SIEMENS

SIMATIC

S7
S7-1200 Programmable controller

System Manual

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Preface

Purpose of the manual

The S7-1200 series is a line of programmable logic controllers (PLCs) that can control a variety of automation applications. Compact design, low cost, and a powerful instruction set make the S7-1200 a perfect solution for controlling a wide variety of applications. The S7-1200 models and the Windows-based STEP 7 programming tool (Page 37) give you the flexibility you need to solve your automation problems.

This manual provides information about installing and programming the S7-1200 PLCs and is designed for engineers, programmers, installers, and electricians who have a general knowledge of programmable logic controllers.

Required basic knowledge

To understand this manual, it is necessary to have a general knowledge of automation and programmable logic controllers.

Scope of the manual

This manual describes the following products:

- STEP 7 Basic and Professional (Page 37)
- S7-1200 CPU firmware release V4.5

For a complete list of the S7-1200 products described in this manual, refer to the technical specifications (Page 1183).

Certification, CE label, C-Tick, and other approvals

Refer to the technical specifications (Page 1183) for more information.

Service and support

In addition to our documentation, Siemens offers technical expertise on the Internet and on the customer support web site (http://support.industry.siemens.com).

Contact your Siemens distributor or sales office for assistance in answering any technical questions, for training, or for ordering S7 products. Because your sales representatives are technically trained and have the most specific knowledge about your operations, process and industry, as well as about the individual Siemens products that you are using, they can provide the fastest and most efficient answers to any problems you might encounter.

A.9 Digital signal modules (SMs)

A.9.1 SM 1221 digital input specifications

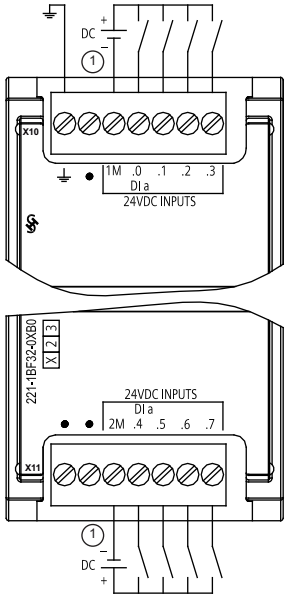
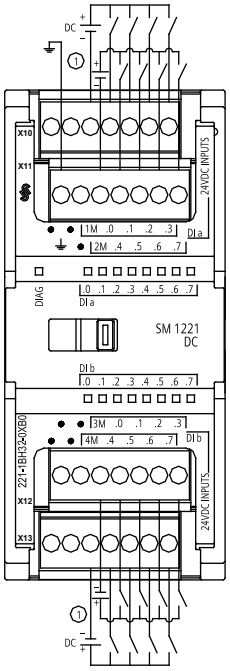
Table A-106 General specifications

Model	SM 1221 DI 8 x 24 V DC	SM 1221 DI 16 x 24 V DC
Article number	6ES7221-1BF32-0XB0	6ES7221-1BH32-0XB0
Dimensions W x H x D (mm)	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 V DC)	4 mA / input used	

Table A-107 Digital inputs

Model	SM 1221 DI 8 x 24 V DC	SM 1221 DI 16 x 24 V DC
Number of inputs	8	16
Type	Sink/Source (IEC Type 1 sink)	
Rated voltage	24 V DC at 4 mA, nominal	
Continuous permissible voltage	30 V DC, max.	
Surge voltage	35 V DC for 0.5 sec.	
Logic 1 signal (min.)	15 V DC at 2.5 mA	
Logic 0 signal (max.)	5 V DC at 1 mA	
Isolation (field side to logic)	707 V DC (type test)	
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	

Table A-108 Wiring diagrams for the digital input SMs

SM 1221 DI 8 x 24 V DC (6ES7221-1BF32-0XB0)	SM 1221 DI 16 x 24 V DC (6ES7221-1BH32-0XB0)
	

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

Table A-109 Connector pin locations for SM 1221 DI 8 x 24 V DC (6ES7221-1BF32-0XB0)

Pin	X10	X11
1	Functional Earth	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-110 Connector pin locations for SM 1221 DI 16 x 24 V DC (6ES7221-1BH32-0XB0)

Pin	X10	X11	X12	X13
1	No connection	Functional Earth	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

Pin	X10	X11	X12	X13
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.9.2 SM 1222 8-point digital output specifications

Table A-111 General specifications

Model	SM 1222 DQ 8 x Relay	SM 1222 DQ 8 Relay Changeover	SM 1222 DQ 8 x 24 V DC
Article number	6ES7222-1HF32-0XB0	6ES7222-1XF32-0XB0	6ES7222-1BF32-0XB0
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 V DC)	11 mA / Relay coil used	16.7 mA/Relay coil used	50 mA

Table A-112 Digital outputs

Model	SM 1222 DQ 8 x Relay	SM 1222 DQ 8 Relay Changeover	SM 1222 DQ 8 x 24 V DC
Number of outputs	8	8	8
Type	Relay, mechanical	Relay change over contact	Solid state - MOSFET (sourcing)
Voltage range	5 to 30 V DC or 5 to 250 V AC	5 to 30 V DC or 5 to 250 V AC	20.4 to 28.8 V DC
Logic 1 signal at max. current	--	--	20 V DC min.
Logic 0 signal with 10K Ω load	--	--	0.1 V DC 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	5 W
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	
Isolation (field side to logic)	1500 V AC (coil to contact) None (coil to logic)	1500 V AC (coil to contact)	707 V DC (type test)
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	--

