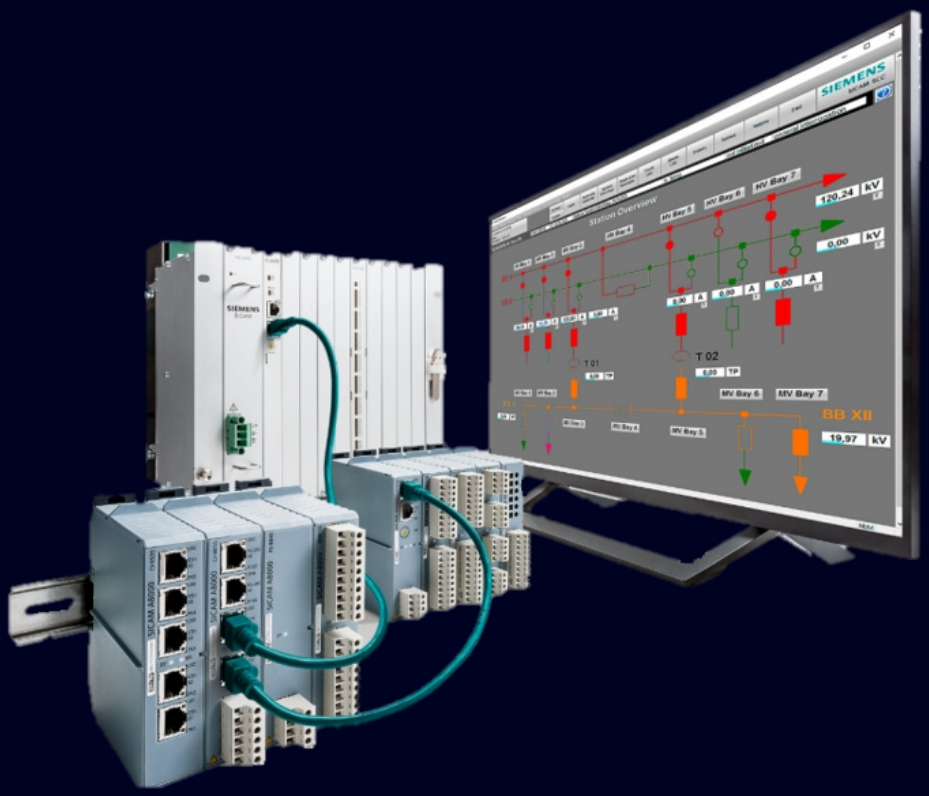
SIEMENS



CATALOG EDITION 8.1

Substation Automation
SICAM

siemens.com/sicam

SICAM Substation Automation

Catalog - Edition 8.1

Invalid:
Edition 8.0

Content

Preface

Siemens won the 2006 Frost & Sullivan Technology Leadership Award in acknowledgment of Siemens' pioneering work in the development of innovative technology – the IEC 61850. Users are in safe hands with the energy automation solutions from Siemens. The combination of extensive experience and the latest innovation provides security for many years. Our solutions are also compatible with older devices.

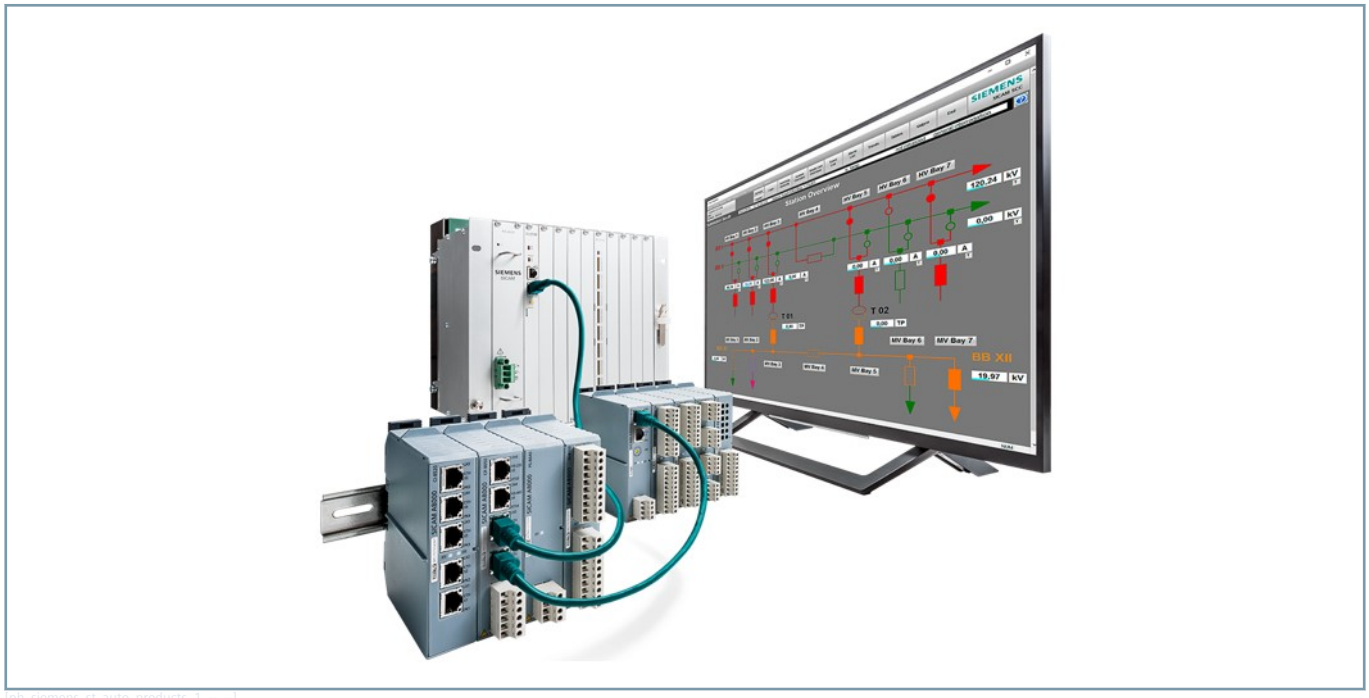
Overview and Solutions

In recent years, influences on the business of power utilities have changed considerably. Running the power grid has changed from a static, virtually stable layout to a dynamic operation. The requirements regarding a longer service life for all grid system components continue to gain importance.

As a result, the importance of substation automation technology has grown considerably and the requirements with respect to control, protection, and remote control have experienced a great paradigm shift:

- Flexible and customized solutions for diverse applications
- Safe and reliable operations management
- Cost-effective investments and economic operation
- Efficient project management
- Long-term concepts, upgradeable and open for new requirements

The energy-automation solutions from Siemens offer a multitude of standardized configurations and functions for many typical tasks. These default settings allow the use of flexible products but, at the same time, are open for more challenging and customized applications. The acquisition of all kinds of data, computing and automation functions as well as versatile communication can be very flexibly combined to create special solutions and facilitate integration into the existing system environment.



[ph_siemens_st_auto_products, 1, --, --]

Figure 1.1/1 Siemens Station Automation Products

Distribution-System Automation

Distribution-system automation from Siemens considerably optimizes the reliability and availability of your energy distribution systems. Here, the functionality extends from the acquisition of network data, telemonitoring and remote control up to fully automated applications such as high-speed FISR (Fault Isolation and Service Restoration), Volt-Var Control and similar.

The technology supports the network operation and, for example, takes over monitoring of the currents and voltage in the distribution system and also the command output to remote-controllable units such as switches and transformers.

Furthermore, the distribution-system automation uses well-proven technologies and characteristics of sensors, control and remote terminal units (RTUs) right up to communication devices such as routers and modems.

The hardware is supplemented by specially developed software and algorithms for special distribution-system functionality.

Advantages

- Continuous power-system monitoring ensures early detection of problems
- Fast Fault Isolation and Service Restoration increases the efficiency level
- Automatic operation and the use of standards provide time and cost savings
- Network automation and control guarantee adherence to the specified voltage range

With the Siemens solutions for distribution-system automation, you will benefit in all respects from a wide spectrum of know-how. As a supplement to distribution-system automation, Siemens offers a complete portfolio for power-system monitoring, power-quality recording, fault recording, phasor measurement, and system-software applications.

The Siemens products of the SICAM product family for power quality and measurement support power utilities and consumers with solutions for precise measurement, recording, and indication of the required information for continuous determination, adaptation, and improvement of power quality. Always the right fit, for your application as well.

[ph_distribution automation, 1, --_--]

Figure 1.2/1 Siemens Short-Circuit Indicators and Distribution-System Automation Products

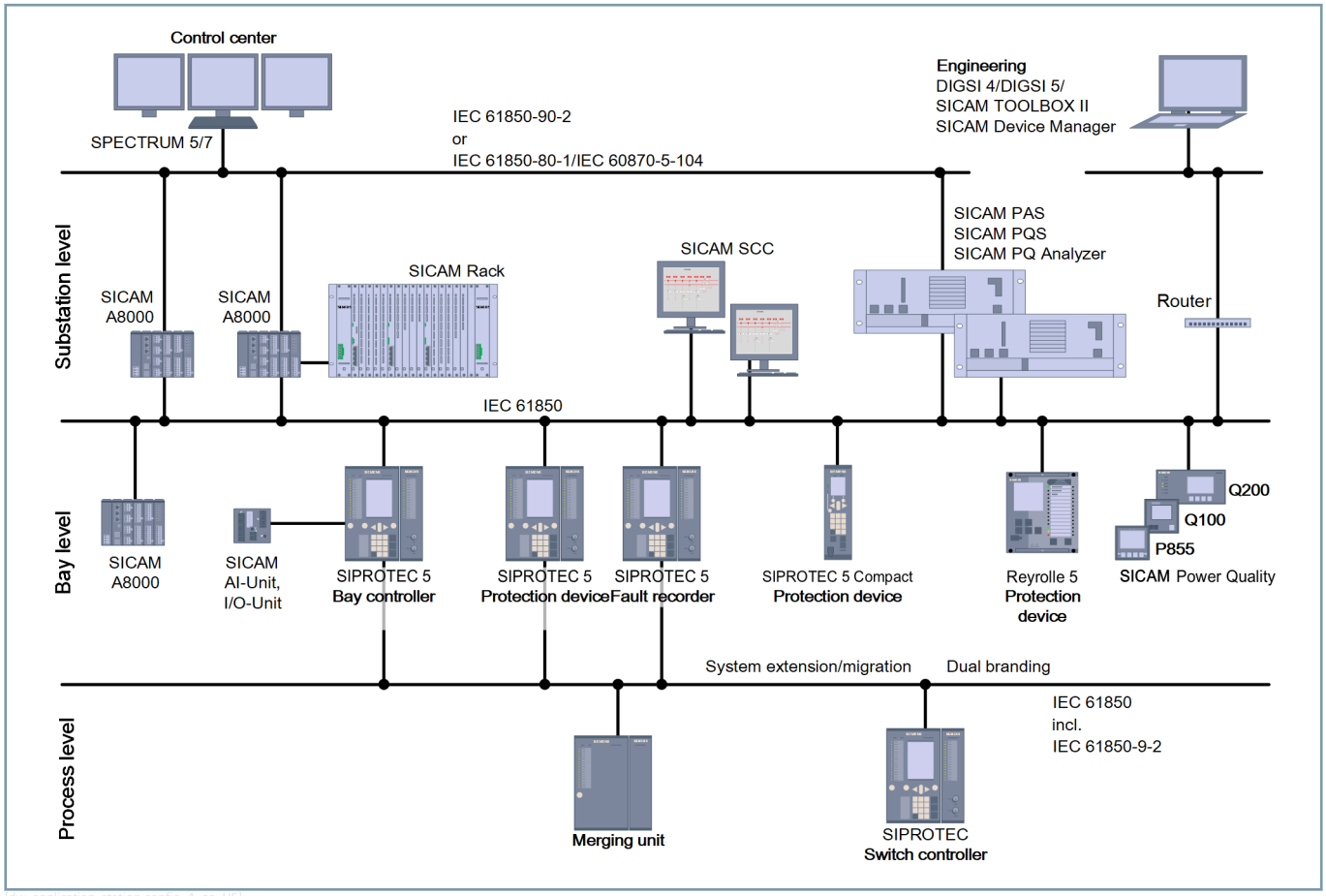
For station automation, Siemens offers proven concepts in all task areas of switchgear automation – on all voltage levels and for all types of switchgear. Distributed solutions on the basis of distributed bay units can also be implemented with our offer in the same way as central telecontrol systems with integrated automation and node functions or multifunctional protection systems for coordination and the interaction of different protection devices.

Advantages

- Excellent overall system performance due to flexibility in the architecture and implementation of redundancies (optional)
- Support of intelligent power systems and applications on the basis of the standard IEC 61850
- Upgradeable due to evolutionary system development and sophisticated migration concepts
- Limited outlay for logistics, training, etc. due to a scalable system family for all power-system levels and the widest variety of energy systems – whether electricity, gas, water, or district heating
- Cost-efficiency through custom solutions – from standard to customer-specific

Siemens products and solutions for switchgear automation correspond to the standard IEC 61850. This standard marks a major step towards power-system intelligence as it fulfills high communication demands with regard to data volume, speed, etc. Additional advantages: easy integration of devices from the competition and highest levels of upgradability due to reusable engineering data. Intelligent applications can also be implemented with IEC 61850.

Siemens offers you preconfigured and hence particularly economic system solutions for switchgear automation for many typical applications. Siemens develops individual solutions for specific customer requirements. Siemens supplies complete secondary equipment in power transmission and distribution systems – for new systems, extensions, and modernization projects. Siemens products and solutions are distinguished by scalable quantity structures. They offer diverse interfaces, efficient operation at all levels and ensure seamless system integration. The information and control of substations is based on distributed devices. This offers a multitude of functions and applications for data acquisition, control and monitoring, for protection and for communication.



[dw_application_station-config, 4, en_US]

Figure 1.3/1 Application Example: Station Automation

Cybersecurity

Product Security

Siemens provides secure solutions by aligning the product development process and security features with international security standards such as IEC 62351, IEC 62443, or ISO 27001. These standards help ensure interoperable and secure products that meet industry best practices for cybersecurity.

Siemens aims to provide:

- Stringent access control measures
- Data integrity
- Secure communication
- Seamless monitoring capabilities

Additionally, Siemens products ensure 24/7 protection together with flexible and secure deployment.

Secure Product Development Process

Product security begins with an initial idea for a new product and shapes the choices to setup technologies, functionalities, processes, and architectures. Siemens follows a **Security by Design** approach to the product development.

The security principles cover a wide range of activities, including:

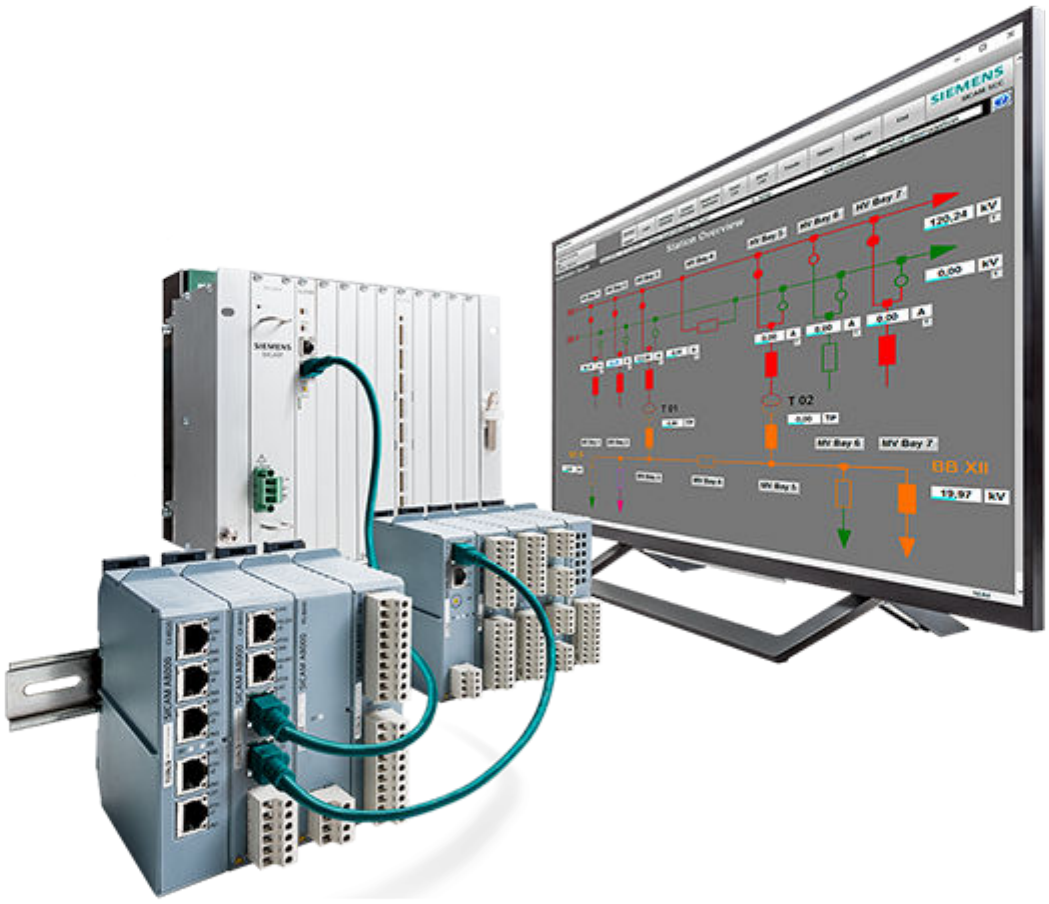
- Security threat and risk analysis
- Supplier and component selection
- Coding
- Configuration and hardening
- Testing

The development process for Siemens protection, automation, and Internet of Things (IoT) products include all the steps and are certified to comply with the cybersecurity requirements of the international standard IEC 62443-4-1 with Maturity Level 4. Additionally, Research and Development, Engineering, Production, Sales and Service operates a certified management system in accordance with ISO/IEC 27001.

Security Features and Functions

The products in the Siemens portfolio offer organized comprehensive security features that adhere to the standard IEC 62351. Some of the key security features include:

- A central user and account management along with role-based access control
- Certificate-based authentication and authorization
- Integrity measures for software and firmware
- Secure communication on application and transport level TLS (Transport Layer Security)
- Centralized security event logging and installed base monitoring


SIEMENS
120.24
kV
0.00
kV
T 01
T 02
MV Bay 6
MV Bay 7
BB XII
19.97
kV




Device	SICAM A8000					
	CP-8000	CP-8010	CP-8012	CP-8021	CP-8022	CP-8031
Fields of Application	Electrical distribution stations, pipelines, gas distribution stations, railway power supplies, tunnels, site protection, data concentrator, telecontrol substations, automation units					
Max. Number of Data Points	20000					
Max. Number of I/O	20 integrated 116 (modular)	128 (modular)	128 (modular)	128 (modular)	128 (modular)	128 (modular)
Max. Number of Interfaces	2 x RJ45: Ethernet 1 x RS232 (serial) 1 x RS485 (serial)	4 x RJ45: 2 x Ethernet 1 x RS485 (serial) 1 x RS232 (serial)	4 x RJ45: 2 x Ethernet 1 x RS485 (serial) 1 x RS232 (serial)	3 x RJ45: 2 x Ethernet/ 1 x RS232 1x RS485	3 x RJ45: 2 x Ethernet/ 1 x RS232 1 x RS232/ RS485 select-able 1 x RS485 1 x LTE CAT1/ GPRS	4 x RJ45: 2 x Ethernet 1 x RS485 (serial) 1 x RS232 (serial)
Human-Machine Interface (HMI)						
SICAM SCC	■	■	■	■	■	■
Engineering						
SICAM PAS software	–	–	–	–	–	–
SICAM Device Manager	■	■	■	■	■	■
Integrated tools	–	–	–	–	–	–
Web server (for device configuration)	■	–	–	■	■	–
Integrated, customer-specific dashboard	–	■	■	–	–	■
Remote maintenance	■	■	■	■	■	■
Automation Functions						
Automation function (CFC/PLC, IEC 61131-3)	128 k	1 x 3 MB	1 x 3 MB	128 k	128 k	1 x 3 MB
CFC/PLC online test	■	■	■	■	■	■
Time Synchronization						
Remote NTP	■	■	■	■	■	■
GPS/DCF	–	–	–	–	–	–
Resolution/sampling rate	1 ms	1 ms	1 ms	1 ms	1 ms	1 ms
PTP (PTP protocol) (IEEE 1588)	–	■[1]	■[1]	–	–	■[1]

1



SICAM A8000		SICAM PAS
CP-8050	**Rack solution**	
Electrical distribution stations, pipelines, gas distribution stations, railway power supplies, tunnels, site protection, data concentrator, telecontrol substations, automation units, hydropower plants, central control units, substation controllers, data nodes with high packing density and direct process connection, front end, or gateway		Power automation to operate switchgear with a single station computer (full server) or with up to 2 additional computers (DIPs)
400000	400000 per expansion firmware (max.4)	80 000 master information objects
0 to 2048 (modular)	0 to 4096 (modular)	Distributed via IEDs
4 x RJ45: 2 x Ethernet 1 x RS485 (serial) 1 x RS232 (serial) 30 x modular, of which max. 10 Ethernet	2 x RJ45 (serial) in conjunction with CI-2530	200 x serial Ethernet depending on PC
■	■	■
–	–	■
■	■	–
–	–	■
–	–	–
■	■	–
■	■	Remote desktop
5 x 3 MB	5 x 3 MB	>1.5 M
■	■	■
–	–	–
■	■	■
–	–	■
1 ms	1 ms	1 ms
■[1]	■[1]	■[1]




Device		SICAM A8000					
		CP-8000	**CP-8010**	**CP-8012**	**CP-8021**	**CP-8022**	**CP-8031**
Communication							
To the server protocol control center	Serial	IEC 60870-5-101 DNP3 Modbus RTU					IEC 60870-5-101 IEC 60870-5-103 DNP3 Modbus RTU




Device		SICAM A8000					
		CP-8000	CP-8010	CP-8012	CP-8021	CP-8022	CP-8031
	TCP/IP	IEC 60870-5-104 IEC 61850 Ed2 DNP3i Modbus					IEC 60870-5-104 IEC 61850 Ed2 DNP3i Modbus
To IEDs client protocols	Serial	IEC 60870-5-101 IEC 60870-5-103 Modbus RTU					IEC 60870-5-101 IEC 60870-5-103 Modbus RTU PROFIBUS DP
	TCP/IP	IEC 60870-5-104 IEC 61850 Ed2 Modbus					IEC 60870-5-104 IEC 61850 Ed2 Modbus PROFINET IO
Service forwarding/pass through for TCP and UDP protocols		–					■
Notifications via SMS or e-mail		–					–
Further IED protocols		■	■	■	■	■	■
Secure Communication							
IEC 60870-5-104 Master/Slave (Transport Layer Security (TLS))		■	■	■	■	■	■
IEC 61850 Client/Server (Transport Layer Security (TLS))		■	■	■	■	■	■
DNP3i master/slave (Transport Layer Security (TLS))		–	■	■	–	–	■
Redundancy		–	–	–	–	–	–
Power Quality Applications							
PQ data (PQDIF) are transmitted by the PQ devices P855, Q100, Q200, and 7KE85 with IEC 61850. Grid-code evaluation, scheduled reports, automatic COMTRADE/PQDIF import and export, notification, fault location		–	–	–	–	–	–

SICAM A8000		SICAM PAS
CP-8050	Rack solution	
IEC 60870-5-101 IEC 60870-5-103 DNP3 Modbus RTU	IEC 60870-5-101 IEC 60870-5-103 DNP3 Modbus RTU	IEC 60870-5-101 DNP3 Modbus RTU
IEC 60870-5-104 IEC 61850 Ed2 DNP3i Modbus	IEC 60870-5-104 IEC 61850 Ed2 DNP3i Modbus	IEC 60870-5-104 IEC 61850 Ed2 DNP3i Modbus OPC DA, OPC XML DA
IEC 60870-5-101 IEC 60870-5-103 Modbus RTU PROFIBUS DP	IEC 60870-5-101 IEC 60870-5-103 Modbus RTU PROFIBUS DP	IEC 60870-5-101 IEC 60870-5-103 DNP3 Modbus RTU PROFIBUS DP (DPV0)
IEC 60870-5-104 IEC 61850 Ed2 Modbus PROFINET IO	IEC 60870-5-104 IEC 61850 Ed2 Modbus PROFINET IO	IEC 60870-5-104 IEC 61850 Ed1, Ed2 DNP3i Modbus PROFINET IO OPC DA; SNMP V2/V3
■	■	–
–	–	■
■	■	■
■	■	■
■	■	■
■	■	■
■	■	■
–	–	■




Device	SICAM A8000					
	CP-8000	CP-8010	CP-8012	CP-8021	CP-8022	CP-8031
Archiving						
Fault records, events, and mean value or PQ data in the device	–	–	–	–	–	–
Process-data archive	■	■	■	■	■	■
Security Functions						
Security Eventlog (syslog)	■	■	■	■	■	■
SNMP agent Asset information, security events	■	■	■	■	■	■
SNMP Client, IEC 61850 Client Asset information	–	–	–	–	–	–
Role Based Access Control (RBAC)	■	■	■	■	■	■
Additional Information						
Supply voltage	DC 18 V to 72 V (PS integrated in the CPU module)	DC 18 V to 72 V (PS integrated in the CPU module)	DC 18 V to 72 V (PS integrated in the CPU module)	DC 18 V to 78 V DC 82.5 V to 286 V (PS as a separate module)		DC 18 V to 78 V DC 82.5 V to 286 V AC 230 V (PS as a separate module)
Memory card for parameters and firmware	SD					
Temperature range	-40 °C to +70 °C					–25 °C to +70 °C [2]
Assembly	DIN rail					
Degree of protection	Max. IP40					

2 -40 °C on request

SICAM A8000		SICAM PAS
CP-8050	Rack solution	
–	–	■[3]
■	–	■
■	■	■
■	■	■
–	–	■[4]
■	■	■
DC 18 V to 78 V DC 82.5 V to 186 V AC 230 V (PS as a separate module)	DC 24 V to 60 V DC 110 V to 220 V AC 230 V (PS as a separate module)	No spec., depends on PC
SD		
–25 °C to +70 °C [2]	–5 °C to +55 °C	
DIN rail	Rack, 19-inch assembly[5]	
Max. IP40	Max. IP30	

3 Fault records can be transmitted to superordinate control centers via an IEC 61850 server.

4 Asset information of connected devices can be passed onto superordinate control centers via an IEC 61850 server.

5 Applicable to A8000 rack I/Os

SICAM 8 Power Automation Platform

SICAM 8 - Description

Description

SICAM 8 is an universal, hardware, and software based all-in-one platform. This platform enables you to meet all the practical requirements in the field of energy supply.

Power Automation Platform – Structure

- The SICAM 8 Core is responsible for:
  - Security functions
  - Time synchronization
  - Certificate and application management
- The SICAM 8 Software is divided into the following SICAM 8 applications and SICAM 8 Controller applications:
  - SICAM S8000 (RTU, communication protocols, SoftPLC)
  - SICAM HMI (control and monitor)
  - SICAM EVA (event and alarm list)
  - SICAM Web (diagnosis, monitoring, and simulation)
  - SICAM Applications (SIAPPs)
  - SICAM DLM (Dynamic Load Management)
  - SICAM MGC (Microgrid Control)
  - SICAM PPC (Photovoltaic Plant Control)
  - SICAM LS (Load Shedding)
  - SICAM SOG (Self optimizing Grid)[6]
- The SICAM 8 Hardware is based on Linux, consists of modules and devices of the SICAM A8000 series and new industrial PCs of different manufacturers:
  - SICAM A8000 CP-8050/8031, PS-, CI- and I/O modules
  - SICAM Rack modules (for high data volume)
  - SICAM EGS (Enhanced Grid Sensor) combination of measuring device and RTU-Gateway for MS- and NS[6]
  - Third-party industrial PCs with Linux operating system

Benefits

SICAM 8 supports with:

- Measures to achieve climate goals
  - Expansion of renewable energies
  - Integration of renewable energies
  - Faster expansion of existing infrastructure
- Meeting the increasing demands of cybersecurity
  - Holistic cybersecurity solutions
  - Competence around energy automation
- Mitigating the shortage of skilled personnel
  - Reduced know-how requirement
  - Performance with minimized personnel

Applications

- Hydro-power plants
  - Turbine controls, sequence controls or switch interlocks with the aid of the integrated logic functions
  - Processing and bundling of information for control centers and neighboring substations
- Solar and onshore windparks: as a bidirectional link between the grid control center and wind or solar farms
  - Information about, for example, the current power flow to the grid control center
  - Operation of feed-in controller from the grid control center
- Power transmission
  - For this application, substation automation is an essential requirement
  - SICAM A8000 CP-8050 is designed for this task, processes and bundles information for control centers and neighboring substations
- Power distribution: monitoring and control of overhead line or cable distribution grids
  - Distribution grid transformers with low-voltage feeders
  - Control of transformer tap changers
- Industry: The SICAM 8 supports the on-demand supply, distribution, and monitoring of electrical power
  - Energy automation system from the power suppliers feed-in to the low-voltage distribution level
- Offshore windparks: more universally applicable with the new SICAM S8000 software variant
  - Hardware independent through IPC applications
  - Marine certified solutions for offshore operations
- IoT: Increasing grid availability and service quality for power grids
- Data node/Gateway
  - Communication gateway for RTU networks based on various networks and communication protocols
- Railway power supply
  - Automation of railway power supply starting with the control system, through protection to communication

6 Development in progress for SICAM 8 platform

Description

SICAM S8000 represents high performance with state-of-the-art technology, modularized architecture and is a part of the universal power automation platform SICAM 8.

As a pioneer in all areas of power automation, with SICAM 8, we support our customers in terms of:

- Resilience
  Resilient and most secure power grids
- Efficiency
  Fast and consistent engineering
- Sustainability
  Technology to achieve climate goals and create a sustainable world

SICAM S8000 is a seamless, hardware independent software product for low-, medium-, and high-voltage power automation and control applications in various industries and can be fully virtualized. The engineering is done with SICAM Device Manager, like the entire portfolio of the SICAM 8 Platform.

All SICAM 8 cybersecurity standards are maintained in SICAM S8000.

Compliance with the following standards can be achieved:

- IEC 62443
- IEC 62351

Engineering with SICAM Device Manager

One engineering tool for all runtimes and applications within the SICAM 8 family minimizes maintenance effort and costs as well as optimizes the efficiency and training needs for operating personnel.

Runtime Selection

SICAM S8000 can be installed on prequalified IPCs or can be deployed fully virtualized. The chosen IPC or the assigned hardware resources define the performance limits.

Selected prequalified IPCs:

- SIMATIC IPC 227G & 277G with on-board display
- RUGGEDCOM APE1808LNX
- WELOTEC RSAEC & RSAPC (incl. PRP/HSR)

Supported hypervisors for virtualization:

- VMware
- Hyper-V

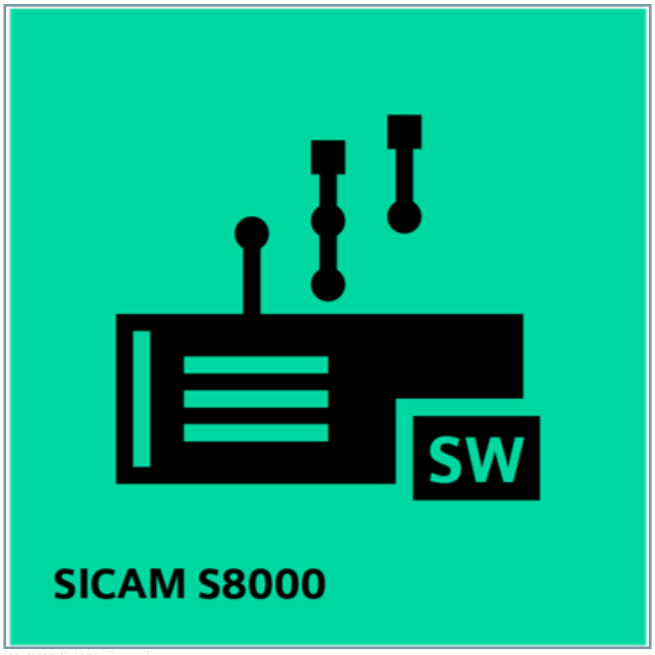
Choose between multiple Linux operating systems:

- Debian
- Red Hat Enterprise Linux
- SIMATIC Industrial OS

For further information on tested hardware types, hypervisors, operating systems, as well as minimum requirements for virtual machines contact your Siemens sales representative.

With the 21 days free trial license, most applications can be tested anytime.

The licences can be generated in the SICAM Function Point Manager and uploaded to specified applications and runtimes via SICAM Web. Dependencies according to manual must be considered.



Benefits

- Select prequalified IPCs or install the substation controller fully virtualized to gain complete hardware independence
- Choose between multiple Linux Operating Systems
- Create virtual testing setups of your IPC based substation controller by deploying the same configuration fully virtualized
- Reduce hardware thanks to the consolidation of multiple functions
- Scale your system in terms of connections, functions, performance, and applications
- Continuously adapt to the changing energy landscape thanks to the endless flexibility
- Integrate state of the art cybersecurity features
- Improve resilience thanks to the decoupling of hardware and software
- Built future ready IT/OT convergent systems

Functions

Features are available for IPC runtimes and fully virtualized:

- Integration of up to 1200 stations (IEDs)
- TCP/IP based communication protocols: IEC 61850, IEC 60870-5-104, DNP 3.0i, Modbus TCP, OPC UA Server, and OCPP Client
- Support of (serial) converter for MODBUS, DNP, Profibus, and Profinet
- CFC logics (up to 8 additional CFC instances with extended processing)
- Security features such as TLS & IPSec encryption

- CIS Benchmark Level 2 with appropriate installation
- Secure Boot with appropriate installation & hardware
- Redundant configurations
- SICAM 8 Core functions such as HTTPS, NTP Client & Server SNMP Server, Syslog, and VLAN for local Ethernet ports
- Support of SIAPPs (3rd-party applications that can be installed on the SICAM 8 platform, allowing for the quick and easy creation of up to three custom applications)

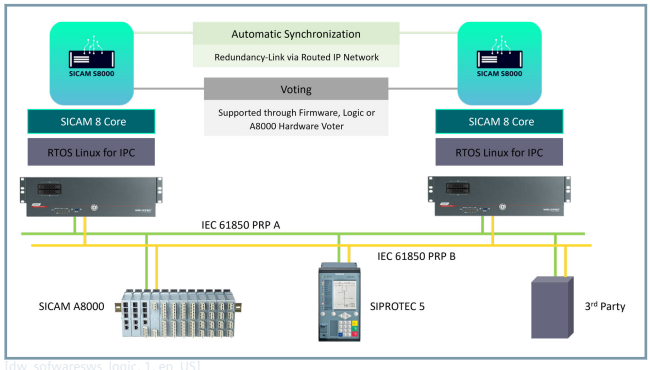
Find all available features and more detailed descriptions in the manual.

Applications

Multiple applications can be combined on one runtime:

- All-in-One configuration for compact substation automation and control (runtime: SICAM S8000 on SIMATIC IPC 227G with onboard display, applications: SICAM S8000 RTU + SICAM HMI + SICAM EVA + SICAM Archive)
- Monitoring of digitalized distribution substations (runtime: SICAM S8000 virtualized as data collector, for on-premise visualization and gateway to Electrification X, SICAM EGS as sensor device in the digital distribution substation, applications: SICAM S8000 RTU + SICAM HMI + SICAM EVA + SICAM Archive + SICAM GridEdge)
- Station controller for primary substation automation, control and monitoring (runtime: SICAM S8000 on IPC, applications: SICAM S8000 RTU + SICAM Archive, connected to SICAM SCC)
- Virtual SCADA front-end & gateway (runtime: SICAM S8000 virtualized, application: SICAM S8000 RTU)
- Virtual closed-loop testbed using digital twins to accelerate pre-FATs, FATs, firmware updates or any other engineering processes (runtime: SICAM S8000 virtualized, connected to SIPROTEC DigitalTwin, applications: SICAM S8000 RTU + SICAM HMI + SICAM EVA)

SICAM S8000 Redundancy



{dw_sofwareswS_logic, 1, en_US}

Figure 2.2/1 SICAM S8000 Supports Redundancy for a S8000 Application (Example)

Description

SICAM HMI is a high performing technology with modularized architecture and is a part of the universal power automation platform SICAM 8. SICAM HMI provides you the advantage of configuring the entire range of the SICAM 8 platform with one engineering tool, that is the SICAM Device Manager.

The visualization and operation tool controls and monitors smaller plants around the entire energy chain from the:

- Power generator to the consumer
- Low voltage to high voltage
- Infrastructure to industry

Features

- SICAM HMI can be used along with SICAM S8000 on a Linux based SICAM A8000 CP-8031/CP-8050
- SICAM HMI can be used along with SICAM S8000 as a software solution on third-party Linux based industrial PCs
- Parameterization with SICAM Device Manager (engineering tool for RTU and HMI)
- Graphics editor integrated in SICAM Device Manager
- Event and alarm list
- Web-browser based application for tablets and HTML5 browser compatibility
- Applications with up to 200 data points are license free
- With SICAM HMI, you have a product with security features such as HTTPS, RBAC (role-based access control), and patch management

Benefits

- One engineering tool for HMI and RTU – minimization of maintenance effort and costs
- Unified platform for hardware, software, controller, and engineering – reduced training effort for operating personnel
- Hardware from SICAM A8000 portfolio
- Use of manufacturer independent hardware (industrial PCs with Linux operating system) in combination with the SICAM S8000

The SICAM HMI configuration is an add-on and works only in conjunction with the SICAM Device Manager.

Description	Versions	Order no.											
		1	2	3	4	5	6	7		8	9	10	11	12
SICAM Device Manager Basic		6	M	F	7	8	0	0	-	2	F	B	0	0
SICAM Device Manager Standard		6	M	F	7	8	0	0	-	2	F	S	0	0
SICAM HMI Configuration		6	M	F	7	8	0	0	-	2	F	H	0	0

Table 2.3/1 SICAM HMI Selection and Ordering Data

SICAM HMI	SICAM HMI Graphic Editor	License with MLFB orderable
	SICAM Event/Alarm List (Configuration)	Included in HMI configuration license
	SICAM HMI Runtime	• Up to 200 data points license free • Up to 2000 data points license can be ordered with SICAM FPM (Function Point Manager)
	SICAM Event/Alarm List (Runtime)	• Up to 4000 data points license free • Up to 30 000 data points license can be ordered with SICAM FPM (Function Point Manager)

Table 2.3/2 SICAM HMI Software Package

The licensing of the SICAM HMI configuration is done as an add-on to the SICAM Device Manager.

- Activation via ALM license (MLFB)
- Delivery via OSD (Online Software Delivery)

The SICAM HMI Runtime and SICAM Event/Alarm List Runtime is licensable with function points.

- License file can be generated with SICAM FPM

Description

Configuration with SICAM WEB can be implemented for modules CP-8000/8021/8022. Configuration for SICAM 8 devices requires the use of SICAM Device Manager.

Using a tablet or PC and a browser, SICAM WEB is the easiest way to configure and test devices of the SICAM A8000 series.[7]

Enter the IP address of the SICAM A8000 device in the browser address bar, and then edit the access data in the SICAM WEB log-on dialog.

This is followed by bidirectional communication with the SICAM A8000 device via an Ethernet connection.

No time-consuming software download and installation.

The SICAM A8000 series supports role-based access control (RBAC).

RBAC is configured online on the device using SICAM WEB. In accordance with IEEE 1686, the BDEW Whitepaper, and IEC 62351-8, 8 roles are predefined in SICAM A8000 series devices. A role contains specific rights to carry out specific functions. Every user can be assigned one or more roles and the associated rights. The ADMINISTRATOR role has all rights, such as the ability to change configuration data and start test runs.

Convenient functions for CP-8000/8021/8022

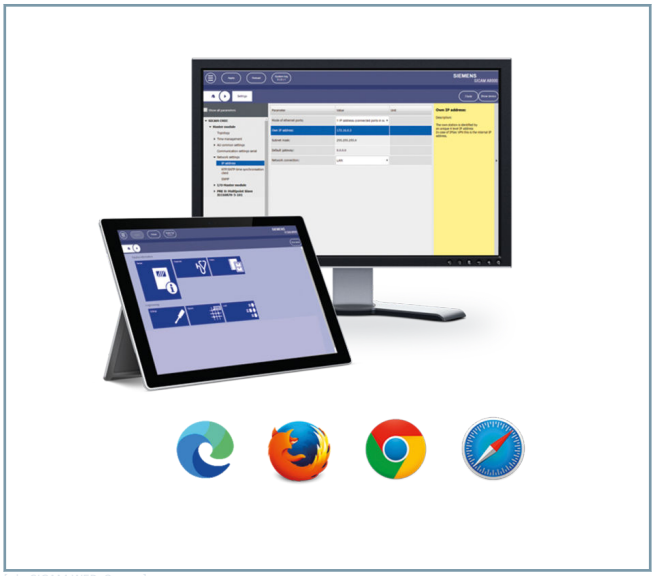
- Easy online parameter entry for CP-8000/21/22 via HTTPS, with maximum ease of use
- Structured user interface and logical operating steps optimized for every working situation
- Free utilization with any current Web browser; no limitation
- No time-consuming installation necessary
- Utilization via tablet or PC
- Connection via direct Ethernet connection or via WLAN with a router

Additional functions for CP-8031 and CP-8050

- System and firmware overviews
- Wiring test of the I/O modules
- I/O data-point simulation
- Monitoring, simulation, and tracking of signals
- Integrated Wireshark functionality
- Protocol-specific Internet pages
- Customer-specific dashboards

Advantage with SICAM WEB for CP-8031 and CP-8050[8]

- Direct access to the device via HTTPS using role-based access (RBAC)
- Simulation functions with corresponding authorization only
- A diagnostic entry is made as soon as signals are decoupled from the process

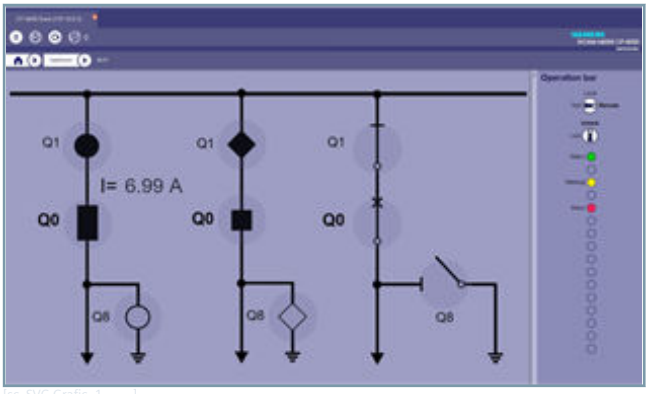


[ph_SICAM WEB, 2, --_--]

Figure 2.4/1 SICAM WEB

Customer-specific dashboards

- Inclusion of individual scalable vector graphics (SVG)
- Design of SVG graphics using Inkscape Open Source software
- Tile-based graphics structuring
- LED icons for alarm visualization
- Integrated system functions (command output, menu bar, key switch)
- Role-based operator access via HTTPS
- Without additional engineering tool



[sc_SVG Grafic, 1, --_--]

Figure 2.4/2 SVG Graphic

7 Configuration for SICAM 8 devices requires the use of SICAM Device Manager.

8 Firmware version 4.5x and higher

[sc_SIMATICTouchpanel, 1, --]

Figure 2.4/3 SIMATIC Touch Panel

Description

Top priority in the digitalization of energy networks is the security culture of grid operators and their increased responsibility due to the connectivity of devices and grids. Generally, cybersecurity is enhanced by employing multiple security controls (defense-in-depth approach).

The security controls include:

- Identity management
  - Unique IDs for personnel and products for authentication
- Access control
  - Specification of roles and restrictions for authorization
- Secure communication
  - Agreement of cryptographic details for securing network protocols
- Malware protection
  - Validation of the source and integrity of OT software and firmware
- Data protection
  - Verification of the integrity of process data
- Protection of setting values
  - Verification of the integrity of OT settings

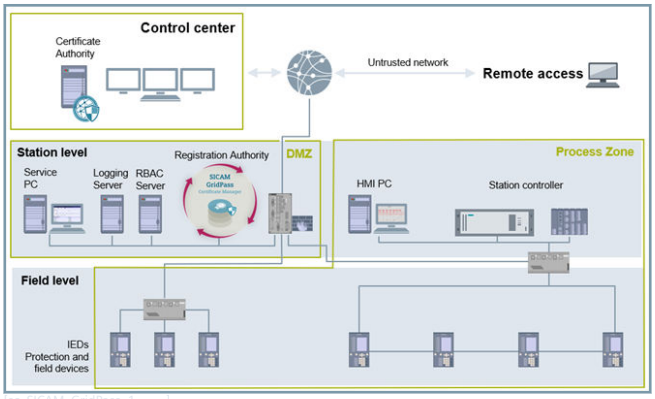
The administration of these security controls can become a complicated and time-consuming task with the increasing number of digitalized and networked products and services in energy systems. Building a public key infrastructure (PKI) helps in managing these increased requirements in a scalable way by bringing security based on certificates to energy systems.

Benefits

- High level of cybersecurity and easy handling of your security controls - automated management of the digital certificates of the substation operator Smart frequency management
- IT/OT interoperability with support for international security standards such as PKCS, CMS, X.509, EST, SCEP, and IEC 62351
- Minimum of installation work and scalable (different license packages available)
- Ready for use with SIPROTEC, SICAM, and third-party products supporting IEC 62351 standard

Functions

- Management of standardized digital X.509 certificates for OT use according to IEC 62351-8 for included role information
- Creating or importing of Certification Authorities (CA) used as Root- or Sub-CA
- Acting as Registration Authority (RA) connected via CMP protocol to an external Certificate Authority (CA)
- Automated issue and management of certificates using EST or SCEP protocol in adherence to IEC 62351-9 for:
  - SICAM A8000 CP-8050/8031 devices for securing IEC 60870-5-104, IEC 61850 MMS, DNP3, IEEE 802.1X network authentication, and WebUI
  - SICAM PAS/PQS for securing IEC 60870-5-104, IEC 61850 MMS, and DNP3



[sc_SICAM_GridPass, 1, --_--]

Figure 2.5/1 SICAM GridPass Workflow

  - SICAM SCC for securing WebUI and DIGSI 5
  - SIPROTEC 5 for securing WebUI, DIGSI 5, and IEEE 802.1X network authentication
- Manual creation and export of certificates with and without corresponding private key and the trust chain
- Import of external generated Certificate Signing Requests (CSR) and the export of certificates
- Export of certificates in a LDAP or Active Directory repository operation to other PLC systems
- Creation and distribution of Certificate Revocation Lists (CRL) for revoked certificates
- OCSP responder service to provide an HTTP based online certificate revocation check
- Web-based engineering and certificate management
- Role-based access control according to IEC 62531-8 with role-based views over local or centrally managed user accounts
- Logging of security-relevant events via Syslog protocol
- Support of elliptic curve cryptography (secp256r1, secp521r1, and brainpool256r1) as well as TLSv1.3
- Custom based firmware signature with CMS standard

Applications

SICAM GridPass manages digital certificates for your OT network automatically and thus allows for the effective and efficient use of the security controls. The digital certificates are managed according to the following criteria:

- Authenticate: Verification of the identity and authenticity of automated certificate issuing requests
- Issue: Automated or manual issuing of certificates
- Renew: Re-issue of certificates
- Revoke: Management and provision of a list for revoked certificates

Selection and Ordering Data

Description	Versions	Order no.																
		1	2	3	4	5	6	7		8	9	10	11	12		13	14	15	16
		6	M	D	7	7	1	1	-	2	A	A	0	0	-	□	□	A	0
																▲	▲		
SICAM GridPass 50 Clients	Software/License key															1	A		
SICAM GridPass 250 Clients	Software/License key															2	A		
SICAM GridPass 1.000 Clients	Software/License key															3	A		
SICAM GridPass 10.000 Clients	Software/License key															4	A		
SICMA GridPass Essential without EST and SCEP support	Software/License key															1	E		
SICAM GridPass internal Trial Version only for Siemens internal tests w/o delivery to a customer	Software/License key															1	S		
SICAM GridPass Trial Version only available over Siemens Industry Online Support portal: *https://support.industry.siemens.com/cs/document/109763384*	Software	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-

Table 2.5/1 SICAM GridPass Selection and Ordering Data

Description

The SICAM A8000 device series has been designed for lots of different tasks, both simple and complex. The area of application spans the entire energy-supply chain. Customer requirements such as IT security, scalability, flexible communication, space-saving design, and the ability to be used in harsh conditions were taken into account when the SICAM A8000 was being designed. The modular SICAM A8000 series offers optimized solutions for all kinds of performance requirements.

SICAM A8000 – Module Types

- Processor modules (up to a max. of 34 interfaces)
- Power-supply modules (DC 24 V to 60 V; DC 110 V to 220 V; AC 230 V)
- Ethernet or serial communication expansion modules
- Interface modules for a max. of 16 expansion lines
- Binary inputs (DC 24 V; DC 48/60 V; DC 110 V; DC 220 V)
- Binary outputs (DC 24/48/60/110/220 V; AC 110/230 V)
- Analog inputs (-20 mA/+20 mA; -10 V/+10 V; Pt 100)
- Analog outputs (-20 mA/+20 mA; -10 mA/+10 mA; -10 V/+10 V)
- Current/voltage inputs (1 A/5 A; LoPo; 230 V)

The universally applicable binary or analog input/output modules can be plugged in any order and are suitable for even the tightest spaces as they have a module width of 30 mm.

Benefits

- They can also be used in harsh ambient temperatures due to the extended temperature range of -40 °C to +70 °C
- The increased EMC stability of up to 5 kV (IEC 60255) qualifies the devices for direct use in switchgears
- Simple engineering with the integrated Web parameterization tool and the SICAM Device Manager
- It meets the most stringent cybersecurity requirements due to an integrated crypto chip and IPSec encryption
- It is a safe investment as international standards such as IEC 61850 IEC 60870-5-101/-103/-104 etc. are followed.
- The modular platform offers a variety of application options and reduces warehousing.
- Adaptation to existing communication infrastructures with a multitude of interfaces and the integrated GPRS module
- The integrated short-circuit indicator functionality enables use in power-system monitoring.
- You can save time and money as installation and maintenance are really simple – plug & play

Device Characteristics

Communication Interfaces and Protocols

- CP-8000: 3 x RJ45 (2 x Ethernet, 1 x RS232), 1 x RS485
- CP-8010: 6 x RJ45 (3 x Ethernet, 1 x RS232), 2 x RS485, 1 x Wireless Gateway, 1 x LTE CAT1/GPRS

[ph_SICAM A8000_5 devices, 1, --_--]

Figure 2.6/1 SICAM A8000 Devices

- CP-8012: 6 x RJ45 (3 x Ethernet, 1 x RS232), 2 x RS485, 1 x Wireless Gateway, 1 x LTE CAT1/GPRS
- CP-8021: 3 x RJ45 (2 x Ethernet, 1 x RS232), 1 x RS485
- CP-8022: 3 x RJ45 (2 x Ethernet, 1 x RS232); 1 x RS485, 1 x RS232/RS485 (selectable), 1 x LTE CAT1/GPRS
- CP-8031: 4 x RJ45 (2 x Ethernet, 1x RS485, 1 x RS232)
- CP-8050: 4 x RJ45 (2 x Ethernet, 1 x RS232, 1 x RS485), up to 12 x Ethernet or 30 x serial with CI modules
- IEC 60870-5-101/-103/-104, Modbus RTU/TCP
- IEC 61850 Ed1/Ed2 client & server incl. GOOSE
- DNP3 serial master/slave, TCP/IP
- Other protocols on request

Auxiliary Voltages

- DC 24 V to 60 V (12 W or 45 W)
- DC 110 V to 220 V (12 W or 45 W)
- AC 230 V (45 W)
- Can be redundant

Inputs and outputs

- CP-8000: max. 116 I/O with up to 6 I/O modules
- CP-8010/CP-8012: max. 144 I/O with up to 8 I/O modules with license 272 I/O with 1 additional expansion row
- CP-8021, CP-8022: max. 128 I/O with up to 8 I/O modules
- CP-8031: max. 128 I/O with up to 8 I/O modules with license 256 I/O with 1 additional expansion row
- CP-8050: max. 2048 I/O with up to 16 expansion lines for every 8 I/O modules

Real-Time Clock

- +/- 2 ppm, time synchronization using NTP protocol, SNTP protocol

Electromagnetic Compatibility

- IEC 60870-2-1, IEC 61010, IEC 60255-5, IEC 61000-4, EN 55022, CE marking

Temperature Range

- CP-8000, CP-8010, CP-8012, CP-8021, CP-8022: from -40 °C to +70 °C
- CP-8021, CP-8022: From -40 °C to +70 °C
- CP-8031, CP-8050: From -25 °C to +70 °C [9]

Housing Specifications

- Plastic housing for DIN rail mounting
- Dimensions of the CP-8000: 128 mm x 124 mm x 123 mm (W/H/D)
- Dimensions of the CP-8010, CP-8012: 153.5 mm x 160 mm x 123 mm (W/H/D) (without DIN rail, including connectors and terminals, locking hooks closed)
- Dimensions of the CP-8021/22/31/50, CI, power-supply module and I/O modules: 30 mm x 132 mm x 124 mm (W/H/D)

Special Features

- Optional display module CM-8880 available for CP-8010 and CP-8012
- Integrated display and function keys for CP-8000
- Integrated Web server for configuration and diagnostics with CP-8000/21/22, engineering using the SICAM Device Manager for the A8000 series
- Data storage using an SD memory card (parameters and device firmware)
- Freely programmable user programs according to IEC 61131-3
- Device redundancy with CP-8050
- The security requirements of the future:
  - Compliance with the BDEW white paper
  - Integrated crypto chip
  - TLS encryption
  - IPSec encryption
  - HTTPS protocol
  - Security Logbook
  - Integrated software firewall
  - Firmware signature
  - Role-based access control
  - Configurable system functions
  - Hardware-based application layer firewall for IEC 60870-5-104
  - Automated certificate handling via the EST protocol with SICAM Grid Pass

Fields of Application

The SICAM A8000 has virtually limitless scalability and can be expanded at any time due to the various power levels in the processor modules, interface modules, and the I/O modules. The area of application for the SICAM A8000 series extends from distribution-system automation, via the connection of renewable energies (wind, solar, hydro), right up to railway power supply and industrial applications.

The I/O modules are pluggable in any order. With a module width of 30 mm, they are suitable for even the most minimal spatial conditions and are scalable and extendable at any time in an almost infinitely variable manner.

Example 1: High power and interfaces for complex tasks

- Automation tasks in power distribution and transmission, microgrids
- Control and turbine regulation in hydropower plants
- Transformer control and regulation
- Control and communication in railway power supply
- Redundant communication gateway for different networks and protocols

Example 2: Everything at a glance with on-site compact solution

- Use in distribution-system automation
- Optimized for use in MS switchgear
- Power-flow control available

Example 3: Without display, dimensioned to be space-saving with slim PCB assembly

- Network connection of solar and wind farms
- Control and monitoring of power and gas distribution stations
- Simple gateway function

9 -40 °C on request

SICAM A8000 with HSR, PRP – Ethernet Redundancy Protocols for Optimal Availability

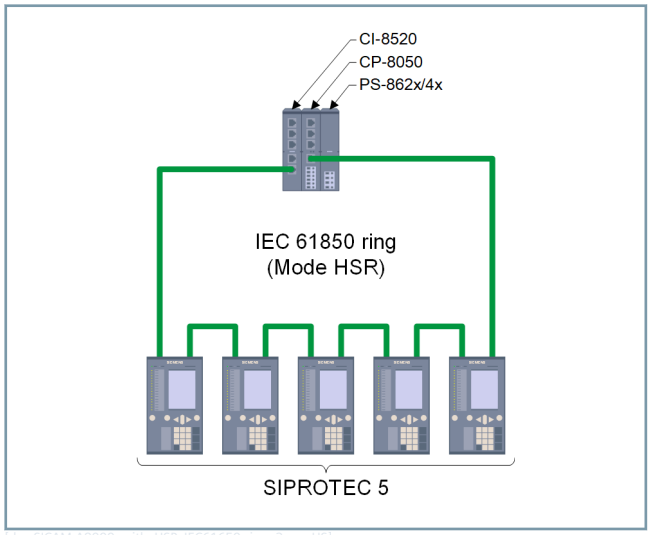
In order to satisfy the requirements of important time-sensitive applications, the latest High Availability Seamless Redundancy (HSR) and Parallel Redundancy Protocol (PRP) Ethernet redundancy systems have been developed in line with the latest IEC 62439-3 standard.

The seamless PRP and HSR redundancy solutions are available for the entire Siemens SICAM A8000, SIPROTEC 4, SIPROTEC Compact, SIPROTEC 5, and Reyrolle 7SR2x series.

High Availability Seamless Redundancy (HSR)

HSR is a redundancy protocol for lossless, redundant transmission of data via Ethernet networks in ring topologies and offers redundancy without changeover times.

Every device in the network is connected via 2 Ethernet interfaces. The notifications are sent to both interfaces and therefore transmitted in both directions in the ring simultaneously. 2 identical notifications arrive at the target (in a healthy state) within a time frame. The 1st one is forwarded to the application whilst the 2nd is discarded. The ring is monitored by cyclical HSR management telegrams (cycle time of 2 seconds). An open ring is signalized by a warning.



[dw_SICAM-A8000_with_HSR_IEC61650-ring, 2, en_US]

Figure 2.6/2 SICAM A8000 with HSR

Configuration notes

- HSR can only be used with the CI-8520 Ethernet interface module.
- Only one HSR ring is permitted per CI-8520 module.
- The selection of the 2 interfaces for the HRS ring per CI-8520 module is arbitrary.
- HSR mode must be activated on the CI-8520 Ethernet interface in use.
- A maximum of 512 MAC addresses are permitted per HSR ring.

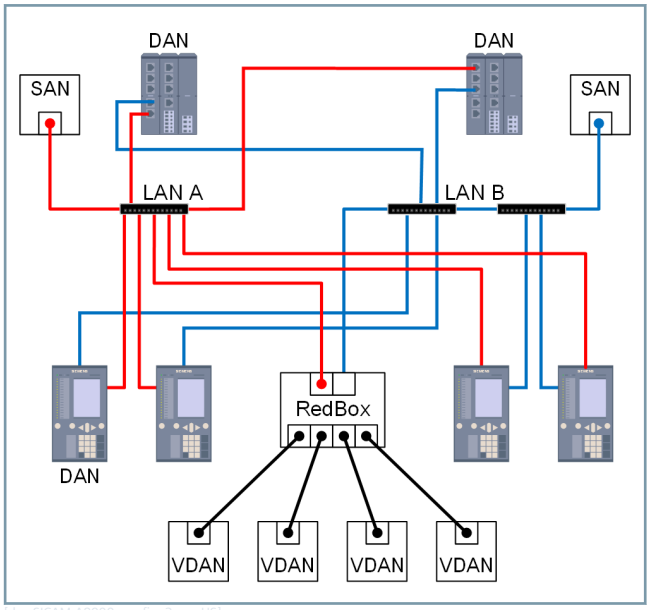
Parallel Redundancy Protocol (PRP)

PRP is a redundancy protocol to support seamless redundancy (= no reconfiguration times in case of a failure in one of the networks). The layer-2 redundancy process was developed for automation networks which require a high degree of availability for continuous operational function.

All data is transmitted simultaneously via 2 independent networks (LAN A and LAN B) with the PRP structure.

Topology, performance, and latency can differ in the case of both networks, however, the latencies must only differ up to a certain upper limit. As shown in the figure, the 2 networks may not be connected to one another.

The advantage of PRP compared to other protocols is that if a communication is interrupted in a network, a seamless switchover takes place. Data losses are therefore avoided.



[dw_SICAM-A8000_config, 2, en_US]

Figure 2.6/3 PRP Structure

Configuration notes

- Dual Attached Nodes (DAN)
  Devices which are connected to both networks. An interface is available for every network connection.
- Single Attached Nodes (SAN)
  Devices which are connected to a single network via an interface.
- Virtual Double Attached Nodes (VDAN)
  VDANS are devices which only have one interface, but are connected to both networks via a redundancy box (RedBox).
- PRP can only be used with the CI-8520 Ethernet interface module

Advantages

- Maximum network reliability, seamless reconfiguration
- Process can be easily configured

- Minimal wiring effort due to the use of efficient ring structures
- Cost-efficient structures
- Easily expandable by integrating additional HSR rings
- Guaranteed interoperability, standardized in IEC 62439
- Full compatibility between IEC 61850 Editions 1 and 2 as well as all other Ethernet protocols

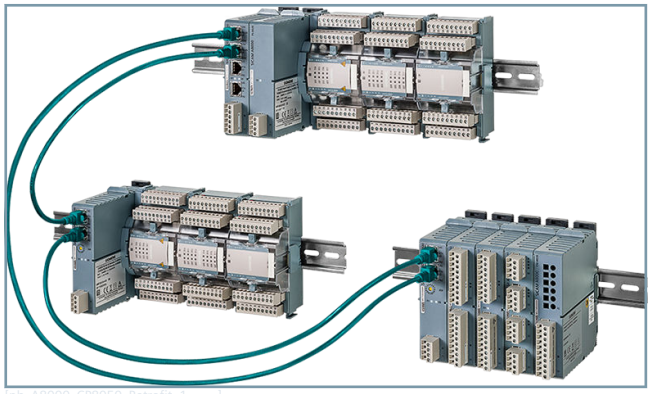
RetroFit with SICAM A8000 - Ready for IP Technology and Cybersecurity by Replacing Parts

Fast and secure communication of telecontrol systems is the key to secure, reliable electrical energy systems in today's highly complex electrical power systems.

SICAM A8000 offers the option of fully and “securely” enjoying the advantages of new IP technology.

Also, the whole system has components from the SICAM MIC or TM1703MIC series.

After replacing the master control and power-supply modules, the available telecontrol systems for the latest SICAM A8000 CP and PS modules, your plant is now ready for integration into the IT network and is optimally secured against cyber attacks.



[ph_A8000_CP8050_Retrofit, 1, --_--]

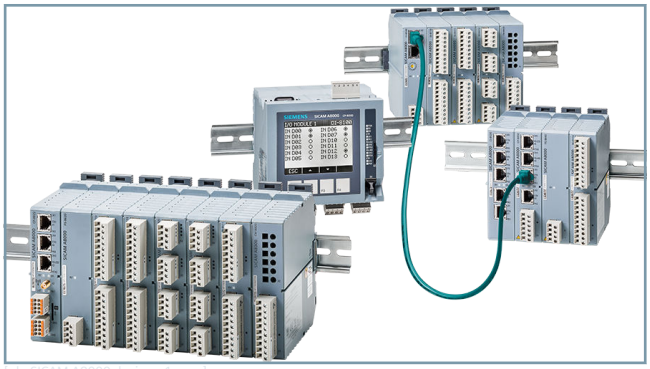
Figure 2.6/4 SICAM A8000-CP8050 Retrofit

The free firmware updates means that, in terms of cyber-security, it demonstrates the high standard expected from Siemens. These downloads are available in our SIOS portal.

Replacement of the SICAM EMIC (CP-6010) with the associated power-supply module (PS-66xx) results in free space of 129 mm on the DIN rail. This can be used to expand with a max. of 2 TM-IO modules.

Advantages

- Cybersecurity requirements in line with BDEW Whitepaper, NERC CIP, and IEC 62351 with support for RADIUS, Syslog, IPSec, and TLS
- Cost-effective upgrading of your telecontrol stations and adapting to the latest technology
- Continued use of available TM/IO modules, resulting in less need for spare parts
- Quick retrofitting due to minimal intervention in the existing wiring
- Use of existing communication lines
- Power-supply modules for almost every auxiliary voltage
- Parameterization via SICAM WEB or SICAM Device Manager



[ph_SICAM A8000 devices, 1, --_--]

Figure 2.6/5 SICAM A8000 Devices

Module Combinations

The SICAM A8000 series is a module combination of a power supply, processor, and extensions, and is used for various tasks such as control, telecontrol, automation, and communication. The SICAM A8000 CP-8000, CP-8010, and CP-8012 compact device combines power supply, display with function key, binary inputs and outputs, 1 analogue input and a wireless gateway.

Module dimensions (L x W x H): 124 mm x 30 mm x 132 mm (dimensions without DIN rail)

You can get an overview of the different module types in the following tables.

System Components and Technical Data

For additional system components and technical data, refer to the current manual: *Industry Online Support*

Compact Device	CP-8000	CP-8010	CP-8012
Dimensions (W x H x D)	132 mm x 30 mm x 142 mm	153.5 mm x 160 mm x 123 mm (without DIN rail, including connectors and terminals, locking hooks closed)	153.5 mm x 160 mm x 123 mm (without DIN rail, including connectors and terminals, locking hooks closed)
Temperature range	-40 °C to +70 °C	-40 °C to +70 °C	-40 °C to +70 °C
Input voltage	DC 18 V to 78 V incl. tolerance	DC 18 V to 78 V incl. tolerance	DC 18 V to 78 V incl. tolerance
Interfaces	2 x Ethernet LAN 1 x RS232 1 x RS485 (galvanically separated)	3 x Ethernet LAN 1 x RS232 2 x RS485 (galvanically separated) 1 x Wireless Interface	3 x Ethernet LAN 1 x RS232 2 x RS485 (galvanically separated) 1 x Wireless Gateway
Storage	SD card up to 2 GB	SD card up to 2 GB	SD card up to 2 GB
Max. number of data points	20000	20000	20000
Special features	Integrated power supply 12 DI and 8 DO integrated Max. 116 I/O (max. 6 expansion modules) 4 function keys and display	Integrated power supply 8 DI, 5 DO (5 A), 2 DO (8 A), 1 AI (-22 mA to 22 mA) Max. 144 I/O (max. 8 expansion modules) 128 I/O with CI-853x and additional license 4 function keys and display Display module CM-8880 optionally available	Integrated power supply 8 DI, 5 DO (5 A), 2 DO (8 A), 1 AI (-22 mA to 22 mA) Max. 144 I/O (max. 8 expansion modules) 128 I/O with CI-853x and additional license 4 function keys and display Display module CM-8880 optionally available LTE modem with GPRS fallback

Table 2.6/1 Compact Device

				
Processor Module	CP-8021	CP-8022	CP-8031	CP-8050
Temperature range	-40 °C to +70 °C		-25 °C to +70 °C [10]	-25 °C to +70 °C [10]
Max. number of interfaces	3 x RJ45: 2 x Ethernet/1 x RS232 1 x RS485	3 x RJ45: 2 x Ethernet/1 x RS232 1 x RS232/RS485 selectable 1 x RS485 1 x LTE CAT1/GPRS	4 x RJ45: 2 x Ethernet 1 x RS485 (serial) 1 x RS232 (serial)	4 x RJ45: 2 x Ethernet 1 x RS485 (serial) 1 x RS232 (serial) 30 x serial (modular) 12 x Ethernet (modular)
Storage	SD up to 2 GB		SD up to 4 GB	SD up to 4 GB
Data points	20000			400000
Distributed archive	Available			
Device redundancy	–	–	–	Yes
Automation function (CFC/PLC, IEC 61131-3)	1 x 128 kB	1 x 128 kB	1 x 3 MB	5 x 3 MB

Table 2.6/2 Processor Modules

2.6

				
Power-supply modules	PS-8620	PS-8622	PS-8640	PS-8642
Input voltages	DC 24 V to 60 V, 12 W	DC 110 V to 220 V, 12 W	DC 24 to 60 V, 45 W	DC110 to 220 V, 45 W AC 100 to 240 V, 45 W
Output voltage 1	DC 5.15 V ± 2 % static, ± 3 % dynamic		DC 5.15 V ± 2 % static, ± 3 % dynamic	
Output current 1	0 A to 1.8 A		0 A to 2 A	
Output voltage 2	DC 28.0 V ± 10 % static, ± 3 % dynamic		DC 28.0 V ± 0 % static, ± 3 % dynamic[11]	
Output current 2	0 A to 0.43 A		0 A to 1.79 A	
Output voltage 3	–		–	DC 24 V + 0 %/ -15 %
Output current 3	–		–	0.42 A

Table 2.6/3 Power-Supply Modules

10 -40 °C on request

11 for the generation of auxiliary voltage for specific transmission devices

			
Communication Modules	CI-8520	CI-8522	CI-8551
Communication redundancy function	HSR, PRP, RSTP, line mode	HSR, PRP, RSTP, line mode	Tri-state mode to serial interfaces
Interface	5 Ethernet/LAN interfaces	5 Ethernet with 2 x SFP modules (optical/electrical) and 3 x sockets for electr. TP cables	2 x serial RS232 1 x serial RS485/422 2 x serial RS232/485/422
Max. number of expansion modules	2	2	6
Operating voltage	DC 28 V input DC 25.2 V to 30.8 V; 2.5 W	DC 28 V input DC 25.2 V to 30.8 V; 4.5 W	DC 28 V input DC 25.2 V to 30.8 V

Table 2.6/4 Communication Modules – Only Used in Conjunction with CP-8050

				
Digital Input Module	DI-8110	DI-8111	DI-8112	DI-8113
Inputs	16 binary inputs 2 groups each with 8 inputs			
Rated voltage	DC 24 V	DC 48 V/60 V	DC 110 V	DC 220 V
Input circuits	DC 18 V to 31.2 V	DC 36 V to 78 V	DC 82.5 V to 143 V	DC 165 V to 253 V
Operating voltage	DC 4.75 to 5.5 V			
Current consumption	0.9 mA to 4.8 mA at 18 V to 31.2 V	0.5 mA to 2.5 mA at 36 V to 78 V	0.4 mA to 1.4 mA at 82.5 V to 143 V	0.3 mA to 0.7 mA at 165 V to 253 V

Table 2.6/5 Digital Input Modules

			
Digital Output Module	DO-8212	DO-8221	DO-8230
Outputs	8 relay outputs (4 groups of 2)	12 relay outputs (1 group)	16 digital outputs (2 groups of 8)
	Galvanic separation		
Rated voltage	DC 24 V to 220 V; AC 110/230 V	DC 24/48/60/110/220 V[12], AC 230 V	DC 24 V to 60 V

12 DC 110/220 V as of CC production status



Digital Output Module		DO-8212	DO-8221	DO-8230
Max. continuous current		Standard wiring • 8 outputs, each max. 3 A (5 A/1 min) Wiring with derating at 5 A • 2 outputs, each with a max. of 5 A • 6 outputs, each with a max. of 2 A or • 4 outputs, each with a max. of 5 A • 4 outputs, each with a max. of 0 A (relay must not be activated) 46 power increase • 4 outputs, 6 A each (max. DC 24 V +20 %; max. AC 230 V +10 % [13]	1 A	Standard wiring • 16 outputs, each max. 0.5 A
Switching power	Direct voltage	DC min. 50 mW at 5 V	1000 VA; 4 A at DC 250 V, L/R ≤ 40 ms[14] 800 VA; 3.25 A at AC 250 V, cos φ ≤ 0.4	• 78 W at DC 78 V (with power increase) • 30 W at DC 60 V • 24 W at DC 48 V • 12 W at DC 24 V
	Alternating voltage	Max. 1250 VA; 5 A/AC 250 V, resistive load Max. 500 VA; 2 A/AC 250 V, cos φ = 0.4		
Power supply	Operating voltage	DC 4.75 to 5.5 V	DC 4.75 V to 5.5 V	DC 4.75 V to 5.5 V
	Power consumption	800 mW	• 2 W during command output • 1.3 W in idle state	500 mW

Table 2.6/6 Digital Output Modules

13 With a parallel connection

14 DO-8221 supports the IEC 60947-4-1 usage category for DC. DC-supported category: DC-1,3,5,6 from IEC 60747-4-1 Table 10.

		
Analog Output Module		AO-8380
4 outputs (4 groups of 1)		All outputs galvanically separated
Current output		Max. ± 20 mA to max. 500 Ω load Max. ± 10 mA to max. 1 kΩ load
Voltage output		Max. ± 10 V to min. 1 kΩ load
Resolution		0.025 % at ± 20 mA, mA to 10 mA, V to 10 V
Accuracy		0.3 % at +25 °C 0.4 % at 0 °C to +50 °C 0.7 % at -20 °C to +70 °C 0.8 % at -40 °C to +70 °C
Power supply	Operating voltage	DC 4.75 V to 5.5 V The voltage is taken from the system bus.
	Power consumption	Max. 2200 mW

Table 2.6/7 Analog Output Module

2.6

				
Analog Input Modules	AI-8310	AI-8320	AI-8330	AI-8340
4 analog inputs	2 groups, 2 inputs each Galvanically separated Voltage between 2 inputs of a group max. DC 600 mV	4 groups, each with 1 input Galvanically separated	3 current measuring inputs The current inputs are galvanically separated by transformers, from each other, and from the logic voltage	4 current inputs (250 V) are galvanically separated by transformers, from each other, and from the logic voltage
Measuring range	40 Ω to 400 Ω (Pt100, Ni100) 400 Ω to 4000 Ω (Pt1000)	Current measurement -20 mA to 0 mA to +20 mA Voltage measurement -10 V to 0 V to +10 V Overrange current ~20 %, voltage ~30 %	300 V rated voltage	300 V rated voltage
Resolution	10 mΩ (Pt100, Ni100) 100 mΩ (Pt1000)	0.004 % at ±20 mA 0.004 % at ±10 V	16 bits	16 bits
Noise rejection	16⅔ Hz, 50 Hz, 60 Hz	50 dB (50 Hz, 60 Hz, 16⅔ Hz)		
Accuracy	0.19 % 0 °C to +50 °C 0.4 % 40 °C to +70 °C	0.15 % at 25 °C		
Power supply	DC 4.75 V to DC 5.5 V; max. 500 mW	DC 4.75 V to 5.5 V; max. 180 mW	DC 4.75 V to 5.50 V; 300 mW	DC 4.75 V to 5.50 V; 1400 mW

Table 2.6/8 Analog Input Modules

Analog Input Modules		AI-8510	AI-8511
Properties		• 3 low-power (LoPo) current measuring inputs (225 mV) • 3 low-power (LoPo) voltage measuring inputs (3.25 V/√3)	• 3 low-power (LoPo) current measuring inputs in conjunction with adaptor module CM-8820 • 3 voltage measuring inputs (can be set as 100 V/√3, 240 V, or 415 V/√3)
Inputs for measuring currents	Input voltage at I_N	AC 225 mV based on IEC 60044-8	
	Max. input voltage	AC 2.25 V	
	Rated frequency	50 Hz, 60 Hz (range between 45 Hz and 65 Hz)	
	Resolution	16 bits	
	Sampling	1 value/ms	
Inputs for measuring voltages	Input voltage U_N	AC 100 V/√3, AC 240 V, AC 415 V/√3 in accordance with IEC 60044-7 (parameterizable)	AC 3.25 V/√3 in accordance with IEC 60044-7
	Max. measuring voltage	150 % U_N (error condition)	
	Rated frequency	50 Hz, 60 Hz (range between 45 Hz and 65 Hz)	
	Resolution	16 bits	
	Sampling	1 value/ms	
	Internal consumption	< 0.3 VA at V_N = AC 240 V < 0.02 VA at V_N = AC 100 V/√3	Internal resistance: 200 kΩ
Power supply	Operating voltage	DC 4.75 V to 5.5 V	
	Power consumption	Max. 800 mW (typ. 625 mW)	

Table 2.6/9 Analog Input Modules

LED module		CM-8830
Power supply	Operating voltage	DC 4.75 V to 5.5 V The voltage is picked off from the bus.
	Power consumption	500 mW

Table 2.6/10 LED Module

		
Current -transformer adaptor module		CM-8820
Inputs for measuring currents	Rated current I_N	1 A/5 A (parameterizable)
	Max. measuring current	200 % I_N
	Rated frequency	50 Hz, 60 Hz (Range between 45 Hz and 65 Hz)
	Internal consumption	< 0.1 W at I_N = 1 A < 0.3 at I_N = 5 A
	Thermal rating	10 A continuously 100 A 1 s
Outputs for measuring currents	Rated voltage	225 mV at I_N = 1 A based on IEC 60044-8 1.125 V at I_N = 5 A
	Max. voltage	2.25 V at I_N = 10 A
	Rated frequency	50 Hz, 60 Hz (Range between 45 Hz and 65 Hz)

Table 2.6/11 Current-Transformer Adaptor Module

				
Expansion Modules	CI-8530	CI-8531	CI-8532	CI-8533
Power supply	DC 24 V to 60 V		DC 110 V to 220 V	
Operating voltage	DC 18 V to 78 V		DC 82.5 V to 286 V	
Input current	0.6/0.3/0.25 A (DC 24/48/60 V)		0.13/0.07 A (DC 110/220 V)	
Output rated voltage	5.15 DCV ± 2 % static, ± 3 % dynamic			
Output rated current	0 A to 1.4 A			
Output power	7 W			
Interfaces	2 x Ethernet	2 x SFP plug-ins for optical Ethernet 2 x LC Multimode plug-ins are provided.	2 x Ethernet	2 x SFP plug-ins for optical Ethernet 2 x LC Multimode plug-ins are provided.
Special features	Up to 8 I/O modules Ethernet-based I/O bus support Ring, star and daisy chain			

Table 2.6/12 Expansion Modules

System Components and Technical Data

For additional system components and technical data, refer to the current manual: *Industry Online Support*

Selection and Ordering Data

Description		Order No.
Compact Device		
CP-8000	Compact device with display/incl. SD card Communication interfaces 2 x Ethernet 1 x RS232, 1 x RS485 Power supply DC 24 V to 60 V **Temperature range -40 °C to +70 °C** 12 DI (DC 24 V to 60 V)/8 DO relays (AC/DC max. 250 V)	6MF2101-1AB10-0AA0
CP-8010	Compact Device with I/Os Communication interfaces 3 x Ethernet, 1 x RS232, 2 x RS485 Power supply DC 24 V to 60 V **Temperature range -40 °C to +70 °C** 8 DI (DC 24 V to 60 V)/7 DO relays (2 x 8 A, 5 x 4 A) 1 A I (-22 mA to 22 mA)	6MF2801-0AA00
CP-8012	Compact Device with I/Os & LTE CAT1/GPRS Communication interfaces 3x Ethernet, 1x RS232, 2x RS485 Power supply DC 24 V to 60 V **Temperature range -40 °C to +70 °C** 8 DI (DC 24 V to 60 V)/7 DO Relays (2 x 8 A, 5 x 4 A) 1 A I (-22 mA to 22 mA)	6MF2801-2AA00
Coupling		
CM-6811	Coupling TM I/O module for CP-8000	6MF1113-0GJ11-0AA0
CM-6812	Coupling TM I/O adaptor	6MF1113-0GJ12-0AA0
CM-8810	Coupling module I/O module for CP-8010 & CP-8012	6MF2881-0AA00
CM-8811	Coupling SICAM I/O module for CP-8000	6MF2881-1AA00
Display Modules		
CM-8880	Display Module for CP-8010 & CP-8012	6MF2888-0AA00
Processor Modules		
CP-8021	Processor module 3 x RJ45, 1 x RS485	6MF2802-1AA00
CP-8022	Processor module 3 x RJ45, 1 x RS485, 1 x RS232/RS485 selectable, 1 x LTE CAT1/GPRS	6MF2802-2AA10
CP-8031	Processor module 4 x RJ45	6MF2803-1AA00
CP-8050	Processor module 4 x RJ45, it can be expanded with CI-85xx	6MF2805-0AA00
Power-Supply Modules		
PS-8620	DC 24 V to 60 V (12 W)	6MF2862-0AA00
PS-8622	DC 110 V to 220 V (12 W)	6MF2862-2AA00
PS-8640	DC 24 V to 60 V (45 W)	6MF2864-0AA00
PS-8642	DC 110 V to 220 V, AC 230 V (45 W)	6MF2864-2AA00
Communication Modules		
CI-8520	Ethernet communication interface module	6MF2852-0AA00
CI-8551	Serial communication module	6MF2855-1AA00
CI-8522	CI-8522 Ethernet communication interface module with 2 x F/O; 3 x RJ45	6MF2852 - 2AA00
Binary Inputs		
DI-8110	2 x 8, DC 24 V, 1 ms	6MF2811-0AA00
DI-8111	2 x 8, DC 48 V to 60 V, 1 ms	6MF2811-1AA00
DI-8112	2 x 8, DC 110 V, 1 ms	6MF2811-2AA00
DI-8113	2 x 8, DC 220 V, 1 ms	6MF2811-3AA00
Binary Outputs		
DO-8212	Binary output relay 4x2, DC 24 V to 220 V/AC 230 V	6MF2821-2AA00
DO-8221	Secure command output	6MF2822-1AA00
DO-8230	DO transistor	6MF2823-0AA00
Analog Output		
AO-8380	4 x, ±20 mA, ±10 mA, ±10 V	6MF2838-0AA00
Analog Inputs		

Description		Order No.
AI-8310	Pt100/Ni100 (2 groups, each with 2 AI)	6MF2831-0AA00
AI-8320	4 x +/-20mA, +/-10 V	6MF2832-0AA00
AI-8330	3 x I (6 A) with AI-8340	6MF2833-0AA00
AI-8340	4 x V (250 V), 2 x DO	6MF2834-0AA00
AI-8510	3 x V (AC 100/√3 V, AC 230 V, AC 400/√3 V), 3 x I (LoPo))	6MF2851-0AA00
AI-8511	3 x V (LoPo), 3 x I (LoPo)	6MF2851-1AA00
Current-Transformer Adaptor Module		
CM-8820	CT adaptor for AI-8510 3 x I 1 A/5 A, 225 mV	6MF2882-0AA00
LED Module		
CM-8830	SICAM I/O module LED display	6MF2883-0AA00

Table 2.6/13 SICAM A8000 Series Selection and Ordering Data

Description		Order No.
Continued from previous page		
SICAM I/O Remote Modules		
CI-8530	Ethernet expansion module for interfacing remote I/Os DC 24 V to 60 V	6MF2853-0AA00
CI-8531	SICAM I/O remote interface module F/O DC 24 V to 60 V	6MF2853-1AA00
CI-8532	Ethernet expansion module for interfacing remote I/Os DC 110 V to 220 V	6MF2853-2AA00
CI-8533	SICAM I/O remote interface module F/O DC 110 V to 220 V	6MF2853-3AA00
	CM-8813 bus connector CP-8031/CP-8050 (this bus connector plug is included for CP-8031/ CP-8050)	C53207-A5813-D481-1
Licenses (OSD)		
	SICAM A8000 CP-803x Extended CI module DL	6MF2750-2EX00
	SICAM A8000 Licensed protocol DL	6MF2750-2PR00
	SICAM A8000 CI-852x Redbox DL	6MF2750-2RB00
	SICAM A8000 Extended processing	6MF2750-2EP00
	SICAM A8000 IEC 104 firewall	6MF2750-2FW40
	SICAM A8000 LXC container	6MF2750-2LX00
	SICAM A8000 Redundancy DL	6MF2750-2RE00
	SICAM A8000 Extended SICAM WEB license DL	6MF2750-2WE00
SICAM Rack Solution, see *Table 2.7/9*		
Spare Parts		
	CM-8812-bus connector plug SICAM I/O (this bus connector plug in included in all SICAM I/O modules)[15]	C53207-A5812-D481-3
	CM-8813 bus connector CP-8031/CP-8050 (this bus connector plug is included for CP-8031/ CP-8050)	C53207-A5813-D481-1
	Locking hook SICAM A8000 3 cm module[15]	C53207-A5014-D481-1
	CM-0822 fieldbus interface star (4 x optical fiber)	6MF1111-0AJ22-0AA0
	PS-6630 power supply DC 24 V to 60 V EMC+	6MF1113-0GG30-0AA0
	PS-6632 power supply DC 110 V to 220 V EMC+	6MF1113-0GG32-0AA0
	SD card 2 GB	6MF1213-AGA05-0AA0
	SD card 512 MB (optional) Temperature range -40 °C to 70 °C	6MF1213-2GA05-0AA0

Table 2.6/14 SICAM A8000 Series Selection and Ordering Data

Function Point Manager

The SICAM & SIPROTEC Function Point Manager is a cloud-based service for SICAM & SIPROTEC customers for the central administration of Function Points and to generate license files. With the Function Point Manager SICAM, SIPROTEC 5 and SIPROTEC 5 Compact device functionality can be easily extended within seconds.

