SO-52v21-AUT

integrated protection relay of MV lines

The SO-52v21-AUT integrated protection relay is designed for the operation and supervision of overhead and internal MV disconnectors and circuit breakers, MV/nN substations, cable lines, along with independent fault passage indicators.

It integrates measurement, control, protection relay, telemetry, fault passage indicator, sectionalizer and disturbance recorder functions. It features a continuous intermittent earth fault detection module, which is the symptom of increasing intensity of partial discharges due to increasing degradation of the cable insulation.

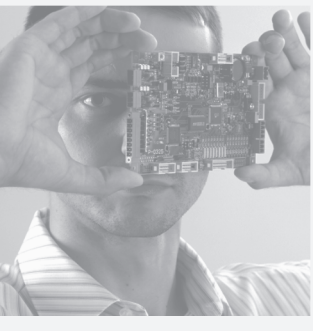
Depending on the software version, it can have an integrated indicator and sectionalizer module or be designed for complex operation of control units for overhead and internal circuit breakers.

The communication resources, including a built-in modem, enable operation in standard protocols in a variety of networks based on Ethernet, GPRS/UMTS/LTE-APN, TETRA and radio transmission in dedicated and open channels.

The device performs advanced voltage and current measurements. It has extensive resources of binary inputs and outputs for the control implementation. It performs typical protection relay functions such as detection of phase-to-phase short circuits and earth faults. It implements the functionality of a sectionalizer. During short-circuits or earth faults, it can open the disconnector in the selected AR cycle.

To ensure data protection and confidentiality, cyber security mechanisms can be activated in the device in accordance with PN-EN 62351.

The SO-52v21-AUT is designed to perform telemetry and automation functions resulting from the needs of Smart Grid technology and FDIR modules.



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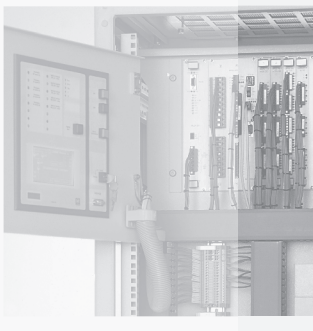


Telemetry and protection relay functions

SO-52v21-AUT performs telemetry and protection relay functions for the fault passage indicator and analyzer or the protection relay of the circuit breaker field. It performs reading of the binary inputs' status, measurements of phase currents and voltages, short circuit detection in MV line, including intermittent earth faults. The states of all inputs, measurement values and short-circuit signaling, as well as information on protection relay tripping, are transmitted by event or can be read cyclically by the SCADA system.

Buttons located on the elevation make it possible to:

- TEST – test a correctness of the signaling device operation followed by transmission of information to the SCADA system
- KAS. – delete the short circuit signaling

Phase-to-phase- and earth faults are detected in networks with different modes of neutral point operation:

- compensated with automatic forcing of the active current component
- with neutral point earthed through a resistor
- with neutral point insulated

Detection of phase-to-phase and earth faults takes place on the basis of measurements *:

- three-phase currents from current transformers and the 3I0 current, obtained from the Holmgreen measurement or three-phase currents from Rogowski coils or other sensors; the 3I0 current is determined from these measurements
- voltage detection or three voltages from reactance dividers or other sensors; from these measurements the voltage 3U0 is determined

* For protection relay of the circuit breaker field, it is also possible to use modules, which can measure current 3I0 and voltage 3U0.

The following standardized protection relay modules are available in the version of the device that performs signaling/sectionalizer and protection relay functions:

