MANUFACTURER DOCUMENT PACKAGE

Manufacturer's Manual

Selected official pages for procurement and maintenance review

PRODUCT BRAND

Siemens

PRODUCT MODEL

6ES7288-1ST20-0AA1

CPU ST20 Transistor Controller. Relevant section pages: 844, 845, 846, 847, 848, 849, 850, 851. Adjacent model text on shared pages is outside this product reference.

OFFICIAL SOURCE

S7-200 SMART System Manual; V2.8, 08/2023

Siemens original documentation and product reference

Siemens V2.8 technical excerpt, not complete installation instructions. Read the CPU ST20 column; other models share these pages. Original warnings and firmware applicability are included. Supplied firmware must be verified.

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Amikon Limited prepared this independent reference package. Selected manufacturer pages follow with their original content and pagination visible.

Legal information

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This manual contains notices you have to observe in order to ensure your personal safety, as well as to prevent damage to property. The notices referring to your personal safety are highlighted in the manual by a safety alert symbol, notices referring only to property damage have no safety alert symbol. These notices shown below are graded according to the degree of danger.

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indicates that death or severe personal injury **may** result if proper precautions are not taken.

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indicates that minor personal injury can result if proper precautions are not taken.

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The product/system described in this documentation may be operated only by **personnel qualified** for the specific task in accordance with the relevant documentation, in particular its warning notices and safety instructions. Qualified personnel are those who, based on their training and experience, are capable of identifying risks and avoiding potential hazards when working with these products/systems.

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We have reviewed the contents of this publication to ensure consistency with the hardware and software described. Since variance cannot be precluded entirely, we cannot guarantee full consistency. However, the information in this publication is reviewed regularly and any necessary corrections are included in subsequent editions.

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A5E03822230-AL
Ⓟ 08/2023 Subject to change

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1.2 New Features

1.2.1 What's new in S7-200 SMART V2.8?

Only the following CPU models with firmware V2.8 support the new features described in this chapter:

Table 1-4 CPU models affected by firmware V2.8

CPU model	Article number
CPU SR20, AC/DC/Relay	6ES7288-1SR20-0AA1
CPU ST20, DC/DC/DC	6ES7288-1ST20-0AA1
CPU SR30, AC/DC/Relay	6ES7288-1SR30-0AA1
CPU ST30, DC/DC/DC	6ES7288-1ST30-0AA1
CPU SR40, AC/DC/Relay	6ES7288-1SR40-0AA1
CPU ST40, DC/DC/DC	6ES7288-1ST40-0AA1
CPU SR60, AC/DC/Relay	6ES7288-1SR60-0AA1
CPU ST60, DC/DC/DC	6ES7288-1ST60-0AA1

Note

CPU models with firmware V2.8 cannot be downgraded to V2.7 or any previous versions.

STEP 7-Micro/WIN SMART V2.8 release provides the following new features:

New instructions

- **Bit logic**
  - Alternating output and alternating output on pulse (Page 225)
- **Convert**
  - Double float to real (Page 274)
  - BCD to Double Integer (Page 274)
  - Double Integer to BCD (Page 274)
  - Scale (Page 291)

A.2 S7-200 SMART CPUs

A.2.1 CPU ST20, CPU SR20, and CPU CR20s

A.2.1.1 General specifications and features

General specifications and features of the CPU ST20, CPU SR20, and CPU CR20s

Table A-8 General specifications

Technical data	CPU ST20 DC/DC/DC	CPU SR20 AC/DC/Relay	CPU CR20s AC/DC/Relay
Article number	6ES7288-1ST20-0AA1	6ES7288-1SR20-0AA1	6ES7288-1CR20-0AA1
Dimensions W x H x D (mm)	90 x 100 x 81	90 x 100 x 81	90 x 100 x 81
Weight	320 grams	367.3 grams	363 grams
Power dissipation	20 W	14 W	6 W
Current available (EM bus)	1400 mA max. (5 V DC)	1400 mA max. (5 V DC)	Not available
Current available (24 V DC)	300 mA max. (sensor power)	300 mA max. (sensor power)	300 mA max. (sensor power)
Digital input current consumption (24 V DC)	4 mA/input used	4 mA/input used	4 mA/ input used

