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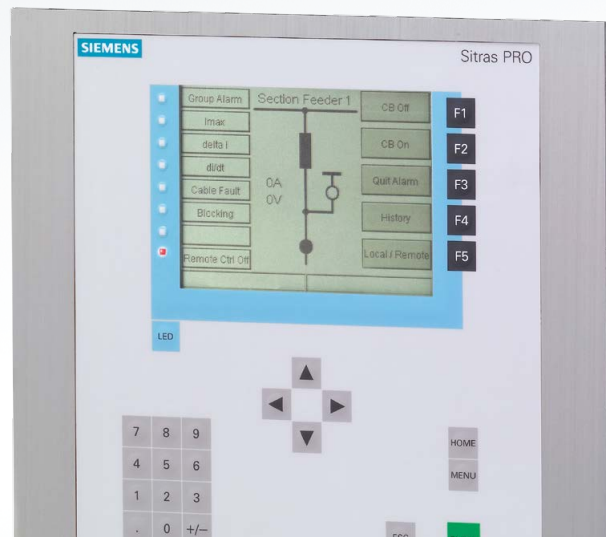
Sitras PRO

**DC protective unit and controller for
DC traction power supply**

The Sitras® PRO combined DC protective unit and controller is used in the power supply for DC railways in mass transit and main-line systems up to 3,000 V DC.

It protects DC switchgear and contact line systems against critical operating conditions and detects short-circuits during the current rise even before the maximum short-circuit currents are reached.

Features

• Complete functionality in a single unit
  – Protection
  – Measurement
  – Control
  – Automation
• Flexible adaptation to system requirements
• Standard communication interfaces
• High-performance diagnostics, comprehensive event, alarm and measured value memory
• Compliance with all relevant standards

Overview

The Sitras PRO secondary protection device has to be integrated into the protection concept of the entire DC traction power supply system.

Product line

The Sitras PRO product line consists of the following modules:
- Sitras PRO CU – Central Unit
- Sitras PRO HMI – Human Machine Interface
- Sitras PRO BA – DC Buffer Amplifier
- Sitras PRO CM – Cable Monitoring Module
- Sitras PRO SW – PC User Software

The Sitras PRO CU Central Unit is the "heart" of the product line. It supplies power to other modules, represents the interface to the system and performs protection and control functions.

Hardware

The modular Sitras PRO CU Central Unit is distinguished by the following architecture:
- Powerful 32-bit microprocessor system
- Fully digital measurement processing and control, from sampling and digitalization of the measured parameters to ON/OFF decisions for the circuit-breaker
- Complete electrical isolation and noise immunity of the internal circuitry from the measuring, control and supply circuits from and to the system

