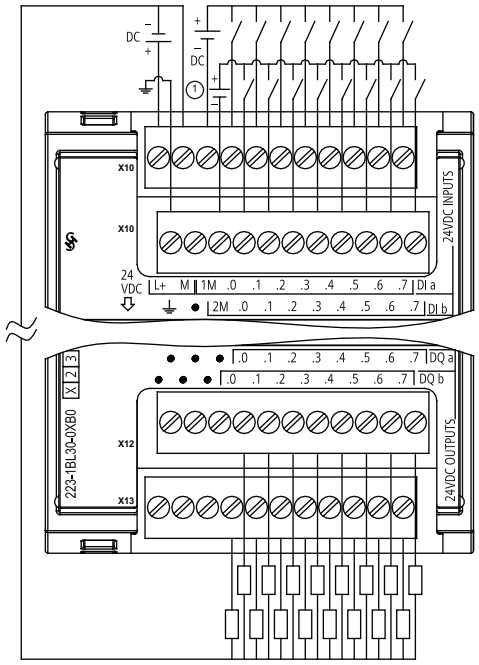
SM 1223 DI 8 x 24 VDC, DQ 8 x 24 VDC (6ES7 223-1BH30-0XB0)	SM 1223 DI 16 x 24 VDC, DQ 16 x 24 VDC (6ES7 223-1BL30-0XB0)	Notes
		① For sinking inputs, connect "-" to "M" (shown). For sourcing inputs, connect "+" to "M".

Table A- 105 Connector Pin Locations for SM 1223 DI 8 x 24 VDC, DQ 8 x 24 VDC (6ES7 223-1BH30-0XB0)

Pin	X10	X11	X12	X13
1	L+ / 24VDC	GND	No connection	No connection
2	M / 24VDC	No connection	No connection	No connection
3	1M	2M	No connection	No connection
4	DI a.0	DI a.4	DQ a.0	DQ a.4
5	DI a.1	DI a.5	DQ a.1	DQ a.5
6	DI a.2	DI a.6	DQ a.2	DQ a.6
7	DI a.3	DI a.7	DQ a.3	DQ a.7

Table A- 106 Connector Pin Locations for SM 1223 DI 16 x 24 VDC, DQ 16 x 24 VDC (6ES7 223-1BL30-0XB0)

Pin	X10	X11	X12	X13
1	L+ / 24VDC	GND	No connection	No connection
2	M / 24VDC	No connection	No connection	No connection
3	1M	2M	No connection	No connection
4	DI a.0	DI b.0	DQ a.0	DQ b.0
5	DI a.1	DI b.1	DQ a.1	DQ b.1
6	DI a.2	DI b.2	DQ a.2	DQ b.2
7	DI a.3	DI b.3	DQ a.3	DQ b.3
8	DI a.4	DI b.4	DQ a.4	DQ b.4
9	DI a.5	DI b.5	DQ a.5	DQ b.5
10	DI a.6	DI b.6	DQ a.6	DQ b.6
11	DI a.7	DI b.7	DQ a.7	DQ b.7

A.6.5 SM 1223 Digital Input/Output AC Specifications

Table A- 107 General specifications

Model	SM 1223 DI 8 x120/230 VAC / DQ 8 x Relay
Order number	6ES7 223-1QH30-0XB0
Dimensions W x H x D (mm)	45 x 100 x 75 mm
Weight	190 grams
Power dissipation	7.5 W
Current consumption (SM Bus)	120 mA
Current consumption (24 VDC)	11 mA per output when on

Table A- 108 Digital inputs

Model	SM 1223 DI 8 x 120/230 VAC / DQ 8 x Relay
Number of inputs	8
Type	IEC Type 1
Rated voltage	120 VAC at 6 mA, 230 VAC at 9 mA
Continuous permissible voltage	264 VAC
Surge voltage	--
Logic 1 signal (min.)	79 VAC at 2.5 mA
Logic 0 signal (max.)	20 VAC at 1 mA
Leakage current (max.)	1 mA
Isolation (field side to logic)	1500 VAC for 1 minute
Isolation groups[1]	4
Input delay times	Typical: 0.2 to 12.8 ms, user selectable Maximum: -
Connection of 2 wire proximity sensor (Bero) (max.)	1 mA
Cable length	Unshielded: 300 meters Shielded: 500 meters
Number of inputs on simultaneously	8

[1] Channels within a group must be of the same phase.

Table A- 109 Digital outputs

Model	SM 1223 DI 8 x 120/230 VAC / DQ 8 x Relay
Number of outputs	8
Type	Relay, dry contact
Voltage range	5 to 30 VDC or 5 to 250 VAC
Logic 1 signal at max. current	--
Logic 0 signal with 10K Ω load	--
Current (max.)	2.0 A
Lamp load	30 W DC / 200 W AC
ON state contact resistance	0.2 Ω max. when new
Leakage current per point	--
Surge current	7 A with contacts closed
Overload protection	No
Isolation (field side to logic)	1500 VAC for 1 minute (coil to contact) None (coil to logic)
Isolation resistance	100 MΩ min. when new
Isolation between open contacts	750 VAC for 1 minute
Isolation groups	2
Current per common (max.)	10 A
Inductive clamp voltage	--

Model	SM 1223 DI 8 x 120/230 VAC / DQ 8 x Relay
Switching delay (max.)	10 ms
Maximum relay switching frequency	1 Hz
Lifetime mechanical (no load)	10,000,000 open/close cycles
Lifetime contacts at rated load	1000,000 open/close cycles
Behavior on RUN to STOP	Last value or substitute value (default value 0)
Number of outputs on simultaneously	• 4 (no adjacent points) at 60° C horizontal or 50° C vertical • 8 at 55° C horizontal or 45° C vertical
Cable length (meters)	500 m shielded, 150 m unshielded

Table A- 110 SM 1223 DI 8 x 120/230 VAC, DQ 8 x Relay (6ES7 223-1QH30-0XB0)

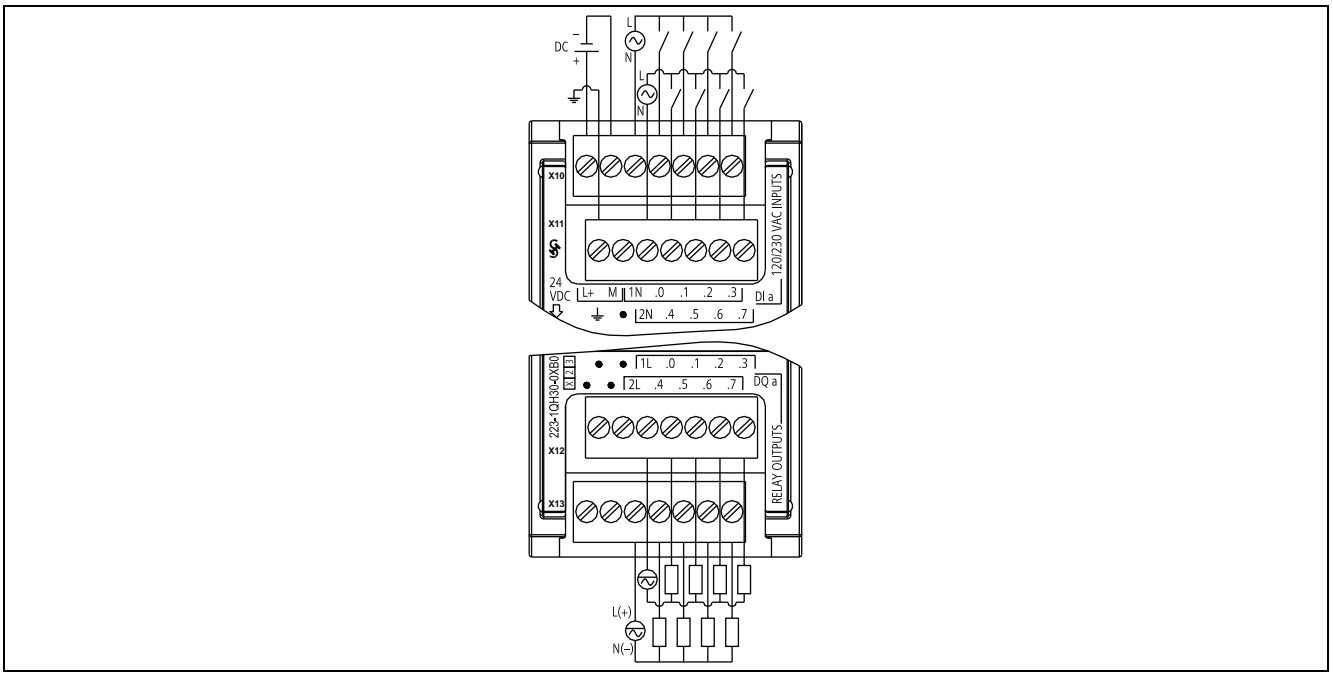


Table A- 111 Connector Pin Locations for SM 1223 DI 8 x 120/240 VAC, DQ 8 x Relay (6ES7 223-1QH30-0XB0)

Pin	X10	X11	X12	X13
1	L+ / 24VDC	GND	No connection	No connection
2	M / 24VDC	No connection	No connection	No connection
3	1N	2N	1L	2L
4	DI a.0	DI a.4	DQ a.0	DQ a.4
5	DI a.1	DI a.5	DQ a.1	DQ a.5
6	DI a.2	DI a.6	DQ a.2	DQ a.6
7	DI a.3	DI a.7	DQ a.3	DQ a.7

A.7 Analog signal modules (SMs)

A.7.1 SM 1231 analog input module specifications

Table A- 112 General specifications

Model	SM 1231 AI 4 x 13 bit	SM 1231 AI 8 x 13 bit	SM 1231 AI 4 x 16 bit
Order number	6ES7 231-4HD30-0XB0	6ES7 231-4HF30-0XB0	6ES7 231-5ND30-0XB0
Dimensions W x H x D (mm)	45 x 100 x 75	45 x 100 x 75	45 x 100 x 75
Weight	180 grams	180 grams	180 grams
Power dissipation	2.2 W	2.3 W	2.0 W
Current consumption (SM Bus)	80 mA	90 mA	80 mA
Current consumption (24 VDC)	45 mA	45 mA	65 mA

Table A- 113 Analog inputs

Model	SM 1231 AI 4 x 13 bit	SM 1231 AI 8 x 13 bit	SM 1231 AI 4 x 16 bit
Number of inputs	4	8	4
Type	Voltage or current (differential): Selectable in groups of 2		Voltage or current (differential)
Range	±10 V, ±5 V, ±2.5 V, or 0 to 20 mA		±10 V, ±5 V, ±2.5 V, ±1.25 V, 0 to 20 mA or 4 mA to 20 mA
Full scale range (data word)	-27,648 to 27,648 voltage / 0 to 27,648 current		
Overshoot/undershoot range (data word) Refer to the section on analog input ranges for voltage and current (Page 770).	Voltage: 32,511 to 27,649 / -27,649 to -32,512 Current: 32,511 to 27,649 / 0 to -4864		Voltage: 32,511 to 27649 / -27,649 to -32,512 Current:(0-20 mA): to 32,511 to 27,649 / 0 to -4864; 4-20 mA: 32511 to 27,649 / -1 to -4,864
Overflow/underflow (data word) Refer to the section on input ranges for voltage and current (Page 770).	Voltage: 32,767 to 32,512 / -32,513 to -32,768 Current: 32,767 to 32,512 / -4865 to -32,768		Voltage: 32,767 to 32,512 / -32,513 to -32,768 Current: 0 to 20 mA 32,767 to 32,512 / -4865 to -32,768 4-20 mA 32,767 to 32,512/ -4,865 to -32,768
Resolution1	12 bits + sign bit		15 bits + sign bit
Maximum withstand voltage/current	±35 V / ±40 mA		
Smoothing	None, weak, medium, or strong Refer to the section on step response times (Page 769).		
Noise rejection	400, 60, 50, or 10 Hz Refer to the section on sample rates (Page 769).		

Model	SM 1231 AI 4 x 13 bit	SM 1231 AI 8 x 13 bit	SM 1231 AI 4 x 16 bit
Input impedance	≥ 9 MΩ (voltage) / 280 Ω (current)		≥ 1 MΩ (voltage) / <315 Ω, >280 Ω (current)
Isolation Field side to logic Logic to 24 VDC Field side to 24 VDC Channel to channel	None		 500 VAC 500 VAC 500 VAC None
Accuracy (25°C / -20 to 60°C)	±0.1% / ±0.2% of full scale		±0.1% / ±0.3% of full scale
Measuring principle	Actual value conversion		
Common mode rejection	40 dB, DC to 60 Hz		
Operational signal range[1]	Signal plus common mode voltage must be less than +12 V and greater than -12 V		
Cable length (meters)	100 m, twisted and shielded		

[1] Voltages outside the operational range applied to one channel may cause interference on other channels.

Table A- 114 Diagnostics

Model	SM 1231 AI 4 x 13 bit	SM 1231 AI 8 x 13 bit	SM 1231 AI 4 x 16 bit
Overflow/underflow	Yes [1]	Yes	Yes
24 VDC low voltage	Yes	Yes	Yes
Open wire	--	--	4 to 20 mA range only (if input is below -4,164; 1.0 mA)

[1] For SM 1231 AI 4 x 13 bit: If a voltage greater than +30 VDC or less than -15 VDC is applied to the input, the resulting value will be unknown and the corresponding overflow or underflow may not be active.

Table A- 115 Wiring diagrams for the analog input SMs

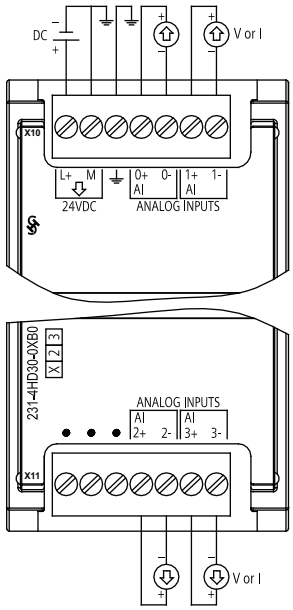
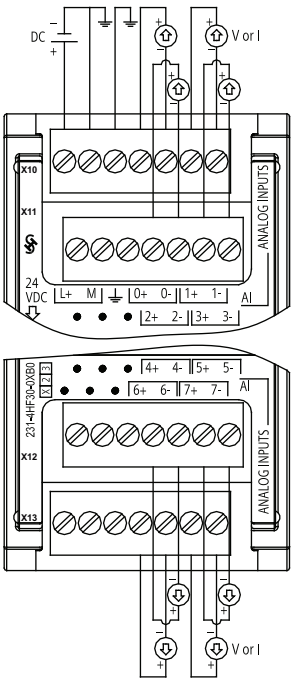
SM 1231 AI 4 x 13 bit (6ES7 231-4HD30-0XB0)	SM 1231 AI 8 x 13 bit (6ES7 231-4HF30-0XB0)
	
Note: Connectors must be gold. See Appendix C, Spare Parts for order number.	

Table A- 116 Connector pin locations for SM 1231 AI 4 x 13 bit (6ES7 231-4HD30-0XB0)

Pin	X10 (gold)	X11 (gold)
1	L+ / 24VDC	No connection
2	M / 24VDC	No connection
3	GND	No connection
4	AI 0+	AI 2+
5	AI 0-	AI 2-
6	AI 1+	AI 3+
7	AI 1-	AI 3-

Table A- 117 Connector pin locations for SM 1231 AI 8 x 13 bit (6ES7 231-4HF30-0XB0)

Pin	X10 (gold)	X11 (gold)	X12 (gold)	X13 (gold)
1	L+ / 24VDC	No connection	No connection	No connection
2	M / 24VDC	No connection	No connection	No connection
3	GND	No connection	No connection	No connection
4	AI 0+	AI 2+	AI 4+	AI 6+
5	AI 0-	AI 2-	AI 4-	AI 6-

Pin	X10 (gold)	X11 (gold)	X12 (gold)	X13 (gold)
6	AI 1+	AI 3+	AI 5+	AI 7+
7	AI 1-	AI 3-	AI 5-	AI 7-

Table A- 118 Wiring diagram for the analog input SM

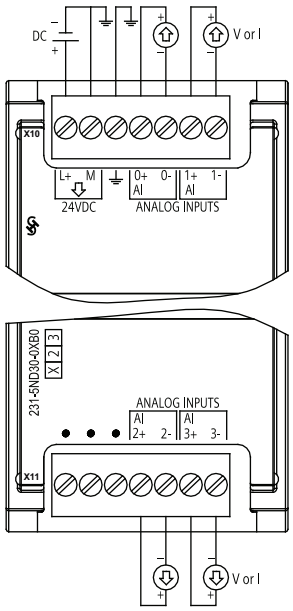
SM 1231 AI 4 x 16 bit (6ES7 231-5ND30-0XB0)

Note: Connectors must be gold. See Appendix C, Spare Parts for order number.