Table A-9 CPU features

Technical data		CPU ST20 DC/DC/DC	CPU SR20 AC/DC/Relay	CPU CR20s AC/DC/Relay
User memory[1]	Program	12 Kbytes	12 Kbytes	12 Kbytes
	User data (V)	12 Kbytes	12 Kbytes	8 Kbytes
	Retentive	12 Kbytes max.[1]	12 Kbytes max.[1]	2 Kbytes max.[1]
On-board digital I/O		12 inputs/8 outputs	12 inputs/8 outputs	12 inputs/8 outputs
Process image		256 bits of inputs (I) / 256 bits of outputs (Q)	256 bits of inputs (I) / 256 bits of outputs (Q)	256 bits of inputs (I) / 256 bits of outputs (Q)
Analog image		56 words of inputs (AI) / 56 words of outputs (AQ)	56 words of inputs (AI) / 56 words of outputs (AQ)	Not available
Bit memory (M)		256 bits	256 bits	256 bits
Temporary (local) memory (L)		64 bytes in the main program and 64 bytes in each subroutine and interrupt routine 60 bytes when programming in LAD or FBD (STEP 7-Micro/WIN reserves 4 bytes)	64 bytes in the main program and 64 bytes in each subroutine and interrupt routine 60 bytes when programming in LAD or FBD (STEP 7-Micro/WIN reserves 4 bytes)	64 bytes in the main program and 64 bytes in each subroutine and interrupt routine 60 bytes when programming in LAD or FBD (STEP 7-Micro/WIN reserves 4 bytes)
Sequential control relays (S)		256 bits	256 bits	256 bits
Expansion modules expansion		6	6	Not available

Technical data		CPU ST20 DC/DC/DC	CPU SR20 AC/DC/Relay	CPU CR20s AC/DC/Relay
Signal board expansion		1 max.	1 max.	Not available
High-speed counters	Total	6	6	4
	Single phase	4 at 200 kHz 2 at 30 kHz	4 at 200 kHz 2 at 30 kHz	4 at 100 kHz
	A/B phase	2 at 100 Khz 2 at 20 kHz	2 at 100 Khz 2 at 20 kHz	2 at 50 kHz
Pulse outputs [2]		2 at 100 kHz[2]	2 at 100 kHz[2]	Not available
Pulse catch inputs		12	12	Not available
Cyclic interrupts		2 at 1 ms resolution	2 at 1 ms resolution	2 at 1 ms resolution
Edge interrupts		4 rising and 4 falling (6 and 6 with optional signal board)	4 rising and 4 falling (6 and 6 with optional signal board)	4 rising and 4 falling
Memory card		microSDHC Card (optional)	microSDHC Card (optional)	Not available
Real time clock accuracy		+/- 120 seconds/month	+/- 120 seconds/month	Not available
Real time clock retention time		7 days typ./6 days min. at 25 °C (maintenance-free Super Capacitor)	7 days typ./6 days min. at 25 °C (maintenance-free Super Capacitor)	Not available

[1] You can configure areas of V memory, M memory, C memory (current values), and portions of T memory (current values on retentive times) to be retentive, up to the specified maximum amount.

[2] The specified maximum pulse frequency is possible only for CPU models with transistor outputs. Pulse output operation is not recommended for CPU models with relay outputs.

Table A-10 PROFINET features

Description	CPU ST20 DC/DC/DC	CPU SR20 AC/DC/Relay
Support Controller function for PROFINET communication	Yes	
Support I-Device function for PROFINET communication	Yes	
Maximum number of PROFINET device	8	
Device number of PROFINET device	1 to 8	
Maximum input size of each PROFINET device	128 Bytes	
Maximum output size of each PROFINET device	128 Bytes	
Maximum input size of PROFINET I-Device	128 Bytes	
Maximum output size of PROFINET I-Device	128 Bytes	
Maximum number of modules	64	
Minimum cyclic update time of PROFINET device	The minimum value of the update time also depends on the communication component set for PROFINET, on the number of PROFINET devices, and the quantity of configured user data.	
CPU address range of PROFINET process image input register	I128.0 to I1279.7	
CPU address range of PROFINET process image output register	Q128.0 to Q1279.7	
CPU address of PROFINET process image input and output register for device #1	I128.0 to I255.7 Q128.0 to Q255.7	