Advantages

- One service for all your SICAM, SIPROTEC 5, SIPROTEC 5 Compact devices
- Switch between different SICAM and SIPROTEC budget accounts via one user account
- Order now, pay later: The Function Points are only invoiced when the license file is generated
- Activate device functionality quickly and easily through ad hoc generated license files
- Specify features late in the engineering process after device purchase
- Use the Function Point Manager to organize and share all generated SICAM and SIPROTEC license files in your organization
- Share your budget account with colleagues
- Create multiple project-related budget accounts

Description		Order No.
Function point budget	1 Function point	6MF2752-1AA

Table 2.6/15 Function Point Budget

15 Minimum order quantity: 10 units

Procedure

- Create SICAM license files (SICLIC) and manage function point budgets with the Function Point Manager. Registration is required in the Function Point Manager and the creation of a budget account.
  Website: *https://sicam-function-point-manager.siemens.com/*.
- To order function points use the account specific article number that is displayed in your SICAM Function Point Manager account.
  Order function points from your regional sales partner or from the *https://sieportal.siemens.com/en-ww/home*.
- When placing an order, you accept the terms and conditions: *https://siprotec-function-point-manager.siemens.com/terms*

SICAM 8 - A8000 Series – Selection and Ordering Data

License Type	Function Points	Can be used with				
		SICAM A8000			SICAM 8	SICAM S8000
		CP-8050	CP-8031	CP-8010/ CP-8012	SICAM EGS	
SICAM 8 HMI & EVA						
SICAM 8 HMI for 200 to 2000 data points	200	X	X	X	X	X
SICAM 8 HMI for up to 4000 data points	330					X
SICAM 8 EVA (Event and Alarm list for > 4000 entries)	30	X	X	X	X	X
SICAM 8 FR-Archive						
Fault record archive up to 100 IEDs	30	X	X	X	X	X
Fault record archive for more than 100 IEDs	100					X
SICAM 8 Dynamic Load Management[16]						
Dynamic load management for ≤ 25 charging units	100	X	X			X
Dynamic load management for ≤ 50 charging units	145	X				X
Dynamic load management for ≤ 75 charging units	190	X				X
Dynamic load management for ≤ 100 charging units	225	X				X
Dynamic load management for ≤ 125 charging units	260	X				X
Dynamic load management for ≤ 150 charging units	295	X				X
Dynamic load management for ≤ 175 charging units	330	X				X
Dynamic load management for ≤ 200 charging units	365	X				X
Dynamic load management for ≤ 225 charging units	400	X				X
Dynamic load management for ≤ 250 charging units	435	X				X
SICAM 8 Fast Power Based Load Shedding Compact[16]						
Fast power based load shedding (96 loads, 10 contingencies)	200	X	X	X		
SICAM 8 Self Optimizing Grid[17]						
Self Optimizing Grid - Static Self-Healing SSH	100	X	X	X	X	X
Self Optimizing Grid - Dynamic Self-Healing DSH	250	X	X	X	X	X
Self Optimizing Grid - Under Voltage Reconfiguration UV	100	X	X	X	X	X
Self Optimizing Grid - Wide Area Voltage Control WAVC	150	X	X	X	X	X
Self Optimizing Grid - All Applications DSH_WAVC_UIV	500	X	X	X	X	X
SICAM Photovoltaic Plant Controller Compact [16]						
Photovoltaic Plant Controller for ≤5 MW	140		X			
Photovoltaic Plant Controller for ≤50 MW	400		X			
SICAM 8 SICORE	100					X
SICAM 8 SICAM S8000 RTU[16]						
S8000 base for ≤ 15 IEDs/connections	60					X
S8000 base for ≤ 50 IEDs/connections	200					X
S8000 base for ≤ 100 IEDs/connections	440					X
S8000 base for ≤ 180 IEDs/connections	840					X
S8000 base for ≤ 400 EDs/connections	1300					X
S8000 base for ≤ 800 IEDs/connections	1700					X
S8000 base for ≤ 1200 IEDs/connections	2300					X
SICAM 8 OPC UA Server	45	X	X	X	X	X
SICAM 8 OCPP Client	40	X	X	X	X	X
SICAM 8 Redundancy[18]	55	X				X
SICAM 8 LXC Container (SIAPP Runtime)	70	X	X	X	X	X
SICAM 8 IEC104 Firewall	35	X	X			
SICAM 8 Extended Processing	90	X				X
SICAM 8 Extended SICAM Web	35	X	X	X	X	X
SICAM 8 Licensed Protocol (Legacy Protocol)	40	X	X	X	X	

16 Only 1 instance of below listed licence can be loaded (upgrade to higher number is possible)

17 License SICAM 8 LXC Container (SIAPP Runtime) is required

18 Per RTU one license needed

License Type	Function Points	Can be used with				
		SICAM A8000			SICAM 8	SICAM S8000
		CP-8050	CP-8031	CP-8010/ CP-8012	SICAM EGS	
SICAM 8 CP-803x Extended CI-Module	85		X			
SICAM 8 CP-801x Extended CI-Module	65			X		
SICAM 8 CI-852X, RedBox[19]	40	X	X			

Table 2.6/16 Function Points

19 For CP-8031, the CI-85XX Extension license is required

Description

The SICAM A8000 rack solution offers the benefits of the proven and powerful SICAM AK 3 in conjunction with the latest SICAM A8000 platform.

Beside all the benefits offered by the SICAM A8000 CP-8050, the rack solution goes the extra mile by allowing for a high level of signal density to further widen its scope of applications. I/O units in 19-inch format and the resulting small footprint enable a wide variety of signals to be channeled into the process.

Retrofit

By using the following components, existing legacy SICAM AK I/O modules can easily be migrated into a SICAM A8000 rack solution and connected to a SICAM A8000 CP-8050 unit:

- SICAM CM-2840 I/O rack
- CI 2530 interfacing module
- PS-2630 or PS-2632 power-supply module
- CM-8846 adaptor for fitting the CP-8050 to a swing frame as necessary

The following SICAM AK modules can continue to be used as SICAM A8000 rack I/O units in conjunction with the CP-8050, and are aligned with the product lifecycle of the SICAM A8000 CP-8050:

- SICAM DI-2112/13/14/15
- SICAM DO-2201
- SICAM DO-2210/11 incl. SM-2506
- SICAM AI-2300 incl. SM-057x

Legacy SICAM AK I/O units are also supported by the CP-8050 and can remain in operation:

- AI-2302/03
- DI-2100/10/11
- MX-2400

To continue using the process wiring of SICAM AK Ax racks, the handle molds of the connector plugs are adapted and locked into position in the new rack.

When the existing I/O rack does not comply with the specifications, it can easily be replaced – with all the wiring of the I/O modules remaining in place! The same goes for the power supply (refer to the *manual* for details).

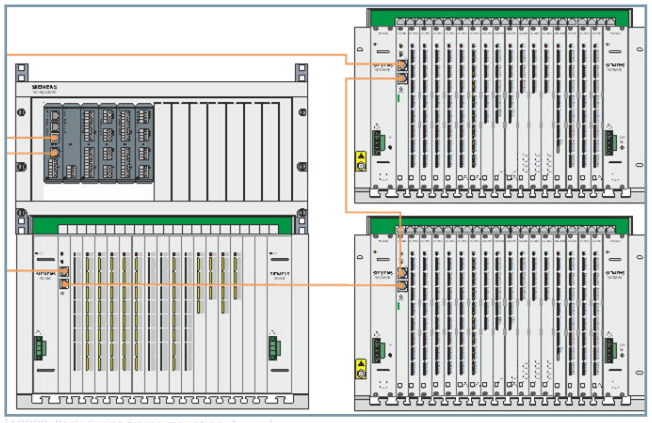
Automation devices used in critical infrastructural areas are subject to stringent requirements, also in terms of ever-evolving cybersecurity. Thanks to the combination of the SICAM A8000 rack and the SICAM A8000 CP-8050, all safety features are state-of-the-art and continuously improved.

[ph_SICAM A8000 Rack, 1, --_--]

Figure 2.7/1 SICAM A8000 Rack

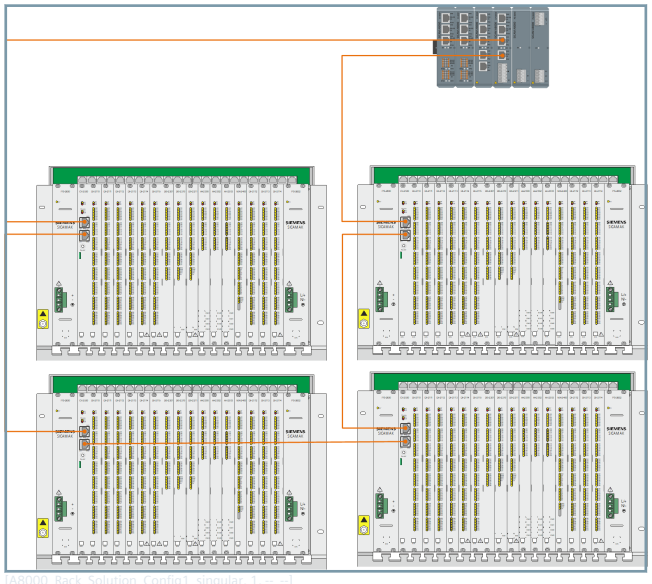
Technical Information and Combination Examples

- CM-8846 adaptor for swing-frame installation in a 19" frame (*Figure 2.7/2*)
- SICAM A8000 CI-2530: Connection interface to connect SICAM I/O racks to a CP-8050 unit
- 1 x CI-2530 required per I/O rack
- One I/O rack can hold a total of 16 rack I/O modules
- Up to 4 I/O racks can be used
- Operating temperature -5 °C to +55 °C
- Singular of redundant power supply can be used for I/O racks supporting PS-2630 and PS-2632



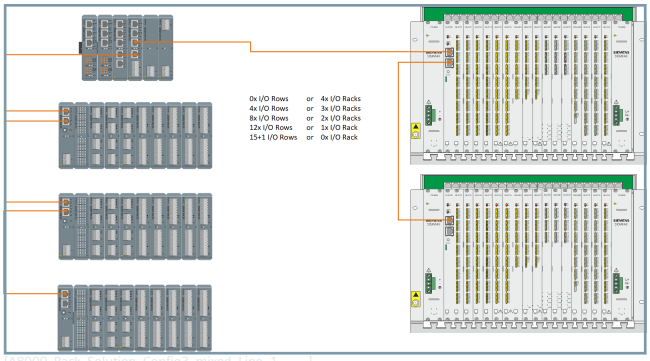
[A8000_Rack_Swing frame mounting, 1, _ _]

Figure 2.7/2 SICAM A8000 Rack – Swing-Frame Mounting



[A8000_Rack_Solution_Config1_singular, 1, _ _]

Figure 2.7/3 SICAM A8000 Rack – Combination Example 1



[A8000_Rack_Solution_Config3_mixed_Line, 1, _ _]

Figure 2.7/4 SICAM A8000 Rack – Combination Example 2

Power-Supply Modules	PS-2630	PS-2632
Operating voltage	DC 18 V to 78 V	DC 82.5 V to 286 V AC 90 V to 264 V
	The 5 V output is galvanically separated and protected against continuous short-circuit	
Output voltage	DC 5.05 V (-1/+2 %)	
Max. output voltage in case of a fault	DC 6 V	
Output rated current	0.5 A to 24 A	
Output rated power (Pout)	• 120 W at –5 °C to + 55 °C • 120 W at +55 °C to + 70 °C Reduction of power from + 55 °C: –10 %/3 °C • 60 W at +70 °C	

Table 2.7/1 SICAM A8000 Rack – Power-Supply Modules

I/O Remote Module		CI-2530
Properties		CI-2530 is an Ethernet expansion module for connecting remote rack I/Os. Up to 4 racks, each with up to 16 rack I/Os can be connected via the EbIO bus. Ring and line topologies can be used. • Communication with the master module CP-8050 via EbIO • It can be installed in the CM-2840 rack • Ethernet-connection status display via LED (LKx, PKx) • Power supply via the bus-connector plug • Module status display via LED (RY, ER) • Master-module status display via LED (RY, ER) • Rack assembly
Power supply	Operating voltage	DC 4.75 to DC 5.25 V The voltage is picked off from the rack bus.
	Power consumption	Typ. 1.3 W

Table 2.7/2 SICAM A8000 Rack I/O Remote Module – Can only be Used in Conjunction with CP-8050

Rack I/O Modules	DI-2112	DI-2113	DI-2114	DI-2115
Recording binary input signals				
64 binary inputs, 8 additional inputs	• 8 groups, 8 inputs and 1 additional input each • Galvanic separation • Each group has a reference potential and configurable polarity • Sensor voltage monitoring via the auxiliary input of each group (optional)			
Rated voltage	DC 24 V	DC 48 V to 60 V	DC 110 V	DC 220 V
Switching thresholds	≤ 12 V (logic "0"); ≥ 18 V (logic "1")	≤ 24 V (logic "0"); ≥ 36 V (logic "1")	≤ 55 V (logic "0"); ≥ 82.5 V (logic "1")	≤ 110 V (logic "0"); ≥ 165 V (logic "1")
Input circuits (operated with external voltage)	DC 18 V to 31.2 V	• DC 36 V to 70 V as per EN 61010-1:2010 • DC 36 V to 60 V as per IEC 61010-1:2010/ AMD1:2016	DC 82.5 V to 143 V	DC 165 V to 250 V
Current consumption	1.4 mA to 5.2 mA (at 18 V to 31.2 V)	0.6 mA to 2.2 mA (at 36 V to 78 V)	0.4 mA to 1.1 mA (at 82.5 V to 143 V)	0.2 mA to 0.4 mA (at 165 V to 250 V)
Operating voltage	DC 4.75 V to 5.25 V The voltage is picked off from the rack bus.			

Table 2.7/3 SICAM A8000 Rack I/O Modules – Can only be Used in Conjunction with CP-8050

I/O Module		DO-2201
Properties		• Processing and output according to IEC 60870-5-101/104 – Up to 40 single-point indications • 40 digital outputs • In terms of galvanic separation, the outputs are divided into 8 groups with 2 outputs and 8 groups with 3 outputs • The groups are galvanically separated from each other and within a group. • The potential that should be switched (plus or minus) can be determined for each output by external wiring. • Any 2 outputs can be connected in parallel to increase switching capacity • If an output short-circuits, it does not affect other outputs. • Input function and status display via LEDs
Rated current (for resistive load)		• 0.7 A at DC 24, 48, 60 V • 1.0 can be achieved when connecting 2 outputs in parallel
Power supply	Operating voltage	DC 4.75 to DC 5.25 V The voltage is picked off from the rack bus.
	Power consumption	type 0.6 W + 0.03 W for each active output

Table 2.7/4 SICAM A8000 Rack I/O Module – Can only be Used in Conjunction with CP-8050

		
I/O Remote Module	DO-2210	DO-2211
Properties	• Processing and output according to IEC 60870-5-101/104 – Up to 32 pulse commands (2-pole) or – Up to 64 pulse commands (1-pole 1 1/2 pole) or – a combination thereof – Secure command output – Internal checks (IC1) – Optional resistance check (RC1) via a SM-2506 measuring-circuit module that can be installed • 64 relay outputs (2 groups) plus – 2 group outputs – 4 pulse outputs • Each group has a common potential. • An intrinsic fuse circuit is produced for each group. • The pulse outputs are current-limited via an electronic fuse. • Input function and status display via LEDs	
Max. contact voltage	DC 24 V to 60 V + 30 %	DC 24 V to 125 V + 20 %
Output circuits (operated with external voltage)	• DC 18 V to 70 V as per EN 61010-1:2010 • DC 18 V to 60 V as per IEC 61010-1:2010/ AMD1:2016	• DC 18 V to 150 V
Rated switching capacity	• 48 W/DC 24 V • 96 W/DC 48 V • 120 W/DC 60 V	• 48 W/DC 24 V • 96 W/DC 48 V • 120 W/DC 60 V • 250 W/DC 125 V
Operating voltage	DC 5 V ± 5 %, typ. 1.0 W without SM-2506 typ. 1.6 W with SM-2506 + 0.6 W during the command output The voltage is picked off from the rack bus.	

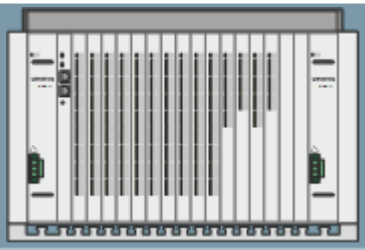
Table 2.7/5 SICAM A8000 Rack I/O Remote Module – Can only be Used in Conjunction with CP-8050

	
Rack I/O Modules	AI-2300
For detection of analog values and counter pulses, as well as for the output of analog values	
16 current inputs	Max. ± 20 mA to 122.5 Ω burden
	• Load voltage 2.45 V • Overrange typ. 2 % • Voltage between the inputs of a group max. DC 4 V • Every 2 inputs form a group (8 groups) • All inputs are galvanically separated from logic circuits and ground. • The inputs of a group are not galvanically separated from each other. • The inputs of a group are galvanically separated from those of the other groups and from the inputs/outputs of the input/output modules.
Operating voltage	DC 4.75 V to 5.25 V The voltage is picked off from the rack bus.

Table 2.7/6 SICAM A8000 Rack I/O Modules – Can only be Used in Conjunction with CP-8050

				
Submodules	SM-0570	SM-0571	SM-0572	SM-0574
Overview	2 current inputs • Max. ± 20 mA to 122.5 Ω burden • Load voltage 2.45 V • Overrange type 2 % • Voltage between 2 inputs max. DC 4 V • All inputs are galvanically separated from logic circuits and ground. • The inputs are not galvanically separated from each other.	2 resistance thermometer inputs • Pt100, Ni100 • Either 2-, 3- or 4-phase technology • The inputs are galvanically separated from logic circuits and ground. • The inputs are not galvanically separated from each other.	2 analog outputs • The current or voltage output can be selected for each submodule. • The measuring range can be adjusted as follows with an output current: – -20 mA to +20 mA – -10 mA to +10 mA – -5 mA to +5 mA • The measuring range can be adjusted as follows with and ouptut voltage: – -1 V to +1 V – -10 V to +10 V	2 pulse inputs • Rated voltage DC 24 V to 60 V • The pulse inputs can be used as follows: – 2 counter inputs – 1 counter input + 1 control input • 1 counter input operates 1 counter (pulse counting) – The counter has a max. counter status of 24-bits width • The submodule functions, which can be operated autonomously, are operated by way of a buffer • This ensures that counter functionality and counter status remain correct, even in the event of a voltage failure lasting up to 72 hours (counter pulse frequency ≤ 50 Hz) • The counter status is either still correct or marked as “lost” in the event of a voltage failure lasting longer than 72 hours
Operating voltage	DC 5 V ±5 %, typ. 0.6 W	DC 5 V ±5 %, typ. 0.9 W	DC 5 V ±5 %, typ. 1.5 W	DC 5 V ±5 %

Table 2.7/7 SM-057x Submodules



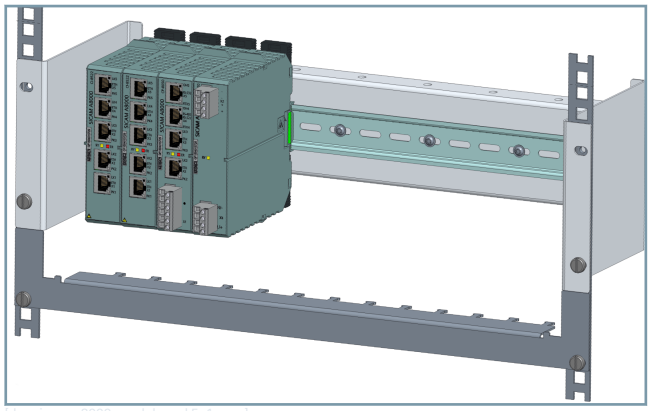
Rack	CM-2840	
Power supply	With power supply	With redundant power supply
Overview	The CM-2840 rack provides 17 slots for double Europe format assemblies. It has primarily been designed for 19" (swing) frame installation, but it is also suitable for rear plate mounting using the rear plate assembly set. The rack (84 TE, 9 HE) can be equipped as follows (these components are not included in the scope of delivery): ● 1 SICAM rack I/O remote module (CI-2530) ● Up to 16 SICAM rack I/O modules – DI-2112, DI-2113, DI-2114, DI-2115 – DO-2201, DO-2210, DO-2211 – AI-2300, AI-2302, AI-2303 ● 1 to 2 power-supply modules (PS-263x)	
Properties	● The installed rack I/O modules are connected to the EbIO, which is operated by exactly 1 master module (CP-8050/CPCi85), that may be redundant. ● Wiring peripherals using prefabricated peripheral cables CM-2890 ● 2 slots for PS-263x power-supply modules ● ESD Earth Facility for connecting a ground strap when replacing a module ● Release tool included for assemblies	
Slot for CI-2530	0	
Slots for SICAM A8000 rack I/O modules	1 to 17	
Slots for PS-263x	● 1st power-supply module, left ● 2nd power-supply module, right	
Operating voltage	5.1 V; supplied by the installed power-supply module PS-263x	
Dimensions	Height: 320 mm Width: 483 mm Depth: 258 mm (power-supply module is not installed) Depth: 280 mm (power-supply module is installed)	

Table 2.7/8 SICAM A8000 Rack – Can only be Used in Conjunction with CP-8050

SICAM A8000 Module Rack CM-8846

The SICAM A8000 module rack CM-8846 allows you to install up to 13 SICAM A8000 modules in one 19" rack.

5 height units (222.25 mm) must be taken into account for the module rack.



[dw_sicam_a8000_module-rack5, 1, --_--]

Figure 2.7/5 SICAM A8000 Module Rack CM-8846

System Components and Technical Data

For additional system components and technical data, refer to the current manual: *Industry Online Support*

Selection and Ordering Data

Description		Order No.
Base Units		
CP-8050 Master Module		6MF2805-0AA00
SICAM rack solution[20]		
CM-2840	17-slot rack	6MF1113-0CJ40-0AA0
CM-2846	Wall-mounting kit	6MF1313-0CH02-0AA0
CI-2530	SICAM rack I/O remote	6MF2253-0AA00
	CI-2530 complete front cover	6MF2253-0FA00
CM-8846	SICAM A8000 module rack	C53207-A5846-D481-1
CM-8813	CP-8031/CP-8050 bus connector (this bus-connector plug is included for CP-8031/CP-8050)	C53207-A5813-D481-1
SICAM A8000 Rack – Power-Supply Modules		
PS-2630	DC 24 V to 60 V	6MF1113-0CG30-0AA0
PS-2632	DC 110 V to 220 V, AC 230 V	6MF1113-0CG3-20AA0
SICAM A8000 Rack I/O Modules		
DI-2112	Binary input 8x8, DC 24 VC,1 ms	6MF1013-0CB1-20AA0
	Front cover DI-2112	6MF1313-0CA7-20AA0
DI-2113	Binary input 8x8, DC 48/60 V,1 ms	6MF1013-0CB13-0AA0
	Front cover DI-2113	6MF1313-0CA73-0AA0
DI-2114	Binary input 8x8, DC 110 V.1 ms	6MF1013-0CB14-0AA0
	Front cover DI-2114	6MF1313-0CA74-0AA0
DI-2115	Binary input 8x8, DC 220 V,1 ms	6MF1013-0CB15-0AA0
	Front cover DI-2115	6MF1313-0CA75-0AA0
DO-2201	Binary output Trans 40x1, DC 24 V to 60 V	6MF1011-0CC01-0AA0
	Front cover DO-2201	6MF1313-0CA76-0AA0
DO-2210	Command output DC 24 V to 60 V	6MF1011-0CC10-0AA0
	Front cover DO-2210	6MF1313-0CA77-0AA0
DO-2211	Command output DC 125 V	6MF1011-0CC11-0AA0
	Front cover DO-2211	6MF1313-0CA78-0AA0
AI-2300	Analog input 16x ±20 mA + 4x opt.IOM	6MF1011-0CD00-0AA0
	AI-2300 front cover	6MF1313-0CA79-0AA0
Submodules		
SM-0570	Analog input extension (2 x ±20 mA)	6MF1011-0AF70-0AA0
SM-0571	Analog value extension (2 x Pt100)	6MF1011-0AF71-0AA0
SM-0572	Analog output extension (2 x ±20 mA, ±1/10 V)	6MF1011-0AF72-0AA0
SM-0574	Counter input (2 x DC 24 V to 60 V)	6MF1011-0AF74-0AA0
SM-2506 M	Measuring-circuit module command output DC 24 V to 60 V	6MF1011-0CF06-0AA0
Licenses (OSD)		
	SICAM A8000 CP-803x Extended CI module DL	6MF2750-2EX00
	SICAM A8000 Licensed protocol DL	6MF2750-2PR00
	SICAM A8000 CI-852x Redbox DL	6MF2750-2RB00
	SICAM A8000 Extended processing	6MF2750-2EP00
	SICAM A8000 IEC 104 firewall	6MF2750-2FW40
	SICAM A8000 LXC container	6MF2750-2LX00
	SICAM A8000 Redundancy DL	6MF2750-2RE00
	SICAM A8000 Extended SICAM WEB license DL	6MF2750-2WE00
Accessories		
CM-2890	Periphery cable crimp 5 m, 100-pole	6MF1313-1CJ00-0AA0

20 1x firmware license, order number 6MF2750-0EP00 is required for each SICAM I/O rack to allow you to use SICAM A8000 rack I/Os in conjunction with SICAM A8000 CP-8050. A front cover is also required for each CI-2530.

Description		Order No.
	Handle mold for CM-2890 plug	6MF1313-0CA00-0AA1
	Empty front cover	6MF1313-0CA86-0AA0

Table 2.7/9 SICAM A8000 Rack – Selection and Ordering Data

Description

Our innovative, compact "all-in-one device solution" enables you to efficiently and digitally monitor low-voltage grids with minimal effort.

The SICAM EGS (Enhanced Grid Sensor) is used in local distribution stations, low-voltage and fuse distribution cabinets, cable distribution cabinets, and house connection boxes.

In combination with the SENTRON 3NACOM fuse inserts, you can capture the low-voltage branch currents with SICAM EGS without retrofitting transformers and rewiring using wireless communication.

- Configure: Even in the office, you can configure the device for your specific application. For this purpose, a user-optimized engineering template is available to you.
- Install: Without any intervention in the existing plant wiring, you can install the pre-parameterized device on-site in the station. Install our new SENTRON 3NACOM fuse inserts in the low-voltage fuse rails.
- Profit: SICAM EGS provides your distribution grid data. With the new functionality for determining the power flow direction, the processes in your distribution grid are now completely transparent.

Benefits

SICAM EGS provides an effective retrofit solution for capturing and forwarding messages and measured values from medium-voltage switchgear and low-voltage fuse distribution boards in existing local grid substations.

- Flexible, easily expandable: prepared for upcoming changes in power distribution
- Permanent grid monitoring: for optimized utilization of the existing infrastructure
- Utilization of smallest space conditions: for narrowest distribution without complete rebuilding
- Designed for harsh operating conditions: direct installation in cable distributors without additional control cabinet, without additional devices
- Cost-effective simple installation: pre-configured devices, simple installation and commissioning guarantee short conversion times
- Proven SICAM A8000 technology: investment in the future based on the SICAM 8 platform
- Cybersecurity: fulfillment of IT security requirements in the critical infrastructure
- Maintenance-free: long service life based on RTU standards

[sc_sicam_egs_2_-_-]

Figure 2.8/1 SICAM EGS Sensor (Rogowski Coil), SENTRON 3NA COM

Applications

- Power Distribution Monitoring: Distribution grid automation optimized for use in LV/MV switchgear. The rapid provision of relevant grid data/detailed information enables controlling interventions in the LV distribution grid.
  The connection of MV devices brings a significant cost reduction of overall solutions.
- Device Monitoring: for switchgear and for the detection of transformer-damaging disturbances.
- Grid Connection Monitoring: for solar parks, wind farms and charging stations for electric vehicles.
- Communication Gateway: for various networks and protocols, simple SCADA connection.
- IoT Gateway: for easy integration of products and solutions for measurement technology, sensors, protection and automation, power quality and measurement technology to cloud-based platforms for asset management and data analysis.
- Technology beyond local distributors: system connections and cloud-based monitoring/control.
- Grid Expansion: SICAM EGS supports data-based grid planning and thus enables cost-saving grid expansion.

Technical Data

The following is an excerpt from the technical data. For more information, refer to the user manual.

- Integrated 3-phase measurement functionality for current and voltage monitoring in the low-voltage grid; additional calculation of electrical quantities (P, Q, S, cos phi, f, etc.)
- Automation functions (IEC 6113-3), e.g. for controlling a regulated distribution grid transformer
- Enables the integration of third-party applications in a Docker-based container runtime environment

- Capturing the outgoing currents from the low-voltage fuse distribution via encrypted radio communication (Wireless based on IEE 802.15.4) between SICAM EGS and SENTRON 3NA COM fuses with integrated current sensors. Detection of the power flow direction
- Remote control communication using standards IEC 61850, IEC 60870-5-104, DNP 3.0
- Connection of multi-measurement devices or short-circuit indicators (e.g. SICAM FCM/FCMplus) via Modbus interface (serial)
- Ethernet interface and integrated LTE module for easy adaptation to existing communication infrastructures
- IoT connectivity: Providing data over a secure internet connection for cloud-based applications and services (MQTT (JSON Coding), Sparkplug B, OPC UA Pub/Sub etc.)
- Auxiliary power supply directly from the measurement voltage reduces the installation effort
- Weight: 1.2 kg
- Protection class: IP50

Selection and Ordering Data

Description	Versions	Order no.																
		1	2	3	4	5	6	7		8	9	10	11	12		13	14	15	16
Enhanced grid sensor, provides transparency for distribution grids and integrates functionality of RTU and gateway, low and medium voltage monitoring		6	M	F	3	6	1	□	-	1	A	A	1	□	-	0	A	A	0
								▲						▲					
Basic								|					|					
All in one RTU with integrated power sensing/measurement functionality with cable set of 1 meter for Rogowski Coils. 1 x LTE Modem, 1 x Ethernet 1 x Serial Interface 1 x Wireless Interface								0						0					
Power Backup								|					|					
All in one RTU with integrated Power Backup supporting Last Gasp and 3 meter for Rogowski Coils cable set for integrated power sensing/measurement functionality. 1 x LTE Modem, 1 x Ethernet 1 x Serial Interface 1 x Wireless Interface								1						1					

Table 2.8/1 SICAM EGS Selection and Ordering Data

Description

The expansion of the electric vehicles infrastructure brings various challenges to the grid. The challenges include grid upgrades, utility capacity limitations, and high demand charges. The SICAM Dynamic Load Management (DLM) is based on SICAM 8 which supports the integration of charging units into electrical grids by dynamically limiting the charging power.

Benefits

- Significant reduction of grid expansions up to complete avoidance
- Prevention of transformers overload
- Minimization of peak loads and the resulting high charges
- Compliance with grid connection conditions, for example, load reduction at the request of the grid operator
- Best possible use of the charging infrastructure with varying simultaneous factors

Functions

The installation of SICAM DLM takes place on a SICAM A8000 CP-8031/CP-8050 in conjunction with the SICAM Device Manager. A user interface is achieved through the integrated SICAM WEB Dashboard functionality. The DLM sends power set point values to the connected chargers of a configured charger group. The SICAM DLM supports a maximum of 250 charging units in 10 groups, where each group is assigned a grid measurement. Phase balancing can also be included.

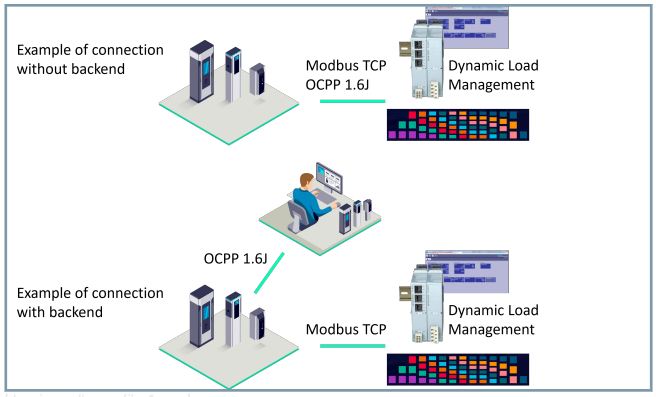
The SICAM DLM allows 5 algorithms for power sharing:

- Split charging without priorities
  - Distributes the power equally among the vehicles based on the maximum power of the charging units, without status information of the charging stations
  - Distributes power evenly among vehicles based on the maximum charging power and pre-set priorities
  - By round-robin: for fleets and long-term parking lots with highly fluctuating charging requirements, ensures that vehicles with low charging requirements are fully charged more quickly
- First-in/First-out
  - For fleets with higher overcrowding rates, ensures fastest possible vehicle charging - based on charge start, ensures fleets always have fully charged vehicles when needed
  - Reverse order as stated in point above - for fleets with higher over-crowding rate, ensures fastest possible vehicle charging - based on charging start, ensures that fleets always have fully charged vehicles when needed

Applications

The SICAM DLM is applied to following areas:

- Depots
- Parking garages
- Real estate
- Industrial sites
- Gas stations



[dw_sicam_dlm_profile, 1, --_--]

Figure 2.9/1 SICAM DLM Architecture

- Truck stations
- Business Parks

Connections

Connection of charging stations and backend systems

- Modbus TCP (electrical data)
- OCPP (electical and process data)

Connection options between SICAM DLM and charging units

- OCPP 1.6J
- Modbus TCP

Connection options between SICAM DLM and grid operator

- Modbus TCP
- IEC 60870-5-101
- IEC 60870-5-104
- IEC 61850
- DNP3
- Digital and analog I/O

Description

The Self Optimizing Grid is an innovative and smart application that combines automation and decentralized functions to monitor and remotely control the distribution grid. The application integrates intelligent automation for Self-Healing, Load Management combined with Overload Reduction and Automatic Source Transfer.

Benefits

SICAM Self Optimizing Grid is comprised of the most relevant applications for semi-decentralized solutions. These applications accurately monitor the grid and remotely control stations to ensure high reliability of supply and improve system performance, using closed loop automation functions. The SICAM Self Optimizing Grid application will effectively and equally support more rural networks that primarily operate with overhead lines, as well as urban networks that predominantly utilize cable infrastructure. All applications operate successfully across medium voltage and low voltage grids alike.

Functions

The SICAM Self Optimizing Grid integrates intelligent functions for closed loop distribution grid automation. The main function groups are:

- Static Self Healing Reconfiguration (SSH)
  Functionality locates the fault using Fault Passage Indicator and Trip/Lockout signals. After locating the fault, the system will isolate the faulty area and reconfiguration is done based on the topology constraints.
- Dynamic Self Healing Reconfiguration (DSH)
  Functionality isolates the segment indicated from the trip/lockout signal and reconfigures the grid based on the NOP, capacity available and measurement signals. In addition it supports directional Earth Fault Handling. This feature uses actual loading information from the field to provide the best solution possible.
- Under Voltage Reconfiguration (UV)
  Whenever low voltage is observed in devices, Undervoltage functionality opens the faulty device and reconfigures the de-energized segments by a NOP to another feeder. If there's an under voltage source which no longer can feed its segments, another source will take over to feed them, respecting the load capacity available if Dynamic Reconfiguration is enabled.
- Wide Area Voltage Control (WAVC)
  This functionality is to manage the voltage level on the grid by controlling the transformers and the Automatic Voltage Regulators (AVR). Each transformer or AVR will monitor its respective area based on the device's voltage measurements and WAVC is triggered to increase or decrease the voltage level.

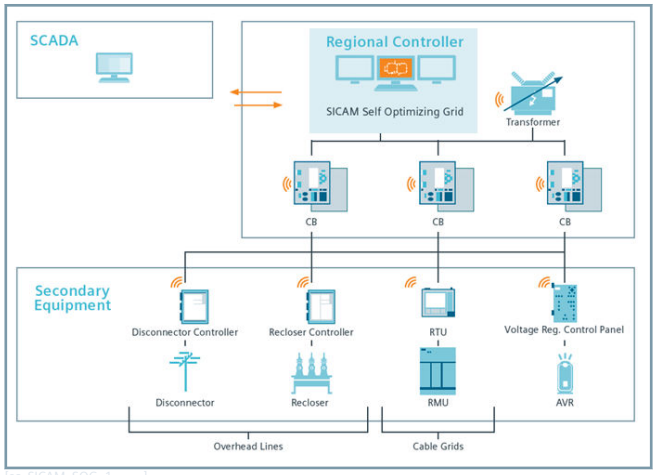


Figure 2.10/1 SICAM Self Optimizing Grid

Applications

The self-optimizing solutions use grid automation to enhance reliability and availability of the power distribution system, which increases the efficiency of grid management and operation and improves the distribution system operator's key performance indicators (KPIs).

In the semi-decentralized architecture on the distribution level creates the perfect balance of utilization the electrical grid and system robustness. The system protects the control center from data overload scenarios by pre-processing data and taking decisions at regional control level.

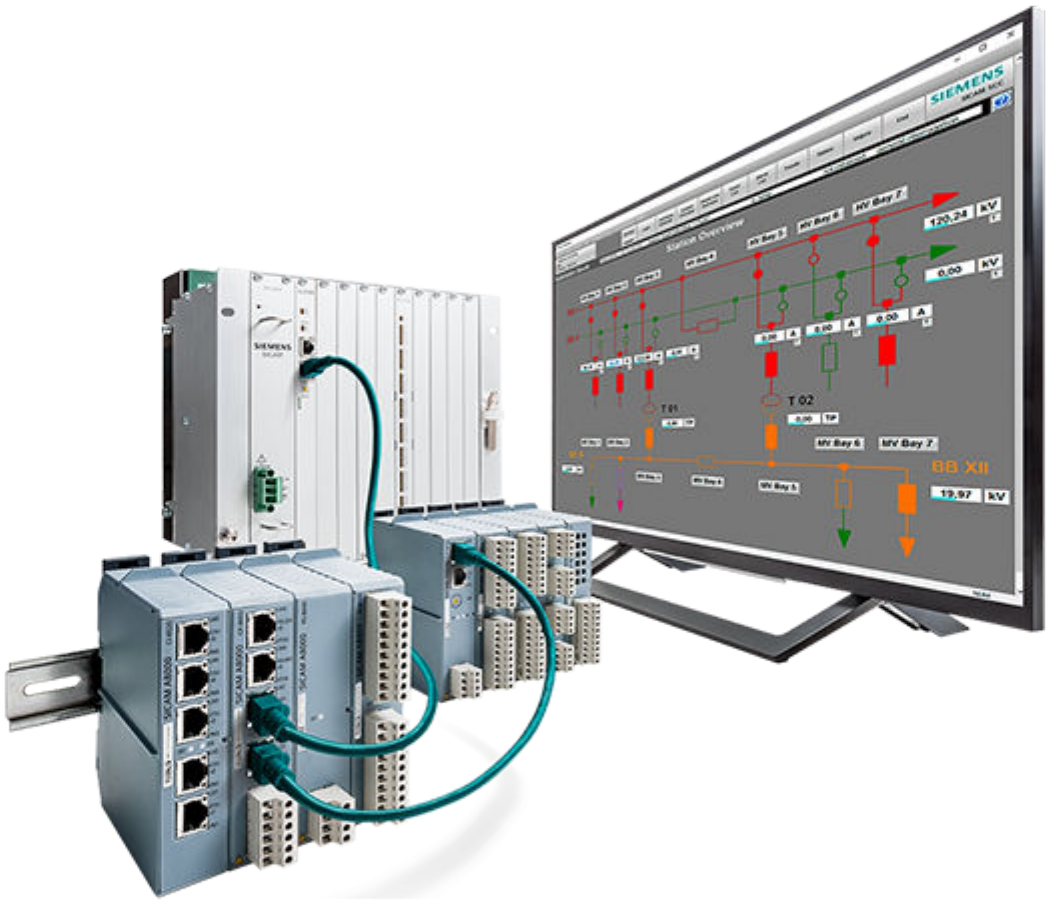
Integrated on SICAM 8 Platform

- SICAM Self Optimizing Grid runs on proven substation automation equipment of the SICAM 8 Platform
- SICAM CP8050, SICAM CP8031, and SICAM EGS
- SICAM Self Optimizing Grid is built on SICAM SIAPP and uses a single runtime container

License Type	Function Points	Can be used with				
		SICAM A8000			SICAM 8	SICAM S8000
		CP-8050	CP-8031	CP-8010/ CP-8012	SICAM EGS	
SICAM 8 Self Optimizing Grid[21]						
Self Optimizing Grid - Static Self-Healing SSH	100	X	X	X	X	X
Self Optimizing Grid - Dynamic Self-Healing DSH	250	X	X	X	X	X
Self Optimizing Grid - Under Voltage Reconfiguration UV	100	X	X	X	X	X
Self Optimizing Grid - Wide Area Voltage Control WAVC	150	X	X	X	X	X
Self Optimizing Grid - All Applications DSH_WAVC_UIV	500	X	X	X	X	X

Table 2.10/1 Function Points

21 License SICAM 8 LXC Container (SIAPP Runtime) is required


SIEMENS
120.24
kV
0.00
kV
T 01
T 02
MV Bay 6
MV Bay 7
BB XII
19.97
kV

Control, Monitoring, and Evaluation

The operation of electricity-supply systems is becoming more and more dynamic. In order to prepare themselves for future requirements, increasing the service lives of plant components is central to power utilities. They also make the highest demands of control, protection, and remote control.

Siemens is a pioneer in flexible and customized process visualization in power automation. Thanks to an extensive product portfolio and many years' experience, Siemens offers you innovative solutions for all voltage levels and every substation. You benefit from cost-effective investments and economic operation – without needing to compromise on safety and reliability. Be persuaded by our upgradeable concepts.

On the following pages, you will find information about:

- SICAM SCC
- SICAM PQ Analyzer (Incident Explorer)
- SICAM DISTO

[BBD, 1, –_–]

Figure 3/1 Operation, Observation, and Diagnosis

3

The protection of power distribution substations is a crucial task in ensuring a reliable electricity supply. Customers expect maximum availability of electrical energy and current at a constantly high quality level. As a result, it becomes more and more difficult in power system protection, for instance, to distinguish between critical load currents and short circuits with very low fault currents. The requirements for the optimum use of protection devices and for their parameterization are steadily increasing. An intensive evaluation of the existing secondary equipment information with regard to fault recorders is therefore indispensable to ensure that the high reliability and availability of electric transmission and distribution systems, which is standard today will be maintained in the future.

Another point is that the increasing use of power electronics has often a noticeable impact on voltage quality. The consequence is an insufficient voltage quality leading to interruptions, production downtimes, and high consequential costs. Compliance with the generally applicable power system quality criteria specified in the European standard EN 50160 is therefore a must. The basis for this is the reliable detection and evaluation of all quality parameters, so that weaknesses and potential sources of errors can be detected and eliminated.

What is Power Quality?

The purpose of power quality is to ensure a constant quality of electrical energy as a product. It requires, as an integral component of technical risk management, measuring devices and applications are able to reliably measure, record and evaluate the required data. Power quality is normally used in medium voltage substations.

Only an optimum availability and quality of energy can safeguard industrial production and its control. Moreover, power generation and distribution companies are as a rule contractually obliged to meet certain limits for values which are relevant for power quality. The task of power quality is the monitoring of these limits, the evaluation of limit violations, the initiation of suitable countermeasures, as well as the creation of long-term analyses and trends.

The European standards describing the voltage characteristics of electricity supplied by public electrical power systems (EN 50160) and the testing and measurement techniques (IEC 61000-4-30) provide the regulatory framework for this.

The variables to be monitored include:

- Voltage dips and swell
- Harmonic currents
- Transients
- Voltage variations (flicker)
- Frequency changes

Basic Principles for the Evaluation of Power Quality

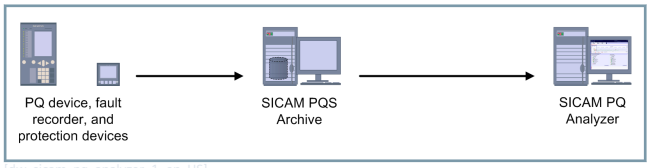
The power quality of an electric power grid is characterized by 2 main properties:

- Grid stability
  Grid stability problems are recorded in the fault records of PQ devices, protection devices, and fault recorders.
- Voltage quality
  The SICAM PQS system evaluates the voltage and current quality by comparing the measured data with the Grid Codes.

Grid Codes define the limiting values of power quality criteria, that is, which limits may never be exceeded, or which limiting values may be exceeded how often/how long. Grid Codes can be based on power quality standards such as the EN 50160 (characteristics of voltage in public electrical power systems).

The PQ Index gives you a quick overview of the power quality of your grid. Grid problems can be recognized at a glance.

The SICAM PQ Analyzer is a tool for display of the data measured by devices (providing PQ data with PQDIF files).

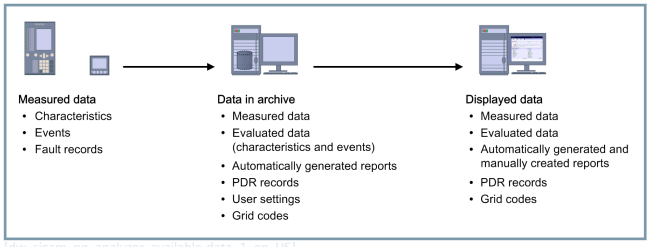


[dw_sicam_pq_analyzer, 1, en_US]

Figure 3.1/1 SICAM PQ Analyzer

Functions of SICAM PQS System

SICAM PQS system collects PQ data (such as measurements, fault records) from the connected devices (providing PQ data with PQDIF files and fault records), creates a comprehensive power quality analysis based on these data, and saves the PQ data and the evaluations in a dedicated archive.



[dw_sicam_pq_analyzer_available-data, 1, en_US]

Figure 3.1/2 Available Data

Functions of the SICAM PQ Analyzer

The SICAM PQ Analyzer connects to the archive of the SICAM PAS/PQS system and displays the data in the archive. Depending on the license, the SICAM PQ Analyzer provides a wide range of tools for analyzing these data.

The SICAM PQ Analyzer can be installed on the same computer as the SICAM PAS/PQS system, or on a separate computer in the network.

The archived PQ measured data and grid faults are evaluated in the different views of the SICAM PQ Analyzer.

- **Incident Explorer**

  The Incident Explorer allows a time-related analysis and provides a topological or configuration view of:
  - Fault events
  - Fault location
  - Fault record
  - Fault record (all)
  - Fault record – travelling wave
  - PDR record (Post Disturbance Review)
  - PQ Violation reports (is generated as soon as a PQ violation against Grid Code happens)
  - SIPROTEC fault record (high-resolution fault record generated from a 7KE85 device)
  - SIPROTEC slow-scan records (slow-scan records generated from a 7KE85 device or from a SIPROTEC 5 device using Flexible Recorder)
  - Slow-scan record
  - Slow-scan record (all)
  - Transient record

  Furthermore, you can export individual fault records. You can reduce the amount of data and select a COMTRADE export format.

- **Fault Event Viewer**

  The Fault Event Viewer is used to visualize a fault event, all the associated fault records, and all the related events for the fault event. A graphical representation of the timeline and trigger information of all the associated fault records enables a better fault event analysis.

- **Event Viewer**

  The Event Viewer visualizes the information points that are mapped in SICAM PAS/PQS UI – Configuration. The events are mostly process events that provides an overview of the status of the energy transmission or distribution system. The Event Viewer, therefore, ensures a better system fault analysis.

- **PQ Explorer**
  - The PQ Explorer gives access to all PQ data stored in the archive.
  - The PQ Explorer provides a topological view of the measuring points of your station.
  - The measured and calculated PQ data are evaluated using PQ diagrams.
  - The PQ Explorer allows you to create and save a favorite and favorite folder.

  Furthermore, you can create reports of the analysis and preview the reports.

- **PQ Inspector**

  The PQ Inspector shows the grid condition over a selectable time range based on the calculated PQ Index.
  It selectively provides a status overview of measured value groups which can be arbitrarily combined, as well as user guidance for the creation of PQ reports.

- **Report Browser**

  The Report Browser gives an overview of the scheduled reports, which are generated automatically at defined intervals (daily, weekly, monthly, and yearly).

- **Grid Code Viewer**

  The Grid Code Viewer displays the Grid Codes defined in SICAM PQS. The Grid Codes contain standardized or customer-specific limiting values for evaluating the grid quality. The PQ Index is determined on the basis of a comparison between the measured values and the limiting values of a Grid Code.

Fields of Application

Incident Explorer

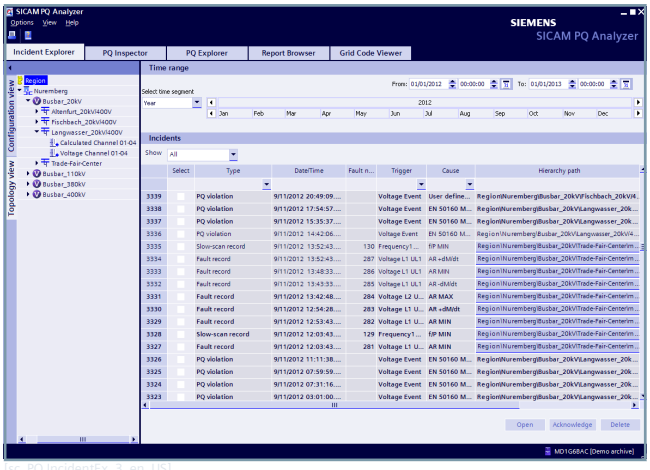
The topological structure of the archive data corresponds to the structure that was defined when the SICAM PAS/PQS station was configured.

The Incident Explorer serves for the following tasks:

- Reading the events (confirm)
- Calling up the analysis programs
- Deleting the events from the archive summary
- Manual fault location

Various filter functions are available for selection of events in the power network

- Selecting the time range in the archive
- Filtering for events
- Commenting events



[sc_PQ IncidentEx, 3, en_US]

Figure 3.1/3 Incident Explorer

PQ Inspector

The PQ Inspector provides the operator with a quick overview of the plant's power quality based on the PQ index. The archived data is analyzed via any selectable time ranges. Causes of deviations in the measured values for the Grid Codes can thus be detected immediately.

PQ Inspector is divided into 3 steps:

- In **Select time range**, define the observation period and identify possible influencing factors for deviations of the power quality.
- In **Select diagrams**, select the properties of a specific measuring point, and define the diagrams in which you want to show these data items.
- In **Finalize report**, complete your report.

Use the **Select time range** step to view the state of the power quality of the system at a glance. You can set up individual measuring point groups and feature groups so that you can observe critical areas in a targeted manner.

The step **Select diagram** allows the compilation of evaluation diagrams with specific features for a report. The diagrams are represented in a synchronized manner. Hence you can rapidly identify connections in the event of fluctuations in power quality.

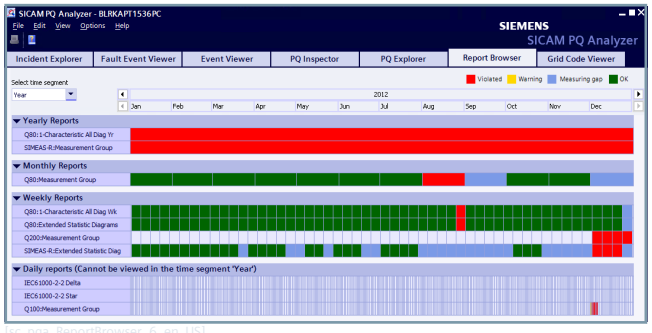
The step **Finalize report** allows reports to be prepared and commented upon.

PQ Explorer

PQ Explorer allows access to all PQ data stored in the archive. It offers a topological view of the measuring points in your plant. Measured and calculated PQ data is evaluated via PQ diagrams. Furthermore, you can generate analysis reports and display these in a preview.

Report Browser

The Report Browser provides an overview of the scheduled reports that are created automatically at specified time intervals (daily, weekly, monthly and yearly). You can view the reports with a viewer, print them and store them for future use.



[sc_pqa_ReportBrowser, 6, en_US]

Figure 3.1/4 Report Browser

In Report Browser, the reports are shown for the selected time range – separated into yearly reports, monthly reports, weekly reports and daily reports. If you select the year time grid you cannot open daily reports. However, you can view the status and the time lapses for which infringement reports are available. Scheduled reports are automatically generated by the SICAM PQS system using the set up report templates. If you set up report templates, among other things define the intervals in which the reports are created, and the PQ devices (providing PQ data with PQDIF files) for which the reports are created. The colors of the reports show their status.

Grid Code Viewer

The Grid Code Viewer displays the Grid Codes defined in SICAM PQS. The Grid Codes include normalized or customer-specifically defined limiting values for evaluating the power quality. The PQ Index is determined from a comparison of the measured values with the limiting values of a Grid Code.

The Grid Code Viewer provides the overview required for a supporting analysis:

- Which Grid Codes are available?
- To which elements in the topology have the Grid Codes been assigned?
- What features do the Grid Codes contain?
- What limits have been defined?

SICAM PQ Collector

The SICAM PQ Collector collects the archive data of the individual (source) archives in a central (collector) archive. Depending on the system configuration, the SICAM PQ Analyzer accesses the data of the (source) archives or (collector) archives for its archive evaluation.

In redundant archive systems, 2 SICAM PQ Collectors are connected. In the event of an interruption of the connection to (source) archives or after the failure of a SICAM PQ Collectors, this permits the archives to be matched, thus reaching an identical and complete contents of both (Collector) archives.

Architecture

- SICAM PAS/PQS with (source) archive and SICAM PQ Analyzer
- System with
  - SICAM PAS/PQS with (source) archive
  - SICAM PQ Analyzer clients
- System with
  - SICAM PAS/PQS
  - Archive servers with (collector) archive
  - SICAM PQ Analyzer clients

The number of components which can be used in a system depends on the individual license.

(Source) archive

SICAM PAS/PQS collects the PQ measured data and fault records from the connected devices and stores them in its local (source) archive. This archive data can be directly evaluated by one or more SICAM PQ Analyzer.

(Collector) archive

In distributed systems with one or several SICAM PAS/PQS, the data of the (source) archives is collected by the SICAM PQ Collector and stored in a central (Collector) archive on an archive computer. This archive data is evaluated by one or more SICAM PQ Analyzer.

SICAM PQ Analyzer – Software and Hardware Requirements

Software and Hardware Requirements

One of the following operating systems is required:

- Windows 11 Professional/Enterprise/IoT Enterprise LTSC (64-bit)
- Windows Server 2022 Standard with Desktop Experience (64-bit)

Computer equipped with:

- Processor:
  - Minimum: Intel Core 2 Duo 1.6 GHz
  - Recommended: Quad Core CPU 3 GHz
- Primary storage capacity:
  - Minimum: 2 GB
  - Recommended: 4 GB
- Hard disk capacity:
  - Minimum: 4 GB
  - (Collector) archive: > 100 GB
- Graphics card:
  - Minimum: 1600 x 1200 pixel
  - Recommended: 1920 x 1200 pixel
- Monitor suitable for graphics card
- Keyboard
- Mouse
- Network interface
- USB port

SICAM PQ Analyzer is released for computers with multi-core processors. Computers with multi-processor main boards are supported when working in single-processor mode.

Selection and Ordering Data

Description	Variants	Order No.																
		1	2	3	4	5	6	7		8	9	10	11	12		13	14	15	16
Delivery form	Electronic delivery – OSD (Download)																		
Incident Explorer for Fault-Record Analysis		6	M	D	5	5	3	2	–	0	**A**	A	1	0	–	3	□	□	0
																▲	▲	▲	
	Version 3.1x															3	|	|	
	Use on the SICAM PAS/PQS full server																A	A	
	Up to 5 clients, archive transfer of 1 server/full server																B	A	
	Up to 5 clients, archive transfer of up to 5 servers/full servers																B	B	
	Up to 5 clients, archive transfer of more than 5 servers/full servers																B	C	
	More than 5 clients, archive transfer of 1 server/full server																C	A	
	More than 5 clients, archive transfer of up to 5 servers/full servers																C	B	
	More than 5 clients, archive transfer of more than 5 servers/full servers																C	C	
Notes: ● 2 redundant PAS/PQS full servers are counted as 1 server. ● 7KE85 and SIPROTEC 5 (if configured accordingly as of V9.20) provide not only fault records but also PQ data (example: continuous records) which are managed with the PQ Explorer. ⇒ for processing 7KE85- and SIROTEC 5- fault records and PQ data, the usage of at least PQ Basic is recommended.																			
PQ Basic		7	K	E	9	2	0	2	–	0	**B**	A	1	0	–	3	□	□	0
Delivery form	Electronic delivery – OSD (Download)																		
Including Incident Explorer for fault-record analysis and PQ Explorer Recommended SICAM PAS/PQS option: Automatic grid-code evaluation																	▲	▲	
	Use on the SICAM PAS/PQS full server																A	A	
	Up to 5 clients, archive transfer of 1 server/full server																B	A	
	Up to 5 clients, archive transfer of up to 5 servers/full servers																B	B	
	Up to 5 clients, archive transfer of more than 5 servers/full servers																B	C	
	More than 5 clients, archive transfer of 1 server/full server																C	A	
	More than 5 clients, archive transfer of up to 5 servers/full servers																C	B	
	More than 5 clients, archive transfer of more than 5 servers/full servers																C	C	

Table 3.1/1 SICAM PQ Analyzer – Selection and Ordering Data

SICAM PQ Analyzer – Selection and Ordering Data

Description	Variants	Order No.															
Continued from previous page		1	2	3	4	5	6	7		8	9	10	11	12		13	14	15	16
Delivery form	Electronic delivery – OSD (Download)																		
PQ Standard		7	K	E	9	2	0	2	–	0	**C**	A	1	0	–	3	☐	☐	0
Including PQ Basic, extended PQ Explorer and Report Browser Recommended SICAM PAS/PQS options: Automatic grid-code evaluation/scheduled PQ reports																	▲	▲	
	Use on the SICAM PAS/PQS full server																A	A	
	Up to 5 clients, archive transfer of 1 server/full server																B	A	
	Up to 5 clients, archive transfer of up to 5 servers/full servers																B	B	
	Up to 5 clients, archive transfer of more than 5 servers/full servers																B	C	
	More than 5 clients, archive transfer of 1 server/full server																C	A	
	More than 5 clients, archive transfer of up to 5 servers/full servers																C	B	
	More than 5 clients, archive transfer of more than 5 servers/full servers																C	C	
PQ Professional		7	K	E	9	2	0	2	–	0	**D**	A	1	0	–	3	☐	☐	0
Including PQ Standard and PQ Inspector Recommended SICAM PAS/PQS options: Automatic grid-code evaluation/scheduled PQ reports																	▲	▲	
	Use on the SICAM PAS/PQS full server																A	A	
	Up to 5 clients, archive transfer of 1 server/full server																B	A	
	Up to 5 clients, archive transfer of up to 5 servers/full servers																B	B	
	Up to 5 clients, archive transfer of more than 5 servers/full servers																B	C	
	More than 5 clients, archive transfer of 1 server/full server																C	A	
	More than 5 clients, archive transfer of up to 5 servers/full servers																C	B	
	More than 5 clients, archive transfer of more than 5 servers/full servers																C	C	

3.1

Table 3.1/2 SICAM PQ Analyzer Selection and Ordering Data

Description	Variants	Order No.															
		1	2	3	4	5	6	7		8	9	10	11	12		13	14	15	16
Continued from previous page																			
Delivery form	Electronic delivery – OSD (Download)																		
Functional Upgrades																			
Power Quality functions		7	K	E	9	2	0	2	–	**4**	□	□	0	0	–	3	A	A	0
	From Incident Explorer to PQ Basic										B	A							
	From PQ Basic to PQ Standard										C	B							
	From PQ Basic to PQ Professional										D	B							
	From PQ Standard to PQ Professional										D	C							
Number of clients [22]		6	M	D	5	5	3	2	–	**4**	A	A	0	0	–	3	□	A	0
	Up to 5 clients																B		
	From up to 5 clients to more than 5 clients																C		
Number of full servers [23]		6	M	D	5	5	3	2	–	**4**	A	A	0	0	–	3	A	□	0
	Up to 5 full servers																	B	
	From up to 5 full servers to more than 5 full servers																	C	
Version Upgrade																			
	Upgrade from SICAM Recpro V5.x to SICAM PQ Analyzer (Incident Explorer)	6	M	D	5	5	3	2	–	**3**	A	A	0	0	–	3	A	A	0
	Version upgrade SICAM PQ Analyzer	6	M	D	5	5	3	2	–	**3**	A	A	0	1	–	3	A	A	0
Demo Version		7	K	E	9	2	0	2	–	7	A	A	0	0	–	3	A	A	0

Table 3.1/3 SICAM PQ Analyzer Selection and Ordering Data

SICAM PQ Analyzer can be extended with SIGRA for extended fault-record analysis (ordered separately).

22 Hint: Both MLFB numbers (..-3BA0 and ..-3CA0) must be ordered when upgrading from 1 client to more than 5 clients.

23 Hint: Both MLFB numbers (..-3AB0 and ..-3AC0) must be ordered when upgrading from "1 full server" to "more than 5 full servers".

SIGRA – Description

Description

The SIGRA user program supports you in analyzing failures in your electrical power system. The program graphically analyzes data recorded during the failure and calculates additional supplemental quantities such as impedances, powers, or RMS values, from the supplied measured values, making evaluation of the fault record easier.

The quantities can be shown as desired in the diagrams of the following views: **time signals, vector diagrams, locus diagrams, harmonic components**, and **fault locators** and represented in the **table** view.

After a system incident, it is especially important to quickly and completely analyze the error, so that the respective measures can be derived immediately from the cause analysis. This will enable the original network status to be restored and the down time to be reduced to an absolute minimum.

As well as the usual time signal display of the recorded measured quantity, the current version is also set up to display vector, pie and bar charts to show the harmonics and data tables. From the measured values recorded in the fault records, SIGRA calculates further values, for instance missing quantities in the 3-phase electrical power system, impedances, outputs, symmetrical components, etc. Using 2 cursors, the fault current can be evaluated easily and conveniently. Using SIGRA however, further fault records can also be added. The signals from another fault record (for example, from the opposite end of the line) are added to the current signal pattern using drag and drop.

SIGRA facilitates the display of signals from various fault records in one diagram as well as a fully automated synchronization of these signals on a common time base. As well as the precise determination of the individual factors of the line fault, the fault location is also of particular interest.

A precise determination of the fault location saves time which the user can use for an on-site inspection of the error. This function is also supported by SIGRA using the **Offline fault location** function. SIGRA can be used for all fault records in COMTRADE file format.

The functions and advantages of SIGRA can often only be best displayed on the product itself. Consequently, SIGRA is available as a 30-day test version.

Functions

- 6 diagram types:
  - Time-signal representation (standard)
  - Pie chart (for example for R/X)
  - Vector diagram (reading angles)
  - Bar chart (for example for displaying the harmonics)
  - Table (list values for different signals at the same time)
  - Fault location (to display the location of faults)
- Additional-value calculation, for example positive-sequence impedances, RMS values, symmetrical components, vectors

[sc_SIGRA_Splash, 1, --_--]

Figure 3.2/1 Fault-Record Analysis with SIGRA

- 2 cursors for for measured values are synchronized in all views
- Powerful zoom function
- User-friendly configuration via drag and drop
- Innovative signal configuration in a clear matrix
- User profiles that save time and can be assigned to individual device types or series
- Additional fault records can be added to the existing fault record
- Synchronization of different fault records to a common time base
- Simple documentation by copying diagrams into documents from other MS Office programs
- Offline fault-location determination

Hardware Requirements

To work with SIGRA, you need a PC or laptop computer with the following minimum specifications, irrespective of the operating-system version you are using:

- Intel® Celeron® Dual Core 2.2 GHz (Ivy/Sandy Bridge) or equivalent
- 2 GB RAM (8 GB recommended)
- Graphic display with resolution of 1024 × 768 pixels (1280 × 1024 recommended)
- 5 GB of available hard-disk space

Operating System	Version/Type	Updates	PC[24]	VM[25]	32-bit[26]	64-bit[27]
Windows 10	Professional	1803;1809;1903	+	+	+	+
Windows 10	Enterprise	1803;1809;1903	+	+	+	+
Windows 7	Professional	SP1[28]	+	+	+	+
Windows 7	Enterprise	SP1[28]	+	+	+	+
Windows 7	Ultimate	SP1[28]	+	+	+	+
Windows Server 2019	Standard	–	+	–	–	+

Table 3.2/1 Supported und Tested Operating Systems

Virtual Machines

SIGRA supports VMware virtual machines with the following versions and higher:

- VMware Workstation V6.5.0
- VMware Player V3.1.2
- VMware Tools for Windows V8.4.4

You can find more information on the Internet page: https://www.vmware.com

You use other Windows and older VMware versions at your own risk.

Interface Languages:

German, English, French, Spanish, Italian, Chinese, Russian, Turkish (selectable)

24 PC: Windows computer

25 VM: Virtual machines (for example VMWare)

26 32 bit: Operating system with 32-bit support (DIGSI 5 cannot be installed or used on a 32-bit operating system)

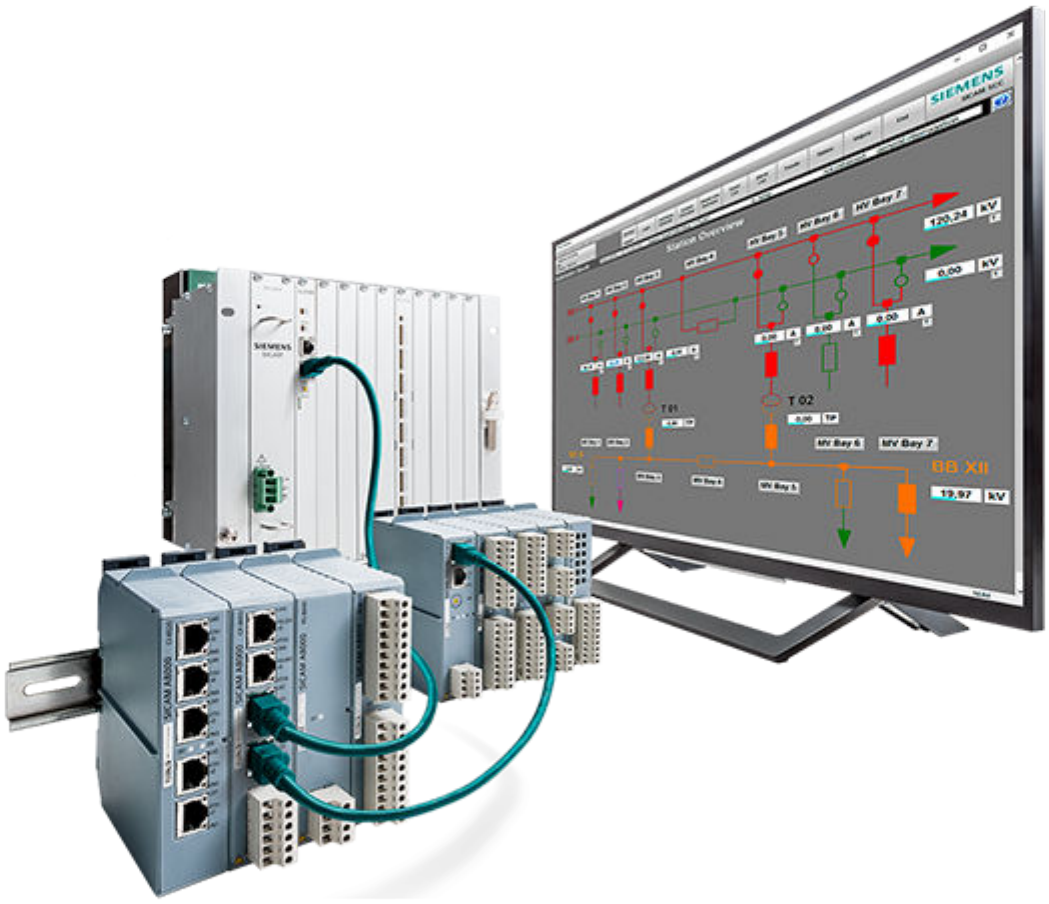
27 64-bit: Operating system with 64-bit support

28 Including security update KB3033929 or other security patch incorporating this security update

Selection and Ordering Data

Description	Variants	Order No.											
		1	2	3	4	5	6	7		8	9	10	11	12
SIGRA		7	S	X	5	4	1	☐	-	0	A	H	0	0
Software for graphical visualization, analysis, and evaluation of fault records For further information about supported service packs of the operating systems including sample fault record, electronic help, and service (update, hotline), refer to the Product information. Interface languages: German, English, French, Spanish Delivery form: Online Software Download (OSD)								▲						
	Installation with and without DIGSI, with an individual license							2						
	Installation with and without DIGSI, with 10 individual licenses							4						

Table 3.2/2 SIGRA – Selection and Ordering Data


SIEMENS
120.24
kV
0.00
kV
T 01
T 02
MV Bay 6
MV Bay 7
BB XII
19.97
kV

Description

SICAM SCC (Station Control Center) is a SCADA system that enables efficient monitoring, control, and data collection in energy distribution and automation. It can be used regardless of the specific station control technology and is compatible with systems such as SICAM 8, among others. SICAM SCC allows direct communication with field and protection devices, and serves as a cross-device HMI (Human-Machine Interface) system.

Benefits

- Platform Independence: Can be deployed on various hardware platforms and virtual systems
- Scalability: Adaptable to the size and needs of various applications
- User Friendliness: Intuitive interface that simplifies management and control
- Integration of Various Systems: Incorporates a wide range of technologies and field devices
- Enhanced Data Analysis: Optimized through detailed data evaluations

Applications

- Ensuring power quality: To avoid fluctuations in power quality and prevent disturbances, grid monitoring, control, and automation systems need to be adapted and optimized across all voltage levels
- Maintaining control of distributed power producers: Identifying, locating, and eliminating disturbances and faults as well as the flexible, quick balancing of power production and load consumption require integrated hardware and software solutions that work smoothly together
- Intelligent technologies for stable grids: Automation solutions and remote control technology enhance the reliability of distribution grids
- Keeping your grids up and running despite outages: Flexible solutions for local and remote monitoring enable the fast and efficient restoration of cable grids and overhead lines
- OPEX savings for municipalities and DSOs: With modern technologies and innovative solutions such as optimized voltage and capacity management

SICAM SCC - based on SIMATIC WinCC

Common HMI for SICAM and SIMATIC SICAM SCC is based on the SIMATIC WinCC system, one of the world leading process visualization systems, adding the functions required for use as substation operating system of the electric process in high-voltage and medium-voltage systems. The compatibility with SIMATIC WinCC allows SICAM SCC to be used as an add-on together with SIMATIC WinCC on one computer. This enables an integrated system solution for visualizing and controlling the industrial manufacturing processes using SIMATIC automation devices (e.g. S7 and PCS7) and the electric energy process (e.g. SICAM PAS).

Basic features

- Alarm and event list
- Archiving

Figure 4.1/1 Process and Visualization System SICAM SCC

- Advanced trend charts
- World view
- Command element
- Picture alarm element
- VBS/C script language
- Communication via IEC 60870-5-104 and IEC 61850
- Multi-touch controls
- Link to SICAM S8000, A8000, PAS, SIPROTEC 5

HMI/SCADA options

- Topological coloring
- Remote alarming (SMS, e-mail)
- Network technology (client-server redundancy, multiserver multiuser system, Web clients)
- Full support for SIMATIC
- Dynamic alarm filter
- Secure communication
- Network monitoring (SNMP)
- Traceability of all user actions (Audit)

Encrypted connection with IEC 61850

- Asymmetric encryption method
- TLS encryption of communication (TLS security, T-profile)
- TLS + authentication of users (ACSE Authentication, A-Profile)
- Certificates manually imported or automatically updated via EST communication (EST = Enrollment via Secure Transport)

System Overview

An important component of power distribution and transmission plants is process visualization and control. In the SICAM product range, this task is undertaken by SICAM SCC, an HMI

system that optimally fulfills the requirements of plant control and monitoring – regardless of the Siemens substation technology used. SICAM SCC can be used with the power-automation system SICAM PAS, as well as the SICAM 8 products.

Common HMI for SICAM and SIMATIC

As a base system SICAM SCC uses SIMATIC WinCC, one of the world's leading process visualization systems and supplements this with the necessary functions for utilization as station operation of the electrical process in high and medium-voltage systems. SIMATIC WinCC compatibility allows the use of SICAM SCC as an add-on together with SIMATIC WinCC on one computer. This enables an integrated system solution for the visualization and control of the industrial production process with SIMATIC automation devices (for example, S7) and the electrical energy process (for example, with SICAM PAS).

Functions for Use with SICAM and IEC 61850

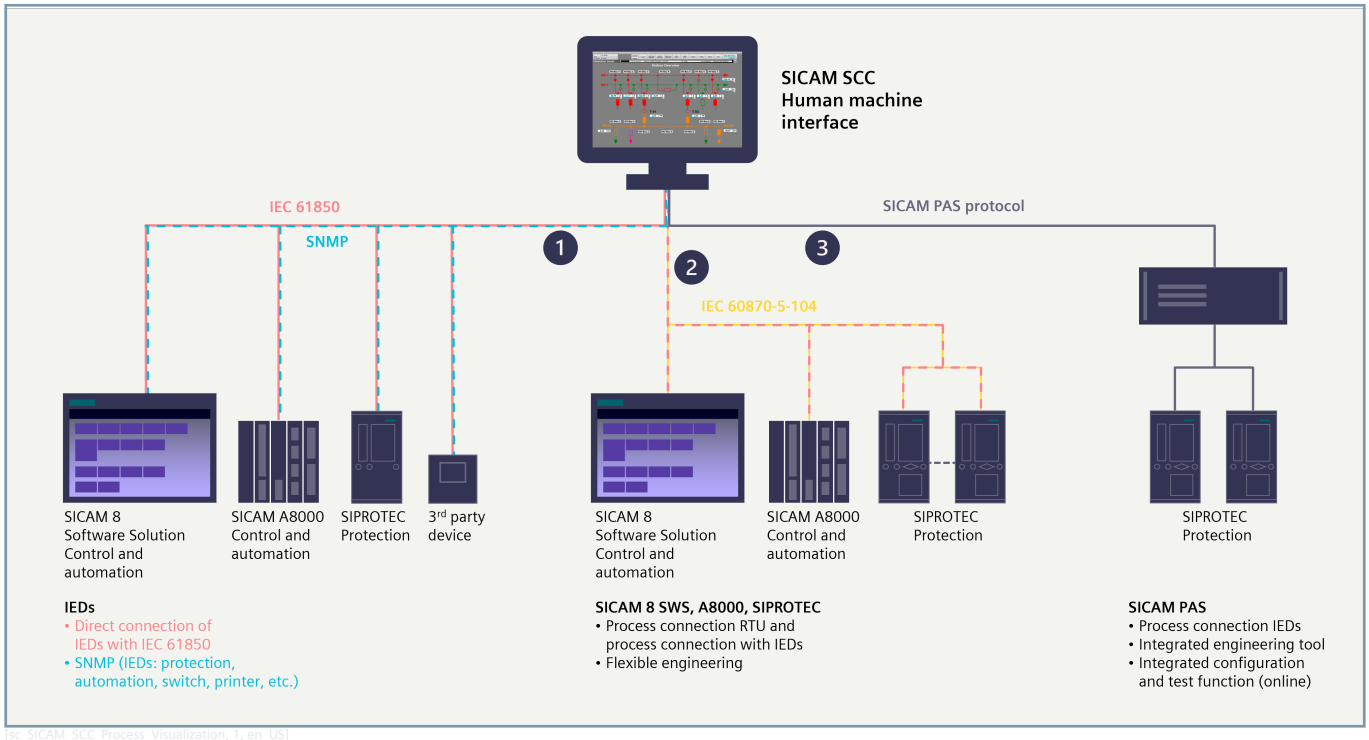
SICAM SCC is customized for use in the energy sector and supports the operational crew in optimizing system management. SICAM SCC allows rapid entry and clear, uncluttered representation of the operating statuses of the plant. The specific properties of the high-voltage and medium-voltage switching devices in the control and monitoring direction (double commands and -indications) are optimally implemented in the message lists and the graphical representation of the process.

Added Value Logging

In the message lists, the original time stamps are logged with ms resolution as they occur in the devices. Each indication is represented with a series of auxiliary information. On the one hand, these provide information about the update status of the information against the background of a device or communication failure (up to date/not up to date) or an activated bay or telecontrol blocking. On the other hand, they provide information about the cause of the status change (spontaneous, command) and, in the case of a command process, about the process source (local, site, remote). In addition to process indication, command indications are also logged. Thus, each command process is documented completely and in detail, from issue of the command by the operational crew and the command output right up to feedback from the process after the change in status of the controlled switching device.

Process Visualization Right up to Topological Coloring

IndustrialX controls are used for control and monitoring of the switching devices in the fully graphic process diagrams (single-line diagrams). These switching device objects support 4 different representation forms (IEC, DIN, SINAUT LSA, SICAM) for circuit breakers and disconnectors. Furthermore, the possibility exists to project-specifically create defined bitmaps to represent the switching devices and to link them with the objects. in addition to target and spontaneous flashing, representation of diverse device and communication states (for example, up to date/not up to date, bay and telecontrol blocking) is also supported for meaningful visualization. Measured values and switching device states that can no longer be updated due to a device or communication failure or applied bay blocking can be updated from the operator console via SICAM SCC. The switching devices can be controlled directly or with **Select before operate**. The option of topological coloration exists for representation of the process with single-line diagrams.



[sc_SICAM_SCC_Process_Visualization, 1, en_US]

Figure 4.1/2 Process Visualization with SICAM SCC

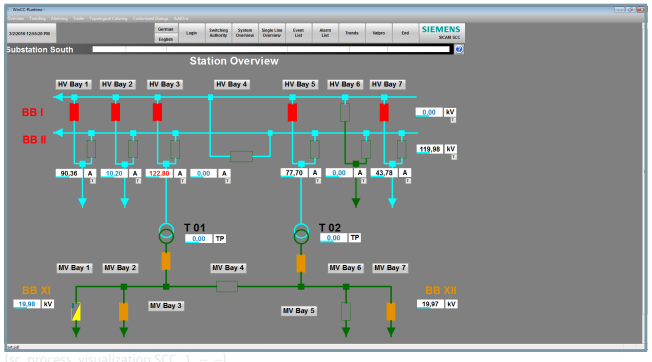
Substation Automation Technology Functions in Common with SICAM PAS

Additional functions are supported when using with SICAM PAS: If, for example, maintenance work or tests must be carried out for the process area of a bay unit, and if any status changes are not to be taken into consideration in the substation automation technology processing of the SICAM PAS and not logged in HMI, this can easily be activated via the **bay blocking** function. If the status changes are to continue being processed within the substation but the information transmission to superordinated control centers is to be suppressed, this can be achieved by means of the **telecontrol blocking** function.

Normally, substations are controlled by the superordinated control centers, while switching commands are to be rejected by the station's internal HMI; the switching authority is assigned to the superordinated control center. Switching authority can be obtained if control must be effected from the HMI for operational reasons. If the substation is connected to several control centers, the switching authority can also be assigned channel-specifically. Furthermore, different switching authorities can be used for different voltage levels.

Reduced Engineering Expenditure

The data exchange with the connected substation often comprises several thousand indications, measured values and commands. The project engineering of this information is considerably simplified in SICAM SCC via wizards. The required description of process data is made available electronically by the configuration tools (SICAM PAS UI – configuration, SICAM Device Manager) of the substation automation technology and is easily imported by SCC wizards. Redundant data input is avoided. SCD files can be imported for directly connected IEC 61850 devices.



[sc_process_visualization SCC, 1, --]

Figure 4.1/3 Process Visualization with SICAM SCC

SIMATIC WinCC

SICAM SCC works on the SIMATIC WinCC platform

The WinCC basic software is the core component of a modular system via which you can compile a flexible, customized SCADA solution via options and add-ons. The WinCC basic software alone already represents a powerful, universally applicable process visualization system that has all the features of sophisticated HMI software.

Runtime software

All HMI functions on board - this is how the runtime components of the basic software are available. Starting with user management that satisfies all requirements of Good Manufacturing Practice (GMP), via a user interface with a multitude of configurable controls and functions right up to the powerful signaling and archiving system based on the integrated MS SQL Server. Reporting and logging system as well as integrated systems control functions as well as integrated systems control function round off the list.

Configuring software

The engineering component WinCC CS has a range of editors that leave nothing to be desired with respect to their efficiency and user-friendliness. Libraries and wizards simplify and accelerate the creation of projects and considerably reduce the occurrence of defects. As software for the most complex HMI tasks, WinCC is also suitable for handling larger projects and bulk data.

Scalability

The basic system is scalable in all respects via WinCC options. Even the basic system is scalable with respect to the quantity structure via a graduated licensing model, in doing so the selected quantity of process tags can be subsequently increased at any time. WinCC/server offers the option of establishing WinCC as a client-server application. WinCC- redundancy makes this solution a highly-available system. With WinCC CAS, the process value archiving system is extended into an independent, high-performance archive server. WinCC/Web Navigator allows operation and observation via the Web with almost identical functionality to a WinCC client, but with unbeatable flexibility.

Virtualization

In addition to WinCC Clients, WinCC Server can be used under VMware ESXi and engineering stations under VMware workstation or VMware Player. In this way, complex client-server structures and also stand-alone systems can be configured with virtual environments.

Openness

SIMATIC WinCC has always stood for the greatest possible level of openness and integration capability because it consistently uses standard technologies and software tools. From the operating systems and the utilized basic technologies right up to communication mechanisms and the possibility of integrating scripts, WinCC focuses on standards in all fields and dispenses with proprietary solutions.

SIMATIC WinCC - basic functionality

Runtime components of WinCC basic software

- Integrated user management
- User Interface
- Message management system
- Archiving system
- Reporting and logging system
- Systems control functions (Basic Process Control)

Integrated user management

With WinCC User Administrator, the access rights of the users for project engineering and runtime are assigned and controlled. At any time, even during runtime, the administrator can create up to 128 user groups each with up to 128 individual user settings and assign them access rights to WinCC functions. In total, up to 999 different authorizations are possible. SIMATIC Logon is a component of the WinCC basic software. User management with SIMATIC Logon integrates into the security system and user management of Windows and hence also covers extended safety requirements in accordance with FDA. SIMATIC Logon supports system-wide user management and protects from unauthorized manipulation of data.

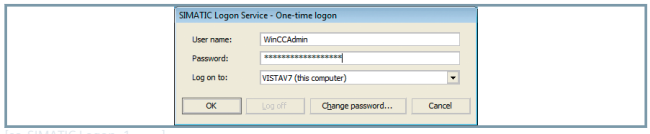


Figure 4.1/4 SIMATIC Logon Service in WinCC Basic System

User Interface

With the WinCC standards, individually configured user interfaces can be created for any application purpose. They make use of a comprehensive selection of configurable standard objects. With online language change, projects that are created in multiple languages can be switched over online during runtime at any time. Windows elements such as menus and toolbars can be integrated into the user interface of the runtime application. With a maximum resolution of 10,000 x 10,000 pixels for the individual process diagrams, the convenient zoom factor proves to be of particular importance. The zoom factor can be smoothly increased or decreased using a scrolling mouse. The panning function allows the overlay of a navigation cross in a zoomed image. The representation of tiers and objects can be made dependent on the current zoom factor by means of decluttering. Thus, it is, for example, possible to only overlay details above a specific zoom factor.

Message management system

SIMATIC WinCC not only records process indications and local events, it also stores them in circular archives and then makes them available either filtered or sorted as required. Indications can result by derivation from individual bits, as a result of an indication telegram directly from the automation system or as a result of analog alarms in the case of limit violations. Individual acknowledgment processes and views, a freely definable indication structure and also parameterizable archiving and logging of indications are other features. In WinCC alarm control, the display can be individually adapted to the indications. Comprehensive selection options, for example, via a user-specific filter matrix, guarantees the best overview. It is also possible to display indications that have already been stored. The represented indications can be exported or printed out as reports at the press of a button. System-specific functions can be realized via freely configurable toolbar functions.

A search function is offered in the alarm editor of WinCC. The filter options in the alarm system have been supplemented with process value blocks with **equals** and **contains** in the case of text values.

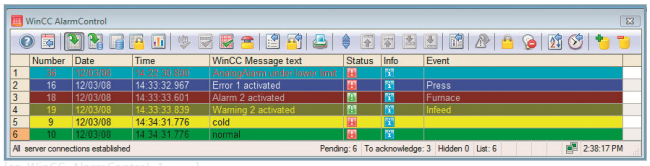


Figure 4.1/5 Report Display via WinCC Alarm Control

Integrated statistic functions allow the harmonic test of hit lists (average and summarized report and acknowledgment times).

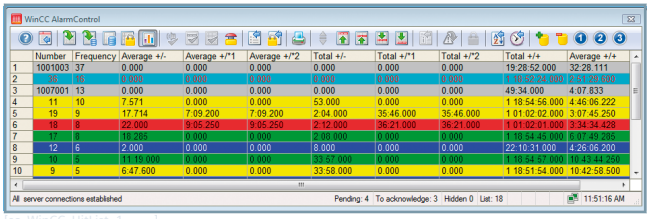


Figure 4.1/6 Report Display with Report Hit List

Indications can also be automatically hidden (alarm hiding). Depending on the current station status (for example, operation, cleaning, maintenance), less relevant indications can be hidden from display.

Archiving system

Historic values or value progressions are stored in process value archives. In addition to process values, WinCC also archives indications and user data. The archiving takes place in circular archives in the integrated MS SQL server database with high performance, that is, up to 10,000 measured values and 100 indications per second. The memory requirement is very low due to effective, lossless compression. In the WinCC base system, 512 archive variables can already be configured. In the final extension, power packs allow extension to up to 120,000 variables. Central, optionally redundant long-term archiving can be realized with a central archive server with the WinCC Central Archive Server option.

In TrendControl (*Figure 4.1/7*) current values (online trends), historic process values and set point values can be represented in the same curve display. It is also possible to display measured values that have already been stored. Here, individual scaling of the time line and the range of values is possible (for example, percentile standardization). The time and value lines of the individual curves can be moved online by movement of the mouse. This function can be used for, for example, batch comparisons.

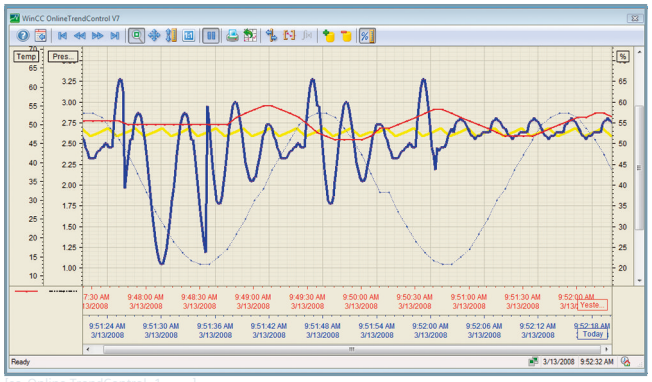


Figure 4.1/7 Online TrendControl

Integrated statistic functions allow the harmonic testing of minimum, maximum, average value, standard deviation and integral calculation at the press of a button. Logarithmic representation of curve progressions is also possible. The process values displayed by selection can be printed out as a report at the press of a button or exported in a CSV file. In addition, system-specific functions can be realized via the freely-definable toolbar functions.

Reporting and logging system

WinCC has an integrated log system, via which data from WinCC or other applications can be brought to paper. In configurable layouts, WinCC prints data recorded in runtime relating to different types of log, from reporting sequence and system report and operation logs right up to user reports. The reports can also be stored as a file and displayed via a preview on the screen. WinCC logs can also contain data from the database and third party data in CSV format as a table or curve.

You can find further information in the current manual:*Industry Online Support*

Cybersecurity

Right from the start: cybersecurity

Make security an integral part right from the earliest planning stages. SICAM SCC is the best way to arrive at a complete, cost-effective system solution that integrates security in all phases of the development process. In the end, it includes precisely those security features that are absolutely necessary. No more, no less. Saving you from expensive, time-consuming upgrades.

Right from the start, SICAM SCC meets the highest security requirements, including:

- BDEW white paper (German Association of Energy and Water Industries)
- NERC CIP (North American Electric Reliability Corporation, Critical Infrastructure Protection)
- Signed installation program

Role-based access control (RBAC)

If you already have centralized user management with Microsoft Active Directory, you can simply integrate our SICAM SCC HMI system. You can then quickly grant authorizations and modify or revoke them at any time, thus ensuring that only authorized persons can access your plant.

