

# eXPert Ecosystem

# eXPert cSTAR controller

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The eXPert cSTAR controller, available in single or dual configuration with hot back-up, constitutes a compact functional control module that directly connects the field with the supervisory level.

The various control nodes are connected on a local network (in redundant configuration with star or ring architecture) based on the Ethernet standard and TCP/IP communication. The controller supports both the typical distributed control architecture (DCS), with the nodes located near the plant areas to be controlled, and that with centralized I/O in a single acquisition and control center.

- Architecture based on DIN bar and rugged components, to guarantee maximum compactness and robustness
- Acquisition from the field using both wired I/O and standard protocols and sending set-points and commands to the field
- Fast signal handling with time-recording Sequence Of Events (SOE), with millisecond timestamp and buffered transmission to the control center
- Communication with a large number of nodes
- Execution of elaborations, logic, control and regulation blocks



#### Headquarters

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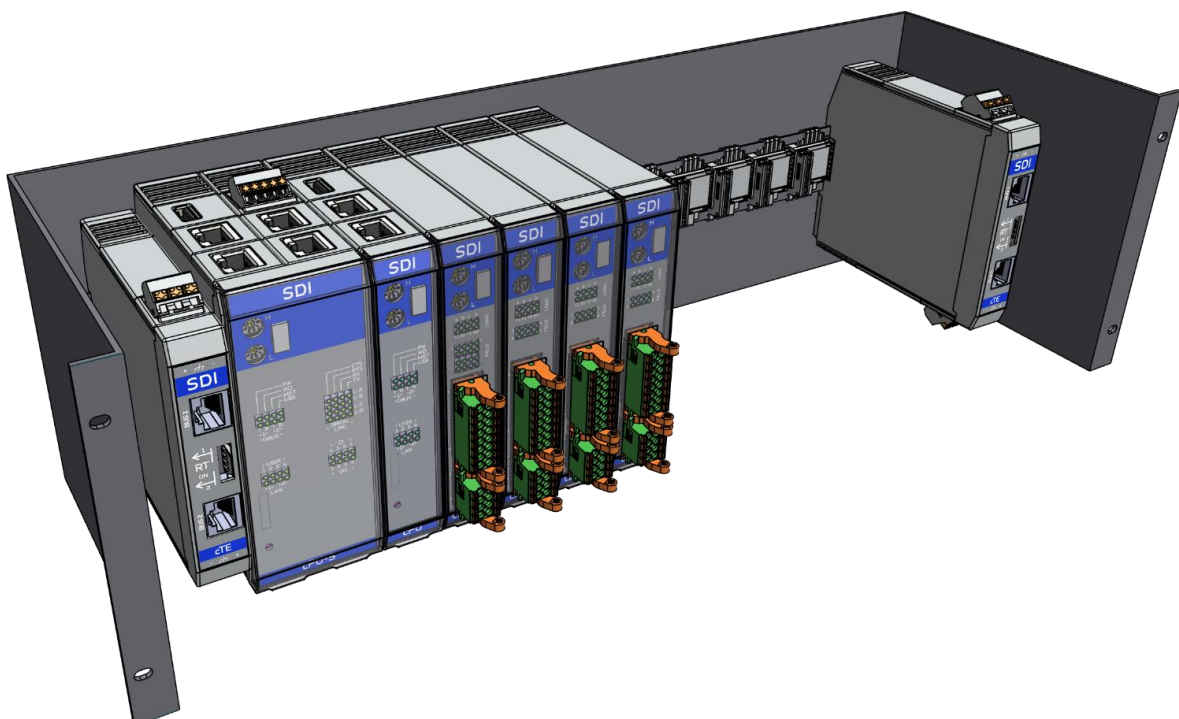
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## Benefits

- High Availability and Security**  
 The adoption of redundant solutions and failover mechanisms regarding CPU, I/O, various levels of network redundancy, automation logic, together with the application of the state-of-the-art in the protection of data, communications and devices from external threats, through redundancy, encryption, authentication and access control, make the eXPert cSTAR controller the optimal tool to guarantee high availability, business continuity and maximum security in monitoring and controlling critical processes.
- System connectivity and openness**  
 I/O is facilitated through both wired connections and standard data protocols, offering maximum flexibility in acquiring data from the field and third-party systems. This, combined with the Server role's capability to open data to external systems, ensures seamless integration and interoperability.
- Flexibility**  
 The modular approach allows the eXPert cSTAR controller both to form the foundation of a SCADA system with centralized RTU and to be the elementary module of a DCS that interfaces with the countless devices distributed in the various areas of a large plant.
 