System configuration
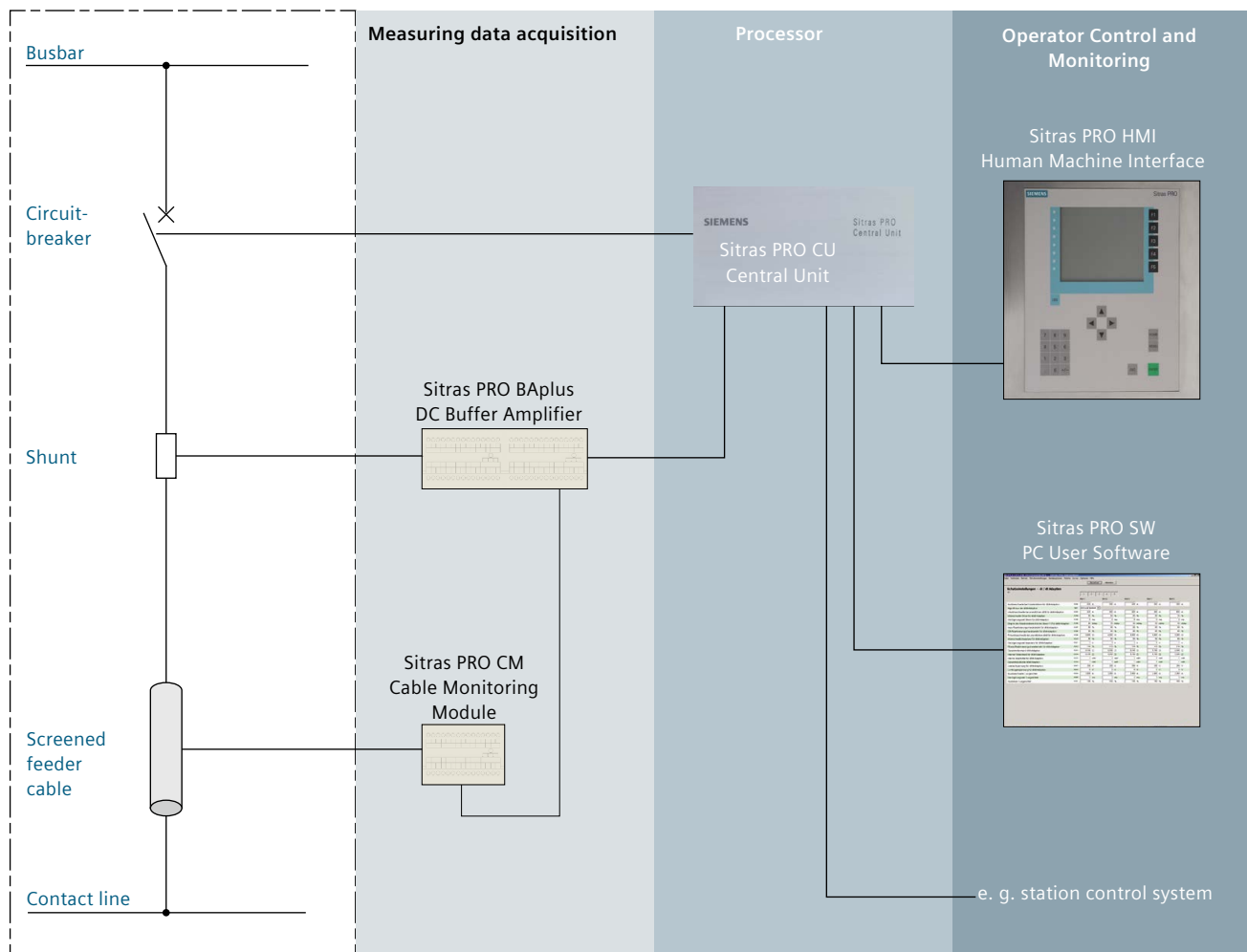
Typical integration of Sitras PRO to the DC traction power supply

Basic functions

Sitras PRO offers the following basic functions as standard:

Overcurrent protection (I_{max})

This monitors the instantaneous current for a maximum current in the direction of incoming supply, in the direction of energy recovery and for an unidirectional maximum current. Tripping is initiated if one limit is exceeded for an adjustable period of time.

Current surge protection (ΔI)

The current surge protection samples the current rise and detects a fast current rise that is not consistent with any operating mode. The short-circuit is detected far below the peak current. This significantly reduces the load on the system.

Current rate of rise protection (di/dt)

The most distant short-circuit must be detected and isolated. This is done by initiating a tripping of the circuit-breaker if the set threshold for the current rate of rise is permanently exceeded and the adjustable period of time has elapsed.

Overcurrent-time protection (I_{DMT})

The overcurrent-time protection detects currents that exist for a long time and are not consistent with any regular operating mode. The current is monitored in the direction of incoming supply and in the direction of energy recovery.

Overvoltage/undervoltage protection (V_{max}/V_{min})

When the outgoing cable voltage rises above or falls below a preset value and if this condition persists longer than the preset delay, a alarm and/or tripping is initiated.

Contact line voltage monitoring

This function is designed to monitor the voltage in the area of the supply and to generate a "Voltage present" message.

Circuit-breaker failure protection

The circuit-breaker failure protection verifies that a tripped circuit-breaker actually interrupts the current flow. Using a parameterizable signal, this allows tripping of an upstream medium-voltage circuit-breaker if necessary.

Impedance protection

The impedance protection monitors the resistance in the area of the supply and trips the circuit-breaker when resistance falls below a preset value.

High-speed capacitor trip

In combination with specially equipped circuit-breakers, the high-speed capacitor trip can be used to achieve even faster disconnection.

Switching between protection parameter groups

With up to five parameter groups, the Sitras PRO can be configured locally or remotely for the respective operating conditions.

Event, alarm and measured value memories

The unit is equipped with three different kinds of memory, each of which is organized as a circular buffer. The event and alarm memory saves the identifier in plain text, as well as value, source, date and time. With the help of Sitras PRO SW, the measured value memory can be used to analyze the current and voltage characteristics.

