

SIMATIC

ET 200PA SMART+ Distributed I/O System ET 200PA SMART+

System Manual

6DL1164-6TH00-0PH1, 6DL1161-6BL00-0PH1,
6DL1165-6TF00-0PH1, 6DL1162-6BL00-0PH1,
6DL1164-6JH00-0PH1, 6DL1161-6BH00-0PH1,
6DL1162-6BH00-0PH1

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Configuration of the ET 200PA SMART+

Note

Updates

Ensure that the latest updates are installed.

You can configure the following components of the distributed I/O system when the following updates are installed:

Component of the distributed I/O system	Required updates
AI 16xTC/8xRTD 2/3/4-wire PA	HSP0319
AI 16xI 2-wire HART PA	
AQ 8xI HART PA	HSP0320
DI 16x24VDC PA	HSP0321
DI 32x24VDC PA	
DQ 16x24VDC/0.5A PA	HSP0322
DQ 32x24VDC/0.5A PA	

Configuring the fail-safe I/O modules

The following hardware and software requirements must be met for you to configure the fail-safe I/O modules of the distributed I/O system.

- Hardware:
 - SIMATIC CPU 41x-5H PN/DP, as of firmware version V6.0
SIMATIC CPU 410-5H (including 410E, 410 PA), as of firmware version V8.2
 - IM155-6 PN HA, as of firmware version V1.2
- Software:
 - S7 F Systems V6.4 (or higher)
PCS 7 V9.1 + HUP (or higher)

Conventions

The following terms are used synonymously in this documentation:

Term	Synonyms	Notes
I/O station	• IO device	Unless otherwise specified, applies for a station of the distributed I/O system (I/O device at a PROFINET IO).
I/O module	• I/O module • Module • Electronic module • PM	Unless otherwise specified, applies to the objects of the distributed I/O in which the electronics for detecting sensor signals and/or for outputting hardware control signals to actuators is implemented.

Applications for safety engineering are possible through:

- Connection to fail-safe automation systems
- Use of fail-safe I/O modules

You perform configuration and programming of your safety program just like the configuration and programming for your standard CPUs.

See also

SIMATIC ET 200PA SMART+ Distributed I/O System (Page 18)

3.2 SIMATIC ET 200PA SMART+ Distributed I/O System [ID: 151019838347]

Definition

The SIMATIC ET 200PA SMART+ distributed I/O system is a scalable I/O system based on SIMATIC ET 200SP HA.

Overview of I/O modules

I/O modules of the ET 200PA SMART+ can be mixed in an I/O station with components of the SIMATIC ET 200SP HA.

As soon as a module of the ET 200PA SMART+ is configured in an I/O station, the maximum size of this I/O system is limited to 24 slots.

The following ET 200PA SMART+ components are available:

Component	Order number
DI 16x24VDC PA	6DL1161-6BH00-0PH1
DI 32x24VDC PA	6DL1161-6BL00-0PH1
DQ 16x24VDC/0.5A PA	6DL1162-6BH00-0PH1
DQ 32x24VDC/0.5A PA	6DL1162-6BL00-0PH1
AI 16xTC/8xRTD 2/3/4-wire PA	6DL1164-6JH00-0PH1
AI 16xI 2-wire HART PA	6DL1164-6TH00-0PH1
AQ 8xI HART PA	6DL1165-6TF00-0PH1
Carrier module 8x (without power bus)	6DL1163-6GC00-8NN0
Carrier module 2x (incl. power bus)	6DL1163-6GA00-0NN0
D-SUB terminal block type H0	6DL1163-6TC00-0DH0

Permissible load current depending on the number of installed terminal blocks:

Number of terminal blocks	Permissible load current in amperes
4	10
5	8
6	7
7	6
8	5
10	4
15	3
20	2

4.8.3 Address space [ID: 151023076747]

Definition

The address space is the number of possible addresses in a memory.

