

# SAN2 EARTH FAULT CONTROL AND LOCALIZATION SYSTEM

Intended for the following industries:



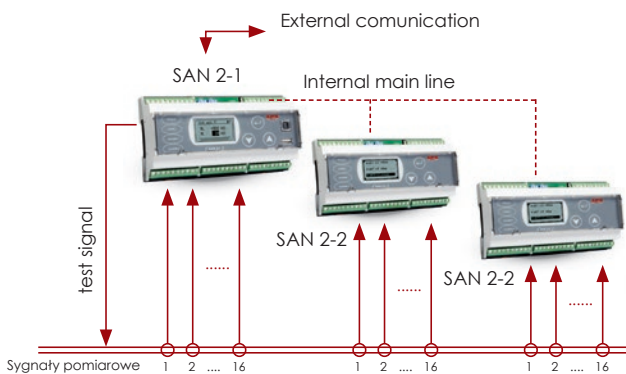
SAN 2 isolation monitoring system is designed to monitor the isolated DC networks with rated voltages from 24 V to 220 V. The system implements the functions of ground fault resistance measurement with respect to the ground fault potential and locates the ground fault outgoings.

The monitoring is carried out continuously and the current results are shown on LCD display. Full configuration of the system is possible through the user console. The resistance fall below the preset thresholds is signaled by the appropriate LED light and activation of the alarms. All events are stored in non-volatile memory device to which the user has local and remote access. Integrated RS-485, USB and Ethernet communication interfaces allow for configuration and transfer of data to the master system.

The used high-speed microprocessor and efficient measurement algorithms allow for precise and rapid measurement of leakage current and the location of the damaged outgoings even in environments with high interferences.

## SAN 2 OPERATION DESCRIPTION

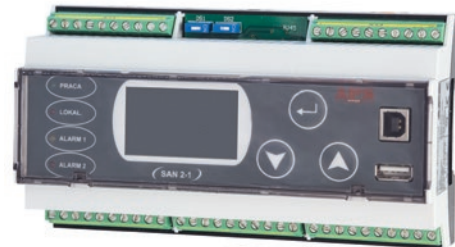
The modular design allows for creating a distributed monitoring system for a large number of DC circuits (up to 1,760 outgoings). An internal bus, compatible with CAN 2.0 A standard is used for communication between the modules.



PIC. SAN 2 system Schematic diagram

SAN 2-1 module consists of two main blocks: ground fault meter and locator. Block of ground fault meter includes test pulse generator and control and measurement block, which controls the generator operation based on current measurements and preset parameters. Locator in SAN 2-1 module monitors up to 16 outgoings.

SAN 2-2 module is an additional locator of ground fault outflows. Locator in SAN 2-2 module monitors up to 16 outgoings.



PIC. SAN 2 Module

## SAN 2 SYSTEM FEATURES

SAN2 series consists of the following two modules:

- SAN2-1 (system central unit) - measurement of ground fault resistance and monitoring of up to sixteen outgoings;
- SAN2-2(locator) - monitoring of up to sixteen outgoings;
- SAN2-1 central unit includes insulation resistance measuring block, ground fault locator (16 outflows) and communication interface;
- It is possible to connect to the central unit up to 110 SAN2-2 expansion modules (16 outgoings each) which allows for monitoring of 1760 outgoings;
- Options of selection from the panel menu, external transmission protocol: Modbus RTU, IEC 60870-5-103, APS6000 other;
- Continuous measurement of DC ground fault resistance;
- Possibility of monitoring and limiting the voltage differences occurring during testing;  $\Delta V$  test, so as to not interfere with other DC system devices;
- Two operating modes: voltage and current ones;
- Fast indication of the outflow, the leakage current of which exceeded a defined value;
- Configurable amplitude of the test current allows for use of the system in the networks with sensitive electrical equipment;
- Signaling alarm states (alert and alarm) via LEDs, messages on the LCD display and relays;
- Possibility to choose the communication language from the menu panel: Polish, English, Russian;
- Signaling connection failure of the measuring current transformer;
- Resistant to interference internal bus, compatible with CAN standard.
- Events logging in the internal memory on SD card;
- RS485, USB, ETHERNET integrated communication interfaces
- Automated testing of current transformers during the leakage current locating;
- Convenient mounting on TS-35 (DIN) bus.