**Maximum care for data**  
 Timestamp recording of events (SOE) with high millisecond time precision, buffering in case of disconnection from the center, native storage with a minimum period of one second in synergy with the eXPert Ecosystem Supervisory environment by SDI.
- Compactness and robustness**  
 The structure of the cSTAR Controller, composed of a DIN bar and highly robust rugged components connected via redundant industrial system bus, guarantees compactness and flexibility of use in contexts where space is an essential requirement, maintaining the typical reliability of the DualBus controllers of SDI. ECM compliance is achieved without the requirement for a metallic cabinet.



## General characteristics

Depending on the customer's needs, the location environment and usage, the eXPert cSTAR controller can be supplied housed inside a container cabinet whose characteristics are chosen based on the specific applications. The final protection degree depends on the container.

### Physical characteristics

- Multifunctional control platform based on high-reliability rugged components for industrial use
- Electronic boards and modules for industrial process control
- Mechanical structure based on DIN rail.

Characteristics	
Protection	Minimum IP20, can be increased with external container
Module dimensions (W x D x H)	122 x 25 x 118 mm for CPU module 122 x 50 x 118 mm for cPU-S module
Connectors	8-pole gold-plated PCB edge connector



## System Bus

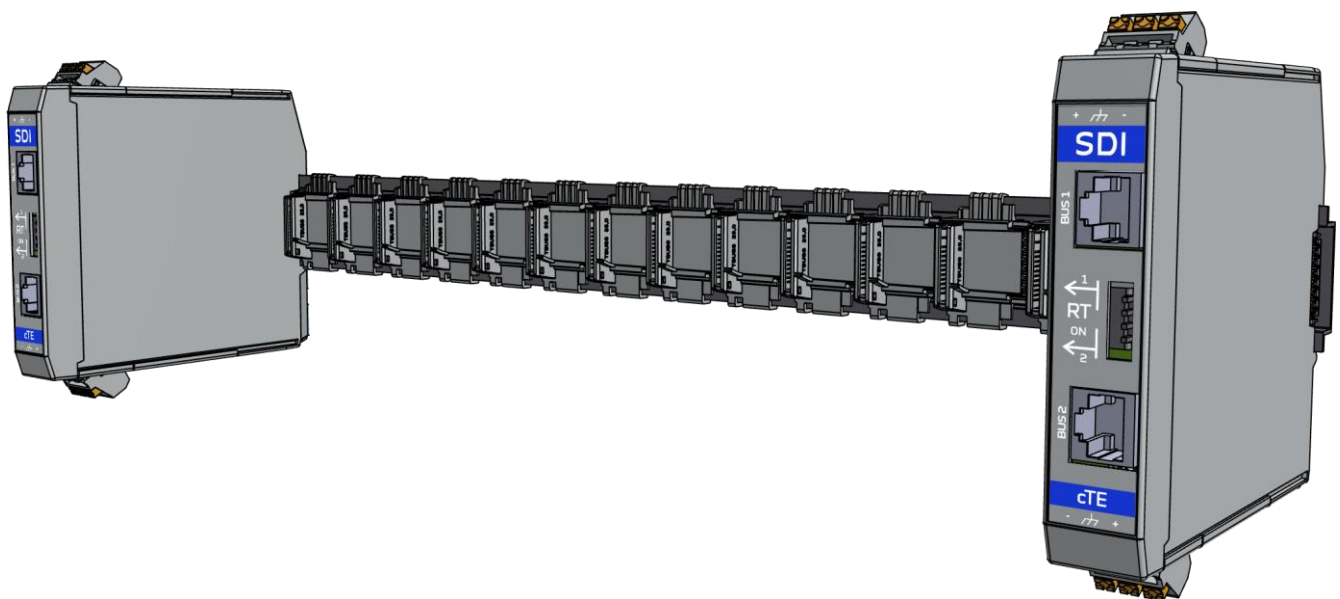
Industrial system bus based on a redundant design.