Description

The address space depends on the following components used:

- Interface module
- IO controller/IO device

4.9 Configurations of the slots of I/O modules

4.9.1 Selection of the terminal blocks: [ID: 151023089291]

Definition

The selection of the terminal blocks specifies the main properties for use of the I/O modules.
Technical specifications - Terminal blocks (Page 174)

Description

Select the terminal block for the slot of an I/O module based on the following dependencies:

- Definition of I/O modules associated with a potential group
- Requirement for configuring redundant I/O modules

- Parameters of the required I/O module (number of process terminals, temperature detection)
- Fast wiring via plug-in connectors

When using carrier modules without a power bus, the light gray or black terminal blocks must be used for the supply of the I/O modules.

The I/O module required in the plant requires an adequate terminal block. The adequate terminal blocks are marked by an "x" in the table.

I/O module	Terminal blocks					
	TB 24V					
	H1	M1	P0	N0	H0	M0
	Push-In	Push-In	Push-In	Push-In	D-SUB	D-SUB
	Single	IO redundancy	L+ terminals	M terminals	Single	IO redundancy
DI 16x24VDC PA	x	x		x ¹⁾	x	
DI 32x24VDC PA	x		x	x ¹⁾	x	
DQ 16x24V/0.5A PA	x	x		x ¹⁾	x	
DQ 32x24V/0.5A PA	x			x	x	
AI 16xI 2-wire HART PA	x	x		x ¹⁾	x	
AI16xTC/8xRTD 2-/3-/4-wire PA	x	x		x ^{1) 2)}	x ²⁾	
AQ 8xI HART PA	x	x		x ¹⁾	x	x

¹⁾ For connection of additional ground cables from the field

²⁾ The terminal block does not provide an internal reference temperature for temperature measurement with a thermocouple.

The following ET 200PA SMART+ terminal blocks are available:

Note

The terms "sensor supply" and "encoder supply" or "sensor" and "encoder" are synonymous in the context of this manual.

Note

The terminal blocks of the SIMATIC ET 200SP HA are compatible with the ET 200PA SMART+ modules and can be used in combination with each other. Detailed information on the terminal blocks of the ET 200SP HA can be found in the respective manual.

Technical specifications

10.1 Standards and approvals

10.1.1 Currently valid markings and approvals [ID: 151029550475]

Introduction

This section contains the technical specifications of the system:

- The standards and test values that the ET 200PA SMART+ complies with and fulfills.
- The test criteria according to which the ET 200PA SMART+ was tested.

Technical specifications of the modules

The technical specifications of the individual modules are provided in the equipment documentation for the relevant modules. If there are deviations between the statements in this document and the equipment documentation, the statements in the equipment documentation take priority.

Validity of the information on the components

NOTICE
Markings and approvals
In the documentation, you can find the markings and approvals which are generally possible or planned in the system.
However, only the label or approval printed on the component of the distributed I/O system is valid!

Reference

The certificates for the markings and approvals can be found on the Internet under Service&Support (<https://support.industry.siemens.com/cs/ww/en/>).

Safety information

Note

The distributed I/O system ET 200PA SMART+ is intended for use in industrial environments; when used in residential areas, it can affect radio/television reception.

10.1.2 CE approval [ID: 151029560075]

Introduction



The distributed I/O system ET 200PA SMART+ meets the requirements and protective objectives of the following EC directives, and satisfies the Harmonized European Standards (EN) for Programmable Logic Controllers which were published in the official pamphlets of the European Community:

- Low voltage directive
- EMC directive

You can find the EC declarations of conformity for download on the Internet (keyword "Declaration of conformity").

Low voltage directive

2014/35/EU "Electrical equipment designed for use within certain voltage limits" (Low Voltage Directive).

According to the requirements of EN 61010-2-201, the components of the distributed I/O system ET 200PA SMART+ have been tested in compliance with the low voltage directive.

EMC directive

2014/30/EU "Electromagnetic compatibility" (EMC directive)

Use in the industrial environment

SIMATIC products are designed for use in industry.

Area of application	Interference emission requirements	Immunity requirements
Industry	EN 61131-2	EN 61131-2

Use in residential areas

If you use the distributed I/O system ET 200PA SMART+ in residential areas, you must ensure that the emission of radio frequency interference complies with EN 61000-6-3.

Suitable measures for achieving RF interference level Class B include, for example:

- Installation of the ET 200PA SMART+ distributed I/O system in grounded control cabinets/boxes
- Use of filters in the supply lines

Use in the field of power plants

The ET 200PA SMART+ distributed I/O system complies with the EMC requirements of EN 61000-6-5.