The insulation monitoring system has two basic functions:

1. Ground fault resistance measurement function;
2. Ground fault circuit location function

## GROUND FAULT RESISTANCE MEASUREMENT FUNCTION

SAN 2-1 module performs insulation resistance measurement in two modes:

- voltage mode (not generating a current signal to the system), the principle of operation is based on an analysis of voltages difference in the system and standard resistive ground fault;
- current mode which involves the analysis of the periodically generated test signal. Both the measuring cycle time, as well as, the test signal amplitude depend on configuration of the ground fault meter and the current network parameters;

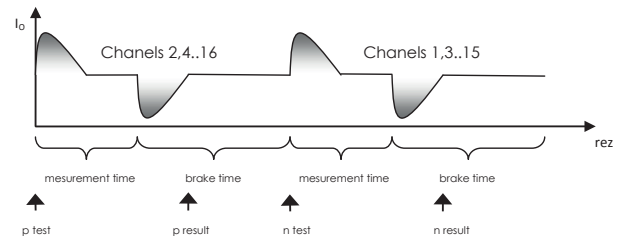
Reducing the level of ground fault resistance below the preset threshold triggers an alarm.

Additionally, the process of damaged outgoing locating starts up.

## DAMAGED OUTGOINGS LOCATION FUNCTION

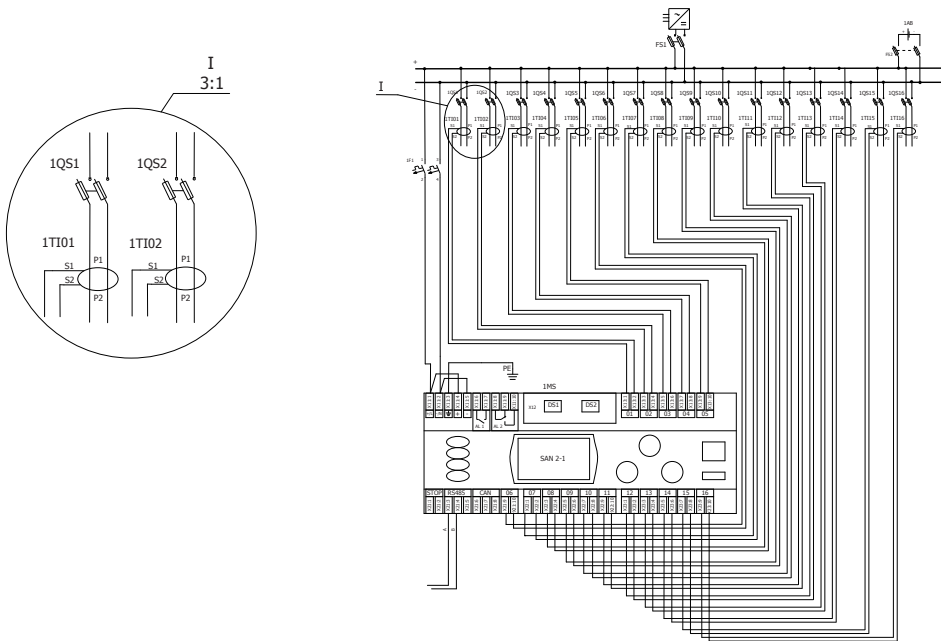
Locator system is used to measure the leakage current in real time. Each monitored outgoing must be equipped with a current transformer connected to the appropriate SAN2-1 module or SAN2-2 module measuring input. For the connected measurement channel the current transformer test is carried out before each measurement cycle. If the test result is positive, the measuring cycle is followed by analysis of the collected measurement series.

The result of analysis of a series of measurements is an indication of the circuit with the greatest ground fault outgoing.

