Highlights V7.9 and V8.0

• SIPROTEC DigitalTwin
• Compatibility of SIPROTEC 4 and SIPROTEC 5 for 87L and 21
• IEC 61850-9-2 Process bus for digital substations (Server/Client)
• SIPROTEC 6MU85 Merging Unit
• Time synchronization with IEEE 1588 for High Precision applications
• SIPROTEC 7SS85 distributed busbar protection based on process bus
• Point-on-wave switching
• Conformal coating of SIPROTEC 5 devices as standard
• Cyber Security
• ATEX certification for 7SK85 and 7UM85
• New overcurrent and feeder protection SIPROTEC 7SJ81
• Web Browser
• Further functions
SIPROTEC 5 –
The benchmark for protection, automation and monitoring

SIPROTEC 5 –
A flexible generation of intelligent, digital field devices with a high degree of modularity

Individually configurable devices –
Save money over the entire life cycle

Trendsetting system architecture –
Flexibility and safety for all kind of grids

Multi-layered integrated safety mechanism –
Highest possible level of safety and availability

Consistent system and device engineering –
Efficient operating concepts, flexible engineering
SIPROTEC – Proven solution for all applications

- 7SJ8  Overcurrent and feeder protection
- 7SA8  Distance protection
- 7SD8  Line differential protection
- 7SL8  Combined line differential & distance protection
- 7UT8  Transformer differential protection
- 7VE8  Paralleling device
- 7SS85 Busbar protection
- 7SK8  Motor protection
- 7VK8  Breaker management
- 7UM85 Generator protection
- 6MD8  Bay controller
- 7KE85 Fault recorder
- 6MU85 Merging unit

Easy engineering and evaluation – DIGSI and SIGRA
Highlights V7.9 and V8.0

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SIPROTEC DigitalTwin

Application Scenarios

Control Center
Integration in SICAM Systems

Station Level
Firewall

SICAM Substation Automation
PAS

SICAM Human Machine Interface
SCC

SICAM Power Quality Analysis
POS

DIGSI 5 Online Testing

Station bus

Communication

Field Level
GOOSE Testing

Field Simulation Device Testing Device Training

Remote Substation
Testing of protection interface

Process Level

Process Simulation Device Testing Device Training
Saves time, increases quality throughout the entire lifecycle of your system

**Maintenance and Service**
- Fault analysis
- COMTRADE replay
- Upgrade scenarios

**Training**
- Device handling
- Operators
- Customer specific
- Flexible at any place

**Operation**
- Device handling
- COMTRADE replay

**Commissioning**
- FAT
- SAT, Field test
- Fault analysis

**Pre-sales and Design**
- Information and Presentations
- Application concept and testing
- Design Specification
- Approvals

**Implementation**
- Planning
- Algorithm
- Settings
- Pre-testing
Benefits –
The customer value proposition

Testing of the energy automation system within minutes, without hardware and without additional effort

• Simulation and validation of product properties
• Faster energization of new systems thanks to shorter project lifetimes
  • Increase engineering quality
  • Virtual testing before start of commissioning
  • Shortest commissioning times
• Reduced OPEX with shorter outages for higher availability thanks to better pre-testing
• Efficient, scalable trainings on the job
• Fast and realistic fault analysis by easily reproducing the behavior of products and systems
Access your SIPROTEC DigitalTwin in 5 Steps

1. Open DIGSI 5 project
2. Export SIM file
3. Connection to the Cloud
4. Import SIM
5. SIPROTEC DigitalTwin
Login to the SIPROTEC DigitalTwin

Supported by all major Webbrowsers
Visualize and interact with the simulated device – Device operation

- Device view
- Operating via SIPROTEC 5 operation panel
- Testing all protection algorithms
- Testing of automation logic (CFC)
- Interaction of several devices
Visualize and interact with the simulated device – Analog values

- Injection of process data (V/I)
- Setting of equal amplitudes for 3 phases
- Settings of the symmetrical phases
- Automatically calculation of V4, I4, I4
- Visualization of the vectors
- Definition of binary and analog profiles
Highlights V7.9 and V8.0

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- Further functions
Interoperability of SIPROTEC 4 and SIPROTEC 5
Line protection – Profile