10.2 Electromagnetic compatibility [ID: 151029911307]

Definition

The electromagnetic compatibility (EMC) is the ability of an electrical device to function in its electromagnetic environment without influencing this environment.

EMC requirements fulfilled

The ET 200PA SMART+ distributed I/O system also fulfills the requirements of the EMC directive for the European domestic market.

Requirement

You must ensure that the configuration of the ET 200PA SMART+ corresponds to the specifications and guidelines for electrical setup.

Pulse-shaped disturbance variables

The following table shows the electromagnetic compatibility of the ET 200PA SMART+ distributed I/O system with pulse-shaped interference.

Table 10-1 Pulse-shaped disturbance variables

Disturbance variable	Tested with	Corresponds to degree of severity
Electrostatic discharge in accordance with IEC 61000-4-2	Air discharge: ± 8 kV	3
	Contact discharge: ± 6 kV	3
Burst pulses (fast transients) in accordance with IEC 61000-4-4 for the frequencies 5 kHz and 100 kHz	± 2 kV (power supply line)	3
	± 2 kV (signal line)	3
High-energy single pulse (surge) in accordance with IEC 61000-4-5 Basic information about the external protective circuit, see the "Designing interference-free controllers (https://support.industry.siemens.com/cs/ww/en/view/59193566)" function manual.		
• Signals	± 1 kV asymmetrical (line to ground)	2
• Signals (with external protection)	± 2 kV unbalanced (line to ground) ± 1 kV balanced (line to line)	3

10.2 Electromagnetic compatibility

Disturbance variable	Tested with	Corresponds to degree of severity
• Signals directly in AC network	±2 kV unbalanced (line to ground) ±1 kV balanced (line to line)	3
• DC supply	±1 kV unbalanced (line to ground) ±0.5 kV balanced (line to line)	2
• DC supply (with external protection)	±2 kV asymmetrical (line to ground) ±1 kV balanced (line to line)	3

Sinusoidal disturbance variables

The following tables show the electromagnetic compatibility of the ET 200PA SMART+ distributed I/O system to sinusoidal interference.

Table 10-2 RF radiation - sinusoidal interference

RF radiation according to IEC 61000-4-3 Electromagnetic RF field, amplitude-modulated		Corresponds to degree of severity
80 MHz to 2.0 GHz	2.0 GHz to 6 GHz	3
10 V/m	3 V/m	
80% AM (1 kHz)		

Table 10-3 HF coupling - sinusoidal interference

RF coupling in accordance with IEC 61000-4-6	Corresponds to degree of severity
150 kHz to 80 MHz	3
10 V _{rms} unmodulated	
80% AM (1 kHz)	

Table 10-4 Magnetic field IEC 61000-4-8

Magnetic field according to IEC 61000-4-8	Corresponds to degree of severity
50/60 Hz 100 A /m	5
50/60 Hz 1 kA/m for 1 s	5

Table 10-5 Voltage with power engineering frequency (line frequency)

Test according to IEC 61000-4-16	Corresponds to degree of severity
10 V	3
100 V for 1 s	3

Table 10-6 Asymmetrical conducted interference

Inspection according to IEC 61000-4-16 and IEC 61000-4-18	Corresponds to degree of severity
• 10 V - 1 V (15 Hz - 150 Hz) • 1 V (150 Hz - 1.5 kHz) • 1 V - 10 V (1.5 kHz - 15 kHz) • 10 V (15kHz - 150 kHz)	3

See the table "Conditions for the design of field wiring".

Components for lightning protection (lightning protection zone transition 0B to 1, 1 to 2 and 2 to 3)

You must use suitable surge protection devices as lightning protection measures.

Emission of radio frequency interference

- Emission of electromagnetic interference according to EN 61000-6-4.
- Interference emission via the mains AC power supply according to EN 61000-6-4.

10.3 Shipping and storage conditions [ID: 151029924747]

Introduction

The ET 200PA SMART+ distributed I/O system surpasses requirements for transport and storage conditions according to IEC 61131-2. The following information applies to modules that are shipped and/or stored in their original packaging.