Table A- 119 Connector pin locations for SM 1231 AI 4 x 16 bit (6ES7 231-5ND30-0XB0)

Pin	X10 (gold)	X11 (gold)
1	L+ / 24VDC	No connection
2	M / 24VDC	No connection
3	GND	No connection
4	AI 0+	AI 2+
5	AI 0-	AI 2-
6	AI 1+	AI 3+
7	AI 1-	AI 3-

Note

Unused analog inputs should be shorted.

When the inputs are configured for "current" mode, no current will flow through the input unless you supply external power to the module.

A.7.2 SM 1232 analog output module specifications

Table A- 120 General specifications

Technical data	SM 1232 AQ 2 x 14 bit	SM 1232 AQ 4 x 14 bit
Order number	6ES7 232-4HB30-0XB0	6ES7 232-4HD30-0XB0
Dimensions W x H x D (mm)	45 x 100 x 75	45 x 100 x 75
Weight	180 grams	180 grams
Power dissipation	1.8 W	2.0 W
Current consumption (SM Bus)	80 mA	80 mA
Current consumption (24 VDC)	45 mA (no load)	45 mA (no load)

Table A- 121 Analog outputs

Technical data	SM 1232 AQ 2 x 14 bit	SM 1232 AQ 4 x 14 bit
Number of outputs	2	4
Type	Voltage or current	Voltage or current
Range	±10 V or 0 to 20 mA	±10 V or 0 to 20 mA
Resolution	Voltage: 14 bits Current: 13 bits	Voltage: 14 bits Current: 13 bits
Full scale range (data word)	Voltage: -27,648 to 27,648 ; Current: 0 to 27,648 Refer to the output ranges for voltage and current (Page 771).	
Accuracy (25°C / -20 to 60°C)	±0.3% / ±0.6% of full scale	
Settling time (95% of new value)	Voltage: 300 µS (R), 750 µS (1 uF) Current: 600 µS (1 mH), 2 ms (10 mH)	
Load impedance	Voltage: ≥ 1000 Ω Current: ≤ 600 Ω	
Behavior on RUN to STOP	Last value or substitute value (default value 0)	
Isolation (field side to logic)	none	
Cable length (meters)	100 m twisted and shielded	

Table A- 122 Diagnostics

Technical data	SM 1232 AQ 2 x 14 bit	SM 1232 AQ 4 x 14 bit
Overflow/underflow	Yes	Yes
Short to ground (voltage mode only)	Yes	Yes
Wire break (current mode only)	Yes	Yes
24 VDC low voltage	Yes	Yes

Table A- 123 Wiring diagrams for the analog output SMs

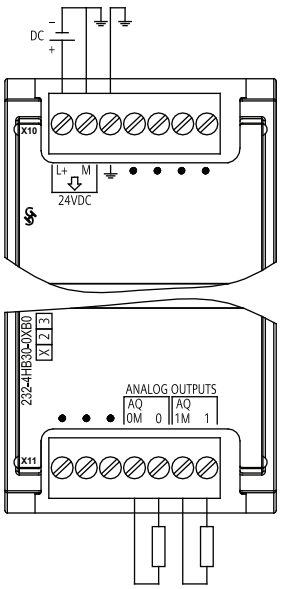
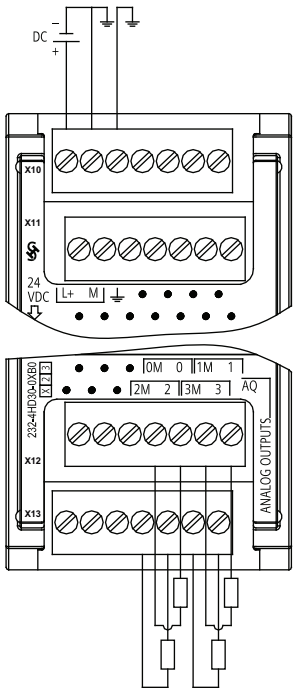
SM 1232 AQ 2 x 14 bit (6ES7 232-4HB30-0XB0)	SM 1232 AQ 4 x 14 bit (6ES7 232-4HD30-0XB0)
	
Note: Connectors must be gold. See Appendix C, Spare Parts for order number.	

Table A- 124 Connector pin locations for SM 1232 AQ 2 x 14 bit (6ES7 232-4HB30-0XB0)

Pin	X10 (gold)	X11 (gold)
1	L+ / 24VDC	No connection
2	M / 24VDC	No connection
3	GND	No connection
4	No connection	AQ 0M
5	No connection	AQ 0
6	No connection	AQ 1M
7	No connection	AQ 1

Table A- 125 Connector pin locations for SM 1232 AQ 4 x 14 bit (6ES7 232-4HD30-0XB0)

Pin	X10 (gold)	X11 (gold)	X12 (gold)	X13 (gold)
1	L+ / 24VDC	No connection	No connection	No connection
2	M / 24VDC	No connection	No connection	No connection
3	GND	No connection	No connection	No connection
4	No connection	No connection	AQ 0M	AQ 2M
5	No connection	No connection	AQ 0	AQ 2
6	No connection	No connection	AQ 1M	AQ 3M
7	No connection	No connection	AQ 1	AIQ 3

A.7.3 SM 1234 analog input/output module specifications

Table A- 126 General specifications

Technical data	SM 1234 AI 4 x 13 bit / AQ 2 x 14 bit
Order number	6ES7 234-4HE30-0XB0
Dimensions W x H x D (mm)	45 x 100 x 75
Weight	220 grams
Power dissipation	2.4 W
Current consumption (SM Bus)	80 mA
Current consumption (24 VDC)	60 mA (no load)

Table A- 127 Analog inputs

Model	SM 1234 AI 4 x 13 bit / AQ 2 x 14 bit
Number of inputs	4
Type	Voltage or Current (differential): Selectable in groups of 2
Range	±10 V, ±5 V, ±2.5 V, or 0 to 20 mA
Full scale range (data word)	-27,648 to 27,648
Overshoot/undershoot range (data word)	Voltage: 32,511 to 27,649 / -27,649 to -32,512 Current: 32,511 to 27,649 / 0 to -4864 Refer to the section on input ranges for voltage and current (Page 770).
Overflow/underflow (data word)	Voltage: 32,767 to 32,512 / -32,513 to -32,768 Current: 32,767 to 32,512 / -4865 to -32,768 Refer to the section on input ranges for voltage and current (Page 770).
Resolution	12 bits + sign bit
Maximum withstand voltage/current	±35 V / ±40 mA
Smoothing	None, weak, medium, or strong Refer to the section on step response times (Page 769).
Noise rejection	400, 60, 50, or 10 Hz Refer to the section on sample rates (Page 769).

Model	SM 1234 AI 4 x 13 bit / AQ 2 x 14 bit
Input impedance	≥ 9 MΩ (voltage) / 280 Ω (current)
Isolation (field side to logic)	None
Accuracy (25 °C / -20 to 60°C)	±0.1% / ±0.2% of full scale
Analog to digital conversion time	625 µs (400 Hz rejection)
Common mode rejection	40 dB, DC to 60 Hz
Operational signal range[1]	Signal plus common mode voltage must be less than +12 V and greater than -12 V
Cable length (meters)	100 m, twisted and shielded

[1] Voltages outside the operational range applied to one channel may cause interference on other channels.

Table A- 128 Analog outputs

Technical data	SM 1234 AI 4 x 13 bit / AQ 2 x 14 bit
Number of outputs	2
Type	Voltage or current
Range	±10 V or 0 to 20 mA
Resolution	Voltage: 14 bits ; Current: 13 bits
Full scale range (data word)	Voltage: -27,648 to 27,648; Current: 0 to 27,648 Refer to to the section on output ranges for voltage and current (Page 771).
Accuracy (25°C / -20 to 60°C)	±0.3% / ±0.6% of full scale
Settling time (95% of new value)	Voltage: 300 µS (R), 750 µS (1 uF) Current: 600 µS (1 mH), 2 ms (10 mH)
Load impedance	Voltage: ≥ 1000 Ω Current: ≤ 600 Ω
Behavior on RUN to STOP	Last value or substitute value (default value 0)
Isolation (field side to logic)	none
Cable length (meters)	100 m twisted and shielded

Table A- 129 Diagnostics

Model	SM 1234 AI 4 x 13 bit / AQ 2 x 14 bit
Overflow/underflow	Yes [1]
Short to ground (voltage mode only)	Yes on outputs
Wire break (current mode only)	Yes on outputs
24 VDC low voltage	Yes

[1] If a voltage greater than +30 VDC or less than -15 VDC is applied to the input, the resulting value will be unknown and the corresponding overflow or underflow may not be active.

Table A- 130 Wiring diagrams for the analog input/output SM

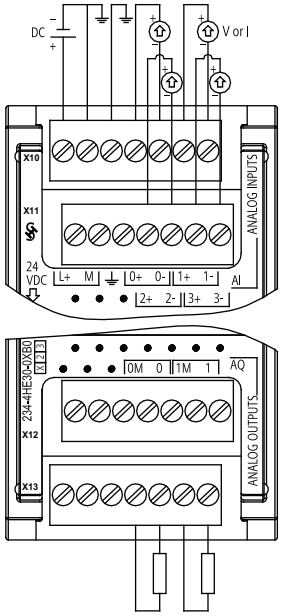
SM 1234 AI 4 x 13 Bit / AQ 2 x 14 bit (6ES7 234-4HE30-0XB0)

Note: Connectors must be gold. See Appendix C, Spare Parts for order number.

Table A- 131 Connector pin locations for SM 1234 AI 4 x 13 Bit / AQ 2 x 14 bit (6ES7 234-4HE30-0XB0)

Pin	X10 (gold)	X11 (gold)	X12 (gold)	X13 (gold)
1	L+ / 24VDC	No connection	No connection	No connection
2	M / 24VDC	No connection	No connection	No connection
3	GND	No connection	No connection	No connection
4	AI 0+	AI 2+	No connection	AQ 0M
5	AI 0-	AI 2-	No connection	AQ 0
6	AI 1+	AI 3+	No connection	AQ 1M
7	AI 1-	AI 3-	No connection	AIQ 1

Note

Unused analog inputs should be shorted.

When the inputs are configured for "current" mode, no current will flow through the input unless you supply external power to the module.

A.7.4 Step response of the analog inputs

Table A- 132 Step response (ms), 0 to full-scale measured at 95%

Smoothing selection (sample averaging)	Noise reduction/rejection frequency (Integration time selection)			
	400 Hz (2.5 ms)	60 Hz (16.6 ms)	50 Hz (20 ms)	10 Hz (100 ms)
None (1 cycle): No averaging	4 ms	18 ms	22 ms	100 ms
Weak (4 cycles): 4 samples	9 ms	52 ms	63 ms	320 ms
Medium (16 cycles): 16 samples	32 ms	203 ms	241 ms	1200 ms
Strong (32 cycles): 32 samples	61 ms	400 ms	483 ms	2410 ms
Sample time				
• 4 AI x 13 bits	• 0.625 ms	• 4.17 ms	• 5 ms	• 25 ms
• 8 AI x 13 bits	• 1.25 ms	• 4.17 ms	• 5 ms	• 25 ms
• 4 AI4 x 16 bits	• 0.417 ms	• 0.397 ms	• 0.400 ms	• 0.400 ms

A.7.5 Sample time and update times for the analog inputs

Table A- 133 Sample time and update time

Rejection frequency (Integration time)	Sample time	Module update time for all channels	
		4-channel SM	8-channel SM
400 Hz (2.5 ms)	• 4-channel SM: 0.625 ms • 8-channel SM: 1.250 ms	0.625 ms	1.250 ms
60 Hz (16.6 ms)	4.170 ms	4.17 ms	4.17 ms
50 Hz (20 ms)	5.000 ms	5 ms	5 ms
10 Hz (100 ms)	25.000 ms	25 ms	25 ms

A.7.6 Measurement ranges of the analog inputs for voltage

Table A- 134 Analog input representation for voltage

System		Voltage Measuring Range						
Decimal	**Hexadecimal**	**±10 V**	**±5 V**	**±2.5 V**	**±1.25V**		**0 to 10 V**	
32767	7FFF	11.851 V	5.926 V	2.963 V	1.481 V	Overflow	11.851 V	Overflow
32512	7F00							
32511	7EFF	11.759 V	5.879 V	2.940 V	1.470 V	Overshoot range	11.759 V	Overshoot range
27649	6C01							
27648	6C00	10 V	5 V	2.5 V	1.250 V	Rated range	10 V	Rated range
20736	5100	7.5 V	3.75 V	1.875 V	0.938 V		7.5 V	
1	1	361.7 µV	180.8 µV	90.4 µV	45.2 µV		361.7 µV	
0	0	0 V	0 V	0 V	0 V		0 V	
-1	FFFF						Negative values are not supported	
-20736	AF00	-7.5 V	-3.75 V	-1.875 V	-0.938 V			
-27648	9400	-10 V	-5 V	-2.5 V	-1.250 V			
-27649	93FF					Undershoot range		
-32512	8100	-11.759 V	-5.879 V	-2.940 V	-1.470 V			
-32513	80FF					Underflow		
-32768	8000	-11.851 V	-5.926 V	-2.963 V	-1.481 V			

A.7.7 Measurement ranges of the analog inputs for current

Table A- 135 Analog input representation for current

System		Current measuring range		
Decimal	**Hexidecimal**	**0 mA to 20 mA**	**4 mA to 20 mA**	
32767	7FFF	23.70 mA	22.96 mA	Overflow
32512	7F00			
32511	7EFF	23.52 mA	22.81 mA	Overshoot range
27649	6C01			
27648	6C00	20 mA	20 mA	Nominal range
20736	5100	15 mA	16 mA	
1	1	723.4 nA	4 mA + 578.7 nA	
0	0	0 mA	4 mA	
-1	FFFF			Undershoot range
-4864	ED00	-3.52 mA	1.185 mA	
-4865	ECFF			Underflow
-32768	8000			

A.7.8 Output (AQ) measurement ranges for voltage and current (SB and SM)

Table A- 136 Analog output representation for voltage

System		Voltage Output Range	
Decimal	**Hexadecimal**	**± 10 V**	
32767	7FFF	See note 1	Overflow
32512	7F00	See note 1	
32511	7EFF	11.76 V	Overshoot range
27649	6C01		
27648	6C00	10 V	Rated range
20736	5100	7.5 V	
1	1	361.7 µ V	
0	0	0 V	
-1	FFFF	-361.7 µ V	
-20736	AF00	-7.5 V	
-27648	9400	-10 V	
-27649	93FF		Undershoot range
-32512	8100	-11.76 V	
-32513	80FF	See note 1	Underflow
-32768	8000	See note 1	

1 In an overflow or underflow condition, analog outputs will behave according to the device configuration properties set for the analog signal module. In the "Reaction to CPU STOP" parameter, select either: Use substitute value or Keep last value.