Selection and Ordering Data

Description	Variants	Order No.																
Take the following into account: For SICAM SCC version V10, order numbers from 6MD5501-.....-0AA0 to 6MD5515-.....-1AA0 are delivered with SIMATIC WinCC V8.1. If you require another SIMATIC WinCC version select an order number which is not included in the scope of delivery for SIMATIC WinCC, and order SIMATIC WinCC (suitable, compatible version) separately!																		
		1	2	3	4	5	6	7		8	9	10	11	12		13	14	15	16
Version and Delivery Form	Version 10															1			
	Online software delivery (OSD)																	H	
Operation and monitoring, runtime (RT)		6	M	D	5	5	0	□	–	0	A	P	0	0	–	1	A	H	0
								▲											
	128 data points							1											
	512 data points							2											
	2048 data points							3											
	8196 data points							4											
	65 536 data points							5											
Operation and monitoring, complete package runtime and configuration (RC)		6	M	D	5	5	1	□	–	0	A	P	0	0	–	1	A	H	0
								▲											
	128 data points							1											
	512 data points							2											
	2048 data points							3											
	8196 data points							4											
	65 536 data points							5											
Operation and monitoring, runtime (RT) compact with limited functionality		6	M	D	5	5	0	3	–	0	C	P	0	0	–	1	A	H	0
	2048 data points (the power pack cannot be upgraded)																		
Functional upgrade of SIMATIC WinCC to SICAM SCC		6	M	D	5	5	□	0	–	0	A	P	0	0	–	1	B	H	0
							▲												
	Runtime (format DLL)						0												
	Complete package (format DLL, configuration kit)						1												
SICAM SCC options		6	M	D	5	5	0	0	–	0	□	P	0	0	–	1	A	H	0
											▲								
	SCD import for direct communication with IEC 61850										E								
	Import for communication with IEC 60870-5-104										F								
	Network Manager										N								
	Topological coloring										T								
	Secure communication										S								
SICAM SCC version upgrade from V5.x, V6.x, V7.x, V8.0x, and V9.0x to V10.x		6	M	D	5	5	0	0	–	3	B	P	0	□	–	1	B	H	0
														▲					
Upgrade for SIMATIC WinCC is not included	Version upgrade from V6.x, V7.x, V8.x, V9.x to V10.x, download w/o topological coloring license													0					
	Version upgrade from V6.x, V7.x, V8.x, V9.x to V10.x, download with topological coloring license													2					

Table 4.1/1 SICAM SCC Selection and Ordering Data

Description	Variants	Order No.															
(Continued from previous page)		1	2	3	4	5	6	7		8	9	10	11	12		13	14	15	16
	Online software delivery (OSD)																	H	
Other options																			
SICAM SCC Archive extension for SIMATIC WinCC V8.1 (8.0, 7.5, 7.4)		6	M	D	5	5	7	1	–	0	A	V	0	8	–	0	☐	☐	0
	1500 archive variables (countable)																A	H	
	5000 archive variables (countable)																B	H	
	10 000 archive variables (countable)																C	H	
	30 000 archive variables (countable)																E	H	
SICAM SCC Web Navigator for WinCC ≥ V7.4		6	M	D	5	5	6	2	–	0	A	V	0	0	–	0	☐	☐	0
	1 client license (countable)																B	H	
	3 client licenses (countable)																D	H	
	10 client licenses (countable)																F	H	
SICAM SCC redundancy for WinCC V8.1 (8.0, 7.5, 7.4)		6	M	D	5	5	7	1	–	0	A	V	0	8	–	1	R	H	0
SICAM SCC server for WinCC V8.1 (8.0, 7.5, 7.4)		6	M	D	5	5	7	1	–	0	A	V	0	8	–	1	S	H	0
SICAM SCC version upgrade for WinCC		6	M	D	5	5	8	1	–	3	☐	☐	☐	☐	–	☐	A	H	0
	Upgrade for SIMATIC WinCC RT version, V7.x → V7.4										R	V	0	7		4			
	Upgrade for SIMATIC WinCC RT version, V7.2/7.3 → V7.5										R	V	3	7		5			
	Upgrade for SIMATIC WinCC RC version, V7.x → V7.4										C	V	0	7		4			
	Upgrade for SIMATIC WinCC RC version, V7.2/7.3 → V7.5										C	V	3	7		5			
	Upgrade for SIMATIC WinCC RT version, V7.3/ V7.4 → V8.0										R	V	4	8		0			
	Upgrade for SIMATIC WinCC RT version, V7.5 → V8.0										R	V	5	8		0			
	Upgrade for SIMATIC WinCC RC version, V7.3/ V7.4 → V8.0										C	V	4	8		0			
	Upgrade for SIMATIC WinCC RC version, V7.5→ V8.0										C	V	5	8		0			
	Upgrade for SIMTAC WinCC RT version, V7.4/7.5 → V8.1 DL										R	V	4	8		1			
	Upgrade for SIMTAC WinCC RT version, V8.0 → V8.1 DL										R	V	5	8		1			
	Upgrade for SIMTAC WinCC RC version, V7.4/7.5 → V8.1 DL										C	V	4	8		1			
	Upgrade for SIMTAC WinCC RC version, V8.0 → V8.1 DL										C	V	5	8		1			

Table 4.1/2 SICAM SCC – Selection and Ordering Data

Description

With SICAM PAS, the Power Automation System for energy automation, you have an instrument for innovative solutions for the most varied conceptual formulations that can occur when using spatially distributed information systems.

The system is equally suitable for use with the switchgear of power utilities and in industrial plants.

SICAM PAS has been designed as a modular, open system which complies with all widely used communication standards and furthermore supports you in the implementation of project-specific automation tasks in the fields of substation automation technology and power automation.

Diverse functions for the determination and evaluation of Power Quality measured data (PQ measured data) to determine power quality supplement the possible fields of application of the SICAM PAS system.

The user-management tool ensures that configuration, operation, and system-management tasks can only be performed by authorized persons. The assignment of individual switching authorization up to the information level further enhances the security of system management. Notification functions inform you via e-mail and/or SMS about pending system incidents, fault records, and reports, such as fault-location reports.

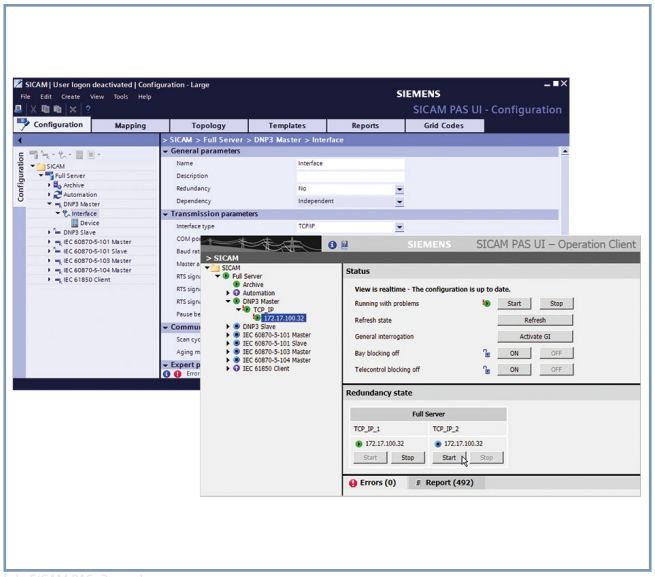
The system can be structured redundantly at the system, interface, and device levels. This approach significantly improves fail-safe operation. When communication connections are interrupted, the redundant component takes over the process connection. Depending on the transmission protocol, the process image of the redundant system is updated either continually or by means of a general interrogation upon process takeover. The DNP3i, IEC 60870-5-104, and IEC 61850 protocols permit TSL-based secure data transmission via certificates. User authentication is also supported for DNP3i. In Ethernet TCP/IP networks, switches are used for communication with terminal devices. SICAM PAS supports the SNMPv2/v3 protocols (Simple Network Management Protocol) for monitoring the operating state of the plant and for fast error detection in order to ensure operational reliability.

Benefits

- Modular and scalable hardware and software
- User-friendly
- Fulfills strict IT security requirements for use in the area of critical infrastructures
- Flexible, graphic project engineering for automation
- Openness from the use of standards

Functions

- Automation – store switching sequences such as busbar changes in SICAM PAS, make functional processes more flexible and also simultaneously increase the cost-effectiveness of your energy plants
- Remote and on-site operation – there is an option at each occasion to carry out manual operating steps – via a control center or directly on site.



[ph_SICAM PAS, 2, --]

Figure 4.2/1 SICAM PAS User Interface

- Acquisition and processing of
  - Indications
  - Measured and metered values
  - Fault records
  - Power-quality data
  - IEC 61850 Common Format for Event Data Exchange (COMFEDE files) can be logged to SIPROTEC 5 devices
- Compression and selective distribution – SICAM PAS does not just constantly collect all power-system data, SICAM PAS also handles corresponding assignment and distribution of data points to, for example control centers, HMIs, and archives
- Logging and archiving – SICAM PAS supports the storage of fault records and events in one archive. Evaluation and visualization of the archive is done via the SICAM PQ Analyzer.

Applications

SICAM PAS can be used for all applications where the following are required:

- Different communications standards and interfaces to connect bay units and substations, or to connect network control centers (Ethernet TCP/IP, serial interfaces, or OPC DA client/server, OPC XML DA server)
- Data acquisition and transmission under real-time conditions
- Secured data transmission
- Ethernet network monitoring, for example, based on SNMPv2/v3
- Dual-channel connection for enhanced availability of communication to control centers
- Data exchange via OPC DA as the connection to office desktop computers
- Realization of automation tasks

- Process visualization – Human-Machine Interface (HMI)
  - Flexible solutions for local visualization, control, archiving, and logging
  - Remove visualization, control, archiving, and logging with SICAM SCC and the SIMATIC Web Navigator
  - Visualization of process data via individually designed user interfaces such as overview diagrams, system diagrams, event lists, etc.
  - Archiving of indications and measured values
- Archiving of fault records and PDR records, as well as evaluation with the SICAM PQ Analyzer
- Archiving of events and evaluation with the SICAM PQ Analyzer
- Notification upon receipt of fault records, status changes of selected information or when creating fault-location reports
- Automatic or manual export of fault records
- Assignment of individual switching authorizations up to information level
- Secure data access via the user-management tool
- Switchgear interlocking in the case of control/remote control
- Redundant configuration of the substation level
- Test and diagnostic functions
- (Remote) visualization and control of SICAM PAS applications, interfaces, and connection to devices and control centers via SICAM PAS UI – Operation Client

SICAM PAS can be used for all applications where the following is required:

- Different communication standards and interfaces for the connection of bay devices and substations or for the connection to telecontrol centers (Ethernet TCP/IP, serial interfaces, or OPC DA Client/Server, OPC XML DA Server)
- Data acquisition and transmission under real time conditions
- Secured data transmission
- Ethernet network monitoring, for example, based on SNMPv2/v3
- Double-channel connection for enhanced availability of communication to the control centers
- Data exchange via OPC DA for connection with office computers
- Realization of automation tasks
- Process visualization - Human-Machine Interface (HMI)
  - Flexible solutions for local visualization, control, archiving, and logging
  - Remote visualization, control, archiving, and logging, using SICAM SCC and the SIMATIC Web Navigator
  - Visualization of process data via individually designed user interfaces such as overview diagrams, station diagrams, and event lists
  - Archiving of measured and metered values
- Archiving fault records and PDR records and evaluation with the SICAM PQ Analyzer
- Archiving events and evaluation with the SICAM PQ Analyzer
- Notification on the arrival of fault records, state changes of selected items of information or the completion of fault location reports
- Automatic or manual export of fault records
- Transmission of fault records from IEC 61850 devices to a control center via IEC 61850 Server
- Transmission of asset Information from IEC 61850 devices and SNMP devices to a control center via IEC 61850 Server
- Assignment of individual switching authorities down to the information level
- Secured data access via the User Administration tool
- Switchgear interlocks for telecontrolling/controlling
- Redundant structure of the substation level
- Test and diagnostic functions
- (Remote) visualization and control of SICAM PAS applications, interfaces, and connection to devices and control centers with SICAM PAS UI – Operation Client

Configuration Examples

Due to its modular system structure, SICAM PAS can be used for multiple purposes on the substation control level of interconnected control centers.

SICAM PAS can be set up in the following different variants:

- With a Full Server and SICAM SCC
- As a distributed system consisting of
  - 1 or several Full Servers
  - 1 or several DIPs (Device Interface Processor)
  - SICAM SCC

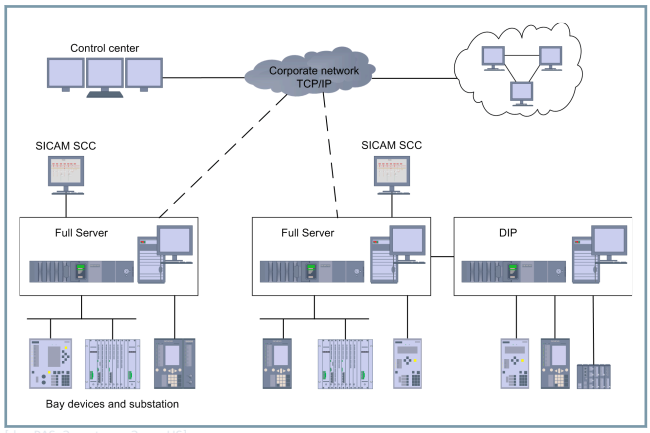
SICAM PAS systems communicate with higher-level control centers through:

- Ethernet TCP/IP (LAN/WAN)
- Serial interfaces

SICAM PAS communicates with bay devices, protection devices, and substations through:

- Ethernet TCP/IP (LAN/WAN)
- Serial interfaces
- PROFIBUS interfaces

The example below illustrates the connection of 2 SICAM PAS systems to a higher-level control center

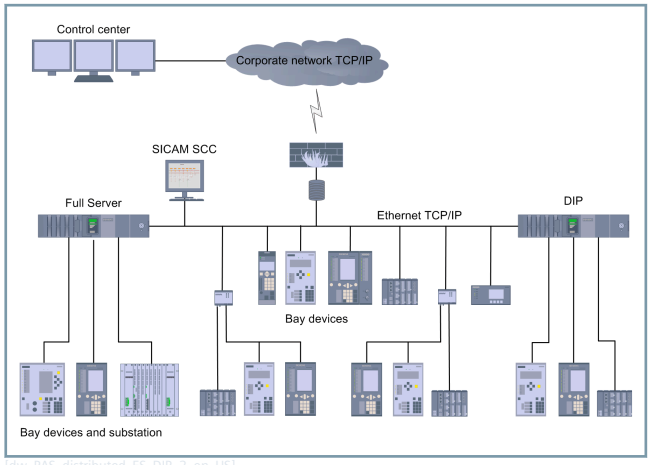


[dw_PAS_2_systems, 2, en_US]

Figure 4.2/2 Sample Configuration with 2 SICAM PAS Systems

Distributed System with Full Server and DIP

The example shows a distributed SICAM PAS system. It consists of a Full Server and DIP and communicates with a control center through TCP/IP. Bay devices and substations are connected to a distributed system through Ethernet and serial interfaces.



[dw_PAS_distributed_FS_DIP, 2, en_US]

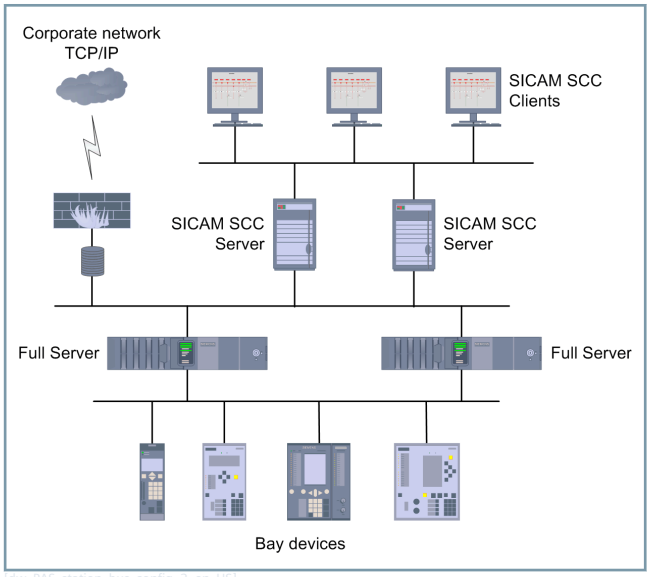
Figure 4.2/3 Example of a Distributed SICAM PAS System with Full Server and DIP

Redundant Connection of Bay Devices and Substations

SICAM PAS supports the redundant connection of bay devices and substations.

The following example illustrates the configuration:

- Redundant Full Servers
- Redundant SICAM SCC implemented in server/client architecture
- Connection of bay devices to 2 SICAM PAS stations



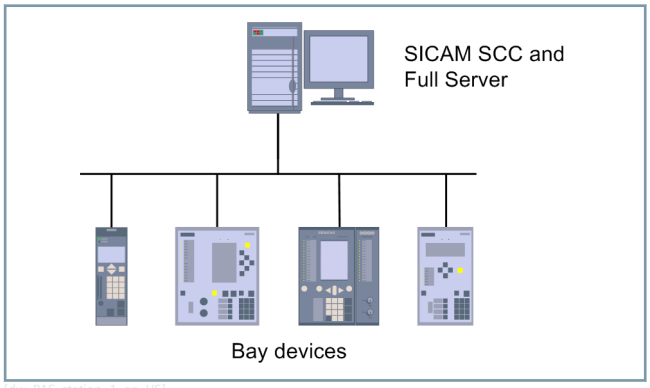
[dw_PAS_station_bus_config, 2, en_US]

Figure 4.2/4 SICAM PAS Station Bus Configuration with Redundant Connection of the Bay Devices through a Switch and Redundant SICAM SCC in Server/Client Architecture

Bay devices with 2 interfaces are required for the redundant connection of bay devices with serial communication. Alternatively, bay devices equipped with 1 interface can be connected redundantly through a modem splitter.

Configuration for Small Applications

With systems comprising up to 80 bay devices and depending on the amount of data and the complexity of the automation and HMI functionality, you can operate SICAM PAS and SICAM SCC on the same computer.

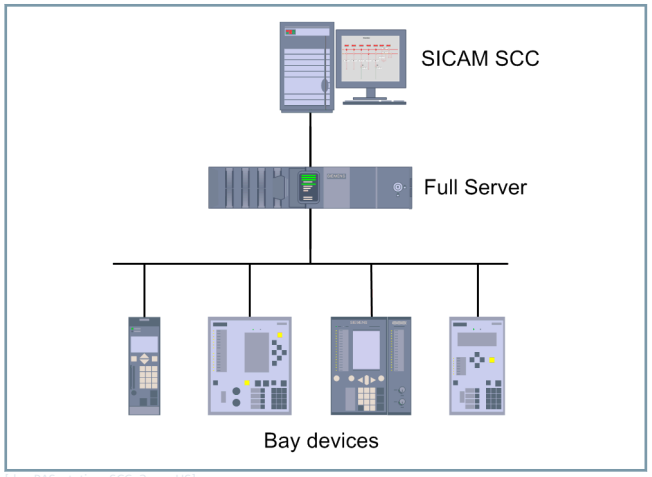


[dw_PAS_station, 1, en_US]

Figure 4.2/5 Connection of Bay Devices to SICAM PAS

Configuration for Medium Applications

If your station comprises more than approximately 80 bay devices, SICAM PAS and SICAM SCC must run on separate computers. The example below illustrates the connection of the bay devices to 1 SICAM PAS computer.



[dw_PAS_station_SCC, 2, en_US]

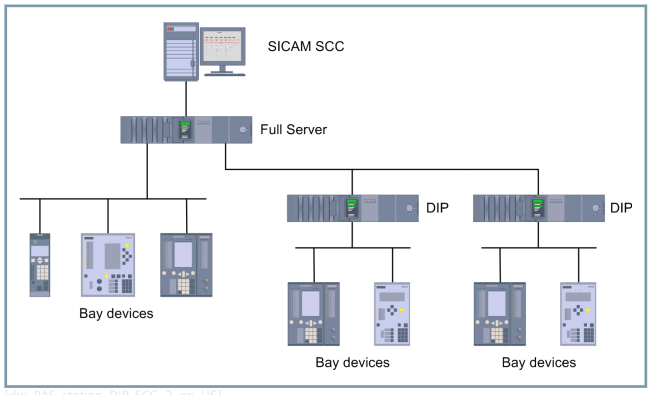
Figure 4.2/6 Connection of Bay Devices to a SICAM PAS Computer

Configuration for Large Applications

Up to 400 bay devices can be connected to 1 SICAM PAS Full Server.

In large appllications with up to 800 bay devices, SICAM PAS is implemented as a distributed system equipped with a Full Server and up to 2 DIPs.

SICAM SCC is installed on a separate computer.



[dw_PAS_station_DIP_SCC, 2, en_US]

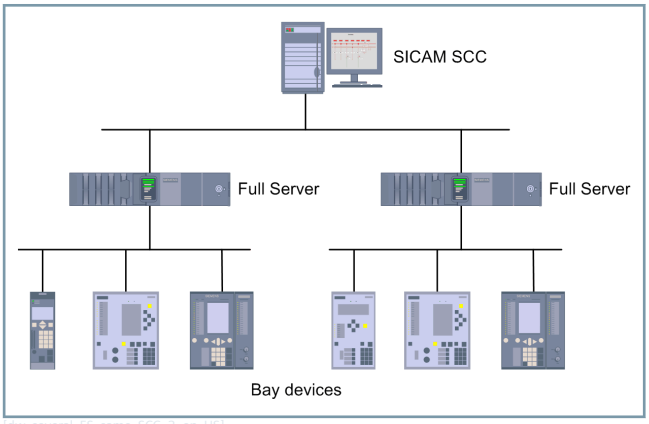
Figure 4.2/7 Connection of Bay Devices in a Distributed System

4.2

Several SICAM PAS Full Servers Connected to a Human-Machine Interface (HMI)

The following example illustrates a SICAM SCC Human-Machine Interface (HMI) with 2 SICAM PAS computers to which bay devices are connected.

This configuration makes sense in cases where no spatially distributed Human-Machine Interface and no fail-safe SICAM SCC are required.

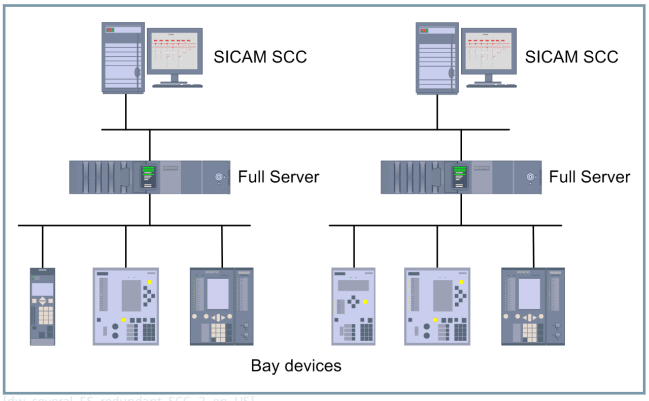


[dw_several_FS_same_SCC, 2, en_US]

Figure 4.2/8 Several Full Server Connected to the same SICAM SCC

Redundant Human-Machine Interface (HMI)

The connection of several Full Servers to a redundant SICAM SCC Human-Machine Interface represents another configuration option. This configuration enhances the system's operational reliability.

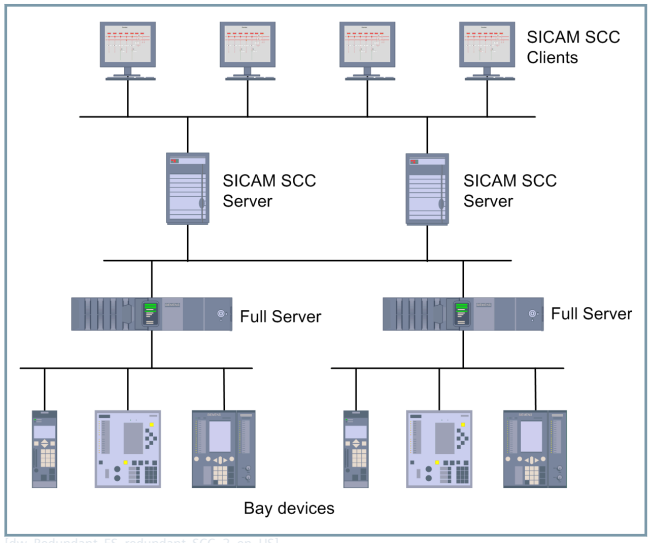


[dw_several_FS_redundant_SCC, 2, en_US]

Figure 4.2/9 Several Full Servers with Redundant SICAM SCC

Redundant Human-Machine Interface (HMI) in Server/Client Architecture

In large stations, it may be necessary to distribute station management tasks between several components. In such cases, you set up a SICAM SCC Human-Machine Interface in server/client configuration. The following example illustrates a redundant SICAM SCC comprising 2 Full Servers.



[dw_Redundant_FS_redundant_SCC, 2, en_US]

Figure 4.2/10 Redundant SICAM SCC with Redundant Full Server

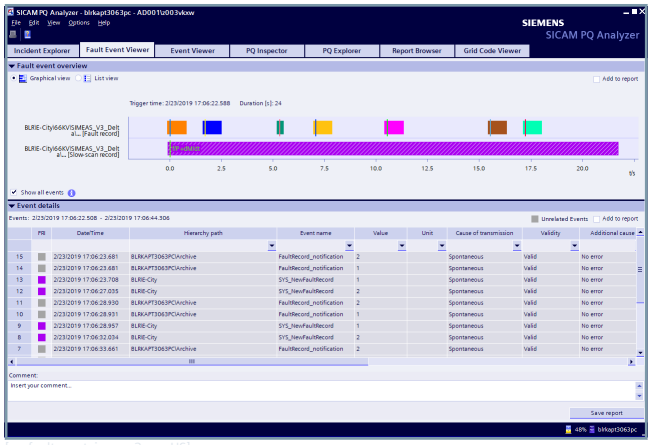
Communication Interfaces

SICAM PAS is a modularly structured system. It is open for the connection of the most versatile components, which exchange process data based on state-of-the-art communication standards.

The following data exchange options are available:

- SICAM PAS with the SICAM SCC Human-Machine Interface (HMI) via Ethernet (TCP/IP)
- SICAM PAS with bay devices and substations
- SICAM PAS with higher-level control centers
- SICAM PAS with OPC DA servers such as the SIMATIC automation system
- SICAM PAS with OPC DA clients, for example, process visualization systems of other manufacturers
- SICAM PAS with systems with OPC XML DA clients

SICAM PAS allows the user to save events, fault records, PDR records, PQ measuring data and fault location information to an archive. The archive contents can be visualized and evaluated in the various views provided by the **SICAM PQ Analyzer** installed on the same or a different computer. With the SICAM PQ Analyzer **Collector** function, the archive can be transferred to a dedicated archive computer, and the (source) archives of several SICAM PAS systems can be combined to a (Collector) archive. In addition to the **Incident Explorer** view, where the fault records are displayed in chronological order, the **Event Viewer** shows the events and the **Fault Event Viewer** shows the fault events detected by SICAM PAS (that is several fault records from different protection devices captured in a predefined, tight time slot). In the **Incident Explorer**, the fault records are sorted into the (device) configuration tree or the (process) topology tree depending on the respective selection.



[sc_faulteventviewer, 2, en_US]

Figure 4.2/11 SICAM PQ Analyzer – Fault Event Viewer

SICAM PAS can also integrate additional PQS functions for the evaluation of PQ measuring data. These include a connection option for third-party devices, which provide fault records or PQ measuring data and the automatic export of fault records (with file naming vonvention IEEE Std. C37.232-2011), messages during a fault (<=> fault log), reports, or PQ data.

The SNMP protocol allows you to monitor the communication links of the switches connected through Ethernet network.

In order to perform **asset monitoring** tasks, SICAM PAS provides an SNMPv3 agent which makes available asset information, for example, the product name, product version, as well as project-specific product applications, to an SNMP client.

In order to perform **security notification** tasks, SICAM PAS provides an SNMPv3 agent to store security related logs, for example, start/stop of system componenets, modification in the archive (import records, import PQDIF, delete records, delete reports, add or edit traffic lights) available as information and traps for the SNMPv3 client. In addition, the spontaneous transmission of safety-relevant events is supported.

Following protocols are included in the basic license:

- SNMP client and agent
- OPC DA servers
- Communication with SICAM MIC RTU (CP-8000, CP-8021/22) based on IEC 60870-5-104
- SIPROTEC 4 service interface master
- SIMEAS R master and SICAM Q80 master
- IEC 61850 GOOSE monitoring and publisher
- Event list/fault events

Via the system's communication interfaces, you can connect SICAM PAS to:

- Higher-level control centers
- Bay devices and substations
- Components for data exchange with industrial automation systems, such as SIMATIC

Communication with Higher-Level Control Centers

Communication takes place via the following protocols:

- IEC 61850 Server [29]
- IEC 60870-5-104 Slave
- IEC 60870-5-101 Slave
- DNP3 Slave (serial, TCP/IP)
- Modbus Slave (serial, TCP/IP)
- Telegyr 8979 Slave
- CDT Slave

Connection of Bay Devices and Substations

Communication takes place via the following protocols:

- IEC 61850 Client, GOOSE status monitoring
- IEC 61850 Server, GOOSE Publisher
- IEC 60870-5-103 Master
- IEC 60870-5-104 Master
- IEC 60870-5-101 Master
- SICAM MIC Master
- DNP3 Master (serial, TCP/IP)
- Modbus Master (serial, TCP/IP)
- PROFIBUS DP Master
- PROFINET IO Master
- SINAUT LSA ILSA Master
- SIPROTEC 4 Service IF Master (fault records)

OPC Connection

- OPC XML DA Server
  Exchange of structured information via Internet in XML format
- OPC Server (DA V3.0)
  Data exchange with OPC clients of other applications, for example, process visualization systems
- OPC Client (DA V3.0)
  Data exchange with any OPC server of other applications, for example, automation systems or other manufacturers' protocol drivers

4.2

IEC 61850

The communication standard for the IEC 61850 station bus is based on Ethernet TCP/IP.

The optional use of TLS (Transport Layer Security) provides additional security during data transmission.

IEC 61850 defines the communication and the exchange of configuration data between bay devices and substations from different manufacturers. Based on the IEC 61850 GOOSE mechanism, bay devices can directly exchange data - independently of the operating state of the substation controller. This cross communication enables for example, the implementation of bay-independent interlocks on the device level.

The state of the IED GOOSE server can be monitored via SICAM PAS and visualized via the SICAM PAS UI – Operation Client Web user interface without the need for additional engineering.

The IEC 61850 Server – GOOSE Publisher enables the transmission of data from other station components (for example, devices connected via IEC 60870-5-103, -101, ...) or from the SoftPLC (Automation) to the IED GOOSE server.

Depending on the project requirements, the IEC 61850 station bus based on Ethernet TCP/IP can be realized in different configurations:

- Star configuration, electrical variant
- Ring structures, optical variant
- Combination of star and ring structures
- Redundant LAN with seamless operation (Parallel Redundancy Protocol – PRP)

Through their integrated communication modules, SIPROTEC 4 and SIPROTEC 5 devices can be incorporated directly into an Ethernet ring. External switches are not required.

In a ring structure, a redundancy mechanism (Rapid Spanning Tree Protocol – RSTP, High-availability Seamless Redundancy – HSR) ensures that the communication to the devices is maintained even in case of a communication interruption in a ring segment or in case of failure of a device in the ring.

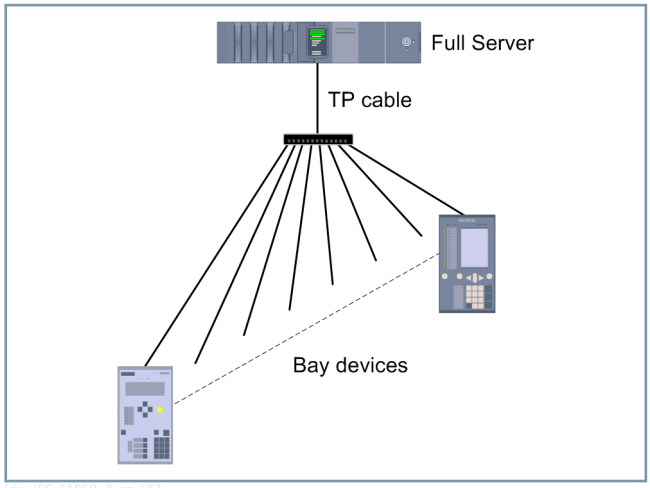
For the connection of other devices to this ring, for example, an industrial PC or third-party devices, Siemens recommends the use of switches manufactured by Siemens, Scalance/Ruggedcom or Hirschmann. The switches used in ring structures must originate from the same manufacturer.

The following paragraphs explain the principal communication configurations for the IEC 61850 connection.

The following connection type is used for stations in which SICAM PAS and the devices connected through a switch are located close to each other.

29 Fault records from IEC 61850 protection devices as well as asset information from devices connected with IEC 61850 or SNMP can be transmitted to higher-level control centers with IEC 61850 Server.

The connection of the bay devices to a switch can be realized either electrically or through FO. For an electrical connection, shielded copper Twisted Pair (TP) cables are required. The cable between the switch and the device must not exceed 20 m in length.

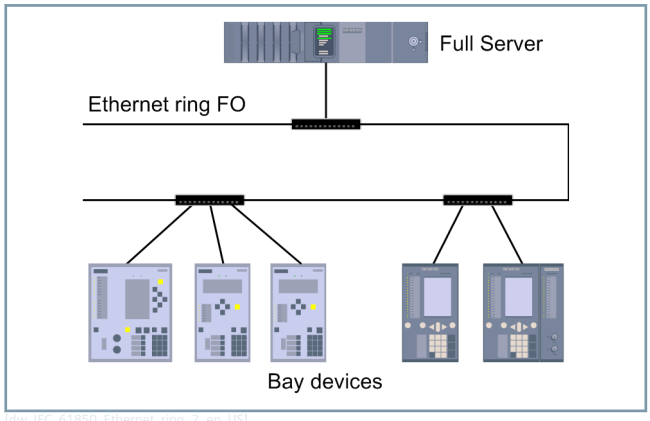


[dw_IEC_61850, 2, en_US]

Figure 4.2/12 IEC 61850 Connection Example

If larger distances have to be overcome or if a larger number of devices have to be connected, the configuration shown below should be considered.

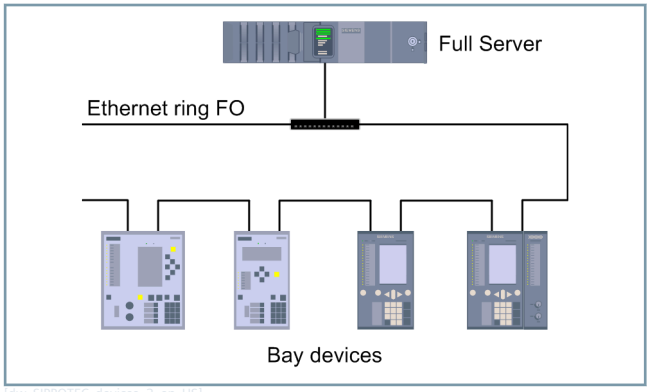
The example below illustrates the connection of bay devices to an Ethernet ring through switches.



[dw_IEC_61850_Ethernet_ring, 2, en_US]

Figure 4.2/13 IEC 61850 Connection Example to an Ethernet Ring through Switches

The example below illustrates the direct connection (without additional switches) of SIPROTEC 4 and SIPROTEC 5 devices which are equipped with Ethernet communication modules.



[dw_SIPROTEC_devices, 2, en_US]

Figure 4.2/14 Connection Example – SIPROTEC 4 and SIPROTEC 5 Devices

IEC 60870-5-103

The IEC 60870-5-103 protocol is supported by the protection and bay devices of numerous manufacturers. For example, SIPROTEC devices, SICAM T, SICAM P850/855, or transformer controllers manufactured by Eberle or Reinhausen can be connected to SICAM PAS.

IEC 60870-5-104

The IEC 60870-5-104 protocol is used for the connection of bay devices and SICAM PAS at the station level using Ethernet TCP/IP.

The optional use of TLS (Transport Layer Security) provides additional security during data transmission.

IEC 60870-5-101

The IEC 60870-5-101 protocol is used for the connection of substations to SICAM PAS through a serial COM port or a modem connection.

The connection through a **COM port** allows the operating modes **balanced** for point-to-point configuration and **unbalanced** for line operation with up to 16 substations.

Modems (IAWD, analog, ISDN, GSM dial-up mode) with the capability of being staggered enable line operation.

If a modem is busy communicating with another substation or if a modem has failed, a configured spare modem automatically takes over the communication.

Siemens recommends the use of INSYS modems.

DNP3

The DNP3 protocol is used for the connection of bay devices and substations to SICAM PAS through Ethernet TCP/IP or serial interfaces.

The optional use of TLS (Transport Layer Security) and authentication provides additional security during data transmission. TLS can only be used if DNP3 protocol is communicating through Ethernet TCP/IP.

Modbus

The Modbus standard is used in the field of automation engineering and supported by distributed I/Os.

The communication can be performed through Ethernet TCP/IP or serial interfaces.

PROFIBUS DP

The PROFIBUS DP bay bus standard is frequently used in the field of automation engineering and supported by distributed I/Os.

The devices equipped with a PROFIBUS DP interface (DPV0), such as SIMEAS P, ET200, or SIPROTEC 4 devices, can be connected to SICAM PAS.

For the connection of PROFIBUS DP devices, Siemens recommends the use of PROFIBUS components manufactured by Siemens (for example, OLM for fiber-optic connections).

PROFINET IO

The PROFINET IO bay bus standard is used in the field of automation engineering and supported by distributed I/Os.

The devices equipped with a PROFINET IO interface, such as ET200, can be connected to SICAM PAS.

The following applies for the connection to SICAM PAS:

- A separate Ethernet module must be used for PROFINET IO.
- The PROFINET configuration is configured using the TIA Portal (≥ SIMATIC Step7 V13 SP1).
- The XML file exported via the TIA Portal is imported using SICAM PAS UI – Configuration.

Additional Station Control Functions

During, for example, maintenance work or for other system-management reasons, information exchange with the control centers or the station itself can be blocked with the **telecontrol blocking** and **bay blocking** functions. You can also configure the telecontrol blocking in a channel-specific manner so that information transmission to a control center can be blocked during operation whilst transmission to other control centers remains unaffected. Bay and telecontrol blocking have an effect in signaling and command direction.

Channel-specific **switching authority** permits distinction between local control (SICAM SCC) and remote control as well as between network control center connections to be made for the control direction.

In addition, you can declare information-specific exceptions for these 3 functions. This permits, for example, certain messages to be transferred despite an activated blocking, or special commands to be processed and output despite a defined switching authority.

There is also an option for an object-specific blocking (individual indication or measured values). Blocked data points (bay blocking, object-specific blocking) or those with an invalid status can also be updated with a substitute value by the operator so that all other recipients (control centers, automation) receive the correct state.

While a 1-of-N check is effective in the individual bay units (this means that only one command is accepted and output at the same time), m-out-of-n control is supported with SICAM PAS on the substation-automation technology side. This permits the number of commands that may be processed simultaneously across the bay units to be defined. Synchronized/unsynchronized control of circuit breaker is possible.

Triggered by an event, the SICAM PAS option **Post Disturbance Review (PDR)** records the status changes of messages and measured values over a period of up to 6 min. The trigger event, the length of the time frame (including 1 min pre-trigger time) and the information objects to be recorded can be parameterized. The resulting disturbance data file is archived. Graphical and tabular evaluation is possible in the Incident Explorer of the SICAM PQ Analyzer.

Automation tasks can be configured in SICAM PAS with the IEC 61131-compliant CFC (Continuous Function Chart). In this editor, the task is resolved graphically by circuiting function blocks. The SICAM PAS scope of delivery includes a large library of CFC function blocks that have been developed and system-tested specifically for power automation. The field of application stretches from group-indication generation via switchgear interlocking up to complex switching sequences. The SFC (Sequential Function Chart) editor supports the creation of switching sequences. In this context, additional preconfigured and system-tested applications, such as frequency-based load shedding, transformer monitoring, and SF6 gas monitor can optionally be licensed. In addition to special function blocks and CFC diagrams, the scope of delivery also includes operation images for SICAM SCC.

If the SICAM PAS station is to take over the **time synchronization** of bay units, substations and SICAM SCC, this can be done via a DCF77 or GPS time-signal receiver with the Network Time Protocol (NTP) or with the IEEE 1588 Precision Time Protocol (PTP) in the computer. Time synchronization of the SICAM PAS system components is also possible from a network control center.

SICAM PAS Applications

SICAM PAS Applications reduces the effort and the technical risk during the implementation of selected automation task in accordance with the automation standard IEC 61131-3, and provides finished applications from automation practice as an enhancement of SICAM PAS.

Redundancy

SICAM PAS contains large redundancy functions to increase the availability of station automation:

- The substation controller can be used twice.
- Communication to bay units and RTUs can be redundant (interface redundancy).
- The network (LAN) can be redundant (PRP).

- Subordinate devices can be duplicated (redundancy at bay-control level).
- Subdevices can be supported that have been designed for communication with only one master (only one serial interface, for example).

The individual applications (communication protocols) work independently of each other in a hot standby relationship. This means that a fault-related switchover (such as switching the IEC 61850 Client from one substation controller to another one) does not have any loading effect on the communication connection to the control center. This connection remains without interruption on the first substation controller. In addition to increased stability in unaffected communication connections, redundancy switchover of affected components is performed within a very short time (depending on application and configuration, between 250 ms and max. 3 s). Adjustments during operation, such as bay and telecontrol blocking, switching authorities, marker commands to the SoftPLC for an operation-related control of the automation functions are kept synchronous in redundancy operation in both substation controllers. The current settings remain valid after redundancy switchover. SICAM SCC communicates simultaneously with both redundant substation controllers. Redundant operation of process visualization with SICAM SCC and of fault recording archiving with SICAM PQ Analyzer (independent of SICAM PAS) is also possible.

SICAM PAS Compact

The SICAM PAS Compact package contains the functionality of the Runtime & Configuration base package supporting up to 2000 master-information objects, up to 4 optional communication protocols, as well as automation with SoftPLC. SICAM PAS Compact can be enhanced with options and add-ons.

Multilanguage Manager Tool

The Multilanguage Manager Tool can be used to translate the SICAM PAS/PQS user interface and the language of the runtime system. The repository with the translated text is integrated into the installed product.

The Multilanguage Manager Tool is installed together with SICAM PAS/PQS and/or SICAM PQ Analyzer. It does not require a licensed version of SICAM PAS/PQS. A project can only be created to check the translation when SICAM PAS/PQS is installed as a demo version or as a licensed version.

Security

SICAM PAS Secure Communication enables tap-proof data traffic via a TCP/IP connection between SICAM PAS and a control center or device. The asymmetrical TLS-based encryption method is used for this purpose.

In addition, an authentication procedure can be set up for DNP3i protocol in order to clearly determine the user's identity before executing critical tasks.

Secure communication is possible with the following communication protocols:

- DNP3i Master/Slave
  Both TLS conform to the IEC 62351-5 standard and authentication can be set up.
  DNP3 Slave secure authentication conforms to Secure Authentication SAv5 based on IEEE Std 1815-2012.
- IEC 60870-5-104 Master/Slave
  TLS conform to the IEC 62351-5 standard can be set up.
- IEC 61850 Client/Server
  TLS conform to the IEC 62351-4 standard can be set up.

Via the **SICAM PAS User Administration**, you can assign passwords in order to define which persons can access individual programs conform to the IEC 62351-8 standard. To this end, you assign different user roles, such as administrator, data engineer or operating personnel. For access authorization, you can either use Windows access rights or define your own SICAM PAS access rights.

Security related logs, for example, user login/logout, start/stop of system components, modifications in the archive (import records, import PQDIF, delete records, delete reports, add or edit traffic lights), are displayed in the **Windows Event Viewer** in the **PASSecurity** and **PQ Analyzer Security** folders.

Use **Syslog** conform to the IEC 62351-14 (Draft) standard to collect the security related logs of the applications within a system on a syslog server.

Use **Enable security notification** to generate these security related logs of the applications within a system as traps to SNMP manager.

Safety-relevant events can also be transmitted to an SNMP client using the SNMP agent.

When installing SICAM PAS for the first time, Windows user groups are added to provide a role-based access control for the archive (**RBAC** conform to the IEC 62351-8 standard) to perform various operations for the archive data.

Software and Hardware Requirements

One of the following operating systems is required:

- Windows 11 Professional/Enterprise/IoT Enterprise LTSC (64-bit)
- Windows Server 2022 Standard with Desktop Experience (64-bit)

Computer equipped with:

- Processor:
  - Minimum: Intel Core 2 Duo 1.6 GHz
  - Recommended: Quad Core CPU 3 GHz
- Primary storage capacity:
  - Minimum: 2 GB
  - Recommended for engineering of large stations: ≥ 8 GB
- Hard disk capacity:
  - Minimum: 4 GB plus configured archive size

SICAM PAS – Software and Hardware Requirements

- Graphics card:
  - Minimum: 1024 x 768 pixel
  - Recommended: 1920 x 1080 pixel
- Monitor suitable for graphics card
- DVD drive
- Keyboard
- Mouse
- Network interface
- USB port

SICAM PAS/PQS is released for computers with multi-core processors. Computers with multi-processor main boards are supported when working in single-processor mode.

Selection and Ordering Data

Description	Variants	Order No.															
		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
SICAM PAS/PQS licensed with ALM is only delivered electronically (OSD = Online Software Delivery). The MLFB position 8 with value 3 defines the ALM license type.									▲								
ALM license									3								
SICAM PAS/PQS UI Configuration																	
	UI Configuration	6	M	D	9	0	0	0	–	3	A	A	2	0	–	8	A	A	0
Features/log, licensed with SICAM PAS Compact and SICAM PAS/PQS RT (basic package and bundles)																	
	SIPROTEC 4 service interface master, SNMP protocol client, SNMP protocol agent, SIMEAS R master, SICAM Q80 master, OPC DA server, IEC 61850 GOOSE monitoring, IEC 61850 GOOSE publisher (SICAM PAS only (incl. control direction)), event list/fault events																
SICAM PAS Compact		6	M	D	9	0	2	0	–	3	M	A	1	0	–	8	A	A	0
	Runtime (RT) supports the following: ● Up to 4 communication protocols ● Max. 2000 master information objects (cannot be upgraded) ● Control and monitoring direction ● Automation ● UI configuration It can be expanded with the options: ● "n" protocols (protocol-independent) ● "n" (PQ) applications (application-independent) ● Secure communication																
SICAM PAS Basic Package																	
Runtime (control and monitoring direction), IEC 61850 client																	
	Small (up to 4 devices)	6	M	D	9	0	0	0	–	3	R	A	1	0	–	8	D	A	0
	Medium (up to 2000 master information objects)	6	M	D	9	0	0	0	–	3	M	A	1	0	–	8	D	A	0
	Large (up to 180 devices)	6	M	D	9	0	0	0	–	3	A	A	1	0	–	8	D	A	0
	XLarge (more than 180 devices)	6	M	D	9	0	0	0	–	3	B	A	1	0	–	8	D	A	0
SICAM PAS Bundles – Large																	
Runtime (control and monitoring direction), supports up to 180 devices, automation, IEC 61850 client, and additional **n** protocols																	
	Large with automation, IEC 61850 client, and additional n=2 protocols	6	M	D	9	0	0	0	–	3	A	L	0	2	–	8	A	A	0
	Large with automation, IEC 61850 client, and additional n=3 protocols	6	M	D	9	0	0	0	–	3	A	L	0	3	–	8	A	A	0
	Large with automation, IEC 61850 client, and additional n=5 protocols	6	M	D	9	0	0	0	–	3	A	L	0	5	–	8	A	A	0

Table 4.2/1 SICAM PAS Selection and Ordering Data ≥ Version 8.17

Description	Variants	Order No.																
		1	2	3	4	5	6	7		8	9	10	11	12		13	14	15	16
Upgrades																			
Functional upgrades with respect to the supported number of devices																			
	RT upgrade to medium (from small)	6	M	D	9	0	0	4	–	3	M	A	1	0	–	8	A	A	0
	Prerequisite	6	M	D	9	0	0	0	–	3	R	A	1	0	–	8	D	A	0
		7	K	E	9	0	0	0	–	3	R	A	1	0	–	8	D	A	0
	RT upgrade to large (from medium)	6	M	D	9	0	0	4	–	3	A	A	1	0	–	8	A	A	0
	Prerequisite	6	M	D	9	0	0	0	–	3	M	A	1	0	–	8	D	A	0
		7	K	E	9	0	0	0	–	3	M	A	1	0	–	8	D	A	0
	RT upgrade to XLarge (from large)	6	M	D	9	0	0	4	–	3	B	A	1	0	–	8	A	A	0
	Prerequisite	6	M	D	9	0	0	0	–	3	A	A	1	0	–	8	D	A	0
		7	K	E	9	0	0	0	–	3	A	A	1	0	–	8	D	A	0
		6	M	D	9	0	0	0	–	3	A	L	0	0	–	8	A	A	0
		7	K	E	9	0	0	0	–	3	A	L	0	0	–	8	A	A	0
Version upgrade – the initial order must be referenced in the order)																			
	SICAM PAS/PQS upgrade to V8.xx	6	M	D	9	0	0	3	–	3	A	A	0	0	–	8	A	A	0
Protocols that must be licensed with an **"n" protocols** license (For options and add-ons, refer to *Table 4.2/3*)																			
Master/client protocols																			
	IEC 60870-5-101, IEC 60870-5-104, IEC 60870-5-103, Modbus, DNP3, SINAUT LSA – ILSA, Driver Module for PROFIBUS DP, PROFINET IO, OPC DA																		
Slave/server protocols																			
	IEC 61850 Server, IEC 60870-5-101, IEC 60870-5-104, Modbus, DNP3, CDT, TG8979, OPC XML-DA Server																		
(PQ) applications that must be licensed with an **"n" (PQ) applications** license (For options and add-ons, refer to *Table 4.2/3*)																			
	Automatic COMTRADE import, automatic COMTRADE export, automatic PQDif import, automatic PQ data export, automatic report export, automatic fault-location determination, automatic GridCode evaluation, notifications (email, SMS), scheduled PQ reports, PDR (Post Disturbance Review)																		

Table 4.2/2 SICAM PAS Selection and Ordering Data ≥ Version 8.17

Description	Variants	Order No.																
		1	2	3	4	5	6	7		8	9	10	11	12		13	14	15	16
Options & Add-ons																			
Applications (Power Automation)																			
	1 protocol (protocol-independent, countable)	6	M	D	9	0	0	0	–	3	S	A	0	1	–	8	A	A	0
	2 protocols (protocol-independent, countable)	6	M	D	9	0	0	0	–	3	S	A	0	2	–	8	A	A	0
	3 protocols (protocol-independent, countable)	6	M	D	9	0	0	0	–	3	S	A	0	3	–	8	A	A	0
	4 protocols (protocol-independent, countable)	6	M	D	9	0	0	0	–	3	S	A	0	4	–	8	A	A	0
	5 protocols (protocol-independent, countable)	6	M	D	9	0	0	0	–	3	S	A	0	5	–	8	A	A	0
	SoftPLC automation	6	M	D	9	0	0	0	–	3	B	A	5	0	–	8	A	A	0
	Secure communication (TLS)	6	M	D	9	0	0	0	–	3	S	C	0	0	–	8	A	A	0
(PQ) applications (Power Quality)																			
	1 (PQ) application (application-independent, countable)	7	K	E	9	0	0	0	–	3	P	A	0	1	–	8	A	A	0
	2 (PQ) applications (application-independent, countable)	7	K	E	9	0	0	0	–	3	P	A	0	2	–	8	A	A	0
	3 (PQ) applications (application-independent, countable)	7	K	E	9	0	0	0	–	3	P	A	0	3	–	8	A	A	0
	4 (PQ) applications (application-independent, countable)	7	K	E	9	0	0	0	–	3	P	A	0	4	–	8	A	A	0
	5 (PQ) applications (application-independent, countable)	7	K	E	9	0	0	0	–	3	P	A	0	5	–	8	A	A	0

Table 4.2/3 SICAM PAS Selection and Ordering Data ≥ Version 8.17

Hint:

- Additional computers with DIP installation:
  DIP installations must be licensed with at least 1 application license (for example 1 protocol (6MD9000-3SA01-8AA0)). This also applies to DIPs that are only used with license-free protocols.

Order Examples

Example 1:

SICAM PAS is required for up to 2000 master information objects incl. automation and in addition to the IEC 61850 client 3 protocols must be supported (for example IEC 6070-5-103 master, Modbus master and IEC 60870-5-104 slave). In future, the system must be expandable for more than 2000 master information objects. The following MLFB numbers must be ordered:

Description	Order No.
Medium (up to 2000 master information objects)	6MD900–3MA10–8DAA0
SoftPLC automation	6MD900–3BA50–8AAA0
3 protocols (protocol-independent, countable)	6MD900–3SA03–8AAA0

Example 2:

SICAM PAS is required for up to 180 devices including automation and in addition to the IEC 61850 client, 4 protocols must be supported (e.g. IEC6070-5-103 master, Modbus master and IEC 60870-5-104 slave, DNP3 slave). The following MLFB numbers must be ordered:

Description	Order No.
Large with automation, IEC 61850 client and additional n=3 protocols	6MD900–3AL03–8AAA0
1 protocol (protocol-independent, countable)	6MD900–3SA01–8AAA0

Example 3:

SICAM PAS is required for more than 180 devices incl. automation and in addition to the IEC61850 client, 2 protocols must be supported (for example IEC 6070-5-103 master and IEC 60870-5-101 slave). The following MLFB numbers must be ordered:

Description	Order No.
XLarge (more than 180 devices)	6MD900–3BA10–8AAA0
SoftPLC automation	6MD900–3BA50–8AAA0
2 protocols (protocol-independent, countable)	6MD900–3SA02–8AAA0

It becomes apparent during the project that IEC 60870-5-104 is required, instead of IEC 60870-5-101 that has been adopted. This does not affect the order as the licenses are protocol-independent <=> it is not needed to be replaced.

Example 4:

For example, the following bundle was ordered first

Description	Order No.
Large with automation, IEC 61850 client and additional n=2 protocols	6MD900–3AL02–8AAA0

Then it becomes apparent that 2 additional protocols need to be supported. In this case, you can order the following at a later date:

Description	Order No.
2 protocols (protocol-independent, countable)	6MD900–3SA02–8AAA0

4 (2+2) protocols can be supported as the protocol licenses are countable.

Description

SICAM PAS/PQS has been designed as a modular system with open communication interfaces. It thus meets the requirements of state-of-the-art substation control and protection systems and of the power management systems required for industrial manufacturing plants. Functions for power quality evaluation complement its versatile fields of application.

The system component **SICAM PAS UI – Configuration** is responsible for:

- Configuration and parameterization of your plant
- Exchange of configuration data

The clearly structured configuration interface provides you with a comprehensive overview of your plant's parameters.

Individual user interface elements can be displayed in a user-specific manner or hidden. For example, table columns which are permanently required can be fixed in position in the individual view; table columns which are not needed can simply be hidden. The settings are also maintained after a restart of the program.

Import and export functions enable data exchange. In this way, expenditure and the tendency to commit errors during system configuration and parameterization can be reduced.

Due to the use of conversion routines, the project data of a SINAUT LSA plant or with older versions of SICAM PAS UI – Configuration generated data can continue to be used.

Predefined device templates, sorting and filter options, copy functions and the processing of parameters in Microsoft Excel increase transparency and flexibility and thus make parameterization more user-friendly.

Plant-specific automation functions are configured via a graphical interface. You can use both standard logic functions and automation blocks specifically developed for the implementation of your power automation tasks.

Your parameter entries are immediately checked for plausibility.

Tooltips provide information on the permissible values or the range of values of a parameter. Explanations on the selected parameter are provided in an information field.

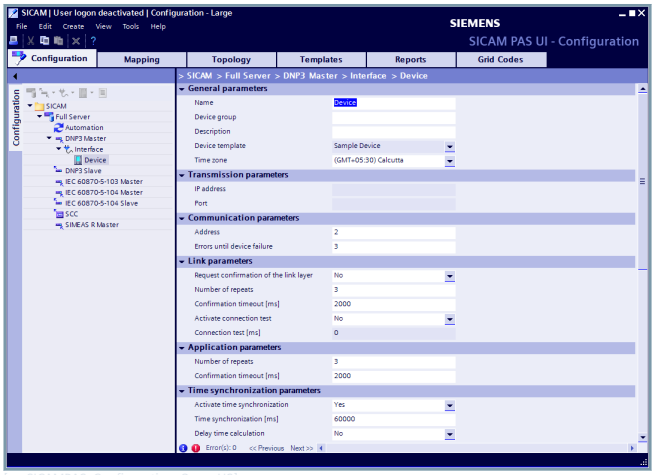
The cause of a setting error is displayed in the error field.

In addition, you are supported by a context-sensitive online help.

The configured and parameterized data does not have to be explicitly generated for the runtime environment.

You can create documentation for your project via the station documentation function. To do this, you can choose between different selection criteria, for example, selection according to individual views (configuration, mapping, topology, etc.) or routed values only. Specific areas of a selected view can be printed out, for example, the routing of individual devices or of a control-center connection.

The project statistics give you an overview of the scope and use of the parameterized information.



[sc_SICAMPAS_Configuration, 2, en_US]

Figure 4.3/1 Configuration of SICAM PAS

SICAM PAS UI – Configuration structures the parameters in the following views:

- Configuration
- Mapping
- Topology
- Templates

In the views **Reports** and **Grid codes**, you can set the parameters of specific power quality functions. You can find further information in the *manuals* **SICAM PQS, SICAM PQS Overview** and **SICAM PQ Analyzer**.

SICAM PAS/PQS UI – Operation

SICAM PAS/PQS UI – Operation can be used to activate and deactivate the individual components, set a bay blocking or telecontrol blocking and update device information. In redundant systems, you can see which component is active. The components can be switched over with SICAM PAS/PQS UI – Operation, such as the interface for the communication to devices or network control centers.

SICAM PAS/PQS UI – Operation Client

With SICAM PAS/PQS UI – Operation Client you can start and stop all redundant connections independently of each other. SICAM PAS/PQS UI – Operation Client provides the functions of SICAM PAS/PQS UI – Operation from a local or remote computer with improved performance via an Internet browser.

There are hints for possible causes for defect for the diagnosis of pending failures.

Value Viewer

With intact communication connections, the Value Viewer shows the information of the selected device or the selected substation. This information view can be used, for example, during commissioning to test data connections and to check whether an interface or a device transfers correct values. A detailed time stamp shows the reliability of the values. For test purposes, you can initiate password-protected command outputs or update information.

You can find further information in the *SICAM PAS/PQS –Configuration and Operation manual*.

Selection and Ordering Data

You can find the selection and ordering data for SICAM PAS UI in the chapter SICAM PAS – *Selection and Ordering Data, Page 91*.

Description

The generation of fault records is an important function of digital protection devices. Fault records support the precise analysis of critical events in the power system. For this task, it has proven its worth for fault records to be retrieved via the station communication of the protection devices and for these to be stored on a hard disk the at station level. Serial communication to digital protection devices was originally standardized in IEC 60870-5-103. Currently, the new standard for communication in power generation and power distribution plants (IEC 61850) has considerably extended and modernized the options for data exchange with instrumentation and control devices.

SICAM DISTO (disturbance data storage) is a software package that detects new fault records in the connected devices, lists these and stores them in preconfigured directories on the hard disk of a PC. In order to support easy evaluation with different software tools, DISTO uses the standardized COMTRADE-format 91 and 99 in accordance with IEC 60255-24 for the files of the fault records. Files that need to be transmitted via IEC 60870-5-103 have to be converted by DISTO into COMTRADE. With IEC 61850, the files arrive in the right format. Some protection devices transmit the COMTRADE files compressed in zip files via IEC 61850. SICAM DISTO detects such files and unpacks them into the correct directories. Basically, with IEC 61850, SICAM DISTO expects the fault record transmissions via MMS. The function variant File Transfer Protocol (FTP) is not supported.

When using IEC 60870-5-103, DISTO additionally creates an event list with all protection-relevant information such as fault record number and fault location, both with absolute and relative real time (within one fault). The stored files contain the temporal behavior of currents and voltages before, during and after a system incident, supplemented with digital events (for example, protection tripping). This data can be represented graphically on the screen and analyzed with the help of SIGRA or other software packages.

For access to station communication, DISTO requires an installed SICAM SCC and its integrated communication drivers. Remote access to the stored files can take place with the standard tools of the operating system.

SICAM DISTO is available for the following system platforms:

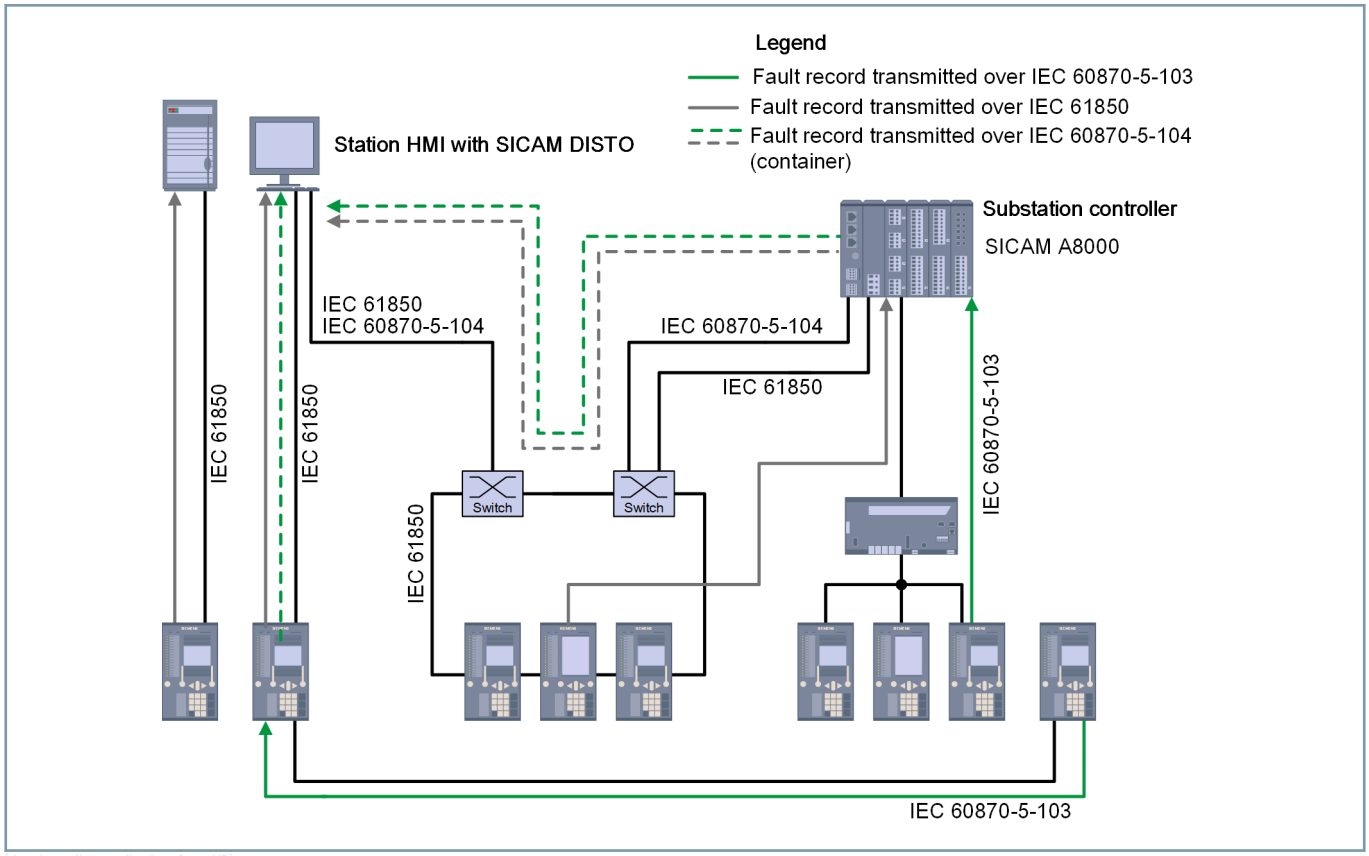
SICAM DISTO/OS	Microsoft Windows 10 Professional	Microsoft Windows 10 Enterprise	Microsoft Windows 11	Microsoft Windows Server 2012 R2	Microsoft Windows Server 2016	Microsoft Windows Server 2019	Microsoft Windows Server 2022
V3.40	■	■	■	■	■	■	■

Table 4.4/1 Overview of Basic System - Windows

Platform-dependent differences only exist with the system requirements. In part, there are also visual differences between the different platforms; there are no functional differences. The host system is used as an interface to the automation system, that is, all those interfaces that the respective host system offers to the automation system can also be used to transfer fault record data.

Dependent on the utilized platform, there are various requirements that have to be fulfilled in order to commence the installation of SICAM DISTO.

SICAM DISTO also provides the option of storing the data in an archive that is supported by the PQ collector to ensure that the fault records can be displayed and evaluated in the SICAM PQ Analyzer – Incident Explorer.



[dw_sicam-disto-application, 4, en_US]

Figure 4.4/1 SICAM DISTO, Example Configuration

Selection and Ordering Data

Description	Versions	Order no.
SICAM DISTO	VZ2-014--	6 M F 1 8 2 7 – 0 C A 1 4 – 0 A H 1

Table 4.4/2 SICAM DISTO Selection and Ordering Data

Description

The IEC 61850 System Configurator is the manufacturer-independent solution for the interoperable engineering of IEC 61850 products and systems. It supports all devices with IEC 61850, not just Siemens products – like SIPROTEC 5, SIPROTEC 4, SIPROTEC Compact, Reyrolle, SICAM RTUs, SICAM IO/AI/P85x/Q200 – but also devices from other Siemens divisions (such as SITRAS PRO) or from third parties.

The IEC 61850 System Configurator supports the SCL configuration files (substation configuration language) from the IEC 61850-6 through import or export of all formats (ICD/IID/CID/SCD/SSD/SED). Thus, IEC 61850 devices can be added and a complete IEC 61850 station is available for substation automation technology.

IEDs from the IEC 61850 standard of Edition 1, 2.0, or 2.1 are supported. The possible engineering therefore includes not only GOOSE communication and client-server configuration via MMS reporting, but also system topology, process bus communication with SMV (sampled measured values) and IEC 60870-5-104 addresses for the gateway to the network control center via IEC 61850-8-1.

Simple engineering thanks to customer-friendly workflows and the universal display of IEC 61850 addresses as well as customer description texts. Users with basic or expert IEC 61850 knowledge find the desired level of detail. For documentation purposes, the engineering can be displayed in the Web browser in a customer-friendly form. Harmonized interfaces of the tool, such with DIGSI 4 and DIGSI 5, reduce the engineering effort for Siemens plants even more.

Benefits

- Comprehensive – one tool for configuring all digital IEC 61850 devices
- Simple extension and adaptation of plants by using IEC 61850 Edition 1 and 2 in a project
- Customer-specific IEC 61850 structures (flexible engineering) permit the implementation of customer standards
- Easy to understand by using application-oriented signal names instead of the specific IEC 61850 language (logical nodes, etc.)
- Proven by experience from worldwide standardization activities and engineering of more than 500 000 devices
- Facilitated engineering by means of integrated interfaces to DIGSI, SICAM SCC, SICAM PAS, SICAM protocol test system and IEC 6150 browser

Applications

- Interoperable engineering of IEC 61850 (MMS; GOOSE; SMV)
- Import and export of all SCL formats, such as ICD, IID, CID, SCD, SSD or SED

[sc_IEC 61850 SysConf, 2, --_--]

Figure 4.5/1 Splash Screen for the IEC 61850 System Configurator

- Supporting of Editions 1, 2.0, and 2.1 of IEC 61850
- Engineering with IEC 61850-80-1
- Engineering independent from manufacturers

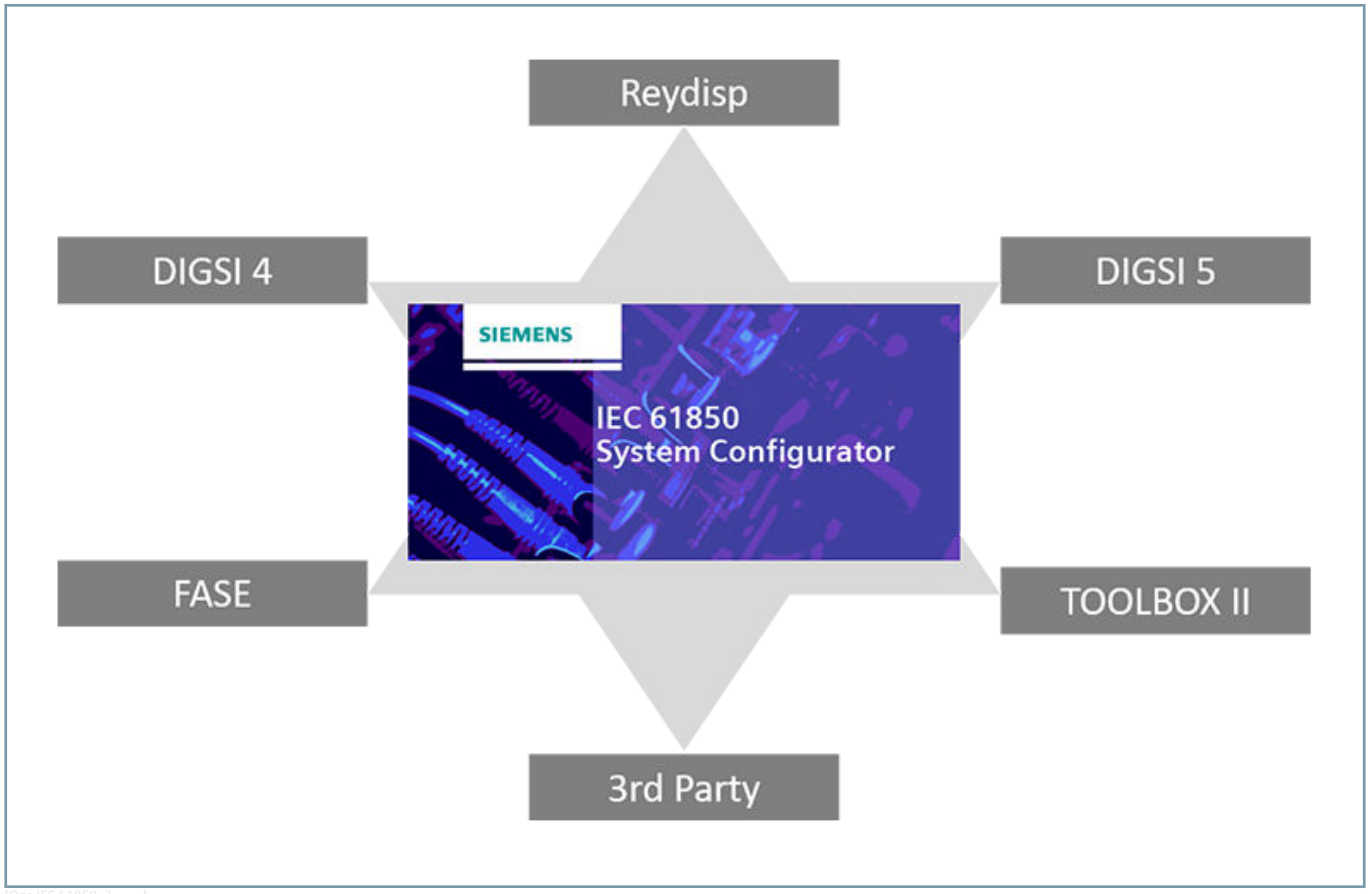
Description

The IEC 61850 System Configurator is the manufacturer-independent solution for the interoperable engineering of IEC 61850 products and systems. It supports all devices with IEC 61850, not just Siemens products – like SIPROTEC 5, SIPROTEC 4, SIPROTEC Compact, Reyrolle, SICAM RTUs, SICAM IO/AI/P85x/Q100 – but also devices from other Siemens divisions (such as SITRAS PRO) or from third parties.

The tool supports SCL configuration files (substation configuration language) from the IEC 61850-6 through the import or export of all formats (ICD/IID/CID/SCD/SSD/SED). Thus, IEC 61850 devices can be added and a complete IEC 61850 station is available for substation automation technology.

IEDs from the IEC 61850 standard of Edition 1 or Edition 2 are supported. The possible engineering therefore includes not only GOOSE communication and client-server configuration via MMS reporting, but also system topology, process bus communication with SMV (sampled measured values) and IEC 60870-5-104 addresses for the gateway to the network control center via IEC 61850-80-1.

Simple engineering thanks to customer-friendly workflows and universal display of IEC 61850 addresses, as well as customer description texts. Users with basic or expert IEC 61850 knowledge find the desired level of detail.



[One IEC 61850, 3, --_-]

Figure 4.5/2 An IEC 61850 System Configurator for All Devices in the Station

Selection and Ordering Data

Description	Versions	Order no.
IEC 61850 System Configurator Software for configuring stations with IEC 61850 communication Executable under 32-bit and 64-bit MS Windows 7 Ultimate, Enterprise and Professional/MS Windows 8.1/MS Windows Server 2012 R2 64-bit/MS Windows 10 Professional and Enterprise (64-bit) See product information for supported service packs of the operating systems including electronic help and service (update, hotline) Interface languages: German, English, French, Spanish, Italian, Portuguese, Chinese, Russian and Turkish selectable Supplied on DVD-ROM.	**Stand-alone** For configuration independent from manufacturers of a plant with IEC 61850 devices (SIPROTEC, Reyrolle and devices from the competition), installation independent from DIGSI, with license for 10 computers (authorization using serial number)	7 X S 5 4 6 1 - 0 A A 0 0

Table 4.5/1 IEC 61850 System Configurator – Selection and Ordering Data

SICAM Device Manager – Description

Description

Engineering is a major cost factor in producing new plants for power generation, distribution, and transfer. Servicing existing plants and maintenance of relevant data resources require heavy expenditure.

- Configuring
- Setting parameters
- Testing
- Putting in operation

These tasks or requirements can be resolved with SICAM Device Manager intuitively whilst saving time and money.

The current engineering software for the SICAM A8000 series supports project and device management for:

- CP-8000
- CP-8021
- CP-8022
- CP-8031
- CP-8050
- SICAM S8000

SICAM Device Manager is available in both German and English.

Benefits

- Simple parameterization and test tool for SICAM A8000 series devices with maximum user friendliness
- Clearly structured user interface and logical steps optimized for each working situation
- Clear administration of projects and devices in directory structures
- Duplication of devices and automatic adaptation of specific parameters
- Compatibility between SICAM WEB and SICAM Device Manager
- Look and feel corresponds to SICAM WEB
- Download engineering data from the device

Functions

- IEC 61850 Client and Server Engineering Edition2 + GOOSE SCL data export for server function incl. creating a server data model
- Logic Editor – Offline Simulation
- Logic Editor – Online Test
- Logic Editor – Function blocks according to IEC 61131
- Logic Editor – User-defined function blocks and structures
- Logic Editor – ST code support
- Logic Editor – Library function

[sc_sicdm__splash, 2, --_--]

Figure 4.6/1 SICAM Device Manager

New Functions from V3.5x for CP-8031/8050

- *Device Manager functions*
  - Graphic management (SVG) for the SICAM A8000 dashboard
  - SICAM A8000 support for 19" rack solution
  - SICAM SCC support
  - SICAM A8000 dashboard
  - Import/export signals incl. attributes
  - Signal engineering across devices
- *Logic Editor functions*
  - Support for automatic chart generation
  - Support for nested structures in structured text (ST) in the building-block interface
  - Support for standard CFC functions and the function block, call up in structured text (ST)

Cybersecurity

The SICAM Device Manager also handles the appropriate cybersecurity requirements for the SICAM A8000 series.

Alongside recognized features such as BDEW Whitepaper conformity, SICAM Device Manager only supports digitally signed firmware.

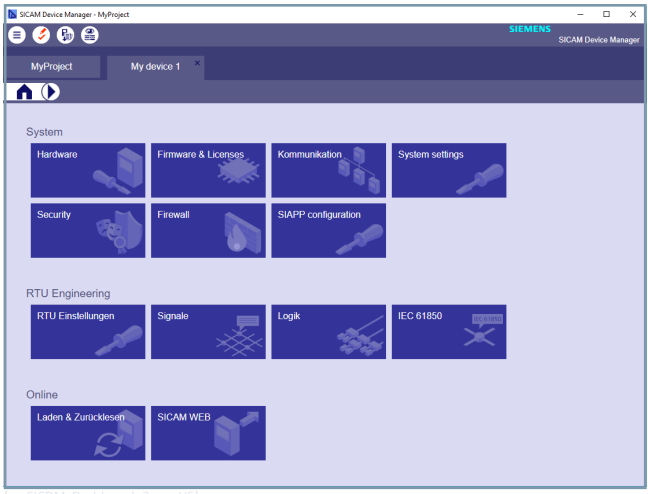
There are 3 licenses available to select:[30]

- 6MF7800-xFB00: SICAM Device Manager Basic, intuitive engineering tool for the SICAM A8000 series
- 6MF7800-xFS00: SICAM Device Manager Standard, intuitive engineering tool for the SICAM A8000 series incl. CFC
- 6MF7800-xGS00: SICAM Device Manager Upgrade Basic to Standard

30 MLFB number 8th position (x): 1 = Physical delivery (DVD/ USB stick)/2 = Electronic delivery (OSD)

Supported Operating Systems

- Microsoft Windows 10
- Microsoft Windows 11
- Microsoft Windows 2016 Server
- Microsoft Windows 2019 Server
- Microsoft Windows 2019 Server
- Microsoft Windows 2022 Server



[sc_SICDM_Dashboard, 2, en_US]

Figure 4.6/2 Simple and Intuitive User Interface

Selection and Ordering Data

Description	Variants	Order No.											
		1	2	3	4	5	6	7		8	9	10	11	12
Delivery form	Physical delivery (DVD/USB stick)									1				
	Electronic delivery (Download (OSD))									2				
SICAM Device Manager		6	M	F	7	8	0	0	–	☐	☐	☐	0	0
	Basic										F	B		
	Standard incl. CFC										F	S		
	Upgrade from Basic to Standard										G	S		
	Addon for HMI configuration									2	F	H		

Table 4.6/1 SICAM Device Manager – Selection and Ordering Data

SICAM TOOLBOX II – Description

Description

The SICAM TOOLBOX II supports all phases of plant engineering, such as configuration, project engineering, diagnostics, testing, documentation and maintenance during the entire plant life cycle. Nowadays, keywords such as integration, networkability, consistent data maintenance and non-redundant data input are an absolute must-have requirement for engineering systems. SICAM TOOLBOX II fulfills all of these requirements and makes use of the latest technological methods to simplify plant engineering. This allows highly-effective working throughout the whole engineering process.

SICAM TOOLBOX II offers all functions for integrated and consistent engineering of the entire plant, such as:

- data collection, data modeling, configuration and parameterization
- engineering of process information for automation and maintenance control
- administration of systems from third party manufacturers and their individual parameters

SICAM TOOLBOX II is an ideal tool for plants of any size.

Benefits

Integrated System

- 1 tool for all systems
- Simple, consistent engineering
- Scalable

Object Orientation

- Easy and transparent engineering
- High efficiency and engineering quality
- Reduced engineering costs

Consistent Data Maintenance

- Central database
- Reduction in the input cost
- No duplicate inputs reduce input errors

Engineering of Process Technology

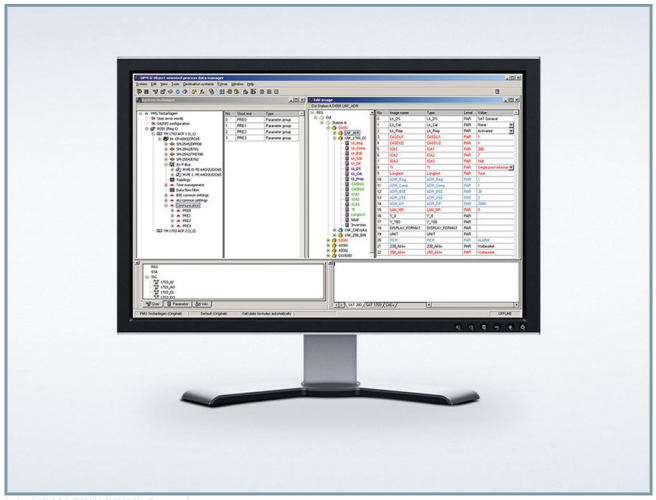
- Reduction of initial creation effort
- Rational, efficient engineering

Functions for SICAM Automation Systems

- Easy system test – online and offline
- Plaintext diagnostics
- Remote servicing
- Logging and simulation of telegrams
- Functions local and remote

Functions for Maintenance Control Systems

- Engineering of process tags
- Redundancy-free data input, for example, reading out SICAM RTU telegram addresses based on IEC 60870-5-101/104 addressing
- Automatic creation of attributes with equations



[ph_SICAM TOOLBOX II, 1, --_--]

Figure 4.7/1 SICAM TOOLBOX II

- Automatic creation of text addresses
- Generation of the database
- Context-sensitive connection of the OPM II from the system image of the maintenance control system

Functions for PLC Applications

- Fully-graphic user interface
- Object oriented
- Compliance with standards in accordance with IEC 61131-3
- Simple offline/online test

Functions for Third-Party Systems

- Open interface
- Storage and removal of engineering data
- Simple reading out of existing data
- Any attributes definable in the customer project itself

System Overview

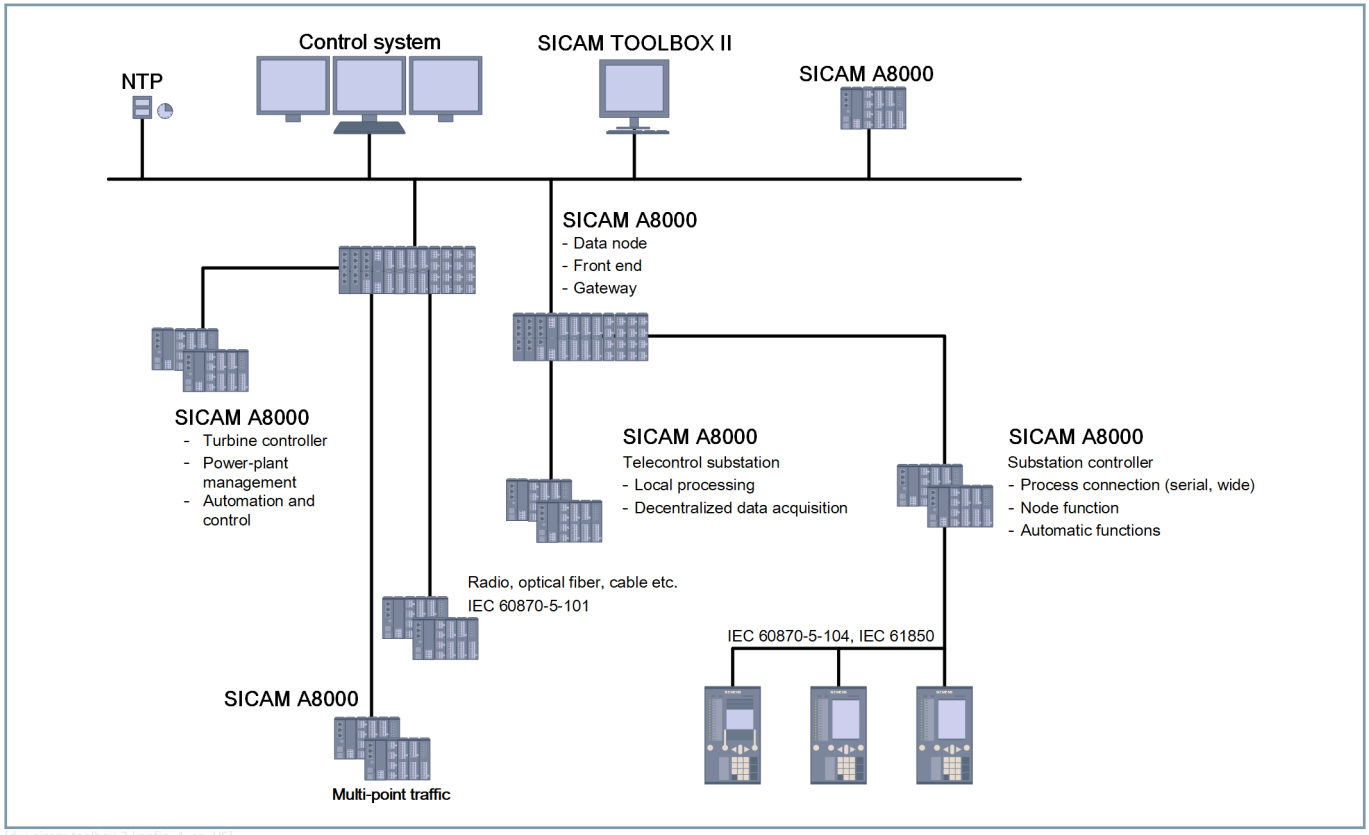
Nowadays, engineering has become an important cost factor, not only in the creation of new plants but also in the maintenance of existing plants and the administration of relevant data resources. With the integrated engineering system SICAM TOOLBOX II, Siemens offers a comprehensive and cost-saving solution for these tasks.

Object Orientation: Work more Rapidly and Safely

With the introduction of object orientation, the designer can describe actual units and equipment in the project planning process and can employ them in the engineering process as defined objects. These can be, for example, individual components such as pumps or circuit breakers, but also larger units, such as feeders. Above all, if a plant is composed of a multitude of identical primary assemblies and equipment (such as voltage transformation substations or hydropower plants, and pipelines), object-orientation offers considerable cost-reduction potential.

In parallel to this, the error quota drops because the structure of the equipment is moved into the background due to the creation of process-technology objects with SICAM TOOLBOX II. Thus, the developer no longer has to deal with a large number of individual signals. Instead, they can concentrate on their actual task: engineering of the plant. In order to make optimum use of this advantage, the objects can be completely freely defined without constraint with respect to sector-specific applications.

With respect to networkability and a collaborative working method, SICAM TOOLBOX II offers all possibilities from the individual workstation right up to complex network solutions, in which several project engineers work in parallel on multiple projects. The function of distributed working even allows several project engineers to work simultaneously on a project, even if the individual SICAM TOOLBOX II PCs are not connected via a network. The distributed data resources are easily and conveniently merged at a later point.