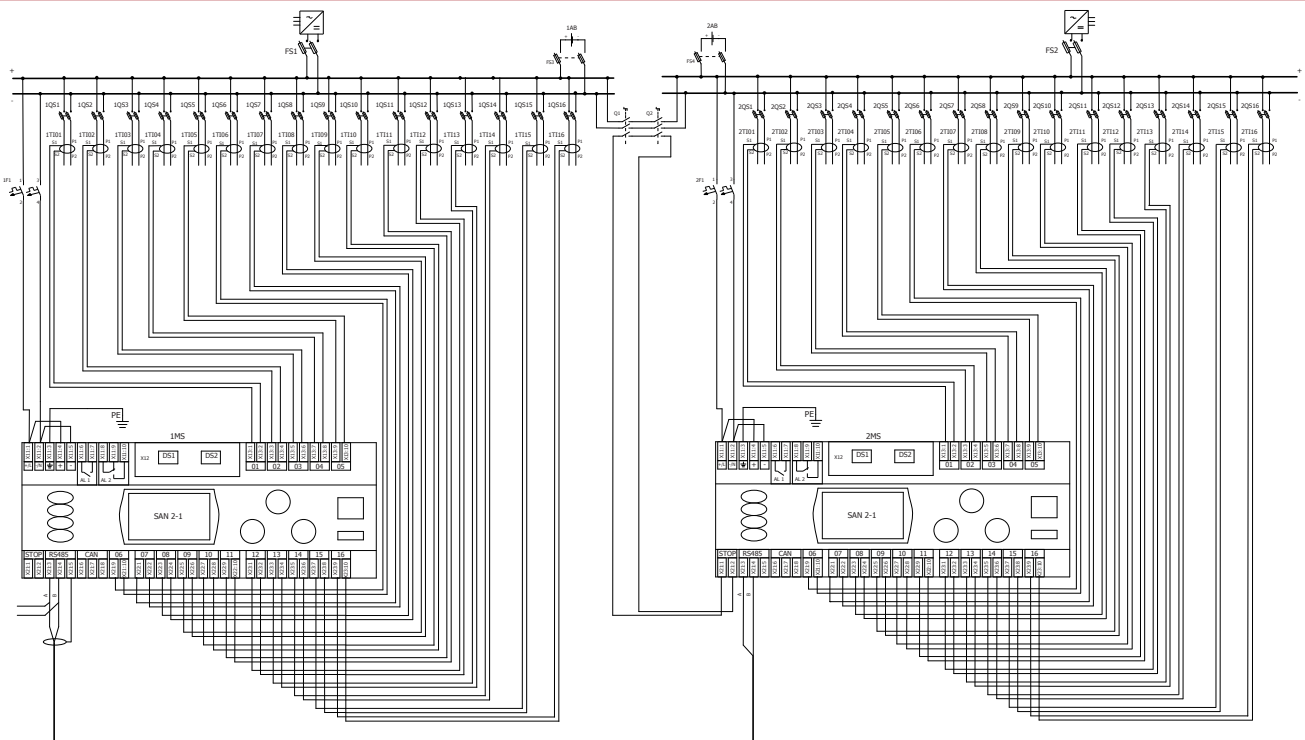


PIC. Locator operation

## PIC. SAN2-1 CONECTION DIAGRAM IN ONE SECTION SWITCH-GEAR



## PIC. SAN2-1 CONECTION DIAGRAM IN TWO SECTION SWITCH-GEAR



# SAN3 AUTOMATIC SUPERVISORY SYSTEM

Intended for the following industries:



SAN 3 automatic visory system is designed to monitor voltage, current, temperature, state of connectors, state of the battery operation in DC and AC switchgear and to analyse collected data. Measurements and analysis of measured values are performed continuously. The use of high-precision analog-digital converters ensures high measurement accuracy.

The system allows for immediate detection of irregularities in the switchgear operation and for notifying the user about any alarm states. The controller has the ability to set the alerts and alarms values

SAN 3 system is embedded in 19" module, and is based on specialized measurement and control cards. The system in its minimum configuration consists of the following: power supply unit, central unit and at least one measurement and control card. Number of the used measurement and control cards depends on the number of signals to be monitored in the object being monitored. For increased safety reasons, each SAN 3 system's communication port has a galvanic isolation. Data collected by the central unit from all the measurement and control cards is analyzed for proper operation of the monitored object. Result of the conducted analysis and values of individual monitored signals are presented to the user in readable synopsis and visualization on a large color display with touch screen.

The power supply unit used in the system has two galvanically isolated inputs allowing for simultaneous supply DC and AC voltages. Supply of one of these voltages is sufficient for proper operation.

Supply of the two voltages allows for increase of operational reliability (the system runs continuously in the case of loss of one of voltages). SAN 3 system elements are embedded in a cassette. The cassette includes: power supply unit, central unit and 1 ÷ 8 measurement and control cards. In the systems requiring more control and measurement cards; for distributed objects it is possible to use few SAN 3 system cassettes. In this case, only one cassette includes a central unit, the other cassettes include measurement and control cards only. Permissible distance between the cassettes when connected via shielded cable is 1200 m. In strongly interfered environments fiber link connection is suggested.