Table A- 137 Analog output representation for current

System		Current Output Range	
Decimal	**Hexadecimal**	**0 mA to 20 mA**	
32767	7FFF	See note 1	Overflow
32512	7F00	See note 1	
32511	7EFF	23.52 mA	Overshoot range
27649	6C01		
27648	6C00	20 mA	Rated range
20736	5100	15 mA	
1	1	723.4 nA	
0	0	0 mA	

1 In an overflow or underflow condition, analog outputs will behave according to the device configuration properties set for the analog signal module. In the "Reaction to CPU STOP" parameter, select either: Use substitute value or Keep last value.

A.8 Thermocouple and RTD signal modules (SMs)

A.8.1 SM 1231 Thermocouple

Table A- 138 General specifications

Model	SM 1231 AI 4 x 16 bit TC	SM 1231 AI 8 x 16 bit TC
Order number	6ES7 231-5QD30-0XB0	6ES7 231-5QF30-0XB0
Dimensions W x H x D (mm)	45 x 100 x 75	45 x 100 x 75
Weight	180 grams	190 grams
Power dissipation	1.5 W	1.5 W
Current consumption (SM Bus)	80 mA	80 mA
Current consumption (24 VDC) [1]	40 mA	40 mA

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

Table A- 139 Analog inputs

Model		SM 1231 AI 4 x 16 bit TC	SM 1231 AI 8 x 16 bit TC
Number of inputs		4	8
Range Nominal range (data word) Overrange/underrange (data word) Overflow/underflow (data word)		See Thermocouple selection table (Page 776).	See Thermocouple selection table (Page 776).
Resolution	Temperature	0.1° C/0.1° F	0.1° C/0.1° F
	Voltage	15 bits plus sign	15 bits plus sign
Maximum withstand voltage		± 35 V	± 35 V
Noise rejection		85 dB for selected filter setting (10 Hz, 50 Hz, 60 Hz or 400 Hz)	85 dB for selected filter setting (10 Hz, 50 Hz, 60 Hz or 400 Hz)
Common mode rejection		> 120 dB at 120 VAC	> 120 dB at 120 VAC
Impedance		≥ 10 MΩ	≥ 10 MΩ
Isolation	Field to logic	500 VAC	500 VAC
	Field to 24 VDC	500 VAC	500 VAC
	24 VDC to logic	500 VAC	500 VAC
Channel to channel		120 VAC	120 VAC
Accuracy		See Thermocouple selection table (Page 776).	See Thermocouple selection table (Page 776).
Repeatability		±0.05% FS	±0.05% FS
Measuring principle		Integrating	Integrating
Module update time		See Noise reduction selection table (Page 776).	See Noise reduction selection table (Page 776).
Cold junction error		±1.5°C	±1.5°C

Model	SM 1231 AI 4 x 16 bit TC	SM 1231 AI 8 x 16 bit TC
Cable length (meters)	100 meters to sensor max.	100 meters to sensor max.
Wire resistance	100 Ω max.	100 Ω max.

Table A- 140 Diagnostics

Model	SM 1231 AI 4 x 16 bit TC	SM 1231 AI 8 x 16 bit TC
Overflow/underflow [1]	Yes	Yes
Wire break (current mode only) [2]	Yes	Yes
24 VDC low voltage [1]	Yes	Yes

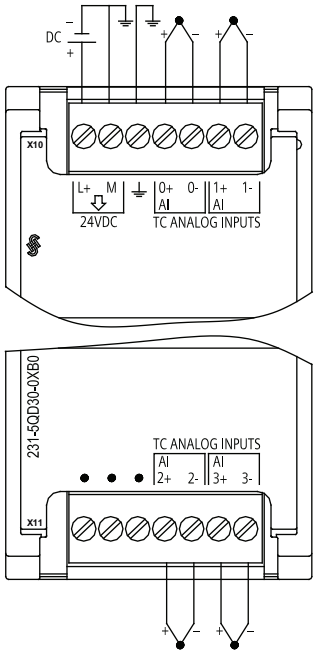
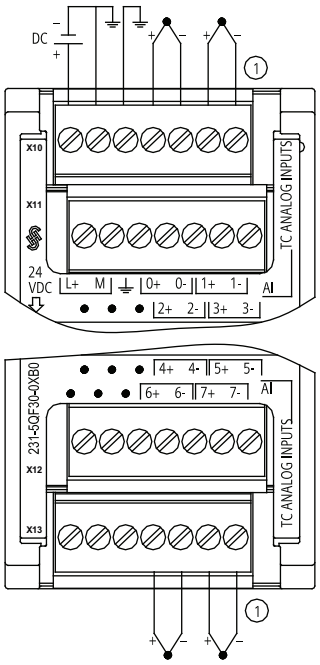
[1] The overflow, underflow and low voltage diagnostic alarm information will be reported in the analog data values even if the alarms are disabled in the module configuration.

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

The SM 1231 Thermocouple (TC) analog signal 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.

Table A- 141 Wiring diagrams for the thermocouple SMs

SM 1231 AI 4 x TC 16 bit (6ES7 231-5QD30-0XB0)	SM 1231 AI 8 x TC bit (6ES7 231-5QF30-0XB0)
	
Note: Connectors must be gold. See Appendix C, Spare Parts for order number.	

① TC 2, 3, 4, and 5 not shown connected for clarity.

Table A- 142 Connector pin locations for SM 1231 AI 4 x TC 16 bit (6ES7 231-5QD30-0XB0)

Pin	X10 (gold)	X11 (gold)
1	L+ / 24VDC	No connection
2	M / 24VDC	No connection
3	GND	No connection
4	AI 0+ /TC	AI 2+ /TC
5	AI 0- /TC	AI 2- /TC
6	AI 1+ /TC	AI 3+ /TC
7	AI 1- /TC	AI 3- /TC

Table A- 143 Connector Pin Locations for SM 1231 AI 8 x TC bit (6ES7 231-5QF30-0XB0)

Pin	X10 (gold)	X11 (gold)	X12 (gold)	X13 (gold)
1	L+ / 24VDC	No connection	No connection	No connection
2	M / 24VDC	No connection	No connection	No connection
3	GND	No connection	No connection	No connection
4	AI 0+ /TC	AI 2+ /TC	AI 4 I- /TC	AI 6 I- /TC
5	AI 0- /TC	AI 2- /TC	AI 4 I+ /TC	AI 6 I+ /TC

Pin	X10 (gold)	X11 (gold)	X12 (gold)	X13 (gold)
6	AI 1+ /TC	AI 3+ /TC	AI 5 M- /TC	AI 7 M- /TC
7	AI 1- /TC	AI 3- /TC	AI 5 M+ /TC	AI 7 M+ /TC

Note

Unused analog inputs should be shorted.

The thermocouple unused channels can be deactivated. No error will occur if an unused channel is deactivated.

A.8.1.1 Basic operation for a thermocouple

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 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.

A.8.1.2 Selection tables for the SM 1231 thermocouple

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

Table A- 144 SM 1231 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	±0.3°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	±1.0°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	1050.0°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 minimum value are reported as 32767.

3 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.

4 In the presence of radiated radio frequency of 970 MHz to 990 MHz, the accuracy of the SM 1231 AI 4 x 16 bit TC may be degraded.

Table A- 145 Noise reduction and update times for the SM 1231 Thermocouple

Rejection frequency selection	Integration time	4 Channel module update time (seconds)	8 Channel module update time (seconds)
400 Hz (2.5 ms)	10 ms [1]	0.143	0.285
60 Hz (16.6 ms)	16.67 ms	0.223	0.445
50 Hz (20 ms)	20 ms	0.263	0.525
10 Hz (100 ms)	100 ms	1.225	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- 146 Representation of analog values of thermocouples type J

Type J in °C	Units		Type J in °F	Units		Range
	Decimal	Hexadecimal		Decimal	Hexadecimal	
> 1450.0	32767	7FFF	> 2642.0	32767	7FFF	Overflow
1450.0 : 1200.1	14500 : 12001	38A4 : 2EE1	2642.0 : 2192.2	26420 : 21922	6734 : 55A2	Overrange
1200.0 : -150.0	12000 : -1500	2EE0 : FA24	2192.0 : -238.0	21920 : -2380	55A0 : F6B4	Rated range
< -150.0	-32768	8000	< -238.0	-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.

A.8.2 SM 1231 RTD

SM 1231 RTD specifications

Table A- 147 General specifications

Technical data	SM 1231 AI 4 x RTD x 16 bit	SM 1231 AI 8 x RTD x 16 bit
Order number	6ES7 231-5PD30-0XB0	6ES7 231-5PF30-0XB0
Dimensions W x H x D (mm)	45 x 100 x 75	70 x 100 x 75
Weight	220 grams	270 grams
Power dissipation	1.5 W	1.5 W
Current consumption (SM Bus)	80 mA	90 mA
Current consumption (24 VDC) [1]	40 mA	40 mA

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

Table A- 148 Analog inputs

Technical data		SM 1231 AI 4 x RTD x 16 bit	SM 1231 AI 8 x RTD x16 bit
Number of inputs		4	8
Type		Module referenced RTD and Ω	Module referenced RTD and Ω
Range Nominal range (data word) Overshoot/undershoot range (data word) Overflow/underflow (data word)		See RTD Sensor selection table (Page 781).	See RTD Sensor selection table (Page 781).
Resolution	Temperature	0.1° C/0.1° F	0.1° C/0.1° F
	Resistance	15 bits plus sign	15 bits plus sign
Maximum withstand voltage		± 35 V	± 35 V
Noise rejection		85 dB for the selected noise reduction (10 Hz, 50 Hz, 60 Hz or 400 Hz)	85 dB for the selected noise reduction (10 Hz, 50 Hz, 60 Hz or 400 Hz)
Common mode rejection		> 120dB	> 120dB
Impedance		≥ 10 MΩ	≥ 10 MΩ
Isolation	Field side to logic	500 VAC	500 VAC
	Field to 24 VDC	500 VAC	500 VAC
	24 VDC to logic	500 VAC	500 VAC
Channel to channel isolation		none	none
Accuracy		See RTD Sensor selection table (Page 781).	See RTD Sensor selection table (Page 781).
Repeatability		±0.05% FS	±0.05% FS
Maximum sensor dissipation		0.5m W	0.5m W
Measuring principle		Integrating	Integrating
Module update time		See Noise reduction selection table (Page 781).	See Noise reduction selection table (Page 781).

Technical data	SM 1231 AI 4 x RTD x 16 bit	SM 1231 AI 8 x RTD x16 bit
Cable length (meters)	100 meters to sensor max.	100 meters to sensor max.
Wire resistance	20 Ω, 2.7 Ω for 10 Ω RTD max.	20 Ω, 2.7 Ω for 10 Ω RTD max.

Table A- 149 Diagnostics

Technical data	SM 1231 AI 4 x RTD x 16 bit	SM 1231 AI 8 x RTD x16 bit
Overflow/underflow [1,2]	Yes	Yes
Wire break [3]	Yes	Yes
24 VDC low voltage [1]	Yes	Yes

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 For resistance ranges underflow detection is never enabled.

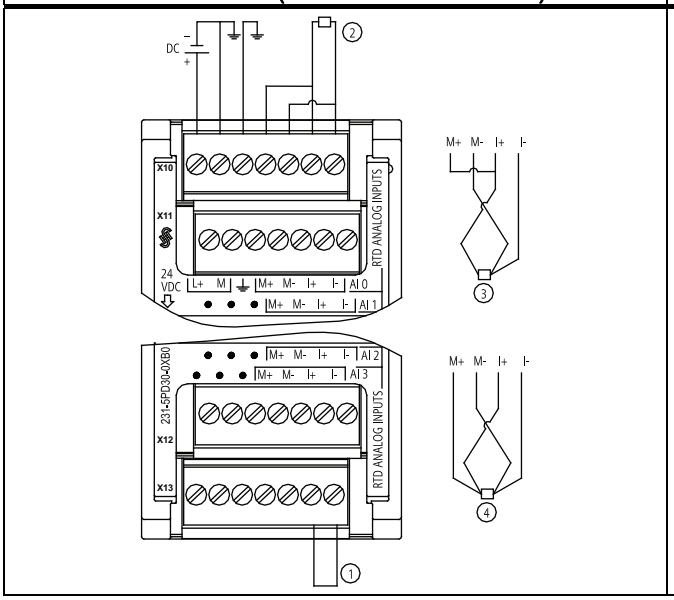
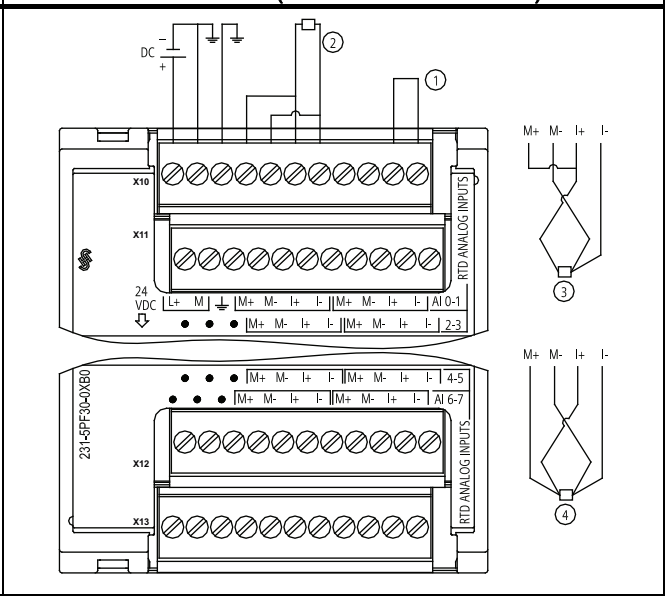
3 When wire break alarm is disabled and an open wire condition exists in the sensor wiring, the module may report random values.

The SM 1231 RTD analog signal module measures the value of resistance connected to the module inputs. The measurement type can be selected as either "Resistor" or "Thermal resistor".

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

The SM 1231 RTD module supports measurements with 2-wire, 3-wire and 4-wire connections to the sensor resistor.

Table A- 150 Wiring diagrams for the RTD SMs

SM 1231 RTD 4 x 16 bit (6ES7 231-5PD30-0XB0)	SM 1231 RTD 8 x 16 bit (6ES7 231-5PF30-0XB0)
	

① Loop-back unused RTD inputs

② 2-wire RTD ③ 3-wire RTD ④ 4-wire RTD

NOTE: Note: Connectors must be gold. See Appendix C, Spare Parts for order number.

Table A- 151 Connector Pin Locations for SM 1231 RTD 4 x 16 bit (6ES7 231-5PD30-0XB0)

Pin	X10 (gold)	X11 (gold)	X12 (gold)	X13 (gold)
1	L+ / 24VDC	No connection	No connection	No connection
2	M / 24VDC	No connection	No connection	No connection
3	GND	No connection	No connection	No connection
4	AI 0 M+ /RTD	AI 1 M+ /RTD	AI 2 M+ /RTD	AI 3 M+ /RTD
5	AI 0 M- /RTD	AI 1 M- /RTD	AI 2 M- /RTD	AI 3 M- /RTD
6	AI 0 I+ /RTD	AI 1 I+ /RTD	AI 2 I+ /RTD	AI 3 I+ /RTD
7	AI 0 I- /RTD	AI 1 I- /RTD	AI 2 I- /RTD	AI 3 I- /RTD

Table A- 152 Connector Pin Locations for SM 1231 RTD 8 x 16 bit (6ES7 231-5PF30-0XB0)

Pin	X10 (gold)	X11 (gold)	X12 (gold)	X13 (gold)
1	L+ / 24VDC	No connection	No connection	No connection
2	M / 24VDC	No connection	No connection	No connection
3	GND	No connection	No connection	No connection
4	AI 0 M+ /RTD	AI 2 M+ /RTD	AI 4 M+ /RTD	AI 6 M+ /RTD
5	AI 0 M- /RTD	AI 2 M- /RTD	AI 4 M- /RTD	AI 6 M- /RTD
6	AI 0 I+ /RTD	AI 2 I+ /RTD	AI 4 I+ /RTD	AI 6 I+ /RTD

Pin	X10 (gold)	X11 (gold)	X12 (gold)	X13 (gold)
7	AI 0 I- /RTD	AI 2 I- /RTD	AI 4 I- /RTD	AI 6 I- /RTD
8	AI 1 M+ /RTD	AI 3 M+ /RTD	AI 5 M+ /RTD	A7 M+ /RTD
9	AI 1 M- /RTD	AI 3 M- /RTD	AI 5 M- /RTD	AI 7 M- /RTD
10	AI 1 I+ /RTD	AI 3 I+ /RTD	AI 5 I+ /RTD	AI 7 I+ /RTD
11	AI 1 I- /RTD	AI 3 I- /RTD	AI 5 I- /RTD	AI 7 I- /RTD

Note

The RTD unused channels can be deactivated. No error will occur if an unused channel is deactivated.