Monitoring analogue value

A message and/or a trip is generated if the analogue value rises over an adjustable limit or slides under a second adjustable limit and stays there longer than an adjustable time delay.

Monitoring of cable insulation and cable screen break

In combination with the Sitras PRO BAplus DC Buffer Amplifier and one or two Sitras PRO CM Cable Monitor Modules, the following faults can be detected:
• Insulation failure between the L+ conductor and the screen
• Insulation failure between screen and earth or the conductor L–
• Screen break

IEC 61850 Communication (depending on hardware)

Process bus, who enables, besides the transfer of status information, measured values, control commands and control parameters to a station control, also the communication of protection and control relays between themselves, e.g. for interlockings. Furthermore the object orientated data model makes the engineering of the station control system more easy.

SNTP time synchronisation

In this type of time synchronisation all devices will get the time from a central master clock via Ethernet.

Different conversational languages

The conversational language can be changed at any time between Chinese, English, German, Italian and Spanish.

Optional functions

In addition to the basic functions there are a number of optional functions which can be implemented as subsequent upgrades.

Control

In addition to the protection function, the central unit is also capable of controlling the section test and the enabling of the circuit-breaker (test and automatic reclose function). This does not require any separate control.

Another feature is the transfer trip function which trips the circuit-breaker in the neighboring substation or causes its own circuit-breaker to trip due to a transfer trip by the neighboring substation.

Bypass disconnect interlocks are also provided on the bypass bus disconnector for the section feeder panels with bypass.

Additional option:
• Another optional control function is the calculation of the residual section resistance based on the measured voltage contact line voltage and the test current.

Integrated programmable logic controller (PLC)

In addition to the dedicated control functionality of the central unit, the integrated PLC enhances the control unit with a freely programmable automation functionality, e.g. for the control of motor-operated disconnectors.

This eliminates the need to use a separate PLC and ensures a uniform design of the control and protection equipment in the entire DC switchgear. The additional module makes a higher number of inputs and outputs available.

PROFIBUS DP and PROFINET IO communication (depending on hardware)

The bus communication enables the transfer of status information, measured values, control commands and control parameters as well as the time synchronization.

Advanced current rate of rise protection (di/dt adaptation)

This continuously changes the I_{max} value as a function of di/dt in order to achieve a significantly finer adjustment of the impedance protection and thus even faster disconnection in case of faults.

100 Hz Monitoring

This frequency monitoring function is used to monitor the harmonic component at the contact line.

Thermal overload protection

The maximum permissible operating temperature of equipment may be exceeded in case of overload without the short-circuit monitoring function detecting a fault. For this reason, the operating temperature of the contact line and/or the feeder cable can be monitored.

Power/energy calculation

This is based on the values of the incoming and recovered power as well as of the incoming and recovered energy of the section feeder.

Storage of breaker loading (maintenance diagnostics)

Various measured and calculated values (e.g. switching cycles, load integral) for the breaker loading are indicated.

Additional conversational languages

The standard conversational languages may be complemented with additional languages (up to eight). This may also include Asian or Cyrillic fonts.

Measured value acquisition

Sitras PRO BA – DC Buffer Amplifier

The DC buffer amplifier is used for measuring the current and voltage while, at the same time, ensuring electrical isolation.

The measured values are output to the Sitras PRO central unit via fiber-optic cable (FO). Analog outputs are also available, such as
• for the display of section feeder current
• for the display of section feeder voltage
• for the display of test voltage (voltage in the feeder section)

Sitras PRO BAplus, the DC buffer amplifier, can also be combined with one or two cable monitoring modules to implement a cable monitoring function.

Sitras PRO CM – Cable Monitoring Module

The cable monitoring module is used for measuring the insulation resistance of the feeder cables. The cable screen can also be monitored for open circuit (breakage). The readings are sent to the central unit via the DC buffer amplifier.