<table>
<thead>
<tr>
<th>Requirement</th>
<th>Solution</th>
<th>Function</th>
<th>Benefits</th>
</tr>
</thead>
<tbody>
<tr>
<td>• Replacement of protection devices after end of live&lt;br&gt;• New devices to be added to the protection topology&lt;br&gt;• Stepwise replacement or retrofit of SIPROTEC 4 protection devices</td>
<td><img src="image1" alt="Diagram of SIPROTEC devices" />  <img src="image2" alt="Diagram of SIPROTEC devices" /> <img src="image3" alt="Diagram of SIPROTEC devices" /></td>
<td>• Modules changeable and upgradeable&lt;br&gt;• Range extension via additional repeater&lt;br&gt;• Monitoring of protection interface transfer quality&lt;br&gt;• Remote commands and signals via protection interface</td>
<td>• Mixed operation SIPROTEC 4 and SIPROTEC 5&lt;br&gt;• Step-by-step replacement and expansion of individual substations&lt;br&gt;• Line differential protection of other systems remains in operation&lt;br&gt;• Short switch-off time during conversion&lt;br&gt;• Use of existing communication links</td>
</tr>
<tr>
<td>• Direct interoperable connection of SIPROTEC 5 and SIPROTEC 4 protection interfaces&lt;br&gt;• 2 – 6 line end differential protection&lt;br&gt;• Distance protection: PUTT or POTT teleprotection&lt;br&gt;• Transformer within protection zone</td>
<td>PUTT: Permissive Underreaching Transfer Trip&lt;br&gt;POTT: Permissive Overreaching Transfer Trip</td>
<td>• Mixed operation SIPROTEC 4 and SIPROTEC 5&lt;br&gt;• Step-by-step replacement and expansion of individual substations&lt;br&gt;• Line differential protection of other systems remains in operation&lt;br&gt;• Short switch-off time during conversion&lt;br&gt;• Use of existing communication links</td>
<td>• Mixed operation SIPROTEC 4 and SIPROTEC 5&lt;br&gt;• Step-by-step replacement and expansion of individual substations&lt;br&gt;• Line differential protection of other systems remains in operation&lt;br&gt;• Short switch-off time during conversion&lt;br&gt;• Use of existing communication links</td>
</tr>
</tbody>
</table>

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Page 14 July 2019
Interoperability of SIPROTEC 4 and SIPROTEC 5
Example 1 – stepwise retrofit of protection relays
Interoperability of SIPROTEC 4 and SIPROTEC 5
Example 1 – stepwise retrofit of protection relays

Station 1

Station 2

Device logoff

Device logon

Station 3

Station 4
Interoperability of SIPROTEC 4 and SIPROTEC 5
Example 1 – stepwise retrofit of protection relays

Station 1

Station 2

Station 3

Station 4

Device logoff

Device logon
Interoperability of SIPROTEC 4 and SIPROTEC 5
Example 1 – stepwise retrofit of protection relays
Interoperability of SIPROTEC 4 and SIPROTEC 5

Example 2 – extension of tapped line

Station 1

Device logoff

Station 2

Device logoff
Interoperability of SIPROTEC 4 and SIPROTEC 5
Example 2 – extension of tapped line
Interoperability of SIPROTEC 4 and SIPROTEC 5
Communication infrastructure

**Customer requirement**

- **USART-AD1FO / USART-AE2FO**
  - Distances of more than 100 km
  - Distances up to 60 km
  - Distances up to 100 km
  - All media between communication converters 7XV5662, e.g. pilot wire, G703, X21
Highlights V7.9 and V8.0

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Digital Substation 4.0

Benefits

• Flexible solutions for different level of digitalization
• Process bus closes the gap to a fully digitalized system
• Agile for future requirements
• Digitalization of all primary data close to the process
• Data for optimizing grid control and monitoring
• Remote engineering and testing
### Digital Substation 4.0
### Process Bus Overview

#### Protocol on ETH-BD-2FO

<table>
<thead>
<tr>
<th></th>
<th>MU</th>
<th>PB Client</th>
<th>PTP (1 µs acc.)</th>
</tr>
</thead>
<tbody>
<tr>
<td>7SA86, 7SA87</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
</tr>
<tr>
<td>7SD86, 7SD87</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
</tr>
<tr>
<td>7SL86, 7SL87</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
</tr>
<tr>
<td>7VK87</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
</tr>
<tr>
<td>7UT85, 7UT86, 7UT87</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
</tr>
<tr>
<td>7SK85</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
</tr>
<tr>
<td>7UM85</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
</tr>
<tr>
<td>7VE85</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
</tr>
<tr>
<td>7SS85</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
</tr>
<tr>
<td>7SJ85, 7SJ86</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
</tr>
<tr>
<td>6MD85, 6MD86</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
</tr>
<tr>
<td>6MU85</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
</tr>
<tr>
<td>7KE85</td>
<td>✗</td>
<td>✓</td>
<td>✓</td>
</tr>
<tr>
<td>7SJ81, 7Sx82 (non modular)</td>
<td>✗</td>
<td>✗</td>
<td>✗</td>
</tr>
<tr>
<td>7ST85, 6MD89</td>
<td>✗</td>
<td>✗</td>
<td>✗</td>
</tr>
</tbody>
</table>