Description	CPU ST20 DC/DC/DC	CPU SR20 AC/DC/Relay
CPU address of PROFINET process image input and output register for device #2	I256.0 to I383.7 Q256.0 to Q383.7	
CPU address of PROFINET process image input and output register for device #3	I384.0 to I511.7 Q384.0 to Q511.7	
CPU address of PROFINET process image input and output register for device #4	I512.0 to I639.7 Q512.0 to Q639.7	
CPU address of PROFINET process image input and output register for device #5	I640.0 to I767.7 Q640.0 to Q767.7	
CPU address of PROFINET process image input and output register for device #6	I768.0 to I895.7 Q768.0 to Q895.7	
CPU address of PROFINET process image input and output register for device #7	I896.0 to I1023.7 Q896.0 to Q1023.7	
CPU address of PROFINET process image input and output register for device #8	I1024.0 to I1151.7 Q1024.0 to Q1151.7	
CPU address of PROFINET process image input and output register for I-Device	I1152.0 to I1279.7 Q1152.0 to Q1279.7	

Table A-11 Performance

Type of instruction	Execution speed
Boolean	150 ns instruction
Move Word	1.2 µs/instruction
Real math	3.6 µs/instruction

Table A-12 User program elements supported

Element		Description
POUs	Type/quantity	Main program: 1 Subroutines: 128 (0 to 127) Interrupt routines: 128 (0 to 127)
	Nesting depth	From main program: 8 subroutine levels From interrupt routine: 4 subroutine levels
Accumulators	Quantity	4
Timers	Type/quantity	Non-retentive (TON, TOF): 192 Retentive (TONR): 64
Counters	Quantity	256

Table A-13 Communication

Technical data	CPU ST20 DC/DC/DC	CPU SR20 AC/DC/Relay	CPU CR20s AC/DC/Relay
Number of ports	PROFINET (LAN): 1 Serial ports: 1 (RS485) Add-on serial ports: 1 (with optional RS232/485 signal board)	PROFINET (LAN): 1 Serial ports: 1 (RS485) Add-on serial ports: 1 (with optional RS232/485 signal board)	PROFINET (LAN): 0 Serial ports: 1 (RS485) Add-on serial ports: 0
HMI device	PROFINET (LAN): 8 connections Serial ports: 4 connections per port	PROFINET (LAN): 8 connections Serial ports: 4 connections per port	PROFINET (LAN): Not available Serial ports: 4 connections per port
Programming device (PG)	PROFINET (LAN): 1 connection Serial ports: 1 connection	PROFINET (LAN): 1 connection Serial ports: 1 connection	PROFINET (LAN): Not available Serial ports: 1 connection
CPUs (PUT/GET)	PROFINET (LAN): 8 client and 8 server connections	PROFINET (LAN): 8 client and 8 server connections	PROFINET (LAN): Not available
Open user communication	PROFINET (LAN): 8 active and 8 passive connections	PROFINET (LAN): 8 active and 8 passive connections	PROFINET (LAN): Not available
Data rates	PROFINET (LAN): 10/100 Mb/s RS485 system protocols: 9600, 19200, and 187500 b/s RS485 freeport: 1200 to 115200 b/s	PROFINET (LAN): 10/100 Mb/s RS485 system protocols: 9600, 19200, and 187500 b/s RS485 freeport: 1200 to 115200 b/s	PROFINET (LAN): Not available RS485 system protocols: 9600, 19200, and 187500 b/s RS485 freeport: 1200 to 115200 b/s
Isolation (external signal to PLC logic)	PROFINET (LAN): Transformer isolated, 1500 V AC RS485: RS485 signal to chassis ground, 500 V AC/ 707 V DC; RS485 signal to CPU logic common, 500 V AC/ 707V DC;	PROFINET (LAN): Transformer isolated, 1500 V AC RS485: RS485 signal to chassis ground, 500 V AC/ 707 V DC; RS485 signal to CPU logic common, 500 V AC/ 707V DC;	PROFINET (LAN): Not available RS485: RS485 signal to chassis ground, 500 V AC/ 707 V DC; RS485 signal to CPU logic common, 500 V AC/ 707V DC;
Cable type	PROFINET (LAN): CAT5e shielded RS485: PROFIBUS network cable	PROFINET (LAN): CAT5e shielded RS485: PROFIBUS network cable	PROFINET (LAN): Not available RS485: PROFIBUS network cable
PROFINET Communication			
PROFINET controller	Yes	Yes	No
PROFINET device	Yes	Yes	No
PROFINET controller			
Services			
PG/OP communication	Yes	Yes	No
S7 routing	Yes	Yes	No
Isochronous mode	No	No	No
Open IE communication	Yes	Yes	No
IRT	No	No	No
MRP	No	No	No
PROFIenergy	No	No	No