Model	SM 1222 DQ 8 x Relay	SM 1222 DQ 8 Relay Changeover	SM 1222 DQ 8 x 24 V DC
Lifetime mechanical (no load)	10,000,000 open/close cycles	10,000,000 open/close cycles	--
Lifetime contacts at rated load (N.O. contact)	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)
Control of a digital input	Yes		
Parallel outputs for redundant load control	Yes (with same common)		
Parallel outputs for increased load	No		
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.9.3 SM 1222 16-point digital output specifications

Table A-113 General specifications

Model	SM 1222 DQ 16 x Relay	SM 1222 DQ 16 x 24 V DC	SM 1222 DQ 16 x 24 V DC sinking
Article number	6ES7222-1HH32-0XB0	6ES7222-1BH32-0XB0	6ES7222-1BH32-1XB0
Dimensions W x H x D (mm)	45 x 100 x 75	45 x 100 x 75	45 x 100 x 75
Weight	260 grams	220 grams	220 grams
Power dissipation	8.5 W	2.5 W	2.5 W
Current consumption (SM Bus)	135 mA	140 mA	140 mA
Current consumption (24 V DC)	11 mA / Relay coil used	100 mA	40 mA

Table A-114 Digital outputs

Model	SM 1222 DQ 16 x Relay	SM 1222 DQ 16 x 24 V DC	SM 1222 DQ 16 x 24 V DC sinking
Number of outputs	16	16	16
Type	Relay, mechanical	Solid state - MOSFET (sourcing)	Solid state - MOSFET (sinking)
Voltage range	5 to 30 V DC or 5 to 250 V AC	20.4 to 28.8 V DC	20.4 to 28.8 V DC
Logic 1 signal at max. current	-	20 V DC min.	0.5 V DC
Logic 0 signal with 10K Ω load	-	0.1 V DC max.	24 V (typical) minus 0.75 V DC
Current (max.)	2.0 A	0.5 A	0.5 A

Model	SM 1222 DQ 16 x Relay	SM 1222 DQ 16 x 24 V DC	SM 1222 DQ 16 x 24 V DC sinking
Lamp load	30 W DC/200 W AC	5 W	5 W
ON state contact resistance	0.2 Ω max. when new	0.6 Ω max.	0.5 Ω max.
Leakage current per point	--	10 µA max.	75 µA max.
Surge current	7 A with contacts closed	8 A for 100 ms max.	8 A for 100 ms max.
Overload protection	No		Yes, current limit protected range 1 A to 3.5 A
Isolation (field side to logic)	1500 V AC (coil to contact) None (coil to logic)	707 V DC (type test)	707 V DC (type test)
Isolation groups	4	1	1
Current per common (max.)	10 A	8 A	Current limit protected
Inductive clamp voltage	-	L+ minus 48 V, 1 W dissipation	45 V
Switching delay	10 ms max.	50 µs max. off to on 200 µs max. on to off	20 µs max. off to on 350 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 (N.O. contact)	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)
Control of a digital input	Yes	Yes	Yes (sourcing input)
Parallel outputs for redundant load control	Yes (with same common)		
Parallel outputs for increased load	No		
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	16
Cable length (meters)	500 m shielded, 150 m unshielded		

See also

New features (Page 35)

Table A-115 Wiring diagrams for the 8-point digital output SMs

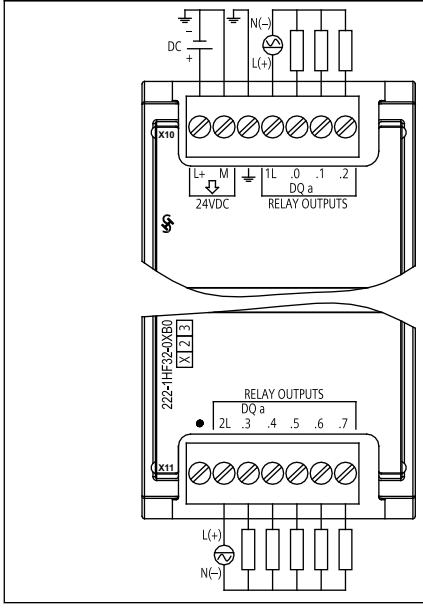
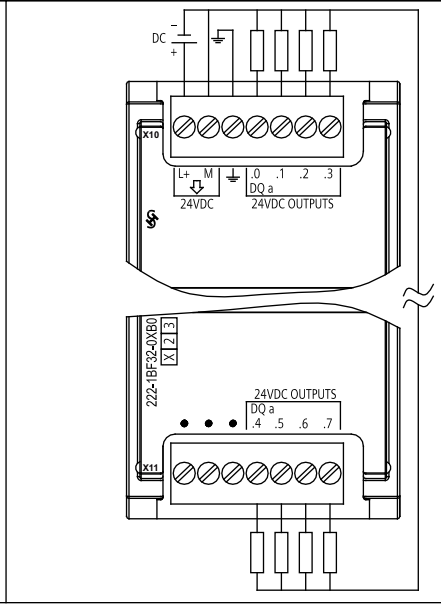
SM 1222 DQ 8 x Relay (6ES7222-1HF32-0XB0)	SM 1222 DQ 8 x 24 V DC (6ES7222-1BF32-0XB0)
	

