EGE spol. s r.o.

ELECTRICAL ENGINEERING DIVISION

Distribution Network Department

SRA 2250/6 RESISTOR
ARS-01 RESISTOR AUTOMATICS

ELA T150.2 en

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SRA 2250/6 RESISTOR
ARS-01 AUTOMATICS

SRA 2250/6 Resistor specification

The SRA 2250/6 Resistor is intended to increase the active component of residual current passing through the point of a ground fault. The device is designed for connection to the secondary winding of an arc-suppression coil. The system of the resistor's automatics makes it possible to fit the resistance of the device to the character of the earth fault and thus enhance reliability – sensitivity of ground-fault protection relays.

The ARS-01 Automatics is designed to control the SRA Resistor, namely to connect it to / disconnect from the winding of the arc-suppression coil while the network is experiencing the ground fault. The automatics matches the resistance of the device to the character of the earth fault and monitors thermal loading of the resistor. When used together with the ARS Automatics, the SRA Resistor offers the optimal value of resistance being connected and improves the reliability – sensitivity of ground-fault protection relays also to high-ohmic faults.

Description of the resistor

The SRA 2250/6 Resistor has a cabinet consisting of two parts: (1) an IP 23 enclosure housing the resistors themselves and (2) an IP 54 control unit. The resistor enclosure contains air-cooled resistive elements while the control unit houses the input terminal block; contactors; heating resistor; thermostat and the automatics proper. Both the resistor enclosure and the control unit casing are made of a stainless steel sheet.

Technical parameters of SRA 2250/06

Type	SRA 2250/6
Rated resistance [Ω]	from 0.22 to 6
Rated voltage [V]	500V
Rated current [A]	2250
Loading time [s]	6
Weight [kg]	83
Cross-section of connecting cable [mm^2, Cu)	95
Control voltage of contactors	230 V / 50 Hz

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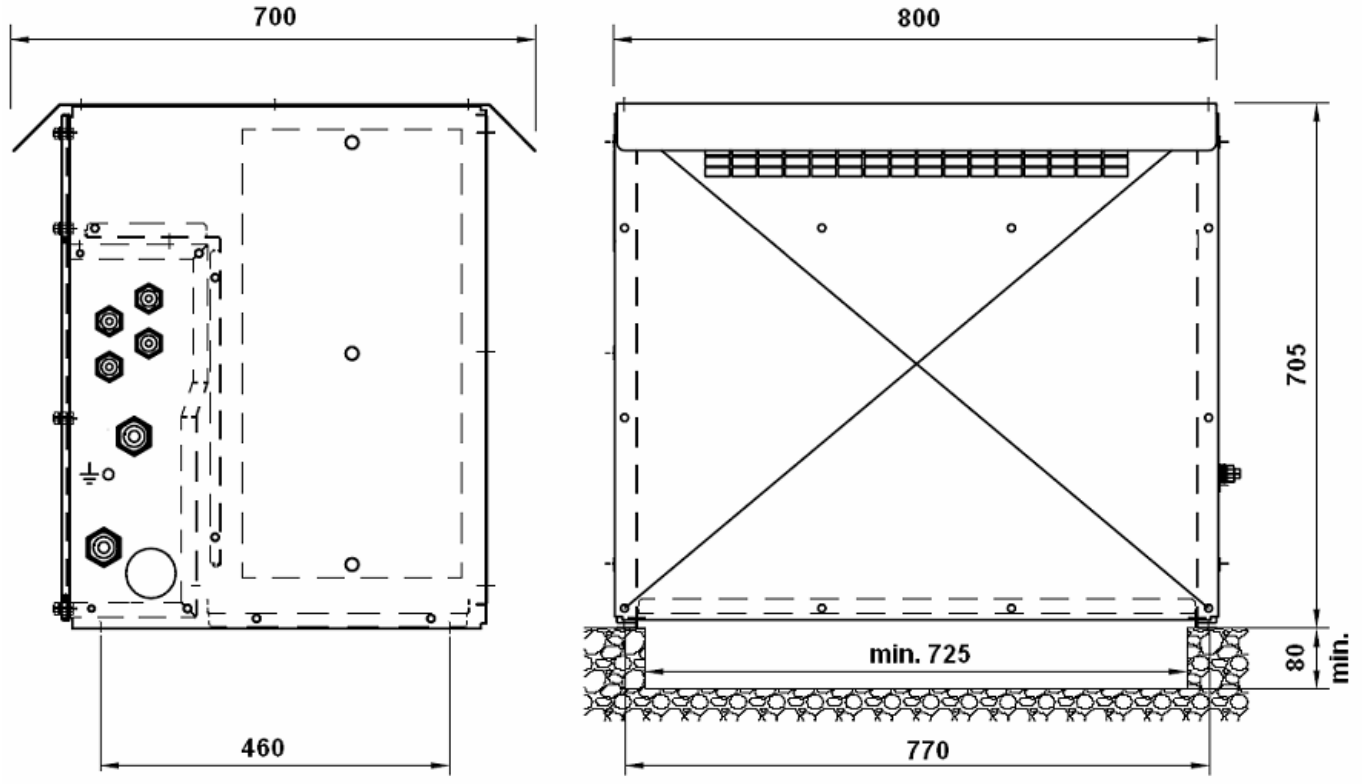
Installation

The resistor is designed for attachment to a concrete foundation block sized no less than 800 mm x 500 mm. The upper surface of the block must not be lower than 300 mm above the adjacent ground level so that the device is protected from surface water and melting snow. Moreover, air has to be allowed to flow freely from the down downside of the resistor up so that the resistive elements may be adequately cooled. The vertical distance left free below the resistor shall not be lower than 80 mm (see the Dimensioned Drawing). In case the device is mounted on a level concrete block, it has to be supported on spacers of the height, i.e. no shorter than 80 mm. If the customer so wishes, the spacers can be delivered as the resistor's accessory. To fix the device to the foundation, it is fitted with four attachment holes, 14 mm DIA each, spaced 770 mm x 460 mm.