The RTD module needs to have the current loop continuous to eliminate extra stabilization time which is automatically added to an unused channel that is not deactivated. For consistency the RTD module should have a resistor connected (like the 2-wire RTD connection).

A.8.2.1 Selection tables for the SM 1231 RTD

Table A- 153 Ranges and accuracy for the different sensors supported by the RTD modules

Temperature coefficient	RTD type	Under range minimum[1]	Nominal range low limit	Nominal range high limit	Over range maximum[2]	Normal range accuracy @ 25°C	Normal range accuracy -20°C to 60°C
Pt 0.003850 ITS90 DIN EN 60751	Pt 10	-243.0°C	-200.0°C	850.0°C	1000.0°C	±1.0°C	±2.0°C
	Pt 50	-243.0°C	-200.0°C	850.0°C	1000.0°C	±0.5°C	±1.0°C
	Pt 100						
	Pt 200						
	Pt 500						
	Pt 1000						
Pt 0.003902 Pt 0.003916 Pt 0.003920	Pt 100	-243.0°C	-200.0°C	850.0°C	1000.0°C	± 0.5°C	±1.0°C
	Pt 200	-243.0°C	-200.0°C	850.0°C	1000.0°C	± 0.5°C	±1.0°C
	Pt 500						
	Pt 1000						
Pt 0.003910	Pt 10	-273.2°C	-240.0°C	1100.0°C	1295°C	±1.0°C	±2.0°C
	Pt 50	-273.2°C	-240.0°C	1100.0°C	1295°C	±0.8°C	±1.6°C
	Pt 100						
	Pt 500						
Ni 0.006720 Ni 0.006180	Ni 100	-105.0°C	-60.0°C	250.0°C	295.0°C	±0.5°C	±1.0°C
	Ni 120						
	Ni 200						
	Ni 500						

Temperature coefficient	RTD type	Under range minimum[1]	Nominal range low limit	Nominal range high limit	Over range maximum[2]	Normal range accuracy @ 25°C	Normal range accuracy -20°C to 60°C
	Ni 1000						
LG-Ni 0.005000	LG-Ni 1000	-105.0°C	-60.0°C	250.0°C	295.0°C	±0.5°C	±1.0°C
Ni 0.006170	Ni 100	-105.0°C	-60.0°C	180.0°C	212.4°C	±0.5°C	±1.0°C
Cu 0.004270	Cu 10	-240.0°C	-200.0°C	260.0°C	312.0°C	±1.0°C	±2.0°C
Cu 0.004260	Cu 10	-60.0°C	-50.0°C	200.0°C	240.0°C	±1.0°C	±2.0°C
	Cu 50	-60.0°C	-50.0°C	200.0°C	240.0°C	±0.6°C	±1.2°C
	Cu 100						
Cu 0.004280	Cu 10	-240.0°C	-200.0°C	200.0°C	240.0°C	±1.0°C	±2.0°C
	Cu 50	-240.0°C	-200.0°C	200.0°C	240.0°C	±0.7°C	±1.4°C
	Cu 100						

1 RTD values below the under-range minimum value report -32768.

2 RTD values above the over-range maximum value report +32767.

Table A- 154 Resistance

Range	Under range minimum	Nominal range low limit	Nominal range high limit	Over range maximum[1]	Normal range accuracy @ 25°C	Normal range accuracy -20°C to 60°C
150 Ω	n/a	0 (0 Ω)	27648 (150 Ω)	176.383 Ω	±0.05%	±0.1%
300 Ω	n/a	0 (0 Ω)	27648 (300 Ω)	352.767 Ω	±0.05%	±0.1%
600 Ω	n/a	0 (0 Ω)	27648 (600 Ω)	705.534 Ω	±0.05%	±0.1%

1 Resistance values above the over-range minimum value are reported as +32767.

Note

The module reports 32767 on any activated channel with no sensor connected. If open wire detection is also enabled, the module flashes the appropriate red LEDs.

When 500 Ω and 1000 Ω RTD ranges are used with other lower value resistors, the error may increase to two times the specified error.

Best accuracy will be achieved for the 10 Ω RTD ranges if 4 wire connections are used.

The resistance of the connection wires in 2 wire mode will cause an error in the sensor reading and therefore accuracy is not guaranteed.

Table A- 155 Noise reduction and update times for the RTD modules

Rejection frequency selection	Integration time	Update time (seconds)	
		4-channel module	8-channel module
400 Hz (2.5 ms)	10 ms [1]	4-/2-wire: 0.142 3-wire: 0.285	4-/2-wire: 0.285 3-wire: 0.525
60 Hz (16.6 ms)	16.67 ms	4-/2-wire: 0.222 3-wire: 0.445	4-/2-wire: 0.445 3-wire: 0.845
50 Hz (20 ms)	20 ms	4-/2-wire: 0.262 3-wire: .505	4-/2-wire: 0.524 3-wire: 1.015
10 Hz (100 ms)	100 ms	4-/2-wire: 1.222 3-wire: 2.445	4-/2-wire: 2.425 3-wire: 4.845

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

NOTICE

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 or 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 RTDs

A representation of the digitized measured value for the RTD standard temperature range sensors are shown in the tables below.

Table A- 156 Representation of analog values for resistance thermometers PT 100, 200, 500, 1000 and PT 10, 50, 100, 500 GOST (0.003850) standard

Pt x00 standard in °C (1 digit = 0.1° C)	Units		Pt x00 standard in °F (1 digit = 0.1 F)	Units		Range
	Decimal	Hexadecimal		Decimal	Hexadecimal	
> 1000.0	32767	7FFF	> 1832.0	32767	7FFF	Overflow
1000.0 : 850.1	10000 : 8501	2710 : 2135	1832.0 : 1562.1	18320 : 15621	4790 : 3D05	Overrange
850.0 : -200.0	8500 : -2000	2134 : F830	1562.0 : -328.0	15620 : -3280	3D04 : F330	Rated range

Pt x00 standard in °C (1 digit = 0.1° C)	Units		Pt x00 standard in °F (1 digit = 0.1 F)	Units		Range
	Decimal	Hexadecimal		Decimal	Hexadecimal	
-200.1 : -243.0	-2001 : -2430	F82F : F682	-328.1 : -405.4	-3281 : -4054	F32F : F02A	Underrange
< -243.0	-32768	8000	< -405.4	-32768	8000	Underflow

A.9 Digital signal boards (SBs)

A.9.1 SB 1221 200 kHz digital input specifications

Table A- 157 General specifications

Technical data	SB 1221 DI 4 x 24 VDC, 200 kHz	SB 1221 DI 4 x 5 VDC, 200 kHz
Order number	6ES7 221-3BD30-0XB0	6ES7 221-3AD30-0XB0
Dimensions W x H x D (mm)	38 x 62 x 21	38 x 62 x 21
Weight	35 grams	35 grams
Power dissipation	1.5 W	1.0 W
Current consumption (SM Bus)	40 mA	40 mA
Current consumption (24 VDC)	7 mA / input + 20 mA	15 mA / input + 15 mA

Table A- 158 Digital inputs

Technical data	SB 1221 DI 4 x 24 VDC, 200 kHz	SB 1221 DI 4 x 5 VDC, 200 kHz
Number of inputs	4	4
Type	Source	Source
Rated voltage	24 VDC at 7 mA, nominal	5 VDC at 15 mA, nominal
Continuous permissible voltage	28.8 VDC	6 VDC
Surge voltage	35 VDC for 0.5 sec.	6 V
Logic 1 signal (min.)	L+ minus 10 VDC at 2.9 mA	L+ minus 2.0 VDC at 5.1 mA
Logic 0 signal (max.)	L+ minus 5 VDC at 1.4 mA	L+ minus 1.0 VDC at 2.2 mA
HSC clock input rates (max.)	Single phase: 200 kHz Quadrature phase: 160 kHz	Single phase: 200 kHz Quadrature phase: 160 kHz
Isolation (field side to logic)	500 VAC for 1 minute	500 VAC for 1 minute
Isolation groups	1	1
Filter times	0.2, 0.4, 0.8, 1.6, 3.2, 6.4, and 12.8 ms; Selectable in groups of 4	0.2, 0.4, 0.8, 1.6, 3.2, 6.4, and 12.8 ms; Selectable in groups of 4

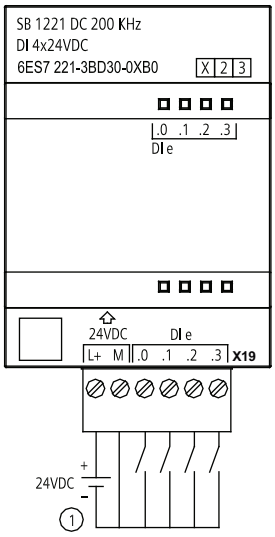
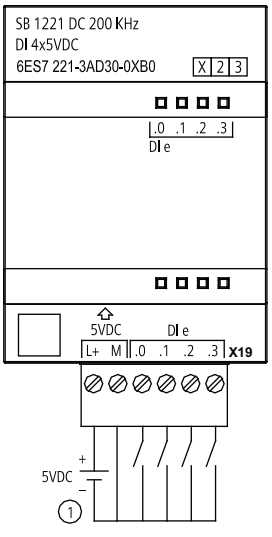
Technical data	SB 1221 DI 4 x 24 VDC, 200 kHz	SB 1221 DI 4 x 5 VDC, 200 kHz
Number of inputs on simultaneously	• 2 (no adjacent points) at 60° C horizontal or 50° C vertical • 4 at 55° C horizontal or 45° C vertical	4
Cable length (meters)	50 shielded twisted pair	50 shielded twisted pair

NOTICE

When switching frequencies above 20 kHz, it is important that the digital inputs receive a square wave. Consider the following options to improve the signal quality to the inputs:

- Minimize the cable length
- Change a driver from a sink only driver to a sinking and sourcing driver
- Change to a higher quality cable
- Reduce the circuit/components from 24 V to 5 V
- Add an external load at the input

Table A- 159 Wiring diagrams for the 200 kHz digital input SBs

SB 1221 DI 4 x 24 VDC, 200 kHz (6ES7 221-3BD30-0XB0)	SB 1221 DI 4 x 5 VDC, 200 kHz (6ES7 221-3AD30-0XB0)
	

① Supports sourcing inputs only

Table A- 160 Connector pin locations for SB 1221 DI 4 x 24 VDC, 200 kHz (6ES7 221-3BD30-0XB0)

Pin	X19
1	L+ / 24VDC
2	M / 24VDC
3	DI e.0
4	DI e.1
5	DI e.2
6	DI e.3

Table A- 161 Connector pin locations for SB 1221 DI 4 x 5 VDC, 200 kHz (6ES7 221-3AD30-0XB0)

Pin	X19
1	L+ / 5VDC
2	M / 5VDC
3	DI e.0
4	DI e.1
5	DI e.2
6	DI e.3

A.9.2 SB 1222 200 kHz digital output specifications

Table A- 162 General specifications

Technical data	SB 1222 DQ 4 x 24 VDC, 200 kHz	SB 1222 DQ 4 x 5 VDC, 200 kHz
Order number	6ES7 222-1BD30-0XB0	6ES7 222-1AD30-0XB0
Dimensions W x H x D (mm)	38 x 62 x 21	38 x 62 x 21
Weight	35 grams	35 grams
Power dissipation	0.5 W	0.5 W
Current consumption (SM Bus)	35 mA	35 mA
Current consumption (24 VDC)	15 mA	15 mA

Table A- 163 Digital outputs

Technical data	SB 1222 DQ 4 x 24 VDC, 200 kHz	SB 1222 DQ 4 x 5 VDC, 200 kHz
Number of outputs	4	4
Output type	Solid state - MOSFET sink and source[1]	Solid state - MOSFET sink and source[1]
Voltage range	20.4 to 28.8 VDC	4.25 to 6.0 VDC
Logic 1 signal at max. current	L+ minus 1.5 V	L+ minus 0.7 V
Logic 0 signal at max. current	1.0 VDC, max.	0.2 VDC, max.
Current (max.)	0.1 A	0.1 A

Technical data	SB 1222 DQ 4 x 24 VDC, 200 kHz	SB 1222 DQ 4 x 5 VDC, 200 kHz
Lamp load	--	--
On state contact resistance	11 Ω max.	7 Ω max.
Off state resistance	6 Ω max.	0.2 Ω max.
Leakage current per point	--	--
Pulse Train Output rate	200 kHz max., 2 Hz min.	200 kHz max., 2 Hz min.
Surge current	0.11 A	0.11 A
Overload protection	No	No
Isolation (field side to logic)	500 VAC for 1 minute	500 VAC for 1 minute
Isolation groups	1	1
Currents per common	0.4 A	0.4 A
Inductive clamp voltage	None	None
Switching delay	1.5 µs + 300 ns rise 1.5 µs + 300 ns fall	200 ns + 300 ns rise 200 ns + 300 ns fall
Behavior on RUN to STOP	Last value or substitute value (default value 0)	Last value or substitute value (default value 0)
Number of outputs on simultaneously	• 2 (no adjacent points) at 60° C horizontal or 50° C vertical • 4 at 55° C horizontal or 45° C vertical	4
Cable length (meters)	50 shielded twisted pair	50 shielded twisted pair

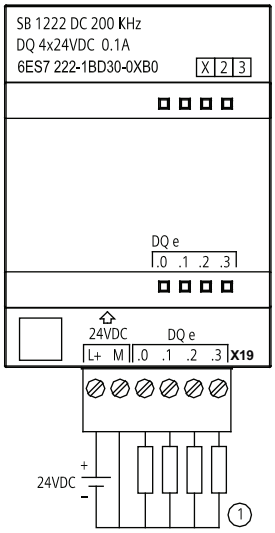
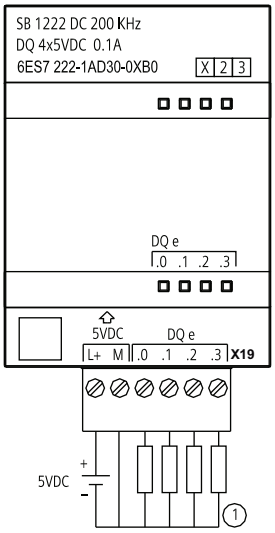
[1] Because both sinking and sourcing configurations are supported by the same circuitry, the active state of a sourcing load is opposite that of a sinking load. A source output exhibits positive logic (Q bit and LED are ON when the load has current flow), while a sink output exhibits negative logic (Q bit and LED are OFF when the load has current flow). If the module is plugged in with no user program, the default for this module is 0 V, which means that a sinking load will be turned ON.

NOTICE

When switching frequencies above 20 kHz, it is important that the digital inputs receive a square wave. Consider the following options to improve the signal quality to the inputs:

- Minimize the cable length
- Change a driver from a sink only driver to a sinking and sourcing driver
- Change to a higher quality cable
- Reduce the circuit/components from 24 V to 5 V
- Add an external load at the input

Table A- 164 Wiring diagrams for the 200 kHz digital output SBs

SB 1222 DQ 4 x 24 VDC, 200 kHz (6ES7 222-1BD30-0XB0)	SB 1222 DQ 4 x 5 VDC, 200 kHz (6ES7 222-1AD30-0XB0)
	

① For sourcing outputs, connect "Load" to "-" (shown). For sinking outputs, connect "Load" to "+". Because both sinking and sourcing configurations are supported by the same circuitry, the active state of a sourcing load is opposite that of a sinking load. A source output exhibits positive logic (Q bit and LED are ON when the load has current flow), while a sink output exhibits negative logic (Q bit and LED are OFF when the load has current flow). If the module is plugged in with no user program, the default for this module is 0 V, which means that a sinking load will be turned ON.