Table A-116 Connector pin locations for SM 1222 DQ 8 x Relay (6ES7222-1HF32-0XB0)

Pin	X10	X11
1	L+ / 24 V DC	No connection
2	M / 24 V DC	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-117 Connector pin locations for SM 1222 DQ 8 x 24 V DC (6ES7222-1BF32-0XB0)

Pin	X10	X11
1	L+ / 24 V DC	No connection
2	M / 24 V DC	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-123 Wiring diagram for the 16-point digital output 24 V DC sinking SM

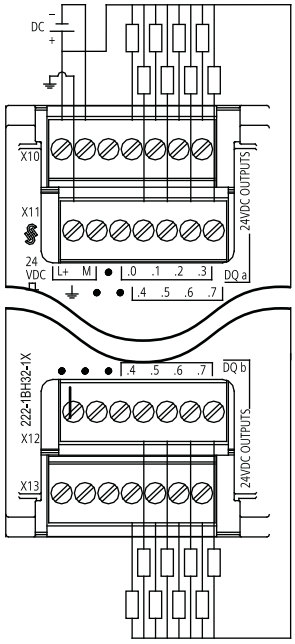
SM 1222 DQ 16 x 24 V DC sinking (6ES7222-1BH32-1XB0)	
	

Table A-124 Connector pin locations for SM 1222 DQ 16 x 24 V DC sinking (6ES7222-1BH32-1XB0)

Pin	X10	X11	X12	X13
1	L+ / 24 V DC	Functional Earth	No connection	No connection
2	M / 24 V DC	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.9.4 SM 1223 digital input/output V DC specifications

Table A-125 General specifications

Model	**SM 1223** **DI 8 x 24 V DC,** **DQ 8 x Relay**	**SM 1223** **DI 16 x 24 V DC,** **DQ 16 x Relay**	**SM 1223** **DI 8 x 24 V DC,** **DQ 8 x 24 V DC**	**SM 1223** **DI 16 x 24 V DC,** **DQ 16 x 24 V DC**	**SM 1223** **DI 16 x 24 V DC,** **DQ 16 x 24 V DC sinking**
Article number	6ES7223-1PH32-0XB0	6ES7223-1PL32-0XB0	6ES7223-1BH32-0XB0	6ES7223-1BL32-0XB0	6ES7223-1BL32-1XB0
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	70 x 100 x 75

Model	**SM 1223 DI 8 x 24 V DC, DQ 8 x Relay**	**SM 1223 DI 16 x 24 V DC, DQ 16 x Relay**	**SM 1223 DI 8 x 24 V DC, DQ 8 x 24 V DC**	**SM 1223 DI 16 x 24 V DC, DQ 16 x 24 V DC**	**SM 1223 DI 16 x 24 V DC, DQ 16 x 24 V DC sinking**
Weight	230 grams	350 grams	210 grams	310 grams	310 grams
Power dissipation	5.5 W	10 W	2.5 W	4.5 W	4.5 W
Current consumption (SM Bus)	145 mA	180 mA	145 mA	185 mA	185 mA
Current consumption (24 V DC)	4 mA / Input used 11 mA / Relay coil used		150 mA	200 mA	40 mA

Table A-126 Digital inputs

Model	**SM 1223 DI 8 x 24 V DC, DQ 8 x Relay**	**SM 1223 DI 16 x 24 V DC, DQ 16 x Relay**	**SM 1223 DI 8 x 24 V DC, DQ 8 x 24 V DC**	**SM 1223 DI 16 x 24 V DC, DQ 16 x 24 V DC**	**SM 1223 DI 16 x 24 V DC, DQ 16 x 24 V DC sinking**
Number of inputs	8	16	8	16	16
Type	Sink/Source (IEC Type 1 sink)	Sink/Source (IEC Type 1 sink)	Sink/Source (IEC Type 1 sink)	Sink/Source (IEC Type 1 sink)	Sink/Source (IEC Type 1 sink)
Rated voltage	24 V DC at 4 mA, nominal	24 V DC at 4 mA, nominal	24 V DC at 4 mA, nominal	24 V DC at 4 mA, nominal	24 V DC at 4 mA, nominal
Continuous permissible voltage	30 V DC max.	30 V DC max.	30 V DC max.	30 V DC max.	30 V DC max.
Surge voltage	35 V DC for 0.5 sec.	35 V DC for 0.5 sec.	35 V DC for 0.5 sec.	35 V DC for 0.5 sec.	35 V DC for 0.5 sec.
Logic 1 signal (min.)	15 V DC at 2.5 mA	15 V DC at 2.5 mA	15 V DC at 2.5 mA	15 V DC at 2.5 mA	15 V DC at 2.5 mA
Logic 0 signal (max.)	5 V DC at 1 mA	5 V DC at 1 mA	5 V DC at 1 mA	5 V DC at 1 mA	5 V DC at 1 mA
Isolation (field side to logic)	707 V DC (type test)	707 V DC (type test)	707 V DC (type test)	707 V DC (type test)	707 V DC (type test)
Isolation groups	2	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	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	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	• 8 (no adjacent points) at 60 °C horizontal or 50 °C vertical • 16 at 55 °C horizontal or 45 °C vertical	8	16	16
Cable length (meters)	500 m shielded, 300 m unshielded	500 m shielded, 300 m unshielded	500 m shielded, 300 m unshielded	500 m shielded, 300 m unshielded	500 m shielded, 300 m unshielded