Technical data	CPU ST20 DC/DC/DC	CPU SR20 AC/DC/Relay	CPU CR20s AC/DC/Relay
Max. number of PROFINET devices that you can connect for RT	8	8	--
Max. number of module	64	64	--
Update times	The minimum value of the update time also depends on the communication component set for PROFINET, on the number of PROFINET devices, and the quantity of configured user data.	The minimum value of the update time also depends on the communication component set for PROFINET, on the number of IO devices, and the quantity of configured user data.	No
With RT			
Send clock of 1 ms	1 ms to 512 ms	1 ms to 512 ms	--

Table A-14 Power supply

Technical data		CPU ST20 DC/DC/DC	CPU SR20 AC/DC/Relay		CPU CR20s AC/DC/Relay	
Voltage range		20.4 to 28.8 V DC	85 to 264 V AC	77 to 138 V DC	85 to 264 V AC	77 to 138 V DC
Line frequency		--	47 to 63 Hz	--	47 to 63 Hz	--
Input current	CPU only at max. load	160 mA at 24 V DC (without driving 300 mA sensor power) 430 mA at 24 V DC (with driving 300 mA sensor power)	210 mA at 120 V AC (with 300 mA power sensor output) 90 mA at 120 V AC (without 300 mA power sensor output) 120 mA at 240 V AC (with 300 mA power sensor output) 60 mA at 240 V AC (without 300 mA power sensor output)	120 mA at 110 VDC (with 300 mA power sensor output) 44 mA at 110 VDC (without 300 mA power sensor output)	90 mA at 120 V AC 60 mA at 240 V AC	120 mA at 110 VDC (with 300 mA power sensor output) 44 mA at 110 VDC (without 300 mA power sensor output)
	CPU with all expansion accessories at max. load	720 mA at 24 V DC	290 mA at 120 V AC 170 mA at 240 V AC	207 mA at 110 VDC (with 300 mA power sensor output)	--	207 mA at 110 VDC (with 300 mA power sensor output)
Hold up time (loss of power)		20 ms at 24 V DC	30 ms at 120 V AC 200 ms at 240 V AC	30 ms at 110 V DC	30 ms at 120 V AC 200 ms at 240 V AC	30 ms at 110 V DC
Inrush current (max.)		11.7 A at 28.8 V DC	9.3 A at 264 V AC		16.3 A at 264 V AC	

Technical data	CPU ST20 DC/DC/DC	CPU SR20 AC/DC/Relay	CPU CR20s AC/DC/Relay
Isolation (input power to logic)	--	1500 V AC	1500 V AC
Ground leakage, AC line to functional earth	--	0.5 mA max.	0.5 mA max.
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-15 Sensor power

Technical data	CPU ST20 DC/DC/DC	CPU SR20 AC/DC/Relay	CPU CR20s AC/DC/Relay
Voltage range	20.4 to 28.8 V DC	20.4 to 28.8 V DC	20.4 to 28.8 V DC
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	< 1 V peak to peak	< 1 V peak to peak
Isolation (CPU logic to sensor power)	Not isolated	Not isolated	Not isolated

A.2.1.2 Digital inputs and outputs

Table A-16 Digital inputs

Technical data	CPU ST20 DC/DC/DC	CPU SR20 AC/DC/Relay	CPU CR20s AC/DC/Relay
Number of inputs	12	12	12
Type	SinkSource (IEC Type 1 sink, except I0.0 to I0.3, I0.6 to I0.7)	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
Continuous permissible voltage	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.
Logic 1 signal (min.)	I0.0 to I0.3, I0.6 to I0.7: 4 V DC at 8 mA Other inputs: 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.)	I0.0 to I0.3, I0.6 to I0.7: 1 V DC at 1 mA Other inputs: 5 V DC at 1 mA	5 V DC at 1 mA	5 V DC at 1 mA
Isolation (field side to logic)	500 V AC for 1 minute	500 V AC for 1 minute	500 V AC for 1 minute
Isolation groups	1	1	1