Table A- 165 Connector pin locations for SB 1222 DQ 4 x 24 VDC, 200 kHz (6ES7 222-1BD30-0XB0)

Pin	X19
1	L+ / 24VDC
2	M / 24VDC
3	DQ e.0
4	DQ e.1
5	DQ e.2
6	DQ e.3

Table A- 166 Connector pin locations for SB 1222 DQ 4 x 5 VDC, 200 kHz (6ES7 222-1AD30-0XB0)

Pin	X19
1	L+ / 5VDC
2	M / 5VDC
3	DQ e.0
4	DQ e.1
5	DQ e.2
6	DQ e.3

A.9.3 SB 1223 200 kHz digital input / output specifications

Table A- 167 General specifications

Technical data	SB 1223 DI 2 x 24 VDC / DQ 2 x 24 VDC, 200 kHz	SB 1223 DI 2 x 5 VDC / DQ 2 x 5 VDC, 200 kHz
Order number	6ES7 223-3BD30-0XB0	6ES7 223-3AD30-0XB0
Dimensions W x H x D (mm)	38 x 62 x 21	38 x 62 x 21
Weight	35 grams	35 grams
Power dissipation	1.0 W	0.5 W
Current consumption (SM Bus)	35 mA	35 mA
Current consumption (24 VDC)	7 mA / Input + 30 mA	15 mA / input + 15 mA

Table A- 168 Digital inputs

Technical data	SB 1223 DI 2 x 24 VDC / DQ 2 x 24 VDC, 200 kHz	SB 1223 DI 2 x 5 VDC / DQ 2 x 5 VDC, 200 kHz
Number of inputs	2	2
Type	Source	Source
Rated voltage	24 VDC at 7 mA, nominal	5 VDC at 15 mA, nominal
Continuous permissible voltage	28.8 VDC	6 VDC
Surge voltage	35 VDC for 0.5 sec.	6 V
Logic 1 signal (min.)	L+ minus 10 VDC at 2.9 mA	L+ minus 2.0 VDC at 5.1 mA
Logic 0 signal (max.)	L+ minus 5 VDC at 1.4 mA	L+ minus 1.0 VDC at 2.2 mA
HSC clock input rates (max.)	Single phase: 200 kHz Quadrature phase: 160 kHz	Single phase: 200 kHz Quadrature phase: 160 kHz
Isolation (field side to logic)	500 VAC for 1 minute	500 VAC for 1 minute
Isolation groups	1 (no isolation to outputs)	1 (no isolation to outputs)
Filter times	0.2, 0.4, 0.8, 1.6, 3.2, 6.4, and 12.8 ms; Selectable in groups of 4	0.2, 0.4, 0.8, 1.6, 3.2, 6.4, and 12.8 ms; Selectable in groups of 4
Number of inputs on simultaneously	2	2
Cable length (meters)	50 shielded twisted pair	50 shielded twisted pair

Table A- 169 Digital outputs

Technical data	SB 1223 DI 2 x 24 VDC / DQ 2 x 24 VDC, 200 kHz	SB 1223 DI 2 x 5 VDC / DQ 2 x 5 VDC, 200 kHz
Number of outputs	2	2
Output type	Solid state - MOSFET sink and source[1]	Solid state - MOSFET sink and source[1]
Voltage range	20.4 to 28.8 VDC	4.25 to 6.0 VDC
Rated value	24 VDC	5 VDC
Logic 1 signal at max. current	L+ minus 1.5 V	L+ minus 0.7 V
Logic 0 signal at max. current	1.0 VDC, max.	0.2 VDC, max.

Technical data	SB 1223 DI 2 x 24 VDC / DQ 2 x 24 VDC, 200 kHz	SB 1223 DI 2 x 5 VDC / DQ 2 x 5 VDC, 200 kHz
Current (max.)	0.1 A	0.1 A
Lamp load	--	--
On state contact resistance	11 Ω max.	7 Ω max.
Off state resistance	6 Ω max.	0.2 Ω max.
Leakage current per point	--	--
Pulse Train Output rate	200 kHz max., 2 Hz min.	200 kHz max., 2 Hz min.
Surge current	0.11 A	0.11 A
Overload protection	No	No
Isolation (field side to logic)	500 VAC for 1 minute	500 VAC for 1 minute
Isolation groups	1 (no isolation to inputs)	1 (no isolation to inputs)
Currents per common	0.2 A	0.2 A
Inductive clamp voltage	None	None
Switching delay	1.5 µs + 300 ns rise 1.5 µs + 300 ns fall	200 ns + 300 ns rise 200 ns + 300 ns fall
Behavior on RUN to STOP	Last value or substitute (default value 0)	Last value or substitute (default value 0)
Number of outputs on simultaneously	2	2
Cable length (meters)	50 shielded twisted pair	50 shielded twisted pair

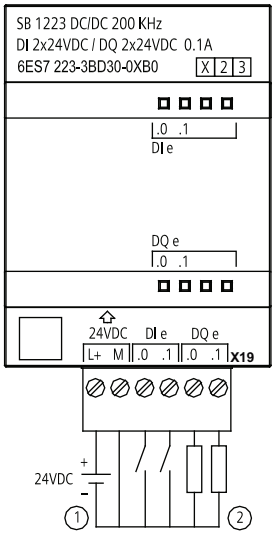
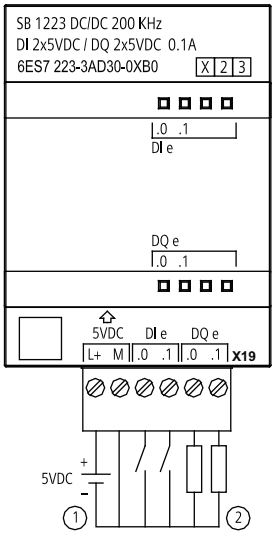
[1] Because both sinking and sourcing configurations are supported by the same circuitry, the active state of a sourcing load is opposite that of a sinking load. A source output exhibits positive logic (Q bit and LED are ON when the load has current flow), while a sink output exhibits negative logic (Q bit and LED are OFF when the load has current flow). If the module is plugged in with no user program, the default for this module is 0 V, which means that a sinking load will be turned ON.

NOTICE

When switching frequencies above 20 kHz, it is important that the digital inputs receive a square wave. Consider the following options to improve the signal quality to the inputs:

- Minimize the cable length
- Change a driver from a sink only driver to a sinking and sourcing driver
- Change to a higher quality cable
- Reduce the circuit/components from 24 V to 5 V
- Add an external load at the input

Table A- 170 Wiring diagrams for the 200 kHz digital input/output SBs

SB 1223 DI 2 x 24 VDC/DQ 2 x 24 VDC, 200 kHz (6ES7 223-3BD30-0XB0)	SB 1223 DI 2 x 5 VDC / DQ 2 x 5 VDC, 200 kHz (6ES7 223-3AD30-0XB0)
	

① Supports sourcing inputs only

② For sourcing outputs, connect "Load" to "-" (shown). For sinking outputs, connect "Load" to "+". [1] Because both sinking and sourcing configurations are supported by the same circuitry, the active state of a sourcing load is opposite that of a sinking load. A source output exhibits positive logic (Q bit and LED are ON when the load has current flow), while a sink output exhibits negative logic (Q bit and LED are OFF when the load has current flow). If the module is plugged in with no user program, the default for this module is 0 V, which means that a sinking load will be turned ON.

Table A- 171 Connector pin locations for SB 1223 DI 2 x 24 VDC/DQ 2 x 24 VDC, 200 kHz (6ES7 223-3BD30-0XB0)

Pin	X19
1	L+ / 24VDC
2	M / 24VDC
3	DI e.0
4	DI e.1
5	DQ e.0
6	DQ e.1

Table A- 172 Connector pin locations for SB 1223 DI 2 x 5 VDC / DQ 2 x 5 VDC, 200 kHz (6ES7 223-3AD30-0XB0)

Pin	X19
1	L+ / 5VDC
2	M / 5VDC
3	DI e.0
4	DI e.1

Pin	X19
5	DQ e.0
6	DQ e.1

A.9.4 SB 1223 2 X 24 VDC input / 2 X 24 VDC output specifications

Table A- 173 General specifications

Technical Data	SB 1223 DI 2 x 24 VDC, DQ 2 x 24 VDC
Order number	6ES7 223-0BD30-0XB0
Dimensions W x H x D (mm)	38 x 62 x 21
Weight	40 grams
Power dissipation	1.0 W
Current consumption (SM Bus)	50 mA
Current consumption (24 VDC)	4 mA / Input used

Table A- 174 Digital inputs

Technical Data	SB 1223 DI 2 x 24 VDC, DQ 2 x 24 VDC
Number of inputs	2
Type	IEC Type 1 sink
Rated voltage	24 VDC at 4 mA, nominal
Continuous permissible voltage	30 VDC, max.
Surge voltage	35 VDC for 0.5 sec.
Logic 1 signal (min.)	15 VDC at 2.5 mA
Logic 0 signal (max.)	5 VDC at 1 mA
HSC clock input rates (max.)	20 kHz (15 to 30 VDC) 30 kHz (15 to 26 VDC)
Isolation (field side to logic)	500 VAC for 1 minute
Isolation groups	1
Filter times	0.2, 0.4, 0.8, 1.6, 3.2, 6.4, and 12.8 ms Selectable in groups of 2
Number of inputs on simultaneously	2
Cable length (meters)	500 shielded, 300 unshielded

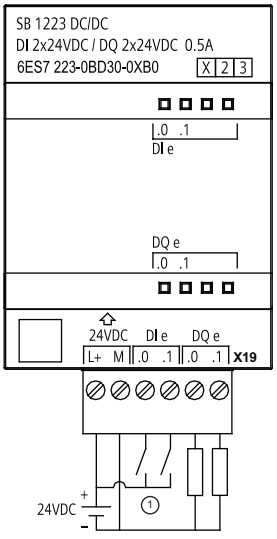
Table A- 175 Digital outputs

Technical Data	SB 1223 DI 2 x 24 VDC, DQ 2 x 24 VDC
Number of outputs	2
Output type	Solid state - MOSFET (sourcing)

Technical Data	SB 1223 DI 2 x 24 VDC, DQ 2 x 24 VDC
Voltage range	20.4 to 28.8 VDC
Logic 1 signal at max. current	20 VDC min.
Logic 0 signal with 10K Ω load	0.1 VDC max.
Current (max.)	0.5 A
Lamp load	5 W
On state contact resistance	0.6 Ω max.
Leakage current per point	10 µA max.
Pulse Train Output (PTO) rate	20 KHz max., 2 Hz min. [1]
Surge current	5 A for 100 ms max.
Overload protection	No
Isolation (field side to logic)	500 VAC for 1 minute
Isolation groups	1
Currents per common	1 A
Inductive clamp voltage	L+ minus 48 V, 1 W dissipation
Switching delay	2 µs max. off to on 10 µs max. on to off
Behavior on RUN to STOP	Last value or substitute value (default value 0)
Number of outputs on simultaneously	2
Cable length (meters)	500 m shielded, 150 m unshielded

[1] Depending on your pulse receiver and cable, an additional load resistor (at least 10% of rated current) may improve pulse signal quality and noise immunity.

Table A- 176 Wiring diagram for the digital input/output SB

SB 1223 DI 2 x 24 VDC, DQ 2 x 24 VDC (6ES7 223-0BD30-0XB0)


① Supports sinking inputs only

Table A- 177 Connector pin locations for SB 1223 DI 2 x 24 VDC, DQ 2 x 24 VDC (6ES7 223-0BD30-0XB0)

Pin	X19
1	L+ / 24VDC
2	M / 24VDC
3	DI e.0
4	DI e.1
5	DQ e.0
6	DQ e.1

A.10 Analog signal boards (SBs)

A.10.1 SB 1231 1 analog input specifications

Note

To use this SB, your CPU firmware must be V2.0 or higher.

Table A- 178 General specifications

Technical data	SB 1231 AI 1 x 12 bit
Order number	6ES7 231-4HA30-0XB0
Dimensions W x H x D (mm)	38 x 62 x 21
Weight	35 grams
Power dissipation	0.4 W
Current consumption (SM Bus)	55 mA
Current consumption (24 VDC)	none

Table A- 179 Analog inputs

Technical data	SB 1231 AI 1x12 bit
Number of inputs	1
Type	Voltage or current (differential)
Range	±10V, ±5V, ±2.5 or 0 to 20 mA
Resolution	11 bits + sign bit
Full scale range (data word)	-27,648 to 27,648

Technical data	SB 1231 AI 1x12 bit
Over/Under range (data word)	Voltage: 32,511 to 27,649 / -27,649 to -32,512 Current: 32,511 to 27,649 / 0 to -4,864 (Refer to Analog input representation for voltage and Analog input representation for current.)
Overflow/Underflow (data word)	Voltage: 32,767 to 32,512 / -32,513 to -32,768 Current: 32,767 to 32,512 / -4,865 to -32,768 (Refer to Analog input representation for voltage and Analog input representation for current.)
Maximum withstand voltage / current	±35V / ±40 mA
Smoothing	None, weak, medium, or strong (refer to Analog input response times for step response time.)
Noise rejection	400, 60, 50, or 10 Hz (refer to Analog input response times for sample rates.)
Accuracy (25°C / -20 to 60°C)	±0.3% / ±0.6% of full scale
Input impedance Differential Common mode	 Voltage: 220 kΩ; Current: 250 Ω Voltage: 55 kΩ; Current: 55 kΩ
Behavior on RUN to STOP	Last value or substitute value (default value 0)
Measuring principle	Actual value conversion
Common mode rejection	400 dB, DC to 60 Hz
Operational signal range	Signal plus common mode voltage must be less than +35 V and greater than -35 V
Isolation (field side to logic)	None
Cable length (meters)	100 m, twisted and shielded

Table A- 180 Diagnostics

Technical data	SB 1231 AI 1 x 12 bit
Overflow/underflow	Yes
24 VDC low voltage	no

Table A- 181 Wiring diagram for the analog input SB

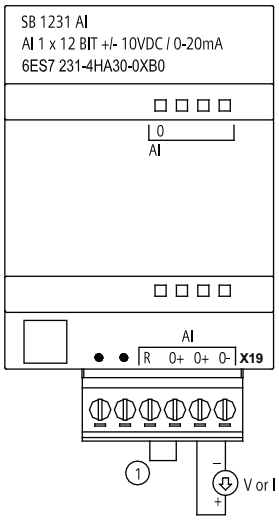
SB 1231 AI x 12 bit (6ES7 231-4HA30-0XB0)

① Connect "R" and "0+" for current
Note: Connectors must be gold. See Appendix C, Spare Parts for order number.