The cable monitoring module is designed to monitor screened feeder cables in traction power supply systems with positive contact line voltages of up to 1,500 V DC. It can be connected to any cable that has a concentric screen and conductor and an insulating outer sheath. The cable monitoring module is connected to the central unit via the Sitras PRO BAplus DC buffer amplifier and is powered by the contact line voltage. A maximum of two cable monitoring modules may be used.
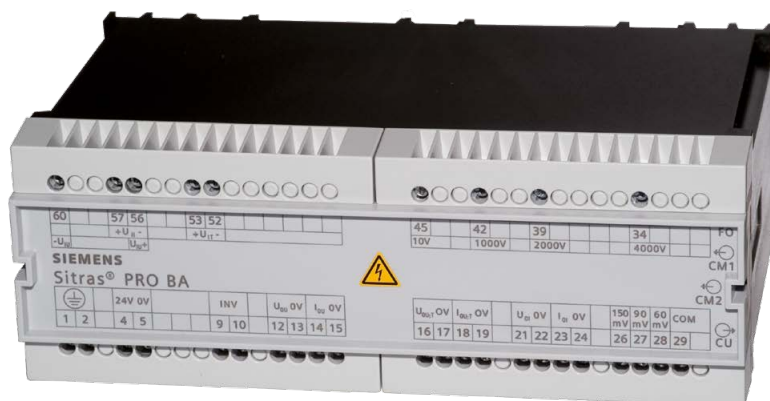
Sitras PRO BA

Sitras PRO CM

Communication

Numerous standardized interfaces and protocols provide flexible communication options for operation, parameterization, service, and time synchronization.

Interfaces

- PROFIBUS RS 485
- Ethernet, Fast Ethernet
- Fiber-optic cable (connection to Sitras PRO BA)

Protocols

- PROFIBUS DP
- PROFINET IO
- IEC 61850
- SNTP

Operator control and monitoring

Sitras PRO can be controlled and parameterized by the operator:

- via the externally accessible Sitras PRO HMI – human machine interface,
- via the Sitras PRO SW PC – User Software, or
- via one of the many communication interfaces using higher level control such as Sitras SCS-DC, Vicos® or Simatic® WinCC.

Sitras PRO HMI – externally accessible human machine interface

Sitras PRO HMI – Human Machine Interface

Sitras PRO HMI is integrated in a user-friendly manner in the door of the low voltage compartment of the DC switchgear.

The features are:
- Monochrome graphical user interface
- Dynamic display of switch positions
- Measured value display of the current and voltage
- Large keypad for convenient handling
- Individually parameterizable LEDs (functional assignment and text labels)
- Individually parameterizable function keys (functional assignment and text labels)

Sitras PRO SW – PC User Software

Sitras PRO SW is a convenient tool that simplifies and accelerates operations and diagnostics – from set-up and start-up of the equipment to analysis and documentation of system faults. The powerful software enables fast troubleshooting and provides valuable insights for possible action by the maintenance personnel.