- The bus accommodates CPU boards and I/O boards.
- Provides a dedicated high-speed bus, synchronization signals, and distributes power to all modules.
- 8-pole DIN rail bus connector with parallel contacts for simplified module-to-module communication.
- Structurally based on the DIN rail mechanical standard
- Supports up to 50 cards with a communication speed of 5 Mbps
- Remote I/O through the use of copper or optical fiber repeaters
- Allows insertion and disconnection of cards under power

## cTE Bus Termination module

The cTE bus termination module, to be inserted at the beginning and at the end of the bus, has the following features:

- Redundant bus power supply: there are two terminals for connecting external power to be supplied to the bus. The two power supplies converge on the bus by coupling with diodes.
- Bus Terminator: termination resistors are present and must be inserted using dipswitches located on the front. Termination prevents signals from being reflected at the end of the line.
- Redundant extension of the bus: two RJ45 connectors, one for each bus line, allow the extension in redundant mode.



## CPU boards

- The system bus is driven by one or two CPUs placed on a DIN rail
- The CPUs can operate in a redundant configuration (master-slave logic) with hot back-up
- The basic cPU version of CPU, only in single non redundant configuration, provides:
  - No. 1 RS232 3 Mbps asynchronous serial line
- To communicate with external systems, the cPU-S version of CPU provides:
  - up to 4 asynchronous serial lines, galvanically isolated from the system bus
  - 4 digital input lines and 4 digital outputs, galvanically isolated from the system bus.

## Field interface

Available on dedicated I/O boards and on cPU-S module.

## Terminal blocks

Removable push-in terminal blocks, suitable for sorting or connecting in the field, are positioned on the sides of the modules.

## Power supply

Characteristics	
Input	24Vdc ±20%
Protections	On board on each module Possibility of general protection modules on DIN rail

## Power consumption

Power consumption depends on the configuration adopted (see absorption of the individual cards).

## Environmental Specifications

Characteristics	
Operating Temperature	-20÷60 °C
Storage temperature	-25÷85 °C
Relative operating humidity	10÷95 % non-condensing

## Placement of Boards

Characteristics	
Distribution	DIN rail top: up to 2 CPUs, up to 50 modules  Possibility of connecting multiple DIN bars with dedicated 8-pole connectors
Insertion	Hot insert

## Maintenance

Characteristics	
Maintenance	Using a specific DTM application (requires a PC on which an "FDT container" is installed)

## Connectivity

### Ethernet

Characteristics	
10/100 Base T	RJ45 connector

### Serial Lines

Characteristics	
Asynchronous	RS232C DCE or DTE, up to 550 Kbps galvanically isolated from the system bus  RS485 2 wires-4 wires up to 5 Mbps galvanically isolated from the system bus

### USB

Characteristics	
Standards 2.0	Type A female connector

## Protocols

To communicate with external systems, including other eXPert systems and third-party applications, the eXPert cSTAR controller can simultaneously activate multiple communication channels, each employing a specific standard protocol.

Each protocol type may have different role names (e.g., Master/Controlling or Slave/Controlled), typically based on the client-server paradigm. Protocols are managed at the CPU level and do not require the presence of I/O boards.