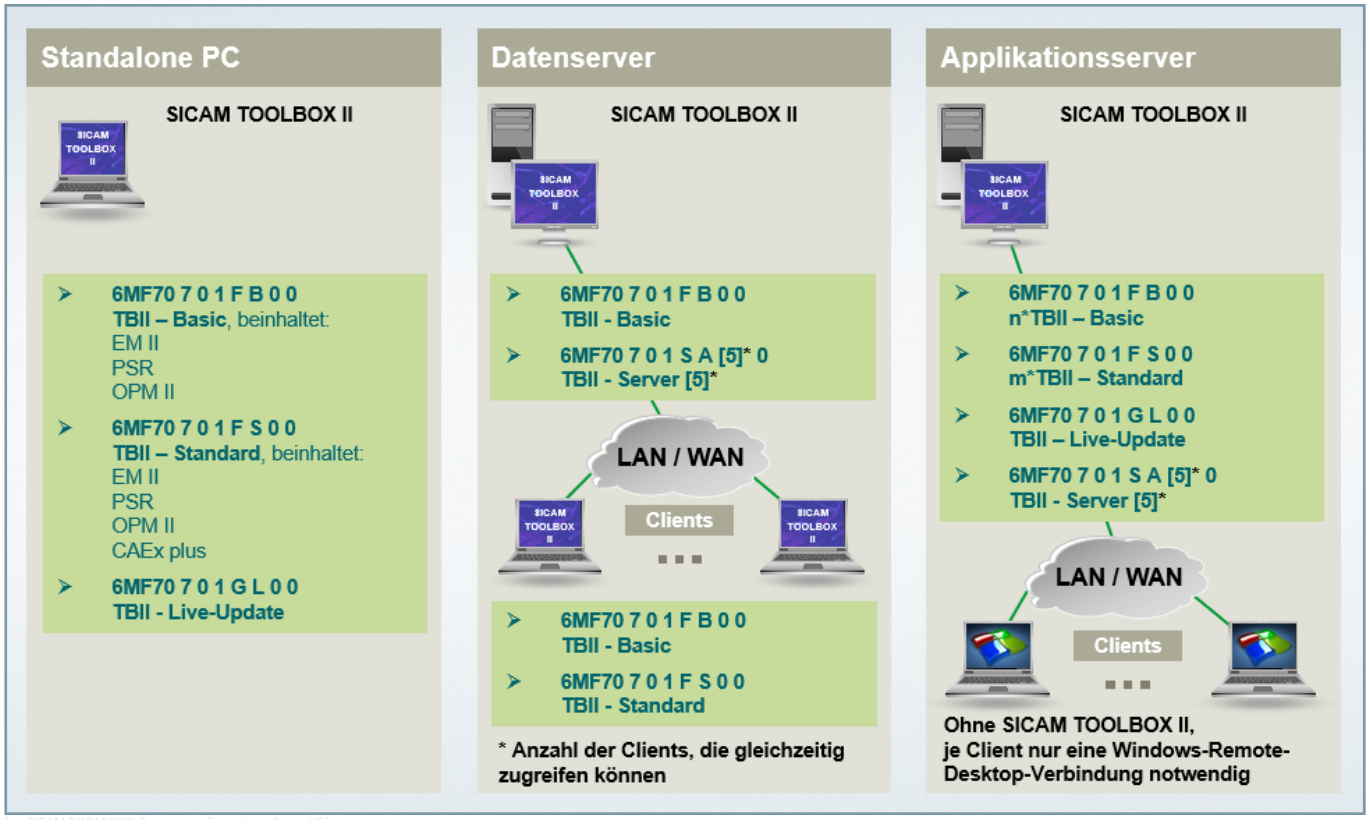
[dw_sicam-toolbox-2-konfig, 4, en_US]

Figure 4.7/2 SICAM TOOLBOX II – Example Configuration (also Continues to be Available for SICAM AK3 and SICAM TM)

Engineering on the Web

The diverse functions of SICAM TOOLBOX II can also offer unlimited benefits on the Internet and Intranet – with the same convenient user interface as in the local installation. The Web functions integrated into SICAM TOOLBOX II allow operation in Internet Explorer without further training. To do this, SICAM TOOLBOX II does not even have to be installed locally on the operator's PC – all functions run on the corresponding Windows terminal server.

The core element of data management in SICAM TOOLBOX II is a central database that is accessed by all tools of SICAM TOOLBOX II and in which all information is stored. Information that has been entered is available to all employees on a project and all tools immediately, and at the latest revision status. This reduces the error quota, avoids double entries and thus reduces engineering effort.



[sc_SICAM TOOLBOXII_System configuration, 3, en_US]

Figure 4.7/3 SICAM TOOLBOX II – Summary of V7.0 ALM Licensing

PLC applications

The linkage, control and regulation applications are created in SICAM TOOLBOX II with CAEx plus. This powerful tool boasts a fully graphic user interface and intuitive operation. This permits short familiarization times and minimized training outlay. CAEx plus is completely integrated in SICAM TOOLBOX II. It allows user programs to be efficiently and easily generated in accordance with the standard IEC 61131-3.

With standardized user programs, the use of typical function block diagrams allows rapid and error-free programming. The concise and clearly-arranged operating structure supports rapid and efficient working, which is further reinforced by a multitude of easily operated functions. Examples include the project explorer, intuitive function block diagram editor, navigator and documentation management. The comprehensive online help provides support at all times in the event of uncertainties. CAEx plus also includes comprehensive and easily operated testing options. The **offline test** can be used – independently from the automation system – for testing the user program under Windows, in almost real time. In the **online test**, the program can then be checked with the automation system.

Functions

For SICAM automation systems

In a SICAM RTU automation network, SICAM TOOLBOX II allows project engineering, loading, system diagnostics, system testing and documentation of the automation and telecontrol functions for local and remote automation units: All functions can be implemented via the communication routes of the automation system (that is, without their own power line). In this way, the plant can be very easily tested and put into operation. The integrated diagnostic options of SICAM TOOLBOX II allow any errors to be quickly and reliably located and rectified. As a result, it considerably increases the availability of the overall system. In the event of an error, the detailed diagnosis displays comprehensive fault information in plaintext and provides information about possible causes and their rectification. Remote maintenance allows access to automation systems from any location via, for example, telephone, modem, ISDN, TCP/IP, and is thus the basis for the corresponding service activities. For data simulation, any number of telegrams can be defined with menu guidance and hence simulated in the automation system. Logging points can be selected with graphic support in order to follow the data flow. With associated telegram filters, only those telegrams are displayed that are relevant for the respective test.

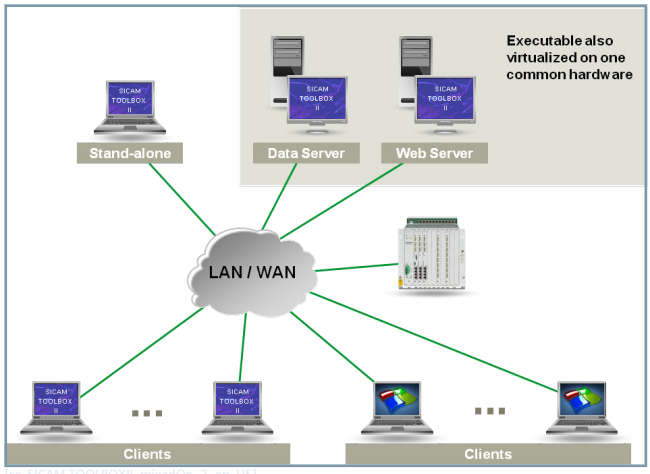
For maintenance control systems

The process data points in the maintenance control systems and local HMIs (such as SICAM SCC) and their attributes can be defined and their parameters set with SICAM TOOLBOX II. Attributes are transferred from the SICAM RTU automation system in a non-redundant manner via the use of SICAM TOOLBOX II references. This means that the project engineer does not have to, for example, enter the telegram address for the maintenance control system. The use of SICAM TOOLBOX II equations provides the option of automatically calculating attributes of the

maintenance control system, hence accelerating engineering and minimizing errors. Furthermore, the text address is automatically created.

For third-party systems

The open interface to any third-party system is an important feature of SICAM TOOLBOX II. Using this interface, data can be removed or third-party data transferred. Removed data can be converted with any program for automatic post-parameterization. The storing of third-party data can also be batch controlled, that is, without actual operation of SICAM TOOLBOX II. In addition to the storing of individual attributes, signals or any higher-value objects can be created (for example, a feeder, a pump, a circuit breaker). In this way, even old data can very easily be inherited by the SICAM TOOLBOX II. Furthermore, the option exists to define and administer parameters of third-party systems or even general parameters. The attributes can be defined by the project engineer in the customer project itself. Examples of this are parameters from third-party manufacturers. With these self-defined parameters, collaborative engineering is also possible in addition to all SICAM TOOLBOX II standard processing activities, such as mass processing, references and equations.



[sc_SICAM TOOLBOXII_mixedOp, 2, en_US]

Figure 4.7/4 SICAM TOOLBOX II Server/Client Configuration

Version 7.10 News

The security ORACLE patch update supports Microsoft Windows 11 and Server 2022 (as well as Microsoft Windows 10 and Server 2019).

Version 7.00

The new version of SICAM TOOLBOX II version 7.00 includes the following extensions and improvements:

New Features

- Support of current operating systems
  - SICAM TOOLBOX II version 7.0 supports Windows 10, Windows Server 2016 R2 and Windows Server 2019.
- ALM (Automation License Manager)
  - All toolsets in SICAM TOOLBOX II version 7.0 are exclusively licensed by the ALM. This means that you do not need to input license keys when you install or query a dongle when starting up CAEx plus. All licenses and the associated permissions are managed in the ALM (see also product information/installation)
- Migration support for SICAM I/O rack modules
  - SICAM I/O rack modules can be reused by transmitting/migrating to CP-8050 in the system technology
- Signal2csv Command Tool
  - Signals (attributes for the general address link – LNK_ADR) can be exported from TOOLBOX II in a *.csv file in SICAM Device Manager import format.
- CP-8031 support
  - Support for device type CP-8031
- ORACLE DB security
  - SICAM TOOLBOX II Version 7.0 has been converted to ORACLE 19c, including a security patch. Display of the version and the patch levels in the dialog versions of the installed toolsets (default TOOLBOX settings, system menu, TOOLBOX info, toolsets, etc.): Oracle version: XX.X.X.X.X PATCH SET FOR ORACLE DATABASE SERVER.

Improved/Changed Features

- Online help
  - SICAM TOOLBOX II version 7.0 includes improved online help, especially for the new features. Its updated form is provided as a *.chm file.
- CP-8050 diagnostics information
  - Updated/additional diagnostics information for existing/new protocol elements
- Firmware updates
  - Master data for SCALA version 7.20
  - Master data 90014.wls
  - Master data for SICAM SCC MPCC00 Revision@13
  - Incorporating SICAM WEB V5.40

Compatibility

- Existing engineering data from SICAM TOOLBOX II versions 6.xx can be imported into the new SICAM TOOLBOX II version 7.0 and can thus continue to be used. Data that has been created with SICAM TOOLBOX II version 7.0 can NOT be imported into earlier versions (for example, V6.xx).

Selection and Ordering Data

Description	Variants	Order No.											
		1	2	3	4	5	6	7		8	9	10	11	12
Delivery form	Physical delivery (DVD/USB stick)									1				
	Electronic delivery (Download (OSD))[31]									2				
SICAM TOOLBOX II		6	M	F	7	0	□	□	-	□	□	□	□	□
							▲				▲	▲	▲	▲
Version 7.0							7				|	|	|	|
License	Basic							|			F	B	0	0
	Standard							|			F	S	0	0
	SERVER 2							|			S	A	2	0
	SERVER 3							|			S	A	3	0
	SERVER 5							|			S	A	5	0
	SERVER 10							|			S	A	6	0
	SERVER 25							|			S	A	7	0
	SERVER 100							|			S	A	8	0
Toolset upgrade								|			|	|	|	|
	SICAM TOOLBOX II – EM II							|			G	E	0	0
	SICAM TOOLBOX II – PSR II							|			G	S	0	0
	SICAM TOOLBOX II – OPM II							|			G	P	0	0
	SICAM TOOLBOX II – CAExplus							|			G	C	0	0
	SICAM TOOLBOX II – CAEsafety							|			G	F	0	0
	SICAM TOOLBOX II – Live update							|			G	L	0	0
Update								|			|	|	|	|
	SICAM TOOLBOX II – Basic update							0		2	U	B	0	0
	SICAM TOOLBOX II – Standard update							0		2	U	S	0	0
	SICAM TOOLBOX II – SERVER 2 update							0		2	U	S	2	0
	SICAM TOOLBOX II – SERVER 3 update							0		2	U	S	3	0
	SICAM TOOLBOX II – SERVER 5 update							0		2	U	S	5	0
	SICAM TOOLBOX II – SERVER 10 update							0		2	U	S	6	0
	SICAM TOOLBOX II – SERVER 25 update							0		2	U	S	7	0
	SICAM TOOLBOX II – SERVER 100 update							0		2	U	S	8	0
								|		|	|	|	|	|
	Version 7.10							|		|	|	|	|	|
	SICAM TOOLBOX II - Update 7.0 to 7.10							1		2	U	T	0	0
	SICAM TOOLBOX II - SERVER 2 update 7.10							1		2	U	S	2	0
	SICAM TOOLBOX II - SERVER 3 update 7.10							1		2	U	S	3	0
	SICAM TOOLBOX II - SERVER 5 update 7.10							1		2	U	S	5	0
	SICAM TOOLBOX II - SERVER 10 update 7.10							1		2	U	S	6	0
	SICAM TOOLBOX II - SERVER 25 update 7.10							1		2	U	S	7	0
	SICAM TOOLBOX II - SERVER 100 update 7.10							1		2	U	S	8	0

Table 4.7/1 SICAM TOOLBOX II Selection and Ordering Data

31 From September 2021

Description

The IEC standard protocols used in modern substation control and protection systems enable homogeneous, manufacturer-independent solutions and provide optimal protection for the investment made.

Despite the use of standardized protocols, it is still necessary in everyday practice when operating and setting up systems controls to analyze more precisely or even simulate the behavior of the devices used.

The SICAM protocol test system (PTS) offers these functions. A simulation of one or more devices simplifies the processes above all during project engineering of plants. For instance, by importing the IEC 61850 standard files, the behavior of devices can be simulated and the running of tests and commissioning thus simplified. Irrespective of the manufacturer, extensive analysis functions make it easier to eliminate erroneous behavior or failures of individual devices.

SICAM PTS helps make everyday work simpler for the plant project engineer and operator and becomes an indispensable tool.

[sc_SICAM PTS, 2, –_–]

Figure 4.8/1 SICAM PTS

Benefits

- **Analysis and Monitoring**

  SICAM PTS is the ideal tool for conformance testing, SAT (site acceptance tests), fault analyses and long-term recordings.

- **Simulation**

  In addition to the extensive analysis functions, it is also possible to simulate partners.
  In this way, the SICAM PTS not only allows individual telegrams but also entire IEC 61850 devices and plants made up of up to 255 devices to be simulated dynamically. This also includes simulation of the command executions including feedback, measured values and fault records, along with the simulation of IEC 61850 client-server connections and GOOSE messages. The individual server-client connections in the network are then shown in the network overview.

The SICAM Protocol Test System supports the following protocols:

- IEC 61850 Ed1 and Ed2 Client
- IEC 61850 Ed1 and Ed2 Server
- IEC 60870-5-101 (balanced and unbalanced)
- IEC 60870-5-103
- IEC 60870-5-104
- SAT PCBE End-End protocol
- SAT PCBU SSI End-End protocol
- NTP Client
- TLS

Features and Technical Highlights

- Product- and manufacturer-independent test system
- Simulation of up to 255 IEC 61850 servers
- Interactive simulation (command and feedback) of entire systems including devices from the competition – SCD, ICD import (ICD files of SIPROTEC 4/5 devices are already integrated in the software package)
- Simulating malfunctions
- Dynamic measured values using auto-simulation
- Simulating fault records
- GOOSE publish
- Network overview analysis – which server is connected to which client?
- Test the NTP time server in the network
- Simple operation – without training
- Plaintext display for IEC 60870-5-101, -104 and -103 as well, using stored data models by importing long texts as .csv files
- Long-term recording

Windows Operating Systems

- Microsoft Windows 10
- Microsoft Windows 2016 Server R2
- Microsoft Windows 2019 Server

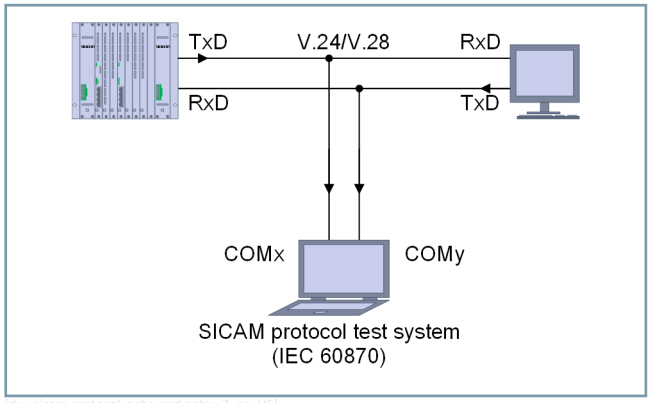
SICAM PTS runs on a PC under MS Windows and is used to record and simulate process interfaces. A COM port (V.24/V.28) or an Ethernet interface is used as an interface. For unsupported protocols, the recorded data is displayed in Hex mode.

Monitoring

IEC 60870-5-101, -103, PCBU, PCBE (*Figure 4.8/2*)

- Statistics display (for example number of bytes, number of telegrams, transmission errors)
- Possible to display the telegrams in Hex mode
- Time stamping of all received telegrams

- Freely definable process-technology address down to bit level, including saving and loading the definition
- Plaintext address import of CSV files (display of the data points with their actual name)
- Possibility of online and offline filtering of IEC 60870-5-2 telegrams, type identifications, transmission causes, link addresses, object addresses (function type, information number)
- Individual adaptation of the display format (for example type identification, time, structure)
- Saving the recorded data in binary and ASCII format
- Loading the saved recording for further offline analyses, including offline filter



[dw_sicam-protocol_pcbe-and-pcbu, 3, en_US]

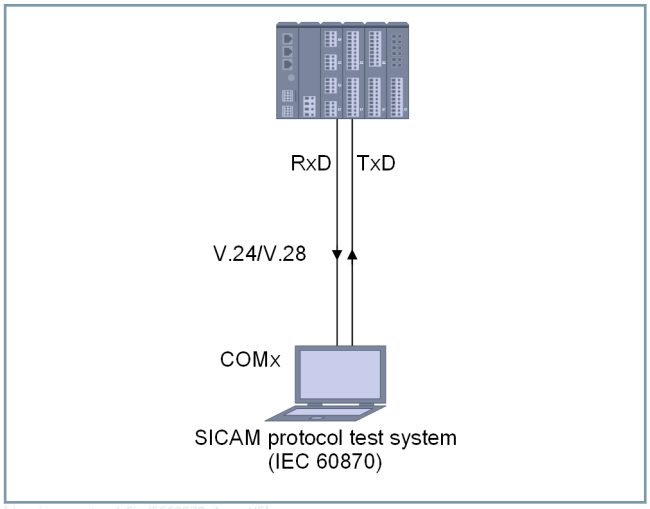
Figure 4.8/2 Monitoring IEC 60870-5-101, -103, PCBE and PCBU

The following function is available when using SICAM PTS (IEC 60870):

- Time stamping with an accuracy of 1 ms

Simulation for IEC 60870-5-101, -103 (*Figure 4.8/3*)

- Telegram definition using dialog, from existing recordings and plaintext imports (for example, data-point tests, in order to automatically generate and transmit telegrams from a data-point list)
- Predefined monitoring telegrams (for example end of initialization, general interrogation, counter interrogation)
- Saving and loading telegram definitions
- Saving and loading different parameter sets
- Option to import recording of the Frontline **serial test** program (including time stamp)
- IEC 60870-5-101: Send/receive file transfers and generate COMTRADE files from DKE fault records



[dw_sicam-protocol_SimIEC60870, 4, en_US]

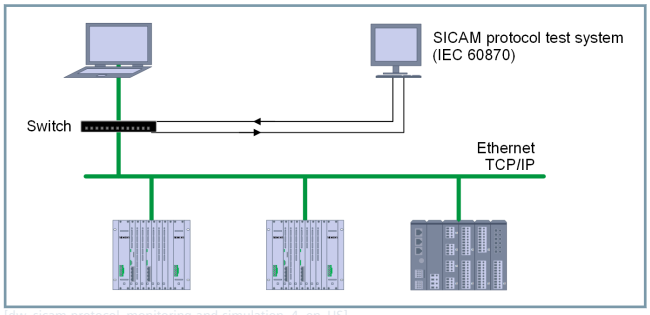
Figure 4.8/3 Simulation for IEC 60870-5-101, -103

Monitoring and Simulation IEC 60870-5-104 (*Figure 4.8/4*)

All data transmitted via the TCP/IP log can be recorded using the SICAM PTS if the system can access it on Ethernet, for example, via a switch with port mirroring. This means that SICAM PTS may not be decoupled from the systems to be tested by a switch or router.

This means that the following possibilities are available:

- Filtering in addition to the filtering possibilities for monitoring on serial interfaces according to log, IP address, host name and port number
- Statistics display
- Simulation of a station on the Ethernet



[dw_sicam-protocol_monitoring-and-simulation, 4, en_US]

Figure 4.8/4 Monitoring and Simulation IEC 60870-5-104

Selection and Ordering Data

Description	Variants	Order No.												
		1	2	3	4	5	6	7		8	9	10	11	12
Delivery form	Physical delivery (DVD/USB stick)									1				
	Electronic delivery (Download (OSD))									2				
SICAM Protocol Test System V8.0		6	M	F	6	0	**8**	0	-	☐	F	☐	0	0
	IEC 60870											B		
	IEC 60870 and IEC 61850											S		
	TLS											T		
	IEC 61850											A	8	

Table 4.8/1 SICAM PTS – Selection and Ordering Data

Description

DIGSI 5 is the versatile engineering tool for parameterization, commissioning, and operating all SIPROTEC 5 devices. Its innovative user interface includes context-sensitive user instructions. Simple connection to the device via USB enables you to work with a device easily and efficiently. The full capabilities of DIGSI 5 are revealed when you connect it to a network of protection devices: Then you can work with all of the devices in a substation in one project. DIGSI 5 offers superior usability and is optimized for your work processes. Only the information you actually need to carry out your tasks is shown. This can be reduced further via expanded filter mechanisms. Consistent use of sophisticated and standardized mechanisms in the user interfaces requires less training.

Functions

Using a PC or laptop computer, you can set parameters for the devices using the interfaces and export the fault data.

DIGSI 5 is available in different variants (Compact, Standard, and Premium) with various functionalities:

- Using the Single-Line Editor, you can visually define a substation and the primary equipment. Connect these elements with the protection function of your protection devices.
- The visual display of the SIPROTEC devices can be configured and edited with the Display Editor or with a graphics program. Take your single-line diagram and convert it into a display image. You can also define your own icons.
- You can configure additional functions like interlocking of the devices graphically with the function block diagrams editor (CFC).
- Using the Siemens IEC 61850 System Configurator, you can configure and set parameters for IEC 61850 stations. Using this tool, you can administer subnetworks, network users and their IP addresses and link the information of various participants.
- The DIGSI 5 test suite provides extensive test tools, which accelerate commissioning and support you with operation. One of the test functions enables you to compile and execute test sequences, to test devices without external test equipment.
- SIGRA for simple, fast, and convenient analysis of fault records, such as those recorded during faults in power plants by fault recorders.

Languages: English, German, French, Italian, Portuguese, Spanish, Turkish, Czech, Polish, and Russian (selectable)

[sc_DIGSI 5_SplashScreen, 2, --_--]

DIGSI 5 is available in 3 different functional scopes:

- **DIGSI 5 Compact**

  Software for configuring and operating smaller projects with up to 8 SIPROTEC 5 Compact (7xx800) or non-modular SIPROTEC 5 devices (7xx82). Contains graphical editors for Continuous Function Charts (CFC) and device display pages. Integrated test and commissioning functions, including the possibility of creating test sequences and their execution in the protection device without external test equipment. Projects may only contain a single SIPROTEC 5 protection device.

- **DIGSI 5 Standard**

  Like DIGSI 5 Compact, but without constraint with regard to the number of supported SIPROTEC 5 devices per project, incl. IEC 61850 System Configurator. Contains additional graphical editors for single-line diagrams and the network topology. SIGRA for professional fault-record analysis is available as an option.

- **DIGSI 5 Premium with SIGRA**

  Same as DIGSI 5 Standard, but with enhanced functionality for IEC 61850, for example, flexible engineering and functional naming. Contains SIGRA for a professional analysis of fault records.

Hardware Requirements

- Intel® Core™ i3-6100U, 2.30 GHz S-ATA with at least 8 GB of available storage capacity
- 4 GB RAM (recommendation: 8 GB)
- HD Ready graphic display, 1280 x 1024 or 1376 x 768 pixels
- DVD ROM drive
- Keyboard and mouse
- USB port

Software Requirements

- Microsoft Windows 10
- Microsoft Windows Server 2019
- VMWare support for virtual machines

Overview of Functions

	Compact	Standard	Premium
Project processing			
Maximum number of devices per project	8 or 1[32]	Unlimited	Unlimited
Copy and paste	■	■	■
Multilingualism is supported	■	■	■
Single-line diagrams and device displays			
Single-Line Editor with ANSI and IEC standard icons available	–	■	■
Device Display Editor permits creation of user-defined displays and icons	[33]	■	■
Setting parameters and routing			
Information routing including filtering and sorting	■	■	■
Graphical visualization of protection parameters	–	■	■
Comparison of devices (offline/offline – offline/online)	■	■	■
Continuous function charts (CFC)			
Graphic continuous function chart editor (CFC) available	■	■	■
Communication			
Assignment of communications to system interface	■	■	■
Assignment of communications to various logs	■	■	■
Graphical network view of devices	–	■	■
Inter-device communication (via IEC 61850 System Configurator)	–	■	■
IEC 61850			
IEC 61850 Edition 2 fully supported	–	■	■
IEC 61850 structure editor for flexible engineering and functional naming	–	–	■
Access and communication			
Via USB and Ethernet	■	■	■
Access to communication partners via system interface	■	■	■
Online			
Measured values (current values, minimum, maximum, average values) and storage in the project as snapshots	■	■	■
Messages (and storage in the project as snapshots)	■	■	■
Logs and records	■	■	■
Display fault records	■ COMTRADE Viewer	■ COMTRADE Viewer [34]	■ SIGRA
Loading settings for the selected device	■	■	■
Commissioning and testing			
Creating and running multistage test sequences, no external equipment necessary	■	■	■
Test views for testing the device configuration	■	■	■
Analysis/debugging of continuous function charts (CFCs) in offline and online mode	■	■	■
Export and import			
SCL formats (IEC 61850– ICD/IID/MICS)	–	■	■
Device configurations (full and partial)	■	■	■
Single-line diagrams/topology	■	■ [35]	■
Display pages	■	■	■
Test object definition (RIO)	■	■	■
Documentation			

32 8 SIPROTEC 5 Compact (7SX800) or non-modular SIPROTEC 5 devices (7xx82); alternatively 1 modular SIPROTEC 5 device

33 For SIPROTEC 5 Compact (7SX800) or non-modular SIPROTEC 5 devices (7xx82)

34 SIGRA available as optional package

35 WMF export only

DIGSI 5 – Overview of Functions

	Compact	Standard	Premium
Printing and exporting project documentation	■	■	■
Creation of user-defined print formats	■	■	■

	Compact	Standard	Premium
Safeguarding and security			
Authorization of access to devices with NERC CIP-compatible password	■	■	■
Secure connection to the device	■	■	■
Configuration data protected from alteration	■	■	■
Confirmation IDs for safeguarding critical activities (for example switching)	■	■	■

DIGSI 5 Order Variants

	DIGSI 5 Compact	DIGSI 5 Standard	DIGSI 5 Premium with SIGRA
Description	• Software for the configuration and operation of smaller projects including transmission of process data from the device • Includes graphical editors for Continuous Function Charts (CFC) and device display pages. • Integrated test and commissioning functions, including the possibility of creating test sequences and executing them in the protection device without external test equipment • Projects can contain up to 8 SIPROTEC 5 Compact (7xx800) or non-modular SIPROTEC 5 devices (7xx82). Alternatively, it is also possible to create 1 individual modular SIPROTEC 5 device.	• Like DIGSI 5 Compact, but without constraint with regard to the number of supported SIPROTEC 5 devices per project, incl. IEC 61850 System Configurator • Contains additional graphical editors for single-line diagrams, device display pages, and the network topology • SIGRA for professional fault-record analysis is available as an option	• Same as DIGSI 5 Standard, but with enhanced functionality for IEC 61850, for example, flexible engineering and functional naming • Contains SIGRA for a professional analysis of fault records
Product features	All features are listed in the *Overview of Functions, Page 113* table.		
Authorization	No license key necessary	Authorization required using the license key; can be used on one computer per license.	
Available interface languages	German, English, Portuguese, Spanish, Italian, French, Russian, Polish, Czech, and Turkish (selectable)		
Contained in the scope of delivery of the DVD version	• Program, device drivers, and online documentation on DVD-ROM • USB stick including a 30-day test license for a free test of DIGSI 5 Premium • Product information • USB cable for connecting a PC/laptop computer and all SIPROTEC 5 device types	• Program, device drivers, and online documentation on DVD-ROM • USB stick with the number of licenses ordered. The program can be used on one computer per license. • Includes a 30-day test license for a free test of DIGSI 5 Premium • Product information • USB cable for connecting a PC/laptop computer and all SIPROTEC 5 device types	• Program, device drivers, and online documentation on DVD-ROM • USB stick with the number of licenses ordered. The program can be used on one computer per license. • Product information • USB cable for connecting a PC/laptop computer and all SIPROTEC 5 device types
DIGSI 5 can also be ordered and delivered via online software delivery (OSD). The delivery of the DVD and USB cable is unnecessary. The program is offered for downloading. The license can be loaded online on the Automation License Manager.			

4.9

Selection and Ordering Data

Versions	Number of licenses	Delivery form	Order no.
DIGSI 5 Compact	Unlimited	DVD/USB[36]	7XX8002-0CA00
DIGSI 5 Standard without SIGRA (with COMTRADE viewer)	1 single license	Download	7XX8002-0SA01
	5 single licenses	Download	7XX8002-0SA05
	10 single licenses	Download	7XX8002-0SA10
DIGSI 5 standard with SIGRA	1 single license	Download	7XX8002-1SA01
	5 single licenses	Download	7XX8002-1SA05
	10 single licenses	Download	7XX8002-1SA10
DIGSI 5 Premium with SIGRA	1 single license	Download	7XX8002-1PA01
	5 single licenses	Download	7XX8002-1PA05
	10 single licenses	Download	7XX8002-1PA10
DIGSI 5 Premium Trial (Premium full version for 30 days)	Unlimited	DVD/USB[36]	7XX8002-1PT00
DIGSI 5 Premium Scientific (only for technical colleges)	10 single licenses	Download	7XX8002-1PC10
DIGSI 5 Premium Sales (only for Siemens sales and distribution Dept.)	10 single licenses	Download	7XX8002-1PS10
Upgrade from DIGSI 5 Standard to Premium	1 single license	Download	7XX8002-1UP01
	5 single licenses	Download	7XX8002-1UP05
	10 single licenses	Download	7XX8002-1UP10
Upgrade from DIGSI 4 professional to DIGSI 5 standard	10 single licenses	Download	7XX8002-0US10
Upgrade from DIGSI 4 professional to DIGSI 5 premium	10 single licenses	Download	7XX8002-1US10
Upgrade from DIGSI 4 Professional + IEC 61850 to DIGSI 5 Standard	10 single licenses	Download	7XX8002-0UC10
Upgrade from DIGSI 4 Professional + IEC 61850 to DIGSI 5 Premium	10 single licenses	Download	7XX8002-1UC10
SIGRA option package for DIGSI 5 Standard	1 single license	DVD/USB[36]	7XS5412-2AA00
	5 single licenses	DVD/USB[36]	7XS5413-2AA00
	10 single licenses	DVD/USB[36]	7XS5414-2AA00

Table 4.9/1 DIGSI 5 Selection and Ordering Data

36 Exclusively physical delivery (DVD/USB)

Description

SICAM PMS LoadShedding enables selected loads to be switched off automatically to ensure that a defined network is operated safely if the energy supply is critical. The load shedding function ensures a proper balance between power that has been produced and consumed by switching off low-priority consumers. Automatic load shedding is the only way to prevent a strong dip in frequency and the protection tripping, or a collapse in frequency following a severe fault.

Load shedding uses a distributed system architecture and is based on the IEC standard 61850. At factory level, the central load-shedding controller is based on individual or redundant SICAM remote terminal unit. At bay level, the Intelligent Electronic Devices (IEDs) are installed on SIPROTEC devices for protection and control. Operation is insured at factory level via a human-machine interface (HMI).

Main Functions

Fast Power-Based Load Shedding (FPLS)

Low-priority consumers must be shedded quickly if there are any critical events to restore the balance between the energy that has been produced and consumed. The active power result is calculated on a regular basis for each critical event to determine how much energy needs to be shedded. The calculation determines which bays are shedded if there is a critical event, for example using the available power, the rotating reserve and the actual topology. Load shedding occurs within 30 ms to 70 ms if a critical event occurs[37]. FPLS automatically detects several islands in the power system and operates each island separately.

Dynamic Power-Based Load Shedding (DPLS)

The power result is monitored on a regular basis in island network operation. If the spinning reserve drops under a user-defined threshold, consumers are shedded, starting with the lowest priority until a sufficient spinning reserve has been restored. DPLS is carried out separately for each island network detected. DPLS is an optional function just like a closing lockout, large consumers such as medium motors are monitored that are currently not in operation. If the input power exceeds the rotating reserve for these loads, they are prohibited from starting.

Frequency-Based Load Shedding (FBLS)

FBLS is provided as an additional reserve function for fast shedding. It works independently of power-based load shedding, and is based on a distributed system architecture. A frequency relay monitors the frequency for up to 4 limiting values for each bus section. The predefined loads are automatically shedded if the limit is violated. Each frequency-relay tripping stage is provided with a time delay to prevent unwanted load shedding. The frequency gradient (DF/DT) can also be monitored to ensure a faster response.

Working Area

Load shedding is carried out by distributed IEDs that communicate via the IEC 61850 protocol. Exceptionally fast GOOSE indications ensure a fast response time. Up to 300 loads can be shedded with a max. of 50 priority levels. Loads of the same priority are treated as a group and shedded together. Up to 60 critical events that trip load shedding can be defined. The FPLS response time is typically a max. of 30 ms to 70 ms[37]. This duration is defined from once a critical event has been detected until a trip signal is activated for the affected loads.

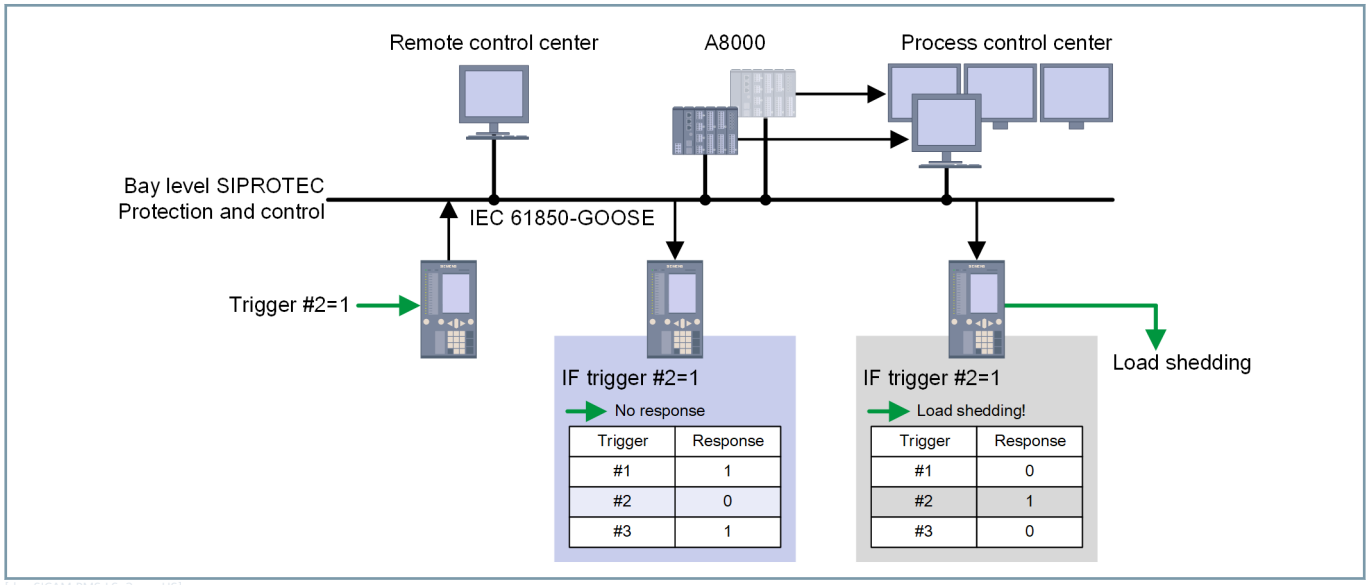
System Requirements

- Load-shedding calculations based on SICAM A8000 (CP-8050 with constraints) with an Ethernet connection to all IEDs via IEC 61850
- IEDs with an IEC 61850 interface which supports GOOSE and a fast function plan
- Operating station based on SICAM SCC or Spectrum Power 5 for adjusting and monitoring load shedding

Advantages

- Full integration into the automation system; only the additional central component is required for calculation
- The power-based load shedding only sheds as many bays as required for the respective situation
- Very fast response time for power-based load shedding
- The network topology is calculated automatically, for example for several islands
- Based on the IEC 61850 standard for communication between all included components. This significantly reduces parallel wirings, improves system availability, and ensures a solution that is fit for the future
- Very high availability: Redundant shedding-matrix calculation and an independent FBLS as a reserve function ensure system availability.

37 In defined conditions

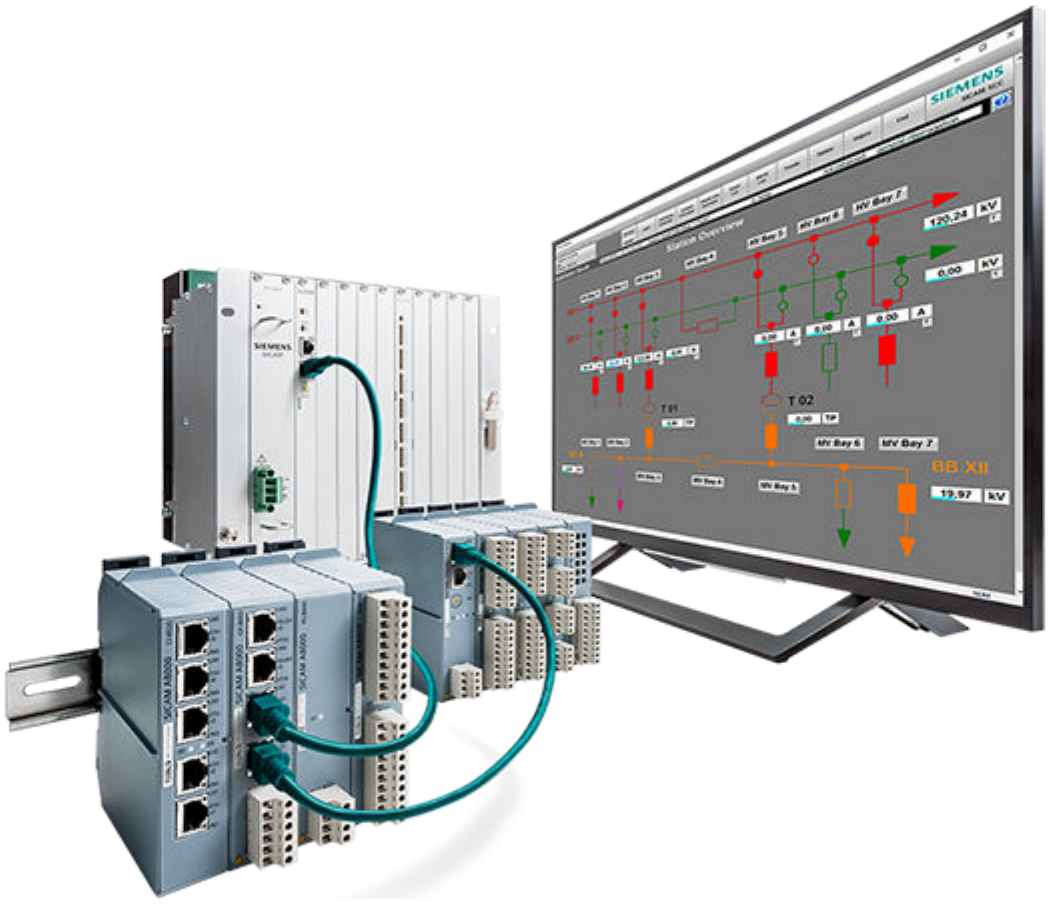


[dw_SICAM-PMS-LS, 2, en_US]

Selection and Ordering Data

Description	Variants	Order No.											
		1	2	3	4	5	6	7		8	9	10	11	12
SICAM PMS LS		6	M	F	4	2	7	1	-	2	☐	☐	☐	☐
											▲	▲	▲	▲
Power Management System	Basic for 8 contingencies										B	S	1	2
Load Shedding	Small for 8 contingencies										C	R	1	3
	Medium for 15 contingencies										C	R	2	3
	Large for 30 contingencies										C	R	3	3
	Max for 60 contingencies										C	R	4	3

Table 4.10/1 SICAM PMS LS – Selection and Ordering Data


SIEMENS
SICAM SCC
120.24
kV
0.00
kV
0.00
A
T 01
T 02
MV Bay 6
MV Bay 7
BB XII
19.97
kV

The SIPROTEC 5 bay controllers control and monitor plants of all voltage levels. The device automatic functions are used in energy-supply fields and important auxiliary functions for safe network operation. These functions include protection, control, measurement, and monitoring. The communication interfaces and protocols satisfy the requirements of communication-based selective protection and automated operation. Commissioning and maintenance is completely safe, quick, and cost-effective with high-performance test functions. The SIPROTEC 5 bay controllers surface mounting is modular and adaptable and flexibly to the mounting requirements. The new device in the 6MD8 family is the IO-Box 6MD84.

Overview SIPROTEC 6MD84 Device

The SIPROTEC 5 IO-Box 6MD84 is a full member of the SIPROTEC 5 family. The SIPROTEC 5 IO-Box 6MD84 is a modular device which provides connection to the binary inputs and outputs. At process level, the device is designed as a circuit-breaker controller for bus systems, similar to the merging unit 6MU85.

Overview SIPROTEC 6MD85 and 6MD86 Devices

The SIPROTEC 5 bay controllers are based on the flexible and powerful SIPROTEC 5 modular system. The expandability of expansion modules allows individual adaptation to specific applications.

The bay controllers are categorized into product groups SIPROTEC 6MD85 and SIPROTEC 6MD86. The SIPROTEC 6MD85 is tailored for applications in distribution systems and also used in high-voltage and overvoltage applications.

The SIPROTEC 6MD86 devices are designed for applications in the power-transmission system and can be used with a maximum auxiliary functions.

Both 6MD85 and 6MD86 device types can be configured flexibly as per the hardware variant.

Overview of the SIPROTEC 6MD89 Device

Additionally, Siemens offers the 6MD89 railway bay controller. SIPROTEC 5 railway bay controllers control and monitor plants in railway power supply. They are suitable for the trunk lines and the distribution systems for contact wire power supply. They are equipped with 1-phase or 2-phase measurement and have a rated frequency of 16.7 Hz.

Bay Controller	Description
SIPROTEC 6MD85	Bay controller for control and automation with optional protection functions Expandable hardware
SIPROTEC 6MD86	Bay controller for control, automation, and optional protection functions AREC (79) and SVS (50BF) Expandable hardware
SIPROTEC 6MD89	Bay controllers for railway power supply

Essential Characteristics	6MD84	6MD85	6MD86	6MD89
Circuit-breaker failure protection	-	-	Optional	Optional
Automatic reclosing	-	-	Optional	Optional
Point-on-Wave switching (PoW)	-	-	Optional	-
Phasor measurement unit (PMU)	-	Optional	Optional	-
Synchrocheck	-	Optional	✓	✓
Switching sequences	Optional	Optional	✓	✓
CFC arithmetic	Optional	Optional	✓	✓
CFC measured values: minimum, maximum, and average	Optional	Optional	✓	✓
Number of switching devices greater than 4	Optional	Optional	✓	✓

Common Features

- Modular expansion of the quantity structure
- High-performance automation with CFC
- Configuration of a large number of protection functions (6MD85, 6MD86)
- Optionally usable as Phasor Measurement Unit (PMU) (6MD85, 6MD86)

[pti_bay controller SIPROTEC, 2, --_--]

Figure 5/1 Siemens Bay Controllers

SIPROTEC 6MD84 – Description

Description

The SIPROTEC 5 IO-Box 6MD84 is a full member of the SIPROTEC 5 family. A modular device which provides connection to the binary inputs and outputs. At process level, the device is designed as a circuit-breaker controller for bus systems, similar to the merging unit 6MU85.

Main function	Circuit-breaker controller for process bus applications, IO-Box Modular extendable Powerful automation, simple configuration with DIGSI
Inputs and outputs	AW1: 19 binary inputs, 11 binary outputs (1 life contact, 10 standard)
	AW2: 45 binary inputs, 35 binary outputs (1 life contact, 34 standard)
Hardware flexibility	Flexibly adjustable and expandable I/O quantity structure within the scope of the SIPROTEC 5 modular system. If high requirements are placed on the quantity structure, then device can be extended in the second row. For example, 240 (and more) binary inputs are possible with the IO230.
Housing width	1/3 x 19 inch, 1/2 x 19 inch

Benefits

- The number of binary inputs and outputs can be scaled
- It can be expanded by a second row
- Additional data acquisition (temperature, pressure, and tapchanger setting)
- Cybersecurity in accordance with NERC CIP and BDEW white-paper requirements
- Highest availability even under extreme environmental conditions by standard coating of the modules

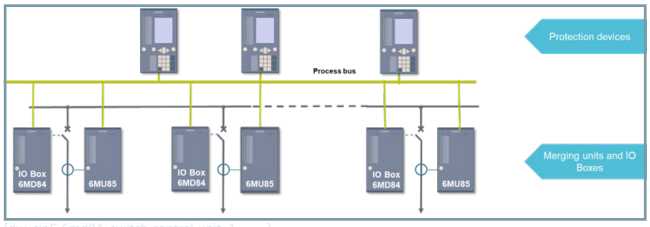
Functions

- Circuit-breaker controller on process level of process bus
- IO-Box for simple control and feedback applications
- Part of decentralized busbar protection system 7SS85 for bays without CTs to send switch positions
- Reliable and redundant data transmission via PRP
- Redundant power supply (optional)
- Expanded temperature ranges (-40 °C to 70 °C)
- Circuit-breaker and disconnector switch functions:
  - Control system with switchgear interlocking
  - Switching statistics

The SIPROTEC 5 6MD84 can be used either as switch control unit on process level in process-bus systems or as modular IO-Box on bay level.

[SIP5_OD_o.LED_W3, 2, --_--]

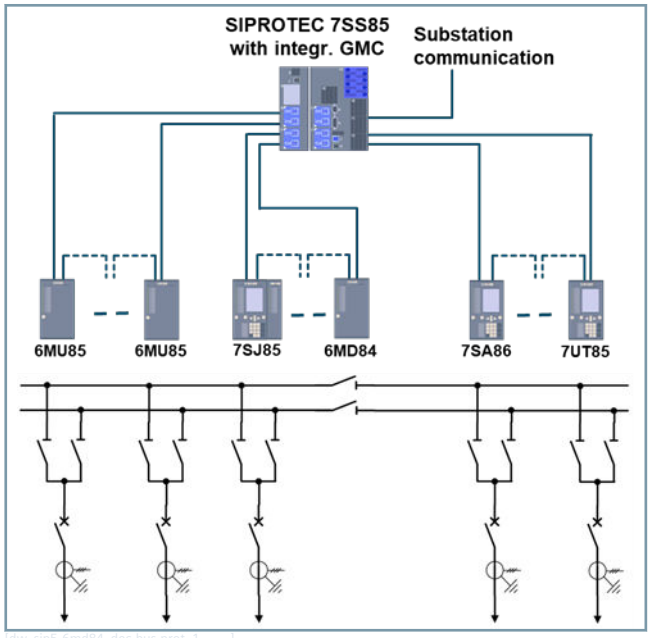
Figure 5.1/1 SIPROTEC 5 IO-Box 6MD84



[dw_sip5-6md84_switch-control-unit, 1, --_--]

Figure 5.1/2 IO-Box in Process Bus Systems as Switch Control Unit

The device can also be used in distributed busbar protection systems to provide information about switching-device positions in bays without measurements (*Figure 5.1/3*). For this purpose, the device supports the communication protocol IEC61850-9-2 MU 7SS85CU.



[dw_sip5-6md84_dec-bus-prot, 1, --_--]

Figure 5.1/3 IO-Box in the Distributed Busbar Protection System

- Pluggable communication modules, usable for different and redundant protocols (IEC 61850-8-1, IEC 60870-5-103, IEC 60870-5-104, Modbus TCP, DNP3 serial and DNP3 TCP, PROFINET IO, PROFINET IO S2 redundancy).
- Serial protection communication via optical fibers, two-wire connections, and communication networks (IEEE C37.94 and others), including automatic switchover between ring and chain topology.
- Extensive cybersecurity functionality, such as:
  - Role-based access control (RBAC)
  - Logging of security-related events
  - Signed firmware or authenticated IEEE 802.1X network access
- Simple, fast, and secure access to the device via a standard Web browser to display all information and diagnostic data, single-line and device display pages.
- Virtual network partitioning (IEEE 802.1Q - VLAN)

The SIPROTEC 6MD84 is delivered with an unconfigured application template.

Type	Description	
AW1	1/3 x 19", 19 BI, 11 BO	
	Housing width 1/3 x 19"	
	No display	
	19 binary inputs	
	11 binary outputs (1 life contact, 10 standard)	
	Contains the modules: base module with PS201 and IO207	

Type	Description	
AW2	1/2 x 19", 45 BI, 35 BO	
	Housing width 1/2 x 19"	
	No display	
	45 binary inputs	
	35 binary outputs (1 life contact, 34 standard)	
	Contains the modules: base module with PS201 and IO207 and extension module IO231	

SIPROTEC 6MD85 – Description

Description

The SIPROTEC 6MD85 bay controller is a general-purpose control and automation device with protection function. It is designed for use in all voltage levels from distribution to transmission. As part of the SIPROTEC 5 family, it enables a wealth of protection functions from the SIPROTEC library. The modular hardware permits integration of the IOs depending on the application. Adapt the hardware exactly to your requirements and rely on future-oriented solutions for protection, control, automation, monitoring, and Power Quality – Basic.

Main function	Bay controller for medium and high to extra-high voltage switchgear with integrated operation and comprehensive protection functions. Powerful automation, simple configuration with DIGSI 5
Inputs and outputs	5 predefined standard variants with 4 current transformers, 4 voltage transformers, 11 to 75 binary inputs, 9 to 41 binary outputs
Hardware flexibility	Flexibly adjustable and expandable I/O quantity structure within the scope of the SIPROTEC 5 modular system. If high requirements are placed on the quantity structure, the device can be extended in the 2nd row. For example, 240 (and more) binary inputs are possible with the IO230.
Housing width	1/3 × 19 inch to 2/1 × 19 inch

Benefits

- Safe and reliable automation and control of your plants
- Purposeful and simple operation of the devices and software thanks to user-friendly design
- Cybersecurity as per NERC CIP and BDEW Whitepaper requirements
- Maximum availability even under extreme environmental conditions by standard coating of the populated printed circuit boards

Functions

DIGSI 5 permits all functions to be configured and combined as required and as per the functional scope that has been ordered.

- Integrated bay controller with versatile protection function from medium to extra-high voltage
- Control of switching devices
- Synchrocheck and switchgear interlocking protection
- Fixed integrated electrical Ethernet RJ45 interface for DIGSI 5 and IEC 61850 (reporting and GOOSE)
- Up to 4 pluggable communication modules, usable for different and redundant protocols (IEC 61850-8-1, IEC 61850-9-2 Client, IEC 60870-5-103, IEC 60870-5-104, Modbus TCP, DNP3 serial and TCP, PROFINET IO, PROFINET IO S2 redundancy)
- Virtual network partitioning (IEEE 802.1Q – VLAN)
- Reliable data transmission via PRP and HSR redundancy protocols
- Arc protection

[SIP5_GD_SS_W3, 2, --_--]

Figure 5.2/1 Bay Controller SIPROTEC 6MD85 (1/3 Device with 1/6 Expansion Module with Key-Switch Operation Panel)

- Extensive cybersecurity functionality, such as role-based access control (RBAC), logging of security-related events, signed firmware, or authenticated IEEE 802.1X network access
- Simple, fast, and secure access to the device using a standard Web browser to display all information and diagnostic data, single-line and device display pages
- Graphical logic editor to create powerful automation functions in the device
- Optional overcurrent protection for all voltage levels with 3-pole tripping
- Also used in switchgear with breaker-and-a-half layout
- Selective protection of overhead lines and cables with single-ended and multi-ended feeders using protection communication
- Overcurrent protection also configurable as emergency function
- Secure serial protection communication, also over great distances and all available physical media (optical fiber, two-wire connections and communication networks)
- PQ – Basic: Voltage unbalance; voltage changes: overvoltage, dip, interruptions; TDD, THD, and harmonics
- Detecting operational measured variables and protection function measured values to evaluate the plant state, to support commissioning, and to analyze faults
- Synchrophasor measured values with the IEEE C37.118 protocol integrated (PMU)
- Powerful fault recording (buffer for a max. record time of 80 s at 8 kHz and 320 s at 2 kHz)
- Auxiliary functions for simple tests and commissioning
- Flexibly adjustable I/O quantity structure within the scope of the SIPROTEC 5 modular system.

Applications

The SIPROTEC 6MD85 bay controller is a general-purpose control and automation device with a protection function based on the SIPROTEC 5 system. The standard variants of the SIPROTEC 6MD85 device are delivered with instrument transformers. Furthermore, protection-class current transformers are also possible in SIPROTEC 6MD85 devices, thus allowing protection functions to be used. Due to its high flexibility, the device is suitable as selective protection equipment for overhead lines and cables with single-ended and multi-ended infeeds when protection communication is used. The device supports all SIPROTEC 5 system characteristics as well as detection and recording of power-quality data in the medium-voltage and subordinate low-voltage power system.

Application Templates

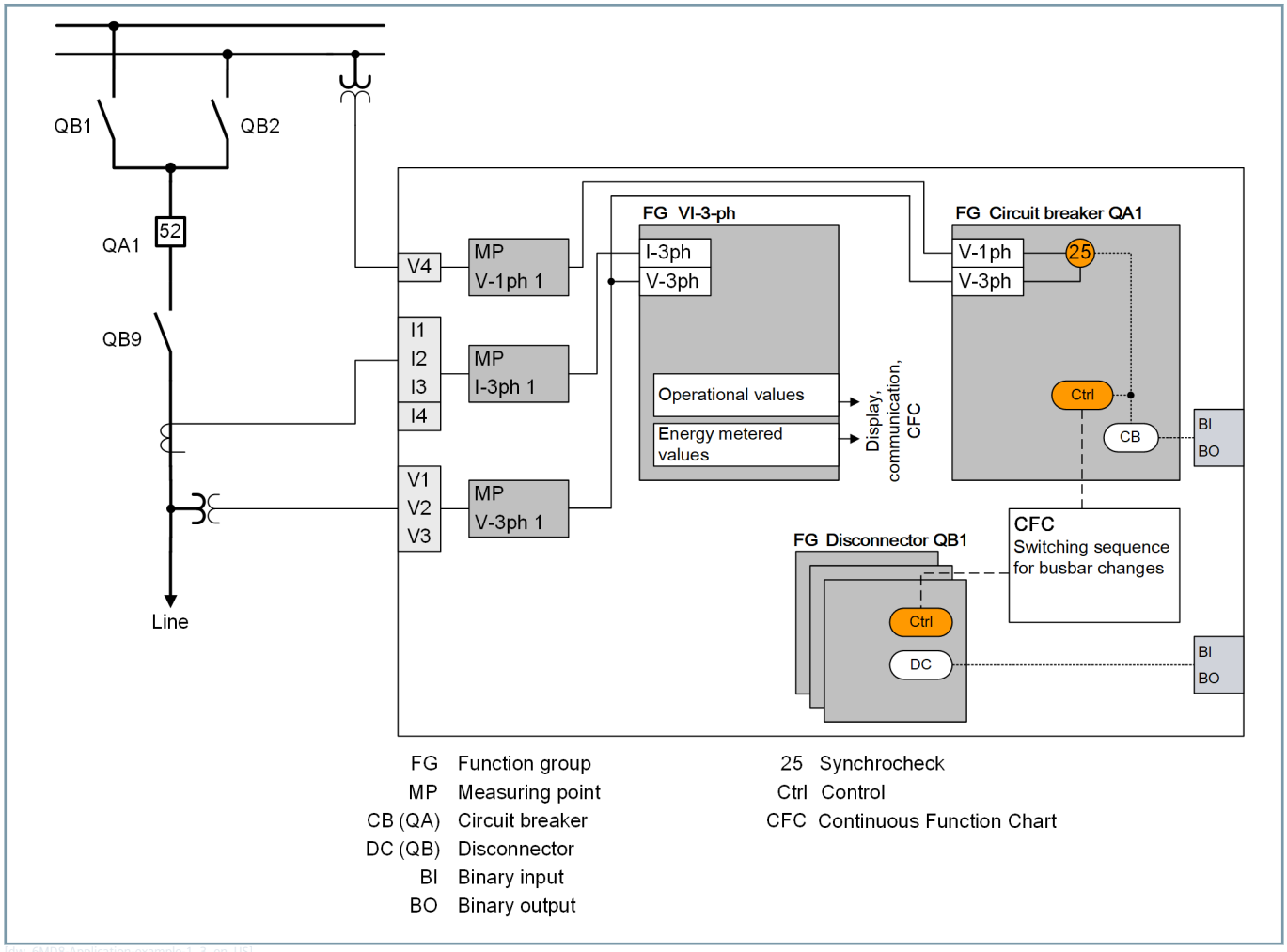
Application templates are available in DIGSI for standard applications. They comprise basic configurations and default settings.

The following application templates are available:

- *SIPROTEC 6MD85 Standard*
  - Double busbar feeder with switchgear interlocking protection
- *SIPROTEC 6MD85 Extended control*
  - In addition to SIPROTEC 6MD85 Standard, also includes the CFC blocks for switching sequences and arithmetic
  - Switching sequence for automatic busbar switchover preconfigured (triggered by function key)

Double Busbar with Switching Sequence

Figure 5.2/2 shows a simple typical application with a SIPROTEC 6MD85 device on a double busbar. The **circuit breaker** function group includes the synchrocheck. The disconnectors are also controlled by one function group each. Operational measured values and energy metered values are calculated in the VI_3-phase function group. They are available for output on the display, transfer to the substation automation technology, and processing in the CFC. A switching sequence stored in the CFC that is activated via a function key starts an automatic flow final node busbar switchover process.



[dw_6MD8-Application-example-1, 3, en_US]

Figure 5.2/2 Application Example: SIPROTEC 6MD85 Bay Controller for Double Busbars with Switching Sequence for Busbar Switchover

	Width of the Mounting Opening
1/3 device (base module)	146^{+2} mm ($5.75^{+0.08}$)
1/2 device (base module with one expansion module)	221^{+2} mm ($8.7^{+0.08}$)
2/3 device (base module with 2 expansion modules)	296^{+2} mm ($11.65^{+0.08}$)
5/6 device (base module with 3 expansion modules)	371^{+2} mm ($14.61^{+0.08}$)
1/1 device (base module with 4 expansion modules)	447^{+2} mm ($17.6^{+0.08}$)

Table 5.2/1 Cut-Out Widths

	Dimension a Housing Widths in mm (in Inches) (Total Width = Housing Width + 5 mm (0.2 in))
1/3 device	145 (5.71)
1/2 device	220 (8.66)
2/3 device	295 (11.61)
5/6 device	370 (14.57)
1/1 device	445 (17.52)

Table 5.2/2 Variable Housing Widths

Selection and Ordering Data

Bay Controllers – 6MD85	
Housing: Extendable, 1/3 x 19" to 2/1 x 19" with painted modules (conformal coating)	
Basic function with hardware standard variant[38]	
	J1: 1/3, 11 BI, 9 BO (1 Life, 2 S, 6 F), 4 current transformers, 4 voltage transformers [39]
	J2: 1/2, 27 BI, 17 BO (1 Life, 10 S, 6 F), 4 current transformers, 4 voltage transformers [40]
	J4: 2/3, 43 BI, 25 BO (1 Life, 18 S, 6 F), 4 current transformers, 4 voltage transformers [40]
	J6: 5/6, 59 BI, 33 BO (1 Life, 26 S, 6 F), 4 current transformers, 4 voltage transformers [40]
	J7: 1/1, 75 BI, 41 BO (1 Life, 34 S, 6 F), 4 current transformers, 4 voltage transformers [40]
Application templates/function points [41]	
	Double busbar, standard
	Extended control (75 function points)
Process-bus functionality/function points [41] [42] [43]	
	Merging-unit functionality for ETH-BD-2FO plug-in module (200 function points)
	Process-bus client functionality (100 function points)
	Connection to the 7SS85 central unit (95 function points)
Warranty extension	
	Warranty extension, annually
Communication	
	Integrated Ethernet interface (RJ45) for DIGSI
	Integrated Ethernet interface (RJ45) for DIGSI and IEC 61850
	Integrated Ethernet interface (RJ45) for DIGSI, IEC 61850 incl. GOOSE[42]
	SIPROTEC 5 plug-in modules
For the product configuration and order no., see *SIPROTEC 5 Configurator*	

Table 5.2/3 SIPROTEC 6MD85 – Selection and Ordering Data

38 Abbreviations: Housing width of 19 inches/BI: Binary inputs/BO: Binary outputs/S: Standard relay/F: Fast relay
39 Small display with 16 LEDs
40 Small display, no key switch, 16 LEDs
41 Available functional scope as specified in the catalog or function-point calculator in the order configurator
42 For CP300 devices only
43 ETH-BD-2FO is required; you cannot simultaneously operate the merging unit and process-bus client on the same plug-in module.

Description

The SIPROTEC 6MD86 bay controller is a general-purpose control and automation device with protection function. It is designed for use in all voltage levels from distribution to transmission. As part of the SIPROTEC 5 family, it enables a wealth of protection functions from the SIPROTEC library. The modular hardware permits integration of the I/Os depending on the application. Adapt the hardware precisely to your requirements and rely on the future-oriented solutions for protection, control, automation, monitoring, and Power Quality – Basic.

Main function	Bay controller for medium and high to extra-high voltage switchgear with integrated operation and comprehensive protection functions; performance automation, simple configuration with DIGSI 5
Inputs and outputs	7 predefined standard variants with 8 current transformers, 8 voltage transformers, 11 to 75 binary inputs, 9 to 41 binary outputs
Hardware flexibility	Flexibly adjustable and expandable I/O quantity structure within the scope of the SIPROTEC 5 modular system. If high requirements are placed on the quantity structure, the device can be extended in the 2nd row. For example, 240 (and more) binary inputs are possible with the IO230 (see Hardware section).
Housing width	1/3 × 19 inches to 2/1 × 19 inches

Benefits

- Safe and reliable automation and control of your plants
- Purposeful and simple operation of the devices and software thanks to user-friendly design
- Cybersecurity in accordance with NERC CIP and BDEW White-paper requirements
- Highest availability even under extreme environmental conditions by standard coating of the populated printed circuit boards

Functions

DIGSI 5 permits all functions to be configured and combined as required and as per the functional scope that has been ordered.

- Integrated bay controller with versatile protection function from medium to extra-high voltage
- Control of switching devices
- Point-on-wave switching
- Synchrocheck, switchgear interlocking protection and switch-related protection functions, such as circuit-breaker failure protection and automatic reclosing
- Fixed integrated electrical Ethernet RJ45 interface for DIGSI 5 and IEC 61850 (reporting and GOOSE)
- Up to 4 pluggable communication modules, usable for different and redundant protocols (IEC 61850-8-1, IEC 61850-9-2 Client, IEC 60870-5-103, IEC 60870-5-104, Modbus TCP, DNP3 serial and TCP, PROFINET IO, PROFINET IO S2 redundancy)
- Virtual network partitioning (IEEE 802.1Q - VLAN)

[SIP5_GD_SS_W3, 2, --_--]

Figure 5.3/1 SIPROTEC 6MD86 (1/3 Device with 1/6 Expansion Module with Key Switch Operation Panel)

- Reliable data transmission via PRP and HSR redundancy protocols
- Extensive cybersecurity functionality, such as role-based access control (RBAC), logging of security-related events, signed firmware, or authenticated IEEE 802.1X network access
- Simple, fast, and secure access to the device via a standard Web browser to display all information and diagnostic data, vector diagrams, single-line and device display pages
- Arc protection
- Graphical logic editor to create powerful automation functions in the device
- Optional overcurrent protection with 3-pole tripping
- Also used in switchgear with breaker-and-a-half layout
- Overcurrent protection also configurable as emergency function
- Secure serial protection communication, also over great distances and all available physical media (optical fiber, two-wire connections and communication networks)
- PQ – Basic: Voltage unbalance; voltage changes: overvoltage, dip, interruption; TDD, THD, and harmonics
- Capturing operational measured variables and protection function measured values to evaluate the plant state, to support commissioning, and to analyze faults
- Synchrophasor measured values with the IEEE C37.118 protocol integrated (PMU)
- Powerful fault recording (buffer for a max. record time of 80 sec. at 8 kHz and 320 sec. at 2 kHz)
- Point-on-wave switching (PoW)
- Auxiliary functions for simple tests and commissioning
- Flexibly adjustable I/O quantity structure within the scope of the SIPROTEC 5 modular system

Applications

The SIPROTEC 6MD86 bay controller is a general-purpose control and automation device with a protection function on the basis of the SIPROTEC 5 system. The standard variants of the SIPROTEC 6MD86 device are delivered with instrument transformers. Furthermore, protection-class current transformers are also possible in SIPROTEC 6MD86 devices, allowing protection functions to be used. Due to its high flexibility, the device is suitable as selective protection equipment for overhead lines and cables with single-ended and multi-ended infeeds when protection communication is used. The device supports all SIPROTEC 5 system characteristics as well as detection and recording of power-quality data in the medium-voltage and subordinate low-voltage power system.

Application Templates

Application templates are available in DIGSI for standard applications. They comprise basic configurations and default settings.

The following application templates are available:

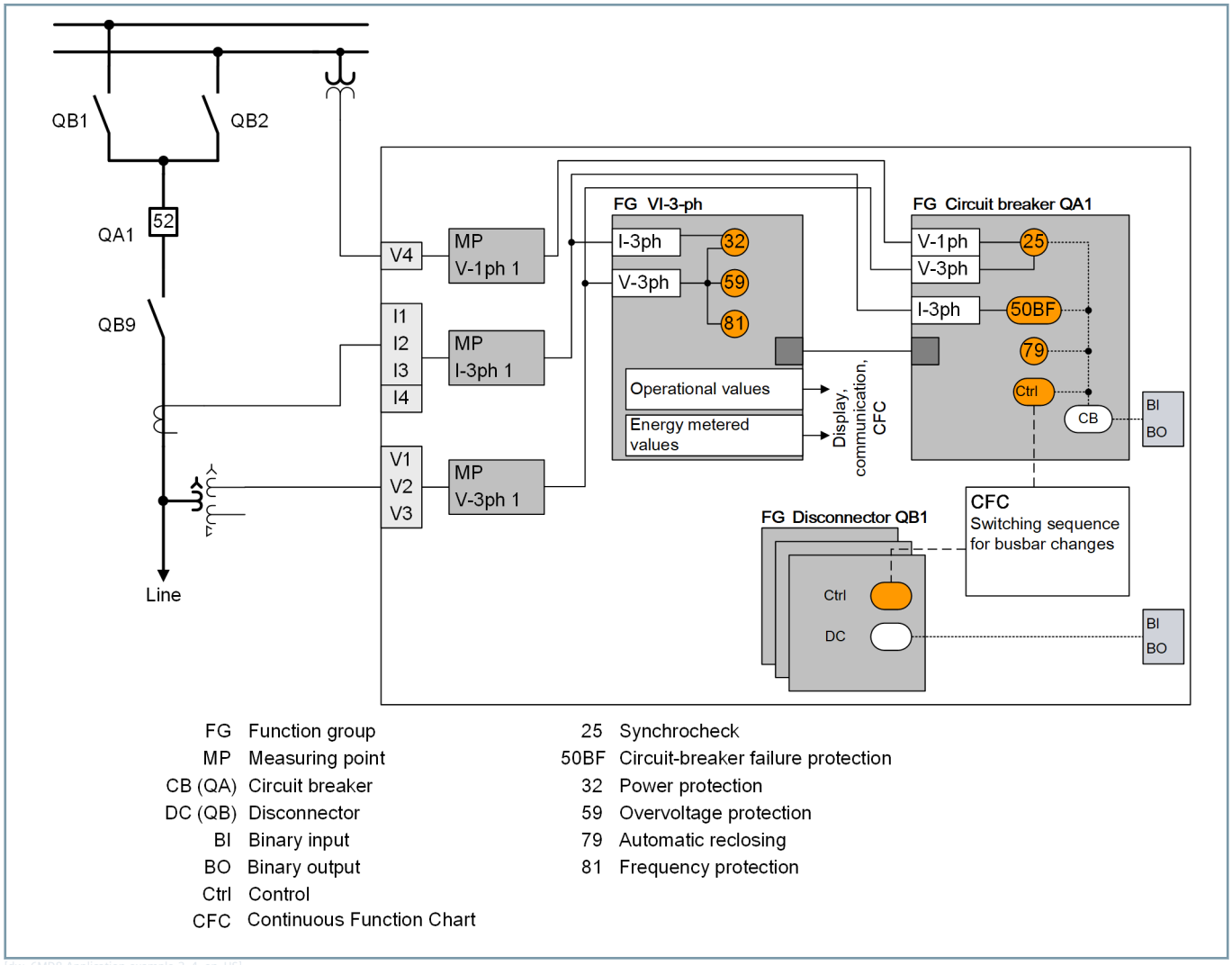
- *SIPROTEC 6MD86 standard double busbar*
  - Double busbar feeder with switchgear interlocking protection
  - Synchrocheck for circuit breaker
  - Switching sequence for automatic busbar switchover preconfigured (triggered by function key)
- *SIPROTEC 6MD86 breaker-and-a-half type 1*
  - Control of a breaker-and-a-half bay (3 circuit breakers, 14 disconnectors)
  - Synchrocheck for the 3 circuit breakers with dynamic measuring-point switchover
- *SIPROTEC 6MD86 breaker-and-a-half type 2*
  - Control of part of a breaker-and-a-half bay
  - Supports concepts with multiple bay controllers per bay
  - Circuit-breaker failure protection and automatic reclosing

SIPROTEC 6MD86 point-on-wave switching

- Preconfiguration for point-on-wave switching (PoW)
- Optimized for the following hardware: Base module with IO202, 2 x IO209 with a high-speed relay, 1 x IO212 (fast 20 mA inputs)

Double Busbar with Protection Functions

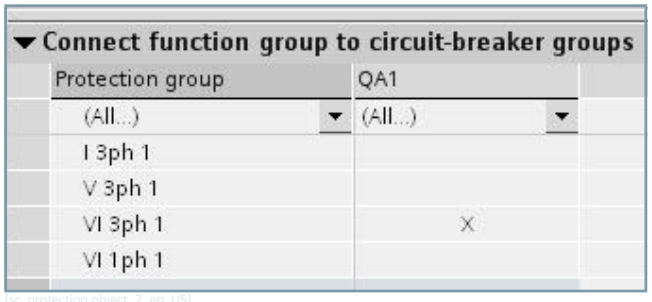
In *Figure 5.3/2* the double busbar feeder is controlled and also protected by a 6MD86. For this purpose, **circuit-breaker failure protection** and **automatic reclosing** are activated in the *circuit breaker* function group. The *UI_3phase* function group contains the protection functions **overvoltage protection**, **frequency protection** and **power protection**. In contrast to *Figure 5.2/2*, it is therefore connected to the circuit breaker so that the resulting trip signals have a destination. Such linkages can quickly and flexibly be created in the DIGSI 5 editor function group connections (*Figure 5.3/3*).



FG	Function group	25	Synchrocheck
MP	Measuring point	50BF	Circuit-breaker failure protection
CB (QA)	Circuit breaker	32	Power protection
DC (QB)	Disconnector	59	Overvoltage protection
BI	Binary input	79	Automatic reclosing
BO	Binary output	81	Frequency protection
Ctrl	Control		
CFC	Continuous Function Chart		

[dw_6MD8-Application-example-2, 4, en_US]

Figure 5.3/2 Application Example: Bay Controller 6MD86 For Double Busbar with Protection Functions

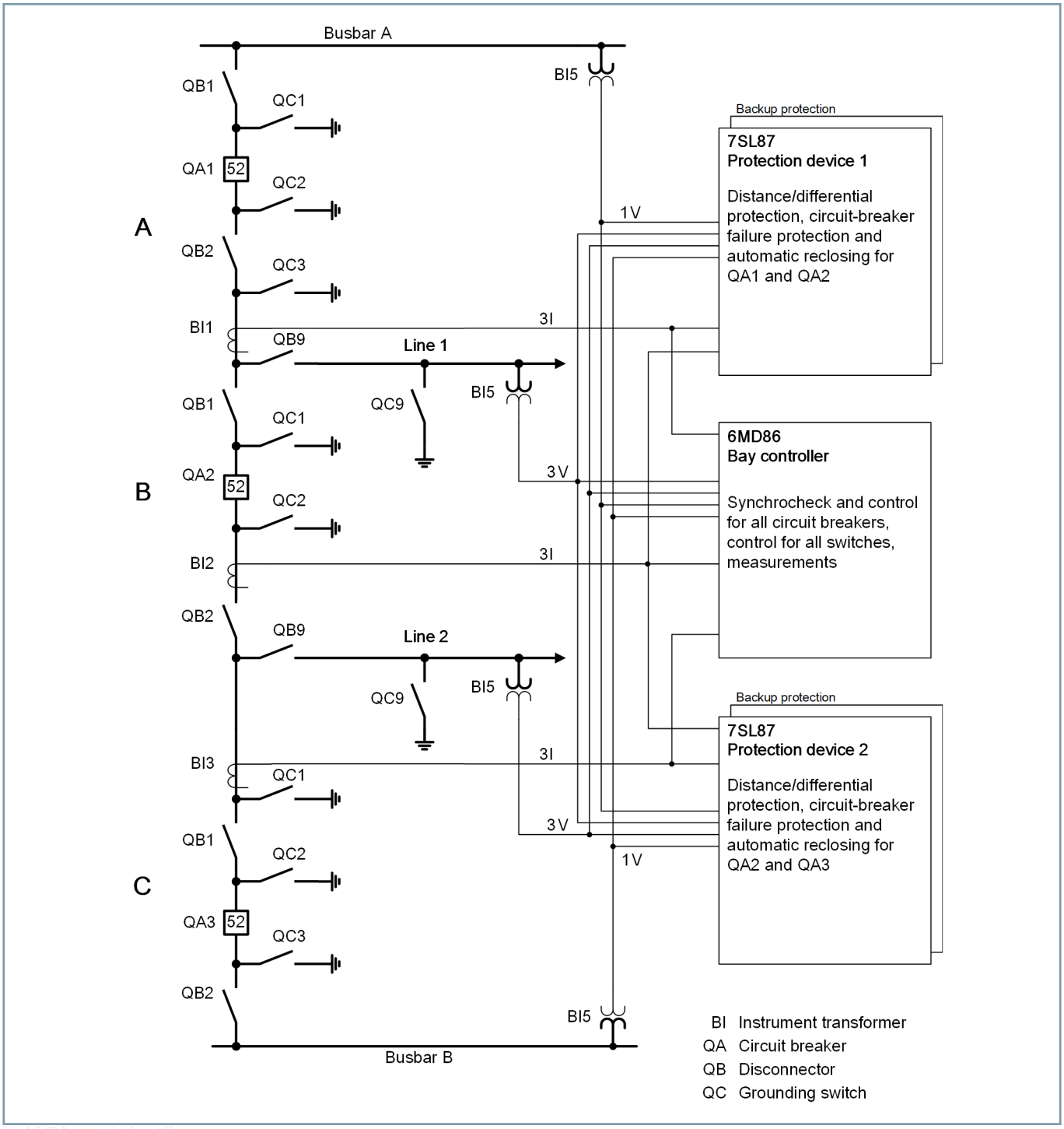


[sc_protection object, 2, en_US]

Figure 5.3/3 Assignment of the Function Group with Protection Functions to the Switch (Protected Object)

Breaker-and-a-half Bay with Protection and Systems Control

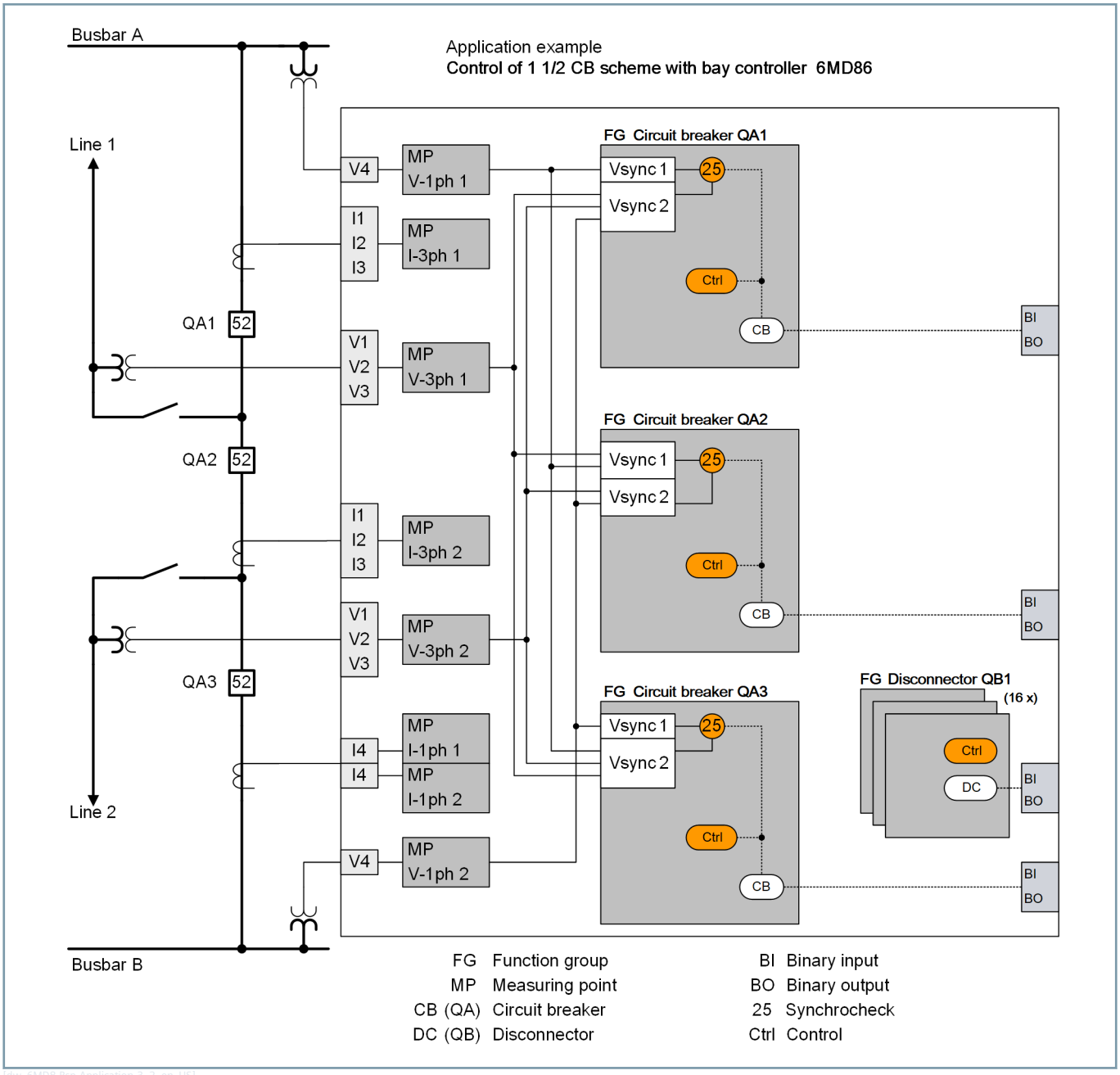
Figure 5.3/4 shows a breaker-and-a-half bay with protection and systems control. It is protected by 2 SIPROTEC 7SL87 line protection devices, which also assume **circuit-breaker failure protection** and **automatic reclosing** of the 3 circuit breakers. Control of all switches and the synchrocheck of the circuit breakers is assumed by the SIPROTEC 6MD86 bay controller. *Figure 5.3/5* provides insight into the functions of the SIPROTEC 6MD86 bay controller.



[dw_1-5_CB-Bay controller, 3, en_US]

Figure 5.3/4 Application Example: Breaker-and-A-Half Layout with a Bay Controller and 2 Line Protection Devices (Overview)

Figure 5.3/5 shows the principle of the dynamic switchover of the voltage measurements for the synchrocheck functions of the 3 circuit breakers in the SIPROTEC 6MD86 bay controller. Each synchrocheck function (ANSI number 25) requires both voltages Vsync1 (feeder voltage) and Vsync2 (reference voltage). With the middle QA2 circuit breaker, there are 2 possibilities for each of the 2 voltages depending on the position of the disconnector and circuit breaker. For the two outer QA1 and QA3 circuit breakers, there is only one possibility (that is, the neighboring busbar), while the other voltage is connected by means of one of the 3 possibilities (likewise depending on the switch position).



[dw_6MD8-Bsp-Application-3, 2, en_US]

Figure 5.3/5 Application Example: Breaker-and-A-Half Layout with a Bay Controller and 2 Line Protection Devices (Detail for Bay Controller)

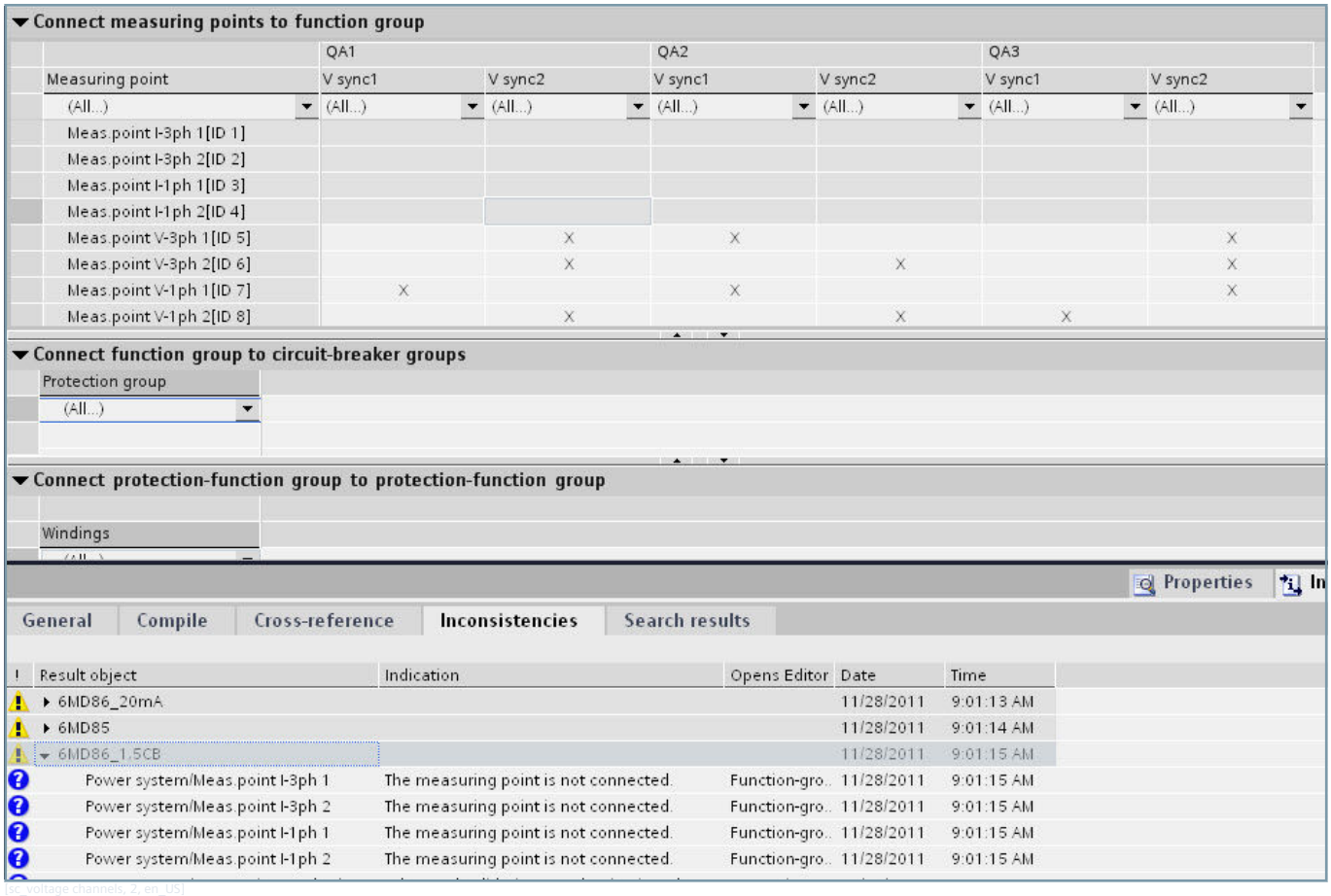


Figure 5.3/6 Routing of the Possible Voltage Terminals to the 3 Circuit-Breaker Function Groups

Figure 5.3/6 shows the routing in the **Function Group Connections** editor. All voltages which are considered as a feeder or reference voltage for the synchrocheck are allocated to the Vsync1 or Vsync2 inputs.