Table A-127 Digital outputs

Model	**SM 1223 DI 8 x 24 V DC, DQ 8 x Relay**	**SM 1223 DI 16 x 24 V DC, DQ 16 x Relay**	**SM 1223 DI 8 x 24 V DC, DQ 8 x 24 V DC**	**SM 1223 DI 16 x 24 V DC, DQ 16 x 24 V DC**	**SM 1223 DI 16 x 24 V DC, DQ 16 x 24 V DC sinking**
Number of outputs	8	16	8	16	16
Type	Relay, mechanical	Relay, mechanical	Solid state - MOSFET (sourcing)	Solid state - MOSFET (sourcing)	Solid state - MOSFET (sinking)
Voltage range	5 to 30 V DC or 5 to 250 V AC	5 to 30 V DC or 5 to 250 V AC	20.4 to 28.8 V DC	20.4 to 28.8 V DC	20.4 to 28.8 V DC
Logic 1 signal at max. current	--	--	20 V DC, min.	20 V DC, min.	0.5 V DC
Logic 0 signal with 10 KΩ load	--	--	0.1 V DC, max.	0.1 V DC, max.	24 V (typical) minus 0.75 V DC
Current (max.)	2.0 A	2.0 A	0.5 A	0.5 A	0.5 A
Lamp load	30 W DC / 200 W AC	30 W DC / 200 W AC	5 W	5 W	5 W
ON state contact resistance	0.2 Ω max. when new	0.2 Ω max. when new	0.6 Ω max.	0.6 Ω max.	0.5 Ω max
Leakage current per point	--	--	10 µA max.	10 µA max.	75 µA max.
Surge current	7 A with contacts closed	7 A with contacts closed	8 A for 100 ms max.	8 A for 100 ms max	Current limit protected
Overload protection	No	No	No	No	Yes, Current limit protected range 1 A to 3.5 A
Isolation (field side to logic)	1500 V AC (coil to contact) None (coil to logic)	1500 V AC (coil to contact) None (coil to logic)	707 V DC (type test)	707 V DC (type test)	707 V DC (type test)
Isolation groups	2	4	1	1	1
Current per common	10A	8 A	4 A	8 A	8 A
Inductive clamp voltage	--	--	L+ minus 48 V, 1 W dissipation	L+ minus 48 V, 1 W dissipation	45 V
Switching delay	10 ms max.	10 ms max.	50 µs max. off to on 200 µs max. on to off	50 µs max. off to on 200 µs max. on to off	20 µs max. off to on 350 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 (N.O. contact)	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)	Last value or substitute value (default value 0)	Last value or substitute value (default value 0)

Model	**SM 1223 DI 8 x 24 V DC, DQ 8 x Relay**	**SM 1223 DI 16 x 24 V DC, DQ 16 x Relay**	**SM 1223 DI 8 x 24 V DC, DQ 8 x 24 V DC**	**SM 1223 DI 16 x 24 V DC, DQ 16 x 24 V DC**	**SM 1223 DI 16 x 24 V DC, DQ 16 x 24 V DC sinking**
Control of a digital input	Yes	Yes	Yes	Yes	Yes (sourcing input)
Parallel outputs for redundant load control	Yes (with same common)	Yes (with same common)	Yes (with same common)	Yes (with same common)	Yes (with same common)
Parallel outputs for increased load	No	No	No	No	No
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	16
Cable length (meters)	500 m shielded, 150 m unshielded	500 m shielded, 150 m unshielded	500 m shielded, 150 m unshielded	500 m shielded, 150 m unshielded	500 m shielded, 150 m unshielded

See also

New features (Page 35)

Table A-128 Wiring diagrams for the digital input V DC/output relay SMs

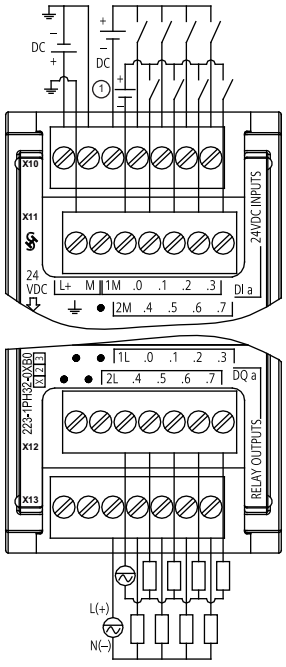
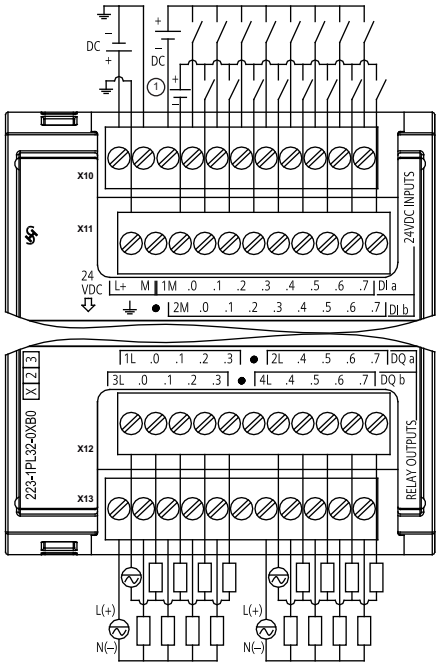
SM 1223 DI 8 x 24 V DC, DQ 8 x Relay (6ES7223-1PH32-0XB0)	SM 1223 DI 16 x 24 V DC, DQ 16 x Relay (6ES7223-1PL32-0XB0)	Notes
		① For sinking inputs, connect "-" to "M" (shown). For sourcing inputs, connect "+" to "M".