**MU:** Merging Unit functionality – Sampled Measured Value server

**PB Client:** Process Bus Client – Sampled Measured Value client

**PTP:** Precision Time Protocol according to IEEE 1588v2/PTP with 1µs accuracy
SIPROTEC Merging Unit
One base module adapts to all sensor types

Principle of a Process Bus

- Stand-Alone merging unit
- Copper wires via short distances
- Digital interface for instrument transformers IEC 61869-9

- Merging unit as part of switchgear
- Low power stand alone current, voltage and combined sensors
- IEC 61869-10 and 11

* In preparation
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- Further functions
SIPROTEC 5 Merging Unit – Perfectly tailored fit to your requirements (examples shown)

<table>
<thead>
<tr>
<th>Aux-PS</th>
<th>Single</th>
<th>Redundant*</th>
</tr>
</thead>
<tbody>
<tr>
<td>CT</td>
<td>4 Rogowski</td>
<td>12 PCIT</td>
</tr>
<tr>
<td>VT</td>
<td>4 C devider</td>
<td>4 MCIT</td>
</tr>
<tr>
<td>BI</td>
<td>19</td>
<td>111</td>
</tr>
<tr>
<td>BO-STD</td>
<td>9</td>
<td>91</td>
</tr>
<tr>
<td>BO-HS</td>
<td>4</td>
<td>8</td>
</tr>
</tbody>
</table>

4 … 20 mA 4

<table>
<thead>
<tr>
<th>Aux-PS</th>
<th>Redundant*</th>
<th>Single</th>
</tr>
</thead>
<tbody>
<tr>
<td>CT</td>
<td>8 PCIT</td>
<td>8 optical*</td>
</tr>
<tr>
<td>VT</td>
<td>4 CIT</td>
<td>8 CIT</td>
</tr>
<tr>
<td>BI</td>
<td>35</td>
<td>11</td>
</tr>
<tr>
<td>BO-STD</td>
<td>15</td>
<td>7</td>
</tr>
<tr>
<td>BO-HS</td>
<td>8</td>
<td>4 … 20 mA 4</td>
</tr>
<tr>
<td>RTD</td>
<td>12</td>
<td></td>
</tr>
</tbody>
</table>

PCIT … Protection CIT, MCIT … Measurement CIT

* in preparation

Perfectly tailored fit

- Adoptable to multiple CT, VT, LPIT inputs
- Scalable BI and BO
- Direct “high speed” tripping of circuit breaker < 1 ms
- Collection of additional data (temperature, pressure, tap changer positions, …)
- Redundant power supply*
- Expendable by a 2nd row
SIPROTEC 5
Merging Unit functionality

• Ethernet communication module **ETH-BD-2FO** for process bus functionality required
• One Sampled Measured Value (SMV) stream per ETH-BD-2FO Ethernet module
  - up to 32 analog values in any combination of CT and VT
  - or 4x CT, 4x VT (IEC 61850-9-2LE)

• Up to 4 **ETH-BD-2FO** modules supported

• IEC 61869-9, IEC 61869-13 compliant
• IEC 61850-8-1 GOOSE, MMS and Merging Unit protocol on the same Ethernet module

• Sample synchronization via IEEE 1588v2/PTP

• Engineering with DIGSI 5 and IEC 61850 System Configurator
SIPROTEC 5
Process Bus Client

- Ethernet communication module **ETH-BD-2FO** necessary
- Up to 32 analog values per ETH-BD-2FO (up to 80\(^1\)) using 3x ETH-BD-2FO)

- Support of IEC 61850-9-2LE streams
- Support of IEC 61869 flexible streams
- IEC 61850-8-1 GOOSE, MMS and Process Bus Client protocol on the same module

- Supported protection functions 87B, 87L, 87T, 21, 67/67N, 50/50N, 51/51N, … 2)
- Test- and Simulation Bit support
- Sample synchronization for mixed configurations of direct connected instrument transformers and sampled measured values via IEEE 1588v2/PTP
- Interoperability with multivendor merging units 3)