Protocol	Connection	Role	Redundable
MODBUS-RTU	Serial	Master	✓
		Slave	✓
MODBUS-TCP-RTU	Ethernet	Master	✓
		Slave	✓
MODBUS-via TCP-RTU	Ethernet	Master	✓
		Slave	✓
MODBUS-ASCII	Serial	Master	✓
		Slave	✓
MODBUS-via TCP-ASCII	Ethernet	Master	✓
		Slave	✓
IEC-60870.5.101	Serial	Controlling	✓
		Controlled	✓
IEC-60870.5.104	Ethernet	Controlling	✓
		Controlled	✓
IEC-60870.5.103	Serial	Controlling	✓
DNP3	Serial	Master	✓
		Oustation	✓
DNP3- via TCP	Ethernet	Master	✓
		Oustation	✓
OPC UA	Ethernet	Client	✓
		Server	✓
IEC-61850	Ethernet	Master	✓
IEC 1107	Serial	Master	✓
SNMP	Ethernet	Agent	

## Synchronization

In the event of multiple synchronization sources, they are managed in backup with priority logic favoring the most accurate source.

Source	Characteristics
GPS	Integrated solution with externally connectable GPS module.
NTP	Up to 3 NTP servers
From protocol	Available for protocols: <ul style="list-style-type: none"><li>• IEC 60870-5-101</li><li>• IEC 60870-5-104</li><li>• DNP3</li></ul>

## CPU

### cPU

Characteristics	
Processor	NXP iMX8X Dual Core
Operating system	Embedded Linux
Dynamic RAM	1 GB
Static RAM	512 KB SRAM with supercap back-up battery for 10 hours
Flash EPROM	4 GB
Additional Memory	MMC/SD board interface
Redundancy	No. 1 high-speed channel for communication with dual CPU
Addressing	2 rotary switches for selecting the node address
Ethernet	No. 2 Fast Ethernet 10/100 Mbps ports
Serials	Only in case of single non-redundant CPU: No. 1 RS232 3 Mbps asynchronous serial line
USB	No. 2 USB 2.0 ports
Towards I/O Cards	No. 2 interfaces on redundant industrial system bus
Accuracy of periodic activities	1 ms
SOE (Sequence Of Events) Accuracy	1 ms
Security	TPM (Trusted Platform Module) for keys and certificates

Switch for factory settings	Internal 8-position dipswitch
Protections	ESD protection on all accessible signals From overcurrent and overvoltage
Insertion	Live insertion
Watch dog	Hardware
Absorption	Maximum 4.0 W

Diagnostics	
LEDs	Watchdog status Master/Slave role Power diagnostics System bus activity Communication lines activities 4 LEDs for general applications
Local monitor	No. 1 dedicated serial line



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## cPU-S

Characteristics	
Processor	NXP iMX8X Dual Core
Operating system	Embedded Linux
Dynamic RAM	1 GB
Static RAM	512 KB SRAM with supercap back-up battery for 10 hours
Flash EPROM	4 GB
Additional Memory	MMC/SD board interface
Redundancy	No. 1 high-speed channel for communication with dual CPU
Addressing	2 rotary switches for selecting the node address
Ethernet	No. 2 Fast Ethernet 10/100 Mbps ports
Serials	4 asynchronous serial lines RS232/RS422/RS485  Only in case of single non-redundant CPU-S: No. 1 asynchronous RS232 3 Mbps serial line
USB	No. 2 USB 2.0 ports
Towards I/O Cards	No. 2 interfaces on redundant industrial system bus
Integrated I/O	No. 4 bipolar digital inputs (galvanically isolated)  No. 4 bipolar dry contact digital outputs (galvanically isolated)  Push-in connectors on the side

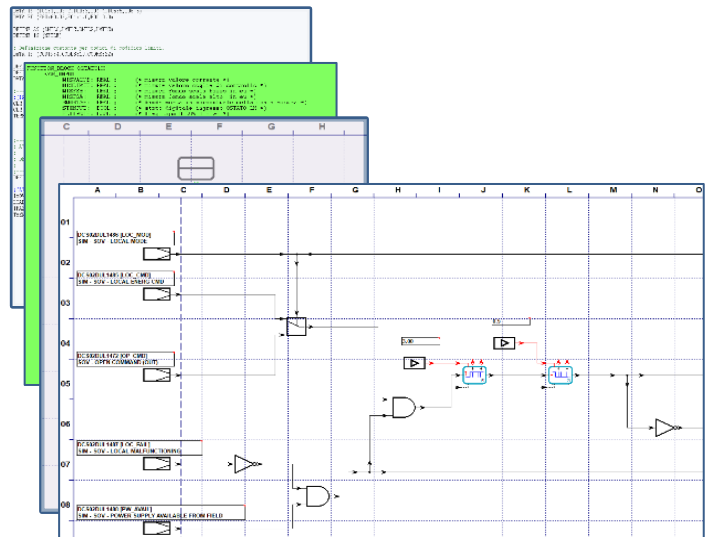
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## Automation logics