Table A-129 Connector Pin Locations for SM 1223 DI 8 x 24 V DC, DQ 8 x Relay (6ES7223-1PH32-0XB0)

Pin	X10	X11	X12	X13
1	L+ / 24 V DC	Functional Earth	No connection	No connection
2	M / 24 V DC	No connection	No connection	No connection
3	1M	2M	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

Table A-130 Connector Pin Locations for SM 1223 DI 16 x 24 V DC, DQ 16 x Relay (6ES7223-1PL32-0XB0)

Pin	X10	X11	X12	X13
1	L+ / 24 V DC	Functional Earth	1L	3L
2	M / 24 V DC	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

Pin	X10	X11	X12	X13
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-131 Wiring diagrams for the digital input V DC/output SMs

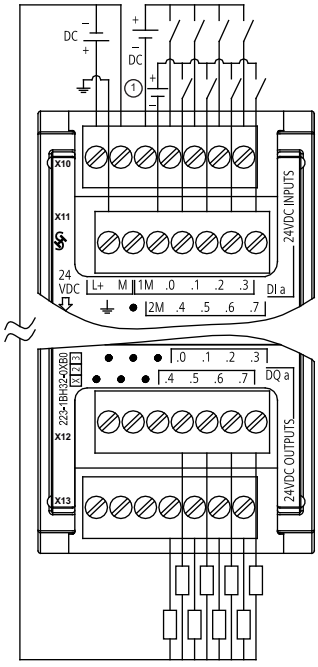
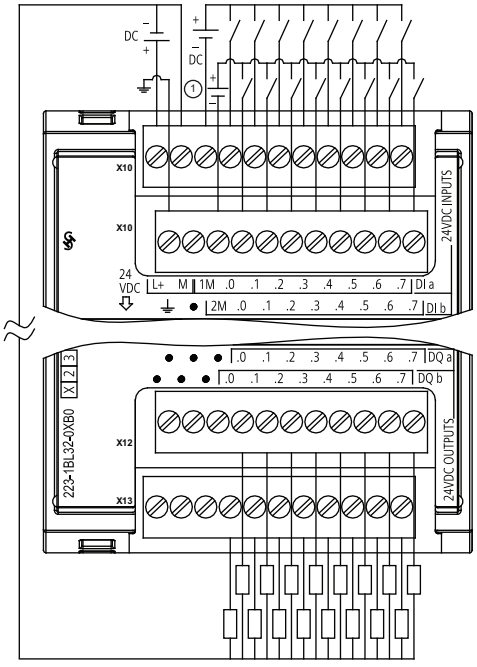
SM 1223 DI 8 x 24 V DC, DQ 8 x 24 V DC (6ES7223-1BH32-0XB0)	SM 1223 DI 16 x 24 V DC, DQ 16 x 24 V DC (6ES7223-1BL32-0XB0)	Notes
		① For sinking inputs, connect "-" to "M" (shown). For sourcing inputs, connect "+" to "M".

Table A-132 Connector Pin Locations for SM 1223 DI 8 x 24 V DC, DQ 8 x 24 V DC (6ES7223-1BH32-0XB0)

Pin	X10	X11	X12	X13
1	L+ / 24 V DC	Functional Earth	No connection	No connection
2	M / 24 V DC	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-139 SM 1223 DI 8 x 120/230 V AC, DQ 8 x Relay (6ES7223-1QH32-0XB0)

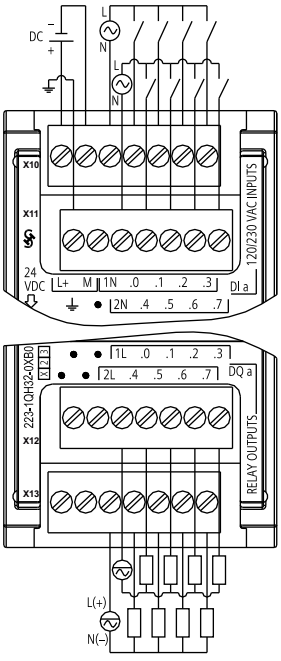


Table A-140 Connector Pin Locations for SM 1223 DI 8 x 120/240 V AC, DQ 8 x Relay (6ES7223-1QH32-0XB0)

Pin	X10	X11	X12	X13
1	L+ / 24 V DC	Functional Earth	No connection	No connection
2	M / 24 V DC	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.10 Analog signal modules (SMs)

A.10.1 SM 1231 analog input module specifications

Table A-141 General specifications

Model	SM 1231 AI 4 x 13 bit	SM 1231 AI 8 x 13 bit	SM 1231 AI 4 x 16 bit
Article number	6ES7231-4HD32-0XB0	6ES7231-4HF32-0XB0	6ES7231-5ND32-0XB0
Dimensions W x H x D (mm)	45 x 100 x 75		