PIC. SAN 3 module

## CHARACTERISTICS:

- Operation parameters' monitoring and analysis:
  - bus bars' currents;
  - bus bars' voltage;
  - switchgear modes;
- Battery full- operation monitoring:
  - battery current measurement;
  - battery voltage measurement;
  - Voltage control in each monoblock;
  - battery isolation control;
  - multipoint temperature measurement ;
  - battery charge display;
- The user can define warning and alarm threshold values for each analog measurement;
- high- accuracy measurement;
- galvanic isolation of the measurements;
- The possibility of communication with the monitoring system by means of isolated communication interface;
- the ability to connect the controller to industrial networks, computer networks and fiber;
- possibility of extending the number of monitored parameters by adding modules SAN 3 with free slots for I/O;
- Possibility of each and every electric or non- electric, analog or digital parameter monitoring;
- standard dimentions 3U/19".

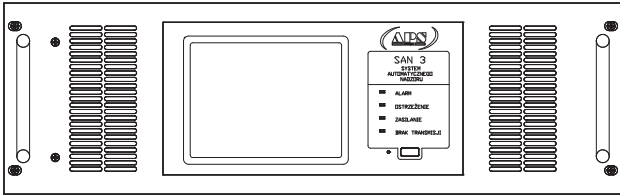
TAB. TYPES OF SAN 3 SYSTEM CARDS

Binary inputs	8	Each input is galvanically isolated. Input signal: 0 - 250 VDC
	16	One common inputs pole. Input signal: 0 - 250 VDC
Binary outputs	8	Each output is galvanically isolated Maximally: 250 V/1 A (DC)
	15	One common outputs pole Maximally: 250 V/0.2A (DC)
Analog inputs	8	Description of possible signals on inputs - in "SAN 3-4 Card Input Signals" table
	8	+/- 30VDC differential inputs on a common potential
Monitoring of battery cells	8	Measurement of the battery cells voltage (3 V) or modules (12V)
Ground fault resistance measurement	1	Maximum input voltage: 300 VDC resistance range: 0 - 250 kOhm

TAB. INPUT SIGNALS SAN 3

No	Input signal	range	unit	Input symbol
1	DC voltage	± 250	VDC	SAN 3-4 DC
2	AC voltage	250	VAC (rms)	SAN 3-4 AC
3	Current loop	4...20 lub ± 25	m A	SAN 3-4 IL
4	Shunt signal	± 200	m V	SAN 3-4 IB
5	Temperature	-20...+80	°C	SAN 3-4 T

## USER INTERFACE (HMI)



### USER CONSOLE:

User's console is located on the front plate of the controller and it comprises the following:

- Liquid crystal display (VGA connector);
- 4 LED indicators;
- USB connector that allows for the computer keyboard connection.

### EXTERNAL COMMUNICATION VIA THE FOLLOWING CONNECTORS AND INTERFACES:

- RS 232;
- RS 485;
- interface to read data of Ethernet with TCP/IP protocol;
- optical fiber connectors;

Those connectors are optional depending on the needs of particular installation.

### CENTRAL UNIT FUNCTIONALITY:

- archiving monitored data form measurement cards and external devices in the read-only memory (HDD or Flash disk);
- readable synopsis, which can be individually modified by the user;
- large colorful display with touch screen and additional signaling LEDs;
- Intuitive operation;
- ability to connect a USB keyboard;
- USB port for connecting a memory stick to copy the archived data;

### DATA PRESENTATION

- ability to create individual synoptic for the monitored installation;
- chronological presentation of changes in the system state;
- tables of all results for a selected group of devices;
- history in the form of tables and charts, with the ability to search for events.