Characteristics	
Reference standard	IEC 61131-3
Number of logics	Native scheduling functionality of independent logics, which can be activated periodically or by trigger
Minimal time step	10 ms
Configuration	Sequential Function Chart (SFC) Functional Block Diagram (FBD) Structured Text (ST)
Regulation blocks	User-extendable basic library available <ul style="list-style-type: none"> <li>• PID</li> <li>• Stateless modules</li> <li>• Stateful modules</li> </ul>
Debugging	In-line availability through connection to the CPU where the logics are executed



## I/O boards

Digital Input	No. Inputs	Description
cDI-16L	16	Voltage 24 Vdc $\pm$ 20%; Inputs share the same common return
Digital Output	No. Outputs	Description
cDO8-L	8	Solid state relay with dry contact; 60 Vdc 500 mA (max)
cDO8-R	8	Mechanical relay with dry contact; 60 Vdc 500 mA (max), 110 Vdc 100 mA (max)
Analog Input	No. Inputs	Description
cAI8-I	8	Nominal Current 4-20 mA (Full range $\pm$ 25 mA)
cAI8-T	8	Thermocouples B, E, J, K, N, R, S, T
cAI8-V	8	Voltage 0-10 V (Full range $\pm$ 10 V)
cAI4-R	4	2, 3, 4 wires RTD; Pt100, Ni100, others upon request
cAI4-F	4	Nominal Current 4-20 mA (Full range $\pm$ 25 mA); Fast, up to 100 conversions/sec
Analog Output	No. Outputs	Description
cAO4-I	4	Nominal Current 4-20 mA (Full range $\pm$ 25 mA)
cAO4-V	4	Voltage 0-10 V (Full range $\pm$ 10 V)

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## Digital Inputs

### cDI16-L

Characteristics	
No. of Inputs	16 (sharing the same common return)
Type of Input	24 Vdc $\pm$ 20% (ref. IEC61131-2 Type 1, 3)
Sampling	1 ms
Common return polarity	Negative
Absorption	0.2 W

Diagnostics	
Channel	Configurable wire break
LEDs	Board Status Status of each input
Local monitor	No. 1 dedicated serial line



## Digital Outputs

### cD08-L

Characteristics	
Number of Outputs	8
Type of Outputs	Solid state relay with dry contacts
Output characteristics	60 Vdc 500 mA (max)
Absorption	0.2 W

Diagnostics	
Field	Monitoring under-voltage of input field power
LEDs	Board Status Status of each output
Local monitor	No. 1 dedicated serial line



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## cD08-R

Characteristics	
Number of Outputs	8
Type of Outputs	Mechanical relay with dry contacts
Output characteristics	60 Vdc 500 mA (max)
	110 Vdc 100 mA (max)
Absorption	0.2 W

Diagnostics	
Field	Monitoring under-voltage of input field power
LEDs	Board Status Status of each output
Local monitor	No. 1 dedicated serial line



## Analog Inputs

### cA18-I

Characteristics	
No. of Inputs	8
Type of Inputs	Current
Range	Nominal: 4 to 20 mA Full Range: $\pm 25$ mA (also for bipolar management)
Resolution	16 bits
Accuracy	Better than 0.1 % in the $-20 \div 70$ °C range
Acquisition speed	Max 5 conversions/sec
Common mode rejection at 50 Hz	> 80 dB
Normal mode rejection at 50 Hz	> 100 dB
Absorption	0.2 W



Diagnostics	
Channel	Out of range
LEDs	Board Status
Local monitor	No. 1 dedicated serial line