SYMBOL	PROTECTION MODULE NAME	ANSI CODE	SECTIONALIZER	PROTECTION
I1>>	instantaneous overcurrent (directional / directionless)	50/67	yes	yes
I2>>	instantaneous overcurrent (directional / directionless)	50/67	yes	yes
I1>	overcurrent (directional / directionless)	51/67	yes	yes
I2>>	instantaneous overcurrent (directional / directionless)	50/67	no	yes
Id>	dependent overcurrent	51	no	yes
Iasym>	against current asymmetry	46/46BC	no	yes
I0>>	non-directional earth fault	50N	no	yes
I0>	non-directional earth fault	51N	yes	yes
I0dir>	directional earth fault	67N	yes	yes
G0>	conductance (directional / directionless)	-	yes	yes
B0dir>	directional susceptance	-	yes	yes
Y0>	admittance	-	yes	yes
U0>	neutral overvoltage	59N	no	yes
U>>	overvoltage	59	yes	yes
U>	overvoltage	59	yes	yes
U<<	undervoltage	27	no	yes
U<	undervoltage	27	yes	yes
f>	overfrequency	81O	yes	yes
f<	underfrequency	81U	yes	yes
df/dt	rate of change of frequency	81R	no	yes
2HI	2nd harmonic inrush restraint	-	yes	yes
AR	automatic reclosing	79	no	yes
CLP	cold load pickup	-	no	yes
SOFT	instantaneous trip after SOTF (Switch-On-To-Fault)	-	no	yes
I0int>(f)	intermittent earth fault - forward	-	yes	yes
I0int>(b)	intermittent earth fault - backward	-	yes	yes

Four setting banks are available for each protection criterion available in the controller, which significantly simplifies operation, especially under conditions where changes to the electric power network configuration are required.

Event recorder

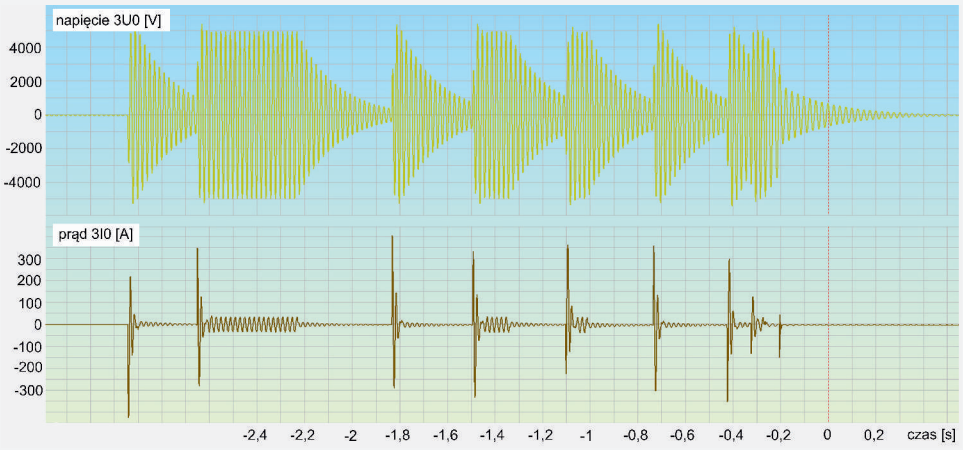
The log of the event recorder is accessible via the pConfig configuration program and the SCADA dispatching system. All events related to the supervised facility are recorded in it. A time stamp with a resolution of 1ms allows analysis of substation events and operations performed both during normal operation, which includes switching on and off, changes to setting banks, configuration changes and in emergency situations.

Disturbance recorder

The SO-52v21-AUT is equipped with a multi-channel disturbance recorder. Analog disturbance waveforms are recorded in non-volatile memory in COMTRADE standard and can be read locally or remotely via an engineering link.

Intermittent earth fault detection

A symptom of progressive cable degradation is the build-up of partial discharges observed during overvoltages. SO-52v21-AUT is equipped with a module for continuous detection of such phenomena, manifested by characteristic steep current "peaks" in the 3I0 current waveform. If such a situation is identified, a warning is sent to the supervisory system and a corresponding state is set in the device's internal data base.



Cybersecurity

The cybersecurity solutions used in SO-52v21-AUT are based on the recommendations of ENISA, NIST, BDEW, BlueCrypt. They comply with PN-EN 62351, IEEE P1686, PN-ISO/IEC 27001, BDEW White Paper "Requirement for Secure Control and Telecommunication Systems". These mechanisms include: communication protection, access control, protection of sensitive data logging/monitoring of user activity. The various functionalities are configurable using pConfig software.

Communication with SCADA systems

SO-52v21-AUT can communicate with SCADA system via built-in 2G/3G modem, Ethernet network or via RS-485 and RS-232 links supporting various communication protocols. For communication with SCADA systems, DNP 3.0 or PN-EN 60870-5-104 protocols are used as standard.

SO-52v21-AUT is adapted for cooperation with TETRA system. An external radio terminal of the TETRA system can be connected via a serial link. The device provides simultaneous, parallel communication with the SCADA system in TETRA and GPRS/UMTS-APN communications.