Table A- 182 Connector pin locations for SB 1231 AI x 12 bit (6ES7 231-4HA30-0XB0)

Pin	X19 (gold)
1	No connection
2	No connection
3	AI R
4	AI 0+
5	AI 0+
6	AI 0-

A.10.2 SB 1232 1 analog output specifications

Table A- 183 General specifications

Technical data	SB 1232 AQ 1 x 12 bit
Order number	6ES7 232-4HA30-0XB0
Dimensions W x H x D (mm)	38 x 62 x 21
Weight	40 grams
Power dissipation	1.5 W
Current consumption (SM Bus)	15 mA
Current consumption (24 VDC)	40 mA (no load)

Table A- 184 Analog outputs

Technical data	SB 1232 AQ 1 x 12 bit
Number of outputs	1
Type	Voltage or current
Range	±10 V or 0 to 20 mA
Resolution	Voltage: 12 bits Current: 11 bits
Full scale range (data word) Refer to the output ranges for voltage and current (Page 800).	Voltage: -27,648 to 27,648 Current: 0 to 27,648
Accuracy (25°C / -20 to 60°C)	±0.5% / ±1% of full scale
Settling time (95% of new value)	Voltage: 300 µS (R), 750 µS (1 uF) Current: 600 µS (1 mH), 2 ms (10 mH)
Load impedance	Voltage: ≥ 1000 Ω Current: ≤ 600 Ω
Behavior on RUN to STOP	Last value or substitute value (default value 0)
Isolation (field side to logic)	None
Cable length (meters)	100 m, twisted and shielded

Table A- 185 Diagnostics

Technical data	SB 1232 AQ 1 x 12 bit
Overflow/underflow	Yes
Short to ground (voltage mode only)	Yes
Wire break (current mode only)	Yes

Table A- 186 Wiring diagram for the SB 1232 AQ 1 x 12 bit

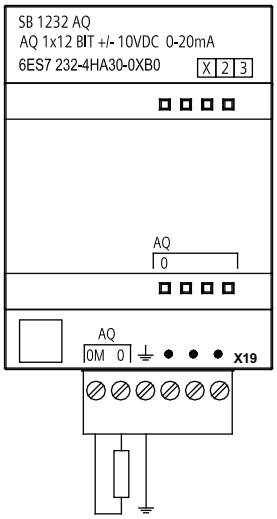
SB 1232 AQ 1 x 12 bit (6ES7 232-4HA30-0XB0)	
	
Note: Connectors must be gold. See Appendix C, Spare Parts for order number.	

Table A- 187 Connector pin locations for SB 1232 AQ 1 x 12 bit (6ES7 232-4HA30-0XB0)

Pin	X19 (gold)
1	AQ 0M
2	AQ 0
3	GND
4	No connection
5	No connection
6	No connection

A.10.3 Measurement ranges for analog inputs and outputs

A.10.3.1 Step response of the analog inputs

Table A- 188 Step response (ms), 0V to 10V measured at 95%

Smoothing selection (sample averaging)	Integration time selection			
	400 Hz (2.5 ms)	60 Hz (16.6 ms)	50 Hz (20 ms)	10 Hz (100 ms)
None (1 cycle): No averaging	4.5 ms	18.7 ms	22.0 ms	102 ms
Weak (4 cycles): 4 samples	10.6 ms	59.3 ms	70.8 ms	346 ms

Smoothing selection (sample averaging)	Integration time selection			
	400 Hz (2.5 ms)	60 Hz (16.6 ms)	50 Hz (20 ms)	10 Hz (100 ms)
Medium (16 cycles): 16 samples	33.0 ms	208 ms	250 ms	1240 ms
Strong (32 cycles): 32 samples	63.0 ms	408 ms	490 ms	2440 ms
Sample time	**0.156 ms**	**1.042 ms**	**1.250 ms**	**6.250 ms**

A.10.3.2 Sample time and update times for the analog inputs

Table A- 189 Sample time and update time

Selection	Sample time	SB update time
400 Hz (2.5 ms)	0.156 ms	0.156 ms
60 Hz (16.6 ms)	1.042 ms	1.042 ms
50 Hz (20 ms)	1.250 ms	1.25 ms
10 Hz (100 ms)	6.250 ms	6.25 ms

A.10.3.3 Measurement ranges of the analog inputs for voltage

Table A- 190 Analog input representation for voltage

System		Voltage Measuring Range						
Decimal	Hexadecimal	±10 V	±5 V	±2.5 V	±1.25V		0 to 10 V	
32767	7FFF	11.851 V	5.926 V	2.963 V	1.481 V	Overflow	11.851 V	Overflow
32512	7F00							
32511	7EFF	11.759 V	5.879 V	2.940 V	1.470 V	Overshoot range	11.759 V	Overshoot range
27649	6C01							
27648	6C00	10 V	5 V	2.5 V	1.250 V	Rated range	10 V	Rated range
20736	5100	7.5 V	3.75 V	1.875 V	0.938 V		7.5 V	
1	1	361.7 µV	180.8 µV	90.4 µV	45.2 µV		361.7 µV	
0	0	0 V	0 V	0 V	0 V		0 V	
-1	FFFF						Negative values are not supported	
-20736	AF00	-7.5 V	-3.75 V	-1.875 V	-0.938 V			
-27648	9400	-10 V	-5 V	-2.5 V	-1.250 V			
-27649	93FF					Undershoot range		
-32512	8100	-11.759 V	-5.879 V	-2.940 V	-1.470 V			
-32513	80FF					Underflow		
-32768	8000	-11.851 V	-5.926 V	-2.963 V	-1.481 V			

A.10.3.4 Measurement ranges of the analog inputs for current

Table A- 191 Analog input representation for current

System		Current measuring range		
Decimal	**Hexidecimal**	**0 mA to 20 mA**	**4 mA to 20 mA**	
32767	7FFF	23.70 mA	22.96 mA	Overflow
32512	7F00			
32511	7EFF	23.52 mA	22.81 mA	Overshoot range
27649	6C01			
27648	6C00	20 mA	20 mA	Nominal range
20736	5100	15 mA	16 mA	
1	1	723.4 nA	4 mA + 578.7 nA	
0	0	0 mA	4 mA	
-1	FFFF			Undershoot range
-4864	ED00	-3.52 mA	1.185 mA	
-4865	ECFF			Underflow
-32768	8000			

A.10.3.5 Output (AQ) measurement ranges for voltage and current (SB and SM)

Table A- 192 Analog output representation for voltage

System		Voltage Output Range	
Decimal	**Hexadecimal**	**± 10 V**	
32767	7FFF	See note 1	Overflow
32512	7F00	See note 1	
32511	7EFF	11.76 V	Overshoot range
27649	6C01		
27648	6C00	10 V	Rated range
20736	5100	7.5 V	
1	1	361.7 µ V	
0	0	0 V	
-1	FFFF	-361.7 µ V	
-20736	AF00	-7.5 V	
-27648	9400	-10 V	

System		Voltage Output Range	
Decimal	Hexadecimal	± 10 V	
-27649	93FF		Undershoot range
-32512	8100	-11.76 V	
-32513	80FF	See note 1	Underflow
-32768	8000	See note 1	

1 In an overflow or underflow condition, analog outputs will behave according to the device configuration properties set for the analog signal module. In the "Reaction to CPU STOP" parameter, select either: Use substitute value or Keep last value.

Table A- 193 Analog output representation for current

System		Current Output Range	
Decimal	Hexadecimal	0 mA to 20 mA	
32767	7FFF	See note 1	Overflow
32512	7F00	See note 1	
32511	7EFF	23.52 mA	Overshoot range
27649	6C01		
27648	6C00	20 mA	Rated range
20736	5100	15 mA	
1	1	723.4 nA	
0	0	0 mA	

1 In an overflow or underflow condition, analog outputs will behave according to the device configuration properties set for the analog signal module. In the "Reaction to CPU STOP" parameter, select either: Use substitute value or Keep last value.

A.10.4 Thermocouple SBs

A.10.4.1 SB 1231 1 analog thermocouple input specifications

Note

To use this SB, your CPU firmware must be V2.0 or higher.

Table A- 194 General specifications

Technical data	SB 1231 AI 1 x 16 bit Thermocouple
Order number	6ES7 231-5QA30-0XB0
Dimensions W x H x D (mm)	38 x 62 x 21

Technical data	SB 1231 AI 1 x 16 bit Thermocouple
Weight	35 grams
Power dissipation	0.5 W
Current consumption (SM Bus)	5 mA
Current consumption (24 VDC)	20 mA

Table A- 195 Analog inputs

Technical data		SB 1231 AI 1x16 bit Thermocouple
Number of inputs		1
Type		Floating TC and mV
Range • Nominal range (data word) • Overrange/underrange (data word) • Overflow/underflow (data word)		See Thermocouple filter selection table (Page 803).
Resolution	Temperature	0.1° C / 0.1° F
	Voltage	15 bits plus sign
Maximum withstand voltage		±35 V
Noise rejection		85 dB for the selected filter setting (10 Hz, 50 Hz, 60 Hz, 400 Hz)
Common mode rejection		> 120 dB at 120 VAC
Impedance		≥ 10 M Ω
Accuracy		See Thermocouple selection table (Page 803).
Repeatability		±0.05% FS
Measuring principle		Integrating
Module update time		See Thermocouple filter selection table (Page 803).
Cold junction error		±1.5° C
Isolation (field side to logic)		500 VAC
Cable length (meters)		100 m to sensor max.
Wire resistance		100 Ω max.

Table A- 196 Diagnostics

Technical data	SB 1231 AI 1 x 16 bit Thermocouple
Overflow/underflow[1]	Yes
Wire break[2]	Yes

1 The overflow and underflow 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 SM 1231 Thermocouple (TC) analog signal module measures the value of voltage connected to the module inputs.

The SB 1231 Thermocouple analog signal board measures the value of voltage connected to the signal board 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.

A.10.4.2 Basic operation for a thermocouple

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 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.

Selection table for the SB 1231 thermocouple

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

Table A- 197 SB 1231 Thermocouple selection table

Thermocouple Type	Under range minimum[1]	Nominal range low limit	Nominal range high limit	Over range maximum[2]	Normal range [3] accuracy @ 25°C	Normal range [3,] accuracy -20°C to 60°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	0.0°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	1050.0°C	±0.6°C	±1.2°C
Voltage	-32511	-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 minimum value are reported as 32767.

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

Table A- 198 Filter selection table for the SB 1231 Thermocouple

Rejection frequency (Hz)	Integration time (ms)	Signal board update time (seconds)
10	100	0.306
50	20	0.066
60	16.67	0.056
400[1]	10	0.036

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. Your user program may need to allow for this initialization time.

Table A- 199 Wiring diagram for the analog input thermocouple SB

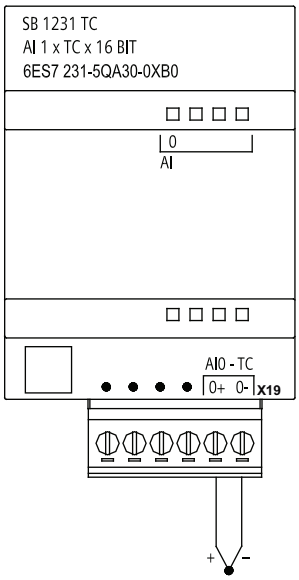
SB 1231 AI 1 x 16 bit thermocouple (6ES7 231-5QA30-0XB0)

Note: Connectors must be gold. See Appendix C, Spare Parts for order number.

Table A- 200 Connector pin locations for SB 1231 AI 1 x 16 bit thermocouple (6ES7 231-5QA30-0XB0)

Pin	X19 (gold)
1	No connection
2	No connection
3	No connection
4	No connection
5	AI 0- /TC
6	AI 0+ /TC

A.10.5 RTD SBs

A.10.5.1 SB 1231 1 analog RTD input specifications

Note

To use this SB, your CPU firmware must be V2.0 or higher.

Table A- 201 General specifications

Technical data	SB 1231 AI 1 x 16 bit RTD
Order number	6ES7 231-5PA30-0XB0
Dimensions W x H x D (mm)	38 x 62 x 2
Weight	35 grams
Power dissipation	0.7 W
Current consumption (SM Bus)	5 mA
Current consumption (24 VDC)	25 mA

Table A- 202 Analog inputs

Technical data		SB 1231 AI 1 x 16 bit RTD
Number of inputs		1
Type		Module referenced RTD and Ohms
Range • Nominal range (data word) • Overrange/underrange (data word) • Overflow/underflow (data word)		See Selection tables (Page 808).
Resolution	Temperature	0.1° C/ 0.1° F
	Voltage	15 bits plus sign
Maximum withstand voltage		±35 V
Noise rejection		85 dB (10 Hz, 50 Hz, 60 Hz, 400 Hz)
Common mode rejection		> 120 dB
Impedance		≥ 10 MΩ
Accuracy		See Selection tables (Page 808).
Repeatability		±0.05% FS
Maximum sensor dissipation		0.5 m W
Measuring principle		Integrating
Module update time		See Selection table (Page 808).
Isolation (field side to logic)		500 VAC
Cable length (meters)		100 m to sensor max.
Wire resistance		20 Ω, 2.7 for 10 Ω RTD max.

Table A- 203 Diagnostics

Technical data	SB 1231 AI 1 x 16 bit RTD
Overflow/underflow[1, 2]	Yes
Wire break [3]	Yes

1 The overflow and underflow diagnostic alarm information will be reported in the analog data values even if the alarms are disabled in the module configuration.

2 For resistance ranges underflow detection is never enabled.

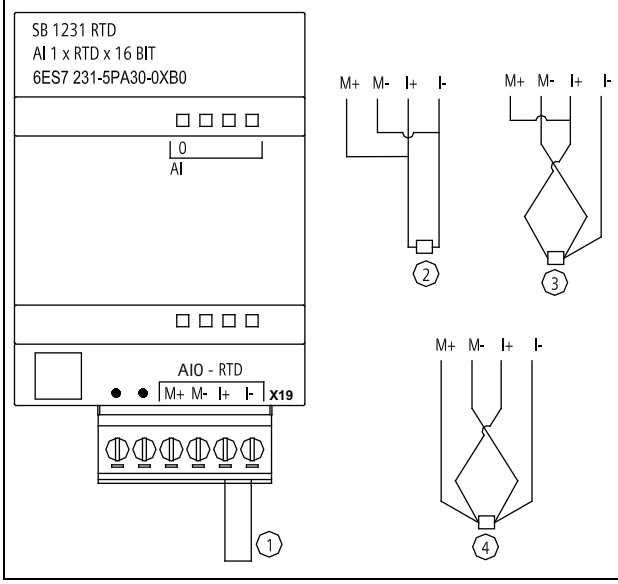
3 When wire break alarm is disabled and an open wire condition exists in the sensor wiring, the module may report random values.

The SM 1231 RTD analog signal board measures the value of resistance connected to the signal board inputs. The measurement type can be selected as either "Resistor" or "Thermal resistor".

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

The SB 1231 RTD signal board supports measurements with 2-wire, 3-wire and 4-wire connections to the sensor resistor.

Table A- 204 Wiring diagram for SB 1231 AI 1 x 16 bit RTD

SB 1231 AI 1 x 16 bit RTD (6ES7 231-5PA30-0XB0)


① Loop-back unused RTD input

② 2-wire RTD

③ 3-wire RTD

④ 4-wire RTD

Note: Connectors must be gold. See Appendix C, Spare Parts for order number.