Sitras PRO SW is distinguished by the following features:
• included per default at Sitras PRO CU
• User guidance in familiar Windows design
• Easy parameterization with
  – context menus
  – drop-down lists for selection of applicable parameters
  – display of limits for values
• Trace visualization
• Recovery function
• Print function
• Help function
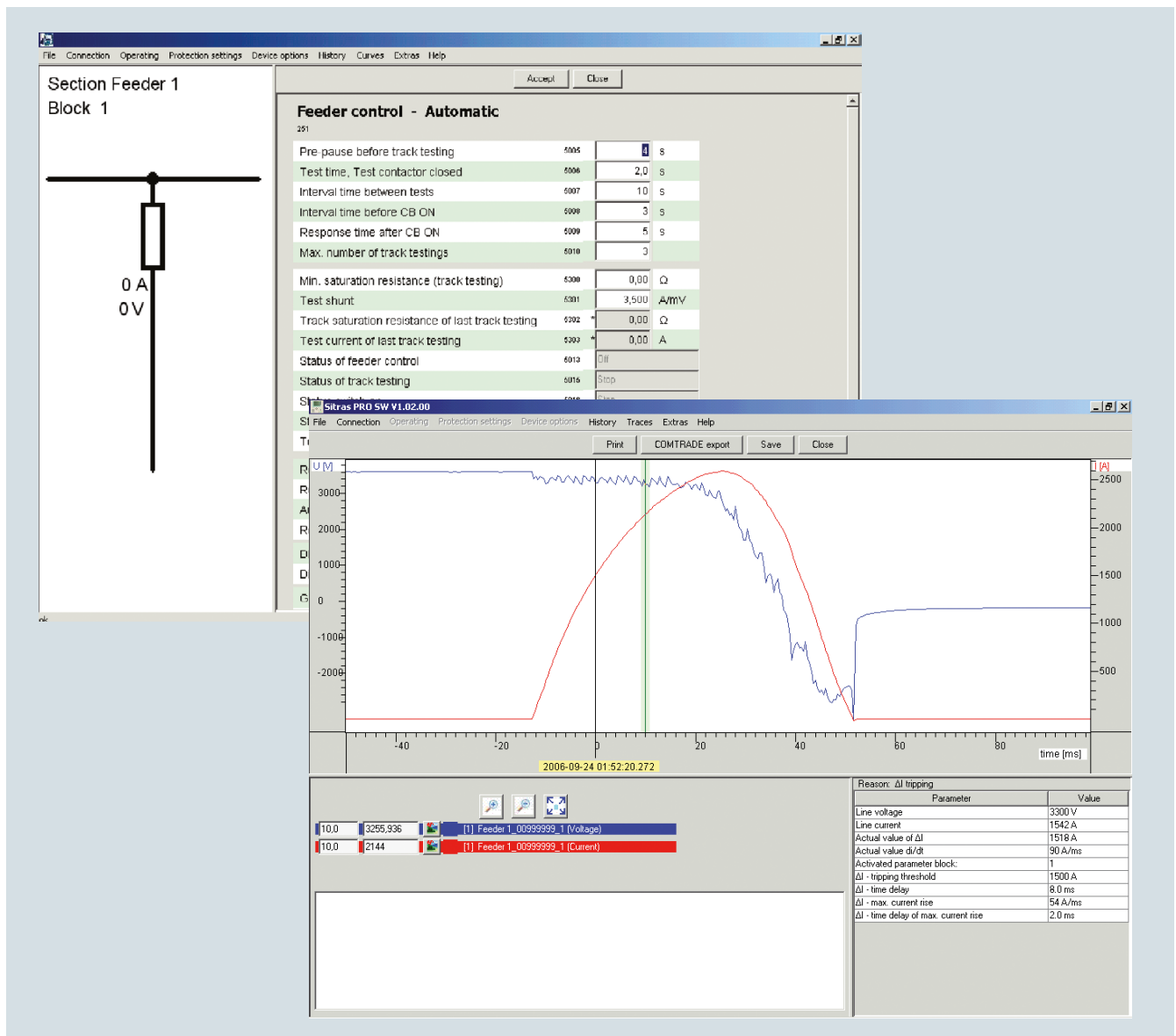
Sitras PRO SW – PC User Software

Technical data

Sitras PRO - Central Unit / Human Machine Interface

Supply voltage	[V DC]	24...240
Voltage range (±20 %)	[V AC]	110...240

Inputs/outputs		
• Relay outputs**		4
• Digital inputs**		24
• Digital outputs**		16
• Analog inputs		4
• Analog outputs		2
• Fiber-optic inputs (connection to DC buffer amplifier)		1

Service interface	Ethernet

Permissible ambient temperature		
Operation	[°C]	-5...+55
Storage, transport	[°C]	-25...+70

Max. humidity (no condensation)*	95 %

Degree of protection acc. to IEC 60529:2003	IP20

Dimensions (W x H x D)		
• Sitras PRO CU – Central Unit	[mm]	270 x 154 x 162
• Sitras PRO HMI – Human Machine Interface	[mm]	276 x 262 x 60

*   other values on request
**   double these figures for the „integrated PLC" Option

Sitras PRO BA – DC Buffer Amplifier

for nominal voltages	600...3,000 V DC

Interfaces	
• Analog outputs	3
• FO output (connection to central unit)	1
• FO inputs, only Sitras PRO BAplus (connection to cable monitoring modules)	2

Permissible ambient temperature	
• Operation	-5...+60 °C
• Storage	-40...+70 °C

Max. humidity (no condensation)	93 %

Degree of protection acc. to IEC 60529:2003	
• Housing	IP40
• Terminals	IP00

Dimensions (W x H x D)	200 x 123 x 84 mm

Sitras PRO CM – Cable Monitoring Module

for positive nominal voltages	600...1,500 V DC

Interfaces	
• FO output (connection to DC buffer amplifier)	1

Permissible ambient temperature	
• Operation	-5...+60 °C
• Storage	-40...+70 °C

Max. humidity (no condensation)	93 %

Degree of protection acc. to IEC 60529:2003	
• Housing	IP40
• Terminals	IP00

Dimensions (W x H x D)	100 x 118 x 84 mm

Security information

In order to protect plants, systems, machines and networks against cyber threats, it is necessary to implement – and continuously maintain – a holistic, state-of-the-art industrial security concept. Siemens' products and solutions constitute one element of such a concept.

For more information about industrial security, please visit:
http://www.siemens.com/industrialsecurity.