The ID number of the measured values are used to select the voltages which are currently operationally attached in a CFC chart (*Figure 5.3/7*).

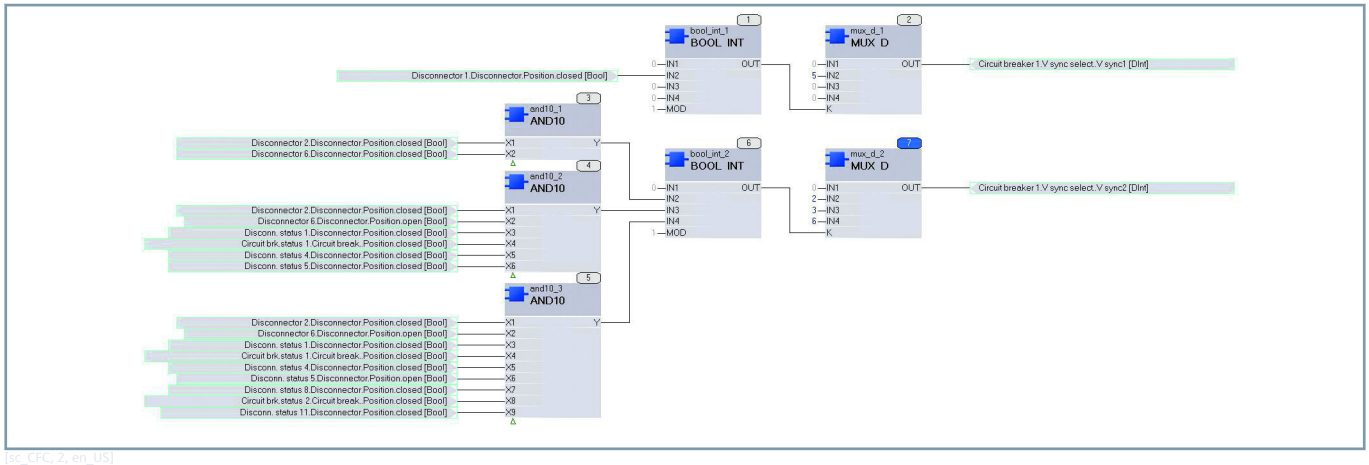
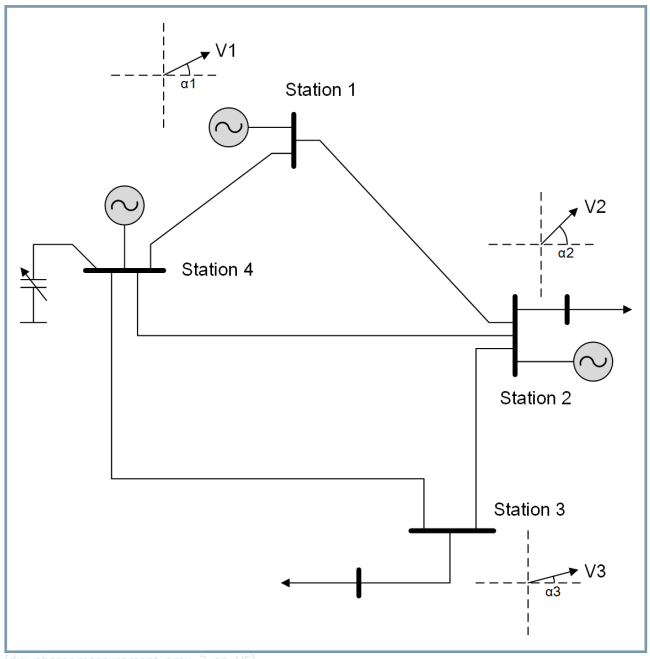


Figure 5.3/7 CFC Chart to Select the Synchrocheck Reference Voltages

Use as a Phasor Measurement Unit

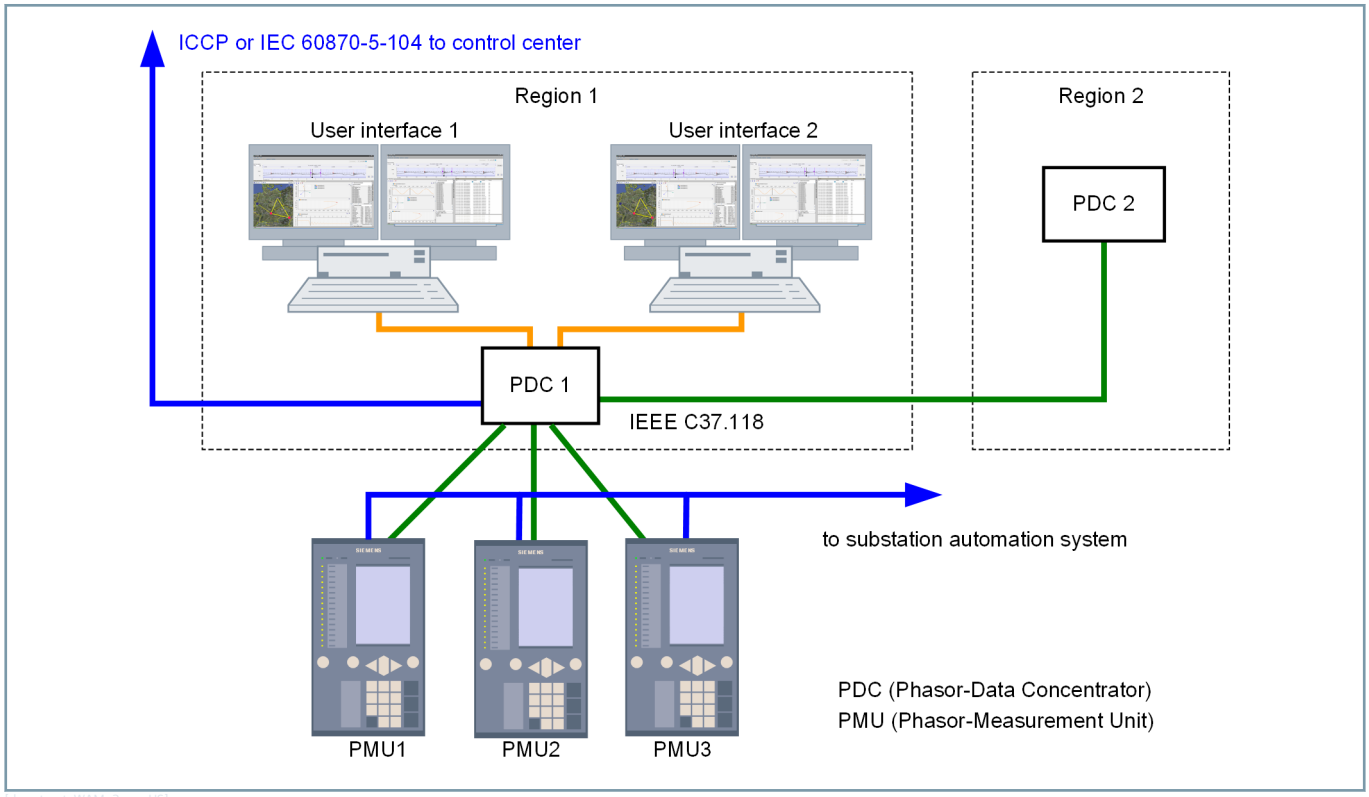
At selected stations of the transmission system, a measurement of current and voltage for absolute value and phase is carried out using PMUs. Due to the high-precision time synchronization (via GPS), the measured values from different substations that are far removed from each other are compared, and conclusions about the system state and dynamic events, such as power fluctuations, are drawn from the phase angles and dynamic curves.



[dw_phasor measurement_pmu, 2, en_US]

Figure 5.3/8 Principle of the Distributed Phasor Measurement

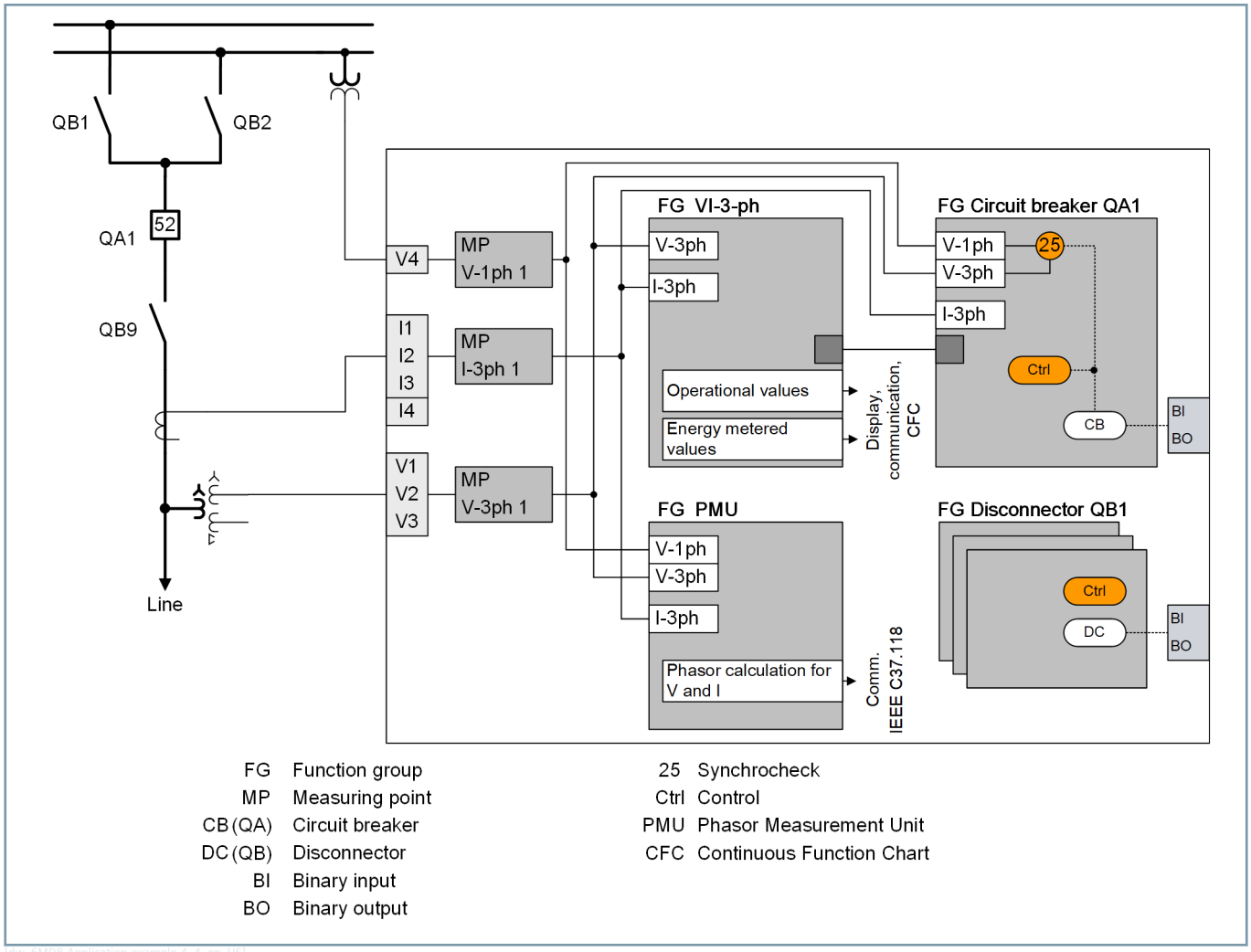
If the *Phasor Measurement Unit* option is selected, the devices determine current and voltage phasors, add high-precision time stamps and send these together with other measured values (frequency, rate of change of frequency) via the communication protocol IEEE C37.118 to an evaluation station, see *Figure 5.3/9*. With the aid of the synchrophasor and a suitable analysis program (for example, SIGUARD PDP), it is possible to automatically detect power swings and trip alarms which, for instance, are sent to the network control center.



[dw_struct_WAM, 3, en_US]

Figure 5.3/9 Connecting 3 Phasor Measurement Units with 2 Phasor Data Concentrators (PDCs) SIGUARD PDP

When the PMU function is used, a **FG PMU** function group is created in the device. This function group calculates the phasor and analog values, performs time stamping and transmits the data with the protocol IEEE C37.118 to the selected Ethernet interface. There, they can be received from one or more clients, saved and processed. Up to 3 IP addresses from clients can be assigned in the device. The multicast method can be used for a larger number of clients.



FG	Function group	25	Synchrocheck
MP	Measuring point	Ctrl	Control
CB (QA)	Circuit breaker	PMU	Phasor Measurement Unit
DC (QB)	Disconnector	CFC	Continuous Function Chart
BI	Binary input		
BO	Binary output		

[dw_6MD8-Application-example-4, 4, en_US]

Figure 5.3/10 Application Example: Double Busbar with SIPROTEC 6MD86 Used as a Bay Controller and Phasor Measurement Unit (PMU)

SIPROTEC 6MD86 – Cut-out and Housing Widths

	Width of the Mounting Opening
1/3 device (base module)	146^{+2} mm ($5.75^{+0.08}$)
1/2 device (base module with one expansion module)	221^{+2} mm ($8.7^{+0.08}$)
2/3 device (base module with 2 expansion modules)	296^{+2} mm ($11.65^{+0.08}$)
5/6 device (base module with 3 expansion modules)	371^{+2} mm ($14.61^{+0.08}$)
1/1 device (base module with 4 expansion modules)	447^{+2} mm ($17.6^{+0.08}$)

5.3

Table 5.3/1 Cut-Out Widths

	Dimension a Housing Widths in mm (in Inches) (Total Width = Housing Width + 5 mm (0.2 in))
1/3 device	145 (5.71)
1/2 device	220 (8.66)
2/3 device	295 (11.61)
5/6 device	370 (14.57)
1/1 device	445 (17.52)

Table 5.3/2 Variable Housing Widths

Selection and Ordering Data

Bay Controllers – 6MD86	
Housing: Extendable, 1/3 x 19" to 2/1 x 19" with painted modules (conformal coating)	
Basic function with hardware standard variant [44]	
	K1: 1/3, 11 BI, 9 BO (1 Life, 2 S, 6 F), 4 current transformers, 4 voltage transformers [45]
	K2: 1/2, 27 BI, 17 BO (1 Life, 10 S, 6 F), 4 current transformers, 4 voltage transformers [46]
	K4: 2/3, 43 BI, 25 BO (1 Life, 18 S, 6 F), 4 current transformers, 4 voltage transformers [46]
	K6: 5/6, 59 BI, 33 BO (1 Life, 26 S, 6 F), 4 current transformers, 4 voltage transformers [46]
	K7: 1/1, 75 BI, 41 BO (1 Life, 34 S, 6 F), 4 current transformers, 4 voltage transformers [46]
	K8: 1/1, 67 BI, 39 BO (1 Life, 26 S, 12 F), 8 current transformers, 8 voltage transformers [46]
Application templates/function points [47]	
	Double busbar, standard
	Breaker-and-a-half, Type 1
	Breaker-and-a-half, Type 2 (75 function points)
	Point-on-wave switching
Process-bus functionality/function points [47] [48] [49]	
	Merging-unit functionality for ETH-BD-2FO plug-in module (200 function points)
	Process-bus client functionality (100 function points)
	Connection to the 7SS85 central unit (95 function points)
Warranty extension	
	Warranty extension, annually
Communication	
	Integrated Ethernet interface (RJ45) for DIGSI
	Integrated Ethernet interface (RJ45) for DIGSI and IEC 61850 without GOOSE
	Integrated Ethernet interface (RJ45) for DIGSI, IEC 61850 incl. GOOSE[48]
	SIPROTEC 5 plug-in modules
For the product configuration and order no., see *SIPROTEC 5 Configurator*	

Table 5.3/3 SIPROTEC 6MD86 – Selection and Ordering Data

44 Abbreviations: Housing width of 19 inches/BI: Binary inputs/BO: Binary outputs/S: Standard relay/F: Fast relay

45 Large display with 16 LEDs and Ethernet module ETH-BA-2EL (electric)

46 Large display with key switch, with 32 LEDs and Ethernet module ETH-BA-2EL (electric)

47 Available functional scope as specified in the function-point calculator in the *SIPROTEC 5 Configurator*

48 For CP300 devices only

49 ETH-BD-2FO is required; you cannot simultaneously operate the merging unit and process-bus client on the same plug-in module.

SIPROTEC 6MD89 – Description

Description

The SIPROTEC 6MD89 bay controller is a universal control and automation device with a protection function for railway applications (1-phase and 2-phase systems with a rated frequency of 16.7 Hz). It is designed for use in all voltage levels from contact wire power supply to power transmission. As part of the SIPROTEC 5 family, it enables a wealth of protection functions from the SIPROTEC library. The modular hardware permits integration of the I/Os depending on the application. Adapt the hardware precisely to your requirements and rely on the future-oriented system solutions with a high level of investment protection and low operating costs.

Main function	Bay controller for railway applications, optimized for 1- and 2-phase systems with a rated frequency of 16.7 Hz. Integrated operation and extensive protection functions are possible. Powerful automation, simple configuration with DIGSI 5
Inputs and outputs	2 predefined standard variants, flexible extension possible
Hardware flexibility	Flexibly adjustable and expandable I/O quantity structure within the scope of the SIPROTEC 5 modular system. If high requirements are placed on the quantity structure, the device can be extended in the 2nd row. For example, 240 (and more) binary inputs are possible with the IO230 (see SIPROTEC 5 Hardware section)
Housing width	1/3 × 19 inch to 2/1 × 19 inch

Benefits

- Safe and reliable automation and control of your plants
- Purposeful and simple operation of the devices and software thanks to user-friendly design
- Cyber security to NERC CIP and BDEW Whitepaper requirements
- Highest availability even under extreme environmental conditions by standard coating of the assemblies
- Powerful communication components ensure safe and effective solutions
- High investment security and low operating costs due to future-oriented system solution

Functions

DIGSI 5 permits all functions to be configured and combined as required.

- Integrated bay controller, optimized for 1-phase and 2-phase systems with a rated frequency of 16.7 Hz.
- Control of switching devices
- Synchrocheck and switchgear interlocking protection
- Fixed integrated electrical Ethernet RJ45 interface for DIGSI 5 and IEC 61850 (reporting and GOOSE)
- Up to 4 pluggable communication modules, usable for different and redundant protocols (IEC 61850, IEC 60870-5-103, IEC 60870-5-104, Modbus TCP, DNP3 serial and TCP, PROFINET IO)

[SIP5_OD_o.LED_W3, 2, --_--]

Figure 5.4/1 Railway Bay Controller SIPROTEC 6MD89 (1/3 Device with 1/6 Expansion Module)

- Reliable data transmission via PRP and HSR protocols
- Extensive cyber security functionality, such as role-based access control (RBAC), logging security-related events or signed firmware
- Simple, quick and secure access to device data via a standard Web browser – without additional software
- Graphical logic editor to create powerful automation functions in the device
- Optional overcurrent protection for all voltage levels with 2-pole tripping
- Overcurrent protection
- Capturing operational measured variables and protection function measured values to evaluate the plant state, to support commissioning, and to analyze faults
- Powerful fault recording (buffer for a max. record time of 20 sec. at 8 kHz and 80 sec. at 2 kHz
- Auxiliary functions for simple tests and commissioning
- Flexibly adjustable I/O quantity structure within the scope of the SIPROTEC 5 modular system

Applications

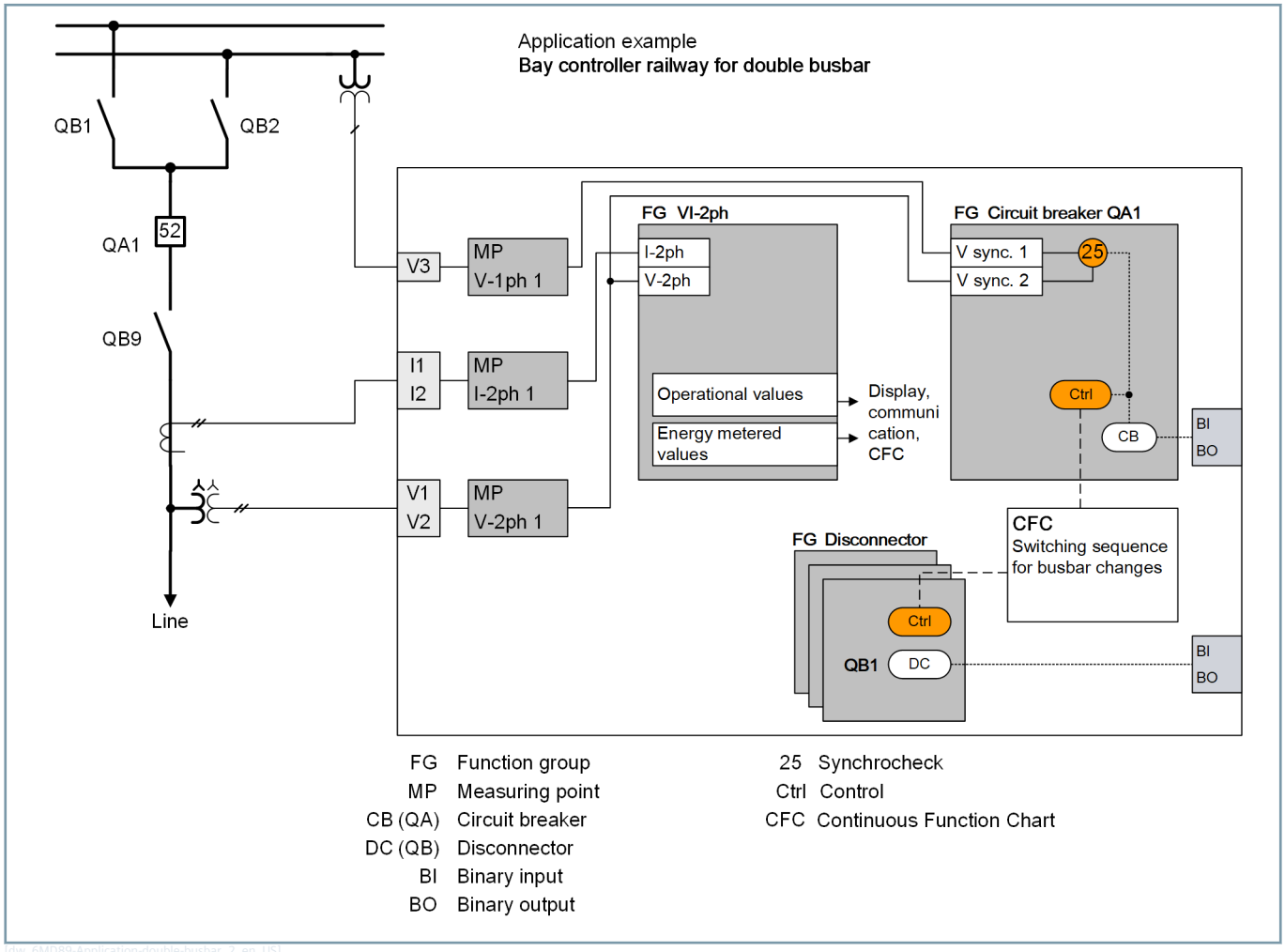
The SIPROTEC 6MD89 bay controller is a general-purpose control and automation device with a protection function for railway applications based on the SIPROTEC 5 system. The device is designed for 1-phase and 2-phase systems with a rated frequency of 16.7 Hz. and supports all SIPROTEC 5 characteristics. The device enables upgradeable system solutions with high investment security and low operating costs.

Application Templates

Application templates are available in DIGSI for standard applications. They comprise basic configurations and default settings.

The following application templates are available:

- *SIPROTEC 6MD89 Standard*
  - Double busbar feeder with switchgear interlocking protection
- *SIPROTEC 6MD89 blank application template*
  - Blank application template for customer-specific engineering



[dw_6MD89-Application-double-busbar, 2, en_US]

Figure 5.4/2 Application Example: Bay Controller Railway 6MD89 for Double Busbar

SIPROTEC 6MD89 – Cut-out and Housing Widths

	Width of the Mounting Opening
1/3 device (base module)	146^{+2} mm ($5.75^{+0.08}$)
1/2 device (base module with one expansion module)	221^{+2} mm ($8.7^{+0.08}$)
2/3 device (base module with 2 expansion modules)	296^{+2} mm ($11.65^{+0.08}$)
5/6 device (base module with 3 expansion modules)	371^{+2} mm ($14.61^{+0.08}$)
1/1 device (base module with 4 expansion modules)	447^{+2} mm ($17.6^{+0.08}$)

Table 5.4/1 Cut-Out Widths

	Dimension a Housing Widths in mm (in Inches) (Total Width = Housing Width + 5 mm (0.2 in))
1/3 device	145 (5.71)
1/2 device	220 (8.66)
2/3 device	295 (11.61)
5/6 device	370 (14.57)
1/1 device	445 (17.52)

Table 5.4/2 Variable Housing Widths

Selection and Ordering Data

Bay Controller – 6MD89	
Housing: Extendable, 1/3 x 19" to 2/1 x 19" with painted modules (conformal coating)	
Basic function with hardware standard variant [50]	
	AB1: 1/3, 11 BI, 9 BO (1 Life, 2 S, 6 F), 4 current transformers, 4 voltage transformers [51]
	AB2: 1/2, 35 BI, 33 BO (1 Life, 26 S, 6 F), 4 current transformers, 4 voltage transformers [52]
Application templates/function points [53]	
	Double busbar, standard
Warranty extension	
	Warranty extension, annually
Communication	
	Integrated Ethernet interface (RJ45) for DIGSI
	Integrated Ethernet interface (RJ45) for DIGSI and IEC 61850 without GOOSE
	Integrated Ethernet interface (RJ45) for DIGSI, IEC 61850 incl. GOOSE
	SIPROTEC 5 plug-in modules
For the product configuration and order no., see *SIPROTEC 5 Configurator*	

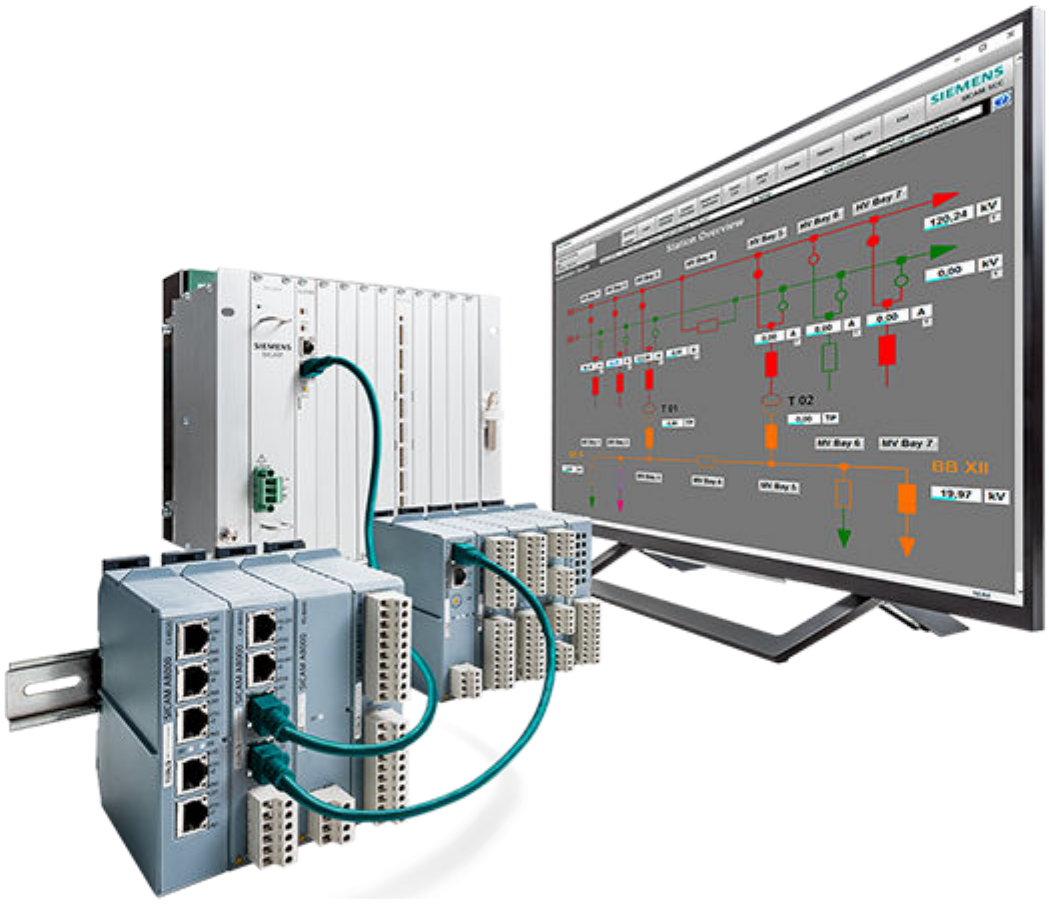
Table 5.4/3 SIPROTEC 6MD89 – Selection and Ordering Data

50 Abbreviations: Housing width of 19 inches/BI: Binary inputs/BO: Binary outputs/S: Standard relay/F: Fast relay

51 Without display, with 16 LEDs and Ethernet module ETH-BA-2EL (electric)

52 Without display, with 32 LEDs and Ethernet module ETH-BA-2EL (electric)

53 Available functional scope as specified in the catalog or function-point calculator in the order configurator


SIEMENS
120.24
kV
0.00
kV
T 01
T 02
MV Bay 6
MV Bay 7
BB XII
19.97
kV

Description

The SICAM A8000 device series has been designed for lots of different tasks, both simple and complex. The area of application spans the entire energy-supply chain. Customer requirements such as IT security, scalability, flexible communication, space-saving design, and the ability to be used in harsh conditions were taken into account when the SICAM A8000 was being designed. The modular SICAM A8000 series offers optimized solutions for all kinds of performance requirements.

SICAM A8000 – Module Types

- Processor modules (up to a max. of 34 interfaces)
- Power-supply modules (DC 24 V to 60 V; DC 110 V to 220 V; AC 230 V)
- Ethernet or serial communication expansion modules
- Interface modules for a max. of 16 expansion lines
- Binary inputs (DC 24 V; DC 48/60 V; DC 110 V; DC 220 V)
- Binary outputs (DC 24/48/60/110/220 V; AC 110/230 V)
- Analog inputs (-20 mA/+20 mA; -10 V/+10 V; Pt 100)
- Analog outputs (-20 mA/+20 mA; -10 mA/+10 mA; -10 V/+10 V)
- Current/voltage inputs (1 A/5 A; LoPo; 230 V)

The universally applicable binary or analog input/output modules can be plugged in any order and are suitable for even the tightest spaces as they have a module width of 30 mm.

Benefits

- They can also be used in harsh ambient temperatures due to the extended temperature range of -40 °C to +70 °C
- The increased EMC stability of up to 5 kV (IEC 60255) qualifies the devices for direct use in switchgears
- Simple engineering with the integrated Web parameterization tool and the SICAM Device Manager
- It meets the most stringent cybersecurity requirements due to an integrated crypto chip and IPSec encryption
- It is a safe investment as international standards such as IEC 61850 IEC 60870-5-101/-103/-104 etc. are followed.
- The modular platform offers a variety of application options and reduces warehousing.
- Adaptation to existing communication infrastructures with a multitude of interfaces and the integrated GPRS module
- The integrated short-circuit indicator functionality enables use in power-system monitoring.
- You can save time and money as installation and maintenance are really simple – plug & play

Device Characteristics

Communication Interfaces and Protocols

- CP-8000: 3 x RJ45 (2 x Ethernet, 1 x RS232), 1 x RS485
- CP-8010: 6 x RJ45 (3 x Ethernet, 1 x RS232), 2 x RS485, 1 x Wireless Gateway, 1 x LTE CAT1/GPRS

[ph_SICAM A8000_5 devices, 1, --_--]

Figure 6.1/1 SICAM A8000 Devices

- CP-8012: 6 x RJ45 (3 x Ethernet, 1 x RS232), 2 x RS485, 1 x Wireless Gateway, 1 x LTE CAT1/GPRS
- CP-8021: 3 x RJ45 (2 x Ethernet, 1 x RS232), 1 x RS485
- CP-8022: 3 x RJ45 (2 x Ethernet, 1 x RS232); 1 x RS485, 1 x RS232/RS485 (selectable), 1 x LTE CAT1/GPRS
- CP-8031: 4 x RJ45 (2 x Ethernet, 1x RS485, 1 x RS232)
- CP-8050: 4 x RJ45 (2 x Ethernet, 1 x RS232, 1 x RS485), up to 12 x Ethernet or 30 x serial with CI modules
- IEC 60870-5-101/-103/-104, Modbus RTU/TCP
- IEC 61850 Ed1/Ed2 client & server incl. GOOSE
- DNP3 serial master/slave, TCP/IP
- Other protocols on request

Auxiliary Voltages

- DC 24 V to 60 V (12 W or 45 W)
- DC 110 V to 220 V (12 W or 45 W)
- AC 230 V (45 W)
- Can be redundant

Inputs and outputs

- CP-8000: max. 116 I/O with up to 6 I/O modules
- CP-8010/CP-8012: max. 144 I/O with up to 8 I/O modules with license 272 I/O with 1 additional expansion row
- CP-8021, CP-8022: max. 128 I/O with up to 8 I/O modules
- CP-8031: max. 128 I/O with up to 8 I/O modules with license 256 I/O with 1 additional expansion row
- CP-8050: max. 2048 I/O with up to 16 expansion lines for every 8 I/O modules

Real-Time Clock

- +/- 2 ppm, time synchronization using NTP protocol, SNTP protocol

Electromagnetic Compatibility

- IEC 60870-2-1, IEC 61010, IEC 60255-5, IEC 61000-4, EN 55022, CE marking

Temperature Range

- CP-8000, CP-8010, CP-8012, CP-8021, CP-8022: from -40 °C to +70 °C
- CP-8021, CP-8022: From -40 °C to +70 °C
- CP-8031, CP-8050: From -25 °C to +70 °C [54]

Housing Specifications

- Plastic housing for DIN rail mounting
- Dimensions of the CP-8000: 128 mm x 124 mm x 123 mm (W/H/D)
- Dimensions of the CP-8010, CP-8012: 153.5 mm x 160 mm x 123 mm (W/H/D) (without DIN rail, including connectors and terminals, locking hooks closed)
- Dimensions of the CP-8021/22/31/50, CI, power-supply module and I/O modules: 30 mm x 132 mm x 124 mm (W/H/D)

Special Features

- Optional display module CM-8880 available for CP-8010 and CP-8012
- Integrated display and function keys for CP-8000
- Integrated Web server for configuration and diagnostics with CP-8000/21/22, engineering using the SICAM Device Manager for the A8000 series
- Data storage using an SD memory card (parameters and device firmware)
- Freely programmable user programs according to IEC 61131-3
- Device redundancy with CP-8050
- The security requirements of the future:
  - Compliance with the BDEW white paper
  - Integrated crypto chip
  - TLS encryption
  - IPSec encryption
  - HTTPS protocol
  - Security Logbook
  - Integrated software firewall
  - Firmware signature
  - Role-based access control
  - Configurable system functions
  - Hardware-based application layer firewall for IEC 60870-5-104
  - Automated certificate handling via the EST protocol with SICAM Grid Pass

For further information see *Fields of Application, Page 25* .

54 -40 °C on request

SICAM DCM – Description

Description

In modern Medium Voltage (MV) electrical systems, ensuring operational reliability, safety, and efficiency is paramount. SICAM DCM - Detection, Control & Monitoring is a modular solution which plays a critical role in achieving these objectives by providing a comprehensive framework for real-time system awareness, intelligent control, and proactive maintenance.

SICAM DCM comprises of a PS–5660 (power supply module) and MV–5511 (fault detection module) and is designed to detect anomalies, faults, and monitor operational conditions across MV networks and operate circuit breakers or load break switches. The modular solution can be extended up-to 6 MV–5511 fault detection devices with 1 PS–5660 module on a high-speed backplane. The MV–5511 module is connected to the PS–5660 module, which is then linked to the CP-801x module via an RJ45 Ethernet interface, facilitating communication with the remote-control centre.

The capabilities of the SICAM DCM MV–5511 include:

- Detection of faults, overloads, and abnormal conditions in real-time
- Monitoring of electrical parameters such as voltage, current, power, and energy measurements
- Control of switching operations of switchgear – circuit–breaker or load break switch
- Advanced automation functions in conjunction with CP-801x

By leveraging the SICAM DCM module(s), MV systems can enhance grid monitoring and stability.

Its modular and scalable architecture ensures compatibility with both legacy and modern infrastructure, making it a vital component in the evolution of smart grid technologies.

Benefits

- Efficient power flow management: Seamlessly manages bidirectional and intermittent power flows, crucial for modern grids
- Reliable fault detection: Offers overcurrent protection and reliable fault detection, crucial for DER-integrated networks
- Improved grid availability: Increases grid availability, reducing system average interruption duration index (SAIDI) and enhancing performance across MV and LV networks
- Minimized downtime: Quickly identifies medium voltage faults using current measurements, minimizing operational disruptions
- Automated network reconfiguration: Implements flexible control strategies for automated reconfiguration post-faults, ensuring continuity
- Increased efficiency: Optimizes network operations to meet rising energy demands efficiently
- Better asset management: Enables continuous monitoring of transformers and substations, improving lifespan and reducing unforeseen failures
- Load management: Effectively manages load shedding and peak shaving to maintain consumption balance

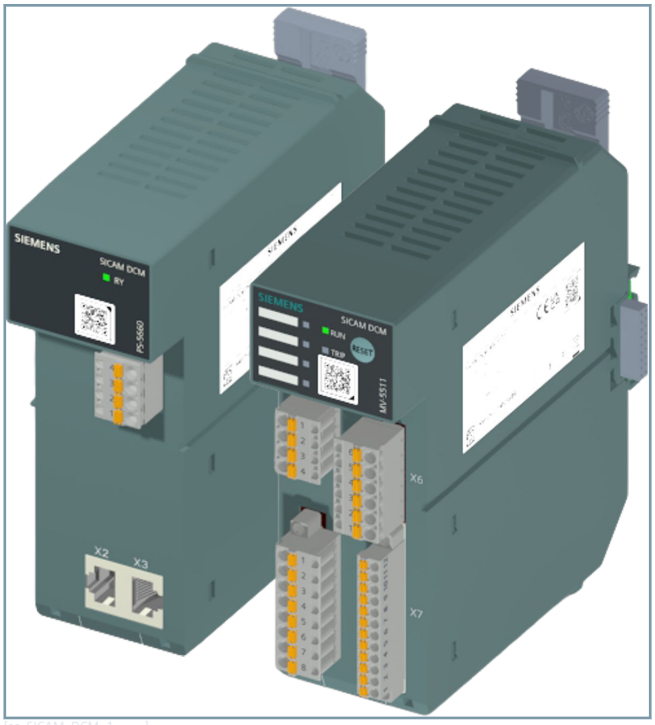


Figure 6.2/1 SICAM DCM Devices

- Cost reduction: Lowers installation, operational, and maintenance expenses through efficient solutions
- Investment optimization: Offers a scalable and modular approach to automation, ensuring cost-effective scaling
- Simplified operations: Provides a unified solution that reduces the need for extensive training and operations management

Functions

Protection Functions

- 27 Undervoltage protection – 3-phase
- 37 Undercurrent protection – phase
- 46 Negative sequence overcurrent
- 50 Instantaneous overcurrent – phase
- 50N Instantaneous earth fault – calculated
- 50GS Instantaneous sensitive earth fault – measured
- 51 Time–delayed overcurrent – phase
- 51N Time–delayed earth fault – calculated
- 51GS Time–delayed sensitive earth fault – measured
- 59 Overvoltage protection – 3 phase
- 67 Directional overcurrent – phase
- 67N Directional earth fault – calculated
- 67GS Directional sensitive earth fault – measured
- 67GS Directional sensitive earth fault – measured cos phi/sin phi

Supervision Functions

- 46BC Broken conductor detection
- 81HBL2 Inrush current detection
- Fault classification – transient or persistant

Communication

The SICAM DCM system uses a proprietary communication protocol known as Commlink for connecting the MV-5511 modules with the master CP-801x module. This ensures a robust and secure data exchange framework for constant system monitoring and control.

For external communications, the CP-801x module interfaces with control centers using standard protocols like IEC 60870-5-104, DNP3, or IEC 61850. This versatility allows the SICAM DCM system to be integrated into a wide range of control center environments, making it a flexible solution for numerous application scenarios.

Configurator Web Software

Supports SICAM Device Manager tool (SICAM DCM Application) for configuration/parameterization and firmware upload via RJ45.

Applications

- Directional short circuit and ground fault detection: It effectively identifies faults in medium voltage systems, including solid, isolated, compensated, and resistive grounded networks.
- Ring main unit monitoring and control: Offers comprehensive management capabilities for ring main units, ensuring optimal performance.
- Automatic sectionalising: Enhances network reliability through automatic isolation of faulted sections.
- Centralised self-healing network applications: Promotes network reliability and uptime by automatically restoring power through alternative paths.

SICAM DCM – Technical Data

Technical Data Overview (MV-5511 + PS-5660)

LEDs	6 LEDs (MV-5511) 1 LED (PS-5660)
Measuring inputs	1 A
Auxiliary voltage	DC 24 V to 60 V
Communication	Proprietary communication protocol: Commlink
Protection functions	50/51/67, 50N/51N/67, 50Gs/51Gs/67Gs, 46, 27, 59, 37
Supervision and control functions	46BC, 81HBL2, fault classification
Digital input	6 DI
Digital output	4 DO (1 changeover contact)
Overvoltage	Category III
Pollution degree	2

Mechnical Data

Dimensions (for both MV-5511 and PS-5660) in mm	50 x 147 x 142 (W x H x D)
Weight (MV-5511)	600 g
Weight (PS-5660)	500 g
Mounting (for both MV-5511 and PS-5660)	DIN-rail mounting

Current Inputs

Quantity	3 x phase and 1 x earth (ground)
Rated current I_{rated}	1 A
Measuring range	50 A 8 A (Sensitive-earth fault –SEF)
Instrumentation	± 0.5 % (0.2 A to 6 A) ± 3 % (< 0.2 A and > 6 A)
	SEF: 0.01 A to 0.5 A (± 1 %) ± 3 % (> 0.5 A)
Frequency	50 Hz (Range: 47.5 Hz to 52.5 Hz) 60 Hz (Range: 57 Hz to 63 Hz)
Thermal withstand continuous	10 A
Thermal withstand short time	120 A for 1 s 50 A for 10 s
Burden @ I_{rated}	≤ 0.02 VA (1 A phase and earth element)

Voltage Inputs

Operating range	3 Vrms to 60 Vrms
Instrumentation	10 V to 30 V ± 1 %
Internal impedance	20 MΩ
Overoltage withstand	60 V

Auxiliary Supply (DC 24 V to 60 V)

Rated voltage	DC 24 V to 60 V Tolerance -20 % to +20 %
Allowable superimposed AC component	15 % of direct voltage
Power consumption max	< 45 W (when 36 W loaded at the output)
Power consumption rated	< 30 W (with 6 x MV-5511 connected)
Maximum interruption time (Collapse to 0)	50 ms (DC 24 V)
Reverse voltage protection	Yes
Overload protection	Yes
Short-circuit protection	Yes
Inrush peak current	Specified acc. to IEC 60870-4 (90) class S1

Digital Inputs

Number	6
DI threshold	18 V
DI operating range	18 V to 60 V
DI control voltage	V_{low} ≤ DC 10 V
	V_{high} ≥ DC 18 V
Current consumption on single DI, excited	DC 0.5 mA to 2 mA
Power consumption on single DI	120 mW maximum
Maximum permitted voltage	DC 60 V
Pickup time	10 ms typical
Dropout time	10 ms typical

Digital Outputs

Number	4 (1 change-over contacts)	
Operating voltage	Voltage-free	
Operating time from energizing digital input	< 20 ms	
Disengaging time	< 20 ms	
Switching voltage	AC 250 V and DC 250 V	
Making capacity	Carry continuous: 8 A, DC 24 V (X6 terminal) 5 A, DC 24 V (X7 terminal) Make and carry: Inductive: 1000 W for 0.5 s at L/R= 40 ms Resistive: 30 A, DC 250 V for 0.2 s	
Making capacity (L/R ≤ 40 ms)	1000 W (V/I=48/21; 110/9.5; 220/4.9)	
Breaking capacity		
DC inductive	30 W at L/R ≤ 40 ms	V/I = 24/1.3; 48/0.7; 110/0.3; 220/0.14
Mechanical endurance	10 000 operations	

Communication Port

Number	2
Electrical connection	RJ45, 2-wire electrical
Protocol support	Commlink
Rate	Transmission rate: 100 Mbps

Data Storage

Fault record	50
Events	500 events (1-ms resolution)

Type Testing

Climatic Stress Test

Tests	Specification	Test standard	Class	Product standard	Class
Dry heat test					
Operational	+70 °C, 96 h	IEC 60068-2-2	Be	IEC 60255-1	-
Storage	+70 °C, 96 h	IEC 60068-2-2	Bb	IEC 60870-2-2	C3
Cold test					
Operational	-40 °C, 96 h	IEC 60068-2-1	Ae	IEC 60255-1	-
Storage	-40 °C, 96 h	IEC 60068-2-1	Ab	IEC 60870-2-2	C3
Damp heat-cyclic test (12 h +12 h cycle)	+25 °C to +55 °C 95 % RH (6 cycles with 12 h + 12 h)	IEC 60068-2-30	Db	IEC 60255-1	-
Damp heat-steady state test	+40 °C and 95 % RH (10 days)	IEC 60068-2-78	Cab	IEC 60255-1	-
Change of temperature test	Lower temperature: -40 °C Upper temperature: +70 °C (5 cycles with 3 h + 3 h)	IEC 60068-2-14	N	IEC 60255-1	-

Table 6.2/1 Climatic stress test

Permissible humidity	95 % relative humidity
Siemens recommends installing the devices in a place where they are not exposed to direct sunlight or great temperature variations that could lead to condensation.	

Table 6.2/2 Humidity

Electrical Tests

Tests	Circuits	Value	Product standard
Dielectric	Between current inputs and GND	2.5 kV/60 s	IEC 61010-1 IEC 60255-27
	Between voltage inputs and GND	3.0 kV/60 s	
	Between digital inputs and GND	2.5 kV/60 s	
	Between digital outputs and GND	3.0 kV/60 s	
	Across open contact	1.0 kV/60 s	
Insulation resistance	Between current inputs and GND	500 V, >100 MΩ	
	Between voltage inputs and GND	500 V, >100 MΩ	
	Between digital inputs and GND	500 V, >100 MΩ	
	Between digital outputs and GND	500 V, >100 MΩ	
Impulse	Between current inputs and GND	5000 V, 1.2/50 µS	
	Between voltage inputs and GND	5000 V, 1.2/50 µS	
	Between digital inputs and GND	5000 V, 1.2/50 µS	
	Between digital outputs and GND	5000 V, 1.2/50 µS	

Table 6.2/3 Insulation tests for SICAM DCM MV-5511

Tests	Circuits	Value	Product standard
Dielectric	Between auxiliary input and GND	(3.0 kV 60 s)/ (3.8 kV 5 s)	IEC 61010-1 IEC 60255-27
	Between communi-cation and GND	(1.6 kV 60 s)/ (1.8 kV 5 s)	
Insulation resistance	Between auxiliary input and GND	500 V, >100 MΩ	
	Between communi-cation and GND	500 V, >100 MΩ	
Impulse	Between auxiliary input and GND	5000 V, 1.2/50 µS	
	Between communi-cation and GND	2500 V, 1.2/50 µS	

Table 6.2/4 Insulation tests for SICAM DCM PS-5660

Mechanical Tests

Tests	Standard	Tests Requirements
Vibration response	IEC 60255-21-1, Class 2	Frequency: 10 Hz to 150 Hz, Acceleration 1 g, Frequency sweep: 1 octave/min 1 cycle in 3 orthogonal axes
Shock response	IEC 60255-21-2, Class 2	Acceleration 10 g, duration 11 ms Each 3 shocks (in both directions of the 3 axes)
Seismic vibration	IEC 60255-21-3, Class 2	Frequency: 5 Hz to 35 Hz Displacement: 7.5 mm (horizontal axis), 3.5 mm (vertical axis) Acceleration: 2 g (horizontal axis), 1 g (vertical axis) Frequency sweep 1 octave/min 1 cycle in 3 orthogonal axes

Table 6.2/5 Vibration and Shock Resistance during Stationary Operation

Tests	Standard	Tests Requirements
Vibration endurance	IEC 60255-21-1, Class 1 IEC 60068-2-6	Frequency: 5 Hz to 500 Hz Acceleration: 1 g and 1.5 g Frequency sweep 1 octave/min 20 cycles in 3 orthogonal axes
Shock endurance	IEC 60255-21-2, Class 1	Acceleration 15 g, duration: 11 ms Each 3 shocks (in both directions of the 3 axes)
Bump test	IEC 60255-21-2, Class 1	Acceleration: 10 g, duration 16 ms 1000 bumps each in both directions of the 3 axes

Table 6.2/6 Vibration and Shock Resistance during Transport

Tests	Standard	Tests Requirements
Degree of protection	IEC 60529	IP20

Table 6.2/7 Enclosure Degree of Protection

EMI/EMC Tests for Immunity

Tests	Standard	Tests Requirements
Electrostatic discharge immunity test	IEC 61000-4-2 IEC 60255-26 IEC 61326-1 IEC 60870-2-1	± 8 kV contact discharge (direct and indirect) ± 15kV air discharge[55] Both polarities
Radiated electromagnetic field immunity test	IEC 61000-4-3 IEC 60255-26 IEC 61326-1 IEC 60870-2-1	80 MHz to 2.7 GHz (10 V/m) 2.7 GHz to 6 GHz (3 V/m) 80 % AM (1 KHz), ± 1 % sweep rate
Power frequency magnetic field immunity test	IEC 61000-4-8 IEC 60255-26 IEC 61326-1 IEC 60870-2-1	100 A/m (continuous) and 1000 A/m (short duration for 3 s) on the X, Y, and Z axis of the product
Impulse magnetic field immunity test	IEC 61000-4-9	1000 A/m (peak) DC input – 5 positive and 5 negative impulses Orientation on X, Y, and Z axis of the product, repetition rate: 10 s
Damped oscillatory magnetic field immunity test	IEC 61000-4-10 IEC 60870-2-1	100 A/m Test duration: 2 s Oscillation frequency: 0.1 MHz and 1 MHz Repetition rate: 40 transients at 0.1 MHz and 400 transients at 1 MHz
Electrical fast transient/burst immunity test	IEC 61000-4-4 IEC 60255-26 IEC 61326-1 IEC 60870-2-1	Test amplitude: ± 4 kV Repetition frequency: 5 kHz Pulse: 5/50 ns
Surge immunity test	IEC 61000-4-5 IEC 60255-26 IEC 61326-1 IEC 60870-2-1	Pulse: 1.2 (8) µs/50 (20) µs Common mode: ± 4 kV Differential mode: ± 2 kV Source impedence: 2 Ω
Conducted susceptibility test	IEC 61000-4-6 IEC 60255-26 IEC 61326-1	150 kHz to 80 MHz (10 V); 80 % AM (1 kHz)

55 15 kV: front enclosure, connector, cables and LED's , 8 kV: enclosure

Tests	Standard	Tests Requirements
Damped oscillatory wave test	IEC 61000-4-18 IEC 60255-26 IEC 60870-2-1	Slow damp Frequency: 100 kHz and 1 MHz Common mode: ± 2.5 kV Differential mode: ± 1 kV Fast damp Frequency: 3 MHz/10 MHz/30 MHz Common mode: ± 2 kV
Conducted power frequency immunity test on binary inputs	IEC 61000-4-16 IEC 60255-26	Frequency: 16 $^{2/3}$ Hz, 50 Hz, and 60 Hz Common mode 300 V, 1 s 30 V, 60 s Differential mode 150 V, 1 s
Voltage dips (DC)	IEC 61000-4-29 IEC 60255-26	40 % dip Duration (s): 0.2, 0.3, 1.0; criterion C 70 % dip Duration (s): 0.3, 0.5, 1.0; criterion C 0 % interruption Duration (s): 0.05, criterion A
Voltage interruptions (DC)	IEC 61000-4-29 IEC 60255-26	0 % interruption Duration (s): 5.0, criterion C
Voltage variation (DC)	IEC 61000-4-29	± 20 % of rated DC voltage Duration (s): 0.1, 0.3, 1.0, 3.0, and 10
Gradual shutdown/ startup (DC)	IEC 60255-26	Shut down ramp: 1 min Power off: 5 min Start-up ramp: 1 min Criterion: C
Ripple on DC input power port immunity test	IEC 61000-4-17 IEC 60255-26	15 % of rated DC voltage 50 Hz/60 Hz
Ring wave immunity test	IEC 61000-4-12	Frequency: 100 kHz Common mode: ± 4 kV Differential mode: ± 2 kV Output impedance: 12 Ω and 30 Ω

Table 6.2/8 EMC Tests for Interference Immunity

Tests	Standard	Tests Requirements
Conducted emission test	CISPR 32 IEC 60255-26	150 kHz to 30 MHz (Class A)
Radiated emission test	CISPR 11 CISPR 32 IEC 60255-26	30 MHz to 1 GHz (Class A) 1 GHz to 6 GHz (Class A)

Table 6.2/9 EMC Tests for Interference Emission

Description	Order no.											
	1	2	3	4	5	6	7		8	9	10	11	12
SICAM DCM	6	M	F	2	5	□	□	-	□	□	□	0	0
						▲	▲		▲	▲	▲		
Power supply module (PS-5660)						|	|		|	|	|		
DC 24 V to 60 V, 2 RJ45 ports to interface to CP801x						6	6		0	T	P		
Fault detection module (MV-5511)						|	|		|	|	|		
3 OC inputs + 1 CBCT input, VDIS LRM voltage input, 6 digital inputs, 4 digital outputs, 6 LEDs for status and fault indication, highspeed backplane ethernet communication and power supply with end bus connector for ring topology						5	1		1	M	V		

Accessories

To establish a connection between the MV-5511 and VDIS LRM device, a VDIS Interface cable is required. This accessory must be ordered separately in addition to MV-5511 unit.

Description	Order no.											
	1	2	3	4	5	6	7		8	9	10	11	12
Voltage detection and indication system (VDIS) Interface cable (10 m)	6	M	F	2	5	9	0	-	8	M	C	1	0

Description

The SIPROTEC 7SC80 distribution system protection is used for protection and automatic functions in feeders with a grounded, low-impedance grounded, isolated or compensated neutral point design.

Protection functions can be configured flexibly; the user can create up to 20 additional protection functions specifically for his requirements. Primary switching devices such as grounding conductors, disconnector switches and load switches/circuit breakers can be monitored.

With the integrated programmable logic (CFC), the user can implement his own functions, such as automation of a bay (interlocking, load shedding programs). The option of generating user-specific messages demonstrates the versatility of the device.

The device has attachable or Web-based HMI 32 LEDs and 9 freely programmable function keys for direct shortcuts or various applications.

Special features

- Support of applications for distribution-system automation
- Designed for harsh environmental conditions
- Extended temperature range from -50 °C to 85 °C
- Flexible communication possibilities, for example for radio transmission specifically for feeder automation
- Built-in GPS module or IRIG B for time synchronization
- Remote access for firmware and parameter updates
- Meets security requirements of the BDEW
- The Web-based HMI allows complete remote control and telemonitoring of the device.
- 9 freely programmable function keys
- 6-line display
- Integrated switch for cost-effective and redundant optical ring feeders; for electrical modules, this can be used for directly cascading (concatenating) devices
- Communication protocols running in parallel
- Redundancy protocols RSTP, PRP and HSR for maximum availability
- Jump detection for currents and voltages
- Expanded programming functions
- Single-mode interface for 24 km
- RTU version without protection function
- Plug-in connections
- Secondary current transformer values (1 A/5 A) can be adjusted with DIGSI
- Back-up battery can be replaced without opening the device
- USB front interface
- Inter-device communication via Ethernet with IEC 61850 GOOSE
- Stainless steel housing for flush mounting or surface mounting

[SIPROTEC_7SC80_W3, 1, --_--]

Figure 6.3/1 SIPROTEC 7SC80 Front View with HMI

6.3

- Millisecond-accurate time synchronization via Ethernet with SNTP
- Inputs for small-signal current and voltage transformers according to IEC 61869-10 and 11

Benefits

- Rapid fault location detection
  Disconnection of the faulty feeder
  Resupply with healthy feeder
- Support and expanded programming functions for feeder automation applications
- Pluggable terminals with integrated 2-pole cross connectors
- Data transmission up to 24 km with single-mode cable, up to 4 km with multi-mode cable
- Flexible communication possibilities, for example for radio transmission specifically for feeder automation
- Built-in GPS module for time synchronization and location detection
- Complete remote control and telemonitoring as well as firmware upgrades
- Battery supervision and management

SIPROTEC 7SC80 – Applications

Applications

The SIPROTEC 7SC80 distribution system protection is a digital protection device that also carries out control and monitoring tasks. This supports economical management by the user and ensures reliable supplying of customers with electrical energy

The device operation was designed according to economic aspects. A great deal of value was placed on a very legible display and large function keys. Numerous conditions and alarms can be displayed with the 32 LEDs.

Control

The integrated control function makes it possible to control disconnectors and circuit breakers via the integrated operation panel, binary inputs, DIGSI 4 or systems control (for example SICAM).

Programmable Logic

The integrated logic functionality allows the user, with a graphical user interface, to implement functions of his own for automating his switching cell (interlocking), switchgear or a distribution network theater and to generate user-defined indications.

Operational measured values

Extensive operational measured values, limiting values and metered values allow an improved operation management and simplified commissioning.

Operational indications

The operation is documented with traceability due to the storage of fault indications, error messages, fault datasets and statistics.

Line protection

The SIPROTEC 7SC80 devices are used as line protection for high-voltage and medium-voltage power systems with grounded, low-impedance grounded, isolated or compensated neutral point design

Transformer protection

As a supplement to a transformer differential protection, the devices also perform all the tasks for backup protection. Inrush-current detection effectively prevents pickup due to inrush currents The high impedance ground fault differential protection detects short circuits and insulation faults on the transformer.

Backup protection

The SIPROTEC 7SC80 - devices can be universally used as backup protection.

High-voltage and medium-voltage switchgear

All devices optimally fit the requirements of high-voltage and medium-voltage applications. Separate measuring devices (for example, for current, voltage, frequency, measuring transducers) or additional control components are usually not necessary in the switchgear cabinets.

Overview of Functions

Protection functions	IEC standard	ANSI standard
Overcurrent protection (independent; dependent)	I>, I>>, I>>>, I_p	50/51
Ground-fault protection	I_E>, I_E>>, I_E>>>, I_{Ep}	50N/51N
Sensitive ground-fault protection	I_{EE}>, I_{EE}>>, I_{EEp}	50N(s)/51N(s)
Circuit-breaker failure protection	CBFP	50BF
Overload protection	ϑ>	46
High-impedance ground fault differential protection		87N
Trip-circuit supervision	AKU	74TC
Undercurrent monitoring	I<, P<	37
Current transformer monitoring		60CTS
Locked OFF/lockout		86
Unbalanced-load protection	I_2>	49
Dynamic pickup value switching		51C
Directional overcurrent protection	Iger.>, Iger.>>, Ip ger.	67
Sensitive ground-fault protection	IE ger.>, IE ger.>>, IEp ger.	67N
Directional/non-directional sensitive ground-fault detection	IEE>, IEE>>, IEEp	67Ns, 50Ns
Overvoltage, zero-sequence system	V_I, V_O>	59N
Overfrequency/Underfrequency protection	f<, f>	81O/V
Synchrocheck		25
Inrush-current detection		81HBL2
Overcurrent protection, 1-phase		64H
Overvoltage/undervoltage protection	V<, V>	27/59
Residual voltage		64/59N
Voltage transformer monitoring		60VTS
Voltage-controlled overcurrent protection		51V
Negative-sequence system overvoltage protection		47NPS
Flexible protection functions (characteristic key values from current and voltage): Voltage, power, power factor, frequency-change protection	P<>, Q<>/cos ϕ/df/dt	32/55/81R
Automatic reclosing	AREC	79
Fault locator	FO	21FL

Table 6.3/1 Overview of Functions

Control functions/programmable logic

- Control commands for circuit breakers and disconnector switches
- Control via keypad, binary inputs, DIGSI 4 or SCADA system
- User-specific PLC logic with CFC (for example, interlocking)

Monitoring functions

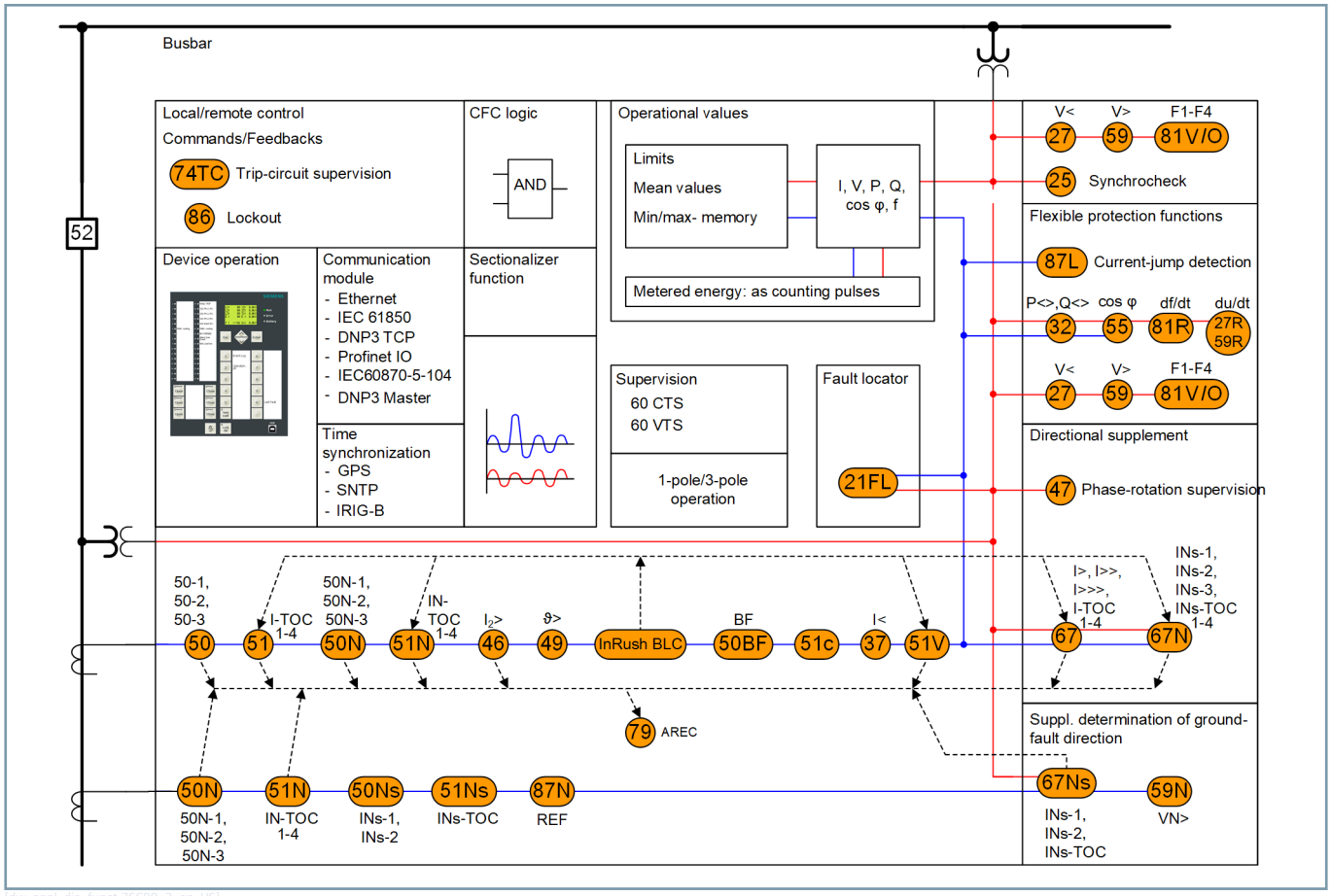
- Measured and metered values V, I, f, Wp, Wq
- Minimum and Maximum Values
- Circuit breaker wear monitoring
- Fuse and trip-circuit supervision
- max. 40 fault records
- Load profile for up to 20 various operational measured values

Communication interfaces and protocols

- Ethernet electrical and optical (multi-mode or single-mode)
- IEC 61850 Edition 1 and 2
- DNP3 TCP, IEC 60870-5-104, PROFINET
- Ethernet redundancy protocols RSTP, PRP and HSR
- USB front interface for DIGSI 4
- Serial DNP3 RS485 module

Hardware

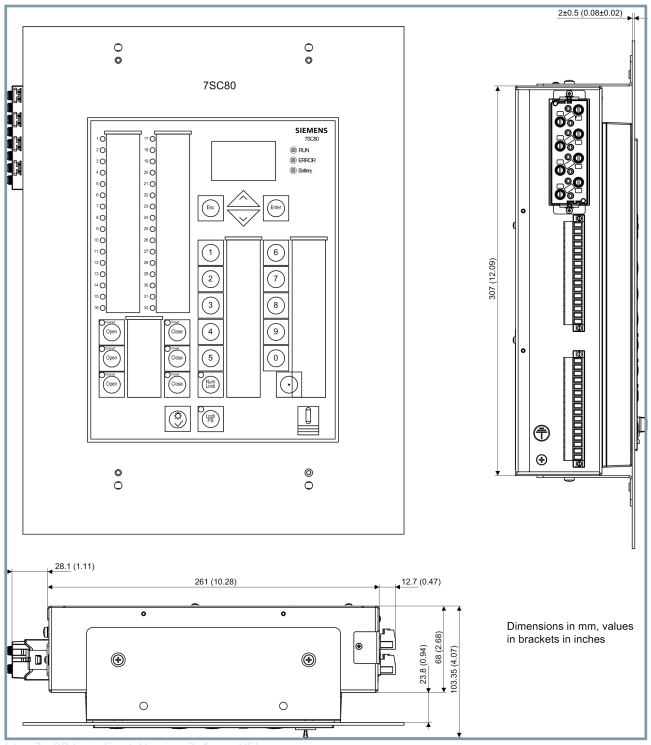
- 4 current transformers
- 1/4/6 voltage transformers
- 12/20 binary inputs
- 8/15 binary outputs
- 1 life contact
- Pluggable current and voltage terminal blocks
- Connection option for small-signal current and voltage transformers



[dw_appl_dia_funct-7SC80, 3, en_US]

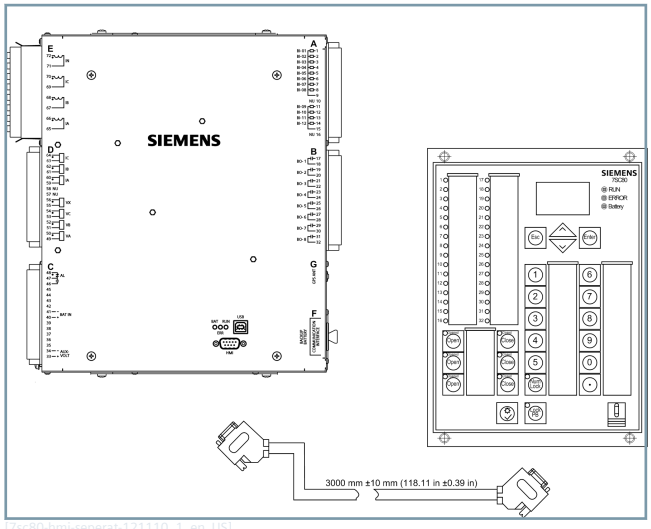
Figure 6.3/2 Functional Scope SIPROTEC 7SC80

Dimensioned Drawings



[dw_7sc80-hmi-direct_Version-2, 1, en_US]

Figure 6.3/3 Variant with Attached Operation Panel



[7sc80-hmi-seperat-121110, 1, en_US]

Figure 6.3/4 Variant with Detached Operation Panel

Selection and Ordering Data

Description	Versions	Order no.																			
		1	2	3	4	5	6	7		8	9	10	11	12		13	14	15	16		17	18	19
SIPROTEC 7SC80		7	S	C	8	0	□	□	-	□	□	□	□	□	-	□	□	□	□	-	□	□	□
							▲	▲		▲	▲	▲	▲	▲		▲	▲	▲	▲		▲	▲	▲
Base device							|	|		|	|	|	|		|	|	|	|		|	|	|
	Housing, 12 BI, 8 BO, 1 life contact						2	|		|	|	|	|	|		|	|	|	|		|	|	|
	Housing, 20 BI, 15 BO, 1 life contact 2 x V [56]						3	|		|	|	|	|	|		|	|	|	|		|	|	|
Measuring inputs								|		|	|	|	|	|		|	|	|	|		|	|	|
	3 x I LPS/LoPo, 1 x V [57]							1		|	|	|	|	|		|	|	|	|		|	|	|
	4 x I_{ph} 1 A/5 A, 1 x V							2		|	|	|	|	|		|	|	|	|		|	|	|
	3 x I LPS/LoPo, 4 x V [57]							3		|	|	|	|	|		|	|	|	|		|	|	|
	4 x I_{ph} 1 A/5 A, 4 x V							4		|	|	|	|	|		|	|	|	|		|	|	|
	3 x I_{ph} 1 A/5 A, 1 x I_{EE} (sensitive) = 0.001 A to 1.6 A/0.005 A to 8 A, 1 x V							5		|	|	|	|	|		|	|	|	|		|	|	|
	3 x I_{ph} 1 A/5 A, 1 x I_{EE} (sensitive) = 0.001 A to 1.6 A/ 0.005 A to 8 A, 4 x V							6		|	|	|	|	|		|	|	|	|		|	|	|
Auxiliary voltage (power supply)										|	|	|	|	|		|	|	|	|		|	|	|
	DC 60 V to 250 V, AC 115 V, AC 230 V									1	|	|	|	|		|	|	|	|		|	|	|
	DC 24 V/48 V									2	|	|	|	|		|	|	|	|		|	|	|
	DC 24 V/48 V, battery supervision									3	|	|	|	|		|	|	|	|		|	|	|
Design structure											|	|	|	|		|	|	|	|		|	|	|
	Surface-mounting housing, screw-type terminals, without operation panel										A	|	|	|		|	|	|	|		|	|	|
	Surface mounting case, flush-mounting housing with operation panel										B	|	|	|		|	|	|	|		|	|	|
	Surface-mounting housing, screw-type terminals, with detached operation panel										C	|	|	|		|	|	|	|		|	|	|
Region-specific configuration and default language settings												|	|	|		|	|	|	|		|	|	|
	Region GE, IEC, German language (language can be changed)											A	|	|		|	|	|	|		|	|	|
	Region World, IEC/ANSI, English language (language can be changed)											B	|	|		|	|	|	|		|	|	|
	Region US, ANSI, American English language (language can be changed)											C	|	|		|	|	|	|		|	|	|
	Region World, IEC/ANSI, French language (language can be changed)											D	|	|		|	|	|	|		|	|	|
	Region World, IEC/ANSI, Spanish language (language can be changed)											E	|	|		|	|	|	|		|	|	|
	Region World, IEC/ANSI, Russian language (language can be changed)											G	|	|		|	|	|	|		|	|	|
														|		|	|	|	|				

Table 6.3/2 SIPROTEC 7SC80 Selection and Ordering Data

56 Only with position 7 = 3, 4 or 6

57 The sensors mentioned in the chapter "SICAM FCM" can be used; if used for protection purposes, usability must be appropriately checked.

Description	Versions	Order no.																			
Continued from preceding page		1	2	3	4	5	6	7		8	9	10	11	12		13	14	15	16		17	18	19
SIPROTEC 7SC80		7	S	C	8	0	□	□	-	□	□	□	□	□	-	□	□	□	□	-	□	□	□
													▲	▲		▲	▲	▲	▲		▲	▲	▲
System interface													|	|		|	|	|	|		|	|	|
	No assembly												0	|		|	|	|	|		|	|	|
	100 Mbit Ethernet, electric, 2 x RJ45 plugs												9	|		|	|	|	|		L	|	R
	100 Mbit Ethernet, with integrated switch, optical, double, 2 x LC connector, multi-mode												9	|		|	|	|	|		L	|	S
	100 Mbit Ethernet, with integrated switch, optical, double, 2 x LC connector, single-mode, 24 km												9	|		|	|	|	|		L	|	T
Protocol for the system interface														|		|	|	|	|			|	
	IEC 61850													|		|	|	|	|			0	
	IEC 61850/DNP3 TCP													|		|	|	|	|			2	
	IEC 61850/PROFINET IO [58]													|		|	|	|	|			3	
	IEC 61850/IEC 60870-5-104													|		|	|	|	|			4	
	DNP3, electrical RS485												9	|		|	|	|	|		L	6	G
														|		|	|	|	|				
Additional interfaces														|		|	|	|	|				
	No assembly													0		|	|	|	|				
	IRIG B-module, optical													6		|	|	|	|				
	GPS module													7		|	|	|	|				
Functionality packages - see next page																|	|	|	|				

Table 6.3/3 SIPROTEC 7SC80 Selection and Ordering Data

58 Only in connection with 100 Mbit Ethernet module, electrical or multi-mode

SIPROTEC 7SC80 – Selection and Ordering Data

Description	Versions	Order no.																
Continued from preceding page		1	2	3	4	5	6		7	8	9	10	11	12		13	14	15	16
SIPROTEC 7SC80		7	S	C	8	0	☐	☐	-	☐	☐	☐	☐	☐	-	3	F	☐	☐
																		▲	▲
Functionality packages																		|	|
ANSI no.	**Base package A**																	A	|
50/51	Overcurrent protection phase I>, I>>, I>>>, Ip																		|
50N/51N	Normal ground-fault protection, protection to ground IGnd>, IGnd>>, IGnd >>>, IGndp																		|
50N(s)/51N(s)	Sensitive ground-fault protection IEE>, IEE>>, IEEp [59]																		|
50BF	Circuit-breaker failure protection																		|
46	Unbalanced-load protection																		|
49	Overload protection																		|
87N	High-impedance ground fault differential protection[60]																		|
74TC	Trip-circuit supervision																		|
37	Undercurrent monitoring																		|
51C	Dynamic pickup value switching																		|
81HBL2	Inrush-current detection																		|
86	Lockout																		|
60CTS	Current transformer monitoring																		|
	Jump detection monitoring with the delta measuring method																		|
	Parameter set switching																		|
	Monitoring functions																		|
	Circuit-breaker control																		|
	Flexible protection functions (characteristic key values from current)																		|
	Underfrequency/overfrequency, f<, f>																		|
	with fault recording, with average calculation, with min/max values																		|
ANSI no.	**Base package B (includes A)** [56]																	B	|
67	Directional addition for overcurrent protection phase, I>, I>>, I>>>, IGndp																		|
67N	Directional addition for overcurrent protection ground, IGnd>, IGnd>>, I>>>, IGndp																		|
67N(s)	Directional sensitive ground-fault protection/normal ground-fault protection IEE>, IEE>>, IEEp [59]																		|
27/59	Undervoltage/overvoltage																		|
81 U/O	Underfrequency/overfrequency (f<, f>)																		|
25	Synchrocheck																		|
47	Rotating field direction																		|
64/59N	Residual voltage																		|
60VTS	Voltage transformer monitoring																		|
32/55/81R	Flexible protection functions (characteristic key values from current and voltage): Voltage, power, power factor, frequency-change protection																		|
	Base package N - see next page																		

Table 6.3/4 SIPROTEC 7SC80 Selection and Ordering Data

59 Depending on the ground-current input, the function operates either as sensitive ground-fault protection (sensitive input) or as normal ground-fault protection (normal input).

60 87N (REF) only available with sensitive ground-current input (position 7 = 5 or 6)

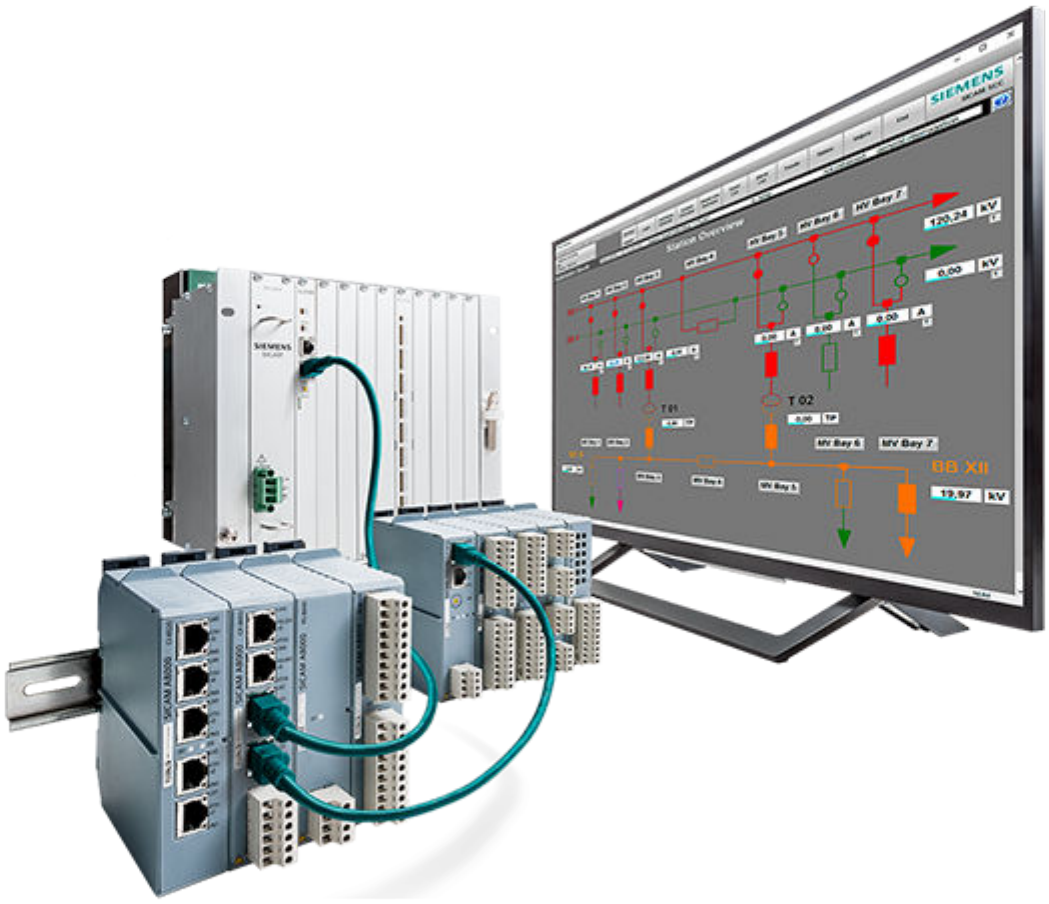
Description	Versions	Order no.																
Continued from preceding page		1	2	3	4	5	6		7	8	9	10	11	12		13	14	15	16
SIPROTEC 7SC80		7	S	C	8	0	☐	☐	-	☐	☐	☐	☐	☐	-	3	F	☐	☐
																		▲	▲
	Base package N (contains R) [6162]																	|	|
	SNTP server function (master), no protection functions																	N	|
	Base package R [61]																	|	|
	Telecontrol functions, no protection functions																	R	|
ANSI no.	**Additional functions**																		|
	Without																		0
79	With AREC																		1
21FL	With fault locator[63]																		2
79/21FL	With AREC, with fault locator [63]																		3
79/TS	With AREC, with 1-/3-pol. operation																		4
79/TS/21FL	With AREC, with 1-/3-pol. operation, with fault locator [63]																		5

Table 6.3/5 SIPROTEC 7SC80 Selection and Ordering Data

61 Only with position 16 = 0,

62 Only with position 12 = 7

63 Only with position 7 = 3, 4 or 6


SIEMENS
SICAM SCC
120.24
kV
0.00
kV
T 01
T 02
MV Bay 6
MV Bay 7
BB XII
19.97
kV

Short-Circuit Indicator

SICAM FCM – Description

Description

The SICAM FCM (Feeder Condition Monitor) is a short-circuit indicator and ground-fault indicator with and without directional indication that operates with detection algorithms and low-power sensor technology in conformity with IEC 60044-8, IEC 61869-10/IEC 60044-7, and IEC 61869-11. Alternatively, the SICAM FCM can also be connected to a capacitive voltage tap. This allows economical directional fault detection in the cable network. SICAM FCM additionally offers the possibility of providing up-to-date measured values via the integrated Modbus RTU interface and thus ensuring a precise assessment of the distribution system.

Benefits

- For grounded, isolated and arc-suppression-coil-ground systems
- Integrated power flow direction indicator
- Directional short-circuit and sensitive ground-fault detection
- Cost savings due to precise and fast fault localization
- Selective fault information with directional indication as a basis for self-healing applications
- Resupply times in the minute or second range (depending on primary equipment) allow minimum power system outages and minimum ultimate consumer payment losses
- Up-to-date measured values for operation and planning support the focused use of investment funds in power system planning and expansion
- Direct voltage measurement in low-voltage power systems
- Support for different ground-fault detection algorithms: cos/sin φ, pulse detection, transient ground-fault detection
- Use of low-power sensors and high quality measurement technology with a high measuring accuracy
- Alternatively: Designed to be connected to the capacitive voltage tap
- Flexible sensitive ground-fault detection from 0.4 A onwards
- Telecontrol parameterization via SICAM A8000 and Modbus

Functions

The SICAM FCM is the first short-circuit indicator that supports standard-compliant sensors according to IEC 60044-8, IEC 61869-10/IEC 60044-7, and IEC 61869-11. This ensures high-precision measurement without calibration and adjustments to the primary values.

- Fault search
  - Overcurrent detection (I>, I>>)
  - Ground-fault detection (In>) using the following methods:
    - cos φ, sin φ
    - Vector method
    - Pulse method
    - Intermittent/interrupting faults
    - Direction-dependent transients
- Expanded fault validation and fault reset function
- Open-phase detection

[ph_SICAM_FCM, 2, --_--]

Figure 7.1/1 SICAM FCM

- Inrush-current detection/blocking
- Phase-sequence monitoring
- Power-flow sign and direction
- Undervoltage alarm and undervoltage warning
- Overvoltage alarm and overvoltage warning
- Overcurrent alarm and overcurrent warning
- Alert counters
- Correction factors for LoPo voltage and current transformers in accordance with IEC 60044-8, IEC 61869-10/IEC 60044-7, and IEC 61869-11

Device Characteristics

Communication

- RS485 interface including Modbus RTU communication for all information and for remote parameterization/FW update, alternatively for PC programming
- SICAM FCM can also be configured by the user for the system parameters using the SICAM device configurator via the Modbus RTU.

Indications

- Display for presenting up-to-date measured values or fault information in the power distribution system, 4 function keys
- 3 LEDs signal the operating state
- 1 binary input for fault reset or field-data acquisition
- 2 binary outputs for fault indication. Outputs can be assigned to predefined function operations.

Measured and Derived Quantities

- RMS measured values
- Phase-to-ground voltages and currents, ground current, power frequency and cos φ, phase angle, phase-sequence display and sequence components, active power, reactive power and apparent power

Energy Measurement

- Import/export of active and reactive energy
- 15-minute to 1-year minimum and maximum values for all line currents as slave-pointer functions

Auxiliary Voltage

- AC 230 V
- DC 24 V to 250 V
- Battery with lifetime > 15 years

Time Synchronization

- Time synchronization via Modbus RTU

Inputs

- 3 inputs for alternating voltage selectively adjustable for 100 V/√3, low-power sensors with 3.25 V/√3 (according to IEC 61869-11) or 3 direct inputs for AC 230 V
- Alternatively: 3 inputs for connection to low resistance-modified (LRM) voltage detection systems (in accordance with IEC 62271-213)
- 3 inputs for AC low-power sensors with 225 mV at rated current (according to IEC 60044-8/IEC 61869-10); the rated primary current is adjustable in SICAM FCM from 10 A to 3000 A; L2 current input selectively, configured for sensitive ground-fault detection with low-power sensor with 225 mV at rated current (according to IEC 60044-8/IEC 61869-10); the rated primary current is adjustable from 0.4 A to 2000 A in SICAM FCM.
- Alternatively: Inputs for conventional instrument transformers 1 A/5 A via adaptors

Temperature range

- From -40 °C to +70 °C

Housing

- Polycarbonate housing for panel flush mounting
- Dimensions: 96 mm x 48 mm x 109.5 mm (W/H/D)
- Protection class: Front panel IP40, rear panel IP20

Applications

The SICAM FCM is used:

- For directional/non-directional short-circuit and sensitive ground-fault detection for networks with direct/fixed grounding, networks with an isolated neutral point, and arc-suppression-coil-ground systems in medium- and low-voltage distribution networks in accordance with IEC 62271-213
- For simple measurement of system values, derived quantities, power-flow direction and energy measurement in medium- and low-voltage distribution systems

Sensors

The SICAM FCM is the first short-circuit indicator that supports standards-compliant sensors for current and voltage measurement according to IEC 60044-8, IEC 61869-10/IEC 60044-7, and IEC 61869-11. This allows high-precision measurement without calibration and adjustments to the primary values.

Low-power summation current sensor for sensitive ground-fault detection

[ph_Core balance current sensor, 1, –_–]

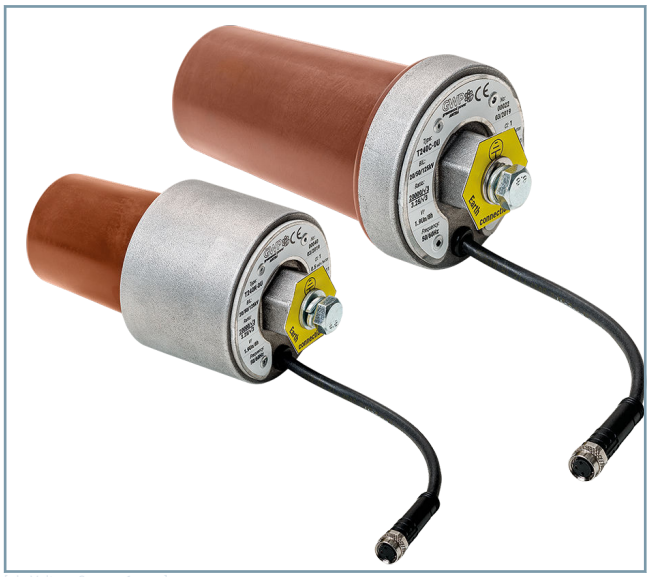
Figure 7.1/2 Summation Current Sensor

Low-power phase current sensor for recording phase current

[ph_Phase current sensor, 1, –_–]

Figure 7.1/3 Phase Current Sensor

Voltage sensors/resistor divider enable precise and linear measurements



[ph_Voltage Sensor, 1, –_–]

Figure 7.1/4 Voltage Sensors - Short and Long Design

SICAM FCM current transformers for connecting to conventional instrument transformers (1 A/5 A) on existing plants.