Model	SM 1231 AI 4 x 13 bit	SM 1231 AI 8 x 13 bit	SM 1231 AI 4 x 16 bit
Weight	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 V DC)	45 mA		65 mA

Table A-142 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, 0 to 20 mA, or 4 mA 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)	-27648 to 27648 voltage / 0 to 27648 current		
Overshoot/undershoot range (data word) Refer to the section on analog input ranges for voltage and current (Page 1285).	Voltage: 32511 to 27649 / -27649 to -32,512 Current: 32511 to 27649 / 0 to -4864		
Overflow/underflow (data word) Refer to the section on input ranges for voltage and current (Page 1285).	Voltage: 32767 to 32512 / -32513 to -32768 Current 0 to 20 mA: 32767 to 32512 / -4865 to -32768 Current 4 to 20 mA: 32767 to 32512 (values below -4864 indicate open wire)		
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 1284).		
Noise rejection	400, 60, 50, or 10 Hz Refer to the section on sample rates (Page 1284).		
Input impedance Before parametertization Voltage Current	 ≥ 1 MΩ ≥ 9 MΩ, FS 06 and above ≥ 1 MΩ ≥ 270 Ω, < 290 Ω		 ≥ 1 MΩ ≥ 1 MΩ < 315 Ω, > 280 Ω
Isolation Field side to logic Logic to 24 V DC Field side to 24 V DC Channel to channel	None		 707 V DC (type test) 707 V DC (type test) 500 V DC (type test) 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-143 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		
24 V DC low voltage	Yes		
Open wire	4 to 20 mA range only (if input is below -4864; 1.185 mA)		

SM 1231 current measurment

You can implement current measurement with either a 2-wire transducer or 4-wire transducer as shown in the following figure:

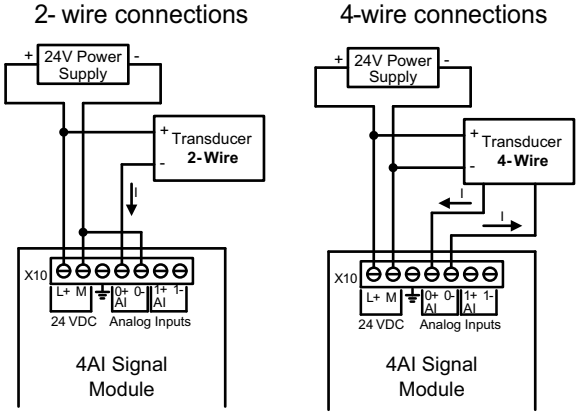


Table A-144 Wiring diagrams for the analog input SMs

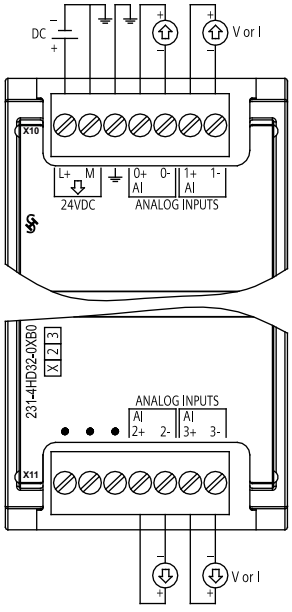
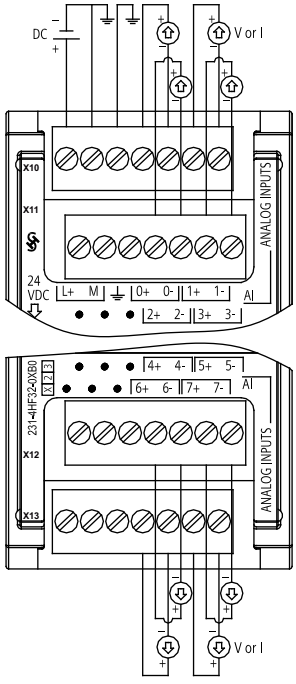
SM 1231 AI 4 x 13 bit (6ES7231-4HD32-0XB0)	SM 1231 AI 8 x 13 bit (6ES7231-4HF32-0XB0)
	
Note: Connectors must be gold. See Appendix C, Spare Parts for article number.	

Table A-145 Connector pin locations for SM 1231 AI 4 x 13 bit (6ES7231-4HD32-0XB0)

Pin	X10 (gold)	X11 (gold)
1	L+ / 24 V DC	No connection
2	M / 24 V DC	No connection
3	Functional Earth	No connection
4	AI 0+	AI 2+
5	AI 0-	AI 2-
6	AI 1+	AI 3+
7	AI 1-	AI 3-

Table A-146 Connector pin locations for SM 1231 AI 8 x 13 bit (6ES7231-4HF32-0XB0)

Pin	X10 (gold)	X11 (gold)	X12 (gold)	X13 (gold)
1	L+ / 24 V DC	No connection	No connection	No connection
2	M / 24 V DC	No connection	No connection	No connection
3	Functional Earth	No connection	No connection	No connection
4	AI 0+	AI 2+	AI 4+	AI 6+
5	AI 0-	AI 2-	AI 4-	AI 6-
6	AI 1+	AI 3+	AI 5+	AI 7+
7	AI 1-	AI 3-	AI 5-	AI 7-