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## cA18-T

Characteristics	
No. of Inputs	8
Type of Inputs	Thermocouples Type: B, E, J, K, N, R, S, T
Range	Unipolar 0 to 78mV (max)
	Bipolar $\pm 78$ mV (max)
Resolution	16 bits
Accuracy	Better than 0.1 % in the $-20 \div 70$ °C range
Acquisition speed	Max 5 conversions/sec
Common mode rejection at 50 Hz	> 80 dB
Normal mode rejection at 50 Hz	> 100 dB
Absorption	0.2 W

Diagnostics	
Channel	Wire break
LEDs	Board Status
Local monitor	No. 1 dedicated serial line



cAI8-V

Characteristics	
No. of Inputs	8
Type of Inputs	Voltage
Range	Nominal: 0 to 10 V  Full Range: $\pm 10$ V (also for bipolar management)
Resolution	16 bits
Accuracy	Better than 0.15 % in the $-20 \div 70$ °C range
Acquisition speed	Max 5 conversions/sec
Common mode rejection at 50 Hz	> 80 dB
Normal mode rejection at 50 Hz	> 100 dB
Absorption	0.2 W



Diagnostics	
Channel	Out of range
LEDs	Board Status
Local monitor	No. 1 dedicated serial line

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## cAI4-R

Characteristics	
No. of Inputs	4
Type of Inputs	2, 3 and 4 wire RTD Type: Pt100, Ni100, others upon request
Range	0 to 3920 $\Omega$
Resolution	16 bits
Accuracy	Better than 0.1 % in the -20÷70 °C range
Acquisition speed	Max 5 conversions/sec
Common mode rejection at 50 Hz	> 80 dB
Normal mode rejection at 50 Hz	> 100 dB
Absorption	0.2 W

Diagnostics	
Channel	Wire break
LEDs	Board Status
Local monitor	No. 1 dedicated serial line



cAI4-F

Characteristics	
No. of Inputs	4
Type of Inputs	Current
Range	Nominal: 4 to 20 mA  Full Range: ±25 mA (also for bipolar management)
Resolution	16 bits
Accuracy	Better than 0.1 % in the -20÷70 °C range
Acquisition speed	Max 100 conversions/sec
Absorption	0.2 W

Diagnostics	
Channel	Out of range
LEDs	Board Status
Local monitor	No. 1 dedicated serial line



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## Analog Outputs

### cA04-I

Characteristics	
No. of Outputs	4
Type of Outputs	Current
Range (Rmax=500 Ω)	Nominal: 4 to 20 mA  Full Range: ±25 mA (also for bipolar management)
Resolution	16 bits
Accuracy	Better than 0.1 % in the -20÷70 °C range
Absorption	0.2 W

Diagnostics	
Channel	Loop interrupted
LEDs	Board Status
Local monitor	No. 1 dedicated serial line



cA04-V

Characteristics	
No. of Outputs	4
Type of Outputs	Voltage
Range (Rmin=2 kΩ)	Nominal: 0 to 10 V Full Range: ±10 V (also for bipolar management)
Resolution	16 bits
Accuracy	Better than 0.1 % in the -20÷70 °C range
Absorption	0.2 W

Diagnostics	
Channel	Short circuit
LEDs	Board Status
Local monitor	No. 1 dedicated serial line



## Reference Standards

### General Directives and Regulations

Directives and Regulations	
EU directives	2014/35EU low voltage 2014/30/EU electromagnetic compatibility (EMC) 2011/65/EU and delegated directive 2015/863 RoHS 3 2012/19/EC (WEEE)
General rules for CE marking	IEC EN 61000-6-2 Electromagnetic compatibility (EMC) – Generic standard - immunity for industrial environments IEC EN 61000-6-4 Electromagnetic compatibility (EMC) – Generic standard - emissions for industrial environments IEC EN 61010-1 safety requirements for electrical equipment for measurement, control and laboratory use – general requirements
Quality Assurance	UNI EN ISO 9001:2008 (ISO9001:2008)
Environmental Protection	UNI EN ISO 14001:2004 (ISO14001:2004)