### COMMUNICATION PROTOCOL:

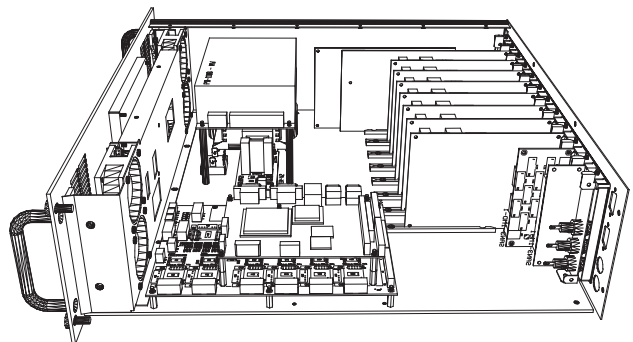
- Own protocol APS 6000 MASTER/SLAVE;
- Own protocol APS 5000 SLAVE;
- MODBUS RTU MASTER/SLAVE protocol;
- MODBUS TCP/IP MASTER/SLAVE protocol;

Other protocols are available as an option.

- password protection of configuration of the most important functions of the system;
- selection of number and type of measuring cards that correspond to the number and type of signals in the object being monitored;
- reading data directly from the device drivers of own production and of other manufactures;
- simple configuration - using ready-made libraries;
- signals division into groups - tree structure.

TAB. SAN 3 TECHNICAL PARAMETERS

Power supply ( $\pm 15\%$ )	220 DC / 230 VAC
Power consumption W	100 W
Operating temperature (EN 50178 class 3k3)	0d +0 do +40 OC
Storage temperature (EN 50178 class 1k4)	0d -25 do +55 OC
Humidity (EN50178 class 3k3)	5÷95 % (no condensation)
Housing type	3U/19"
IP (PN 22/E-08106)	IP 20
Mounting	Plug-in module
Dimension (W x H x D)	482 x 133 x 465 mm
Color	RAL 7035
Weight	15 kg



PIC. Housing of SAN 3

# SAN5 MICROPROCESSOR CHEMICAL BATTERIES MONITORING SYSTEM

Intended for the following industries:



SAN 5-1 microprocessor monitoring system (SAN 5-1.2) is designed for continuous monitoring of chemical battery state. The device measures voltage and current of the battery, battery symmetry voltage, battery and ambient temperature. The measurement results are compared with the thresholds values and where irregularities are detected in the battery operation, SAN 5-1 signals failure states. The main purpose of the monitoring system is to detect irregularities in the monitored battery and localize the "weakest" cells.

Embedded LCD display allows for communication with the user in two modes:

- display of all measured values and alarm states occurring in the system;
- display of intuitive menu to view all current measurements, parameters, system state, alarm buffers. It also allows for configuration of the device and its operating parameters.

## SAN 5 SYSTEM FEATURES:

- High stability of operation;
- Double measuring system:
  - Entire battery voltage, battery and ambient temperature, etc.;
  - Voltage of battery cells (SAN 5-1) or battery symmetry (SAN 5-1.2).
- Signaling the following operational states:
  - alarm state;
  - alert;
  - deep battery discharge;
  - system power supply;
  - buffer operation;
  - system operation;
  - battery charging;
  - battery discharge.
- Intuitive and easy to use user interface consisting of LCD display, keypad and LEDs;
- Events Archiving - recorded and archived in non-volatile memory each appearance and disappearance of alarm states, alerts, data of the whole system and change of that state;
- USB 2.0 port allowing for recording the alarm buffers on portable FLASH memory (USB);
- Alarm states remote signaling - potential-free relay contacts;
- Possibility of integration with other monitoring systems through RS485 connector;
- Communication with PC via RS-232 connector.

## SPECIAL VERSIONS OR OPTIONS OF THE EQUIPMENT

Upon request, it is possible to adapt the equipment to the specific design requirements, e.g.:

- Battery other rated voltage;
- Another supply voltage, e.g., suitable for the battery being monitored;
- Another RS-232 transmission speed compliant with EIA
- DC output voltage level;
- Environmental requirements in the ambient temperature range (-20 °C to + 55 °C), presence of aggressive factors, etc.;



PIC. SAN 5 Module

## SAN 5 OPERATION DESCRIPTION

During operation, the device performs battery voltage measurements. In the event that any of the measured values exceeds the threshold of alert or alarm, it is signaled by lighting up corresponding LED and connecting the relevant relay output. The current state of the system is also displayed in the form of appropriate messages on the LCD screen. All the details of the monitored battery can be displayed by using the device menu functions.

State of deep discharge, alert and alarm are additionally signaled by LEDs on the device panel. Alarm due to differences of halves battery voltage (symmetry control) is displayed as  $\Delta U$ .