Configuration and diagnostics

Remote, local configuration and diagnostics are performed through the dedicated pConfig program. Diagnostics is also possible through the web interface, SMS messages and telemetry protocols or SNMP v3 protocol, allowing the controller to be connected to a telecommunications network monitoring system. Configuration and diagnostics are possible via the ETHERNET interface and via the GPRS/UMTS-APN network.

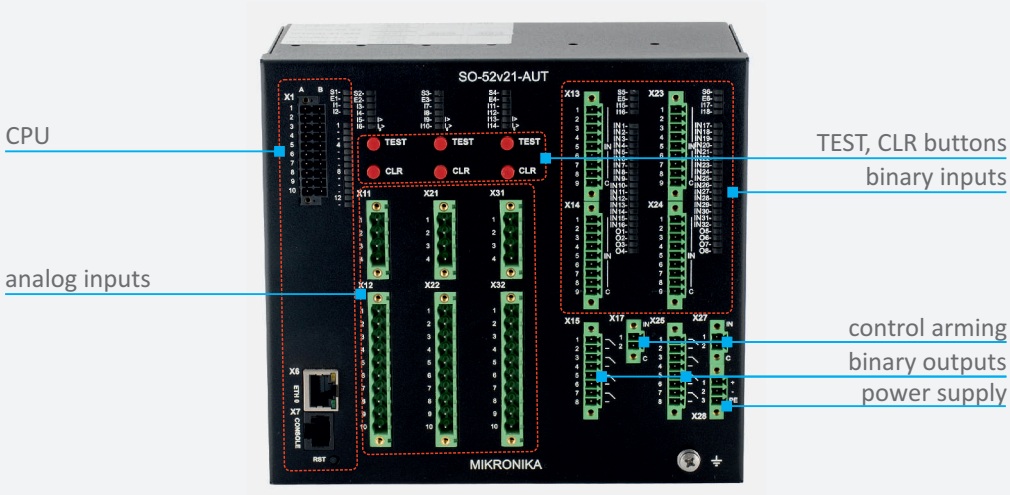
Design

The SO-52v21-AUT is made in a metal enclosure, resistant to hard environmental conditions. It is suitable for mounting on a 35mm DIN rail. It can be installed surface-mounted or flush-mounted. The power supply is galvanically separated from the communication interfaces and logic circuits, which guarantees resistance to overvoltage and non-sensitive transmission to disturbances.

The device is equipped with galvanically separated two-state inputs for the acquisition of states from the object and galvanically separated two-state outputs for the realization of controls. The analog inputs are suitable for measuring currents from current transformers, Rogowski coils or other sensors, and measuring voltages from reactance dividers or other sensors.

Configuration example

Shown below is an example configuration of the SO-52v21-AUT, in which phase-to-phase and earth fault detection is based on measurements of three phase currents from current transformers and 3I0 current and voltage detection.



RESOURCE TYPE	CONNECTORS	RESOURCE
central unit	X1, X6, X7	2x RS-485, 2x RS-232, 1-Wire, Ethernet TP 10/100, RS-232-serv.
analog inputs	X11, X21, X31 X12, X22, X32	9x 100V AC inputs, 9x 1A AC inputs
binary inputs	X13, X14, X23, X24	48x binary inputs
binary outputs	X15, X25	8x binary outputs
power supply	X28	nominal supply voltage: 24V DC
control arming	X17, X27	external control arming capability

Technical data

Insulation

RESOURCE TYPE	DIELECTRIC WITHSTAND	SURGE IMMUNITY
power supply	2.5 kV; RMS / 1 min	5kV; 1.2 / 50µs
digital inputs/outputs	2.5 kV; RMS / 1 min	5kV; 1.2 / 50µs
analog inputs	0.5 kV DC / 1 min	2kV; 1.2 / 50µs

Input and output characteristics

PARAMETER	OUTPUTS	INPUTS	MEASUREMENT
number	12	48	9
nominal voltage	24÷60V	24V, 48V, 60V	57.7/100V
current	6A/24V DC	3mA / wejście	0÷1A, 0÷5A; 2V *)
maximum connecting power	1500VA AC	0.2W / wejście	-

*) for low-voltage inputs from Rogowski coils and sensors