Ordering Information

C

C.1 CPU modules

Table C-1 S7-1200 CPUs

CPU models		Article number
CPU 1211C	CPU 1211C DC/DC/DC	6ES7211-1AE40-0XB0
	CPU 1211C AC/DC/Relay	6ES7211-1BE40-0XB0
	CPU 1211C DC/DC/Relay	6ES7211-1HE40-0XB0
CPU 1212C	CPU 1212C DC/DC/DC	6ES7212-1AE40-0XB0
	CPU 1212C AC/DC/Relay	6ES7212-1BE40-0XB0
	CPU 1212C DC/DC/Relay	6ES7212-1HE40-0XB0
CPU 1214C	CPU 1214C DC/DC/DC	6ES7214-1AG40-0XB0
	CPU 1214C AC/DC/Relay	6ES7214-1BG40-0XB0
	CPU 1214C DC/DC/Relay	6ES7214-1HG40-0XB0
CPU 1215C	CPU 1215C DC/DC/DC	6ES7215-1AG40-0XB0
	CPU 1215C AC/DC/Relay	6ES7215-1BG40-0XB0
	CPU 1215C DC/DC/Relay	6ES7215-1HG40-0XB0
CPU 1217C	CPU 1217C DC/DC/DC	6ES7217-1AG40-0XB0

C.2 Signal modules (SMs), signal boards (SBs), and battery boards (BBs)

Table C-2 Signal modules (SMs)

Signal modules		Article number
Digital input	SM 1221 8 x 24 V DC Input (Sink/Source)	6ES7221-1BF32-0XB0
	SM 1221 16 x 24 V DC Input (Sink/Source)	6ES7221-1BH32-0XB0
Digital output	SM 1222 8 x 24 V DC Output (Source)	6ES7222-1BF32-0XB0
	SM 1222 16 x 24 V DC Output (Source)	6ES7222-1BH32-0XB0
	SM 1222 16 x 24 V DC Output (Sinking)	6ES7222-1BH32-1XB0
	SM 1222 8 x Relay Output	6ES7222-1HF32-0XB0
	SM 1222 8 x Relay Output (Changeover)	6ES7222-1XF32-0XB0
	SM 1222 16 x Relay Output	6ES7222-1HH32-0XB0

Signal modules		Article number
Digital input / output	SM 1223 8 x 24 V DC Input (Sink/Source) / 8 x 24 V DC Output (Source)	6ES7223-1BH32-0XB0
	SM 1223 16 x 24 V DC Input (Sink/Source) / 16 x 24 V DC Output (Source)	6ES7223-1BL32-0XB0
	SM 1223 16 x 24 V DC Input / 16 x 24 V DC Output (Sinking)	6ES7223-1BL32-1XB0
	SM 1223 8 x 24 V DC Input (Sink/Source) / 8 x Relay Output	6ES7223-1PH32-0XB0
	SM 1223 16 x 24 V DC Input (Sink/Source) / 16 x Relay Output	6ES7223-1PL32-0XB0
	SM 1223 8 x 120/230 V AC Input (Sink/Source) / 8 x Relay Outputs	6ES7223-1QH32-0XB0
Analog input	SM 1231 4 x Analog Input	6ES7231-4HD32-0XB0
	SM 1231 8 x Analog Input	6ES7231-4HF32-0XB0
	SM 1231 4 x Analog Input x 16 bit (high feature)	6ES7231-5ND32-0XB0
	SM 1238 Energy Meter 480 V AC	6ES7238-5XA32-0XB0
Analog output	SM 1232 2 x Analog Output	6ES7232-4HB32-0XB0
	SM 1232 4 x Analog Output	6ES7232-4HD32-0XB0
Analog input / output	SM 1234 4 x Analog Input / 2 x Analog Output	6ES7234-4HE32-0XB0
RTD and thermocouple	SM 1231 TC 4 x 16 bit	6ES7231-5QD32-0XB0
	SM 1231 TC 8 x 16 bit	6ES7231-5QF32-0XB0
	SM 1231 RTD 4 x 16 bit	6ES7231-5PD32-0XB0
	SM 1231 RTD 8 x 16 bit	6ES7231-5PF32-0XB0
Technology modules	SM 1278 4xIO-Link Master	6ES7278-4BD32-0XB0
	SIWAREX WP231, calibrater weighing electronic (1 channel) for strain guage load cells / full bridges (1-4 MV/V) for SIMATIC S7-1200, RS485 and Ethernet - interface, onboard I/O: 4 DI / 4 DO, 1 AO (0/4...20 MA)	7MH4960-2AA01
	SIWAREX WP241, belt weigher electronic (1 channel) for strain guage load cells / full bridges (1-4 M/V) for SIMATIC S7-1200, RS485 and Ethernet-interface, onboard I/O: 4 DI / 4 DO, 1 AO (0/4...20 MA)	7MH4960-4AA01
	SIWAREX WP251, weighing electronic for batching and filling processes (1 channel) for strain guage load cells / full bridges (1-4 MV/V) for SIMATIC S7-1200, RS485 and Ethernet - interface, onboard I/O: 4 DI / 4 DO, 1 AO (0/4...20MA),	7MH4960-6AA01