TAB. SAN 5-1 TECHNICAL PARAMETERS

Battery voltage	220/110/48/24 VDC
Battery voltage measurement range	$U_{bat} + 30\% U_{bat}$ [V]
Voltage accuracy measurement	<0.5 %
Battery current accuracy measurement	<1 %
Battery symmetry voltage measurement range	0-150 VDC
Battery symmetry voltage accuracy measurement	<1 %
Temperature measurement range	-40 ÷ 100 °C
Temperature accuracy measurement	1 °C
Load capacity of binary outputs	6 A 250 VAC
RS232 transmission speed	38400 bps
RS232 isolation	2,5 kV
RS485 transmission range	38400 bps
RS485 isolation	2,5 kV
RS485 cable type	2 wires
Power consumption	12 W
Power supply	24-90 VDC ±15% or 90-300 VDC ±15%
<b>HOUSING</b>	
Housing type	LDG70
Mounting	DIN 46277
IP	IP20
Dimensions (W x H x D)	225x70x110 mm
Color	RAL7032

# SAN DIR SAN DIR VISUALIZATION PROGRAM

Intended for the following industries:



DIR SAN visualization program is used for fast collection and display of key information about the state of the monitored equipment. It is designed for monitoring (data collection) of multiple devices connected via multiple buses RS-232/RS-485 in APS5000, APS6000, MODBUS RTU or MODBUS protocols on Ethernet link.

The program allows for transferring the collected data to the monitoring master system in MODBUS RTU/IEC103 protocol on RS232/485 link or MODBUS TCP on Ethernet link. A configuration is possible so that the locally running SAN DIR program collecting data via RS may transmit the data via Ethernet to another SAN DIR program installed on another computer within the network. This way monitoring of many positions can be performed.

## DESCRIPTION OF SAN DIR PROGRAM OPERATION

THE PROGRAM CONSISTS OF THE FOLLOWING TWO MODULES:

Monitoring Module - used to monitor the current state of the system.

Reporting Module - used to view and analyze archived data.

### MONITORING MODULE

Main screen - shows the monitored devices in graphical form. It allows to assess the state of the entire monitored installation and to detect the irregularities in the system operation.

The individual graphical elements represent the devices, groups of devices (e.g. devices installed in the switching station) or selected groups of signals (e.g. all rectifiers).

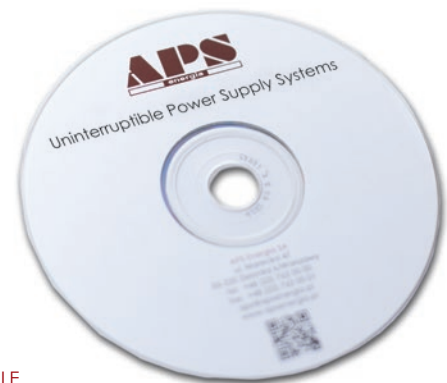
The individual components of the system are highlighted with one of 4 colors defining the status or state of the device, i.e.: OK, ALLERT, ALARM, NO COMMUNICATION.



PIC. The graphic representation is strictly dependent on the list of objects, equipment and signals.

In practice, this means the ability to monitor any device manufactured by APS Energia and any device of another manufacturer communicating in MODBUS RTU or MODBUS TCP protocol.

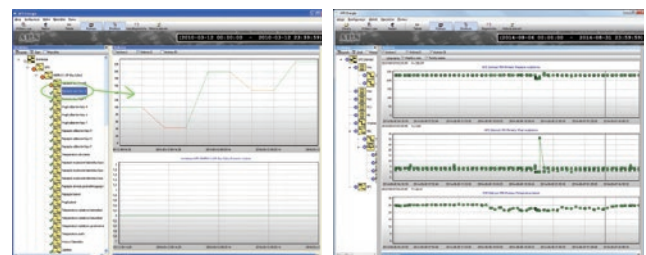
SAN DIR allows for remote monitoring of the devices within the computer network. With proper network configuration monitoring via the Internet from any location is also possible.



### REPORTING MODULE

The program records the data on the parameters and states of monitored devices and allows for viewing of the parameters and states recorded during operation. The archive is stored in archiwum.dat file in the directory including the current installation. If the file takes too much space it can be moved to another location or deleted if the archived data is no longer needed. The copied file, can be viewed using the archive module of the program installed on another computer.

The history can be viewed as a selected record or by defining specified period of time. The data can be viewed in form of summary tables as graphs.