- Engineering with DIGSI 5 and IEC 61850 system configurator

---

1) Limitations: network bandwidth of 100Mbit/s, limitation of 40 analog values per SIPROTEC 5 device (except 7SS85 limit of 80 values)
2) 87L supports two terminals
3) Interoperability is regulated in IEC 61850-9-2 Edition 2.1 (not published at this time), use of 3rd party MU must be coordinated with DG SA&P headquarter

---

**Availability of Process Bus Client functionality**

<table>
<thead>
<tr>
<th>PB Client</th>
<th>7SA86, 7SA87</th>
<th>✓</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>7SD86, 7SD87</td>
<td>✓</td>
</tr>
<tr>
<td></td>
<td>7SL86, 7SL87</td>
<td>✓</td>
</tr>
<tr>
<td></td>
<td>7VK87</td>
<td>✓</td>
</tr>
<tr>
<td></td>
<td>7UT85, 7UT86, 7UT87</td>
<td>✓</td>
</tr>
<tr>
<td></td>
<td>7SK85</td>
<td>✓</td>
</tr>
<tr>
<td></td>
<td>7UM85</td>
<td>✓</td>
</tr>
<tr>
<td></td>
<td>7VE85</td>
<td>✓</td>
</tr>
<tr>
<td></td>
<td>7SS85</td>
<td>✓</td>
</tr>
<tr>
<td></td>
<td>7SJ85, 7SJ86</td>
<td>✓</td>
</tr>
<tr>
<td></td>
<td>6MD85, 6MD86</td>
<td>✓</td>
</tr>
<tr>
<td></td>
<td>6MU85</td>
<td>✓</td>
</tr>
<tr>
<td></td>
<td>7KE85</td>
<td>✓</td>
</tr>
<tr>
<td></td>
<td>7SJ81, 7Sx82 (non modular)</td>
<td>☓</td>
</tr>
<tr>
<td></td>
<td>7ST85, 6MD89</td>
<td>✗</td>
</tr>
</tbody>
</table>
SIPROTEC 5 Process bus example
Physically network segregation example

Simplify complexity
Use of more than one redundant process bus network reduces the network engineering

Increase the bandwidth with additional Ethernet interfaces

Efficient use of network bandwidth with customization of the analog values per SMV streams (not only IEC 61850-9-2LE data set)
Central Protection for small substations

Process Bus (PRP)

Central Protection with 7SS85

IEEE 1588v2 / PTP GMC
Samplesynchronisation
Central Protection for small substations and Line Protection

Central Protection with 7UT87

Sample synchronisation

IEEE 1588v2 / PTP GMC

Process Bus (PRP)

PI

FG Line

FG Transf. side 1

FG Transf. side 2

FG Transf.

FG Circuit Breaker 1

FG Circuit Breaker 2

FG Circuit Breaker 3

FG Circuit Breaker 4

6MU85

6MU85

6MU85

6MU85

PI

CTRL

CTRL

CTRL

CTRL

CTRL

CTRL

CTRL

CTRL
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SIPROTEC 5
New Ethernet module – ETH-BD-2FO

Communication module for the transmission of Ethernet protocols via 2 optical interfaces

Supports modular SIPROTEC 5 devices 7xx85/86/87*

Available protocols (DIGSI 5 V7.90)
- PRP
- Line Mode
- IEC 61850-8-1 GOOSE, MMS
- COMFEDE support via MMS file transfer
- IEEE 1588v2/PTP (1µs accuracy) ordinary slave clock for radial networks (PRP and Line Mode)
- DIGSI 5 protocol
- DCP, DHCP
- Homepage
- WebUI
- SysLog
- RADIUS

Additional protocols (DIGSI 5 V8.00)
- Process Bus Client
- Merging Unit

<table>
<thead>
<tr>
<th>Connector type</th>
<th>2 x duplex LC</th>
</tr>
</thead>
<tbody>
<tr>
<td>Wavelength</td>
<td>λ = 1300 nm</td>
</tr>
<tr>
<td>Baud rate</td>
<td>100 Mbit/s</td>
</tr>
<tr>
<td>Max. line length</td>
<td>2 km for 62.5 µm/125 µm optical fibers</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Transmit Power</th>
<th>Minimum</th>
<th>Typical</th>
<th>Maximum</th>
</tr>
</thead>
<tbody>
<tr>
<td>50 µm/125 µm, NA1 = 0.2</td>
<td>-24.0 dBm</td>
<td>-21.0 dBm</td>
<td>-17.0 dBm</td>
</tr>
<tr>
<td>62.5 µm/125 µm, NA1 = 0.275</td>
<td>-20.0 dBm</td>
<td>-17.0 dBm</td>
<td>-14.0 dBm</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Receiver sensitivity</th>
<th>Maximum -12.0 dBm</th>
<th>Minimum -31.0 dBm</th>
</tr>
</thead>
<tbody>
<tr>
<td>Optical budget</td>
<td>Minimum 7.0 dB for 50 µm/125 µm, NA1 = 0.2</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Minimum 11.0 dB for 62.5 µm/125 µm, NA1 = 0.275</td>
<td></td>
</tr>
<tr>
<td>Interface design</td>
<td>Corresponds to IEEE 802.3, 100Base-FX</td>
<td></td>
</tr>
<tr>
<td>Laser class 1 as per EN 60825-1-2</td>
<td>With the use of 62.5 µm/125 µm and 50 µm/125 µm optical fibers</td>
<td></td>
</tr>
</tbody>
</table>