### Emission Standards

Standard	
Power lines (supply) Emission	IEC 60255-26 CISPR11 EN55011 <ul style="list-style-type: none"> <li>• 0,15MHz-0,50MHz</li> <li>• 0,50MHz-5MHz</li> <li>• 5MHz-30MHz</li> </ul>

### Functional Standards

Standard	
Digital Input	IEC 61131-2
Automation Logic	IEC 61131-3

## Safety Standards

Standard	
Safety requirements for electrical equipment for measurement, control and use in laboratories - Part 1: General requirements	EN 61010-1:2017
Safety requirements for electrical equipment for measurement, control and laboratory use – Part 2-201: Particular requirements for control equipment	IEC 61010-2-201
Resistance and continuity of protective bonding	IEC60255-27
Dielectric	CEI EN 61010-1 2KV IEC60255-27 2KV
Insulation resistance	CEI EN 61010-1 100M <sup>c</sup> IEC60255-27 100M <sup>c</sup>
Impulse voltage	IEC60255-27 1.5KV criterion B 2KV criterion B without electronics, line-to-line, line-to-ground

## Immunity Standards

Immunity	Norm
Immunity to electrostatic discharges	IEC 61000-4-2
Immunity to radiated radio frequencies	IEC 61000-4-3
Immunity to fast transients	IEC 61000-4-4
Immunity to impulse	IEC 61000-4-5
Immunity to conducted disturbances induced by radio frequency fields	IEC 61000-4-6
Immunity to magnetic fields	IEC 61000-4-8
Immunity to common mode disturbances conducted in the frequency range 0-150 kHz	IEC 61000-4-16
Immunity to damped oscillatory waves	IEC 61000-4-18
Immunity to voltage sags, short interruptions and direct current voltage variations	IEC 61000-4-29

## Manuals and Documentation

Document	Code
eXPert cSTAR controller Installation, use and maintenance manual	4000264100
eXPert STAR controller Safety and environmental impact	90000164

## Related products and modules of the eXPert Ecosystem

- **eXPert SCADA**  
for the most advanced supervisory functions, managing over 1,500,000 tags, in single, redundant and disaster recovery configurations.
- **eXPert DCS**  
SDI's product for automation and distributed control, capable of interfacing up to 255 eXPert STAR DualBus or eXPert cSTAR nodes (controllers).
- **eXPert PPC**  
the eXPert cSTAR is the most compact environment for hosting eXPert PPC, the Power Plant Controller produced by SDI for renewable, storage and hybrid power plants, in compliance with the main grid codes around the world.
- **eXPert STAR DualBus**  
the most complete SDI controller for monitoring, automation and control functions, with a rack and trays structure housed in a metal cabinet, with a wired and protocol interface to the field.
- **eXPert vSTAR**  
the SDI virtualized controller for monitoring, automation and control functions, with interface to the field via protocol. Easily instantiated on a physical or virtual machine, scaled out, to handle higher workloads when needed.

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## About SDI

Since 1973, SDI is the main Italian company in the field of automation, supervision, control and remote control of highly critical industrial plants.

SDI develops, builds and supplies complete DCS and SCADA systems and special application equipment to main Italian players like Eni, SNAM and ENEL Green Power.

More than 50 years of experience grant the know-how for continue innovation and evolution of SDI's offer.

Our value: ahead on Automation path

Flexibility & Integration at first place: we can provide a completely custom solution that meets every control, monitoring and remote-control needs.

Field-proven reliability: hundreds of applications in the field of oil & gas, power production and distribution, public utilities, water, renewables, transport.

Our commitment in development: we invest every day in improving our solutions, thus creating a strong relationship with the customer.

Valuable data, everywhere: we can provide the information you need on every device, anytime.

For years, we have had a certified Management System in accordance with ISO 9001 (Quality), ISO 14001 (Environment), ISO 45001 (Occupational Health and Safety), and ISO/IEC 27001 (Information Security) standards. DNV - one of the leading global certification bodies - periodically verifies its effectiveness.



## Contacts

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