[ph_FCM CT Adapter, 1, –_–]

Figure 7.1/5 SICAM FCM Current Transformer Adaptor

SICAM FCM with adaptor cable for connecting a LRM voltage testing system according to IEC 62271-213.

[ph_FCM_Kap_Adapter, 1, --_--]

Figure 7.1/6 SICAM FCM - Adaptor for Capacitive Voltage-Detection Systems

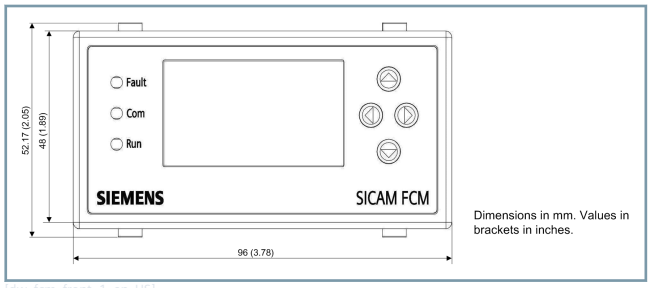
Application Example

[ph_Schaltfeld, 1, --_--]

Figure 7.1/7 Phase Current Sensors in a 8DJH Bay

SICAM FCM – Dimensioned Drawings

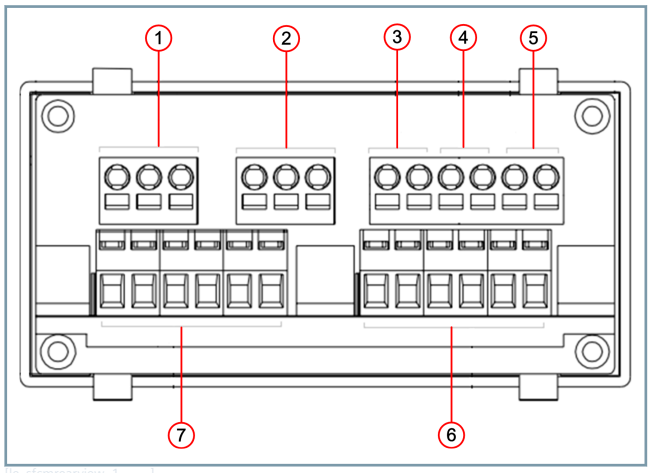
Front View



[dw_fcm_front, 1, en_US]

Figure 7.1/8 Front View

Rear View

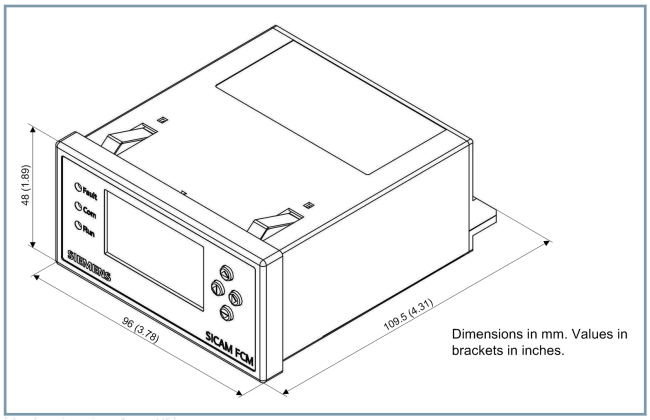


[le_sfcmrearview, 1, –_–]

Figure 7.1/9 Rear View with Terminals

(1) Power supply
(2) Modbus
(3) Digital input
(4) Digital output 2
(5) Digital output 1
(6) Voltage input
(7) Current input

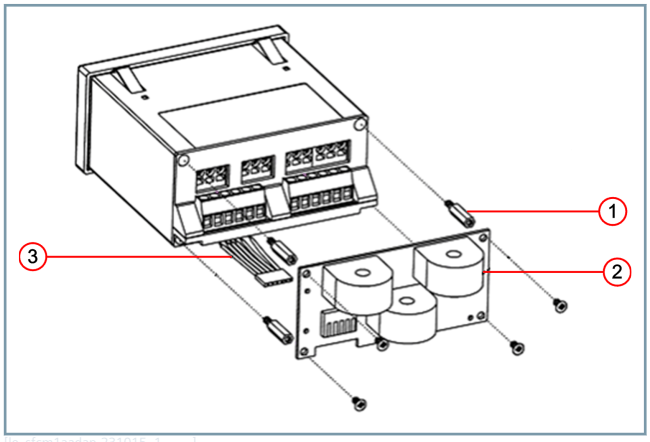
Isometric View



[dw_fcm_iso_view, 1, en_US]

Figure 7.1/10 Isometric View

1 A/5 A Adaptor Drawing



[le_sfcm1aadap-231015, 1, –_–]

Figure 7.1/11 1 A/5 A Adaptor

(1) Threaded stud
(2) CT adaptor PCB
(3) Cable assembly

SICAM FCM with VDIS Interface Cable (only for 6MD2322-1AA00-1AA0)

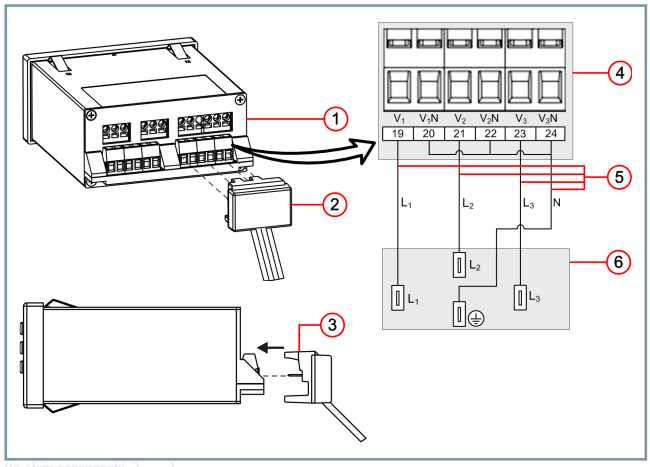


Figure 7.1/12 Interface Cable of SICAM FCM

(1) SICAM FCM

(2) Interface cable (6MD2322-0AA80-0AB3 or 6MD2322-0AA80-3AB0); necessary for 6MD2322-1AA00-1AA0

(3) Orientation of interface cable to SICAM FCM voltage-input terminals

(4) SICAM FCM voltage-input terminals

(5) Interface cable (L_1, L_2, L_3, ground)

(6) Voltage detection and indication system

Selection and Ordering Data

Description	Versions	Order No.																
		1	2	3	4	5	6	7		8	9	10	11	12		13	14	15	16
SICAM FCM		6	M	D	2	3	2	□	–	□	□	□	□	□	–	□	□	□	□
								▲		▲	▲	▲	▲	▲		▲	▲	▲	▲
LoPo current transformer according to IEC 60044-8, IEC 61869-10 Fault indicator with directional indication and measurement of V, I, f, P, Q, S, cos φ and power-flow direction Energy metered values for panel flush mounting with display Housing: 96 mm x 48 mm x 109.5 mm Power supply: DC 24 V to 250 V/AC 230 V 1 digital input 2 digital outputs Modbus RTU	*Voltage measurement*							|		|	|	|	|	|		|	|	|	|
	Resistive LoPo voltage transformers according to IEC 60044-7, IEC 61869-11, traditional voltage transformers and 230 V							1		1	A	A	0	0		1	A	A	0
	Capacitive For voltage measurement in LRM voltage testing systems according to IEC/EN 62271-213 The mandatory interface cable (6MD2322-0AA80-0AB3 or 6MD2322-0AA80-3AB0) for linkage to the Voltage-Detection and Indicating Systems (VDIS) must be ordered separately.							2		1	A	A	0	0		1	A	A	0
	Resistive variant – without battery Voltage measurements: LoPo VTs according to IEC 60044-7, IEC 61869-11, conventional VT and 230 V Battery-less variant							1		1	A	A	0	0		0	B	A	0
Phase current sensor	Split core Ratio: 225 mV@300 A IEC 61869-10 Accuracy class 0.5 (FCM V3.30 and higher), otherwise 1 & 5P10; extension 200 %; connecting cable: 2 m, open end; inside diameter: 92 mm							0		0	G	A	0	0		1	A	A	0
	Closed ring core Ratio: 225 mV@700 A IEC 60044-8 Accuracy class 0.2 (FCM V3.30 and higher), otherwise 0.5 & 5P10, connecting cable: 2 m, open end; inside diameter 85 mm							0		0	J	A	0	0		0	B	A	1
Core balance current sensor	Ratio: 225 mV@60 A, IEC 61869-10 Accuracy class 1 (FCM V3.30 and higher), otherwise 3; Connecting cable: 2 m Window diameter: 160 mm							0		0	A	F	0	0		1	A	A	0
	Ratio: 225 mV@60 A, IEC 60044-8 Accuracy class: 1 Connecting cable: 3.5 m Window diameter: 120 mm; GOST certificate							0		0	A	F	0	0		1	A	A	1

Table 7.1/1 SICAM FCM Selection and Ordering Data

Description	Versions	Order No.																
		1	2	3	4	5	6	7		8	9	10	11	12		13	14	15	16
SICAM FCM		6	M	D	2	3	2	□	–	□	□	□	□	□	–	□	□	□	□
								▲		▲	▲	▲	▲	▲		▲	▲	▲	▲
Low Power Phase Current Sensor	3 x current sensor 225 mV@100 A to 400 A, split core type According to IEC 61869-10 Wide-range sensor Inside diameter: 28 mm Accuracy class: 0.5 (FCM V3.30 and higher), otherwise 1; ref. to rated current 100 A With connecting cable: 7 m; open end							0		0	C	L	0	0		1	A	A	0
	3 x current sensor 225 mV@300 A to 1000 A, split core type According to IEC 61869-10 Wide-range sensor Inside diameter: 44 mm Accuracy class: 0.5 (FCM V3.30 and higher), otherwise 1; ref. to rated current 300 A With connecting cable: 7 m; open end							0		0	H	L	0	0		A	A	0	0
Adaptor 1 A In LoPo IEC 60044-8	3 inputs; transformer ratio 225 mV@1 A Accuracy class: 1 Thermal overload: 100 A for 1 s Coil diameter: 5.8 mm							0		0	A	A	1	0		1	A	A	0
Adapter 5 A In LoPo IEC 60044-8	3 inputs; transformer ratio 225 mV@5 A Accuracy class: 3 Thermal overload: 100 A for 1 s Coil diameter: 5.8 mm							0		0	A	A	2	0		1	A	A	0
Voltage Sensor 10 kV	10 kV/√3: 3.25/√3 Accuracy class: 1 IEC 60044-7 for symmetrical T-connectors with C-cones for cables: Nexans (K) 440TB/Cellpack CTS-S/Südkabel SEHDT13 and SEHDT23							0		0	A	A	0	4		1	A	A	0
	10 kV/√3: 3.25/√3 Accuracy class: 0.5 IEC 60044-7 for asymmetrical T-connectors with C-cones for cable nkt CB-24, CC-24 and Raychem RSTI-58xx							0		0	A	A	0	4		1	A	B	0
Voltage Sensor 20 kV	20kV/√3: 3.25/√3 Accuracy class 0.5 (FCM V3.30 and higher), otherwise 1 IEC 61869-11 for asymmetrical T-connectors with C-cones for cables: Nexans (K) 440TB/Cellpack CTS-S/Südkabel SEHDT13 and SEHDT23							0		0	A	A	0	7		1	A	A	0
	20kV/√3: 3.25/√3 Accuracy class 0.5 (FCM V3.30 and higher), otherwise 1 IEC 61869-11 for asymmetrical T connectors of nkt cables type CB-24, CC-24 and Raychem RSTI-58xx/RSTI-CC-58xx							0		0	A	A	0	7		1	A	B	0

Table 7.1/2 SICAM FCM Selection and Ordering Data

SICAM FCM – Selection and Ordering Data

Description	Versions	Order no.																
		1	2	3	4	5	6	7		8	9	10	11	12		13	14	15	16
SICAM FCM		6	M	D	2	3	2	□	–	□	□	□	□	□	–	□	□	□	□
								▲		▲	▲	▲	▲	▲		▲	▲	▲	▲
DIN rail adapter for housing 48 mm x 96 mm																			
	2 pieces; to snap on TS35 DIN rails; each adapter has 2 cut outs with 45 mm x 92 mm for flush-mounting housings with max. dep. of 135 mm, incl. cable bending, for example for SICAM FCM W/H/D: 105 mm/122 mm/140 mm; alternative wall mounting possible							0		0	A	A	4	0		0	M	A	1
Voltage-detection and indicating systems (VDIS) interface cable																			
	4-wire connection lead with integrated protection circuit to connect SICAM FCM 6MD2322-1AA00-1AA0/CC and higher with the LRM voltage detection and indication system 1 ground input; length: 0.3 m							2	–	0	A	A	8	0	–	0	A	B	3
	4-wire connection lead with integrated protection circuit to connect SICAM FCM 6MD2322-1AA00-1AA0/CC and higher with the LRM voltage detection and indication system 1 ground input; length: 3 m							2	–	0	A	A	8	0	–	3	A	B	0

7.1 **Table 7.1**/3 SICAM FCM Selection and Ordering Data

Description

SICAM FCM plus (Feeder Condition Monitor plus) is an Intelligent Electronic Device (IED) used for detecting and indicating short circuits or ground faults with and without directional information. SICAM FCM plus accurately monitors, measures, and displays operational measured values and performs the condition monitoring task in a medium-voltage distribution system. SICAM FCM plus is typically used in the medium-voltage substation that ranges from 6.6 kV to 40.5[64] kV. SICAM FCM plus measures the RMS value for alternating voltage, alternating current, and power frequency.

Benefits

- Suitable for solidly, low-resistive, isolated, and resonant-grounded systems
- Integrated power-flow direction indicator
- Selective fault information with direction indication used as a basis for self-healing applications
- Service restoration times in the range of minutes or seconds
- Up-to-date measured values for operational management
- Remote firmware update[65] via SICAM A80xx RTU and Modbus
- Self-test mode function for remote communication connection
- Easy installation and plug-in interface on RJ45 connectors, push in type connectors based on the variant
- Reduced cost of installation, faster to troubleshoot, and easy maintenance
- Minimum 8 hours of fault-status indication in absence of auxiliary power supply
- Up to 50 events can be stored
- Improved measurement accuracy based on auto adaption of correction factor
- Flexible sensitive ground-fault detection from 0.4 A onwards[66]

Functions

SICAM FCM plus provides 2 setting groups – Group 1 and 2 which can both be viewed/edited via the device HMI or configurator Web software.

- Directional and non-directional phase-fault detection (ANSI 50/51/67)
- Directional and non-directional ground-fault detection-derived (ANSI 50N/51N/67N)
- Directional and non-directional ground-fault detection-measured (ANSI 50GS/51GS/67GS)[66]
- Ground-fault detection (In>) using the following methods:
  - Vector
  - cos φ and sin φ
  - pulse location

[ph_SICAM_FCM_plus, 2, --_--]

Figure 7.2/1 SICAM FCM plus

  - Directional and non directional intermittent
  - transient
- Inrush-current detection and blocking (ANSI 81HBL2)
- Open-phase detection (ANSI 46BC)
- Undervoltage detection and overvoltage detection (ANSI 27,59)
- Under and Overpower detection (ANSI 32P)[66]
- Fault validation logic with direction detection and reset, based on configurable network voltage and current absence[66]
- Temporary and permanent fault identification[66]

Device Communication and Protocol

- Serial interface on RS485 – Modbus RTU for data communication and remote configuration
- Supports user configurable Modbus map
- Supports the device configurator tool (offline/online) for configuration/parameterization and firmware upload via the front USB and the rear RS485 port.
- Signed firmware upgrade support ensures secure, authenticated software updates[66]

Device Characteristics

Salient Features

- Device powered via front USB to configure and firmware update
- Current acquisition based on Rogowski sensor inputs
- Auto adaption of correction factors (CF) using a JSON file SIbushing sensor
- Wide measurement range with accuracy of 0.5 % class

64 MLFB 6MD2323-1AA00-1AA0 6.6 KV to 36 KV
65 Applicable only for 6MD2323-1AA00-1AA0
66 Applicable only for 6MD2323-1AA00-2AA0

- Minimum 8 hours of fault-status indication by super capacitor during auxiliary supply failure
- Correction factors for LoPo voltage and current transformers in accordance with IEC 60044-8, IEC 61869-10/IEC and IEC 61869-11

Archiving and Logging

- Fault information – 50 faults are stored as event logs
- Trailing pointers function for measured values of current, voltage, and power – I_{min}/I_{max}, V_{min}/V_{max}, and P_{min}/P_{max} for 15/30/45/60 minutes, 1 day, 30 days, and 1 year.
- Self-monitoring and supervision – watchdog functionality to indicate device health status

Auxiliary Power Supply Range

- AC 230 V ± 20 %
- DC 24 V to 250 V ± 10 %

Analog Inputs

- 3 x RJ45 interfaces for current and voltage inputs directly from the Siemens SIBushing sensors in accordance with IEC 61869-10 and IEC 61869-11[65]
- Alternatively 3 inputs for connection to low resistance-modified (LRM) voltage detection systems (in accordance with IEC 62271-213)[66]
- 3 inputs for alternating voltage selectively adjustable for 10000:1, low-power sensors with 3.25 V/√3 (according to IEC 61869-11)[66]
- 3 inputs for AC low-power sensors with 225 mV at rated current (according to IEC 60044-8/IEC 61869-10)[66]
- Measured variables – RMS measured values of phase voltages and currents, power system frequency, and cos (ϕ) phase angle

User Interface and Display

- Graphical color[66] display provides intuitive visualization of measured values, derived values, event fault logs, and fault screens for instant operational clarity
- Binary inputs and binary outputs status indication on HMI.
- 4 function keys for HMI navigation, information, and configuration.
- 3 LEDs to indicate the operating mode – Fault, Com, and Run
- Additional fault direction LEDs provide instant visual indication of fault direction[66]

Binary Inputs/Outputs (User-Configurable) with User Assignable Texts

- 6 binary inputs
- 4 binary outputs for indication and configurable for control operations

Time Synchronization

- Supported via Modbus RTU

Operating Environment

- Temperature range: -40 °C to +70 °C
- Altitude: maximum 2000 m above sea level

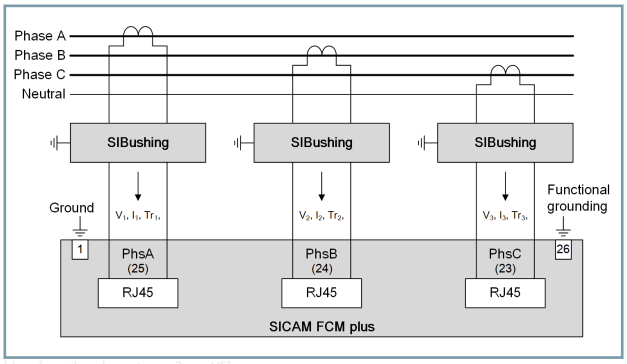
Housing

- Polycarbonate housing for panel flush mounting
- Dimensions: 96 mm x 48 mm x 120 mm (W/H/D)
- Protection class: front panel IP40, rear IP20

Applications

The SICAM FCM plus is:

- For directional/non-directional short-circuit and sensitive ground-fault detection for networks with direct/fixed grounding, networks with an isolated neutral point, and arc suppression-coil-ground systems in medium voltage distribution networks up to 40.5 KV
- Applicable for radial/ring and compact distribution networks
- Compatible with SIBushing sensor and 3M make current and voltage sensors
- Compatible with low-power sensor technology in conformity with IEC 60044-8, IEC 61869-10 and IEC 61869-11, low resistance-modified (LRM) voltage detection systems (in accordance with IEC 62271-213)
- Having a wide measuring range of accuracy with class 0.5 as per IEC 61869
- Remote device management - firmware upload using Siemens A80xx RTU
- A simple load-flow, power and energy measurement device for ring main units (RMU)



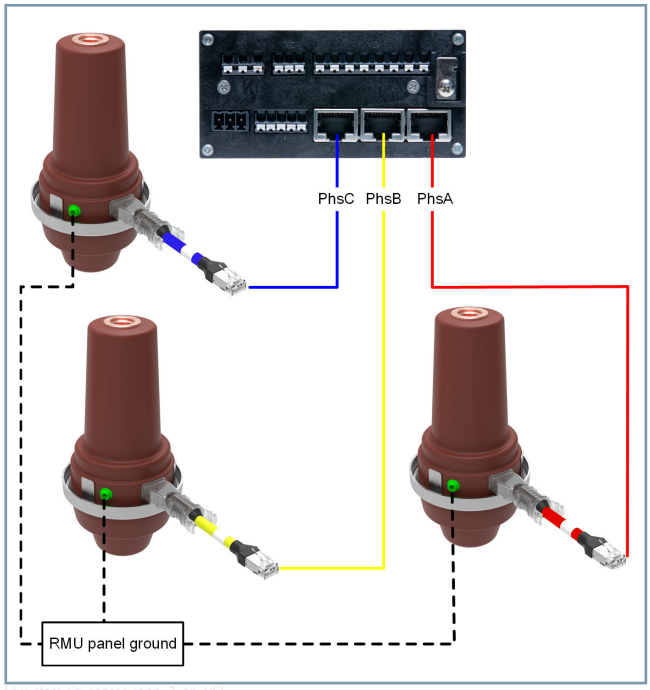
[dw_sfcm-sib_vol-curr-temp, 2, en_US]

SIBushing Sensor

SICAM FCM plus is compatible with SIBusing sensor according to IEC 61869-10, IEC 61869-11. SICAM FCM plus is also compatible with 3M make current and voltage sensors.

[ph_SICAM_FCM_plus_Bushing, 1, _ _]

Figure 7.2/2 SICAM FCM plus with SIBushing



[dw_sicm-sib_sensor-conn, 2, en_US]

Figure 7.2/3 SIBushing Sensor Connection to SICAM FCM plus

Sensors (only applicable for 6MD2323-1AA00-2AA0)

The SICAM FCM plus is the first short-circuit indicator that supports standards-compliant sensors for current and voltage measurement according to IEC 60044-8, IEC 61869-10, and IEC 61869-11. This allows high-precision measurement without calibration and adjustments to the primary values.

Low-power summation current sensor for sensitive ground-fault detection

[ph_Core balance current sensor, 1, _ _]

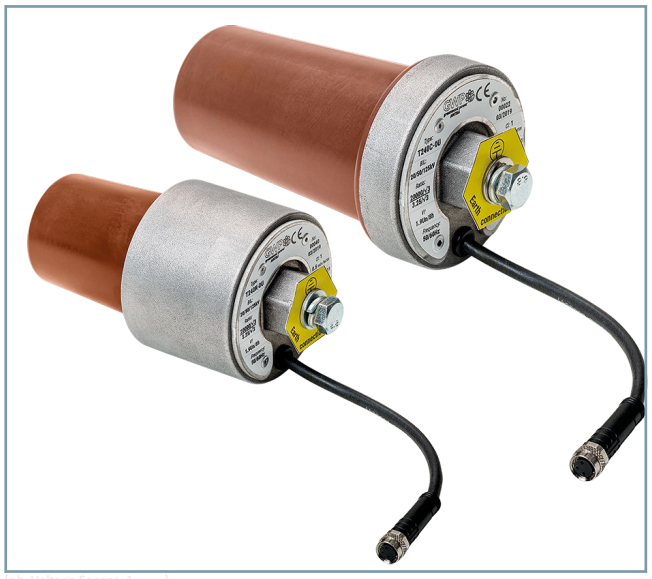
Figure 7.2/4 Summation Current Sensor

Low-power phase current sensor for recording phase current

[ph_Phase current sensor, 1, _ _]

Figure 7.2/5 Phase Current Sensor

Voltage sensors/resistor divider enable precise and linear measurements



[ph_Voltage Sensor, 1, –_–]

Figure 7.2/6 Voltage Sensors - Short and Long Design

SICAM FCM plus with adaptor cable for connecting a LRM voltage testing system according to IEC 62271-213.

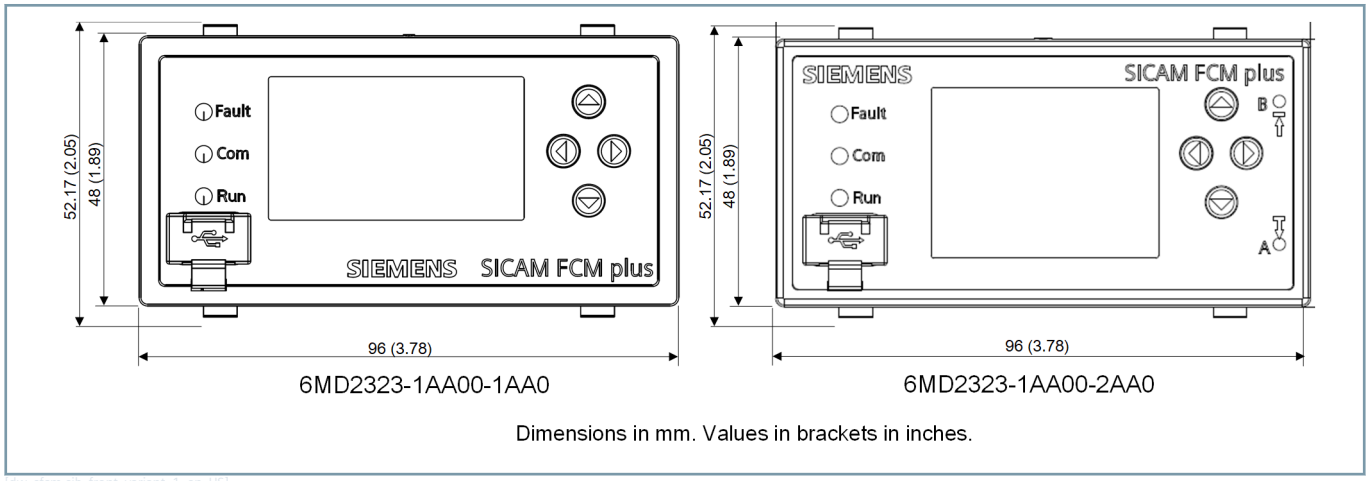
[ph_FCM_Kap_Adapter_Plus, 1, –_–]

Figure 7.2/7 SICAM FCM plus - Adaptor for Capacitive Voltage-Detection Systems

Application Example

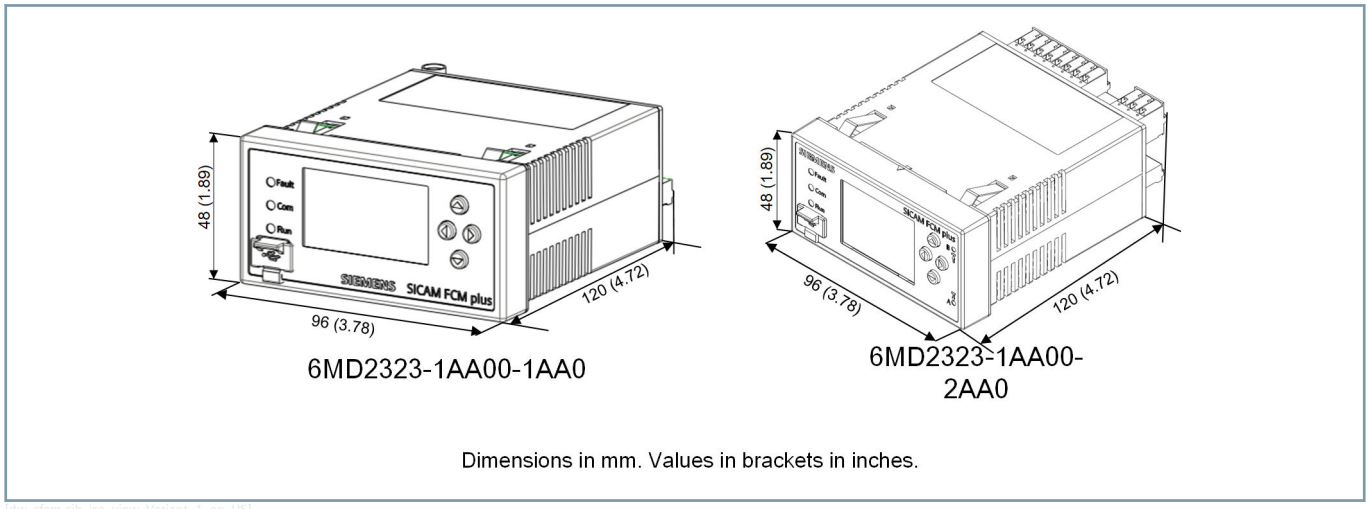
[ph_Schaltfeld, 1, –_–]

Figure 7.2/8 Phase Current Sensors in a 8DJH Bay



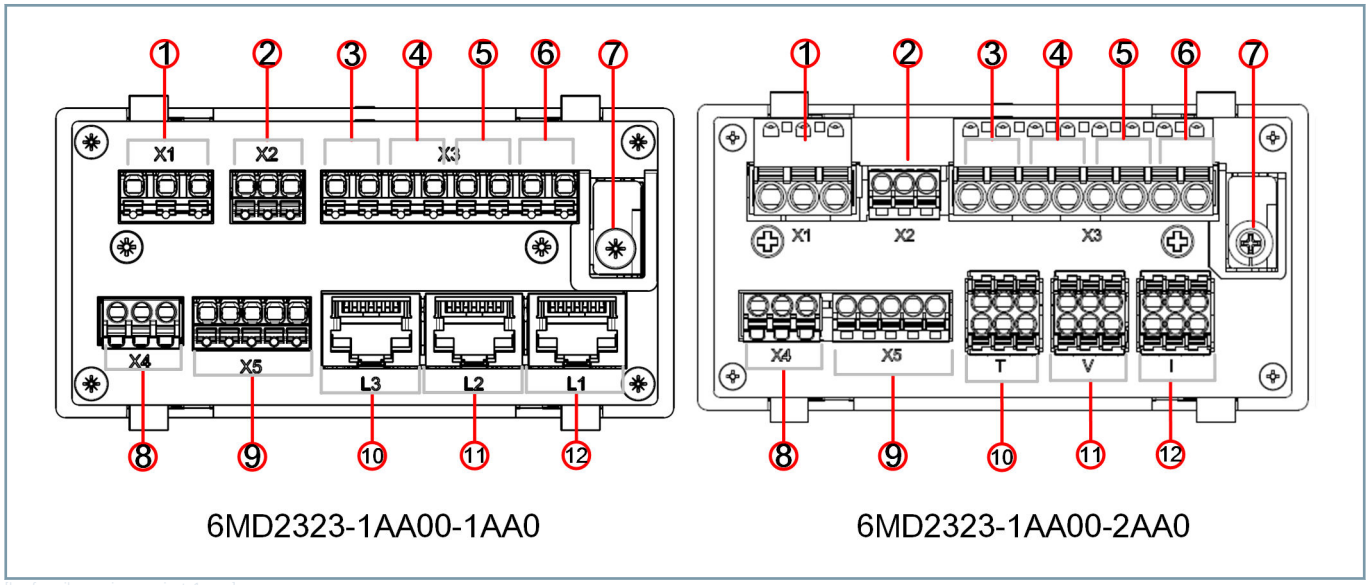
[dw_sfcm-sib_front_variant, 1, en_US]

Figure 7.2/9 Front View



[dw_sfcm-sib_iso_view_Variant, 1, en_US]

Figure 7.2/10 Isometric View



{ie_sfcm-sib_rearview_variant, 1, "_"}

Figure 7.2/11 Rear View with Terminals

(1) Power supply
(2) Digital inputs 1 and 2
(3) Digital output 4
(4) Digital output 3
(5) Digital output 2
(6) Digital output 1
(7) Functional grounding
(8) RS485 Modbus RTU
(9) Digital inputs 3, 4, 5, and 6
(10) RJ45 interface 3 (L3) (6MD2323-1AA00-1AA0)
Sensor input for temperature measurement (6MD2323-1AA00-2AA0)
(11) RJ45 interface 2 (L2) (6MD2323-1AA00-1AA0)
Sensor input for voltage measurement (6MD2323-1AA00-2AA0)
(12) RJ45 interface 1 (L1) (6MD2323-1AA00-1AA0)
Sensor input for current measurement (6MD2323-1AA00-2AA0)

Medium-voltage range	6.6 kV to 36 kV, Δ 0.1 kV
Frequency range	50 Hz (± 10%) to 60 Hz (± 10%)
Auxiliary power-supply voltage range	DC 24 V to 250 V (± 10 %)
	AC 230 V (± 20 %)
Life expectancy of super capacitor	10 years at 55 °C

Table 7.2/1 General Specifications

Voltage transformation ratio	10 000:1
Measuring range ph-n	76 V to 39.49 kV
Input impedance	2 MΩ/50 pF typical

Table 7.2/2 Measuring Input for Voltage

Rated primary current	50 A
Rated secondary voltage	22.5 mV at 50 Hz 27 mV at 60 Hz
Measuring range	1 A to 12 000 A

Table 7.2/3 Measuring Input for Current (sensor type: Derivative (Rogowski))

Measuring range	-40 °C to 130 °C
Measured value accuracy	±0.5 °C

Table 7.2/4 Measuring Input for Temperature

Measured Variable	Accuracy Class 0.5 as per IEC 61869-11		
Measuring range	$0.02 \cdot V_N$ [67]	$0.2 \cdot V_N$ [67]	$0.8 \cdot V_N$ to $1.9 \cdot V_N$
Ratio error in %	6	3	0.5
Phase error in minutes	240	120	20

Table 7.2/5 Measured Value Accuracy – Voltage

Measured Variable	Accuracy Class 0.5 as per IEC 61869-10				
Measuring range	$0.05 \cdot I_{PR}$	$0.2 \cdot I_{PR}$	$1 \cdot I_{PR}$	1250 A	6000 A
Ratio error in %	1.5	0.75	0.5	0.5	1
Phase error in minutes	90	45	30	30	60

Table 7.2/6 Measured Value Accuracy – Current

	Current Range	Power Factor	1-Phase (Typical Accuracy)	3-Phase (Typical Accuracy)
Apparent power	$0.4 \cdot I_N$ to $25 \cdot I_N$	–	± 1 %	± 1 %
Active power		Unity power factor	± 1 %	± 1 %
		Power factor > 0.707	± 1 %	± 1 %
		Power factor < 0.707	< ± 3 %	< ± 3 %
Reactive power		Zero power factor	± 1 %	± 1 %
		Power factor < 0.707	± 1 %	± 1 %
		Power factor > 0.707	< ± 3 %	< ± 3 %
The accuracy claimed is carried at rated current (I_N) = 50 A				

Table 7.2/7 Accuracy Power

Rear RS485 interface	
Electrical interface	RS485
Connection type	Terminal block with spring-loaded terminals
Supported communication protocol	Modbus RTU
Functionality	Slave
Baud rate (Bit/s)	9600, 19 200, 38 400, 57 600, 115 200, and 128 000 Default value: 115 200 Bit/s
Data format	8N1, 8E1, 8O1 Default value: 8N1
Supported address	1 to 247 Default value: 247

Table 7.2/8 Communications

Front USB Interface	
Type	Micro-B USB 1.0, maximum length < 5 m
Power consumption	< 500 mA

Digital inputs[68]	6, DC 24 V to 60 V maximum[69]
Digital input control voltage	$V_{low} \leq$ DC 10 V
	$V_{high} \geq$ DC 19 V
Current consumption on single BI, excited	DC 0.5 mA to 2 mA
Power consumption on single BI	120 mW maximum
Digital outputs	4, dry contact type, Form A, latching relay
Maximum permitted voltage	DC 60 V

67 Accuracy class 3P as per IEC 61869-11

68 The digital inputs are unipolar and the internal fuse is not available.

69 AC voltage input not supported

Maximum switching capacity	1250 VA/AC 250 V (AC, resistive) 150 W/DC 30 V (DC, resistive)
Permissible current per contact (continuous)	5 A
Permissible current per contact (switching)	5 A
Pickup time	10 ms typical
Dropout time	10 ms typical

Table 7.2/9 Digital Inputs and Outputs

Type of fixing	Panel flush mounting
Cut-out (W x H)	92+0.5 mm x 45+0.5 mm
Overall depth	120 mm
Permissible switch panel thickness for installation	2 mm to 4 mm
Mounting position	Horizontal
Weight	≤ 350 g

Table 7.2/10 Dimensions

Location of use	Indoor
Altitude	Maximum up to 2000 m
Operating temperature range	-40 °C to +70 °C
Storage temperature range	-40 °C to +70 °C -40 °C for maximum 2 weeks
Relative humidity	0 % to 95 %, non-condensing
Mains supply voltage fluctuations	±10 % (DC 24 V to 250 V) ±20 % (AC 230 V)
Overvoltage category	III
Pollution degree	2

Table 7.2/11 Normal Environment Conditions

Device front	IP 40
Device rear	IP 20

Table 7.2/12 Degree of Protection

Peak inrush current	50 A in 350 µs

Table 7.2/13 Inrush Current of Auxiliary Power Supply at SICAM FCM plus Powerup

DC 24 V to 250 V	≤ 4 W
AC 230 V	≤ 11 VA
Allowable superimposed AC component	15 % of auxiliary DC voltage

Table 7.2/14 Power Consumption

Medium-voltage range	6.6 kV to 40.5 kV, Δ 0.1 kV
Frequency range	50 Hz (± 10%) to 60 Hz (± 10%)

Auxiliary power-supply voltage range	DC 24 V to 250 V (± 10 %)
	AC 230 V (± 20 %)
Life expectancy of super capacitor	10 years at 55 °C

Table 7.2/15 General specifications

Voltage transformation ratio	10 000:1
Measuring range ph-n for sensor (primary)	76 V to 44.4 kV
Input impedance	2 MΩ/50 pF typical

Table 7.2/16 Measuring input for voltage: sensor 10 000:1

Voltage transformation ratio	3.25/√3 V
Measuring range ph-n for sensor (primary)	76 V to 44.4 kV
Input impedance	2 MΩ/50 pF typical

Table 7.2/17 Measuring input for voltage: sensor 3.25/√3

Capacitive voltage	3 V to 60 V
Internal impedance	20 MΩ

Table 7.2/18 Measuring Input for Voltage: VDIS LRM as per IEC 62271-213

Rated primary phase current	300 A	700 A
Measuring range	1.5 A to 6500 A	3.5 A to 15000 A
Rated secondary voltage	225 mV	

Table 7.2/19 Measuring input for current (sensor type: linear (resistive))

Rated primary ground current	60 A (50 Hz/60 Hz)
Rated secondary voltage	225 mV
Measuring range	0.1 A to 1600 A

Table 7.2/20 Measuring input for current

Measuring range	0.3 V_N - 0.4 V_N	0.4 V_N – 1.2 V_N	1.2 V_N - 2 V_N
Ratio error in %	3 %	0.5 %	1 %
Phase error in minutes	120	180	120

Table 7.2/21 Accuracy with calibration for 10 V to 30 V nominal (Auto/field calibration): SICAM FCM plus + VDIS LRM interface

Measured Variable	Accuracy Class 0.5 as per IEC 61869-11 for sensors 10000 :1 and 3.25/√3		
Measuring range	0.02·V_N [70]	0.2·V_N [70]	0.8·V_N to 1.9·V_N
Ratio error in %	6	3	0.5
Phase error in minutes	240	120	20

Table 7.2/22 Measured value accuracy – voltage

70 Accuracy class 3P as per IEC 61869-11

Measured variable	Accuracy class 0.5 as per IEC 61869-10			
Measuring range	$0.05 \cdot I_{PR}$	$0.2 \cdot I_{PR}$	$1 \cdot I_{PR}$	$20 \cdot I_{PR}$
Current (300 A primary)	15 A	60 A	300 A	6000 A
Current (700 A primary)	35 A	140 A	700 A	15000 A
Ratio error in %	1.5	0.75	0.5	0.5
Phase error in minutes	90	45	30	30

Table 7.2/23 Measured value accuracy for phase current

Measured variable	Low range	Accuracy class 0.5 as per IEC 61869-10				
Measuring range	$0.0019 \cdot I_{PR}$	$0.05 \cdot I_{PR}$	$0.2 \cdot I_{PR}$	$1 \cdot I_{PR}$	$20 \cdot I_{PR}$	I_{max}
Current (60 A primary)	0.11 A	3 A	12 A	60 A	1200 A	1600 A
Ratio error in %	1.5	1.5	0.75	0.5	0.5	0.5
Phase error in minutes	90	90	45	30	30	30

Table 7.2/24 Measured value accuracy for ground current

NOTE

The phase error is defined when using the sensors 10 000:1 and 3.25/√3 only.

	Current range	Power factor	1-Phase (Typical accuracy)	3-Phase (Typical accuracy)
Apparent power	$0.2 \cdot I_N$ to $6 \cdot I_N$	–	± 1 %	± 1 %
Active power		Unity power factor	± 1 %	± 1 %
		Power factor > 0.707	± 1 %	± 1 %
		Power factor < 0.707	< ± 3 %	< ± 3 %
Reactive power		Zero power factor	± 1 %	± 1 %
		Power factor < 0.707	± 1 %	± 1 %
		Power factor > 0.707	< ± 3 %	< ± 3 %
The accuracy is claimed at nominal voltage.				

Table 7.2/25 Accuracy power for 10 000:1 and 3.25/√3

	Current range	Power factor	1-Phase (Typical accuracy)	3-Phase (Typical accuracy)
Apparent power	$0.2 \cdot I_N$ to $6 \cdot I_N$	–	± 1 %	± 1 %
Active power		Unity power factor	± 1 %	± 1 %
		Power factor > 0.707	± 4 %	± 4 %
		Power factor < 0.707	< ± 6 %	< ± 5 %
Reactive power		Zero power factor	± 1 %	± 1 %
		Power factor < 0.707	± 3 %	± 2 %
		Power factor > 0.707	< ± 3 %	< ± 3 %
The accuracy is claimed at nomianl voltage (10 V to 30 V)				

Table 7.2/26 Accuracy power with VDIS LRM as input voltage (with auto caliberation)

Rear RS485 interface	
Electrical interface	RS485
Connection type	Terminal block with spring-loaded terminals
Supported communication protocol	Modbus RTU
Functionality	Slave
Baud rate (Bit/s)	9600, 19 200, 38 400, 57 600, 115 200, and 128 000 Default value: 115 200 Bit/s

Rear RS485 interface	
Data format	8N1, 8E1, 8O1 Default value: 8N1
Supported address	1 to 247 Default value: 247

Table 7.2/27 Communications

Front USB Interface	
Type	USB Type-C

Digital inputs[71]	6, DC 24 V to 60 V maximum[72]
Digital input control voltage	$V_{low} \leq$ DC 10 V
	$V_{high} \geq$ DC 19 V
Current consumption on single BI, excited	DC 0.4 mA to 2 mA
Power consumption on single BI	120 mW maximum
Digital outputs	4, dry contact type, Form A, latching relay
Maximum permitted voltage	DC 60 V
Maximum switching capacity	1250 VA/AC 250 V (AC, resistive) 150 W/DC 30 V (DC, resistive)
Permissible current per contact (continuous)	5 A
Permissible current per contact (switching)	5 A
Pickup time	10 ms typical
Dropout time	10 ms typical

Table 7.2/28 Digital Inputs and Outputs

Type of fixing	Panel flush mounting
Cut-out (W x H)	92+0.5 mm x 45+0.5 mm
Overall depth	120 mm
Permissible switch panel thickness for installation	2 mm to 4 mm
Mounting position	Horizontal
Weight	≤ 350 g

Table 7.2/29 Dimensions

Location of use	Indoor
Altitude	Maximum up to 2000 m
Operating temperature range	-40 °C to +70 °C
Storage temperature range	-40 °C to +70 °C -40 °C for maximum 2 weeks
Relative humidity	0 % to 95 %, non-condensing
Mains supply voltage fluctuations	±10 % (DC 24 V to 250 V) ±20 % (AC 230 V)
Overvoltage category	III
Pollution degree	2

Table 7.2/30 Environment conditions

Device front	IP 40
Device rear	IP 20

Table 7.2/31 Degree of protection

Peak inrush current	50 A in 350 µs

Table 7.2/32 Inrush current of auxiliary power supply at SICAM FCM plus powerup

DC 24 V to 250 V	≤ 6 W
AC 230 V	≤ 11 VA
Allowable superimposed AC component	15 % of auxiliary DC voltage

Table 7.2/33 Power consumption

NOTE

The given performance specifications apply only to LPIT. For detailed specifications of other sensor configurations, please refer to the user manual.

Current setting (I_{set})	10 A to 3000 A, Δ1 A
Time delay (t_{delay}) for 50-1	0 s to 60 s, Δ1x10 ms
Time delay (t_{delay}) for 50-2	0 s to 300 s, Δ1x10 ms
Operate level (I_{op})	100 % I_{set}, ± 5 %
Reset level	≥ 94 % I_{op}
Basic operating time (t_{basic})	0 to 2 · I_{set}: 40 ms ± 10 ms 5 · I_{set}: 30 ms ± 10 ms
Operate time following delay	t_{basic} + t_{delay}, ± 1 % or ± 10 ms

Table 7.2/34 50-1/50-2 Definite time phase-fault detection

Current setting (I_{set})	10 A to 3000 A, Δ1 A[73]
Time multiplier setting (T_m)	1 to 1500, Δ1x1/100
Characteristic curve	IEC NI, IEC VI, IEC EI, IEC LTI
Operate level (I_{op})	110 % I_{set}, ± 5 %

71 The digital inputs are unipolar and the internal fuse is not available.

72 AC voltage input not supported

73 Threshold of independent time operation (G_D) = 20, applicable up to setting value of 450 A for a nominal primary current of 300 A.

Reset level	≥ 90 % I_{op}
Operating time (t_{op})	$t_{op} = \left[\frac{K}{\left(\frac{I}{I_{set}}\right)^{\alpha} - 1}\right] \cdot Tm$ ± 5 % or ± 40 ms For IEC-NI: K = 0.14, α = 0.02 IEC-VI: K = 13.5, α = 1.0 IEC-EI: K = 80.0, α = 2.0 IEC-LTI: K = 120.0, α = 1.0

Table 7.2/35 51 Inverse time-delayed phase-fault detection

Characteristic angle setting (θ_{set})	0° to 60°, Δ15°
Operating angle (forward)	θ_{set} - 85° ± 5° to θ_{set} + 85° ± 5°
Operating angle (reverse)	(θ_{set} - 180°) - 85° ± 5° to (θ_{set} - 180°) + 85 ° ± 5°
Minimum voltage	> 10% of rated primary voltage (phase-to-phase)
Operate time (t_{op})	> 40 ms at characteristic angle + 50/51 element operate time

Table 7.2/36 67 Directional phase-fault detection

Current settting (I_{set})	3 A to 2000 A, Δ1 A
Time delay (t_{delay}) for 50N-1	0 s to 60 s, Δ1x10 ms
Time delay t_{delay} for 50N-2	0 s to 300 s, Δ1x10 ms
Operate level (I_{op})	100 % I_{set}, ± 5 %[74]
Reset level	≥ 90 % I_{op} for 3 A to < 10 A
	≥ 94 % I_{op} for > 10 A
Basic operating time (t_{basic})	0 to 2 · I_{set}: 40 ms ± 10 ms
	5 · I_{set}: 30 ms ± 10 ms
Operate time following delay	t_{basic} + t_{delay}, ± 1 % or ± 10 ms

Table 7.2/37 50N-1/50N-2 Definite time ground-fault detection - derived

Current setting (I_{set})	3 A to 2000 A, Δ1 A[75]
Time multiplier setting (T_m)	1 to 1500, Δ1x1/100
Characteristics settings	IEC NI, IEC VI, IEC EI, IEC LTI
Operate level (I_{op})	110 % (I_{set}), ± 5 %[74]

Reset level	≥ 90 % (I_{op})
Operating time (t_{op})	$t_{op} = \left[\frac{K}{\left(\frac{I}{I_{set}}\right)^{\alpha} - 1}\right] \cdot Tm$ ± 5 % or ± 40 ms For IEC-NI: K = 0.14, α = 0.02 IEC-VI: K = 13.5, α = 1.0 IEC-EI: K = 80.0, α = 2.0 IEC-LTI: K = 120.0, α = 1.0

Table 7.2/38 51N Inverse time-delayed ground-fault detection - derived

Characteristic angle setting (θ_{set})	0° to -60°, Δ15° (for solid connection)
	0° (for resonant connection)
	90° (for isolated connection)
Operating angle (forward)	θ_{set} - 85° ± 5° to θ_{set} + 85° ± 5°
Operating angle (reverse)	(θ_{set} - 180°) - 85° ± 5° to (θ_{set} - 180°) + 85 ° ± 5°
Minimum voltage	4 % to 100 % of V_{rated} phase-to-neutral
Basic operating time (t_{basic})	40 ms, ± 10 ms + 50N/51N function operate time
Operate time following delay (t_{delay})	t_{basic} + t_{delay}, ± 1 % or ± 10 ms

Table 7.2/39 67N Directional ground-fault detection - derived

Setting range (I_{set})	0.4 A to 1200 A, Δ 0.1 A
Time delay (t_{delay}) for 50G-1	0 s to 60 s
Time delay t_{delay} for 50G-2	0 s to 300 s
Operate level (I_{op})	100 % (I_{set}), ± 5 %
Reset level	≥ 90 % (I_{op}) for 0.4 A to < 3 A
	≥ 94 % (I_{op}) for > 3 A
Basic operating time (t_{basic})	0 to 2 · I_{set}: 40 ms ± 10 ms
	0 to 5 · I_{set}: 30 ms ± 10 ms
Operate time following delay (t_{delay})	t_{basic} + t_{delay}, ± 1 % or ± 10 ms

Table 7.2/40 50GS-1/50GS-2 Definite time ground-fault detection - measured

Current setting (I_{set})	0.4 A to 1200 A, Δ0.1[76]
Time multiplier setting (T_m)	0.01 to 15

74 Claim is valid for I_{set} > 10% of load current.

75 Threshold of independent time operation (G_D) = 20, applicable up to setting value of 450 A for a nominal primary current of 300 A.

76 Threshold of independent time operation (G_D) = 20, applicable up to setting value of 80 A.

Characteristics settings	IEC NI, IEC VI, IEC EI, IEC LTI
Operate level (I_{op})	110 % (I_{set}), ± 5 %[77]
Reset level	≥ 90 % (I_{op})
Operating time (t_{op})	$t_{op} = \left[\frac{K}{\left(\frac{I}{I_{set}}\right)^{\alpha} - 1}\right] \cdot Tm$ ± 5 % or ± 40 ms For IEC-NI: K = 0.14, α = 0.02 IEC-VI: K = 13.5, α = 1.0 IEC-EI: K = 80.0, α = 2.0 IEC-LTI: K = 120.0, α = 1.0

Table 7.2/41 51GS Inverse time-delayed ground-fault detection - measured

Characteristic angle setting (θ_{set})	0° to -60°, Δ15° (for solid connection)
	0° (for resonant connection)
	90° (for isolated connection)
Operating angle (forward)	θ_{set} - 85° ± 5° to θ_{set} + 85° ± 5°
Operating angle (reverse)	(θ_{set} - 180°) - 85° ± 5° to (θ_{set} - 180°) + 85 ° ± 5°
Minimum voltage	4 % to 100 % of V_{rated} phase-to-neutral
Basic operating time (t_{basic})	40 ms, ± 10 ms + 50GS/51GS function operate time
Operate time following delay (t_{delay})	t_{basic} + t_{delay}, ± 1 % or ± 10 ms

Table 7.2/42 67GS Directional ground-fault detection - measured

NOTE

50GS-n, 51GS, and 67GS is available in 6MD2323-1AA00-2AA0 only.

I_{dir} setting ($I_{dir.}$)	1.0 A to 30.0 A, Δ0.1 A
Operate level (I_{op})	100 % $I_{dir.}$, ± 5 %
Angle tolerance	3°
Reset ratio	0.8 for $I_{dir.}$≤ 10 A
	0.95 for $I_{dir.}$> 10 A

Table 7.2/43 Ground-fault detection (derived) with Cos φ/Sin φ measurement (Watt-metric)

I_{dir} setting ($I_{dir.}$)	0.2 A to 30.0 A, Δ0.1 A
Operate level (I_{op})	100 % $I_{dir.}$, ± 5 %
Angle tolerance	3°
Reset ratio	0.8 for $I_{dir.}$≤ 10 A
	0.95 for $I_{dir.}$> 10 A

Table 7.2/44 Ground-fault detection (measured) with Cos φ/Sin φ measurement (Watt-metric)

NOTE

Ground-fault detection (measured) is available in 6MD2323-1AA00-2AA0 only.

Current setting (I_{set})	10 % to 80 %, Δ1 %
Operate level (I_{op})	102 % I_{set}
Reset level	10 % to 20 %, 50 mA
	21 % to 35 %, 80 % of setting
	35 % to 80 %, 90 % of setting
Operating time delay	180 ms
Additional delay for 50/51/67 and 50N/51N/67N	15 ms
Cross-block timer (CBT)	40 ms to 60 s, Δ1x10 ms

Table 7.2/45 81HBL2 Inrush-current detection

NOTE

For reliable operation, the second harmonic current must be greater than 5 A.

Load current	50 A to 1250 A	Below 50 A
3I0 threshold value	4 A to 2000 A, Δ1 A	2 A to 3 A, Δ1 A
3I0 Delta pulse off-on ($3I_0$ Delta)	5 % to 300 %, Δ1 %	10 % to 300 %, Δ1 %
Error tolerance for 3I0 delta	5 % to 10 %, ±10 %	10 % and above, ±10 %
	11 % and above, ±5 %	
Pulse-on duration (TPulse On)	0.2 s to 20 s, Δ0.01 s	0.2 s to 20 s, Δ0.01 s
Pulse-off duration (TPulse Off)	0.2 s to 20 s, Δ0.01 s	0.2 s to 20 s, Δ0.01 s
Number of pulses for operate (PulseTh Op.)	0 to 100, Δ1	0 to 100, Δ1
Number of pulses for monitoring (PulseTh Mon.)	0 to 100, Δ1	0 to 100, Δ1

Table 7.2/46 Pulse-location detection (derived ground)

ground current	0.2 A to 1200A
3I0 threshold value	0.4 A
3I0 Delta pulse off-on ($3I_0$ Delta)	5 %
Error tolerance for 3I0 delta	5 % and above ±10 %

Table 7.2/47 Pulse-location detection (measured ground)

77 Claim is valid for I_{set} > 10% of load current.

V_0 threshold	10 % to 100 %, Δ1 %
Maximum operation V_0	10 % to 100 %, Δ1 %
Operate delay	0 s to 60 s, Δ0.01 s
Dropout delay	0 s to 60 s, Δ0.01 s
3I0 threshold value	0.4 A to 2000 A, Δ0.1 A
3I0 threshold operate	0.4 A to 2000 A, Δ0.1 A

Table 7.2/48 Transient ground-fault detection (measured ground and derived ground)

Timing tolerance	
DO operating time (pickup, forward/reverse, operate)	100 ms, ±60 ms
DO reset time (pickup, forward/reverse, operate)	100 ms, -80 ms/+30 ms
Accuracy tolerance	
Current tolerance for derived ground	±0.3 A of setting value Minimum $3I_0$ setting value is 1 A, for load current from 1 A to 100 A
	±2.1 A of setting value Minimum $3I_0$ setting value is 1 % of load current from 101 A to 630 A)
Current tolerance for measured ground	±0.05 A of setting value Minimum $3I_0$ setting value is 0.4 A
Voltage tolerance for derived ground (V_{NE})	5 % of setting value (V_0 threshold or V_0 maximum threshold)

Table 7.2/49 Transient ground-fault detection (timing and accuracy)

NOTE

Transient ground-fault detection (measured) is available in 6MD2323-1AA00-2AA0 only.

Fault pickup current - derived ground	1 A to 2000 A, Δ1 A
Fault pickup current - measured ground	0.4 A to 1200 A
No. of detection (Nos det.)	2 to 10, Δ1
Time reset	1 s to 600 s, Δ1x10 ms
Time sum	40 s to 100 s, Δ1x10 ms
T-det.ext	0 s to 10 s
Pickup tolerance	5 % of fault pickup current
Time tolerance	1 % of set value (time sum) or 40 ms 1 % of set value (time reset) or 40 ms

Table 7.2/50 Non-directional intermittent ground fault

Number of pulses	2 to 50, Δ1
Monitor time	0.1 ms to 10 ms, Δ1x10 ms
Minimum voltage	4 % to 100 % of of V_{rated} (phase-to-neutral), Δ1
Tolerance for minimum voltage	5 % of set value
Time tolerance	1 % of set value or 40 ms

Table 7.2/51 Directional intermittent ground fault

Setting (V_{set})	10 % to 95 % · V_{rated} (phase-to-ground)
Alarm time delay (t_{delay}) Warning time delay (t_{delay})	4 ms to 6000 ms, Δ 10 ms 0 ms to 6000 ms, Δ 10 ms
Hysteresis	3 % to 10 %, Δ1 %
U/V guard (V_g)	0 % to 20 %, Δ1 %
Operate level (V_{op})	100 % V_{set}, ± 5 %
Reset level	(100 % + hysteresis) · V_{op} ± 1 %
Operate time (t_{op})	0.95 · V_{set} to 0.5 · V_{set} with t_{delay} ± 50 ms
Reset time	100 ms, ± 20 ms

Table 7.2/52 27 Undervoltage alarm and warning

Setting (V_{set})	105 % to 170 % · V_{rated} (phase-to-ground)
Time delay (t_{delay})	0 ms to 6000 ms, Δ 10 ms
Hysteresis	3 % to 10 %, Δ1 %
Operate level (V_{op})	100 % V_{set}, ± 5 %
Reset level	(100 % - hysteresis) · V_{op} ± 1 %
Operate time (t_{op})	1.05 · V_{set} to 2 · V_{set} with t_{delay} ± 50 ms, > 2 · V_{set} with t_{delay} ± 30 ms
Reset time	100 ms, ± 20 ms

Table 7.2/53 59 Overvoltage alarm and warning

Setting (S_{set})		0.05 to 2.0 · S_{rated}, Δ 0.01
Applied power (for operate time)	Overpower	0 to 1.1 · S_{set}: V_{rated}, 1.1 · I, PF = 1 0 to 2 · S_{set}: V_{rated}, 2 · I, PF = 1
	Underpower	1.1 to 0.5 · S_{set}
Delay setting		0 to 20 s, Δ 0.01 s 20 to 100 s, Δ 0.1 s 100 to 1000 s, Δ 1 s 1000 to 10000 s, Δ 10 s 10000 to 14400 s, Δ 100 s
Operate level (S_{op})		S_{set}: ± 5 %
Reset level	Overpower	≥ 95 % S_{op}
	Underpower	≤ 105 % S_{op}
Repeatability		± 1 %

Element basic operate time (t_{basic})	Overpower	1.1 · S_{set}: 60 ms ± 10 ms
		2 · S_{set}: 45 ms ± 10 ms
	Underpower	0.5 · S_{set}: 40 ms ± 10 ms
Operate time following delay (t_{op})		t_{basic} + t_{delay} ± 1 % or ± 10 ms

Table 7.2/54 32 power protection

NOTE

32P power protection is available in 6MD2323-1AA00-2AA0 only.

Setting range (I_{set})	50 A to 2500 A, Δ 1 A
Time delay (t_d)	1 min to 120 min, Δ1 min
Operate level (I_{op})	100 % (I_{set}), ±5 %
Reset level	≤ 95 % (I_{op})
Operate time (t_{delay})	t_d ± 200 ms
Reset time	100 ms, ±20 ms

Table 7.2/55 Overcurrent alarm and warning

I_2/I_1	0, 20 to 100 %
Time delay (t_{delay})	1 s to 3600 s, Δ 1 s
U/C guard	0 % to 600 % of I_{rated}, Δ 1 %
Pickup accuracy	± 1 % I_2/I_1 0.1% of t_{delay}
Operate time (t_{op})	t_{delay} ± 100 ms
Reset ratio	≥ 0.97 I_2/I_1
Reset time	100 ms ± 20 ms

Table 7.2/56 Open-phase detection

Timer logic T1	1 s to 60 s, Δ 1 s
Timer logic T2	1 s to 25 s, Δ 1 s
Timer logic T3	30 s to 240 s, Δ 1 s
Operate time	± 100 ms

Voltage absence or presence	1 kV to 20 kV, Δ 0.1 kV
Current absence or presence	5 A to 100 A, Δ 1 A

Table 7.2/57 Enhanced fault validation - permanent fault

Fault validation duration	0.04 s to 2 s
Fault confirmation duration	0.2 s to 3000 s
Fault classification setting current	0.05 · I_n to 0.2 · I_n
Fault classification setting voltage	10% to 100% of rated primary voltage
Operate time following delay (t_{op})	t_{delay} ± 1 % or ± 20 ms
Operate level (I_{op})	100% I_{set}, ±5%
Reset level	≥ 94% I_{op}
Operate level (V_{op})	100% V_{set}, ±5%
Reset level	V_{op} ±1%

Table 7.2/58 Enhanced fault validation - temporary or permanent (fault classification)

NOTE

Fault classification - temporary or permanent fault is available in 6MD2323-1AA00-2AA0 only.

NOTE

The function specifications for phase-fault detection (50-n, 51), 81HBL2 Inrush-current detection, overcurrent alarm and warning, and open-phase detection are defined based on 2 configurations:

- 3-phase current inputs
- 2-phase current inputs + 1 ground current input

NOTE

The accuracy for all protection functions is defined based on a 300 A nominal primary current sensor. For a 700 A nominal primary current sensor, the minimum setting threshold for all functions must be multiplied by a factor of 2.3.

Use the following ordering number to order SICAM FCM plus:

Description	Article number																
Directional fault detection and condition monitoring.	1	2	3	4	5	6	7		8	9	10	11	12		13	14	15	16
Compatible with SIBusing sensor according to IEC 61869-10, IEC 61869-11. • Voltage, current, and temperature measurement • Power supply: DC 24 V to DC 250 V/AC 230 V • 6 digital inputs • 4 digital outputs • RS485 Modbus RTU and USB • 3 RJ45 analog interfaces	6	M	D	2	3	2	3	–	1	A	A	0	0	–	1	A	A	0
Directional fault detection and condition monitoring. Compatible with low power current transformer according to IEC 60044-8,IEC 61869-10 and low power voltage transformer according to IEC 61869-11 (resistive) and VDIS LRM according to IEC/EN 62271-213 (capacitive) • Voltage and current measurement • Power supply: DC 24 V to DC 250 V/AC 230 V • 6 digital inputs • 4 digital outputs • RS485 Modbus RTU and USB	6	M	D	2	3	2	3	–	1	A	A	0	0	–	2	A	A	0

Compatibile Sensors with 6MD2323-1AA00-1AA0

3M Product Name	Type of Product
IPVS v12 Series	Voltage sensors
IPVS v24 Series	
IPVS v36 Series	
QX-2.0 92-EES Series	
QX-2.0 92-ES Series	
QX-2.0 93-EES Series	
QX-2.0 93-ES Series	
500A/225mV; Split Core, CCS	Rogowski coil current sensor

Table 7.2/59 3M Current and Voltage Sensors Compatibility

Compatibile Sensors with 6MD2323-1AA00-2AA0

Description	Versions	Article number																	
Phase current sensor	Split core Ratio: 225 mV@300 A IEC 61869-10 Accuracy class 0.5 & 5P10; extension 200 %; connecting cable: 2 m, open end; inside diameter: 92 mm	6	M	D	2	3	2	0	–	0	G	A	0	0	–	1	A	A	0
	Closed ring core Ratio: 225 mV@700 A IEC 60044-8 Accuracy class 0.2 & 5P10, connecting cable: 2 m, open end; inside diameter 85 mm	6	M	D	2	3	2	0	–	0	J	A	0	0	–	0	B	A	1
Core balance current sensor	Ratio: 225 mV@60 A, IEC 61869-10 Accuracy class 1 Connecting cable: 2 m Window diameter: 160 mm	6	M	D	2	3	2	0	–	0	A	F	0	0	–	1	A	A	0
	Ratio: 225 mV@60 A, IEC 60044-8 Accuracy class: 1 Connecting cable: 3.5 m Window diameter: 120 mm; GOST certificate	6	M	D	2	3	2	0	–	0	A	F	0	0	–	1	A	A	1
Low Power Phase Current Sensor	3 x current sensor 225 mV@300 A, 300 A to 1000 A, split core type According to IEC 61869-10 Wide-range sensor Inside diameter: 44 mm Accuracy class: 0.5; ref. to rated current 300 A With connecting cable: 7 m; open end	6	M	D	2	3	2	0	–	0	H	L	0	0	–	A	A	0	0
Voltage Sensor 12 kV	12 kV/√3: 3.25/√3 Accuracy class: 1 IEC 60044-7 for symmetrical T-connectors with C-cones for cables: Nexans (K) 440TB/Cellpack CTS-S/Südkabel SEHDT13 and SEHDT23	6	M	D	2	3	2	0	–	0	A	A	0	4	–	1	A	A	0
	12 kV/√3: 3.25/√3 Accuracy class: 0.5 IEC 60044-7 for asymmetrical T-connectors with C-cones for cable nkt CB-24, CC-24 and Raychem RSTI-58xx	6	M	D	2	3	2	0	–	0	A	A	0	4	–	1	A	B	0
Voltage Sensor 24 kV	24 kV/√3: 3.25/√3 Accuracy class 0.5 IEC 61869-11 for asymmetrical T-connectors with C-cones for cables: Nexans (K) 440TB/Cellpack CTS-S/Südkabel SEHDT13 and SEHDT23	6	M	D	2	3	2	0	–	0	A	A	0	7	–	1	A	A	0
	24 kV/√3: 3.25/√3 Accuracy class 0.5 IEC 61869-11 for asymmetrical T connectors of nkt cables type CB-24, CC-24 and Raychem RSTI-58xx/RSTI-CC-58xx	6	M	D	2	3	2	0	–	0	A	A	0	7	–	1	A	B	0

Table 7.2/60 Compatibile Sensors with 6MD2323-1AA00-2AA0

Compatibile Accessories with SICAM FCM plus

Description	Versions	Article number																	
DIN rail adapter for housing 48 mm x 96 mm																			
	2 pieces; to snap on TS35 DIN rails; each adapter has 2 cut outs with 45 mm x 92 mm for flush-mounting housings with max. dep. of 135 mm, incl. cable bending; alternative wall mounting possible	6	M	D	2	3	2	0	–	0	A	A	4	0	–	0	M	A	1
Voltage-detection and indicating systems (VDIS) interface cable																			
	4-wire connection lead with integrated protection circuit to connect SICAM FCM plus 6MD2323-1AA00-2AA0 and higher with the LRM voltage detection and indication system 1 ground input; length: 0.4 m	6	M	D	2	3	2	3	–	0	A	A	8	0	–	0	A	B	4

Table 7.2/61 Accessories

Description

To operate modern distribution systems efficiently, it is necessary to quickly detect faults and provide local and remote indications across each phase for further diagnosis. A device designed for this purpose is the SICAM Fault-Passage Indicator(FPI). This is used for detection, indication, and reporting of phase faults as well as ground faults in radial or open ring cable networks in the medium-voltage range.

4 external current sensors ensure phase faults (A, B, C) and ground faults (Gnd) are detected. The current sensor detects phase faults and ground faults based on the set current threshold and transmits this information to the SICAM FPI device via an optical signal. With the rotary switch on each sensor, you can adjust the fault-current threshold for phase sensors from 200 A to 1200 A and for ground sensors from 10 A to 100 A or 40 A to 300 A. If the current exceeds the set threshold, then current sensor transmits the signal via plastic fibre-optic cables to the SICAM FPI. In this case, the corresponding LEDs flash and the binary contacts are activated. The LEDs are inactive under normal operating conditions.

Medium-voltage distribution	10 kV to 36 kV
Frequency range	50 Hz/60 Hz
Temperature range	From -30 °C to +70 °C
Housing	• Polycarbonate housing for panel flush mounting • Dimensions: 96 mm x 48 mm x 45 mm (W x H x D) • Protection class: Front IP 50, rear panel IP 20, sensors IP 67
Internal battery	Lithium battery (Li-$SOCl_2$), type AA/3.6 V/2400 mAh Expected shelf life of the SICAM FPI with battery installed is around 10 years >2000 hours of flashing time in active mode (fault indication mode)

Benefits

- Self sustained, continues to function using internal lithium battery even after the main incomer feeder has tripped.
- Complies with the IEC 61010-1 safety standards
- Simple setting via DIP switches
- Configurable binary outputs, for remote indication to SCADA for faults/diagnostics via RTU
- Extended diagnostic functions, support for self-diagnostics and sensor cable diagnostics
- 4 LED displays, 3 red LEDs for phase fault, 1 red LED for ground faults, 1 yellow LED for battery status
- Multiple reset functions, auto-reset (via manual reset using push buttons on front fascia), remote reset via binary input or via external front keys
- Longer battery life- more than 2000 hours of operation under fault conditions (blinking)

[ph_SICAM_FPI_W4, 1, --_--]

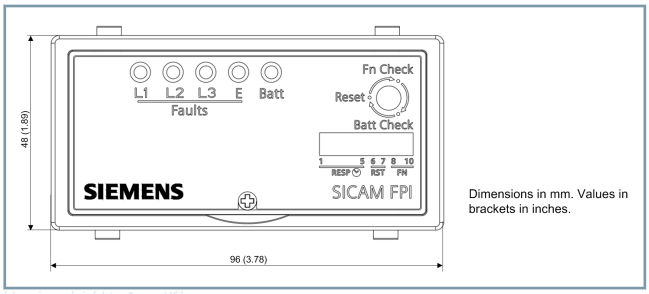
Figure 7.3/1 SICAM FPI

- Sensors, IP 67 complaint self sustained accurate sensors with a noise immune plastic fibre-optic cable interface to the SICAM FPI Indicator unit.
- Interference-free connection electrically separated via plastic optical fiber between sensors and SICAM FPI

Applications

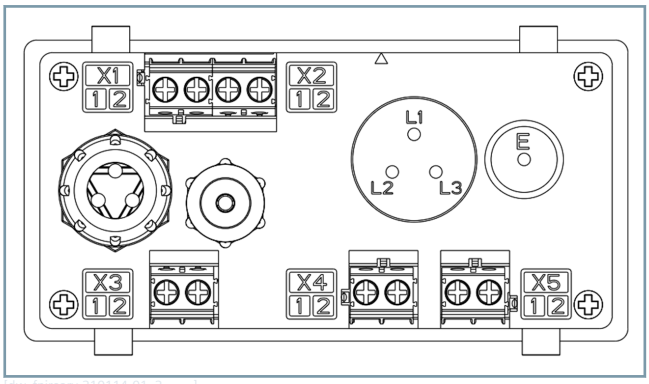
- SICAM FPI can be applied to medium-voltage distribution systems ranging from 10 kV to 36 kV
- SICAM FPI is used in 50 Hz/60 Hz networks
- SICAM FPI is primarily intended for radial or open ring medium-voltage cable networks

Dimensioned Drawings



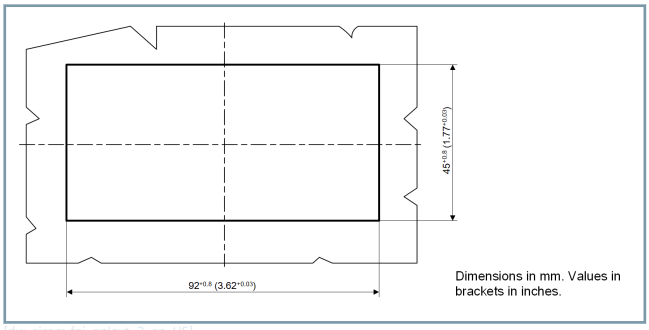
[dw_sicam-fpi_frbtv, 1, en_US]

Figure 7.3/2 Front View



[dw_fpirearv-210114-01, 2, --]

Figure 7.3/3 Rear View



[dw_sicam-fpi_pnlcut, 2, en_US]

Figure 7.3/4 RMU Panel Cut-Out

Technical data

The following is an excerpt from the technical data. Please find additional information in the current manual.

Inputs and Outputs

Current sensor inputs	Phase current inputs: L1, L2, L3 (via a plastic fibre-optic cable) Ground inputs: E (via a plastic fibre-optic cable)
Binary inputs (for reset functions)	AC 230 V reset input (range AC 35 V to AC 275 V), 50 Hz/60 Hz Remote reset input from dry contact
Binary outputs	Number: 2 Type: Potential-free contacts Maximum switching voltage: AC 250 V/DC 220 V Maximum rated current: 2 A Maximum switching current: 0.25 A, AC 250 V/0.13 A, DC 220 V

Phase-Fault Current Range (Type 1 Series)

Phase-fault current range	AC 200 A/400 A/500 A/600 A/800 A/1000 A/1200 A
Accuracy	≤10 % of the selected range (cable ∅ 25 mm to ∅ 45 mm)

Ground-Fault Current Range (Type 1 Series)

Ground-fault current range	AC 10 A/20 A/30 A/40 A/60 A/80 A/100 A
Accuracy	≤10 % of the selected range (cable ∅ 80 mm to ∅ 105 mm)

Ground-Fault Current Range (Type 2 Series)

Ground-fault current range	AC 40 A/80 A/120 A/160 A/200 A/260 A/300 A
Accuracy	≤10 % of the selected range (cable ∅ 80 mm to ∅ 105 mm)

Response Time

Response time	40 ms, 60 ms, 80 ms, 160 ms, 200 ms, 300 ms, 500 ms

Auto Reset Time

Auto reset time	1 h, 2 h, 4 h, 8 h

Environment

Humidity range	0 to 95 %, non-condensing
Altitude above sea level	Maximum up to 2000 m

Dimensions

Type of fixing	Flush mounting, plug-in (screw less), IEC 61554
Cut-out (W x H)	92+0.8 mm x 45+0.8 mm
Overall depth (D)	46 mm
Mounting position	Horizontal
Weight	≤ 300 g

Electrical Tests

Test	Reference
Dielectric withstand	IEC 60950-1 IEC 61010-1
Impulse voltage withstand	IEC 60950-1 IEC 61010-1
Electrostatic discharge (ESD)	IEC 61000-4-2
Electrical fast transient (EFT)	IEC 61000-4-4

Insulation Test According to IEC EN 61010-1

Test Circuits	Dielectric Voltage
Between binary input (BI1), binary output (BO1 and BO2) and battery terminals	AC 3.0 kV, 1 min [double insulation] AC 3.510 kV, 5 s [double insulation]

Terminal 1	Terminal 2	Voltage Level	Duration	Category
BO1 and BO2	BI1	3.0 kV, 50 Hz	1 min	Cat. III
BO1 and BO2	Battery terminals shorted	3.0 kV, 50 Hz	1 min	Cat. III
BI1	Battery terminals shorted	3.0 kV, 50 Hz	1 min	Cat. III

Terminal 1	Terminal 2	Voltage Level	Duration	Category
BO1 and BO2	BI1	3.5 kV, 50 Hz	5 s	Cat. III
BO1 and BO2	Battery terminals shorted	3.5 kV, 50 Hz	5 s	Cat. III
BI1	Battery terminals shorted	3.5 kV, 50 Hz	5 s	Cat. III

Environmental Test

Test	Reference
Temperature	
Dry cold test	IEC 60068-2-1
Dry heat test	IEC 60068-2-2
Damp heat test, cyclic	IEC 60068-2-30

SICAM FPI – Type Testing

IP Tests	
IP 50 – SICAM FPI indicator front IP 20 – SICAM FPI indicator rear IP 67 – SICAM FPI sensor – phase and earth	IEC 60529

Routine/Production Test

Test	Reference
Production test	IEEE 495 (clause no. 4.2.1 and 4.2.2)

Description	Versions	Order no.																
		1	2	3	4	5	6	7		8	9	10	11	12		13	14	15	16
Type 1 Series **Phase-fault sensor:** AC 200 A to AC 1200 A, 10 % accuracy; **Ground-fault sensor:** AC 10 A to AC 100 A, 10 % accuracy																			
Phase-fault and ground-fault indicator with 2 binary outputs (NO), With 3 phase-fault and 1 ground-fault sensors (for L1/L2/L3/E), Plastic fibre-optic cable (3 m in length)		6	M	D	2	3	1	0	-	0	A	A	0	0	-	0	A	A	0
Phase-fault and ground-fault indicator with 2 binary outputs (NO), without sensor		6	M	D	2	3	1	0	-	0	A	D	0	0	-	0	A	A	0
Phase-fault and ground-fault indicator with 2 binary outputs (NO), With 3 phase-fault and 1 ground-fault sensors (for L1/L2/L3/E), Plastic fibre-optic cable (10 m in length)		6	M	D	2	3	1	0	-	0	A	A	1	0	-	0	A	A	0
Ground-fault indicator with 1 binary output (NO), With 1 ground-fault current sensor (for E), Plastic fibre-optic cable (3 m in length)		6	M	D	2	3	1	0	-	0	C	C	0	0	-	0	A	A	0
Type 2 Series **Phase-fault sensor:** AC 200 A to AC 1200 A, 10 % accuracy; **Ground-fault sensor:** AC 40 A to AC 300 A, 10 % accuracy																			
Phase-fault and ground-fault indicator with 2 binary outputs (NO), With 3 phase-fault and 1 ground-fault sensors (for L1/L2/L3/E), Plastic fibre-optic cable (3 m in length)		6	M	D	2	3	1	0	-	0	A	E	0	0	-	0	A	A	0

Table 7.3/1 SICAM FPI Selection and Ordering Data

Description	Versions	Order no.																	
		1	2	3	4	5	6	7		8	9	10	11	12		13	14	15	16
Lithium battery (Li-SOCL2) type AA/3.6 V/2400 m Ah		6	M	D	2	3	0	0	-	0	A	B	0	0	-	0	A	A	0
Type 1 Series **Phase-fault sensor:** AC 200 A to AC 1200 A, 10 % accuracy; **Ground-fault sensor:** AC 40 A to AC 300 A, 10 % accuracy																			
With 3 phase-fault and 1 ground-fault sensors (for R/Y/B/E), Plastic fibre-optic cable (3 m in length)		6	M	D	2	3	0	0	-	2	F	A	0	0	-	0	A	A	1
Type 2 Series **Phase-fault sensor:** AC 200 A to AC 1200 A, 10 % accuracy; **Ground-fault sensor:** AC 10 A to AC 100 A, 10 % accuracy																			
1 SET – 3 phase-fault and 1 earth-fault current sensors (for R/Y/B/E), with 3 m FoC connected to R/Y/B/E sensors		6	M	D	2	3	0	0	-	3	F	A	0	0	-	0	A	A	1

Table 7.3/2 SICAM FPI Spares

SICAM EFI – Description

Description

The SICAM Earth Fault Indicator (EFI) is a device that is used for the detection and signaling of ground faults on medium-voltage underground distribution cable networks. It uses an external current sensor to detect ground faults (E). The device together with the current sensor detects the current unbalance in the underground cables and indicates it as ground fault. The fault indications are based on the ground-fault current threshold set in the device.

SICAM EFI provides a quick detection and localization of faults. This decreases fault outage times and helps in maintaining the medium voltage feeder availability. This device is used in the distribution automation systems having voltage ratings up to 36 kV (+10%) with a highest withstandable voltage for equipment of up to 40.5 kV.

Medium-voltage distribution	Up to 36 kV (+10%)
Highest withstandable voltage	Up to 40.5 kV
System frequency	50 Hz/60 Hz networks, ± 10 % tolerance
Internal battery	Field replaceable Lithium thionyl chloride battery (Li-$SOCl_2$) type AA cell size/3.6 V/ 2700 mAh • Either up to 15 years expected operational life • Or up to 2000 h of fault indication flashing (single blink/second) under standard operating temperature of 25 °C
Auxiliary power supply	AC 110 V to 230 V, ± 20 % tolerance Power rating: 6 VA
	DC 12 V to 24 V, ± 20 % tolerance Power rating: 0.5 W Operating range: 9 V to 38 V (Safety extra low voltage - SELV)
Sensor input interface	Ground sensor input: S1 and S2 (via an electrical cable)

Benefits

- Easy to operate and install ground fault indicator for medium voltage cable networks
- Current sensors are IP68W compliant and apt for outdoor use
- SICAM EFI suitable for surface mounting

Applications

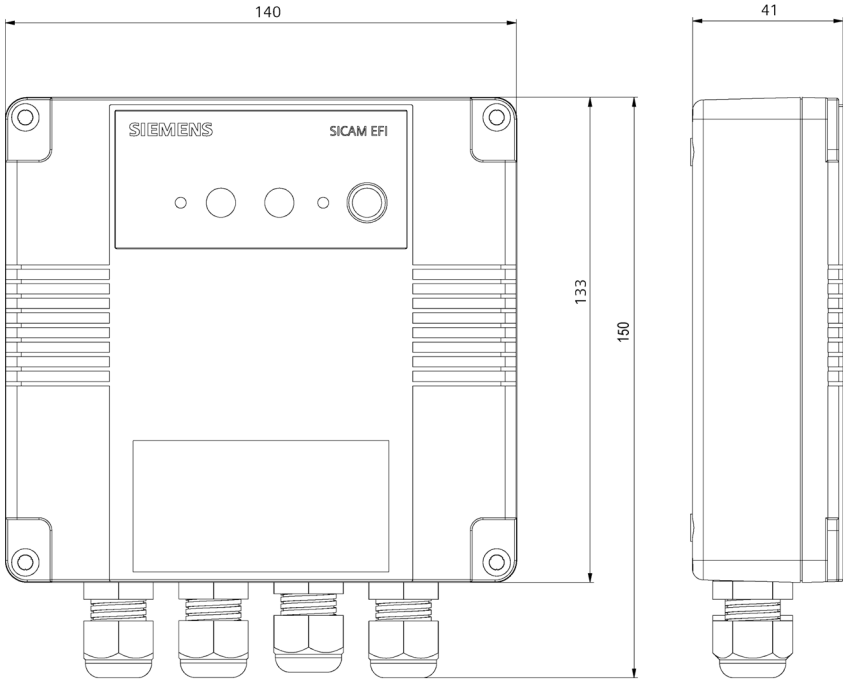
The SICAM EFI detects and indicates (locally and remotely) ground faults in radial or open ring cable networks - solidly grounded or low-resistive grounded. This is made possible using an external current sensor.

Figure 7.4/1 SICAM EFI

You can choose between 4 types of sensors with different diameters and a sensor cable length of 3.5 m, 5 m, and 16 m.
The split core sensors allow installation even with an already installed medium voltage cable. So, you can optimally adapt the SICAM EFI to your needs and use it, for example, for retrofit measures.

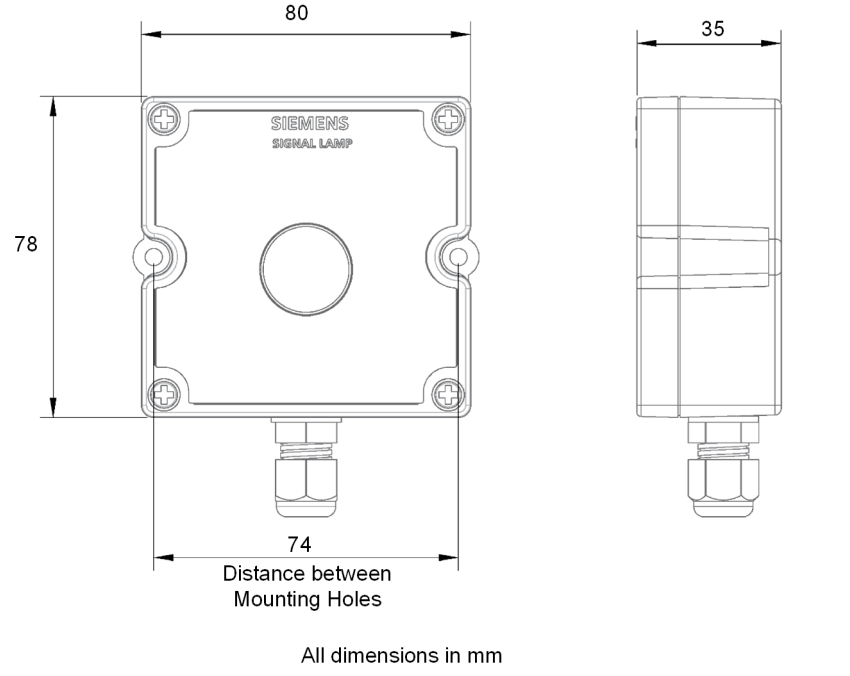
- The SICAM EFI is used in 50 Hz/60 Hz networks.
- The device is primarily intended for radial or open ring medium-voltage cable networks.
- Supports application on solidly grounded or low-resistive grounded networks.
- The SICAM EFI and the signal lamp material are UV stabilized, of flame retardant grade, and of weatherproof polymeric material.
- Split core encapsulated low-power sensor with insulation are for outdoor applications – UV stabilized, flame retardant grade, corrosion-resistant, and weatherproof polymeric material.
- The SICAM EFI fault LED visibility is up to 20 m during the day time and 200 m during the night time.
- The Siemens signal lamp visibility is up to 70 m during the day time and 300 m during the night time.

Dimensions



[dw_efi_casedimensions_frontview, 1, en_US]

Figure 7.4/2 SICAM EFI Front View and Side View



[dw_efi_signallmap_casedimensions_frontview, 1, en_US]

Figure 7.4/3 Siemens Signal Lamp Front and Side View

Short-Circuit Indicator

SICAM EFI – Technical Data

Technical data

The following is an excerpt from the technical data. Please find additional information in the current manual.