Comment: 1 numerical aperture (NA = sin θ (launch angle))
## Time and Sample synchronization

### Precision Time Protocol – IEEE 1588v2/PTP

<table>
<thead>
<tr>
<th>Communication Plug-In Module</th>
<th>NEW ETH-BD-2FO</th>
<th>ETH-BA-2EL ETH-BB-2FO</th>
</tr>
</thead>
<tbody>
<tr>
<td>Protocol</td>
<td>IEEE 1588v2-2008</td>
<td>IEEE 1588v2-2008</td>
</tr>
<tr>
<td>Type of implementation</td>
<td>Hardware / FPGA</td>
<td>Software</td>
</tr>
<tr>
<td>Accuracy</td>
<td>1µs</td>
<td>1 ms</td>
</tr>
<tr>
<td>Supported devices</td>
<td>modular SIPROTEC 5 devices 7xx85/86/87 (except 7ST85)</td>
<td>All SIPROTEC 5 devices</td>
</tr>
<tr>
<td>Supported Redundancy</td>
<td>PRP Line Mode</td>
<td>PRP (symmetrical) Line Mode</td>
</tr>
<tr>
<td>Supported Profiles</td>
<td>IEC 61850-9-3</td>
<td></td>
</tr>
<tr>
<td>Clock Type</td>
<td>Ordinary Slave Clock (OSC)</td>
<td>Ordinary Slave Clock (OSC)</td>
</tr>
</tbody>
</table>

### Applications
- Date and Time synchronization
- Sample Synchronization for Process Bus
- PMU data synchronization
- 87L stabilization for unsymmetrical PI networks
- Date and Time synchronization
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- Further functions
Universal protection device for centralized and distributed busbar protection solutions

Fully compatible IEC 61850 distributed busbar protection
Universal protection device for centralized and distributed busbar protection solutions

- Optional connection of the process data directly to the central unit or in the field to the merging unit
- Acquisition of measured values in the field at the merging unit and transmission compliant to IEC 61850-9-2 and/or via central IO module in SIPROTEC 7SS85
- Acquisition of binary input signals (e.g. isolator and circuit breaker positions, LS failure protection messages) in the field at the merging unit and transmission compliant with IEC 61850 GOOSE and/or via central IO module in the SIPROTEC 7SS85
- Output of binary signals (e.g. protection trips, transfer trip, bay out of service) in the field via the merging unit compliant with IEC 61850 GOOSE and/or via central IO module in the SIPROTEC 7SS85
- New hardware standard variant V4 (1/3 housing, 19 BI, 11 BA, 0 CT, 0 VT) as preferred version for distributed busbar protection solutions

<table>
<thead>
<tr>
<th>Hardware Variant</th>
<th>Binary Inputs</th>
<th>Binary Outputs</th>
<th>CTs</th>
<th>ETH-BD-2FO Module</th>
<th>Remarks</th>
</tr>
</thead>
<tbody>
<tr>
<td>V1</td>
<td>15</td>
<td>13 (2S, 10F, 1 Life)</td>
<td>12</td>
<td>0</td>
<td>Standard variant for significant feature 9 (centralized)</td>
</tr>
<tr>
<td>V2</td>
<td>11</td>
<td>11 (2S, 8F, 1 Life)</td>
<td>16</td>
<td>0</td>
<td>Standard variant for significant feature B (centralized)</td>
</tr>
<tr>
<td>V3</td>
<td>15</td>
<td>15 (2S, 12F, 1 Life)</td>
<td>24</td>
<td>0</td>
<td>Standard variant for significant feature C, D, E (centralized)</td>
</tr>
<tr>
<td>V4</td>
<td>19</td>
<td>11 (10S, 0F, 1 Life)</td>
<td>0</td>
<td>1</td>
<td>Standard variant for all significant features (distributed)</td>
</tr>
</tbody>
</table>
Fully compatible IEC 61850
distributed busbar protection