Table 10-7 Shipping and storage conditions for modules

Type of condition	Permissible range
Free fall (in shipping package)	≤1 m
Temperature	From -40 °C to +70 °C
Air pressure ¹⁾	From 1080 hPa (corresponds to a depth of approx. -1000 m) Up to 606 hPa (corresponds to an elevation of approx. 4000 m)
Relative humidity	5% to 95%, without condensation
Sinusoidal oscillations according to IEC 60068-2-6	5 - 8.4 Hz: 3.5 mm 8.4 - 500 Hz: 9.8 m/s ²
Impact according to IEC 60068-2-27	250 m/s ² , 6 ms, 1000 shocks

¹⁾ Note that I/O modules with relay contacts are only suitable for an elevation up to 3000 m (corresponds to air pressure of around 690 hPa).

10.4 Mechanical and climatic environmental conditions [ID: 151029933707]

Operating conditions

The ET 200PA SMART+ distributed I/O system is designed for stationary use in weather-proof locations. The operating conditions exceed requirements according to EN / IEC 60721-3-3:

- Class 3M3 (mechanical requirements)
- Class 3K3 (climatic requirements)

An enclosure is required:

Notes on the safe use of the ET 200PA SMART+ (Page 41)

Use with additional measures

The described components may not be used without additional measures:

- At locations with a high degree of ionizing radiation
- In harsh operating environments caused, for example, by:
 - Accumulation of dust
 - Corrosive vapors or gases
 - Strong electrical or magnetic fields
- In installations requiring special monitoring, for example:
 - Elevator systems
 - Electrical systems in potentially hazardous areas

An additional measure, for example, can be installation in a cabinet or enclosure.

Mechanical ambient conditions

The following table shows the mechanical ambient conditions in the form of sinusoidal vibrations.

Frequency range in Hz	
$5 \leq f \leq 8.4$	Amplitude 3.5 mm
$8.4 \leq f \leq 150$	constant acceleration 9.8 m/s^2

Reduction of vibration

If the described components are subject to big shock or vibration, appropriate measures must be taken to reduce the acceleration or the amplitude.

We recommend mounting the described components on damping materials (rubber-metal anti-vibration mountings, for example).

Tests of mechanical ambient conditions

The following table provides important information with respect to the type and scope of the tests of mechanical ambient conditions.

Condition tested	Test standard	Comment
Vibration	Vibration test to EN / IEC 60068-2-6 (sine)	Type of vibration: - Frequency sweeps with a rate of change of 1 octave/minute. 5 Hz ≤ f ≤ 8.4 Hz, constant amplitude 3.5 mm 8.4 Hz ≤ f ≤ 150 Hz, constant acceleration 9.8 m/s² Duration of vibration: 10 frequency sweeps per axis at each of three vertically aligned axes
Shock	Shock, tested to EN / IEC 60068-2-27	Type of shock: - Half-sine Shock intensity¹⁾: - Peak value 150 m/s² - Duration 11 ms Direction of shock: 3 shocks in each direction (+/-) at each of three vertically aligned axes

¹⁾ Note that I/O modules with relay contacts are tested and approved in accordance with the relay manufacturer's specifications. You can find more information in the documentation of I/O module with relay contacts.

Climatic ambient conditions

The following table shows the permissible climatic ambient conditions for the ET 200PA SMART+ distributed I/O system.

Ambient conditions	Permissible range	Comments
Temperature	- Horizontal installation: from -40 °C to 70 °C - Vertical installation: from -40 °C to 60 °C Note: No icing	Observe any load-dependent limitations. Refer to the documentation of the employed component. Tested according to EN / IEC 60068-2-2 (Dry heat)
Air pressure	- From 1 080 hPa (corresponds to a depth of approximately -1 000 m) - Up to 606 hPa (corresponds to an elevation of approximately 4 000 m)	The density of the air decreases with increasing altitude. The cooling effect of air in accordance with the elevation is shown in the following table on derating.
Relative humidity	From 10 to 95% Max. 95% at +25 °C	Without condensation, corresponds to relative humidity (RH) stress grade 2 in accordance with EN / IEC 61131 part 2 Tested according to EN / IEC 60068-2-78 (Damp heat)

10.5 Information on insulation, protection class, degree of protection and rated voltage

Ambient conditions	Permissible range	Comments
Concentration of pollutants	- SO₂: <0.5 ppm - RH: <60 %, no condensation - H₂S: <0.1 ppm - RH: <60 %, no condensation	Test: 10 ppm; 4 days Test: 1 ppm; 4 days
	ISA-S71.04 severity level G1; G2; G3	All PCBs have a protective coating.