Binary Output

Maximum switching voltage	AC 250 V/DC 220 V
Maximum switching power	62.5 VA/30 W
Maximum carry current	2 A
Maximum switching current	0.25 A, AC 250 V/0.13 A, DC 220 V

Operating Temperature

Operating temperature and ambient storage temperature	Device • -20 ° C to +75° C – 6MD2311-1BB00-0AA3 – 6MD2311-1BE00-0AB6 – 6MD2311-1DC00-0AB6 – 6MD2311-1DD00-0AB6 – 6MD2311-1DE00-0AB6 • -30 ° C to +75° C – 6MD2311-2BB10-0AA5 – 6MD2311-1DC10-0AB6 Signal Lamp • -30 ° C to +75° C

Mechanical Data

Dimensions (W x H x D)	140 mm x 150 mm x 41 mm (with glands)
Weight	447 g
Mounting position	Surface mounting position (on RMU panel or wall)

Ground-Fault Current Range (for all sensors)

Ground-fault current range	25 A to 100 A (for type 1 sensor) 25 A to 240 A (for type 2, type 3 and type 4 sensor)
Typical accuracy	±10 % of the selected setting

Type 1 Sensor (for 3-core cable)

Sensor ∅	150 mm
Sensor wire length	3.5 m or 5 m
Current cable ∅ supported	60 mm to 150 mm
Material	Flexible insulated and UV stabilized material

Type 2 Sensor (for 3-core cable)

Sensor ∅	140 mm
Sensor wire length	16 m
Current cable ∅ supported	90 mm to 140 mm
Material	Flexible insulated and UV stabilized material

Type 3 Sensor (for single-core cable)

Sensor ∅	280 mm
Sensor wire length	16 m
Current cable ∅ + pitch ∅ supported	220 mm - 340 mm
Material	Flexible insulated and UV stabilized material

Type 4 Sensor (for 3-core cable)

Sensor ∅	120 mm
Sensor wire length	16 m
Current cable ∅ supported	60 mm to 120 mm
Material	Flexible insulated and UV stabilized material

Signal Lamp Output Rating

Signal lamp BO rating in the following MLFBs: 6MD2311-1BB00-0AA3 and 6MD2311-1BE00-0AB6

Contact rating (resistive load)	1 A, DC 30 V 0.3 A, AC 125 V
Maximum switching voltage	AC 250 V/DC 220 V
Maximum switching power	62.5 VA/30 W
Maximum carry current	2 A

Signal lamp BO rating in the following MLFBs: 6MD2311-2BB10-0AA5, 6MD2311-1DC00-0AB6, 6MD2311-1DD00-0AB6, 6MD2311-1DE00-0AB6 and 6MD2311-1DC10-0AB6.

Contact rating (resistive load)	2 A, DC 30 V 3 A, DC 30 V 0.5 A, AC 125 V
Maximum switching voltage	AC 277 V/DC 220 V
Maximum switching power	62.5 VA/90 W
Maximum switching current	4 A

Description		Order No.																
		1	2	3	4	5	6	7		8	9	10	11	12		13	14	15	16
SICAM Earth Fault Indicator		6	M	D	2	3	1	1	-	□	□	□	□	0	-	0	A	□	□
										▲	▲	▲	▲					▲	▲
Device Hardware										|	|	|	|					|	|
Battery-Powered	Ground-fault indicator (Li-$SOCl_2$ battery) with:									1	B	B	0					A	3
	• 1 BO (CO type for ground fault) • 1 signal lamp BO (NO type) • 2 BI (Potential-free, AC 110 V/230 V, ± 20 % tolerance) • LED indications									1	B	E	0					B	6
	Ground-fault indicator (Li-$SOCl_2$ battery) with: • 3 BO (1 CO type and 1 NO type spare for ground fault, 1 NO type for battery health) • 1 signal lamp BO (NO type) • 2 BI (Potential-free, AC 110 V/230 V, ± 20 % tolerance) • LED and flag indications									2	B	B	1					A	5
Dual-Powered	Ground-fault indicator (Li-$SOCl_2$ battery + auxiliary power supply: DC 12 V to 24 V, ± 20 % tolerance (operating range: 9 V to 38 V), AC 110 V/230 V, ± 20 % tolerance) with:									1	D	C	0					B	6
										1	D	D	0					B	6
	• 2 BO (1 CO type for ground fault, 1 NO type for battery health) • 1 signal lamp BO (NO type) • 3 BI (Potential-free, DC 9 V to 38 V, AC 110 V/230 V, ± 20 % tolerance) • LED indications									1	D	E	0					B	6
	Ground-fault indicator (Li-$SOCl_2$ battery + auxiliary power supply: DC 12 V to 24 V, ± 20 % tolerance (operating range: 9 V to 38 V), AC 110 V/230 V, ± 20 % tolerance) with: • 2 BO (1 CO type for ground fault, 1 NO type for battery health) • 3 BI (Potential-free, DC 9 V to 38 V, AC 110 V/230 V, ± 20 % tolerance) • LED and flag indications									1	D	C	1					B	6
Sensor Details												|						|	|
Type 1 Sensor	• Ground-fault trip current range: 25 A to 100 A • Sensor ∅: 150 mm • Sensor secondary wire length: 3.5 m or 5 m • Used for three-core cable • Supports cable ∅ range: 60 mm to 150 mm (10 % Accuracy)											B						A	3/5
Type 2 Sensor	• Ground-fault trip current range: 25 A to 240 A • Sensor ∅: 140 mm • Sensor secondary wire length: 16 m • Used for three-core cable • Supports cable ∅ range: 90 mm to 140 mm (10 % Accuracy)											C						B	6
Type 3 Sensor	• Ground-fault trip current range: 25 A to 240 A • Sensor ∅: 280 mm • Sensor secondary wire length: 16 m • Used for 3 single-core cable • Supports cable pitch range: 220 mm to 340 mm (10 % Accuracy) Type 3 sensor diameter can be adjusted using the line marker and stopper position provided to achieve the desired diameter. This allows for flexibility and customization as per your requirements.											D						B	6
Type 4 Sensor	• Ground-fault trip current range: 25 A to 240 A • Sensor ∅: 120 mm • Sensor secondary wire length: 16 m • To be used for three-core cable • Supports cable ∅ range: 60 mm to 120 mm (10 % Accuracy)											E						B	6
Sensor Connecting Wire Length (Refer description before ordering sensor wire length)																		|	|
3.5 m	3.5 m wire length is only available for 6MD2311-1BB00-0AA3 MLFB variant																	A	3
5 m	5 m wire length is only available for 6MD2311-2BB10-0AA5 MLFB variant																	A	5
16 m	16 m wire length is available for the remaining MLFB variants.																	B	6

Table 7.4/1 SICAM EFI Selection and Ordering Data

SICAM EFI - Spares and Accessories

MLFB	Description	
6MD2301-1BA00-0AA3 Type 1 Sensor	• Ground-fault trip current range: 25 A to 100 A • Sensor Ø: 150 mm • Sensor secondary wire length: 3.5 m • Used for three-core cable • Supports cable Ø range: 60 mm to 150 mm (10 % Accuracy)	
6MD2301-1BA00-0AA5 Type 1 Sensor	• Ground-fault trip current range: 25 A to 100 A • Sensor Ø: 150 mm • Sensor secondary wire length: 5 m • Used for three-core cable • Supports cable Ø range: 60 mm to 150 mm (10 % Accuracy)	
6MD2301-1CA00-0AB6 Type 2 Sensor	• Ground-fault trip current range: 25 A to 240 A • Sensor Ø: 140 mm • Sensor secondary wire length: 16 m • To be used for three-core cable • Supports cable Ø range: 90 mm to 140 mm (10 % Accuracy)	
6MD2301-1DA00-0AB6 Type 3 Sensor	• Ground-fault trip current range: 25 A to 240 A • Sensor Ø: 280 mm • Sensor secondary wire length: 16 m • Used for 3 single-core cable • Supports cable pitch range: 220 mm to 340 mm (10 % Accuracy) Type 3 sensor diameter can be adjusted using the line marker and stopper position provided to achieve the desired diameter. This allows for flexibility and customization as per your requirements.	
6MD2301-1EA00-0AB6 Type 4 Sensor	• Ground-fault trip current range: 25 A to 240 A • Sensor Ø: 120 mm • Sensor secondary wire length: 16 m • To be used for three-core cable • Supports cable Ø range: 60 mm to 120 mm (10 % Accuracy)	
6MD2301-0AB00-0AA0	Flush mounting bracket (L-clamp)	
6MD2301-0AA00-1LA5	Signal lamp with 5 m wire length	
6MD2301-0AA00-1LB5	Signal lamp with 15 m wire length	

Description

The SICAM Fault Collector Gateway (FCG) device receives both distribution line faults and the load current values from the SICAM Fault Sensor Indicator (FSI) via short-range radio (SRR) communication.

The received current measured values and status information are transmitted to:

- the control center based on the selected communication protocol.
- the MindSphere cloud via General Packet Radio Service (GPRS).

The fault detected by SICAM FSI is communicated to SICAM FCG via SRR communication.

SICAM FCG provides 6 binary inputs and 3 binary outputs. SICAM FCG can be configured and diagnosed locally using the Web GUI by connecting to a PC or laptop computer or remotely via General Packet Radio Service (GPRS).

SICAM FCG must be mounted inside a housing which can comply with standard IP54 or IP65. The Global System for Mobile Communications (GSM) and short-range radio antennas must be mounted outside the housing. Installation distance between short-range and GSM antennas must be atleast 30 cm (centre to centre distance) to avoid interference.

SICAM FCG Web GUI allows you to configure the parameters, displays error and operational log, upgrade of firmware, and download the configuration.

Functions

Binary inputs and outputs

- On the terminal block L, all the 3 binary inputs are independent and have a fixed threshold of 8 V. On the terminal block P, 2 binary inputs have a common input (P8, P9, and P10) and 1 binary input (P11, P12) which is independent. These binary inputs have selectable thresholds of DC 19 V, DC 88 V, and DC 176 V. Therefore an optimal adjustment of pickup voltage can be made in case of increased interference level. The binary outputs are designed as relay contacts. The terminal block P has 2 relay outputs - Normally Open (NO) and 1 relay output Change Over (CO). The relays can switch voltages up to AC/DC 250 V and currents up to AC/DC 5 A.

[ph_SICAM_FCG_W3, 1, --_--]

Figure 7.5/1 SICAM FCG

Communication

- SICAM FCG is the gateway device in the communication network between the SICAM FSIs and the control center/cloud service. It provides interfaces and supports communication protocols to the SICAM FSI devices (via short-range radio) and to the network control center/cloud service (via cellular networks). The gateway contains a common function for communication exchange between the SICAM FSI devices and the control center/cloud service. The various communication interfaces and protocols are available for communication between the SICAM FCG and the control center. The SICAM FCG device has an Ethernet interface for device parameterization and monitoring. The communication interface supports device parameterization and transmission of messages and measured values. The information is transmitted securely via telegrams.

GSM/GPRS Module

- The GPRS/GSM module[78] supports 4 frequency bands: 850 MHz, 900 MHz, 1800 MHz, and 1900 MHz.
  The communication can be established over the GSM/GPRS network based on:
  - Telecontrol protocols IEC 60870-5-104 or DNP3 to the control center
  - MindConnectLib to the SICAM Localizer

  You can execute the configuration, firmware update and perform diagnosis using SICAM FCG Web GUI via GPRS.

Short-range radio module

- The short-range radio module communicates directly with SICAM FSI via a radio link in the license-free 2400-MHz band and up to 100 meters. Any overhead distribution line fault or other status change detected by SICAM FSI is communicated to the SICAM FCG through the short-range radio module.

78 The distance between SICAM FCG (along with GSM and SRR antennas) and SICAM FSI must be less than or equal to 100 m (line of sight). The GSM antenna (MLFB: 6MD2318-0CA10) and Short-range radio antenna (MLFB: 6MD2318-0CA20) are tested along with SICAM FCG.

Short-Circuit Indicator

SICAM FCG – Technical Data

DC 12 V or DC 24 V Power Supply

Rated input voltages	DC 12 V or DC 24 V (Safety Extra Low Voltage - SELV)
Operating voltage range	DC 10.5 V to 28.8 V
Power input typical (12 V)	3 W
Maximum power input	12 W (peak)
Maximum input current	1 A (peak)
Safety	CAT III Fixed installation according to IEC 61010-1 ed. 3
Degree of pollution	2 (according to IEC 61010-1 ed.3)

Binary Inputs (Terminal Block P)

Number according to device	3
Rated input voltage range	DC 24 V to 250 V; AC not allowed
Threshold voltages (adjustable)	
Threshold voltage 19 V (at rated voltage 24 V)	V high ≥ 19 V V low ≤ 14 V
Threshold voltage 88 V (at rated voltage 110 V)	V high ≥ 88 V V low ≤ 66 V
Threshold voltage 176 V (at rated voltage 220 V)	V high ≥ 176 V V low ≤ 132 V
Maximum input voltage	DC 300 V

Binary Inputs (Terminal Block L)

Number according to device	3
Input voltage range	up to DC 20 V; AC not allowed
Rated voltage	12 V
Threshold voltage 8 V (at rated voltage 12 V SELV)	V high ≥ 10 V V low ≤ 4 V

Binary Outputs (Relay Outputs)

Type of relay	NO relay	CO relay
Number	2	1
Output values		
Switching capacity	On: 1000 W/VA Off: 30 VA; 40 W ohmic 25 W/VA at L/R ≤ 40 ms	
Contact voltage AC and DC	250 V	
Permissible current per contact	Continuous: 5 A Switching on and holding: 30 A for 1 s (make contact)	
Short-time current across closed contact	250 A at 30 ms	
Total permissible current for contacts connected to common potential	5 A	
Switching time (OOT)	≤ 10 ms; (OOT = output operating time) more delay of the output medium used	
Rated data of the output contacts		
AC 120 V	5.0 A, GP	
AC 277 V	5.0 A, GP	
AC 277 V	0.7 HP	
NEMA B300, R300		
Anti-interference capacitor across the contacts	4.7 nF, ± 20 %, AC 250 V	
Contact life		
Expected contact life (resistive load)	> 10^5, electric (AC), at 20 switching cycles/min	

Ethernet Interface

Ethernet, electrical	Connection	Device top side RJ45 connector socket 100BaseT acc. to IEEE802.3 LED green: Link/Activity LED amber: Unused/ Reserved
	Voltage strength	DC 700 V
	Transmission rate	10/100 Mbit/s
	Cable for 100Base-T	100 Ω to 150 Ω STP, CAT5
	Maximum cable length 100Base-T	100 m, if installed

GSM Antenna and Antenna Interface

Requirements for Antenna Type	
Fixed antenna	For use in industrial environment acc. to EN/IEC 61010-1 Ed. 3 CAT III
Detached antenna	For remote installation in residential, commercial, and light industrial environments (EN/IEC 61010-1 Ed. 3 CAT III).
Antenna Data	
Antenna Gain	
GSM 850 MHz	≤ 6 dBi
GSM 900 MHz	No maximum value
GSM 1800 MHz	No maximum value
GSM 1900 MHz	≤ 2.25 dBi
Connection Values	
Impedance	50 Ω
VSWR	≤ 2:1
Antenna Interface at the Device	
Type of antenna socket	SMA
Physical Dimensions	
Diameter X Height	76 mm X 23 mm
Mounting Hole Diameter	16.2 mm

Short-Range Radio Antenna and Antenna Interface

Recommended Antenna Specifications	
Frequency band	2440 MHz ±100 MHz
Antenna Data	
Antenna Gain	≤ 4 dBi (typical)
Connection Values	

Impedance	50 Ω
VSWR	≤ 1.5:1
Antenna Interface at the Device	
Type of antenna socket	RP-SMA (RP = Reverse Polarity)
Physical Dimensions	
Diameter X Height	76 mm X 23 mm
Mounting Hole Diameter	16.2 mm

Mobile Communication

GSM frequency bands	GSM 850 GSM 900 GSM 1800 GSM 1900
Maximum transmitted RF power	2 W (33 dBm) for GSM 850 and GSM 900 1 W (30 dBm) for GSM 1800 and GSM 1900
Maximum transmission rate	Up to 80-kbit/s uplink Up to 40-kbit/s downlink
General data	GPRS multislot class 10, Coding schemes CS 1-4

Short-Range Radio Communication

Operating frequency band	2.4 GHz
Maximum transmission rate	250 kbit/s
RF output power range used by SICAM FCG per country/region	10 mW to 250 mW (10 dBm to 24 dBm)

Environmental Data

Temperature	Open type; surrounding air temperature	Maximum 63 °C (131 °F), normal operation
	Operating temperature	-20 °C to +70 °C or -4 °F to +158 °F
	Temperature during transport	-25 °C to +70 °C or -13 °F to +158 °F
	Temperature during storage recommendation	-25 °C to +70 °C or -13 °F to +158 °F +10 °C to +35 °C or +50 °F to +95 °F
	Maximum temperature gradient	20 K/h
Air humidity	Mean relative air humidity per year	≤ 75 %
	Maximum relative air humidity	95 %, 30 days a year
	Condensation during operation	Not permitted
	Condensation during transport and storage	Permitted

General Data

Battery	Type	PANASONIC CR2032 or VARTA 6032 101 501
	Voltage	3 V
	Capacity	230 mAh
	Typical life	10 years In operation with continuous supply voltage
		2 months within 10 years in operation where supply voltage is not applied continuously
Protection class	DIN rail side	IP20
	Terminal side (terminals)	IP20
	Top side	IP20

Selection and Ordering Data

Description	Versions	Order no.															
		1	2	3	4	5	6	7		8	9	10	11	12		13	14	15	16
SICAM Fault Collector Gateway		6	M	D	2	3	4	0	-	□	□	□	□	□	-	□	A	A	□
										▲	▲	▲	▲	▲		▲			▲
Power supply										|	|	|	|	|		|			|
DC 12 V compatible (suitable for interface with 12 V battery for backup)										3	|	|	|	|		|			|
Input/output interface 1 (Terminal P)											|	|	|	|		|			|
Without Binary input/output (3 BI/3 BO)											A	|	|	|		|			|
Binary input/output (3 BI/3 BO)											J	|	|	|		|			|
Input/output interface 2 (Terminal L)												|	|	|		|			|
Short-range radio & I/O (3 BI + short-range radio coordinator)												M	|	|		|			|
Communication interface													|	|		|			|
Ethernet													0	|		|			|
Ethernet and General packet radio services (GPRS)													7	|		|			|
Device with/without antenna														|		|			|
	Device without antenna[79]													0		|			|
	Device with antenna[80] GPRS antenna – MLFB number 6MD2318-0CA10 Short-range radio frequency antenna– MLFB number 6MD2318-0CA20													1		|			|
Protocol																|			|
	IEC 60870-5-104 (server) / MindConnect Library/ DNP3slave (TCP/IP) with SMS functionality															8			|
IPSec																			
	with IPSec																		2

Table 7.5/1 SICAM FCG Selection and Ordering Data

7.5

NOTE

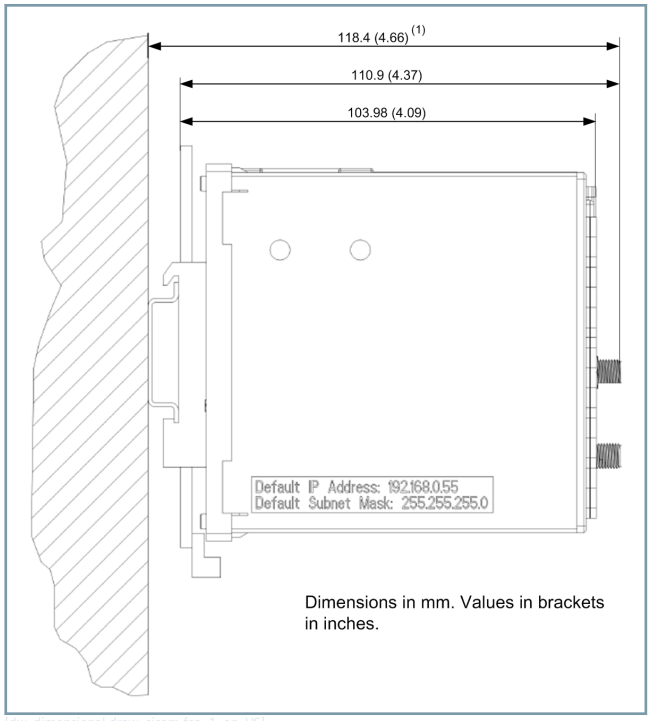
For markets requiring FCC certification and ISED certification, SICAM FCG should be ordered as: 6MD2340-3JM71-8AA2-Z/DD.

Weight	Approx. 0.550 kg
Dimensions (W x H x D)	96 mm x 96 mm x 100 mm 3.78 in x 3.78 in x 3.94 in

Table 7.5/2 Dimensions

79 Applicable only for spares/external router based applications. For external router based applications, it is mandatory to order short-range radio frequency antenna (MLFB: 6MD2318-0CA20).

80 For SICAM FCG (6MD2340-3AM01-8AA2), only short-range radio frequency antenna is provided.



[dw_dimensional-draw_sicam-fcg, 1, en_US]

Figure 7.5/2 Dimensional Drawing

(1) Valid for DIN rail DIN EN 60715-35x7.5

SICAM FSI – Description

Description

The SICAM FSI (Fault Sensor Indicator) measures the phase current continuously and detects the phase fault and ground fault when it is mounted on the medium-voltage overhead line network. The device indicates both the temporary fault and permanent fault via an optical indication. The SICAM FSI is used to improve the distribution grid reliability and reduce the power outages on the medium-voltage overhead line network.

The SICAM FSI can be mounted (in groups of 3 or 6 or 9) on each phase after the branching points and sectionalizer.

SICAM FSI is available in the following variants:

- 6MD2314-1Ax10: The faults are displayed locally via LEDs on the device. Depending on the fault type, a specific flashing sequence is generated.
- 6MD2314-1Ax11 – with integrated communication: In addition to the local LED display, the phase fault and ground fault events are communicated via a secure wireless connection to a gateway (SICAM FCG, 6MD2340-3JM71-8AA2). The SICAM FCG (Fault Collector Gateway) establishes the connection via GSM/GPRS to a higher-level network control center and transmits the messages using the standardized telecontrol protocols IEC 60870-5-104 or DNP3.

Benefits

- Supports installation on non-insulated and insulated cables
- Higher availability for overhead line systems – reduction of down time
- Fast fault detection – accurate fault-location determination and information to the maintenance team
- High sensitivity – measurement starts at 50 A – reliable fault detection for high-impedance faults
- Self supplying sensors reduce the energy consumption of the device – increase the lifetime of the supply batteries in the device (Battery life: 10 years)
- Unique security key and IPSec encryption for data exchange with SICAM FSI – maximum security against unauthorized access (intruders)
- Easy and fast device configuration with the aid of a QR code at the SICAM FSI and a Web browser instead of DIP switches – high level of convenient configurability.
- Maintenance-free design of the device – the SICAM FSI is maintenance-free other than battery replacement after 10 years. The large-format display of the years since the date of commissioning of the device allows the operational crew to determine the proper time for battery replacement from the ground.
- Different frequency of the flashing light depending on the fault type – fast and precise fault diagnosis for the maintenance team

[ph_sicamfsi_isoview20, 2, --_--]

Figure 7.6/1 SICAM FSI

Functions

Fault Detection

- Trip threshold range 75 A to 1500 A: I_{rated} adjustable between 50 A and 500 A; enables better coordination with the upstream protection system for the network. The tripping time can be adjusted in steps of 0.5 I_{rated} between 1.5* I_{rated} and 3* I_{rated}.
- ΔI tripping adjustment 5 A to 160 A: The amperage change ΔI can be set in steps of 5 A to 80 A, 120 A, 160 A.
- Inrush-current detection:
  Adjustable time delay for inrush current or abrupt changes under load
- Checking of zero potential state for fault confirmation

Configuration

- The SICAM FSI – 6MD2314-1Ax10 – is configured with the **SICAM FSI Configurator** software.
- The SICAM FSI – 6MD2314-1Ax11 – can be configured using the SICAM FCG Web GUI.

Reset Mechanism

- By magnet
- Automatically upon recovery of the system voltage

- Automatically over a predetermined time lapse (adjustable timer)
- Via an acknowledgment signal from the network control center

Applications

Suitable for all overhead lines in the medium voltage range from 3.3 kV to 66 kV, 50/60 Hz

Technical data

The following is an excerpt from the technical data. Please find additional information in the current manual.

Mechanical Data

Weight	0.78 kg	
Dimensions	Diameter	Height
	116 mm	210 mm

Application Data

Rated voltage (V_{rated})	3.3 kV, 6.6 kV, 11 kV, 22 kV, 33 kV, 44 kV[81], 66 kV (non-insulated cable) 6.6 kV, 11 kV, 22 kV, 33 kV, 44 kV[81], 66 kV (insulated cable) NOTE: For ANSI voltage nominal ranges, you can select the nearest rated voltage. For example, for 69 kV ANSI voltage, please select 66 kV rated voltage.
System frequency	50 Hz/60 Hz
Cable overall diameter	5 mm to 40 mm (non-insulated) 15 mm to 40 mm (insulated)[82]
Measurement cycle period	20 ms for 50 Hz 16.6 ms for 60 Hz
Voltage presence	> 70 % of V_{rated}
Voltage absence	< 45 % of V_{rated}
Rated current (I_{rated})	50 A to 500 A (increments of 50 A)
Current measurement accuracy	± 10 % from 50 A to 800 A (50 Hz and 60 Hz)[83]
Power source	Lithium-thionyl chloride battery + energy harvesting[84]
Total fault-indication time	400 h of LED flashing
Temperature with-stand of clamping material	120 °C

Fault Indication – LEDs

Indication	6 red LEDs
Luminous flux	40 lm
Visibility angle	360° (from ground level)
Visibility range	50 m at day time, 300 m at night time

Fault-Detection Parameters

di current	5 A to 80 A (steps of 5 A), 120 A, 160 A
Current threshold value	$1.5 \cdot I_{rated}$ to $3 \cdot I_{rated}$ (steps of 0.5)
Protection measurement range of device	75 A to 1500 A
Fault-indication time	2 h to 16 h (steps of 0.5 h)
Inrush restraint time	3 s, 30 s, and 60 s
Permanent-fault verification time	3 s, 35 s, and 70 s
Automatic reclosing time	0.1 s to 99.9 s

81 The 44 kV setting option is only available for combination of SICAM FSI with firmware version V03.03 or higher and SICAM FCG with firmware version V04.12 or higher.

82 SICAM FSI with cable overall diameter 5 mm to 15 mm (insulated cables) can be ordered on a special request. Contact the local Siemens office for more information.

83 Current measurement accuracy is applicable for temperature range of -25 °C to 70 °C.

84 Energy harvesting starts if the phase current is above 60 A.

Selection and Ordering Data

Description	Versions	Order no.											
		1	2	3	4	5	6	7		8	9	10	11	12
		6	M	D	2	3	1	4	-	1	A	□	1	□
												▲		▲
SICAM FSI												|		|
	• Phase-fault detection • Ground-fault (di/dt) detection • UV stabilised polycarbonate IP68 rated housing • Operating temperature range: -25°C to +70°C											B		|
	• Phase-fault detection • Ground-fault (di/dt) detection • UV stabilised polycarbonate IP68 rated housing • Operating temperature range: -40°C to +70°C											C		|
	Visual fault indication of 40 lumens by 6 high luminous red LEDs											|		0
	Visual fault indication of 40 lumens by 6 high luminous red LEDs SICAM FSI with integrated communication, short-range radio communication for fault status and measured values[85]											|		1
Spare parts and accessories		6	M	D	2	3	1	8	-	4	□	□	0	□
											▲	▲		▲
Spare part											|	|		|
	SICAM FSI Li-TH Battery Set (Pack of 6)										B	B		0
Accessories											|	|		|
	UART cable for device configuration (recommended type: FTDI chip, part number TTL-232R-RPi) For more detailed information visit: *http://www.ftdichip.com*										A	A		0
	Magnetic adaptor for device reset, accessory for **hot stick with shotgun** or **hot stick (telescopic)**										M	A		4
	Device adaptor for SICAM FSI mounting via hot stick (telescopic)										M	A		5
Accessory Description														
Hot stick with shotgun for SICAM FSI mounting, 4 m	Recommended brand: Terex hot stick with shotgun, Ritz, catalog number: RC403-0295 For more detailed information visit: *http://www.terexutilities.com.br*													
	Recommended brand: Hubbell hot stick with shotgun, catalog number: C4030295 For more detailed information visit: *https://www.hubbell.com/hubbellpowersystems/en/*													
Hot stick (telescopic) for SICAM FSI mounting, 12 m	Recommended brand: Terex Ritz, catalog no.: VTT-1/9 For more detailed information visit: *http://www.terexutilities.com.br*													

Table 7.6/1 SICAM FSI Selection and Ordering Data

NOTE

For markets requiring FCC certification and ISED certification, SICAM FSI with integrated communication should be ordered as: 6MD2314-1AC11 along with SICAM FCG (6MD2340-3JM71-8AA2 -Z /DD).

85 SICAM FSI with integrated communication along with SICAM FCG (6MD2340-3JM71-8AA2) must be ordered when the communication with control center is required.

Description

SICAM Fault Sensor Indicator (FSI) V2.0 is the second generation of overhead line fault passage indicator solutions from SIEMENS; a member of the SIEMENS SICAM short-circuit indicator product family. The device is used to improve reliability and to reduce the down-time on the MV overhead distribution grid.

The device can be mounted on MV overhead lines in branching points and areas of frequent fault. It continuously measures the current on the phase which it is mounted and detects the phase fault and ground fault. The device indicates both the temporary fault and the permanent fault by visible indication (LED flashing).

Benefits

Higher availability of overhead line networks

- Quick fault detection and localization, reduced downtime

Ease of use

- The device is effortlessly powered ON/OFF for installation, storage and transportation using a single switch activation.
- Providing user-friendliness, the default auto-threshold function automatically decides threshold values based on rated current and helps to use the device to detect the fault with minimal configuration of parameters.

Installation

- Supports installation on both insulated and non-insulated overhead lines

Simple configuration

- Easy configuration of device parameters using the SICAM FSI Configurator (version 3.03 and above)

Safe mounting

- Safely mountable on the MV overhead line by using a hot stick with shotgun or hot stick (telescopic) with device adaptor.

Long range fault indication visibility

- Fault localization becomes easier with the 6 high luminous fault LEDs of the device, which offer a visibility for up to 400 m during the day and 800 m during night time[86]

Long battery life

- 10 years of battery life, under standard operating conditions
- Configurable blinking interval of LEDs for optimal battery life

Maintenance free

- The device housing is weatherproof, UV stabilized, and flame retardant with an IP68 rating for durability.

Conformal coating

- The conformal coating on the device electronic modules increases the protection against harmful environmental influences such as extreme moisture, corrosive gases, and aggressive dust.

[dw_sicamfsi-b-sensor_isoview, 1, --_--]

Figure 7.7/1 SICAM FSI V2.0 B-Sensor

Functions

Multiple settings available for fault detection

- Threshold settings, auto threshold, and di/dt settings.

Auto-threshold algorithm

- Self-adjustment of the trip threshold based on the phase current.

Inrush restraint

- Avoids false fault detection due to transformer magnetization during the voltage restoration on the MV overhead line.

Auto-reclosure restraint

- Blocks the redundant fault detection during the auto-reclosure retries which are made to restore the MV overhead line.

Multiple fault-indication reset functionalities

- Voltage restoration in MV overhead line, auto-timer reset, and magnetic reset

Self-Test

- Self-test by magnetic reset to verify the battery health of the device. The success/failure of the self-test is indicated by a specific LED flashing pattern.

Low temperature cut-off

- Built-in with an automatic cut-off feature when the temperature falls below -40 °C.[86]

Applications

- This device is suitable for outdoor applications on the MV overhead line.
- The device supports applications on solidly grounded or resistive star-point grounded systems.

86 Only applicable for B-Sensor Type 2. For information on B-Sensor Type 1 and Type 2, refer to *Ordering Information – SICAM FSI V2.0 B-Sensor, Page 215*.

Short-Circuit Indicator

SICAM FSI B-Sensor – Description

- The device must be configured in close coordination with the protection systems in the MV network. This results in improved fault detection and localization.
- The device can be mounted in groups of 3, one device on each phase.
- The device uses LED patterns to identify faults quickly, distinguishing between temporary and permanent faults.

Indication of Conformity

This product complies with the directive of the Council of the European Communities on the harmonization of the laws of the Member States relating to electromagnetic compatibility (EMC Directive 2014/30/EU) and concerning electrical equipment for use within specified voltage limits (Low Voltage Directive 2014/35/EU) as well as restriction on usage of hazardous substances in electrical and electronic equipment (RoHS Directive 2011/65/EU).

This conformity has been proved by tests conducted by Siemens AG in accordance of the Council Directive in accordance with the product standard IEC/EN 61326-1 for the EMC directives, and with the standard IEC/EN 61010-1 for the low-voltage directive. RoHS directive 2011/65/EU is met using the standard IEC/EN 63000. The device has been designed and produced for industrial use.

Application Data

Rated voltage (V_{rated})	6.6 kV, 11 kV, 12.5 kV, 13.8 kV, 22 kV, , 33 kV, 34.5 kV, 44 kV, 45 kV, 66 kV, and 69 kV
Maximum operating voltage	83 kV
Maximum operating current	1500 A
Maximum continuous operating current	800 A
Operating current range	0 A to 1500 A
Power frequency	50 Hz or 60 Hz network as per IEC 62689-1
Grounding type	Solidly grounded system or resistive star-point grounded systems
Detection of voltage presence/absence	Supported
Fault detection time	2 cycles ± 1 cycle
Current measuring accuracy	± 10 % or ± 5 A whichever is greater from 0 A to 800 A
Power source	Lithium thionyl chloride batteries (Each battery: 3.6 V, 19000 mAh). B-Sensor Type 1: 2 batteries, B-Sensor Type 2: 3 batteries 10 years of expected operational life under standard operating temperature of 25 °C
Total fault-indication time	B-Sensor Type 1: 1500 h of LED flashing B-Sensor Type 2: 400 h of LED flashing
Cable overall diameter	5 mm to 40 mm (non-insulated) 15 mm to 40 mm (insulated)
Non-insulated conductor type	Aluminum Conductor Steel Reinforced (ACSR), All Aluminum Alloy Conductor (AAAC)
Insulated conductor type	Single core, aluminum conductor steel reinforced with/without waterblocking, XLPE insulated
Temperature withstand of clamping material	230 °C continuous

Fault-Detection Parameters

Fault current threshold (I_{set})	10 A to 1500 A • 10 A to 100 A (steps of 10 A) • 100 A to 300 A (steps of 25 A) • 300 A to 800 A (steps of 50 A) • 800 A to 1500 A (steps of 100 A)
Auto threshold fault factor	2x to 4x (steps of 1x)
Range-change monitoring time (T1)	20 s to 120 s (steps of 10 s)
Range-change memorizing time (T2)	0 s to 120 s (steps of 30 s)
DI current	5 A to 80 A (steps of 5 A), 120 A, 160 A Starting from 10 A phase current
Fault-indication time	B-Sensor Type 1: 2 h to 16 h (steps of 1 h) B-Sensor Type 2: 2 h to 4 h (steps of 1 h)
Permanent-fault verification time	3 s, 35 s, and 70 s
Inrush-restraint time	3 s, 30 s, and 60 s
Auto reclosure time	0.1 s to 99.9 s

Reset Device

Voltage restoration reset	Based on voltage-presence detection
Magnet reset	Using magnetic adaptor
Auto timer reset	B-Sensor Type 1: 2 h to 16 h (steps of 1 h) B-Sensor Type 2: 2 h to 4 h (steps of 1 h)

Fault Indication – LEDs

Indication	6 red LEDs
Luminous flux	40 lm
Visibility angle	360° (from ground level)
Visibility range (for fault indication only)[87]	B-Sensor Type 1: 100 m at day time, 500 m at night time B-Sensor Type 2: 400 m at day time, 800 m at night time[88]
MTBF of LEDs	45000 h

87 The specified visibility range for the LED indications is based on clear weather conditions.

88 To have a fault-indication visibility range of 400 m at day time and 800 m at night time on B-Sensor 2, set a 2 s blinking interval.

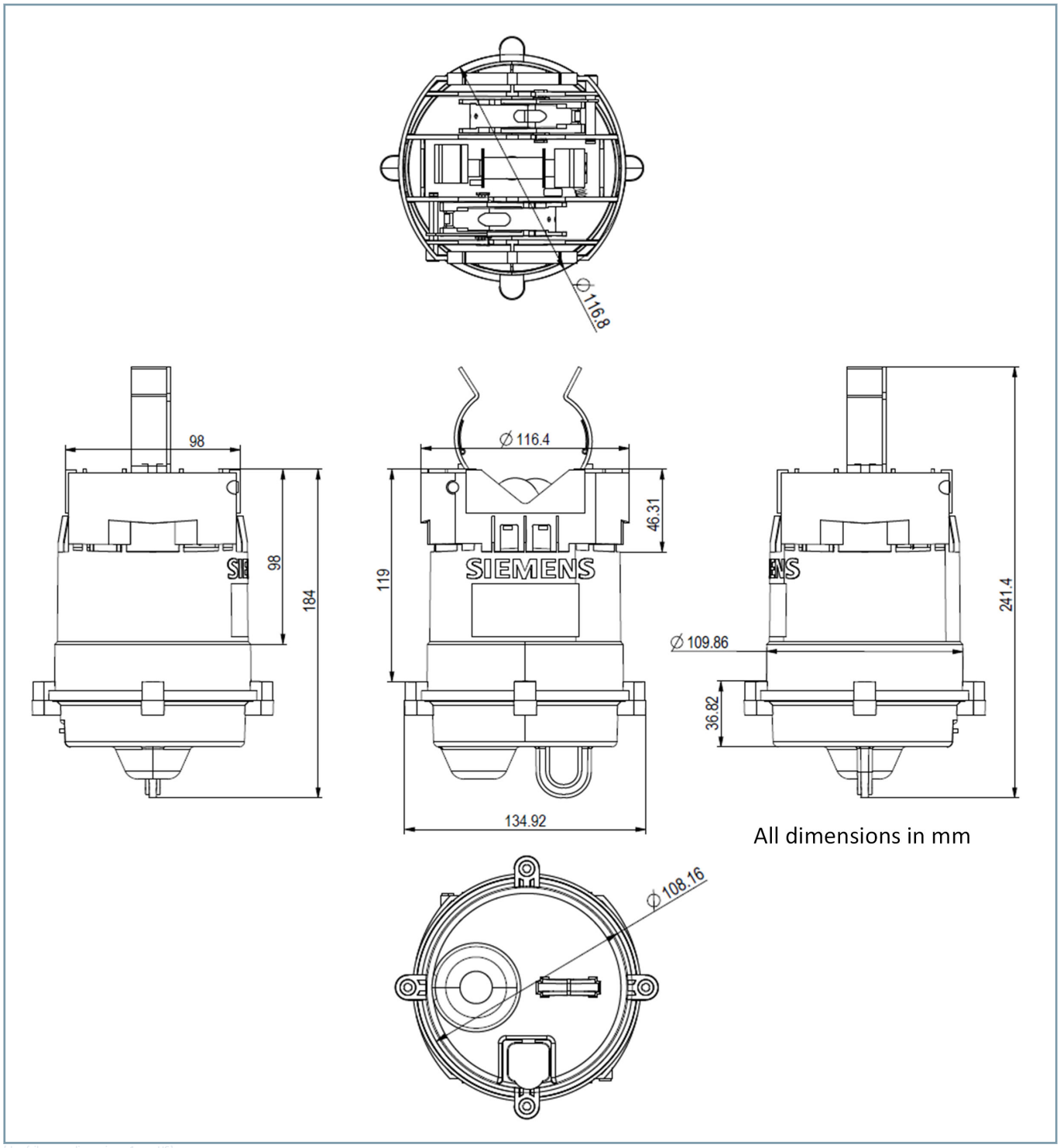
Mechanical Data

Weight	B-Sensor Type 1: approximately 1.04 kg B-Sensor Type 2: approximately 1.15 kg	
Dimensions	Diameter	Height
	116.8 mm	241.4 mm

Environmental Conditions

Outdoor applications as per IEC 61010-1	
Degree of pollution	Category 2
Maximum altitude above sea level	5000 m

Device Dimensions



[dw_fsibsensordimensions, 1, en_US]

Figure 7.7/2 Device Dimensions

Ordering Information – SICAM FSI V2.0 B-Sensor

Description	Versions	Order no.											
		1	2	3	4	5	6	7		8	9	10	11	12
		6	M	D	2	3	1	4	-	2	B	□	□	0
												▲	▲	
SICAM FSI V2.0 B-Sensor												|	|	
B-Sensor Type 1	• Phase-fault detection • Ground-fault (di/dt) detection • UV stabilized polycarbonate IP68 rated housing • Operating temperature range: -25°C to +75°C • Fault indication visibility: 100 m during daytime, 500 m during night time											B	2	
B-Sensor Type 2	• Phase-fault detection • Ground-fault (di/dt) detection • UV stabilized polycarbonate IP68 rated housing • Operating temperature range: -40°C to +75°C • Fault indication visibility: 400 m during daytime, 800 m during night time											C	3	
Spare parts and accessories		6	M	D	2	3	1	8	-	4	□	□	0	□
											▲	▲		▲
Spare part											|	|		|
	SICAM FSI V2.0 B-Sensor Lithium-thionyl chloride battery set (pack of 6)										B	B		1
Accessories											|	|		|
	Magnet adaptor for device reset, accessory for hot stick with shotgun										M	A		4
	Device adaptor for SICAM FSI V2.0 mounting via hot stick (telescopic)										M	A		6
Accessory Description														
Hot stick with shotgun for SICAM FSI V2.0 B-Sensor mounting, 4 m	Recommended brand: Terex hot stick with shotgun, Ritz, catalog number: RC403-0295 For more detailed information visit: *http://www.terexutilities.com.br*													
	Recommended brand: Hubbell hot stick with shotgun, catalog number: C4030295 For more detailed information visit: *https://www.hubbell.com/hubbellpowersystems/en/*													
Hot stick (telescopic) for SICAM FSI V2.0 B-Sensor mounting, 12 m	Recommended brand: Terex Ritz, catalog no.: VTT-1/9 For more detailed information visit: *http://www.terexutilities.com.br*													
USB Type C cable for SICAM FSI V2.0 B-Sensor configuration	Standard USB Type-A to Type-C communication cable for device configuration using FSI configurator.													

Table 7.7/1 SICAM FSI V2.0 B-Sensor Selection and Ordering Data

Short-Circuit Indicator

SICAM FSI Communicable Sensors – Description

Description

SICAM Fault Sensor Indicator (FSI) V2.0 is the second generation of overhead line fault passage indicator solution from SIEMENS; a member of the SIEMENS SICAM short-circuit indicator product family. The device is used to improve reliability and to reduce the downtime on the MV overhead distribution grid.

SICAM FSI V2.0 is powered by Lithium-Ion rechargeable batteries and harvests energy from the overhead lines to charge the batteries. The device can be mounted on MV overhead lines in branching points and areas of frequent fault. It continuously measures the current on the phase which it is mounted and detects the phase fault and ground fault.

The device indicates both the temporary fault and the permanent fault by visible indication (LED flashing).

SICAM FSI V2.0 C-Sensor

- The device comes equipped with a local LED display and an integrated communication interface. Every installation location shall have at least one SICAM FSI V2.0 M-Sensor which will act as a master to aggregate data from C-Sensors. C-Sensors communicates data with M-Sensors over short range radio. Up to 8 sensors can communicate with one M-Sensor. SICAM FSI V2.0 M-Sensor further uses IoT protocol MQTT(JSON) over cellular for upstream communication purposes. For control center communication, the FSI manager application is required in the control center for aggregating data from different locations over MQTT and translating it to IEC 60870-5-104 or DNP3 as per the requirement of Control Center.

SICAM FSI V2.0 D-Sensor

- Building over the capabilities of C-Sensor, SICAM FSI V2.0 D-Sensor introduces directional fault indication with an additional GREEN colour LED. The direction information of fault and Conductor Temperature data are also available for comprehensive monitoring. Similar to C-Sensor, SICAM FSI V2.0 D-Sensor also will need at least one SICAM FSI V2.0 M-Sensor in every installation location.

Applications

- This device is suitable for outdoor applications on MV overhead lines.
- The device detects phase fault and ground fault with and without direction when it is mounted on the MV overhead line network.
- Supports application on solidly grounded or resistive star-point grounded systems.
- The device is to be configured in close coordination with the protection systems in the MV network. This results in improved fault detection and localization.
- The device can be mounted in groups of 3, one device on each phase. At least one master device is required in every location. A master device can support up to 8 sensor devices.

[sc_fsiv2_devicephotoCSensor, 1, --_--]

Figure 7.8/1 SICAM FSI V2.0 Communicable Sensor

- The device provides distinct RED/GREEN LED patterns to identify faults and differentiate between temporary, permanent, forward, and reverse direction faults.
- The device enables seamless communication of fault, event, and measurement data to both control centers and cloud-based systems.

Functions

Multiple settings available for fault detection

- Threshold settings, auto-threshold, and di/dt settings.

Directional fault

- Directional fault indicated with RED and GREEN LED.

Auto threshold algorithm

- Self-Adjustment of trip threshold based on phase current.

Measurements

- Measurement of fault current, periodic min, max, avg currents, ambient temperature, and conductor temperature.

Inrush restraint

- Avoids false fault detection due to transformer magnetization during the voltage restoration on the MV overhead line.

Auto reclosure restraint

- Blocks the redundant fault detection during the auto-reclosure retries which are made to restore the MV overhead line.

Multiple fault indication reset functionalities

- Voltage restoration in MV overhead line, auto timer reset, and magnetic reset

Unbalance detection

- Unbalance detection based on current settings.

Communication and configuration

- Communication between sensor and master FSIs over short range radio. Communication to Control Center or Cloud over LTE Cat 1 with 2G fallback.

Configuration and device management

- Local configuration using SICAM SDA Configurator.
- Remote configuration and asset management using SICAM FSI Manager.

Self-Test

- Self-test by magnetic reset to verify the battery health of the device. The sucess/failure of self-test is indicated by a specific LED flashing pattern.

Low temperature cutoff

- Built-in with an automatic cutoff feature when the temperature falls below -40 °C.

Benefits

Higher availability of overhead line networks

- Quick location identification of fault (with direction option), broken conductor, and hotspots, to ensure higher availability.

Energy harvesting

- Harvests energy from the line reducing dependency on batteries.

Ease of installation and ease of use

- With single switch power activation and auto threshold function, it takes not more than 5 min from unboxing to be ready for installation/service.
- Line Mounted Gateway: Mount using hotstick and walk away. One of the devices in a location acts as a sensor as well as a gateway.
- Suitable for distribution voltage levels across the world 6.6 kV to 69 kV.
- Simple configuration
- Local USB configuration using SICAM SDA Configurator (version 1.0 and above).
- Remote configuration using SICAM FSI Manager.

Suitable for resistive grounded networks and last mile installations

- Fault threshold settings starting from 10 A

Long range visibility

- Fault localization becomes easier with fault indication visibility of up to 400 m during the day and 800 m during the night.

Long battery life

- 10 years of battery life along with fault indication time mentioned for corresponding MLFB, under standard operating conditions.

Maintenance free

- 10 years of battery life with 1500 hours of flashing.
- Inbuilt LTE Cat 1 modem in SICAM FSI V2.0 M-Sensor. No separate gateway required in the location.
- The device housing is weatherproof, UV stabilized, and flame retardant with an IP65/IK09 rating for durability.
- The conformal coating on device electronic modules increases protection against harmful environmental influences such as extreme moisture, corrosive gases, and aggressive dust.

Device and asset management

- Remote asset management, diagnostics, firmware, and configuration updates using SICAM FSI Manager.

Effective diagnostics

- Communication test mode: To check healthiness of short range radio and LTE communication.
- Fault simulation test mode: To simulate and check end to end fault indication healthiness; from LED indication to communication sequence.
- LED flashed hours information for debugging battery topics.

Indication of Conformity

CE

This product complies with the directive of the Council of the European Communities on the harmonization of the laws of the Member States relating to electromagnetic compatibility (EMC Directive 2014/30/EU) and concerning electrical equipment for use within specified voltage limits (Low Voltage Directive 2014/35/EU) as well as restriction on usage of hazardous substances in electrical and electronic equipment (RoHS Directive 2011/65/EU).

This conformity has been proved by tests conducted by Siemens AG in accordance of the Council Directive in accordance with the product standard IEC/EN 61326-1 for the EMC directives, and with the standard IEC/EN 61010-1 for the low-voltage directive.

Standards for short-range radio and mobile communication according to RED directive 2014/53/EU:

- EMC testing according to EN 301 489
- Radio testing according to EN 301 511, EN 301 908-1, EN 301 908-13
- Short-range radio according to EN 300 328

RoHS directive 2011/65/EU is met using the standard IEC/EN 63000.

Short-Circuit Indicator

SICAM FSI Communicable Sensors – Technical Data

Application Data

Rated voltage (V_{rated})	6.6 kV, 11 kV, 12.5 kV, 13.8 kV, 22 kV, 25 kV, 33 kV, 34.5 kV, 44 kV, 45 kV, 66 kV, and 69 kV
Maximum continuous operating voltage	83 kV
Maximum operating voltage	103.5 kV for 30 s
Operating current range	0 A to 2500 A
Maximum continuous operating current	600 A 800 A up to 50 °C
Maximum operating current	2500 A
System frequency	50 Hz or 60 Hz network as per IEC 62689-1
Grounding type	Solidly grounded system or resistive star-point grounded systems
Detection of voltage presence/absence	Supported
Fault detection time	2 cycles
Current measurement accuracy	±5 A up to 20 A ±5% from 20 A to 800 A
Power source	Lithium-ion batteries (Each battery: 4.1 V, 330 mAh). Rechargeable by energy harvesting with line current >5 A. 10 years of expected operational life under standard operating temperature of 25 °C
Total fault-indication time	1500 h of LED flashing
Cable overall diameter	5 mm to 40 mm (non-insulated) 15 mm to 40 mm (insulated)
Non-insulated conductor type	Aluminum Conductor Steel Reinforced (ACSR), All Aluminum Alloy Conductor (AAAC)
Insulated conductor type	Single core, Aluminum Conductor Steel Reinforced with/without waterblocking, XLPE insulated
Temperature withstand of clamping material	230 °C continuous

Fault-Detection Parameters

Fault current threshold (I_{set})	Auto threshold OR Manual (10 A to 1500 A) • 10 A to 100 A (steps of 10 A) • 100 A to 300 A (steps of 25 A) • 300 A to 800 A (steps of 50 A) • 800 A to 1500 A (steps of 100 A)
Auto threshold fault factor	2x to 4x (steps of 1x)
Range change monitoring time (T1)	20 s to 120 s (steps of 10 s)
Range change memorize time (T2)	0 s to 120 s (steps of 30 s)
DI current	5 A to 80 A (steps of 5 A), 120 A, 160 A Starting from 10 A phase current
Fault-indication time	Sensor Type 1: 1 h, 2 h, 3 h, 4 h, 8 h, 12 h, 16 h Sensor Type 2 or D-Sensor: 1 h, 2 h, 3 h, 4 h
Permanent-fault verification time	3 s, 35 s, and 70 s
Inrush-restraint time	3 s, 30 s, and 60 s
Auto reclosure time	0.1 s to 300 s
Directional fault	Supported
Undercurrent detection	Supported

Fault Indication – LEDs

Indication	6 red LEDs and/or 6 green LEDs
Luminous flux	70 lumens
Visibility angle	360 ° (from ground level)
Visibility range (for fault indication only)[89]	Sensor Type 1: 100 m at day time, 500 m at night time Sensor Type 2 or D-sensor: 400 m at day time, 800 m at night time[90]
MTBF of LEDs	45000 h

Reset Device

Voltage restoration reset	Supported
Magnet reset	Using magnetic adaptor
Auto timer reset	C-Sensor Type 1: 1 h, 2 h, 3 h, 4 h, 8 h, 12 h, 16 h C-Sensor Type 2 or D-Sensor: 1 h, 2 h, 3 h, 4 h
Remote reset	Supported

Communication Short Range

Operating frequency band	2.4 GHz (IEEE 802.15.4)
RF output power	10 dBm to 20 dBm
Range	100 m

Communication Cellular

Cellular technology	LTE CAT 1 with 2G fallback
RF output power	Maximum transmitting power: 24 dBm for all LTE FDD & TDD bands 33 dBm for GSM 850 and GSM 900 30 dBm for GSM 1800 and GSM 1900
Bands	LTE Band FDD 1, 3, 5, 7, 20, TDD 28 LTE Band 2, 4, 12, 13, EGSM/GPRS/EDGE 900/1800 MHz

89 The specified visibility range for the LED indications is based on clear weather conditions.

90 C-Sensor Type 2 to have a fault-indication visibility range of 400 m at day time and 800 m at night time with 2 s blinking interval only.

Protocols and Security

Control center	IEC 60870-5-104, DNP 3.0 (via FSI Manager)
Cloud	MQTT (JSON)
Security	End to end security Secure engineering Role-based access Secure pairing Secure onboarding Signed firmware Secure roll-out Syslog support

Mechanical Data

Weight	Approximately 1.5 kg
Dimensions	183 mm(W) x 228 mm(H) x 134 mm(D)

Environmental Conditions

Outdoor applications as per IEC 61010-1	
Degree of pollution	Category 2
Maximum altitude above sea level	5000 m

This section describes the type testing performed on SICAM FSI V2.0 Communicable according to IEC 61326-1, IEC 62689-1, and IEC 61010-1.

EMI/EMC Tests

Test	Reference Standard	Test Requirement
Electrostatic discharge test	IEC 62689-1 IEC 61000-4-2 IEC 61326-1 ETSI EN 301 489-1 ETSI EN 301489-17 ETSI EN 301489-19 ETSI EN 301 489-52	Severity class 3 6 kV contact discharge, 8 kV air discharge
Power frequency magnetic field immunity 50 Hz/60 Hz	IEC 62689-1 IEC 61000-4-8 IEC 61326-1	Severity class 4 30 A/m continuous, 300 A/m for 1 s to 3 s
Pulse magnetic field immunity	IEC 62689-1 IEC 61000-4-9 IEC 61326-1	Severity class 4 300 A/m peak value
Radiated emission test	CISPR 32 EN 55032 IEC 61326-1 ETSI EN 301 489-1 ETSI EN 301489-17 ETSI EN 301489-19 ETSI EN 301 489-52	Class A 30 MHz to 6 GHz
Damped oscillatory magnetic field test	IEC 62689-1 IEC 61000-4-10	Severity class 4, 30 A/m peak value Oscillation frequency: 0.1 MHz and 1 MHz
Radio frequency, electromagnetic field immunity	IEC 62689-1 IEC 61000-4-3 IEC 61326-1	Severity class 3 0.08 GHz to 1 GHz 10 V/m, 80% AM 1 kHz, 1 % step 1 GHz to 6 GHz 3 V/m, 80 % AM 1 kHz, 1 % step Dwell time: 2.85 s

Environmental Tests

Test	Reference Standard	Test Requirement
Dry heat test	IEC 62689-1 IEC 60068-2-2	+75 °C Duration: 16 h with device turned OFF 16 h with device turned ON
Dry heat test (storage)[91]	IEC 60068-2-2	(+85 ±2) °C Duration: 16 h
Cold test	IEC 62689-1 IEC 60068-2-1	-40 °C Duration: 16 h with device turned OFF 16 h with device turned ON
Cold test (storage)[91]	IEC 60068-2-1	(-40 ± 2) °C Duration: 16 h
Damp heat steady state test	IEC 60068-2-78	40 °C, (95 ±3)% Duration: 4 days
Damp heat cyclic test (12 h + 12 h)	IEC 60068-2-30	Lower temperature: 25 °C Upper temperature: 55 °C Relative humidity: 95 %, ± 3 % No of cycles: 6 cycles

91 For optimum battery capacity, it is recommended to store the device below 30 °C; 30% RH

Short-Circuit Indicator

SICAM FSI Communicable Sensors – Type Testing Data

Test	Reference Standard	Test Requirement
Change of temperature test	IEC 62689-1 IEC 60068-2-14	(-40 ±2) °C, (+75 ±2) °C Rate of change: (1 ± 0.2) K/min Dwell at upper and lower temperatures 3 h + 3 h 50 h 25 min OFF + 50 h 25 min ON
Salt mist test	ASTM B117 IEC 60068-2-11	Salt solution: 95 parts distilled water by weight and 5 parts sodium chloride by weight Duration of exposure: 168 h
Exposure to solar radiation	IEC 62689-1 IEC 60068-2-5	1000 W/m^2 Duration: 4 h
Exposure to direct sunlight (UV)	ASTM G155-13	Exposure cycle 1 Irradiance for wave lengths: 340 nm/W (m^2 · nm) Duration of light: 102 min Total exposure time: 14 days
Wind pressure test		Withstand wind speed of 200 km/h at wind pressure 195 Kg/m^2 at 30 m height
Average rainfall test		Average rainfall per year: 3500 mm

Mechanical Tests

Test	Reference Standard	Test Requirement
Vibration response test (sinusoidal)	IEC 62689-1 IEC 60068-2-6	Frequency: 10 Hz to 500 Hz 1g, 10 m/s^2 amplitude 0.075 mm, 23 min Sweep rate: 1 oct./min Number of sweep cycles: 2/axis in 3 directions
Bump test	IEC 60068-2-27	10 g Duration of pulse: 16 ms Number of axes: 3 (X, Y, and Z) Number of bumps: 1000 per direction Number of directions: 2 per axis Total number of bumps: 6000 shocks in 3 axes
Ingress protection	IEC 62689-1 IEC 60529	IP65
Mechanical impact test	IEC 62689-1 IEC 62262	IK09, Impact energy: 10 J

Electrical Tests

Test	Reference Standard	Test Requirement
Dielectric withstand	IEC/EN 61010-1	125 kV with the help of hotstick
Overvoltage	IEC/EN 61010-1	Category IV
Degree of pollution	IEC/EN 61010-1	Category 2
Maximum altitude above sea level	IEC/EN 61010-1	5000 m
Short-circuit current/ dynamic test	IEC 62689-1 IEEE495	12.5 kA @ 1 s and 31.25 kA peak 25 kA @ 170 ms and 62.5 kA peak 25 kA RMS for 3 s and 62.5 kA peak 31.25 kA RMS for 2 s and 78.125 kA peak 40 kA RMS for 1 s and 100 kA peak
Switching impulse test	IEC 60060-1	250 kV peak
Lightning impulse test	IEC 60060-1	350 kV peak

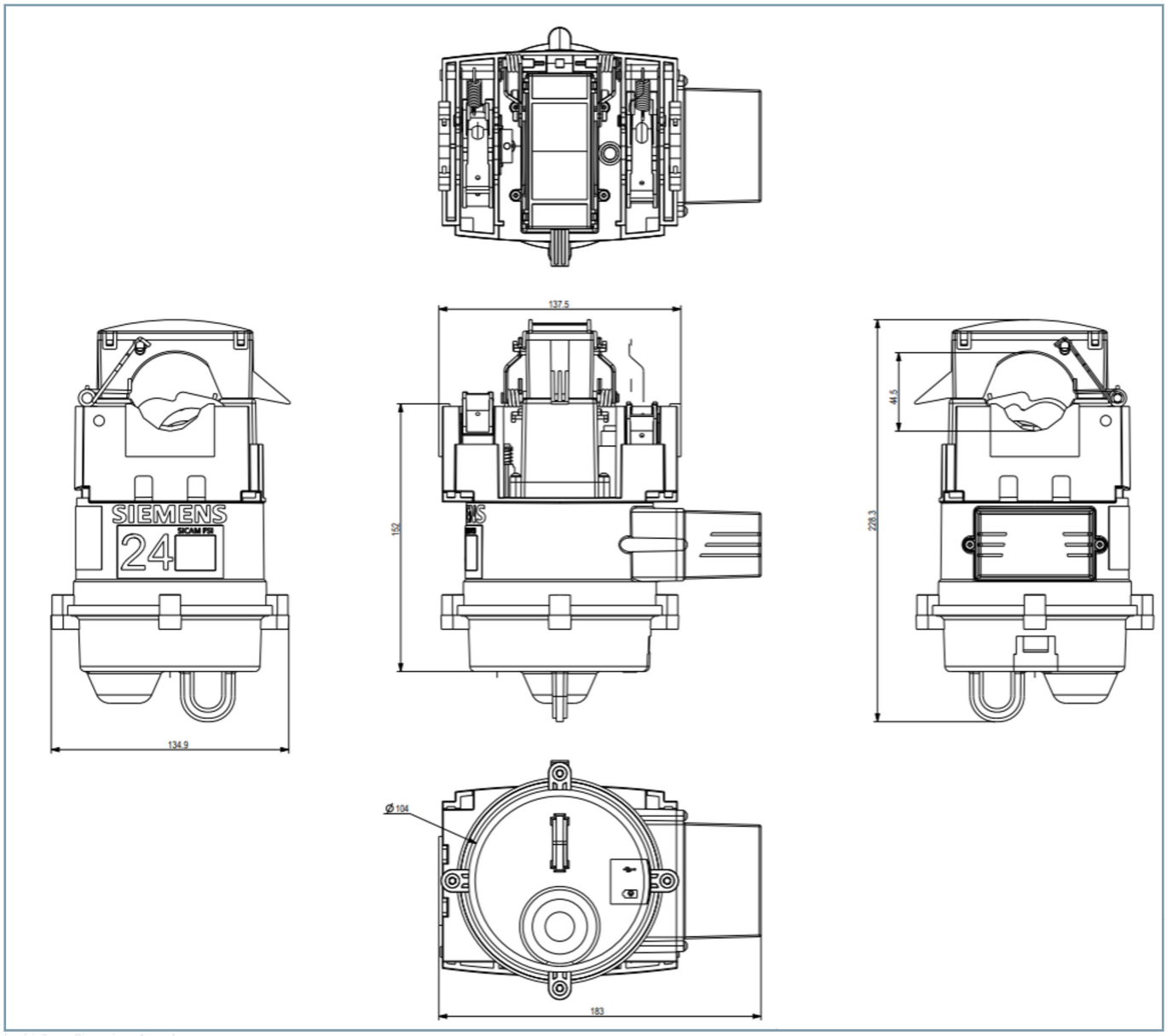
Safety Tests

Test	Reference Standard	Test Requirement
Product safety test	IEC/EN 61010-1 IEC/EN 62368-1	Marking and documentation as per clause no. 5 Protection against mechanical hazard as per clause no. 7 Resistance to mechanical stresses (shock and impact) as per clause no. 8 Protection against the spread of fire as per clause no. 9 Protection against liberated gases and substances, explosion, and implosion as per clause no. 13 Components and subassemblies as per clause no. 14 Hazards resulting from application as per clause no. 16 Risk assessment as per clause no. 17
Spurious emission test (transmitter unwanted emissions in the spurious domain and reciever spurious emissions)	ETSI EN 300 328 ETSI EN 301 511 ETSI EN 301 908	Radiated spurious emissions – mobile station (MS) allocated a channel (30 MHz to 1 GHz), 1 GHz to 12.75 GHz) Operating frequency range: 2400 MHz to 2480 MHz
Radio frequency human exposure evaluation	IEC 62311	10 MHz to 400 MHz 2 W/m^2 400 MHz to 2000 MHz 200 W/m^2 Above 2 GHz 10 W/m^2

Certification

PTCRB, FCC, ISED, RED, WPC

Device Dimensions



[sc_fsiv2_caseDimensions, 1, --_--]

Figure 7.8/2 Device Dimensions

Ordering Information – SICAM FSI V2.0 Communicable Sensors

Description	Versions	Order no.											
		1	2	3	4	5	6	7		8	9	10	11	12
		6	M	D	2	3	1	4	-	2	□	□	□	1
											▲	▲	▲	
SICAM FSI V2.0 Communicable Sensors											|	|	|	
C-Sensor Type 1	• Phase-fault detection • Ground-fault (di/dt) detection • UV stabilized polycarbonate IP65 rated housing • Fault indication visibility: 100 m during daytime, 500 m during night time • Short-range radio communication										C	C	2	
C-Sensor Type 2	• Phase-fault detection • Ground-fault (di/dt) detection • UV stabilized polycarbonate IP65 rated housing • Fault indication visibility: 400 m during daytime, 800 m during night time • Short-range radio communication										C	C	3	
D-Sensor	• Phase-fault detection • Ground-fault (di/dt) detection • UV stabilized polycarbonate IP65 rated housing • Directional fault, conductor temperature measurement • Fault indication visibility: 400 m during daytime, 800 m during night time • Short-range radio communication										D	C	3	
M-Sensor Type 1	• Phase-fault detection • Ground-fault (di/dt) detection • UV stabilized polycarbonate IP65 rated housing • Fault indication visibility: 100 m during daytime, 500 m during night time • Short-range radio communication, LTE radio communication, gateway function										M	C	2	
M-Sensor Type 2	• Phase-fault detection • Ground-fault (di/dt) detection • UV stabilized polycarbonate IP65 rated housing • Directional fault, conductor temperature measurement • Fault indication visibility: 400 m during daytime, 800 m during night time • Short-range radio communication, LTE radio communication, gateway function										M	C	3	
Spare parts and accessories		6	M	D	2	3	1	8	-	4	□	□	0	□
											▲	▲		▲
Spare part											|	|		|
	Battery spare										B	B		2
Accessories											|	|		|
	Magnet adaptor for device reset										M	A		4
	Device adaptor for SICAM FSI V2.0 mounting via hot stick (telescopic)										M	A		6
Accessory Description														
Hot stick with shotgun for SICAM FSI V2.0 mounting, 4 m	Recommended brand: Terex hot stick with shotgun, Ritz, catalog number: RC403-0295 For more detailed information visit: *http://www.terexutilities.com.br*													
	Recommended brand: Hubbell hot stick with shotgun, catalog number: C4030295 For more detailed information visit: *https://www.hubbell.com/hubbellpowersystems/en/*													
Hot stick (telescopic) for SICAM FSI V2.0 mounting, 12 m	Recommended brand: Terex Ritz, catalog no.: VTT-1/9 For more detailed information visit: *http://www.terexutilities.com.br*													
USB Type C cable for SICAM FSI V2.0 configuration	Standard USB Type-A to Type-C communication cable for device configuration using FSI configurator.													

Table 7.8/1 SICAM FSI V2.0 Communicable Sensors Selection and Ordering Data

Short-Circuit Indicator

SICAM VDIS, VDIS PRO – Description

Description

The SICAM voltage detecting and indicating system provides 3-phase integrated voltage detection and indication. It is used to detect and indicate the presence or absence of operating voltage in a medium-voltage distribution system (3.3 kV to 40.5 kV, ±10 %).

The device complies with the requirements of the standard IEC 62271-213 for voltage detection and indication systems. SICAM VDIS, VDIS Pro is used as a low-resistance modified interface (LRM) for connecting a short-circuit indicator to measure voltages.

Main function	3-phase voltage detection in medium-voltage distribution systems
System frequency	50 Hz/60 Hz, ±5 % tolerance
Housing	Polycarbonate case, flush mounting
Mounting	Horizontally or vertically mounted depending on the space in the RMU feeders

SICAM VDIS, VDIS Pro types:

Type and Feature	Capacitance Values (C2)
SICAM VDIS Fixed capacitance (C2)	3900 pF
SICAM VDIS Configurable capacitance (C2)	820, 1200, 1210, 1820, 2020, 2400, 2410, 3020, 3520, 3900, 3910, 4720, 5100, 5110, 5720, 5920, 6420, 6800, 6810, 6920, 8000, 9500, 10700, 11200, 15820, 16800, 16820 pF
SICAM VDIS Pro Configurable capacitance (C2) with digital output contacts, auxiliary power supply, and LEDs	820, 1200, 1210, 1820, 2020, 2400, 2410, 3020, 3520, 3900, 3910, 4720, 5100, 5110, 5720, 5920, 6420, 6800, 6810, 6920, 8000, 9500, 10700, 11200, 15820, 16800, 16820 pF

Benefits

- **Enhanced safety**
  - Ensures personnel safety by accurately signaling voltage presence, voltage absence, and over voltage. Reducing the risk of accidental contact and minimizing the potential for electrical shocks or injuries.
- **Compliance with regulations**
  - Ensures, compliance with safety regulations and standards.
- **Time-saving**
  - Identifies quickly whether or not a particular RMU is energized, eliminating time-consuming manual checks.
  - Maintenance free and requires minimum space for installation.
  - For voltage detection and display test no external power supply or battery is required.
  - Masked C2 value on rotor switch for error prevention.
  - The device can be mounted horizontally or vertically without any tool depending on the space in the RMU panel.
- **Easy integration**
  - Easily integrated into existing electrical systems.
  - Pluggable connectors for easy installation without rewiring.

Figure 7.9/1 SICAM VDIS, VDIS Pro

  - Check box for marking set C2 values, ensuring future traceability of configured C2 value.
- **Long-life cycle**
  - Prevents accidental energization or unauthorized access. SICAM VDIS, VDIS Pro helps to extend the service life of electrical equipment and reduce potential damage.
- **Electrical interlocking**
  - Based on voltage presence or absence the device provides reliable digital output signal to the RMUs control system, facilitating interlocking such as ground-switch interlocking

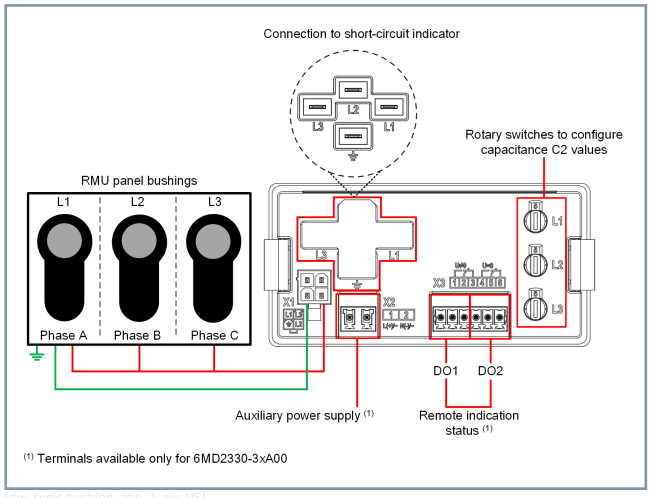
Functions

- Detection and indication of operating voltage, presence and absence
- Detection and indication of overvoltage, presence and absence
- LED indications to indicate voltage status
- Relay outputs to indicate voltage status remotely
- LCD segments for improved readability
- Fixed and configurable C2 capacitance
- Testing points for phase comparision at primary circuits and to perform maintanance test.
- Test button for checking the functioning of display
- Finger-settable (tool-less) rotor switches for appropriate C2 value configuration

- 2 digital outputs (DOs) for connection to external RTUs for remote status indication or electrical interlocking coils.
- No auxiliary power required for voltage detection
- Wide auxiliary power supply range:
  DC 24 V to 250 V (-20 % to 10 %)
  AC 110 V to 240 V (-20 % to 10 %)

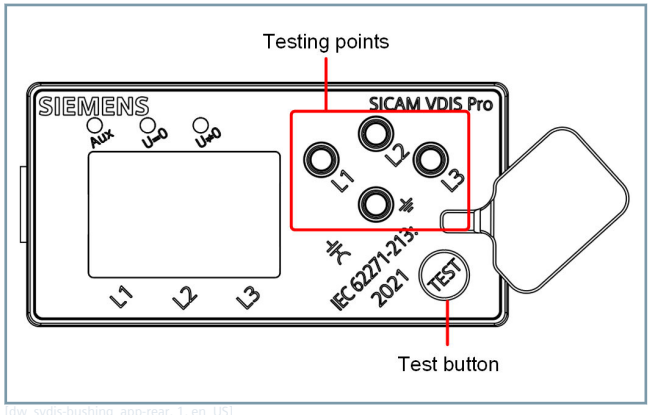
Application

- Device is used to detect and indicate the presence or absence of operating voltage in a medium-voltage applications ranging 3.3 kV to 40.5 kV, ±10 %
- Built for the installation in switchgear units
- Applicable for solidly, low resistive, high resistive, capacitive, and isolated-grounded systems
- Used to enable, measure, and detect faults accurately and reliably by transmitting voltage signals from the primary element to the short-circuit indicator



[dw_svdis-bushing_app, 1, en_US]

Figure 7.9/2 Connections on the Rear of the Device



[dw_svdis-bushing_app-rear, 1, en_US]

Figure 7.9/3 Connections on the Front of the Device

Phase Comparison

SICAM VDIS, VDIS Pro has a front accessible sockets (L1, L2, L3, and ⏚) which are used as a testing point interface.

For each phase, the functional uses of the interface at the testing points are to deliver a signal for:

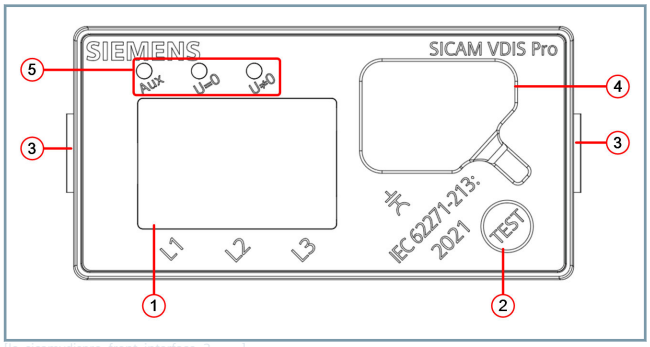
- Phase comparision
- Maintenance test of the SICAM VDIS, VDIS Pro

The sockets (L1, L2, L3, and ⏚) deliver electrical signal proportional in amplitude to the operating voltage of the main circuit. The phase comparision devices, in turn, indicate whether the connection is secure and safe for RMU maintenance.

To check the correct operation of 3-phase electrical systems and to test the phase-angle synchronization between different feeders in the RMU, the sockets (L1, L2, L3, and ⏚) are connected to the phase comparator or a polarity tester.

The polarity tester verifies the correct phase sequence of the 3-phases in the RMU.

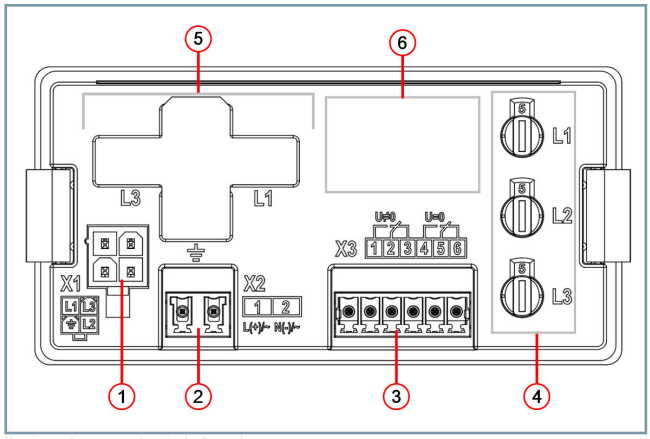
Front, Isometric, and Rear Views



[fe_sicamvdispro_front_interface, 2, --_--]

Figure 7.9/4 Front View (6MD2330-3xA00)

(1) Liquid crystal display
(2) Test button
(3) Protective cap for testing points
(4) LEDs (Aux, U=0, U≠0)



[fe_sicamvdispro_rear_terminals, 3, --_--]

Figure 7.9/5 Rear View Terminals (6MD2330-3xA00)

(1) Connection from RMU panel bushing

(2) Auxiliary power supply

(3) Digital outputs 1, 2

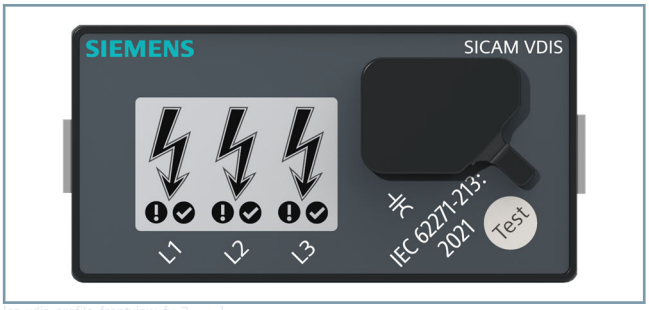
(4) Rotary switches to configure capacitance C2 values

(5) LRM cable connection to a short-circuit indicator (L1, L2, L3, ground)

(6) QR code

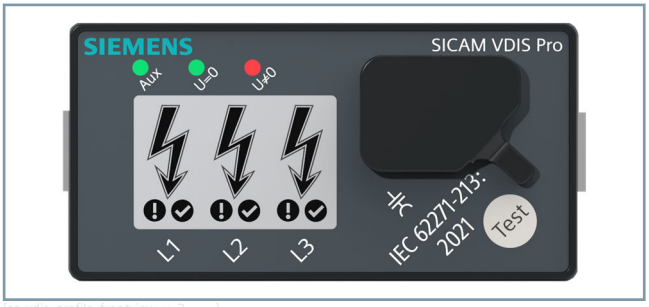
Hardware Components

- Liquid crystal display (LCD)
  Shows the indications for absence, presence, and overvoltage conditions per phase. For more information on LCD indications, refer to *Table 7.9/3*.
- Testing points (L1, L2, L3, and ⏚) - front side
  Connect various testing equipment, such as phase comparators and phase-sequence meters, to measure and analyze the electrical characteristics of the system.
- Test button
  For checking the display functioning.
- LEDs
  2 LEDs for voltage presence and absence status indication.
  1 LED for auxiliary power supply status indication.
  Applicable for SICAM VDIS Pro variant only.
  For more information of LED indications, refer to *Table 7.9/3*.
- Bushing connection (X1)
  Cable connection from RMU panel bushing to the device.
- Auxiliary power-supply connection (X2)
- Digital output (X3)
  Change-over type monostable potential free contacts. 2 digital outputs for remote status indication.
- Connecting point (L1, L2, L3, and ⏚)
  Interface to connect a short-circuit indicator.



[sc_vdis_profile_frontview_fv, 3, --_--]

Figure 7.9/6 SICAM VDIS Front View (Fixed and Configurable)



[sc_vdis_profile_frontview_v, 2, --_--]

Figure 7.9/7 SICAM VDIS Pro Front View

[sc_vdis_profile_rearviews_fv, 3, --_--]

Figure 7.9/8 SICAM VDIS Rear View (Fixed) - without Protection Cap

[sc_vdis_profile_rearviews_fv1, 3, --_--]

Figure 7.9/9 SICAM VDIS Rear View (Configurable)

[sc_vdis_profile_rearview_v, 2, --_--]

Figure 7.9/10 SICAM VDIS Pro Rear View

Terminal Number	Terminal Name	Description
–	L1, L2, L3 Front side	Testing points across 1-phase, 2-phase, and 3-phase of a feeder
		Testing points grounding

Table 7.9/1 Terminal Connections – Front Side

Terminal Number	Terminal Name	Description
X1	L1	Connection from RMU panel bushing, 1-phase of a 3-phase feeder
	L2	Connection from RMU panel bushing, 2-phase of a 3-phase feeder
	L3	Connection from RMU panel bushing, 3-phase of a 3-phase feeder
		Grounding connection to RMU panel
X2	1	Auxiliary power supply (+)/~
	2	Auxiliary power supply (-)/~
X3	1, 2, 3	Digital output 1 (changeover contact, U≠0)
	4, 5, 6	Digital output 2 (changeover contact, U=0) For more information of relay status indications, refer to *Table 7.9/3*.
–	L1, L2, L3 Rear side	Cable connection to short-circuit indicator (V1, V2, V3)
		Ground connection to short-circuit indicator

Table 7.9/2 Terminal Connections – Rear Side

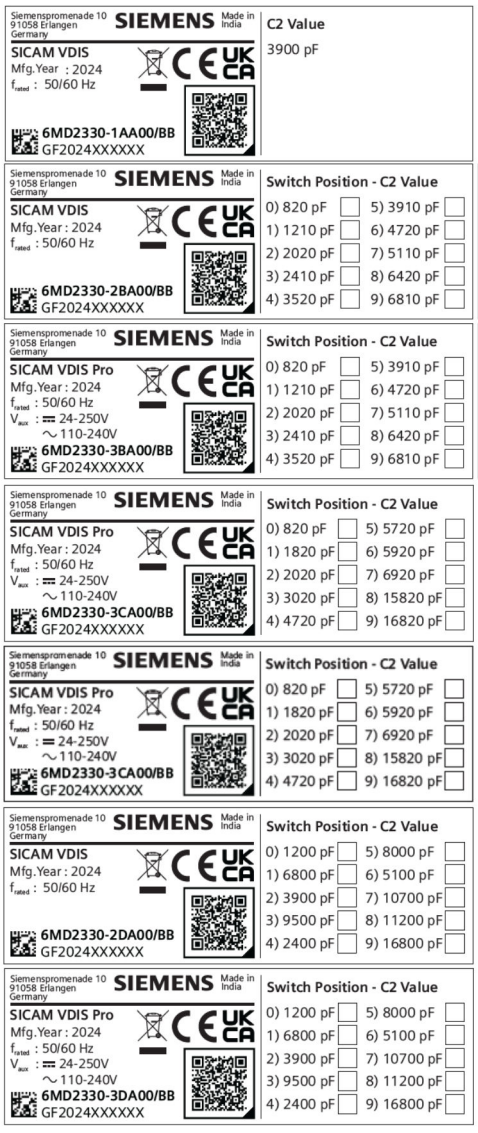
The following tables provide technical details of connecting plugs for X1, X2, and X3:

Connection Elements (X1)	Specifications
Connection type	4-positions rectangular power connector, discrete wire receptacle
Insertion force	15 N
For more information on cable length and type, contact *Siemens Customer Support*.	

Connection Elements (X2)	Specifications
Connection type	2 positions, screw type M2 connection with tension sleeve
Conductor cross-section	0.14 mm^2 to 1.5 mm^2
AWG (max. and min.)	28.0 and 16.0
Tightening torque	0.22 Nm ±10 %

Connection Elements (X3)	Specifications
Connection type	6 positions, screw type M2 connection with tension sleeve
Conductor cross-section	0.14 mm^2 to 1.5 mm^2
AWG (max. and min.)	28.0 and 16.0
Tightening torque	0.22 Nm ±10 %

The device details are located on top of the housing and available C2 value for configuration and check box to mark the configured value. The device label also displays the ordering code, serial number, description, and safety symbols.

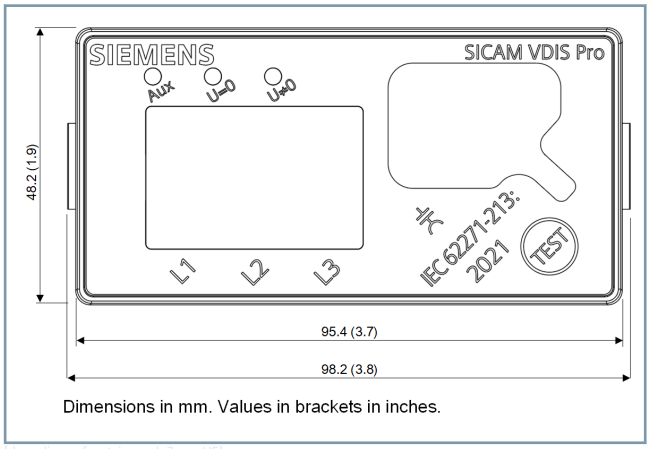


[dw_vdis_devicelabels, 2, –, –]

Figure 7.9/11 Device Labels

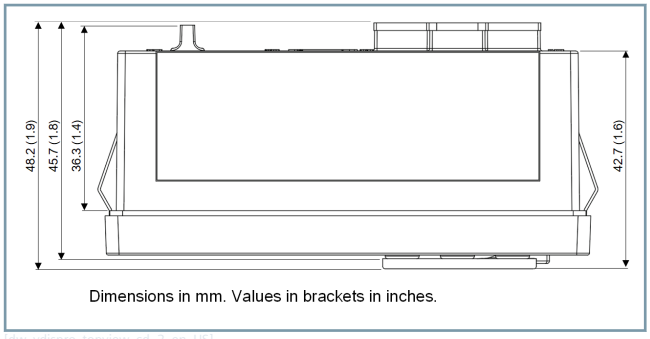
CE	European CE marking
	Warning, risk of electric shock
	Waste Electrical and Electronic Equipment Directive (WEEE)
UK CA	United Kingdom (UK) Conformity Assessed marking
	Capacitive VDIS

Dimensional Drawings



[dw_vdispro_frontview_cd, 2, en_US]

Figure 7.9/12 Front View – Dimensional Details



[dw_vdispro_topview_cd, 2, en_US]

Figure 7.9/13 Top View – Dimensional Details

Following tables describes SICAM VDIS, VDIS Pro - LCD, LED indications, and relay function positions scenarios.

Scenario	Display Indication	LED Indications[92] and Relay Function Positions					Description
	Phases L1 L2 L3	Aux LED	U = 0 LED	U ≠ 0 LED	Relay 2 U = 0	Relay 1 U ≠ 0	U_n = rated voltage U = 0 indicating LED is Green U ≠ 0 indicating LED is Red Auxiliary voltage Aux = 0 → absent Aux ≠ 0 → present
1		○	○	○	4 5 6 NO NC	1 2 3 NO NC	Auxiliary voltage not present[92] Operating voltage (U_n < 10 %) in all 3 phases
2		●	●	○	4 5 6 NO NC	1 2 3 NO NC	Auxiliary voltage present[92] Operating voltage (U_n < 10 %) present in all 3 phases
3		●	○	●	4 5 6 NO NC	1 2 3 NO NC	Auxiliary voltage present[92] Operating voltage (10 % ≤ U_n ≤ 45 %) present in all 3 phases, not an operating voltage[93]
4		●	○	●	4 5 6 NO NC	1 2 3 NO NC	Auxiliary voltage present[92] Operating voltage (U_n ≥ 45 %) present in all 3 phases Maintenance test passed
5		●	●	●	4 5 6 NO NC	1 2 3 NO NC	Auxiliary voltage present[92] Failure of phase L1 voltage (U_n < 10 %)[94] Operating voltage (U_n > 10 %) present with L2, L3[94]
6		●	●	●	4 5 6 NO NC	1 2 3 NO NC	Auxiliary voltage present[92] Overvoltage (U_n > 120 %) present in all phases[95]
7		*	*	*	*	*	*Depends on the auxiliary and operating voltage availability Display test passed.

Table 7.9/3 SICAM VDIS, VDIS Pro Indications and Relay Function Positions

Performing the Display Test

The test button is accessed from front fascia of the device. By pressing the test button, you will understand whether the display is operational or not.

Once the test button is pressed and released, all display segments lights up shortly as shown below, then it is an indication of:

- Display is operational

- When the display is operational and if the voltage presence or absence is indicated, then device is healthy.

92 Applicable for SICAM VDIS Pro

93 Depending on the combination of switchgear type, bushing capacitance, and connecting cable used, the LCD and LED indications for 10 % ≤ U_n ≤ 45 % will vary.

94 Indications are similar for 1-phase and 2-phase

95 Voltage presence and overvoltage segment for phases must be of same intensity to confirm the overvoltage scenario.

SICAM VDIS, VDIS PRO – Indications and Relay Positions

After pressing the test button, if the display has blank screen or distorted or disrupted, it is an indication of defective device.