• SIPROTEC 7SS85 as process bus client

• Merging Unit (Process bus Server) can be:
  • SIPROTEC 6MU85
  • Any modular SIPROTEC 5 device with a process bus communication module ETH-BD-2FO
  • IEC 61850 compatible third-party Merging Unit

• Analog and binary process information
  • Acquisition of measured values in the field at the merging unit and transmission compliant with IEC 61850-9-2
  • Acquisition of binary input signals (e.g. isolator and circuit breaker positions, LS failure protection messages) in the field at the merging unit and transmission compliant with IEC 61850 GOOSE
  • Output of binary signals (e.g. protection trips, transfer trip, bay out of service) in the field via the merging unit compliant with IEC 61850 GOOSE

• Engineering
  • Standard IEC 61850-Konfigurationstools, e.g. IEC 61850 System Configurator
  • DIGSI 5
Distributed busbar protection
SIPROTEC 7SS85

Smart transition of energy systems
• Interoperable IEC 61850 busbar protection solution
• Distributed process data acquisition:
  • Merging Unit SIPROTEC
  • Every modular SIPROTEC 5 device
  • Third party merging unit
• Simple expansion of existing SIPROTEC 5 systems with distributed busbar protection
• Open engineering through standard IEC 61850 configuration tools and DIGSI 5
Busbar protection SIPROTEC 7SS85 as centralized protection

- Busbar protection (87B) for up to 20 bays
- Impedance protection (21T) for up to 10 bays
- Directional time-overcurrent protection phase/ground (67/67N) for up to 10 bays
- Nondirectional time-overcurrent protection phase/ground (50/51N) for up to 20 bays
- Circuit-breaker failure protection (50BF) for up to 20 bays
- End fault protection (50EF) for up to 20 bays
- Voltage protection for up to 4 voltage measurements
  ...
Highlights V7.9 and V8.0

- SIPROTEC DigitalTwin
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- Time synchronization with IEEE 1588 for High Precision applications
- SIPROTEC 7SS85 distributed busbar protection based on process bus
- **Point-on-wave switching**
  - Conformal coating of SIPROTEC 5 devices as standard
  - Cyber Security
  - ATEX certification for 7SK85 and 7UM85
  - New overcurrent and feeder protection SIPROTEC 7SJ81
- Web Browser
- Further functions
**Point-on-Wave Switching with SIPROTEC 5 (V7.90)**

- Minimization of electro-dynamic and dielectric stress on equipment as a result of switching operations
- Longer service life of equipment and reduced aging
- Increased system reliability (due to reduced voltage fluctuations and lower harmonic stress)

### Requirement

- 6MD86 as „stand alone“ PoW device
- 6MD86 as Bay Controller + PoW functionality
- **Protection device (7UT8, 7SJ85, LineProt 7xx87) + BCU + PoW functionality**

### Solution

**Necessary Hardware:**
- 2x IO209 with high-speed outputs for controlled one-phase CB-opening/
- 1x IO212 with 8x fast transducer inputs

### Benefits

- Reduced aging and increase system reliability
- Low invest: One device for control, protection and PoW function
- **One device for all type of loads**
- Integration into substation automation system with standard protocols like IEC 61850
- Easy engineering
Why „Point-on-Wave“ Switching?

- “Point-on-Wave“ Switching minimizes electro-dynamic and dielectric stress for operational equipment as a consequence of switching (control) operations.
- By this, aging of operational equipment can be reduced and life time extended.

Switching a capacitive load:
1) Closing time not optimized
2) Closing time optimized.
### point-on-wave switching with siprotec 5

#### applications

<table>
<thead>
<tr>
<th>Type of load / operational equip.</th>
<th>Operation</th>
<th>Avoided stress / Reduction of</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Inductive:</strong></td>
<td>Opening</td>
<td>Re-striking, overvoltage</td>
</tr>
<tr>
<td>• Transformer</td>
<td>Closing</td>
<td>Inrush current</td>
</tr>
<tr>
<td>• Shunt reactor (coil)</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Capacitive:</strong></td>
<td>Opening</td>
<td>Re-striking, overvoltage</td>
</tr>
<tr>
<td>• Capacitor bank</td>
<td>Closing</td>
<td>Overvoltage, Inrush current</td>
</tr>
<tr>
<td>• Filter bank</td>
<td></td>
<td></td>
</tr>
<tr>
<td>• Transmission line</td>
<td></td>
<td></td>
</tr>
<tr>
<td>• Cable</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

#### reduction of inrush currents:
- minimizes electro-dynamical and dielectric stress → Longer service life

#### minimization of overvoltage:
- minimizes dielectric stress → Increased system reliability
Point-on-Wave Switching with SIPROTEC 5 Function

How works Point-on-Wave Switching (simplified)?