Table A- 205 Connector pin locations for SB 1231 AI 1 x 16 bit RTD (6ES7 231-5PA30-0XB0)

Pin	X19 (gold)
1	No connection
2	No connection
3	AI 0 M+ /RTD
4	AI 0 M- /RTD
5	AI 0 I+ /RTD
6	AI 0 I- /RTD

A.10.5.2 Selection tables for the SB 1231 RTD

Table A- 206 Ranges and accuracy for the different sensors supported by the RTD modules

Temperature coefficient	RTD type	Under range minimum[1]	Nominal range low limit	Nominal range high limit	Over range maximum[2]	Normal range accuracy @ 25°C	Normal range accuracy -20°C to 60°C
Pt 0.003850	Pt 10	-243.0°C	-200.0°C	850.0°C	1000.0°C	±1.0°C	±2.0°C
ITS90 DIN EN 60751	Pt 50	-243.0°C	-200.0°C	850.0°C	1000.0°C	±0.5°C	±1.0°C
	Pt 100						
	Pt 200						
	Pt 500						
	Pt 1000						
Pt 0.003902 Pt 0.003916 Pt 0.003920	Pt 100	-243.0°C	-200.0°C	850.0°C	1000.0°C	± 0.5°C	±1.0°C
	Pt 200						
	Pt 500						
	Pt 1000						
Pt 0.003910	Pt 10	-273.2°C	-240.0°C	1100.0°C	1295°C	±1.0°C	±2.0°C
	Pt 50	-273.2°C	-240.0°C	1100.0°C	1295°C	±0.8°C	±1.6°C
	Pt 100						
	Pt 500						
Ni 0.006720 Ni 0.006180	Ni 100	-105.0°C	-60.0°C	250.0°C	295.0°C	±0.5°C	±1.0°C
	Ni 120						
	Ni 200						
	Ni 500						
	Ni 1000						

Temperature coefficient	RTD type	Under range minimum[1]	Nominal range low limit	Nominal range high limit	Over range maximum[2]	Normal range accuracy @ 25°C	Normal range accuracy -20°C to 60°C
LG-Ni 0.005000	LG-Ni 1000	-105.0°C	-60.0°C	250.0°C	295.0°C	±0.5°C	±1.0°C
Ni 0.006170	Ni 100	-105.0°C	-60.0°C	180.0°C	212.4°C	±0.5°C	±1.0°C
Cu 0.004270	Cu 10	-240.0°C	-200.0°C	260.0°C	312.0°C	±1.0°C	±2.0°C
Cu 0.004260	Cu 10	-60.0°C	-50.0°C	200.0°C	240.0°C	±1.0°C	±2.0°C
	Cu 50	-60.0°C	-50.0°C	200.0°C	240.0°C	±0.6°C	±1.2°C
	Cu 100						
Cu 0.004280	Cu 10	-240.0°C	-200.0°C	200.0°C	240.0°C	±1.0°C	±2.0°C
	Cu 50	-240.0°C	-200.0°C	200.0°C	240.0°C	±0.7°C	±1.4°C
	Cu 100						

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

2 RTD values above the over-range maximum value are reported as +32768.

Table A- 207 Resistance

Range	Under range minimum	Nominal range low limit	Nominal range high limit	Over range maximum[1]	Normal range accuracy @ 25°C	Normal range accuracy -20°C to 60°C
150 Ω	n/a	0 (0 Ω)	27648 (150 Ω)	176.383 Ω	±0.05%	±0.1%
300 Ω	n/a	0 (0 Ω)	27648 (300 Ω)	352.767 Ω	±0.05%	±0.1%
600 Ω	n/a	0 (0 Ω)	27648 (600 Ω)	705.534 Ω	±0.05%	±0.1%

1 Resistance values above the over-range maximum value are reported as 32767.

Note

The module reports 32767 on any activated channel with no sensor connected. If open wire detection is also enabled, the module flashes the appropriate red LEDs.

When 500 Ω and 1000 Ω RTD ranges are used with other lower value resistors, the error may increase to two times the specified error.

Best accuracy will be achieved for the 10 Ω RTD ranges if 4 wire connections are used.

The resistance of the connection wires in 2 wire mode will cause an error in the sensor reading and therefore accuracy is not guaranteed.

Table A- 208 Noise reduction and update times for the RTD modules

Rejection frequency selection	Integration time	4-/2-wire, 1-channel module Update time (seconds)	3-wire, 1-channel module Update time (seconds)
400 Hz (2.5 ms)	10 ms [1]	0.036	0.071
60 Hz (16.6 ms)	16.67 ms	0.056	0.111
50 Hz (20 ms)	20 ms	0.066	1.086
10 Hz (100 ms)	100 ms	0.306	0.611

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

NOTICE

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 or the module in your configuration. If required, you can include logic in your user program to accommodate the initialization time of the module.

A.11 BB 1297 Battery Board

BB 1297 Battery Board

The S7-1200 BB 1297 Battery Board is designed for long-term backup of the Real-time clock. It is pluggable in the signal board slot of the S7-1200 CPU (firmware 3.0 and later versions). You must add the BB 1297 to the device configuration and download the hardware configuration to the CPU for the BB to be functional.

The battery (type CR1025) is not included with the BB 1297 and must be purchased by the user.

Note

The BB 1297 is mechanically designed to fit the CPUs with the firmware 3.0 and later versions.

Do not use the BB 1297 with earlier version CPUs as the BB 1297 connector will not plug into the CPU.

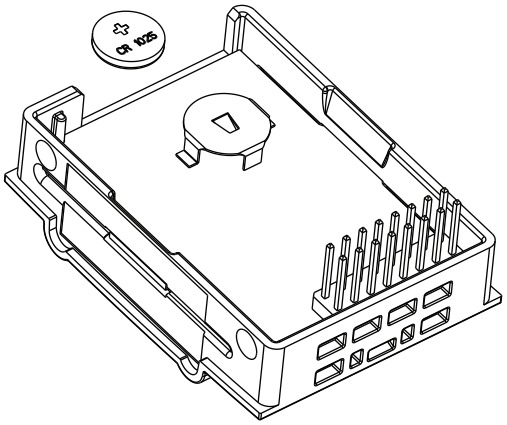
Table A- 209 General specifications

Technical data	BB 1297 Battery Board
Order number	6ES7 297-0AX30-0XA0
Dimensions W x H x D (mm)	38 x 62 x 21
Weight	28 grams
Power dissipation	0.5 W
Current consumption (SM Bus)	11 mA
Current consumption (24 VDC)	none

Battery (not included)	BB 1297 Battery Board
Hold up time	Approximately 1 year
Battery type	CR1025 Refer to Installing or replacing a battery in the BB 1297 battery board (Page 51)
Nominal voltage	3 V
Nominal capacity	At least 30 mAH

Diagnostics	BB 1297 Battery Board
Critical battery level	< 2.5 V
Battery diagnostic	Low voltage indicator: • Low battery voltage causes the CPU MAINT LED to illuminate with the amber light continuously ON. • Diagnostic Buffer Event: 16#06:2700 "Submodule maintenance demanded: At least one battery exhausted (BATTF)"
Battery status	Battery status bit provided 0 = Battery OK 1 = Battery low
Battery status update	Battery status is updated at power up and then once per day while CPU is in RUN mode.

Table A- 210 Insertion diagram for the BB 1297 battery board

BB 1297 battery board (6ES7 297-0AX30-0XA0)


A.12 Communication interfaces

A.12.1 PROFIBUS

A.12.1.1 CM 1242-5

Table A- 211 Technical specifications of the CM 1242-5

Technical specifications	
Order number	6GK7 242-5DX30-0XE0
Interfaces	
Connection to PROFIBUS	9-pin D-sub female connector
Maximum current consumption on the PROFIBUS interface when network components are connected (for example optical network components)	15 mA at 5 V (only for bus termination) *)
Permitted ambient conditions	
Ambient temperature	
• during storage	• -40 °C to 70 °C
• during transportation	• -40 °C to 70 °C
• during operation with a vertical installation (DIN rail horizontal)	• 0 °C to 55 °C
• during operation with a horizontal installation (DIN rail vertical)	• 0 °C to 45 °C
Relative humidity at 25 °C during operation, without condensation, maximum	95 %

Technical specifications	
Degree of protection	IP20
Power supply, current consumption and power loss	
Type of power supply	DC
Power supply from the backplane bus	5 V
Current consumption (typical)	150 mA
Effective power loss (typical)	0.75 W
Dimensions and weights	
• Width	• 30 mm
• Height	• 100 mm
• Depth	• 75 mm
Weight	
• Net weight	• 115 g
• Weight including packaging	• 152 g

*)The current load of an external consumer connected between VP (pin 6) and DGND (pin 5) must not exceed a maximum of 15 mA (short-circuit proof) for bus termination.

PROFIBUS interface

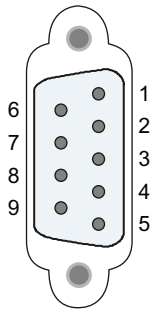


Table A- 212 Pinout of the D-sub socket

Pin	Description	Pin	Description
1	- not used -	6	P5V2: +5V power supply
2	- not used -	7	- not used -
3	RxD/TxD-P: Data line B	8	RxD/TxD-N: Data line A
4	RTS	9	- not used -
5	M5V2: Data reference potential (ground DGND)	Housing	Ground connector

A.12.1.2 CM 1243-5

Table A- 213 Technical specifications of the CM 1243-5

Technical specifications	
Order number	6GK7 243-5DX30-0XE0
Interfaces	
Connection to PROFIBUS	9-pin D-sub female connector
Maximum current consumption on the PROFIBUS interface when network components are connected (for example optical network components)	15 mA at 5 V (only for bus termination) *)

Technical specifications	
Permitted ambient conditions	
Ambient temperature	
• during storage	• -40 °C to 70 °C
• during transportation	• -40 °C to 70 °C
• during operation with a vertical installation (DIN rail horizontal)	• 0 °C to 55 °C
• during operation with a horizontal installation (DIN rail vertical)	• 0 °C to 45 °C
Relative humidity at 25 °C during operation, without condensation, maximum	95 %
Degree of protection	IP20
Power supply, current consumption and power loss	
Type of power supply	DC
Power supply / external	24 V
• minimum	• 19.2 V
• maximum	• 28.8 V
Current consumption (typical)	
• from 24 V DC	• 100 mA
• from the S7-1200 backplane bus	• 0 mA
Effective power loss (typical)	
• from 24 V DC	• 2.4 W
• from the S7-1200 backplane bus	• 0 W
Power supply 24 VDC / external	
• Min. cable cross section	• min.: 0.14 mm^2 (AWG 25)
• Max. cable cross section	• max.: 1.5 mm^2 (AWG 15)
• Tightening torque of the screw terminals	• 0.45 Nm (4 lb-in)
Dimensions and weights	
• Width	• 30 mm
• Height	• 100 mm
• Depth	• 75 mm
Weight	
• Net weight	• 134 g
• Weight including packaging	• 171 g

*)The current load of an external consumer connected between VP (pin 6) and DGND (pin 5) must not exceed a maximum of 15 mA (short-circuit proof) for bus termination.

Note

The CM 1243-5 (PROFIBUS master module) must receive power from the 24 VDC sensor supply of the CPU.

PROFIBUS interface

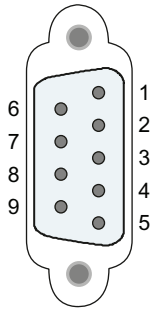


Table A- 214 Pinout of the D-sub socket

Pin	Description	Pin	Description
1	- not used -	6	VP: Power supply +5 V only for bus terminating resistors; not for supplying external devices
2	- not used -	7	- not used -
3	RxD/TxD-P: Data line B	8	RxD/TxD-N: Data line A
4	CNTR-P: RTS	9	- not used -
5	DGND: Ground for data signals and VP	Housing	Ground connector

PROFIBUS cable

NOTICE
Contacting the shield of the PROFIBUS cable The shield of the PROFIBUS cable must be contacted. To do this, strip the insulation from the end of the PROFIBUS cable and connect the shield to functional earth.

A.12.2 GPRS

Note

The GPRS CP is not approved for Maritime applications

The following module does not have Maritime approval:

- CP 1242-7 GPRS module

Note

To use these modules, your CPU firmware must be V2.0 or higher.

A.12.2.1 CP 1242-7

Table A- 215 Technical specifications of the CP 1242-7

Technical specifications	
Order number	6GK7 242-7KX30-0XE0
Wireless interface	

Technical specifications	
Antenna connector	SMA socket
Nominal impedance	50 ohms
Wireless connection	
Maximum transmit power	• GSM 850, class 4: +33 dBm ±2dBm • GSM 900, class 4: +33 dBm ±2dBm • GSM 1800, class 1: +30 dBm ±2dBm • GSM 1900, class 1: +30 dBm ±2dBm
GPRS	Multislot class 10 device class B coding scheme 1...4 (GMSK)
SMS	Mode outgoing: MO service: point-to-point
Permitted ambient conditions	
Ambient temperature	
• during storage	• -40 °C to 70 °C
• during transportation	• -40 °C to 70 °C
• during operation with a vertical installation (DIN rail horizontal)	• 0 °C to 55 °C
• during operation with a horizontal installation (DIN rail vertical)	• 0 °C to 45 °C
Relative humidity at 25 °C during operation, without condensation, maximum	95 %
Degree of protection	IP20
Power supply, current consumption and power loss	
Type of power supply	DC
Power supply / external	24 V
• minimum	• 19.2 V
• maximum	• 28.8 V
Current consumption (typical)	
• from 24 V DC	• 100 mA
• from the S7-1200 backplane bus	• 0 mA
Effective power loss (typical)	
• from 24 V DC	• 2.4 W
• from the S7-1200 backplane bus	• 0 W
24 V DC power supply	
• Min. cable cross section	• min.: 0.14 mm^2 (AWG 25)
• Max. cable cross section	• max.: 1.5 mm^2 (AWG 15)
• Tightening torque of the screw terminals	• 0.45 Nm (4 lb-in)

Technical specifications	
Dimensions and weights	
• Width	• 30 mm
• Height	• 100 mm
• Depth	• 75 mm
Weight	
• Net weight	• 133 g
• Weight including packaging	• 170 g

Technical specifications of the ANT794-4MR GSM/GPRS antenna

ANT794-4MR	
Order number	6NH9860-1AA00
Mobile wireless networks	GSM/GPRS
Frequency ranges	• 824 to 960 MHz (GSM 850, 900) • 1 710 to 1 880 MHz (GSM 1 800) • 1 900 to 2 200 MHz (GSM / UMTS)
Characteristics	omnidirectional
Antenna gain	0 dB
Impedance	50 ohms
Standing wave ratio (SWR)	< 2,0
Max. power	20 W
Polarity	linear vertical
Connector	SMA
Length of antenna cable	5 m
External material	Hard PVC, UV-resistant
Degree of protection	IP20
Permitted ambient conditions	
• Operating temperature	• -40 °C through +70 °C
• Transport/storage temperature	• -40 °C through +70 °C
• Relative humidity	• 100 %
External material	Hard PVC, UV-resistant
Construction	Antenna with 5 m fixed cable and SMA male connector
Dimensions (D x H) in mm	25 x 193
Weight	
• Antenna incl. cable	• 310 g
• Fittings	• 54 g
Installation	With supplied bracket

Technical specifications of the flat antenna ANT794-3M

Order number	6NH9870-1AA00	
Mobile wireless networks	**GSM 900**	**GSM 1800/1900**
Frequency ranges	890 - 960 MHz	1710 - 1990 MHz
Standing wave ratio (VSWR)	≤ 2:1	≤ 1,5:1
Return loss (Tx)	≈ 10 dB	≈ 14 dB
Antenna gain	0 dB	
Impedance	50 ohms	
Max. power	10 W	
Antenna cable	HF cable RG 174 (fixed) with SMA male connector	
Cable length	1.2 m	
Degree of protection	IP64	
Permitted temperature range	-40°C to +75°C	
Flammability	UL 94 V2	
External material	ABS Polylac PA-765, light gray (RAL 7035)	
Dimensions (W x L x H) in mm	70.5 x 146.5 x 20.5	
Weight	130 g	

A.12.3 CM 1243-2 AS-i Master

A.12.3.1 Technical data for the AS-i master CM 1243-2

Table A- 216 Technical data for the AS-i master CM 1243-2

Technical data	
Order number	3RK7243-2AA30-0XB0
Interfaces	
Maximum current consumption	
From the SIMATIC backplane bus	Max. 250 mA, SIMATIC backplane bus supply voltage 5 V DC
From the AS-i cable	Max. 100 mA
Pin assignment	See section Electrical connections of the AS-i master CM 1243-2 (Page 819)
Conductor cross-section	0.2 mm² (AWG 24) ... 3.3 mm² (AWG 12)
ASI connector tightening torque	0.56 Nm

Technical data	
Permissible ambient conditions	
Ambient temperature	
During storage	-40 °C ... 70 °C
During transport	-40 °C ... 70 °C
During the operating phase, with vertical installation (horizontal standard mounting rail)	0 °C ... 55 °C
During the operating phase, with horizontal installation (vertical standard mounting rail)	0 °C ... 45 °C
Relative humidity at 25 °C during operating phase, no condensation, maximum	95 %
Degree of protection	IP20
Power supply, current consumption, power loss	
Type of power supply	DC
Current consumption (typically)	
From the S7-1200 backplane bus	200 mA
Power loss (typically) From the S7-1200 backplane bus	2.4 W from AS-i 0.5 W
Dimensions and weights	
Width	30 mm
Height	100 mm
Depth	75 mm
Weight	
Net weight	122 g
Weight including packaging	159 g

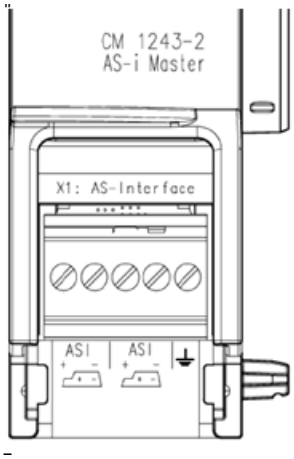
A.12.3.2 Electrical connections of the AS-i master CM 1243-2

Power supply of the AS-i master CM 1243-2

The AS-i master CM 1243-2 is supplied over the communications bus of the S7-1200. This means that a diagnostics message can still be sent to the S7-1200 following failure of the AS-i supply voltage. The connection to the communications bus is on the right-hand side of the AS-i master CM 1243-2.