Indication of Conformity

This product complies with the directive of the Council of the European Communities on the harmonization of the laws of the Member States relating to electromagnetic compatibility (EMC Directive 2014/30/EU) and concerning electrical equipment for use within specified voltage limits (Low Voltage Directive 2014/35/EU) as well as restriction on usage of hazardous substances in electrical and electronic equipment (RoHS Directive 2011/65/EU).

This conformity has been proved by tests performed according to the Council Directive and in accordance with the generic standard IEC/EN 61326-1 (for EMC directive) and with the standards IEC/EN 61010-1 and IEC/EN 61010-2-30 (for Low Voltage Directive) by Siemens AG.

The device is designed and manufactured for application in an industrial environment.

RoHS directive 2011/65/EU is met using the standard IEC/EN 63000.

The product conforms with the international standards of IEC 61326-1.

General Technical Data

Medium-voltage range	3.3 kV to 40.5 kV, ±10 %
Frequency	50 Hz/60 Hz, ± 5 % tolerance
Auxiliary power supply (applicable for 6MD2330-3xA10-0AA0 only)	DC 24 V to 250 V (-20 % to 10 %) AC 110 V to 240 V (-20 % to 10 %)
Cable to short-circuit indicator	Interface cable connection from SICAM VDIS, VDIS Pro

Measuring Inputs for Voltage

Measuring range (phase-to-phase) – based on C1, C2 combination	3.3 kV to 40.5 kV, ±10 %
Output voltage at testing and connecting points	0 V to 60 V

Digital Outputs

Digital outputs	2 x CO type monostable (non-latching type) and potential-free contacts
Permissible rated voltage	250 VAC
Pickup time	8 ms
Dropout time	8 ms
Maximum switching capacity	AC 5 A/250 V (1250 VA), DC 5 A/30V (150 W)
Display response time	≤ 1 s
Device and relay response time	≤ 1 s

Mechanical Data

Housing	Flush mounting, polycarbonate case
Overall dimensions	96 mm x 48 mm x 48 mm (WxDxH)
Cut-out (W x H)	92 + 0.8 mm x 45 + 0.6 mm
Switch-panel thickness	1.5 mm to 3 mm
Mounting position	Horizontal or vertical
Weight	102 g approximately for 6MD2330-1AA00 106 g approximately for 6MD2330-2[B/D]A00 140 g approximately for 6MD2330-3[B/D]A00

Environment

Operating temperature	-40 °C to +75 °C[96]
Storage temperature	-40 °C to +75 °C
Humidity	0 % to 98 %, non-condensing
Altitude above sea level	Maximum 2000 m
Minimum admissible atmospheric pressure	86 kPa to 106 kPa

Degree of Protection

Device front	IP 54
Device rear	IP 20

Power Consumption

Power consumption	< 2 W at DC 24 V < 4 VA at AC 230 V

Display Indications

Symbols	Operating voltage presence Overvoltage
Indications	Horizontal mounting (0°) Vertical mounting (90° clockwise)
Power supply	The display is powered by the measured voltage.
Visibility angle	±15°
Visibility range	1 m

LED Indications

Indication	2 green LEDs 1 red LED
Visibility angle	±15°
Visibility range	1 m

96 At temperatures below -25 °C, the display becomes sluggish and the readability may be impaired.

Climatic Environmental Tests

Temperature

Tests	Test Requirements
Type tested acc. to IEC 60086-2-1 and IEC 60086-2-2, tested for 16 h	-40 °C to +75 °C
Permissible temporary operating temperature (tested for 16 h)	-40 °C to +75 °C
Limiting temperature for storage and transport	-40 °C to +75 °C

Tests	Standards	Test Requirements
Dry heat test: Bd	IEC 62271-213	+75 °C, 16 h
Cold test: Ad	IEC 60068-2-2	-40 °C, 16 h
Damp heat test	IEC 62271-213	40 °C ±2 °C
	IEC 60068-2-78	Relative humidity 93 % ±3 %
		Duration: 96 h
Composite temperature/humidity cyclic test	IEC 62271-213	Lower temperature: -10 °C
	IEC 60068-2-38	Upper temperature: 40 °C
		Humidity: 93 % ±3 % (21 cycles of 24 h period)
Insulation resistance under pollution	IEC 62271-213	Temperature: 35 °C ± 2 °C
	IEC 60068-2-11	Salt concentration: 5 % ± 1 %
		pH between: 6.5 and 7.2
		Duration: 3 h

Humidity

Permissible humidity	93 % ±3 % relative humidity
Siemens recommends installing the devices in a place where they are not exposed to direct sunlight or wide temperature variations that could lead to condensation.	

Electrical Tests

Safety Tests

Tests and Standards	Test Requirements	High Voltage Test (1 min)	Impulse Voltage Test [97]
High voltage and impulse voltage test (IEC 61010-1, IEC 61010-2-30)	Insulation test between all terminals of auxiliary power supply connected together with respect to all terminals of DO1, DO2, and 3-phase voltage sensor connected together	2.21 kV	4 kV
	Insulation test between all terminals of DO1 and DO2 connected together with respect to all terminals of auxiliary power supply and 3-phase voltage sensor connected together		
	Insulation test between all terminals of 3-phase voltage sensor connected together with respect to all terminals of auxiliary power supply, DO1, and DO2 connected together		
Insulation resistance (IEC 61010-1, IEC 61010-2-30)	DC 500 V, 60 s, ≥100 MΩ	–	–

NOTE

In compliance with IEC 62271-213:2021 standard, the voltage limiting element operates within a maximum threshold of AC 90 V and remains dormant when the voltage is less than AC 60 V.

Mechanical Tests

Tests	Standards	Test Requirements
Vibration response	IEC 60068-2-6, Class 1	Sinusoidal
	IEC 60255-21-1	10 Hz to 150 Hz: ± 0.035 mm amplitude, 0.5 g acceleration
		Frequency sweep rate 1 octave/min
		1 cycle in 3 orthogonal axes

97 1.2 µs/50 µs, 5 positive and negative cycles

Short-Circuit Indicator

SICAM VDIS, VDIS PRO – Type Test Specifications

Tests	Standards	Test Requirements
Vibration withstand	IEC 60068-2-6, Class 1 IEC 60255-21-1	Sinusoidal
		10 Hz to 150 Hz: ± 0.075 mm amplitude, 1 g acceleration
		Frequency sweep rate 1 octave/min
		20 cycles in 3 orthogonal axes
	IEC 62271-213 IEC 60068-2-6	Sinusoidal
		10 Hz to 150 Hz: ± 0.15 mm constant amplitude in the range of 10 Hz to 58 Hz
		2 g acceleration in the range of 58 Hz to 150 Hz
		Frequency sweep rate 1 octave/min
		10 cycles in 3 orthogonal axes
Shock response	IEC 60068-2-27, Class 1 IEC 60255-21-2	Semi-sinusoidal
		Acceleration 5 g, duration 11 ms
		18 shocks each in both directions of the 3 orthogonal axes
Shock withstand	IEC 60068-2-27, Class 1 IEC 60255-21-2	Semi-sinusoidal
		Acceleration 15 g, duration 11 ms
		18 shocks each in both directions of the 3 orthogonal axes
Seismic vibration	IEC 60255-21-3	Sinusoidal
		1 Hz to 35 Hz: ± 3.5 mm constant amplitude
		1 g (for X & Y axis) acceleration in the range of 1 Hz to 9 Hz
		0.5 g (for Z axis) acceleration in the range of 9 Hz to 35 Hz
		Frequency sweep rate 1 octave/min
		1 cycle in 3 orthogonal axes
Bump	IEC 60255-21-2	Semi-sinusoidal
		Peak acceleration 10g, duration of pulse 16 ms
		Number of pulses 1000 in each direction

EMI/EMC Tests for Immunity

Test	Standards	Test Requirements
Electrostatic discharge immunity test	IEC 62271-213 IEC 61000-4-2 IEC 61326-1	8 kV air discharge 6 kV contact discharge
Electromagnetic high frequency disturbance (radiated susceptibility test)	IEC 62271-213 IEC 61000-4-3 IEC 61326-1	80 MHz to 6 GHz (10 V/m)

Test	Standards	Test Requirements
Electrical fast transient/ burst immunity test	IEC 62271-1 IEC 61000-4-4 IEC 61326-1	±2 kV for all ports
Surge immunity test	IEC 61000-4-5, Level 3 IEC 61326-1, Level 3	Auxiliary power supply, DO1, and DO2 Differential mode: ± 1 kV Common mode: ± 2 kV
Conducted susceptibility test	IEC 61000-4-6, Level 2 IEC 61326-1, Level 2	150 kHz to 80 MHz (10 V) on all ports
Damped oscillatory wave immunity test	IEC 62271-213 IEC 62271-1 IEC 61000-4-18	Auxiliary power supply, DO1, and DO2 Differential mode: 1.0 kV Common mode: 2.5 kV
Power frequency magnetic field	IEC 61326-1 IEC 61000-4-8	100 A/m (continuous field) and 1000 A/m pulsed (short duration for 3 s) on the X, Y, Z axis of the product
Voltage dips and interruptions	IEC 61000-4-11 , IEC 61000-4-29 , IEC 61326-1 IEC 62271-1	0 %, 40 %, and 70 % dips on auxilairy power supply 0 % short interruptions for 250/300 cycles (50 Hz/60 Hz)
Ripple on DC input power port	IEC 61000-4-17 IEC 62271-1	Test level 3 (10 % of the rated DC input) Frequency of ripple: 150Hz/180Hz

EMC Tests for Noise Emission

Tests	Standards	Test Requirements
Disturbance voltage on lines, only auxiliary power supply voltage (conducted emission)	IEC 61326-1 CISPR 11	150 kHz to 30 MHz Class A Group 1
Disturbance-field strength (radiated emission)	IEC 61326-1 CISPR 11	30 MHz to 6 GHz Class A Group 1

Ingress Protection of Enclosure

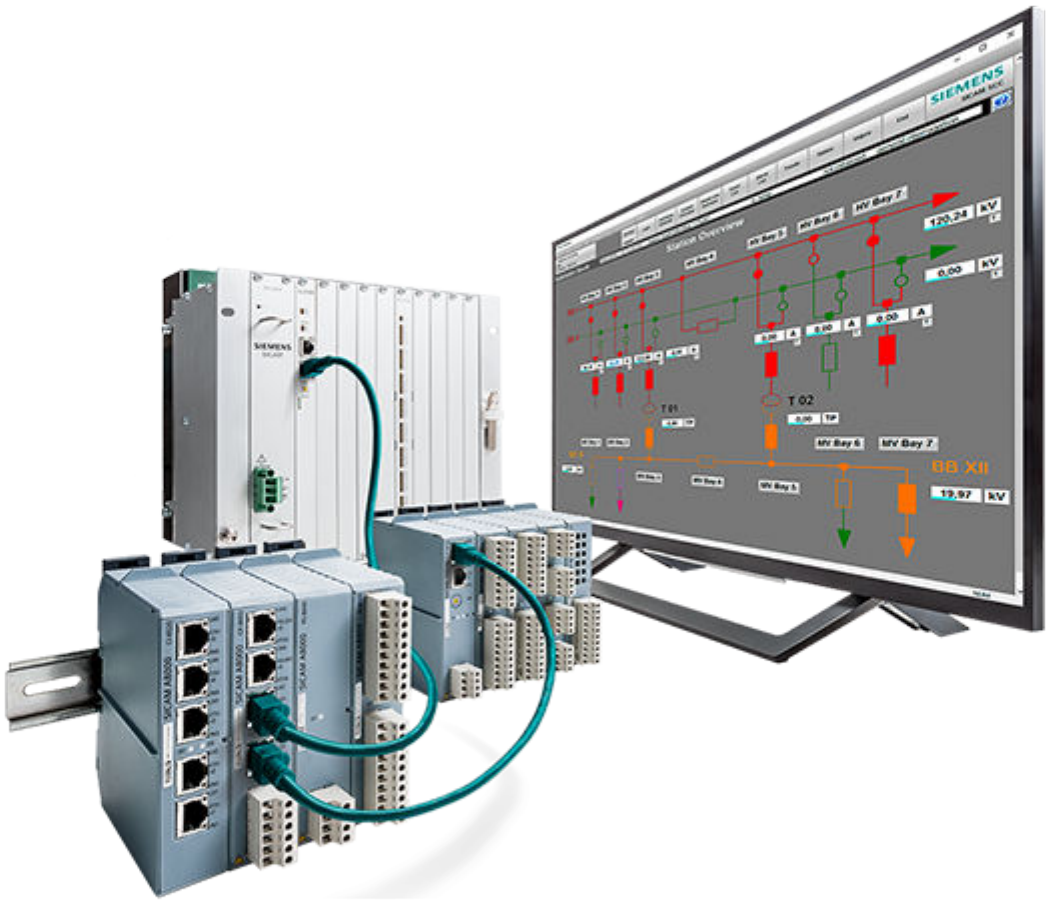
Tests	Standard	Test Requirements
Degree of protection	IEC 60529	IP54 for front side IP20 for rear side

Description	Order No.												
	1	2	3	4	5	6	7		8	9	10	11	12
SICAM Voltage Detecting and Indicating System	6	M	D	2	3	3	0	–	☐	☐	A	0	0

Description		Order No.												
SICAM VDIS	Voltage detecting and indicating system with ● LCD ● Testing points and test button								1	|				
	Fixed capacitance C2: 3900 pF								|	A				
SICAM VDIS	Voltage detecting and indicating system with ● LCD ● Testing points and test button								2	|				
	Adjustable capacitance C2: 820, 1210, 2020, 2410, 3520, 3910, 4720, 5110, 6420, 6810 pF								|	B				
	Adjustable capacitance C2: 820, 1820, 2020, 3020, 4720, 5720, 5920, 6920, 15820, 16820 pF								|	C				
	Adjustable capacitance C2: 1200, 2400, 3900, 5100, 6800, 8000, 9500, 10700, 11200, 16800 pF								|	D				
SICAM VDIS Pro	Voltage detecting and indicating system with ● LCD ● Testing points and test button ● Digital outputs, LEDs, and auxiliary power supply								3	|				
	Adjustable capacitance C2: 820, 1210, 2020, 2410, 3520, 3910, 4720, 5110, 6420, 6810 pF									B				
	Adjustable capacitance C2: 820, 1820, 2020, 3020, 4720, 5720, 5920, 6920, 15820, 16820 pF									C				
	Adjustable capacitance C2: 1200, 2400, 3900, 5100, 6800, 8000, 9500, 10700, 11200, 16800 pF									D				

NOTE

SICAM VDIS, VDIS Pro can be used with various types of Siemens switchgear units. For detailed configuration of other switchgear units, contact Siemens customer support.


SIEMENS
120.24
kV
0.00
kV
T 01
T 02
MV Bay 6
MV Bay 7
BB XII
19.97
kV

Powerlink IP

Where and why do I use PowerLink IP with PLC technology?

Deregulation of energy markets and rapidly growing distributed power generation are leading to more complex management of power grids with increasingly demanding redundancy requirements. Traditional high-voltage (HV) substations require a low bit rate communication channel for applications like binary teleprotection signals, control center commands, or analog voice. Integration into enterprise IT is not required.

New digital HV substations typically use packet-based broadband communication infrastructure. Central data analytics and application services demand extended data bandwidth. The data flow is primarily asymmetrical; cybersecurity is an integral feature.

The new PowerLink IP solution is designed for Ethernet/IP environments typically found in digital HV substations. It supports extended bandwidth requirements and the integration of legacy interfaces. This combined with the new HF filter (small / broadband) allows PowerLink IP to seamlessly integrate with existing PLC and digital solutions

[ph-power-link-ip, 1, --_--]

Figure 8.1/1 PowerLink IP

Benefits

- Highly efficient utilization of scarce bandwidth resources
- Smart frequency management
- High availability and reliabilit
- Cloud connectivity for access to performance and quality data
- Optimized for packet-based architecture of modern HV substations
- Continuous updating of latest cybersecurity recommendations
- Seamless integration into existing PLC infrastructure
- Cost-efficient consolidation of traditional PLCs
- Data communication channel for data exchange, high quality service telephony or even video
- Transition to digital substation through flexible migration scenarios (integration of legacy devices)

Functions

PLC functions/features

- Bandwidth
  Narrowband (4 kHz to 16 kHz)
  Broadband (32 kHz to 256 kHz)
- Integrated legacy interface for voice and data services
- Transmission rates up to 2 Mbps
- Efficient bandwidth utilization
  - Notching (non-contiguous frequency bands)
  - Channel spreading (dynamic transmission rate adaptation)
  - Asymmetrical data streams
- Integrated spectrum analyzer
- Stable operation and fast synchronization time even under adverse conditions
- Parallel operation to other PLC systems
- Primary or backup communication solution for HV power lines

Teleprotection functions/features

- Integrated Teleprotection Signaling System eTP61850 for up to 8 independent signaling commands
- Support of IEC 61850 GOOSE connected to eTP61850

Packet function/features

- Pure packet-based architecture
- Web-based administration
- Integrated L2 switch with MPLS support
- Integration into network management system using latest SNMP technology

Cybersecurity

- VLAN and QoS features
- TLS support
- GOOSE gateway for teleprotection signalling
- RADIUS authentication for client web access
- Firmware signature
- MAC filtering
- Firewall
- Non-volatile recording of SYSLOG events

Applications

PLC systems utilize the high-voltage line between transformer substations as an economical communication path for data, teleprotection, or voice. Such systems are typically used as primary or backup communication connection between HV substations.

Even in modern power line networks, there are many HV substations where the installation of fiber is not cost-effective and where wireless communication is not sufficiently reliable. In those cases, power line is the sole communication path between HV substations.

PowerLink IP serves as a single communications system for the diverse communication requirements of state-of-the-art HV substations. It supports any type of IP-based traffic as well the

migration of analog RTU - or analog voice – traffic or the transmission of teleprotection signals.

PowerLink IP is the best solution for ensuring highest availability by establishing an alternative communication path for critical grid applications (for example, protection devices, RTUs, and voice). In combination with fiber-optic communication technology PowerLink IP warrants the best possible reliability for critical HV links.

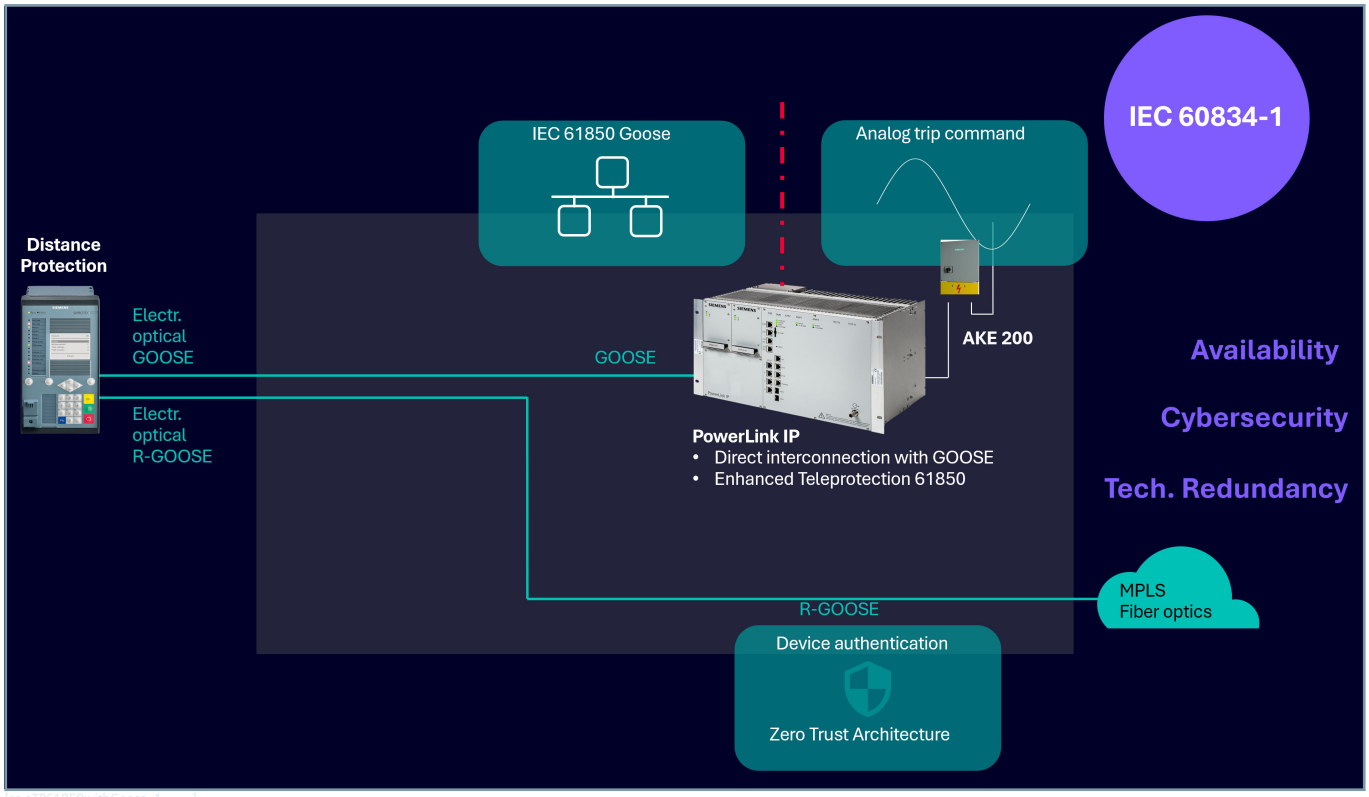


Figure 8.1/2 PowerLink IP with enhanced Teleprotection eTP61850

Powerlink IP – Technical Data

Transmission Method

Modulation	Multicarrier modulation (windowed OFDM) for data transmission Frequency shift keying for teleprotection
HF-frequency range	TFLT-C/D: 24 to 500 kHz in steps of 2 kHz TFLT-A/B: 36 to 500 kHz in steps of 4 kHz
HF bandwidth	TFLT-C/D: 4, 8, 12, 16 kHz TFLT-A/B: 32 to 256 kHz in steps of 8 kHz
Frequency management	Dynamic[98] and predefined bandwidth allocation Notching of occupied frequencies (up to 20 notches) Adjustable asymmetric traffic Adjacent and non-adjacent Tx/Rx band operation Teleprotection communication via anchor frequencies

HF-Interface

Output power	50 W-amplifier, up to +47 dBm PEP Adjustable 10 W to 50 W 100 W-amplifier, up to +50 dBm PEP Adjustable 20 W to 100 W
Rated output impedance	75 Ω unbalanced or 150 Ω balanced
Spurious emission, return loss, tapping loss, balance to ground, receiver sensitivity and selectivity	In accordance with: • IEC 60495 • IEC 62488-2 • IEC 62488-3
Tx filter	Simple adjustment by jumpers
Rx filter	The Rx filtering is done in digital domain and is adjusted automatically

Transmission Characteristics

Transmission characteristics	Transmission capacity up to 1.5 Mbps Spectral efficiency 0.8 to 10.2 bit/s/Hz Minimum SNR: • 42.6 dB for 16,384 QAM • 36.6 dB for 4,096 QAM • 30.6 dB for 1,024 QAM • 24.5 dB for 256 QAM • 18.2 dB for 64 QAM • 11.4 dB for 16 QAM • 3.3 dB for 4 QAM All values rated at 64-kHz bandwidth and BLER 10E-6
Dynamic transmission path adaption	Modulation steps 4/16/64/256/1024/4096/16384-QAM
Latency	Typically 20 ms Latency depends on frame length and the currently used transmission scheme

Ethernet Interface

Ethernet	1 x 100BASE-TX Full Duplex; RJ45 service interface (LCT port) 3 x 10BASE-T or 100BASE-TX Half/Full Duplex/Auto Negotiation; PoE on port 3 acc. to IEEE 802.3af, 15.4 W; RJ45 user interfaces 2 x Ethernet 100BASE-FX; SFP user interfaces
Layer 2 switch	Transparent Layer 2 bridging Ethernet II, IEEE 802.3, IEEE 802.1Q IEEE 802.1ad Provider Bridge/Q-in-Q (Carrier Ethernet) MPLS labeled Layer 2 VPN frames Jumbo frame: max. frame size 2000 bytes (including header information) on all five user interfaces Maximum Transmit Unit (MTU) for IPv4 over Ethernet: 1500 byte on service interface (LCT)
QoS	Layer 2/3: VLAN ID, IEEE 802.1p, TOS/DSCP Layer 4: VoIP, IEC 60870-5-104, CCTV, SCADA

Analog Interface

VF- Telephone Channel E&M (2/4 Wire)	
Number of channels	1
Signaling	DTMF
Impedance input/output	600 Ω balanced
Max. input level (4 / 2 wire)	15 dBm
Max. output level (4 / 2 wire)	14 dBm
Control wires	Telephone signaling channel (S2) S2 OUT: typ. 48 VDC, max. 72 VDC, 50 mA resistive load S2 IN: typ. 48 VDC, max. 72 VDC, max. 500 Ω loop resistance

VF- Telephone Channel FXS (2 Wire)	
Number of channels	4
Signaling	DTMF/Dial pulse
Impedance	600 Ω balanced
Infeed current	48 V, 24.1 mA
Max. loop resistance	1690 Ω
Ringing voltage	25 Hz, 75 Vrms
Max. input level	9 dBm
Max. output level	7 dBm

98 Automatic bandwidth adaption within the frequency domain adjacently operating PowerLink IP devices

VF- Telephone Channel FXO (2 Wire)	
Number of channels	1
Signaling	DTMF/Dial pulse
Impedance	600 Ω balanced
Ringing detection	25 Hz, 50 Hz, 60 Hz (> 24 Vrms) The ringing signal must contain polarity reversal to be detected.
Loop resistance	< 500 Ω
Loop current	15 mA to 112 mA (depending on line feed resistance)
Max. input level	14 dBm
Max. output level	12 dBm

RS-232	
Number of channels	4
Data rate	300, 600, 1200, 2400, 4800, 9600, 19 200, 38 400, 57 600, 115 200 bps
Serial mode	7N1, 7N2, 7E1, 7E2, 7O1, 7O2, 8N1, 8N2, 8E1, 8E2, 8O1, 8O2
Port B	Only available in RS-232-2 and RS-232-4

Integrated Teleprotection

Overview	
Operation modes	Alternate Multi-Purpose (AMP)
Number of trip commands	Up to 8
Number of IEC 61850 interfaces	Up to (4 with 1 eTP61850)
Modulation	Coded tripping
AMP frequencies	Trip 0.36 – 2.62 kHz when using 4 command option Trip 0.50 – 3.79 kHz when using 8 command option Guard 2.61 kHz

Command Input/Output – IEC 61850 Command Input (eTP61850)	
Electrical interface	RJ45; 100Base-TX; max. range 20 m
Optical interface	SFP; 100Base-FX; 1,300 nm; LC connector; Max. range 1.5 km

Command Transmission – Transmission Time	
Alternate multi purpose	≤ 19 ms

Command Transmission – Security (Analog Transmission Path)	
Probability of unwanted commands	$P_{UC} < 10^{-6}$

Command Transmission – Dependability (Analog Transmission Path)	
Probability of missing commands	$P_{MC} < 10^{-4}$ at SNR of +6 dB

Miscellaneous

Maintenance Interfaces	
Service-PC	Web UI via Web browser, HTTPS secure protocol DHCP client for ETH interface
Service telephone	Via IP telephone or PC app

Network Management	
Element manager	Web browser for local and remote access with username/password for configuration and maintenance
Integration with NMS at higher level	Via SNMP v2/3, alarm management (up to 4 destinations for alarm traps), inventory and performance management

Event Recorder	
Recording capacity	PowerLink IP 10000 events
Real-time clock	NTP, IRIG-B, Line clock sync 1-ms resolution

SD Card	
File system	FAT32

Alarm Modules Input/Output – Binary Input ALR Module	
Binary input 1	
Nominal voltage	DC 24 V to DC 250 V (tolerance: -20 % to +15 %)
used for synchronization with	Yes
Polarity independence	
IRIG-B	DC 5 V, DC 12 V, DC 24 V (tolerance: ±15%)
Polarity independence	No, defined polarity required

Alarm Modules Input/Output – Output ALR Module (Relay)	
Number of alarm outputs	3 relay contacts
Contact type	Change over contact
Switching power	300 W (DC) 1000 VA
Switching voltage	250 V (DC or peak AC)
Switching current	5 A (DC or peak AC)
Carry current	1 A (DC or peak AC)

Power Supply	
Input voltage range	
PSPA2-DC	DC 38 V to DC 72 V

Powerlink IP – Technical Data

Power Supply	
PSPA2-AC	AC 93 V to AC 264 V (47 Hz to 63 Hz) DC 85 V to DC 264 V
Power consumption	
50 W amplifier (AC/DC)	typ. value normal operation 301VA/104W typ. value max operation 394VA/146W
100 W amplifier (AC/DC)	typ. value normal operation 358VA/131W typ. value max operation 559VA/215W

EMC Immunity	
Standards	Testlevels
Electrostatic discharge IEC 61000-4-2	direct/indirect contact discharge: 8 kV air discharge: 15 kV
Radiated immunity IEC 61000-4-3	10 V/m 80 to 1000 MHz 3 V/m 1 to 6 GHz
Electrical fast transient (burst) IEC 61000-4-4	AC/DC supply lines: +/- 2 kV HF input/output lines: +/- 1 kV (+/- 4 kV) Data input/output: +/- 1 kV (+/- 2 kV)
Surge immunity IEC 61000-4-5	1,2/50 us (8/20) pulse Signal/control lines: +/-1 kV line to earth (+/- 1 kV line to earth) HF input/output lines: +/- 1 kV line to earth (+/- 2 kV line to earth) DC supply lines: +/- 0,5 kV line to earth; +/- 0,5 kV line to line (+/- 2 kV line to earth; +/- 1 kV line to line) AC supply lines: +/- 2 kV line to earth; +/- 1 kV line to line
Immunity to conducted disturbances IEC 61000-4-6	0.15 MHz to 80 MHz 10 Vrms (signal lines >3 m and AC/DC power supply lines)
Power frequency magnetic field immunity IEC 61000-4-8	50/60 Hz; 30 A/m (100 A/m; 1000 A/m for 1 s)
Voltage dips AC supply line IEC 61000-4-11	Dip: 0% 20 ms 1 P Dip: 0% 100 ms 5 P Dip: 40% 200 ms 10 P Dip: 40% 1000 ms 50 P Dip: 70% 20 ms 1 P Dip: 70% 500 ms 25 P
Voltage interruptions AC supply line IEC 61000-4-11	0% 5 s 250/300 P
Ring wave immunity test IEC 61000-4-12	100 kHz 2.5 kV LTG 1 kV LTL

EMC Immunity	
Standards	Testlevels
Test for immunity to conducted, common mode disturbances IEC 61000-4-16	(Signal/control lines: 50/60 Hz; 10 V cont., 300 V for 1 s (HF input/output lines: 50/60 Hz; 30V and 300V for 1s) (DC supply lines: 50/60 Hz; 10V cont., 300 V for 1 s)
Ripple on DC input power port immunity IEC 61000-4-17	(DC supply lines: 10% Un)
Damped oscillatory wave immunity test IEC 61000-4-18	(HF input/output lines: 1 MHz; 2,5 kV common mode and 1 kV differential mode)
Voltage dips, short interruptions and voltage variations on DC input power IEC 61000-4-29	0%, 0.010 s 0%, 0.050 s 40%, 0.100 s 70%, 0.100 s

EMC Emission	
Standards	Testlevels
Emission standard for industrial environments IEC 61000-6-4	Class A

International Standards	
Single side band power-line carrier terminals	IEC 60495[99] IEC 62488-2 ED1[99]
Climatic conditions	IEC 60870-2-2 Climatic-Storage/Operation: B3 (3k4/1k2); C1 (3k5/1k3) no condensation, no icing Climatic-Transport: Ct1 (2k2) Mechanical-Storage, Installation, Transport: B^m

Climatic Conditions	
Standards	Testlevels
Cold IEC 60068-2-1	-10 °C
Dry heat IEC 60068-2-2	+ 55 °C
Damp heat, cyclic IEC 60068-2-30	+ 25 °C at 95 % humidity + 55 °C at 93 % humidity

99 IEC 60495 valid for applicable parameters on digital PLC

Mechanical Conditions	
Standards	Testlevels
Degree of protection	IP 20
Vibration stationary use IEC 60068-2-6	Resonance: 5 Hz to 9 Hz: 0,35 mm amplitude 9 Hz to 500 Hz: 1 m/s^2 acceleration
	Endurance: 5 Hz to 9 Hz: 3,5 mm amplitude 9 Hz to 200 Hz: 10 m/s^2 acceleration 200 Hz to 500 Hz: 15 m/s^2 acceleration
Test of dynamical behaviour during mechanical stress (Shocktest) IEC 60068-2-27: test Ea	Half sine; 30 g acceleration; duration 18 ms

Mechanical Design	
19" frame	
Dimensions	482 mm x 266 mm x 300 mm (W x H x D)
Weight with 50-W amplifier with 100-W amplifier	 17 kg 19 kg

Insulation Withstand Voltage		
Module	I/F Name	Insulation Withstand Voltage
PSPA2-AC	Power-IN	1.77 kV (2.5 kVp) AC 60 s
PSPA2-DC	Power-IN	2.5 kV DC 60 s
DMB	LCT	1 kV AC 60 s
	ETH1, ETH2, , ETH3/POE	1 kV AC 60 s
ALR	ALARM	2.83 kV (4 kVp) AC 60 s
TFLT	HF OUT/IN	1.77 kV (2.5 kVp) AC 60 s

Impulse Withstand Level		
Module	I/F Name	Impulse Withstand Level 1.2/50 µs, 0.5 J
PSPA2-AC	Power-IN	5 kVp
PSPA2-DC	Power-IN	5 kVp
DMB	LCT	1.5 kVp
	ETH1, ETH2, , ETH3/POE	1.5 kVp
ALR	ALARM	5 kVp
TFLT	HF OUT/IN	5 kVp

Powerlink IP – Ordering and Selection Data

Description	Variants	Article No.																
		1	2	3	4	5	6	7		8	9	10	11	12		13	14	15	16
PowerLink IP		7	V	R	5	4	1	□	-	□	□	□	□	0	-	1	A	A	□
							▲	▲		▲	▲	▲	▲	▲		▲	▲	▲	▲
Device Type generation							|	|		|	|	|	|	|		|	|	|	|
	Backplane, PSCFS2, ALR, front cover						1	|		|	|	|		|		|	|	|	|
								|		|	|	|		|		|	|	|	|
								|		|	|	|		|		|	|	|	|
Transmit Power and Power Supply								|		|	|	|		|		|	|	|	|
	50 W Amplifier, 110/220 VDC, 110/230 VAC							0		|	|	|	|	|		|	|	|	|
	50 W, Redundant 2x 110/220/230 VDC/VAC							1		|	|	|	|	|		|	|	|	|
	50 W Amplifier, 48/60 VDC							3		|	|	|	|	|		|	|	|	|
	50W, Redundant 2x 48/60 VDC							4		|	|	|	|	|		|	|	|	|
	100 W Amplifier, 110/220 VDC, 110/230 VAC							6		|	|	|	|	|		|	|	|	|
	100 W Amplifier, 48/60 VDC							7		|	|	|	|	|		|	|	|	|
Digital Modulation Board Type										|	|	|	|	|		|	|	|	|
	DMB Version									1	|	|	|	|		|	|	|	|
	DMB aund CIB board									2	|	|	|	|		|	|	|	|
Teleprotection											|	|	|	|		|	|	|	|
	without										A	|	|	|		|	|	|	|
	eTP61850 license										T	|	|	|		|	|	|	|
Filter modules												|	|	|		|	|	|	|
	Wideband Filter TFLT-A&B											A	|	|		|	|	|	|
	Narrowband Filter TFLT-C&D											B	|	|		|	|	|	|
ETH 100 FX-SFP for optical Ethernet access													|	|		|	|	|	|
	without												1	|		|	|	|	|
	1x SFP module multimode												2	|		|	|	|	|
	2x SFP module multimode												3	|		|	|	|	|
	1x SFP module singlemode												4	|		|	|	|	|
	2x SFP modules singlemode												5	|		|	|	|	|
	1x SFP multimode,1x singlemode												6	|		|	|	|	|
Future use														|		|	|	|	|
	-													0		|	|	|	|
Manual and Tools																|	|	|	|
	for PL IP (download)															1	|	|	|
																	|	|	|

Table 8.1/1 PowerLink IP - Ordering and Selection Data

Description	Variants	Article No.																
		1	2	3	4	5	6	7		8	9	10	11	12		13	14	15	16
PowerLink IP 7VR54		7	V	R	5	4	1	□	-	□	□	□	□	0	-	1	A	A	□
																	▲	▲	▲
																	|	|	|
Future use																	A	|	|
	-																	|	|
Software and other features																		|	|
	PowerLink IP - PLC functionality																	A	|
License Features - Bandwidth limitation and Analyzer mode																			|
	Bandwidth up to 64 kHz without Analyzer																		1
	Bandwidth up to 256 kHz without Analyzer																		2
	Bandwidth up to 16 kHz enabled Analyzer																		3

Description	Variants	Article No.																
	Bandwidth up to 64 kHz enabled Analyzer																	4
	Bandwidth up to 256 kHz enabled Analyzer																	5

Table 8.1/2 PowerLink IP - Ordering and Selection Data

Description	Variants	Article No.																
		1	2	3	4	5	6	7		8	9	10	11	12		13	14	15	16
License Upgrade		7	V	R	9	7	9	0	-	1	A	A	☐	☐					
	Upgrade from 64 kHz without analyzer to 256 kHz without analyzer												1	2					
	Upgrade from 64 kHz without analyzer to 64 kHz with analyzer												1	4					
	Upgrade from 64 kHz without analyzer to 256 kHz with analyzer												1	5					
	Upgrade from 256 kHz without analyzer to 256 kHz with analyzer												2	5					
	Upgrade from 16 kHz with analyzer to 64 kHz with analyzer												3	4					
	Upgrade from 16 kHz with analyzer to 256 kHz with analyzer												3	5					
	Upgrade from 64 kHz with analyzer to 256 kHz with analyzer												4	5					
	Upgrade from 16/64/256 kHz with/without analyzer to eTP 61850												5	0					

Table 8.1/3 PowerLink IP - License Upgrade

Power Line Communications

AKE 200

The coupling unit AKE represents the communication interface between high voltage power lines and PLC equipment.

The high-frequency currents from and to the PLC components must be fed into or tapped from the lines at chosen points without the operating personnel or PLC terminals being exposed to a high-voltage hazard. The coupling unit together with the directly to the HV power lines connected high voltage capacitor, forms a high pass filter for the required carrier frequencies determined by the rating of the coupling capacitor and the chosen matching ratio.

The AKE coupling unit provides a safe and robust interface between HV power lines and PLC components like PowerLink 50/100, PowerLink IP, PowerLink CM and SWT 3000, even in harsh environment.

AKE provides phase-to-ground and phase-to-phase communication over HV power lines and can be easily adapted for different line impedances and coupling capacitors.

[ph_AKE_original, 1, --_--]

Benefits

- Low distortion phase-to-ground and phase-to-phase communication over HV power lines
- Safe isolation between high voltage side and PLC equipment
- Meets latest safety standards

Functions

- Robust communication interface between High Voltage power lines and PLC equipment like PowerLink 50/100, PowerLink IP, PowerLink CM and SWT 3000
- Compliant to standard IEC 60481
- Successor and fully functional compatible replacement of Coupling Unit AKE100
- Phase-to-ground and phase-to-phase communication over HV power lines
- Adaptable to different line impedances and coupling capacitors
- Operating temperature -40 °C to +50°C
- Protection class IP54

Technical Data AKE 200 A3, A4

PLC Cable Feed (SEC, SEC1, SEC2)	
With built in strain relief	11 to 17 mm cable diameter
Sealing of the PLC cable	According to cable manufacturer's instructions
Nominal impedance on equipment side	150 Ω balanced 75 Ω unbalanced (switchable)
Transmittable power	Multitone transmission: < 600 W PEP

Equipment Main Ground (PE)	
Screw connection	M10
Strain relief	Minimum 6 mm ∅ overall Maximum 70 mm2 or 10 mm ∅ CU

Line Terminal for Coupling Capacitor (PRI)	
Screw connection	M10
Strain relief	Minimum 6 mm ∅ overall Maximum 70 mm2 or 10 mm ∅ CU
Nominal impedance line side	Phase-Earth 360 Ω, Phase-Phase 600 Ω

Grounding Switch	
Current carrying grounding switch	250 A

Primary Surge Arrester	
Power-freq. sparkover voltage	< 2.1 kV 50 Hz
Impulse sparkover voltage	< 6 kVp
Discharge AC current	max. 8 kA/0.2 s
Max. pulse discharge current (without destruction)	5 kA; 8/20 µs

Drain and Tuning Coil	
Coil inductance	< 8 mH
50 Hz impedance	< 20 Ω, typ 4 Ω
Winding-to-ground dielectric strength	10 kV AC; 10 kVp 1.2/50 µs
Permissible current loading	50 A/0.2 s; 1.5 A continuous

Isolation Transformer	
Dielectric strength	10 kV
Surge withstand capability	10 kV, 1.2/50 µs

Gas-Filled Surge Arrester	
Nominal DC sparkover voltage	75 Ω config: 4 · 230 V = 920 V DC; P to PE 150 Ω Config: 460 V DC; P,N, to PE
Impulse spark over voltage	75 Ω Config: 4 · 700 Vp= 2.8k Vp; P to PE 150 Ω Config: 1.4 kVp; P,N to PE

Hybrid Transformer (A4 only)	
Hybrid loss	< 0.4 dB

Mechanical Design	
Weight	max. 12.5 kg
Dimensions	53.5 x 31 x 15 cm
Type of protection	IP54
Temperature range	-40 °C to +50 °C

Recommendations and Regulations Taken into Account
IEC 60481, IEC 60664-1

Technical Data AKE 200 A1 (HF Hybrid Transformer in Separate Case)

PLC Cable Feed (HA, HB, HS)	
With built in strain relief	11 to 17 mm cable diameter
Sealing of the PLC cable	According to cable manufacturer's instructions
Nominal impedance on equipment side	150 Ω balanced 75 Ω unbalanced (switchable)
Transmittable power	Multitone transmission: < 600 W PEP

Equipment Main Ground (PE)	
Screw connection	M10
Strain relief	Minimum 6 mm ∅ overall Maximum 70 mm2 or 10 mm ∅ CU

Hybrid Transformer	
Hybrid loss	< 0.4 dB

Mechanical Design	
Weight	8.5 kg
Dimensions	53.5 x 31 x 15 cm
Type of protection	IP54
Temperature range	-40 °C to +50 °C

Recommendations and Regulations Taken into Account
IEC 60481, IEC 60664-1

AKE 200 – Ordering and Selection Data

Description	Variants	Article No.															
		1	2	3	4	5	6	7		8	9	10	11	12	13	14	15	16
AKE 200		7	V	R	9	6	7	0	-	0	A	K	☐	☐				
													▲	▲				
Line Tuner / Coupling Device													|	|				
	AKE 200-A1, Hybrid Transformer, 75 Ohm												1	0				
	AKE 200-A1, Hybrid Transformer, 150 Ohm												1	1				
	AKE 200-A3, Phase to ground, 75 Ohm												3	0				
	AKE 200-A3, Phase to ground,150 Ohm												3	1				
	AKE 200-A4, Phase to ground coupling with hybrid transformer, 75 Ohm												4	0				
	AKE 200-A4, Phase to ground coupling with hybrid transformer, 150 Ohm												4	1				

Table 8.2/1 AKE 200 - Ordering and Selection Data

Description

The SICAM I/O-Unit 7XV5673 is a binary input/output device that has been developed for substations and industrial sectors with increased environmental demands. The SICAM I/O-Unit permits transmission from binary inputs to binary outputs locally or over large distances. It can be used for protection applications, such as overcurrent protection, permissive overreach transfer trip scheme, distance protection with signal connection, or as I/O extension in substation automation systems.

Binary inputs	• 6 robust EMC-hardened binary inputs • The pickup threshold can be set to DC 19 V, DC 88 V, or DC 176 V for different rated voltages of the station battery
Binary outputs	• 6 command relay outputs • Secure contact status after loss of connection, set by the user
Signal/alarm outputs	4 LEDs
Wide-range power supply unit	DC 24 to 250 V ± 20 % and AC 100 V to 230 V, 45 Hz to 65 Hz
Electrical RJ45 Ethernet interface	Cascading many devices without additional cost by using the integrated switch
Serial fiber-optic interface (optional)	ST connector, 820 nm for multimode optical fiber 62.5/125 µm, typical range: 2000 m with optical fiber 62.5 µm/125 µm, baud rate: 1.2 Kbps to 187.5 Kbps, set by software
Communication protocols	• IEC 61850 (GOOSE, MMS, Reporting) for the connection to protective and substation controllers • Modbus TCP or Modbus RTU for connection to a substation controller • Modbus UDP for point-to-point connection between 2 SICAM I/O-Units • SNTP for time synchronization
Time synchronization	• External time synchronization via Ethernet NTP • External time synchronization via Fieldbus with communication protocol Modbus RTU, Modbus TCP, or Modbus UDP
Housing	IP20, DIN rail

Functions

All types of binary signals from switching devices/protective procedures (such as trip commands, switch position signals, fault and status messages) are reliably recognized via binary inputs. This information can be transferred via contacts directly on this SICAM I/O-Unit or via communication connections to other SICAM I/O-Units or substation automation systems. Secured telegrams are used for communication via Ethernet or serial connections. The parameters of the SICAM I/O-Units can be set easily via a standard Web browser on the PC that is connected via the Ethernet interface.

The SICAM I/O-Unit can for example, be used as:

- Binary signal transmitter (BST): Point-to-point transmission of binary signals between 2 SICAM I/O-Units via Ethernet or a serial connection. Signal inputs and outputs can be assigned by the user.
- I/O extension:
  - Extension of protection devices via binary inputs and outputs with GOOSE
  - Detection and output of binary states via substation controllers with the standard protocols Modbus RTU, Modbus TCP, or IEC 61850
  - Extension for protection devices of the compact classes SIPROTEC 7SJ80 and SIPROTEC 7SK80 by connection to their low-cost Ethernet interface (port A)
- Contact duplicator: Transmission of signals via one or more binary inputs by means of relay contacts of the same SICAM I/O-Units, for example for separation between different voltage levels

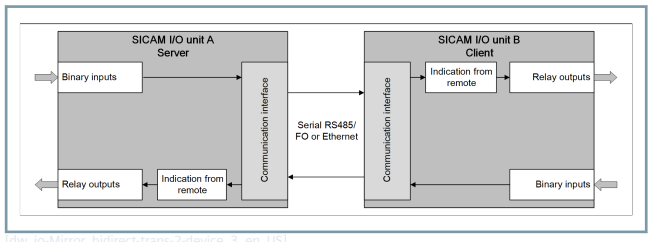
[ph_SICAM IO_Unit, 1, _ _]

Figure 9.1/1 SICAM I/O-Unit 7XV5673

Applications

Binary signal transmitter

If the SICAM I/O-Unit is used as a binary signal transmitter to *Figure 9.1/2*, there is a bidirectional transfer of binary signals of exactly 2 units at any one time. The transmission takes place between server and client device via serial connections (option) or via Ethernet networks. Via the relay output contacts, voltages of up to AC/DC 250 V and currents of up to AC/DC 5 A can be switched. The pickup threshold of the binary inputs can be set by the user on different levels. The user can assign signal inputs and outputs as required.



[dw_io-Mirror_bidirect-trans-2-device, 3, en_US]

Figure 9.1/2 Binary Signal Transmitter, Bidirectional Transmission between 2 Units

Extension of the communication route

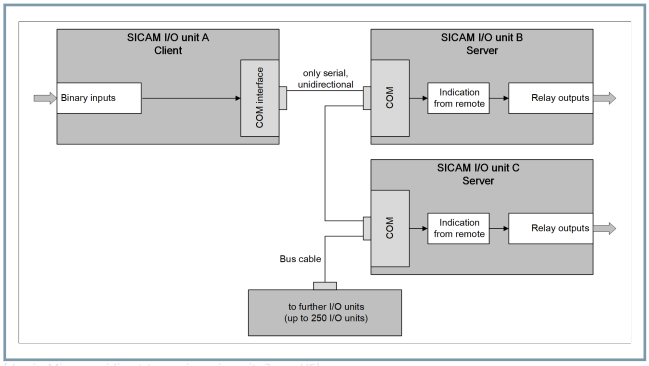
An extension of the communication route is possible.

The following devices can be used:

- With serial optical repeater 7XV5461, scalable up to 170 km
- Optical fiber connection also with mini star coupler 7XV5450, CM-0822 or RS485/optical fiber converter 7XV5650
- With different communication converters 7XV5662 (pilot wires, X.21/G.703.1 and G.703.6)
- Media converter for Ethernet RMC (Ruggedcom)
- Wireless transmission RS 900WNC (Ruggedcom)

Unidirectional binary signal transmission

When you use SICAM I/O-Units for unidirectional binary signal transmission to *Figure 9.1/3* then the units transfer binary signals in one direction from a client unit to several server units. In this application, the transmission takes place exclusively in one direction. Input signals (max. 6) are transmitted from the left device to the output contacts of one or more devices on the right side. The serial ports of the I/O-Unit can be electrical or serial. Alternatively, you may use RS485/optical fiber converters 7XV5650 and mini star couplers 7XV5450 or CM-0822 for cascading.



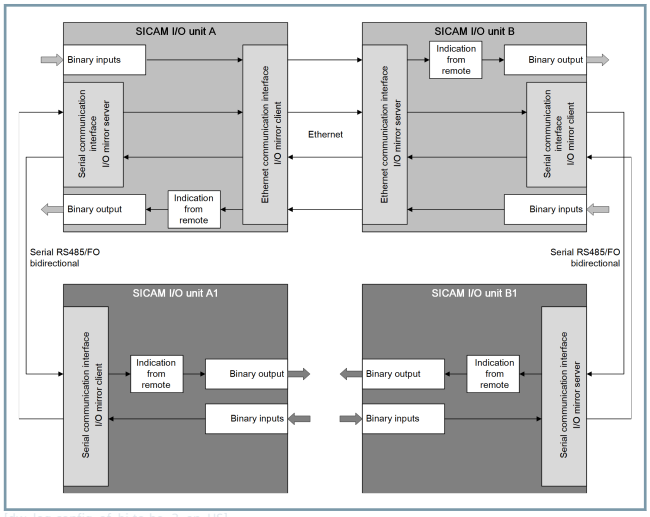
[dw_io-Mirror_unidirect-trans-sicam-io-unit, 3, en_US]

Figure 9.1/3 Binary Signal Transmitters, Unidirectional Transmission from One SICAM I/O-Unit to Several SICAM I/O Units

Binary signal transmitters with gateway function

The application shows 2 separate bidirectional binary signal transmissions. The main application is the following constellation:

- Due to EMC environments, one SICAM I/O-Unit is to be installed, for example, in the switch bay and connected via a serial optical fiber.
- The optical fiber arrives in a central communication room and is to be converted to electrical Ethernet. This is implemented via SICAM I/O-Units as a serial gateway server. The logic structure is described in *Figure 9.1/4*.



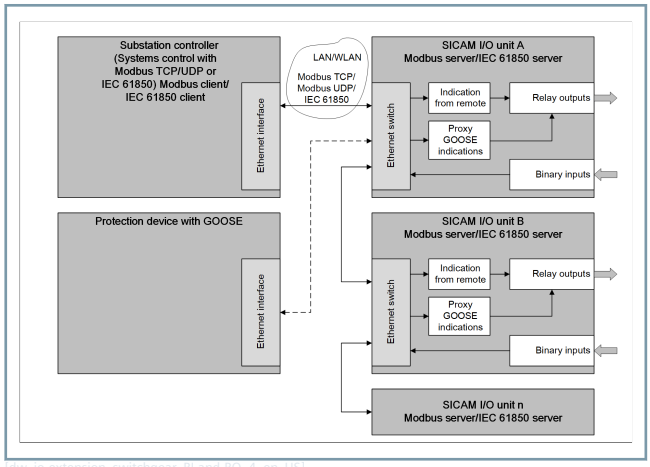
[dw_log-config_of_bi-to-bo, 3, en_US]

Figure 9.1/4 Logical Structure of Two Separate Binary Signal Transfers from Binary Input (BI) to Binary Output (BO) between Corresponding SICAM I/O Units A1 and B1, Using the Gateway Function of the Units A and B

In this structure, only the pair A-B and the pair A1-B1 exchange the states of their binary inputs to the binary outputs. Here, the SICAM I/O-Units A1 and B1 use the gateway function of devices A and B.

I/O extension of protection devices or direct connection to a station control or power systems control via Ethernet. Protocols: IEC 61850 GOOSE/Reporting/MMS, Modbus TCP/UDP

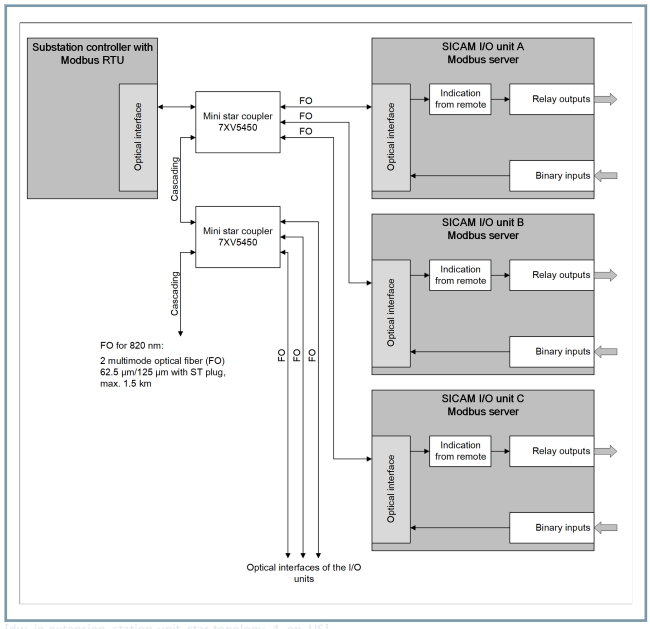
The SICAM I/O-Unit is used as I/O extension in accordance with *Figure 9.1/5*. Binary signals are exchanged between a substation controller of the automation substation as Modbus or IEC 61850 client, such as SICAM PAS/SCC, SICAM RTUs or Spectrum Power - CC or a protection device, such as SIPROTEC with GOOSE, SIPROTEC Compact (also directly, proprietary) and the SICAM I/O-Units via an Ethernet network. If the integrated switch in the SICAM I/O-Unit is used, the devices can be operated in a line without an additional external switch.



[dw_io-extension_switchgear_BI-and-BO, 4, en_US]

Figure 9.1/5 I/O Extension of Switchgear with Binary Inputs and -Outputs

Instead of an Ethernet network, a serial connection with the protocol Modbus RTU can also be used. The connection can be made by an RS485 bus line or an optical star topology.



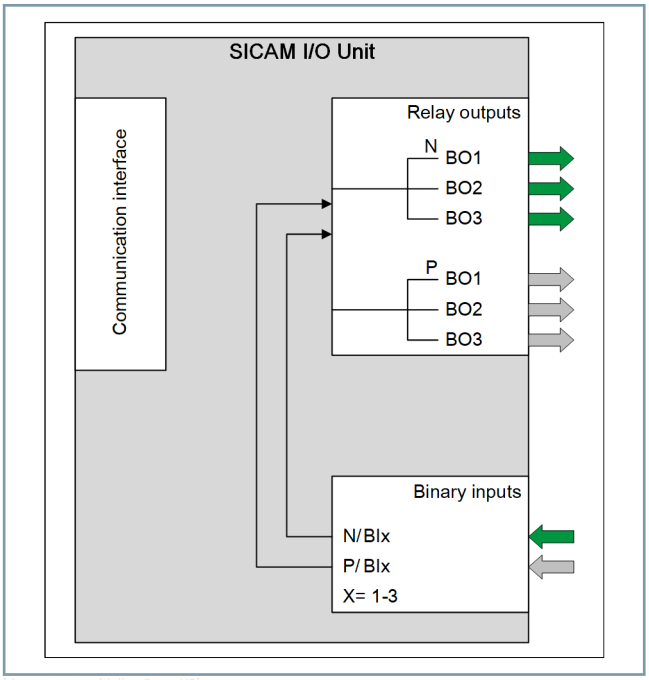
[dw_io-extension_station-unit_star-topology, 4, en_US]

Figure 9.1/6 I/O Extension for the Connection to the Substation Controller with Serial, Optical Star Topology

Contact duplicator

Input signals at one or more binary inputs can be allocated to binary outputs of the local unit (*Figure 9.1/7*).

- 1 binary signal at up to 6 relay outputs
- Several binary signals to several relay outputs that can be assigned
- Different voltage levels for inputs and outputs in a wide voltage range to isolate different voltage levels



[dw_contact-multiplier, 3, en_US]

Figure 9.1/7 Contact Duplicator

Applications for the Teletransmission of Binary Signals

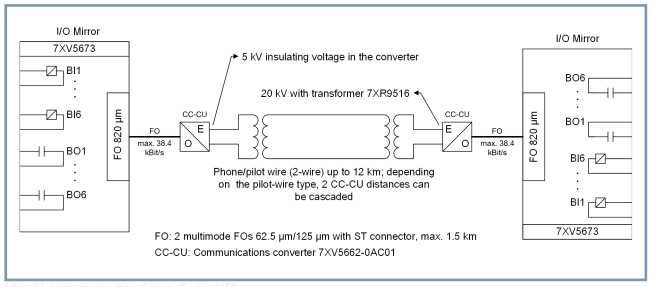
Binary Signal Transmission via Two-Wire Copper Line with Locking

Figure 9.1/8 shows the optical fiber connection of a SICAM I/O-Unit to a communication converter 7XV5662-0AC03, that establishes a connection via pilot wires. Only 1 pair is required for bidirectional signal exchange.

An additional isolating transformer allows 20 kV isolation of the pilot wire connection.

A maximum of 6 individual binary signals can be transmitted bidirectionally via the pilot wires. The additional time delay that is caused by the transmission via the communication converter and the pilot wires is less than 1 ms.

A typical application is the permissive overreach transfer trip scheme of a directional overcurrent protection via pilot wires. In this case, the independent overcurrent protection is connected to the SICAM I/O-Unit via contacts and binary inputs and directional signals are transmitted.



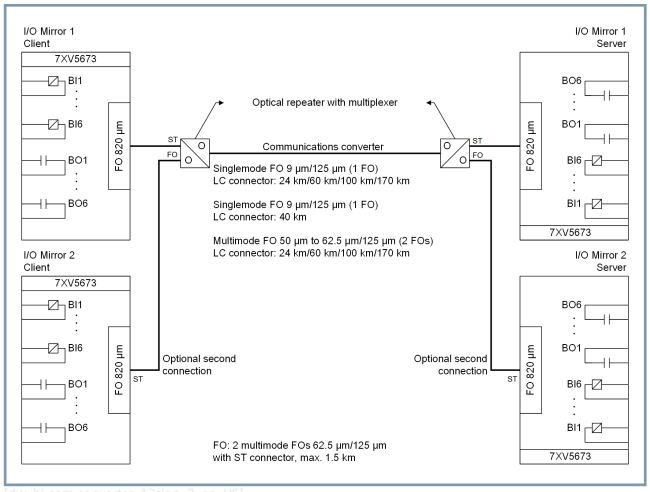
[dw_bi-com-converter_6sign, 5, en_US]

Figure 9.1/8 Binary Signal Exchange of 6 Signals via a Pilot Wire Connection

Binary Signal Exchange via Long Optical Fiber Connections

Figure 9.1/9 shows the optical fiber connection of a SICAM I/O-Unit to a serial optical repeater 7XV5461-0B_00, which establishes a connection to multi-mode or single-mode fiber-optic cables. With this application, a radius of up to 170 km can be attained without additional amplifiers.

A maximum of 12 binary signals can be exchanged via long optical fiber connections because the repeater allows the connection of 2 SICAM I/O-Units.

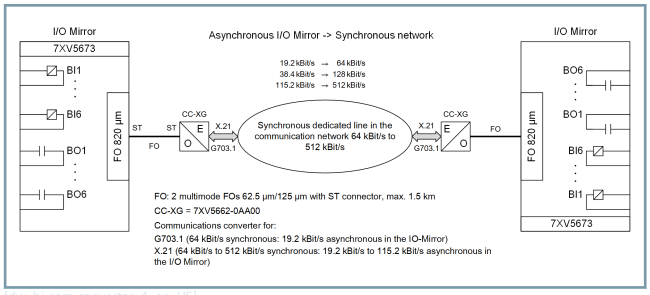


[dw_bi-com-converter_12sign, 3, en_US]

Figure 9.1/9 Binary Signal Exchange of Up to 12 Signals via Long Optical Fiber Connections

Transmission of Binary Signals via Communication Networks with a G.703.1-/X.21 Interface

Figure 9.1/10 shows the optical connection of a SICAM I/O-Unit to a communication converter (KU-XG) 7XV5662-0AA00, which establishes a connection with a multiplexer with G.703.1 or X.21 interface. In this way, this communication converter can be used to transmit the signals via a communication network. The average time delay in the network and the signal quality are monitored by the SICAM I/O-Unit. Furthermore, a connection loss is displayed. In this case, the state of the binary outputs can be set by the user to a secure state depending on the application. A maximum of 6 individual binary signals can be transmitted bidirectionally via the communication network.



[dw_bi-com-converter, 4, en_US]

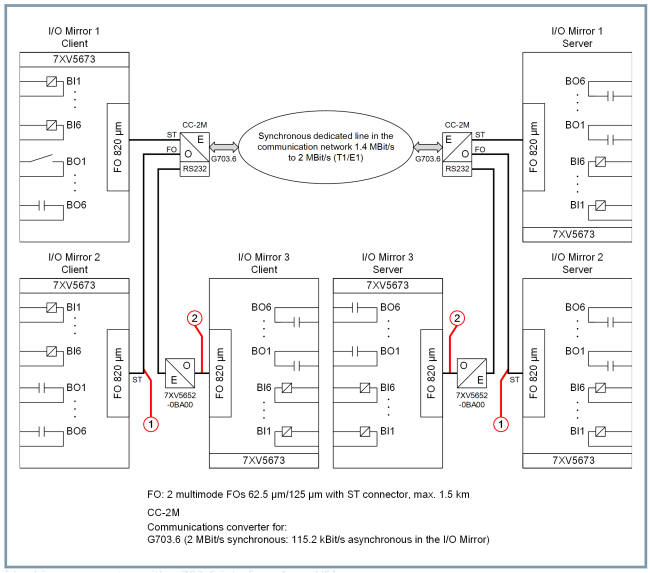
Figure 9.1/10 Binary Signal Exchange via a Communication Converter with a G.703.1-/X.21 Interface via a Communication Network

Transmission of Binary Signals via Communication Networks with a G.703.6 Interface

The application (*Figure 9.1/11*) shows the optical fiber connection of 1 to 3 SICAM I/O-Units to a communication converter KU-2M 7XV5662-0AD00, which establishes a connection to a multiplexer with a G.703.6 interface (1.44 Kbps/2 megabits/s, E1/T1).

A maximum of 18 individual binary signals can be transmitted bidirectionally via the communication network. The communica-

tion converter KU-2M has 2 optical interfaces and one electrical RS232 interface. 2 SICAM I/O-Units can be connected directly with the KU-2M via a fiber-optic cable. At the RS232 interface you can connect another SICAM I/O-Unit via an optoelectronic converter 7XV5652. With the use of all input interfaces (2 optical fibers, 1 RS232) of the KU-2M, a maximum of 18 signals can be bidirectionally exchanged.



[dw_bi-com-converter_with_g703-6-interface, 4, en_US]

Figure 9.1/11 Binary Signal Exchange with G.703.6 Interface via a Communication Network

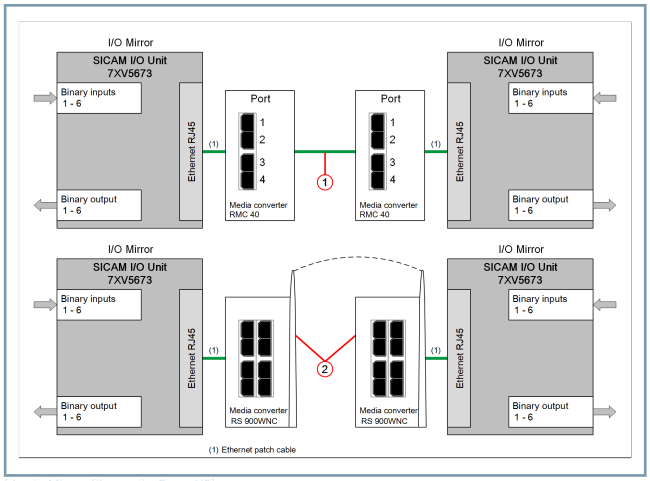
(1) Optional 2nd connection

(2) Optional 3rd connection

For dial-up network connections via Ethernet, media converters or Ethernet networks are used. The SICAM I/O-Unit supports IP address settings and settings for a standard gateway. The electrical Ethernet interface of the SICAM I/O-Unit is connected with one media converter or switch that transmits the signals of the devices via dial-up network connections with Ethernet. The average time delay in the network is measured by the SICAM I/O-Unit.

Binary Signal Transfer via Optical Fibers or Wireless Connection

The application (*Figure 9.1/12*) shows the electrical connection of a binary signal transmitter (BST) SICAM I/O-Unit 7XV5673 to Ethernet-based transmission units via patch cables that establish a connection via optical fibers or a wireless connection at the trunk line end. The connection could also be made via switches with long-distance modules or via IP networks.



[dw_io-Mirror_fiber-optic, 5, en_US]

Figure 9.1/12 Binary Signal Transmission via Optical Fiber or Wireless Connection; Connection via the Integrated Ethernet Interface to External Transmission Devices

(1) Optical-fiber transmission with media converter for Ethernet, for example RMC40 from Ruggedcom

(2) Wireless power transmission with media converter for Ethernet, for example RS900WNC from Ruggedcom

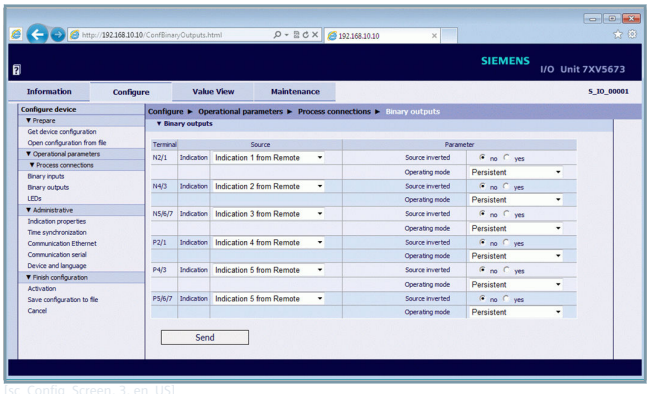
Typical application examples can be found in the Internet *www.siemens.com/sicam-io* -> Downloads.

Device Configuration

The SICAM I/O-Unit is equipped with an integrated Web server that simplifies the settings with the help of a standard Internet Web browser (Microsoft Internet Explorer). *Figure 9.1/13* shows the user interface. In the same way, operational logs and commissioning aids are supported by the browser such as display of the actual state of the inputs and outputs.

The SICAM I/O mapping tool is used to configure the IEC 61850 GOOSE.

As soon as the IEC 61850 GOOSE configuration is completed, the SICAM I/O mapping tool reads the corresponding SCD file and generates the binary IEC 61850 parameter set, which can be uploaded via HTML.



[sc_Config_Screen, 3, en_US]

Figure 9.1/13 Configuration Screen of the SICAM I/O-Unit in the Web Browser

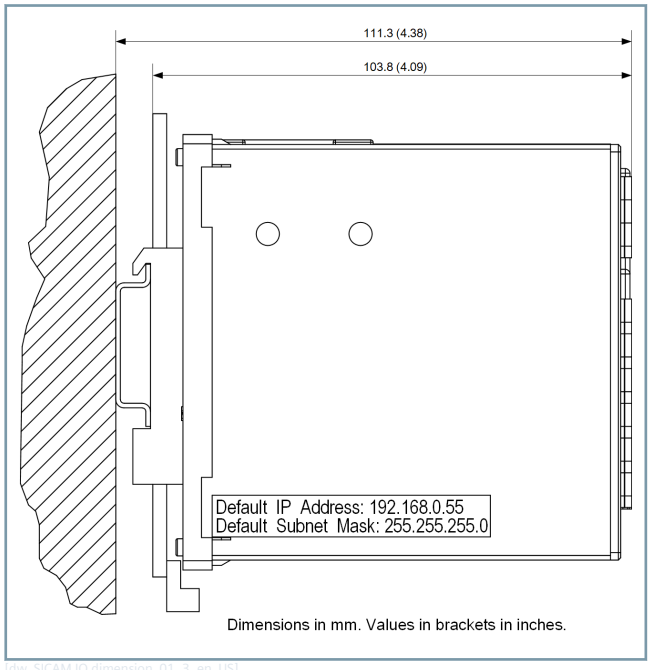
SICAM I/O-Unit – Selection and Ordering Data/Dimensioned Drawing

Selection and Ordering Data

Description	Order No.															
	1	2	3	4	5	6	7		8	9	10	11	12		13	14	15	16
SICAM I/O-Unit	7	X	V	5	6	7	3	–	0	J	J	□	0	–	□	A	A	1
												▲			▲			
Serial Interface and Communication Protocol												|			|			
Without serial communication												0			|			
RS485 – Modbus RTU, binary signal transmission												1			|			
Optical, 820 nm – Modbus RTU, binary signal transmission												2			|			
Ethernet Interface and Communication Protocol															|			
Ethernet interface with Modbus TCP/UDP, binary signal transmission															1			
Ethernet interface with Modbus TCP/UDP, binary signal transmission, and IEC 61850 server (GOOSE and reporting/MMS)															2			
Accessories																		
Y-bus cable (required for using the internal switch/cascading)	7	K	E	6	0	0	0	–	8	G	D	0	0	–	0	B	A	2
Device Type DIN rail device IP20; Dimensions 96 mm x 96 mm x 100 mm (W x H x D); Power supply: DC 24 to 240 V, AC 100 V to 230 V; Integrated Web server for parameterization; Ethernet interface RJ45 connector; integrated switch function; CE and UL approved *Inputs/Outputs* 6 binary inputs with selectable threshold voltage; 6 relay outputs (4 make contacts, 2 change-over contacts)																		

Table 9.1/1 SICAM I/O-Unit Selection and Ordering Data

Dimensional Drawing



[dw_SICAM IO dimension_01, 3, en_US]

Figure 9.1/14 Dimensions SICAM I/O-Unit 7XV5673

Description

The SICAM AI-Unit 7XV5674 is an analog input device (20 mA) that is used by power utilities in the field of substations and in the industrial sector where there are increased environmental demands. Besides analog signal input, the SICAM AI-Unit can compress the measured data by demand calculation, and can monitor and signal parameterized limiting values. Measured values and messages can be transferred to a protection device, to a SICAM I/O-Unit, or to a substation or power-system control for process automation. Interoperable standard protocols IEC 61850 GOOSE, Reporting/MMS, and Modbus RTU/TCP/UDP are used here. The SICAM AI-Unit is thus a practical external 20mA extension and a local or remote automation unit.

Inputs	12 x 20 mA for direct current measurements (in accordance with IEC 60688)
Insulated housing	96 mm x 96 mm x 100 mm (W x H x D) Assembly on a DIN rail
Degree of protection	IP20
Approval	CE and UL

[ph_SICAM AI Unit, 1, --_--]

Figure 9.2/1 SICAM AI-Unit 7XV5674

Benefits

- Wide field of application (SCADA, protection and automation processes) from swift and protected real-time applications to continuous long-term acquisition (24-h value):
  - Current measured value every 642 ms
  - 10 sec, 1 min, 1 hr, 24 hr demand calculation in the device. This on-site compression reduces the data volume that is to be transferred and processed (making handling mass data possible)
  - Independent on-site automation and monitoring unit with signaling of the parameterized limit violation conditions in the unit
- Connection to serial interfaces or Ethernet interfaces of SIPROTEC 4 or SIPROTEC 5 devices
- Connection to all protection and bay devices via IEC 61850-GOOSE messages and IEC 61850 reporting
- Compact and robust design (-25°C to 70°C operating temperature)
- Flexible communication options (Ethernet, optical fiber or RS485 electrical)
- Modbus RTU/TCP, SIPROTEC 20-mA, serial or Ethernet connection to SIPROTEC 5 devices via SUP protocol
- Precise process measurement (0.2% with reference conditions)
- Time synchronization via NTP (support of 2 time servers, fieldbus (Modbus RTU/TCP), IEC 61850, PC, internal RTC
- Cost saving with integrated Ethernet switch permits a chain structure to be built up (cascading with Y adaptor 7KE6000-8GD00-0BA2)
- Web server for parameterization with an IWeb browser. No special parameterization software necessary
- 4 LEDs for different parameterizable messages/alarms
- 4 freely parameterizable group indications
- Battery-backed real-time clock (RTC) and message logs (can be exported as .csv)
- Binary message and alarm stamp exact to 1 ms
- Simulation of input signals for easier system commissioning (IBS)
- Comparison of redundant measured data from different SICAM AI - units is possible due to the simultaneous start of the average value window generation
- Integrated communication and device supervision

Applications

The SICAM AI-Unit supports various applications. It can be used in the following sections for the acquisition of DC field signals:

- Power system protection
- SCADA (station and power systems control)
- DMS (Distribution Management System)
- EMS (Energy Management System)
- GIS (Gas-insulated switchgear) – gas pressure monitoring
- Other industrial processes
- Modernization of old plants: Automation/interface to old 20 mA technology (for example, 7SA511/513 issuing the fault location)

The currents from the connected transducers (such as temperature, pressure or position sensors) can be transferred via the supporting communication protocols automation processes for further processing (such as visualization). See also *Figure 9.2/2*.

The DC inputs of the SICAM AI-Unit can be parameterized for the following ranges:

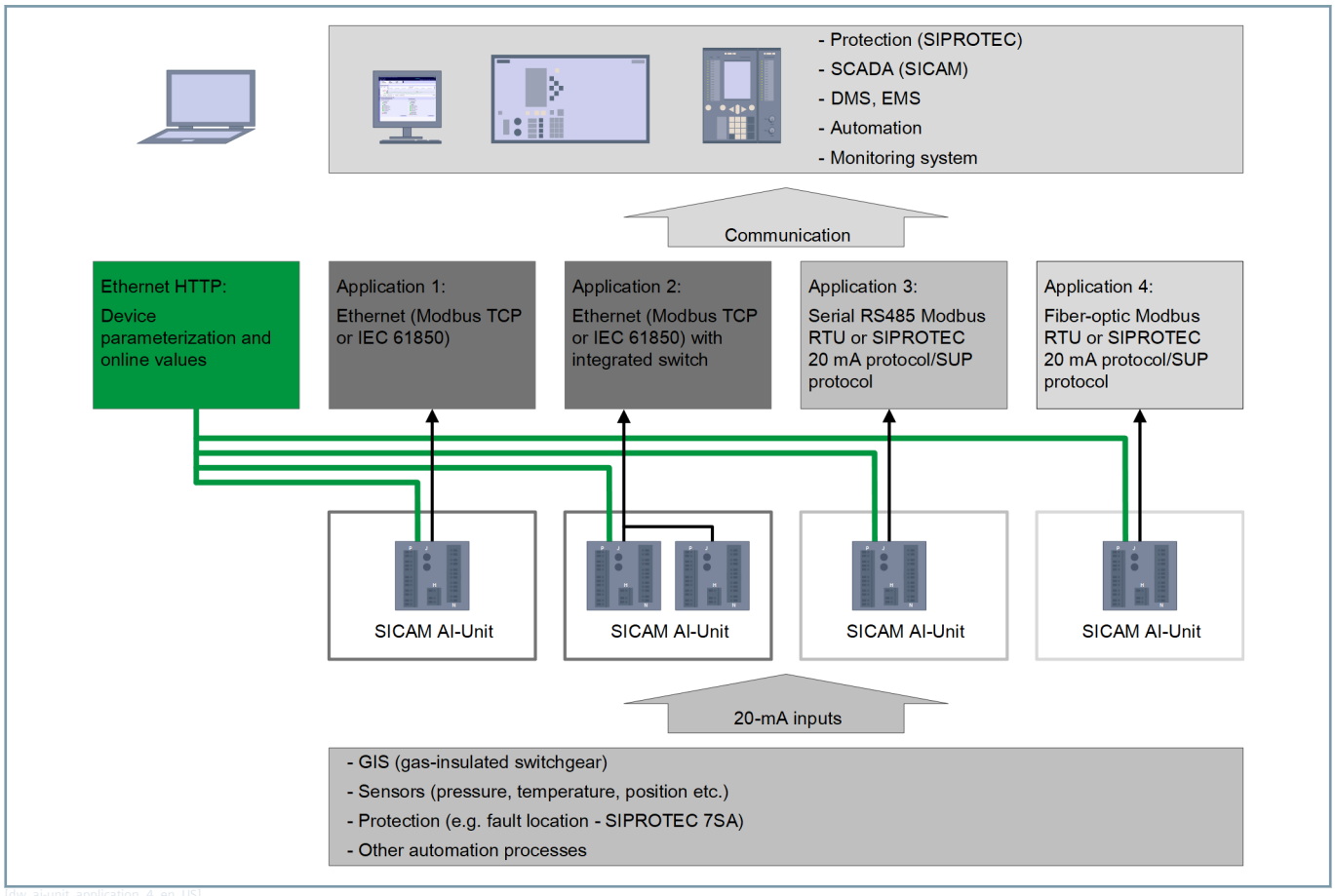
- 0 mA to 20 mADC
- 4 mA to 20 mADC

SICAM AI-Unit – Description

The measuring accuracy is 0.2% of the rated current (20 mA) at reference conditions. Under environmental influence (including EMC), the measuring accuracy is 1.0% of the rated current (20 mA).

With the integrated Web server, parameterization is carried out by means of HTML pages with the use of a Web browser.

Typical applications can be found on the Internet *www.siemens.com/sicam-ai* -> Downloads



{dw_ai-unit_application, 4, en_US}

Figure 9.2/2 Application Example

Measured quantities

The SICAM AI-Unit permits only direct current to be measured. The measurement cycles on both PCB assemblies are carried out at the same time. A complete measuring cycle via 6 channels takes 642 ms. The measurement of a channel takes 107 ms and is repeated after 642 ms. Using the Internet browser, the measured current, 10 second, minute, hour, and day average values of all channels can directly be viewed and measured by the device, and transferred via communication protocols, together with messages (such as limit violation conditions).

Limit settings

Up to 16 limit violations of current measured values in both directions can be set via the **automation functions** menu. Limit violation conditions of the upper and lower range of values can be indicated as an individual or group indication on 3 LEDs. The parameters of 4 group indications can be set, wherein each indication can be assigned up to 16 logically linked single-point indications.

Communication

To communicate with the substation controller / protection device and the other peripheral devices, the SICAM input measuring device has an Ethernet interface and optionally a serial interface (RS485 or optical).

The ordering options for communication via Ethernet are:

- With integrated Ethernet switch: Modbus TCP protocol
- With integrated Ethernet switch: Modbus TCP protocol **and** IEC 61850 protocol

The following functions are supported via Ethernet:

- Connection to SIPROTEC 5 devices via SUP (Slave Unit Protocol)
- Device parameterization
- Transmission of measured data
- Transmission of messages
- Time synchronization via NTP

- Communication protocols Modbus TCP and IEC 61850 (reporting and GOOSE)
- Integrated Ethernet switch

With the Ethernet switch integrated in the device, further network components can be cascaded via a Y-cable and hence also included in an available network with IEC 61850 or a further Ethernet protocol.

- Serial interface
  - With RS485 interface
  - With optical interface
- Communication with existing RS485 or optical 820 nm interface
  - With the Modbus RTU protocol and SIPROTEC RTU protocol 20 mA/SUP (Slave Unit Protocol)

The serial interface supports the following functions:

- Transmission of measured data
- Transmission of messages
- Time synchronization via Modbus RTU

When selecting the serial interface, either Modbus RTU or the SIPROTEC RTU 20 mA/SUP (Slave Unit Protocol) communication protocol can be used.

Time synchronization

During operation, the SICAM AI-Unit needs the date and time for all time-relevant processes. In communication with peripheral devices, this ensures a uniform time base and allows correct time stamping of the process data.

The following types of time synchronization can be carried out:

- External time synchronization via Ethernet NTP (preferred)
- External time synchronization via Fieldbus with communication protocol Modbus RTU
- Internal time synchronization via RTC (Real-Time Clock) – if external time synchronization is unavailable

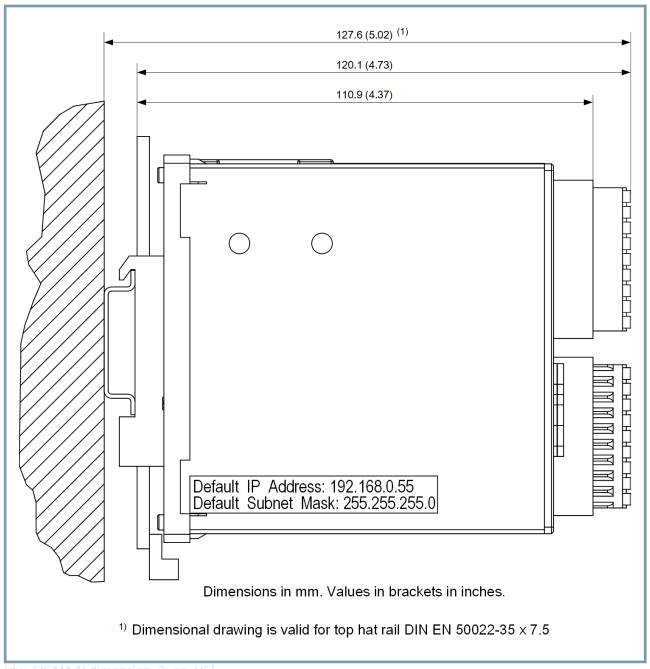
LED indications

The SICAM AI-Unit automatically monitors communication connections and the functions of its hardware/software/firmware components. The LEDs on the top of the housing signal the current state of the device. They can be parameterized for individual or group indication.

Parameterization

No special software is required for parameterization. Parameter setting is carried out by the computer via HTML pages and a Web browser. Internet Explorer 6 (or higher) is necessary for this purpose.

Dimensional Drawing



{dw_SICAM AI dimension, 3, en_US}

Figure 9.2/3 Dimensions of the SICAM AI-Unit 7XV5674

Selection and Ordering Data

Description	Order no.															
	1	2	3	4	5	6	7		8	9	10	11	12		13	14	15	16
SICAM AI-Unit	7	X	V	5	6	7	4	–	0	K	K	□	0	–	□	A	A	1
												▲			▲			
Serial Interface and Communication Protocol												|			|			
Without serial communication												0			|			
RS485 – Serial Modbus RTU and SIPROTEC 20 mA protocol/point-to-point connection												3			|			
FO 820 nm, ST connector – serial Modbus RTU and SIPROTEC 20 mA protocol/point-to-point connection												4			|			
Ethernet Interface and Communication Protocol															|			
Ethernet interface with Modbus TCP															1			
Ethernet interface with Modbus TCP and IEC 61850 server (GOOSE and reporting/MMS)															2			
Accessories																		
Y-bus cable (required for using the internal switch/cascading)	7	K	E	6	0	0	0	–	8	G	D	0	0	–	0	B	A	2
Device Type DIN rail device, IP20; 12 x 20-mA inputs for example SIPROTEC-/SICAM units; Dimensions: 96 mm x 96 mm x 100 mm (WxHxD); Power supply: DC 24 to 240 V, AC 100 V to 230 V; Ethernet interface, RJ45 connector; integrated switch function; integrated Web server for parameterization; CE and UL approved																		

Table 9.2/1 SICAM AI-Unit Selection and Ordering Data

Indication of conformity

CE

This product complies with the directive of the Council of the European Communities on harmonization of the laws of the Member States concerning electromagnetic compatibility (EMC Directive 2014/30/EU), restriction on usage of hazardous substances in electrical and electronic equipment (RoHS Directive 2011/65/EU), and electrical equipment for use within specified voltage limits (Low Voltage Directive 2014/35/EU).

This conformity has been proved by tests performed according to the Council Directive in accordance with the product standard EN 60255-26 (for EMC directive), the standard EN IEC 63000 (for RoHS directive), and with the product standard EN 60255-27 (for Low Voltage Directive) by Siemens.

The device is designed and manufactured for application in an industrial environment.

The product conforms with the international standards of IEC 60255 and the German standard VDE 0435.

Disclaimer of Liability

Subject to changes and errors. The information given in this document only contains general descriptions and/or performance features which may not always specifically reflect those described, or which may undergo modification in the course of further development of the products. The requested performance features are binding only when they are expressly agreed upon in the concluded contract.

Copyright

Trademarks

SIPROTEC, DIGSI, SIGRA, SIGUARD, SICAM, and MindSphere are trademarks of Siemens. Any unauthorized use is prohibited.

OpenSSL

This product includes software developed by the OpenSSL Project for use in OpenSSL Toolkit (*http://www.openssl.org/*).

This product includes software written by Tim Hudson (*tjh@cryptsoft.com*).

This product includes cryptographic software written by Eric Young (*eay@cryptsoft.com*).

Published by
Siemens AG

Smart Infrastructure
Electrification & Automation
Mozartstrasse 31c 91052
Erlangen, Germany

For more information, please contact
Phone: +49 9131 1743072
Email: support.ea.si@siemens.com
Web: siemens.com/reyrolle

For the U.S. published by
Siemens Industry Inc.

3617 Parkway Lane
Peachtree Corners, GA 30092
United States

We create technology to transform the everyday, for everyone. Our world is changing at an unprecedented rate. Demographic change, urbanization, glocalization, environmental change, resource efficiency, and digitalization are presenting new challenges and opportunities.

Siemens Smart Infrastructure addresses these topics by combining the real and the digital worlds.

Our technology transforms infrastructure, across buildings, electrification, and grids, at speed and scale, enabling collaborative ecosystems to accelerate our customers' digital journey to become more competitive, more resilient, and more sustainable.

siemens.com/smart-infrastructure

Article no. SIEA-C10132-00-7600 (Status 11.2025)