- The PoW function operates the CB pole-selectively and determines the optimal switching instance for each phase / pole individually, with an IED accuracy of ~ 50µs

→ PoW switching can only be applied on circuit breaker supporting phase-selective switching

- Example: Switching a “shunt reactor”
- Switching shall take place in the voltage maximum to avoid inrush currents

Switching sequence: C → B → A
Point on Wave Switching SIPROTEC 5
Device configuration

- **IO202**: 4xI, 4xV: & voltage measurement:
  - for reference voltage
  - for switching monitoring / recording

- **IO209**: overall 8 x high-speed outputs (< 50μs switching accuracy)
  - for controlled CB-opening and CB-closing

- **IO212**: 8 x fast transducer inputs (0..20 mA)
  - 3 inputs for Siemens-CB reference contacts
  - 2 inputs for CB-open / close control voltage
  - 1 input for temperature

- Optionally: one plug-in module with 4 additional normal-speed transducer inputs:
  - 3 inputs for hydraulic CB pressure

Remarks:
- All transducer inputs are passive and require external 24 VDC supply
- CB control voltage must be externally transduced into 4..20 mA
Point-on-Wave switching device with SIPROTEC 5
Possible Device Types

PoW switching will be a platform functionality. This allows to apply this functionality in different device application options:

1. Stand alone PoW-switching device: 6MD86
2. Bay Control and PoW-switching in one physical device: 6MD86
3. Protection, Bay Controller and PoW-switching in one physical device: e.g. 7SJ85 (7SJ85 = Capacitor bank protection device)

The “PoW” function is available for configuration as a new function in the DIGSI device-function library:
Point on wave Switching with SIPROTEC 5

Properties

1. PoW-device switching accuracy: < 50μs
2. PoW-device switching applications:
   - Shunt reactors
   - Capacitors
   - Transformers
   - simple Lines and cables (no compensated lines)
3. Switching time compensation features:
   - Control voltage of CB closing and opening circuit
   - Ambient Temperature
   - Hydraulic CB pressure
4. Reference contact detection for Siemens CBs
   (the reference contact allows a precise determination of the CBs mechanical contact or mechanical separation time)
5. Monitoring of the PoW-switching accuracy
6. Logging and Recording of all relevant data and signals
Highlights V7.9 and V8.0

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- Web Browser
- Further functions
Conformal Coating as standard SIPROTEC 5 devices

Conformal Coating:
- Double-sided coating of electronic modules, as standard
- As standard, at no additional charge, for all new orders of SIPROTEC 5 and SIPROTEC Compact devices

Customer Benefit:
- Highest lifetime and availability of SIPROTEC devices even under extreme environmental conditions:
- Increased protection against harmful environmental influences such as corrosive gases, salts, and moisture
- Additional mechanical protection against dust and abrasion
- Highest coating quality due to qualified production process
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  - Further functions
Security News in SIPROTEC 5

Cyber Security

Customer-authorized DIGSI 5 Instances (V7.90)
- Use customer-issued client certificates in DIGSI 5 instances so that only these instances (and not any standard DIGSI 5 installation) can communicate with the customer’s SIPROTEC 5 IEDs

Role-based Views In DIGSI 5 (V7.90)
- Users can only view or operate those functionalities in DIGSI 5, that are permitted for their assigned roles

Authenticated network access for COM-Modules (V8.00)
- COM-modules authenticate themselves using IEEE 802.1X und customer certificates against the switch in order to gain network access

…and other improvements in RBAC, security logging and HTTPS functionalities
Customer-authorized DIGSI 5 Instances (V7.90)

1. Install customer-issued client certificate in the Windows User account (Client authorization)

2. Install in the device the customer CA that is used to sign the DIGSI 5 client certificates

3. Mutually authenticated und encrypted communication between DIGSI 5 and the SIPROTEC 5 device

- NEW: Only DIGSI 5 installations that connect using certificates signed by customer’s CA are permitted

- Device-side support for role-based access control including central user management and emergency access

- Recording of security-relevant events and alarms over Syslog and in non-volatile security log in device

- Confirmation codes for safety-critical operations

- AS BEFORE -

SIPROTEC 5

Bay level

Customer CA and Certificates can be issued using SICAM GridPass

Other Windows users with DIGSI 5 without customer-issued certificates
Role-based Views In DIGSI 5 (V7.90)