Table C-3 Signal boards (SB) and battery boards (BBs)

Signal and battery boards		Article number
Digital input	SB 1221 200 kHz 4 x 24 V DC Input (Source)	6ES7221-3BD30-0XB0
	SB 1221 200 kHz 4 x 5 V DC Input (Source)	6ES7221-3AD30-0XB0
Digital output	SB 1222 200 kHz 4 x 24 V DC Output (Sink/Source)	6ES7222-1BD30-0XB0
	SB 1222 200 kHz 4 x 5 V DC Output (Sink/Source)	6ES7222-1AD30-0XB0
Digital input / output	SB 1223 2 x 24 V DC Input (Sink) / 2 x 24 V DC Output (Source)	6ES7223-0BD30-0XB0
	SB 1223 200 kHz 2 x 24 V DC Input (Source) / 2 x 24 V DC Output (Sink/Source)	6ES7223-3BD30-0XB0
	SB 1223 200 kHz 2 x 5 V DC Input (Source) / 2 x 5 V DC Output (Sink/Source)	6ES7223-3AD30-0XB0

Table C-17 S7-1200 SMs V3.2 and later - Terminal block spare kits

If you have S7-1200 SMs V3.2 and later (article number)	Use this terminal block spare kit (4/pk)		
	Terminal block (screw-type) article number	Equivalent Push-in terminal block article number	Terminal block description
SM 1221 DI 8 x DC (6ES7221-1BF32-0XB0)	6ES7292-1AG30-0XA0	6ES7292-2AG30-0XA0	7 pin, tin-plated
SM 1222 DQ 8 x DC (6ES7222-1BF32-0XB0)	6ES7292-1AG30-0XA0	6ES7292-2AG30-0XA0	7 pin, tin-plated
SM 1222 DQ 8 x Relay (6ES7222-1HF32-0XB0)	6ES7292-1AG40-0XA1	6ES7292-2AG40-0XA1	7 pin, tin-plated, keyed-left
SM 1238 Energy Meter 480 V AC (6ES7238-5XA32-0XB0) for voltage input (top)	6ES7292-1AG40-0XA2	6ES7292-2AG40-0XA2	7-pin, tin-plated, keyed-middle
SM 1238 Energy Meter 480 V AC (6ES7238-5XA32-0XB0) for current input (bottom)	6ES7292-1AG30-0XA0	6ES7292-2AG30-0XA0	7-pin, tin-plated
SM 1231 AI 4 x 13 bit (6ES7231-4HD32-0XB0)	6ES7292-1BG30-0XA0	6ES7292-2BG30-0XA0	7 pin, gold-plated
SM 1232 AQ 2 x 14 bit (6ES7232-4HB32-0XB0)	6ES7292-1BG30-0XA0	6ES7292-2BG30-0XA0	7 pin, gold-plated
SM 1231 AI 4 x TC (6ES7231-5QD32-0XB0)	6ES7292-1BG30-0XA0	6ES7292-2BG30-0XA0	7 pin, gold-plated
SM 1231 AI 4 x 16 bit (6ES7231-5ND32-0XB0)	6ES7292-1BG30-0XA0	6ES7292-2BG30-0XA0	7 pin, gold-plated
SM 1221 DI 16 x DC (6ES7221-1BH32-0XB0)	6ES7292-1AG30-0XA0	6ES7292-2AG30-0XA0	7 pin, tin-plated
SM 1222 DQ 16 x DC (6ES7222-1BH32-0XB0)	6ES7292-1AG30-0XA0	6ES7292-2AG30-0XA0	7 pin, tin-plated
SM 1222 DQ 16 x Relay (6ES7222-1HH32-0XB0)	6ES7292-1AG40-0XA0	6ES7292-2AG40-0XA0	7 pin, tin-plated, keyed-right
SM 1223 DI 8 x DC/DQ 8 x DC (6ES7223-1BH32-0XB0)	6ES7292-1AG30-0XA0	6ES7292-2AG30-0XA0	7 pin, tin-plated
SM 1223 8 x DC/8 x Relay (6ES7223-1PH32-0XB0)	6ES7292-1AG30-0XA0	6ES7292-2AG30-0XA0	7 pin, tin-plated
	6ES7292-1AG40-0XA0	6ES7292-2AG40-0XA0	7 pin, tin-plated, keyed-right
SM 1223 8 x AC/8 x Relay (6ES7223-1QH32-0XB0)	6ES7292-1AG40-0XA0	6ES7292-2AG40-0XA0	7 pin, tin-plated, keyed-right
SM 1234 AI 4 / AQ 2 (6ES7234-4HE32-0XB0)	6ES7292-1BG30-0XA0	6ES7292-2BG30-0XA0	7 pin, gold-plated
SM 1231 AI 8 x 13 BIT (6ES7231-4HF32-0XB0)	6ES7292-1BG30-0XA0	6ES7292-2BG30-0XA0	7 pin, gold-plated
SM 1232 AQ 4 x 14 bit (6ES7232-4HD32-0XB0)	6ES7292-1BG30-0XA0	6ES7292-2BG30-0XA0	7 pin, gold-plated
SM 1231 AI 4 x RTD (6ES7231-5PD32-0XB0)	6ES7292-1BG30-0XA0	6ES7292-2BG30-0XA0	7 pin, gold-plated