PIC. The reporting module allows for fast analysis of data variability over time by observing changes in value of the signals generated in graphs. Displaying the waveform on the graph is done in a simple and intuitive way by dragging the signal from the signals tree to the selected chart format (one of three possible ones).

### MINIMUM REQUIREMENTS TO INSTALL THE SOFTWARE:

- Pentium 4 1.5 GHz or more;
- 2GB of RAM;
- 100MB of free hard disk space

# SAN KP1 IEC 61850 SAN KP1 STANDARD CONVERTER

Intended for the following industries:



IEC 61850 standard is used to configure the electrical substations automatic machinery. Used protocols (MMS, GOOSE, SMV, Network Services, DNP3 and IEC60870-5-104) operate in networks based on TCP/IP or Ethernet local networks offering response time of less than 4 ms. IEC 61850 standard has several advantages compared to the previously used technologies:

- automatic names of devices: applications that are connected to devices via IEC 61850 are able to download the names and descriptions of all devices without any manual configuration;
- standardization of names of devices: the names and descriptions of devices do not depend on the manufacturer nor the end user, but are standardized;
- lower cost of installation, the devices are connected to LAN, not directly to each other which allows to economize on number of cables and conduits;
- lower costs of start-up: compared to the previous standards, IEC 61850 requires much less time and manual work during the configuration;
- lower costs of extension: adding more devices to the existing systems does not generate additional costs of connectors or configuration.

SAN KP1 device is designed to convert data from IEC 60870-5-103 protocol to IEC 61850 standard. Internal links of communication of RS-485 and Ethernet are isolated. Operating status of the device is presented on the console by means of LEDs. Configuration of the device and its operating parameters is performed remotely through a network browser.

## SAN KP1 CONVERTER SPECIFICATION:

- High stability of operation;
- Signaling the following operating states:
  - Power supply;
  - Normal operation;
  - Communication on IEC 61850;
  - Communication on IEC 60870-5-103 - transmitting;
  - Communication on IEC 60870-5-103 – offtake;
- Button to reset the default device settings;
- RS 485 – 300 V insulated connector
- Ethernet – 100 V insulated connector
- Service and system logs record in the internal memory.

The module housing provides mounting to the wall with a snap on 35mm symmetrical bus. Ethernet cable (twisted pair cable), RS 485 twisted cable together with cable shield and power supply with a ground cable should be connected to the device.

The device can be power supplied with one of two available voltage ranges:

- from 18V to 36VDC,
- from 100V to 250VAC.

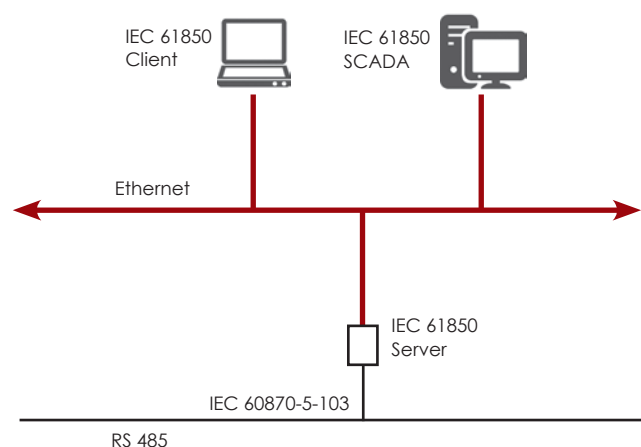
Selection of the scope of power supply is determined by the manufacturer and depends on the power supply voltage required by the customer.



PIC. Converter SAN KP1

## TAB. SAN KP1 TECHNICAL PARAMETERS

Supply voltage	230/110/24 V
RS485 isolation	300 V
RS485 transmission speed	19200 bps
Transmission parameters RS485	8N1
Ethernet transmission speed	10/100 Mbps
Ethernet protocols	HTTP, SNMP, IEC 61850
Power consumption	3 W
<b>HOUSING</b>	
Housing type	CP-23-106
Mounting	DIN 46277
IP	IP 21
Dimension (W x H x D)	76x92x60 mm
Color	RAL7031
<b>ENVIRONMENTAL</b>	
Operating temperature (EN 50178 class 3K3)	0 to 35 °C
Storage temperature	-25 to 65 °C
Humidity	max 75%



PIC. Sample configuration of automation system in IEC 61850