AS-Interface terminals

The removable terminal for connecting the AS-i cable is located behind the lower cover on the front of the AS-i master CM 1243-2.



If the AS-i shaped cable is used, you can recognize the correct polarity of the cable by means of the symbol .

Information on how to remove and re-install the terminal block can be found in the system manual "SIMATIC S7-1200 Programmable Controller" (Order No.: 6ES7298-8FA30-8AH0).

NOTICE
Maximum current carrying capacity of the terminal contacts The current carrying capacity of the connection contacts is max. 8 A. If this value is exceeded on the AS-i cable, the AS-i master CM 1243-2 must not be "looped in" to the AS-i cable, but must instead be connected via a spur line (only one connection pair assigned on the AS-i master CM 1243-2). You will find additional information on connecting the AS-i cable in the section "Installation, connection and commissioning of the modules" in the manual "AS-i Master CM 1243-2 and AS-i data decoupling unit DCM 1271 for SIMATIC S7-1200".

Terminal assignment

Label	Meaning
ASI+	AS-i connection – positive polarity
ASI–	AS-i connection – negative polarity
	Functional ground

A.12.4 RS232, RS422, and RS485

A.12.4.1 CB 1241 RS485 Specifications

Note

To use this CB, your CPU firmware must be V2.0 or higher.

Table A- 217 General specifications

Technical data	CB 1241 RS485
Order number	6ES7 241-1CH30-1XB0
Dimensions W x H x D (mm)	38 x 62 x 21
Weight	40 grams

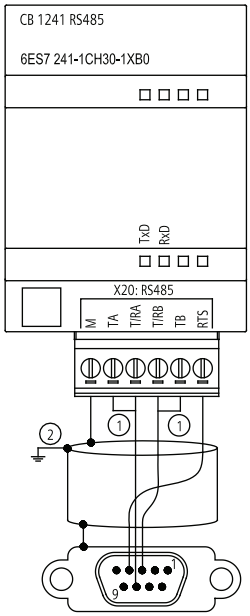
Table A- 218 Transmitter and receiver

Technical data	CB 1241 RS485
Type	RS485 (2-wire half-duplex)
Common mode voltage range	-7 V to +12 V, 1 second, 3 VRMS continuous
Transmitter differential output voltage	2 V min. at R_L = 100 Ω 1.5 V min. at R_L = 54 Ω
Termination and bias	10K to +5 V on B, RS485 Pin 3 10K to GND on A, RS485 Pin 4
Optional termination	Short Pin TB to Pin T/RB, effective termination impedance is 127 Ω, connects to RS485 Pin 3 Short Pin TA to Pin T/RA, effective termination impedance is 127 Ω, connects to RS485 Pin 4
Receiver input impedance	5.4K Ω min. including termination
Receiver threshold/sensitivity	+/- 0.2 V min., 60 mV typical hysteresis
Isolation RS485 signal to chassis ground RS485 signal to CPU logic common	500 VAC, 1 minute
Cable length, shielded	1000 m max.
Baud rate	300 baud, 600 baud, 1.2 kbits, 2.4 kbits, 4.8 kbits, 9.6 kbits (default), 19.2 kbits, 38.4 kbits, 57.6 kbits, 76.8 kbits, 115.2 kbits,
Parity	No parity (default), even, odd, Mark (parity bit always set to 1), Space (parity bit always set to 0)
Number of stop bits	1 (default), 2
Flow control	Not supported
Wait time	0 to 65535 ms

Table A- 219 Power supply

Technical data	CB 1241 RS485
Power loss (dissipation)	1.5 W
Current consumption (SM Bus), max.	50 mA
Current consumption (24 VDC) max.	80 mA

CB 1241 RS485 (6ES7 241-1CH30-1XB0)



① Connect "TA" and TB" as shown to terminate the network. (Terminate only the end devices on the RS485 network.)

② Use shielded twisted pair cable and connect the cable shield to ground.

You terminate only the two ends of the RS485 network. The devices in between the two end devices are not terminated or biased. See the S7-1200 System Manual section on "Biasing and terminating an RS485 network connector"

Table A- 220 Connector pin locations for CB 1241 RS485 (6ES7 241-1CH30-1XB0)

Pin	9-Pin connector	X20
1	RS485 / Logic GND	--
2	RS485 / Not Used	--
3	RS485 / TxD+	3 - T/RB
4	RS485 / RTS	1 - RTS
5	RS485 / Logic GND	--
6	RS485 / 5V Power	--
7	RS485 / Not used	--
8	RS485 / TxD-	4 - T/RA

Pin	9-Pin connector	X20
9	RS485 / Not Used	--
Shell		7 - M

See also

Biasing and terminating an RS485 network connector (Page 564)

A.12.4.2 CM 1241 RS232 Specifications

Table A- 221 General specifications

Technical data	CM 1241 RS232
Order number	6ES7 241-1AH30-0XB0
Dimensions (mm)	30 x 100 x 75
Weight	150 grams

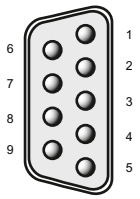
Table A- 222 Transmitter and receiver

Technical data	CM 1241 RS232
Type	RS232 (full-duplex)
Transmitter output voltage	+/- 5 V min. at R_L = 3K Ω
Transmit output voltage	+/- 15 VDC max.
Receiver input impedance	3 K Ω min.
Receiver threshold/sensitivity	0.8 V min. low, 2.4 max. high 0.5 V typical hysteresis
Receiver input voltage	+/- 30VDC max.
Isolation RS 232 signal to chassis ground RS 232 signal to CPU logic common	500 VAC, 1 minute
Cable length, shielded	10 m max.
Baud rate	300 baud, 600 baud, 1.2 kbits, 2.4 kbits, 4.8 kbits, 9.6 kbits (default), 19.2 kbits, 38.4 kbits, 57.6 kbits, 76.8 kbits, 115.2 kbits,
Parity	No parity (default), even, odd, Mark (parity bit always set to 1), Space (parity bit always set to 0)
Number of stop bits	1 (default), 2
Flow control	Hardware, software
Wait time	0 to 65535 ms

Table A- 223 Power supply

Technical data	CM 1241 RS232
Power loss (dissipation)	1.1 W
From +5 VDC	220 mA

Table A- 224 RS232 connector (male)

Pin	Description	Connector (male)	Pin	Description
1 DCD	Data carrier detect: Input		6 DSR	Data set ready: Input
2 RxD	Received data from DCE: Input		7 RTS	Request to send: Output
3 TxD	Transmitted data to DCE: Output		8 CTS	Clear to send: Input
4 DTR	Data terminal ready: Output		9 RI	Ring indicator (not used)
5 GND	Logic ground		SHELL	Chassis ground

A.12.4.3 CM 1241 RS422/485 Specifications

CM 1241 RS422/485 Specifications

Table A- 225 General specifications

Technical data	CM 1241 RS422/485
Order number	6ES7 241-1CH31-0XB0
Dimensions W x H x H (mm)	30 x 100 x 75
Weight	155 grams

Table A- 226 Transmitter and receiver

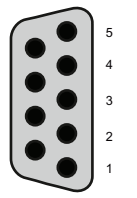
Technical data	CM 1241 RS422/485
Type	RS422 or RS485, 9-pin sub D female connector
Common mode voltage range	-7 V to +12 V, 1 second, 3 VRMS continuous
Transmitter differential output voltage	2 V min. at R_L = 100 Ω 1.5 V min. at R_L = 54 Ω

Technical data	CM 1241 RS422/485
Termination and bias	10K Ω to +5 V on B, PROFIBUS Pin 3 10K Ω to GND on A, PROFIBUS Pin 8 Internal bias options provided, or no internal bias. In all cases, external termination is required, see Biasing and terminating an RS485 network connector (Page 564) and Configuring the RS422 and RS485 in the S7-1200 System Manual (Page 599)
Receiver input impedance	5.4K Ω min. including termination
Receiver threshold/sensitivity	+/- 0.2 V min., 60 mV typical hysteresis
Isolation RS485 signal to chassis ground RS485 signal to CPU logic common	500 VAC, 1 minute
Cable length, shielded	1000 m max. (baud rate dependent)
Baud rate	300 baud, 600 baud, 1.2 kbits, 2.4 kbits, 4.8 kbits, 9.6 kbits (default), 19.2 kbits, 38.4 kbits, 57.6 kbits, 76.8 kbits, 115.2 kbits,
Parity	No parity (default), even, odd, Mark (parity bit always set to 1), Space (parity bit always set to 0)
Number of stop bits	1 (default), 2
Flow control	XON/XOFF supported for the RS422 mode
Wait time	0 to 65535 ms

Table A- 227 Power supply

Technical data	CM 1241 RS422/485
Power loss (dissipation)	1.2 W
From +5 VDC	240 mA

Table A- 228 RS485 or RS422 connector (female)

Pin	Description	Connector (female)	Pin	Description
1	Logic or communication ground		6 PWR	+5V with 100 ohm series resistor: Output
2 TxD+ [1]	Connected for RS422 Not used for RS485: Output		7	Not connected
3 TxD+	Signal B (RxD/TxD+): Input/Output		8 TXD-	Signal A (RxD/TxD-): Input/Output
4 RTS [2]	Request to send (TTL level) Output		9 TXD- [1]	Connected for RS422 Not used for RS485: Output
5 GND	Logic or communication ground		SHELL	Chassis ground

[1] Pins 2 and 9 are only used as transmit signals for RS422.

[2] The RTS is a TTL level signal and can be used to control another half duplex device based on this signal. It is active when you transmit and is inactive all other times.

A.13 TeleService (TS Adapter and TS Adapter modular)

The following manuals contain the technical specification for the TS Adapter IE Basic and the TS Adapter modular:

- Industrial Software Engineering Tools
  Modular TS Adapter
- Industrial Software Engineering Tools
  TS Adapter IE Basic

A.14 SIMATIC memory cards

Order Number	Capacity
6ES7 954-8LF01-0AA0	24 MB
6ES7 954-8LE01-0AA0	12 MB
6ES7 954-8LB01-0AA0	2 MB

A.15 Input simulators

Table A- 229 General specifications

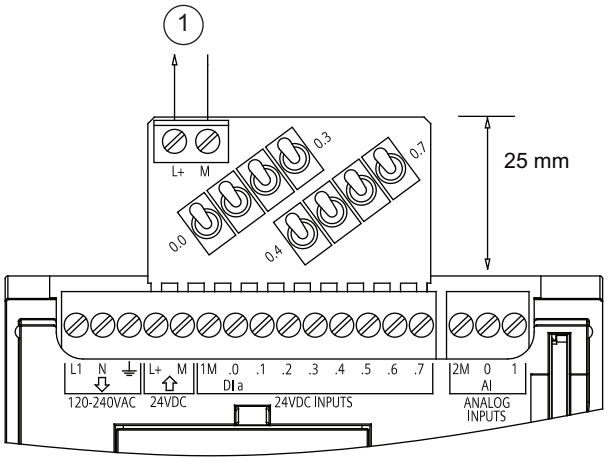
Technical data	8 Position Simulator	14 Position Simulator
Order number	6ES7 274-1XF30-0XA0	6ES7 274-1XH30-0XA0
Dimensions W x H x D (mm)	43 x 35 x 23	67 x 35 x 23
Weight	20 grams	30 grams
Points	8	14
Used with CPU	CPU 1211C, CPU 1212C	CPU 1214C

⚠ WARNING

These input simulators are not approved for use in Class I DIV 2 or Class I Zone 2 hazardous locations. The switches present a potential spark hazard/explosion hazard if used in a Class I DIV 2 or Class I Zone 2 location.

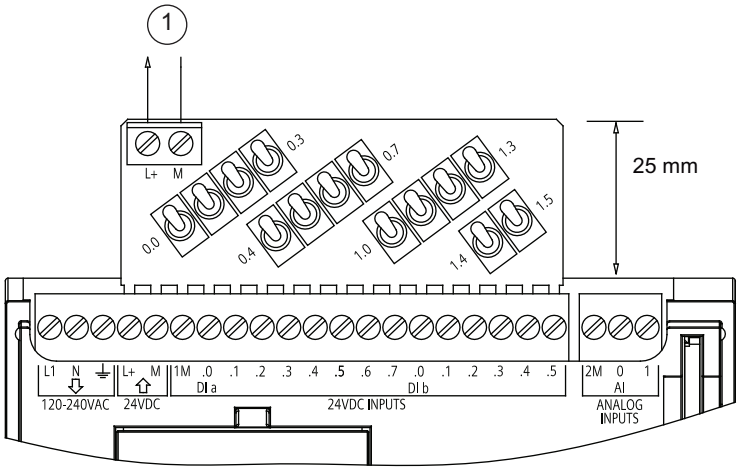
8 Position Simulator (6ES7 274-1XF30-0XA0)

① 24 VDC sensor power out



14 Position Simulator (6ES7 274-1XF30-0XA0)

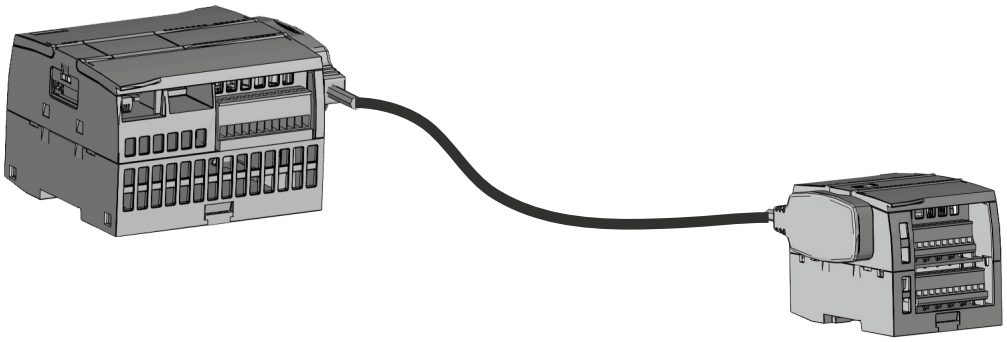
① 24 VDC sensor power out



A.16 I/O expansion cable

Technical Data	
Order number	6ES7 290-6AA30-0XA0
Cable length	2 m
Weight	200 g

Refer to the installation section (Page 56) for information about installing and removing the S7-1200 expansion cable.



A.17 Companion products

A.17.1 PM 1207 power module

The PM 1207 is a power supply module for the SIMATIC S7-1200. It provides the following features:

- Input 120/230 VAC, output 24 VDC/2.5A
- Order number 6ESP 332-1SH71

For more information about this product and for the product documentation, refer to the customer support web site (http://www.siemens.com/automation/).

A.17.2 CSM 1277 compact switch module

The CSM1277 is an Industrial Ethernet compact switch module. It can be used to multiply the Ethernet interface of the S7-1200 to allow simultaneous communication with operator panels, programming devices, or other controllers. It provides the following features:

- 4 x RJ45 sockets for connecting to Industrial Ethernet
- 3 pole plug in terminal strip for connection of the external 24 VDC supply on top
- LEDs for diagnostics and status display of Industrial Ethernet ports
- Order number 6GK7 277-1AA00-0AA0

For more information about this product and for the product documentation, refer to the customer support web site (http://www.siemens.com/automation/).