Technical data	CPU ST20 DC/DC/DC	CPU SR20 AC/DC/Relay	CPU CR20s AC/DC/Relay
Filter times	Individually selectable on each channel (points I0.0 to I1.3): µs: 0.2, 0.4, 0.8, 1.6, 3.2, 6.4, 12.8 ms: 0.2, 0.4, 0.8, 1.6, 3.2, 6.4, 12.8	Individually selectable on each channel (points I0.0 to I1.3): µs: 0.2, 0.4, 0.8, 1.6, 3.2, 6.4, 12.8 ms: 0.2, 0.4, 0.8, 1.6, 3.2, 6.4, 12.8	Individually selectable on each channel (points I0.0 to I1.3): µs: 0.2, 0.4, 0.8, 1.6, 3.2, 6.4, 12.8 ms: 0.2, 0.4, 0.8, 1.6, 3.2, 6.4, 12.8
HSC clock input rates (max.)	Single phase: 4 HSCs at 200 kHz; 2 HSCs at 30 kHz A/B phase: 2 HSCs at 100 kHz; 2 HSCs at 20 kHz	Single phase: 4 HSCs at 200 kHz; 2 HSCs at 30 kHz A/B phase: 2 HSCs at 100 kHz; 2 HSCs at 20 kHz	Single phase: 4 HSCs at 100 kHz A/B phase: 2 HSCs at 50 kHz
Number of inputs on simultaneously	12	12	12
Cable length (max.), in meters	I0.0 to I0.3: Shielded (only): • 500 m normal (low-speed) inputs • 50 m HSC (high-speed) inputs I0.6 to I0.7: • Shielded (only): 500 m normal inputs All other inputs: • Shielded: 500 m normal inputs • Unshielded: 300 m normal inputs	All inputs: Shielded: • 500 m normal inputs • 50 m HSC inputs Unshielded: • 300 m normal inputs	All inputs: Shielded: • 500 m normal inputs, • 50 m HSC inputs Unshielded: • 300 m normal inputs

Table A-17 Digital outputs

Technical data	CPU ST20 DC/DC/DC	CPU SR20 AC/DC/Relay	CPU CR20s AC/DC/Relay
Number of outputs	8	8	8
Type	Solid state - MOSFET (sourcing)	Relay, dry contact	Relay, dry contact
Voltage range	20.4 to 28.8 V DC	5 to 30 V DC or 5 to 250 V AC	5 to 30 V DC or 5 to 250 V AC
Logic 1 signal at max. current	20 V DC min.	--	--
Logic 0 signal with 10 KΩ load	0.1 V DC max.	--	--
Rated current per point (max.)	0.5 A	2.0 A	2.0 A
Rated current per common (max.)	6 A	10.0 A	10.0 A
Lamp load	5 W	30 W DC/200 W AC	30 W DC/200 W AC
ON state resistance	0.6 Ω max.	0.2 Ω max. when new	0.2 Ω max. when new
Leakage current per point	10 µA max.	--	--
Surge current	8 A for 100 ms max.	7 A with contacts closed	7 A with contacts closed

Technical data	CPU ST20 DC/DC/DC	CPU SR20 AC/DC/Relay	CPU CR20s AC/DC/Relay
Overload protection	No	No	No
Isolation (field side to logic)	500 V AC for 1 minute	1500 V AC for 1 minute (coil to contact) None (coil to logic)	1500 V AC for 1 minute (coil to contact) None (coil to logic)
Isolation resistance	--	100 M Ω min. when new	100 M Ω min. when new
Isolation between open contacts	--	750 V AC for 1 minute	750 V AC for 1 minute
Isolation groups	2	1	1
Inductive clamp voltage	L+ minus 48 V DC, 1 W dissipation	Not recommended	Not recommended
Switching delay (Qa.0 to Qa.3)	1.0 µs max., off to on 3.0 µs max., on to off	10 ms max.	10 ms max.
Switching delay (Qa.4 to Qa.7)	50 µs max., off to on 200 µs max., on to off	10 ms max.	10 ms max.
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
Output state in STOP mode	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	8	8
Cable length (max.), in meters	Shielded: 500 m Unshielded: 300 m	Shielded: 500 m Unshielded: 300 m	Shielded: 500 m Unshielded: 300 m