Role-based Views with central user management in DIGSI 5 – also when not connected to the device

NEW in V7.90: DIGSI 5 automatically determines the user’s roles from his Windows session

- Users can only view or operate those functionalities in DIGSI 5, that are permitted for their assigned roles
- Usage of (existing) central user administration for role-based DIGSI 5 experience
- Works with existing Microsoft Active Directory (AD) installations
- Roles and rights correspond to standards and guidelines e.g. IEC 62351, IEEE 1686, BDEW Whitepaper
- Works hand-in-hand with the RBAC feature in SIPROTEC 5 devices
- The role-based views are also available for Windows user accounts that are not centrally managed in AD
Authenticated Network Access for COM-Modules using IEEE 802.1X (V8.0)

1. Install customer-issued IEEE 802.1X Client certificates for COM modules (for network client authentication)

2. During bootup, the device’s COM module presents the client certificate for authentication to the switch using IEEE 802.1X

1. Install customer-issued IEEE 802.1X CA certificate in RADIUS Server

Customer CA und certificates can be created and managed with SICAM GridPass

3. RADIUS Server authenticates the device using its certificate and the switch grants or denies network access to the COM module

Other products without customer-issued IEEE 802.1x client certificates
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• New overcurrent and feeder protection SIPROTEC 7SJ81
• Web Browser
• Further functions
ATEX-Certification for SIPROTEC 7SK85 and 7UM85

**Application**

- Use of Motor Protection and Machine Protection in potentially explosive atmospheres (e.g. Chemical-Industry)

**Solution**

- Certification of Hardware and Firmware by an independent and accredited institution: PTB = Physikalisch-Technische Bundesanstalt

**Advantage**

- SIPROTEC protection devices are applicable directly and without customer approvals in potentially explosive atmospheres
Highlights V7.9 and V8.0

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- Further functions
Overcurrent protection SIPROTEC 5  7SJ81
Profile

• Your start with SIPROTEC 5 – device family
• Good price value
• Optimized functionality for feeder protection
• based on the successful SIPROTEC 7SJ82, with limited functionality
Overcurrent protection SIPROTEC 5 7SJ81
Profile

Application

- Feeder protection
- All network types, medium voltage level
- 4 CT, with 11 BI, 9 BO or 18 BI, 14 BO
- 4 CT, 4 VT with 11 BI, 9 BO or 16 BI, 11 BO
- Up to 1 plug-in module
- 12 programmable LEDs
- Non-expandable via 1/6 modules
- Standard and large graphical display

Device functions

- Dir. & Non-Dir. OC protection with basic functionality
- Ground fault protection for comp./isolated networks
- V, f, P/Q protection functions
- AR, Sync function

Suitable device 7SJ81

- IEC 61850 (Edition 1 and 2)
- Cyber security
- Redundant communication
- SIPROTEC 5 standard functions for control and monitoring
Highlights V7.9 and V8.0

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- Web Browser
- Further functions
SIPROTEC 5
Web Browser - Extensions

Simple, fast and secure access to device data

Recording:
• Download, Delete and Trigger of Fault Records

Parameterization:
• Change of settings within an active setting-group

Display all signal state:
• Indication of all information
• Centralized view on warnings, alarms and inactive functions
Highlights V7.9 and V8.0

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- Further functions
• Accurate fault location by measuring at both ends of a 2-ended line with communication link via protection interface (Accuracy of 1%)
• Separate line sections with individual line data for non-homogeneous lines, e.g. for overhead line/cable sections
• Section specific auto-reclosure (AR) on overhead line sections
SIPROTEC 5
Further functions

Positive-sequence overcurrent protection function (ANSI 50/51) – New function

The Positive-sequence overcurrent protection function detects short circuits in electric equipment and is applied when the zero-sequence current or negative-sequence current should not influence the tripping, for example, on the tertiary delta winding of an auto transformer.

Frequency protection in function group Voltage/current 1-phase – New application

Overfrequency protection (ANSI 81O) and underfrequency protection (ANSI 81U) functions are now available in the 1-phase voltage/current function group.
SIPROTEC 5
Further functions

Phasor Measurement Unit (PMU) – Improvement

• Up to 40 channels supported (20 channels in V7.8)
• Applications with pure CT connections possible
• Additional information in configuration frame 3 (according to IEEE C37.118) available, e.g. GPS-Data, Global PMU ID, Configuration Change counter
• Longer names possible in Config Frame 3 for phasor names and channel names as well as for PMU-station name
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