Derating

The cooling effect of air decreases at higher altitudes as a result of its lower density.

The table shows the derating factor for the maximum permissible ambient temperature depending on the use of the devices at an elevation above sea level.

Elevation above sea level ¹⁾	Derating factor for ambient temperature ²⁾
(-1 000 m) up to 2 000 m	1.0
3 000 m	0.9
4 000 m	0.8

¹⁾ Please note that I/O modules with relay contacts are only suitable for an elevation up to 3 000 m.

²⁾ Relating to the maximum permissible ambient temperature in °C for 2000 m.

Application of non-fail-safe modules

- Effects on the module availability**
 - During operation at altitudes above 2000 m, the stronger cosmic radiation also affects the error rate of electronic components (referred to as soft error rate). In rare cases, this can result in a transition of the modules to the safe state, especially with fail-safe modules. However, the functional safety of the modules is fully maintained.
 - Up to 3000 m, fail-safe modules can be operated together with standard components.
 - Up to 4000 m, fail-safe modules can be operated together with standard components.
 $U_{\text{rated}} \leq 150 \text{ V AC}$
- Information on PFDAvg and PFH values for fail-safe modules**
You can find the module-specific information on PFDAvg and PFH values in the fail-safe I/O module documentation.

10.5 Information on insulation, protection class, degree of protection and rated voltage [ID: 151029943691]

The information for the specific components takes precedence over the information in this documentation. The statements in the product information always have priority over all other information.

10.5 Information on insulation, protection class, degree of protection and rated voltage

Insulation

The insulation is designed to fulfill the requirements of EN 61010-2-201 .

Location	Test
Backplane bus to supply voltage L+	1500 V DC/1 min, type test

Pollution severity/overvoltage category according to IEC 61010-2-201

- Pollution degree 2
- Overvoltage category: II

Protection class according to IEC 61010-2-201

The ET 200PA SMART+ distributed I/O system fulfills Safety Class III. Safety classes I and II may apply to I/O modules. You can find additional information on this in the documentation of the I/O modules. The grounding of the rail must meet the requirements for functional grounding.

Recommendation:

To ensure interference-free installation, the cable for the functional grounding should have a cross-section $> 6 \text{ mm}^2$.

The installation location (e.g. enclosure, control cabinet) must have a protective conductor connection that meets the standard to maintain protection class I.

Degree of protection IP20

IP20 degree of protection according to IEC 60529 for all modules of the distributed I/O system ET 200PA SMART+, i.e.:

- Protection against contact with standard probe
- Protection against foreign objects with diameters in excess of 12.5 mm
- No protection against water

Rated voltage for operation

The ET 200PA SMART+ distributed I/O system works with the nominal voltage that is shown in the following table.

- Observe the tolerance range of the nominal voltage.
- When selecting the nominal voltage, note the maximum permissible supply voltage of each module.

10.6 Technical specifications of subcomponents of the ET 200PA SMART+

Table 10-8 Rated voltage for operation

Rated voltage	Tolerance range
24 V DC	19.2 to 28.8 V DC ¹
	18 to 31.2 V DC ²

¹ Static value: Creation as functional extra-low voltage with safe electrical isolation according to IEC 60364-4-41

² Dynamic value: Including ripple, e.g. as in the case of three-phase bridge power rectification

10.6 Technical specifications of subcomponents of the ET 200PA SMART+

10.6.1 Technical specifications for the modules [ID: 151029955595]

The technical specifications of the individual modules can be found in the manuals of the modules themselves. In the event of deviations between the statements in this document and the manuals, the statements in the manuals take priority.

10.6.2 Technical specifications - Carrier modules (TM) [ID: 151029977995]

Use

You can find information on this in section "Carrier module (Page 24)".