To connect the resistor to the electrical system, the device is fitted with 6 cable glands. Power cables are attached using cable lugs sized to accommodate the M10 bolts; the recommended cable will be made of copper and will offer the cross section no smaller than 95 mm^2. The control cables and the cable used to power the heating elements are connected directly to the terminal block. The heating resistor is supplied with 230 V AC, 50 Hz. Protective purposes require that the device is bonded to the grounding grid of the electrical station - that is why it is furnished with an M12 bolt prepared at the cabinet side, next to the cable glands. For the positions of the glands and the other points of connection see the Dimensioned Drawing below.

SRA 2250/6 Resistor - Dimensioned Drawing



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ARS-01 Automatics - Principle functions

The ARS-01 Automatics can operate in two modes offering different functions, where a specific mode is selected parametrically.

Mode of SR resistors control: Responding to a ground fault experienced by the system, the automatics will connect the resistor to the auxiliary power winding of the arc-suppression coil so that the active component of the coil current is increased and the performance of the ground-fault protections is improved. The Uo voltage will be monitored all the time, and with the ground-fault setpoint of the voltage exceeded, the device will first wait for the preset "time of R connection delay" and then connect the resistor to the auxiliary power winding of the coil for the preset "time of R connection". Provided the "number of connection cycles repeated" is set at a figure different from zero, the device will first wait for the "time of repeated R connection delay" and then it will connect the R resistor once again.

Mode of SRA resistors control: The proper resistance to be connected is determined in accordance with (1) the voltages measured across the auxiliary power winding of the arc-suppression coil (0 to 500 V) and (2) the loading current passing through the winding when the testing resistor is connected to the coil while the ground fault is being experienced. The resistance is built by a suitable series-parallel combination of the resistive elements of the SRA Resistor connected to the power winding of the arc-suppression coil. In case the ground-fault protections fail to extend signals proving they tripped as expected, the resistance adjusted as described above can be connected repeatedly. In that way the active component of the fault current will be increased to the optimal level, without causing inadvertent drop in voltage below the level required to trip the protections - consequently, the system will provide greater reliability in detecting even the high-resistance faults.

To protect the resistor from overloading possibly caused by constant metering of current flowing through the device, the automatics will calculate the expected temperature rise using an implemented model of temperature buildup. With the thermal capacity of the resistor used up to the full, the automatics will prevent the resistor from being connected, or it will even disconnect the resistor when already connected. The resistor will remain safely disconnected until its temperature drops to approx. 80% of its overall thermal capacity.

The automated diagnostics system will measure the current passing through the resistor and the Uo voltage developed across the device whenever the resistor is connected. Using the two values the diagnostics will calculate the actual resistance of the device, a piece of information then employed to monitor aging of the resistive material and integrity of the resistive route.

Description of the automatics

Design

The automatics is designed as a dedicated item of microprocessor equipment consisting of two printed-circuit boards enclosed in aluminium profiles to be attached to the DIN rail. It comprises the power supply unit; metering analog circuits; decision-making microprocessor unit; binary inputs; relay outputs utilized to control contactors connecting the different resistive elements; signalling outputs; and a communication interface intended to set the parameters and communicate with the higher-level Control System. Concept of the design put the strongest emphasis on the ability of enduring the EMC interferences while suppressing the spurious EMC emissions.

Power supply

The automatics is powered by the grid voltage, i.e. 230 V AC, 50 Hz. The power supply circuitry of the ground-fault protection makes it possible to feed the device from also an emergency DC source. The power supply unit itself consists of an EMC filter; protective elements (fuses); and a switching power supply source capable of offering the required internal levels of powering.

Metering

The input circuits are used to measure, within three automatically set ranges, the voltage across the auxiliary power winding of the arc-suppression coil (U) , and the current flowing through the power winding with the resistor connected (I). After being treated in the relevant current or voltage transformers of the instrument type, the signals are amplified, filtered, and fed into the inputs of the processor's analog-digital converter to be there subject to more processing. The signals being digitally processed are sampled at the frequency of 2.4 kHz.

Inputs

The automatics has four universal binary inputs:

- R_ON - a remote command to connect the resistor;
- BLOCK - a remote blocking function of the ARS Automatics (both the automated and the manual connections are thus inhibited);
- GSC - a summary signal extended by the ground-fault protections tripping;
- BLOCK_AUT - blocking function of the automated resistor connection possibly initiated by the U_0 voltage measured

The automatics is also fitted with two analog inputs able to read current in the loop - 0/4 to 20 mA DC.

Outputs

The protection offers 8 binary relay outputs:

- 5 outputs fitted with a switch-over contact set (having a common central contact) used to switch the individual resistive elements;
- 3 outputs with a switch-over contact set used to signal the different states of the automatics, namely:
    - READY/ERROR - puts the automatics to a performance test;
    - BLOCK - prevents connecting the resistors if (1) the thermal capacity of the resistive elements is used up to the full, or if (2) a remote command to that effect has been received;
    - RELAY_SIG - switches the measured U_0 signal for the ground-fault protections.

Moreover, the protection provides two parameterized analog outputs of the current loops 0/4 to 20 mA DC.

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Decision-making CPU unit

The entire connection / disconnection algorithm runs on a 16-bit control microprocessor offering the DSP functions. The processor takes care of digitizing the measured analog values of voltage (U0) and current (I0). Having evaluated the binary inputs indicated and the voltage & current levels measured, the processor will decide about the optimal resistance to be connected. To prevent voltage across the auxiliary power winding from dropping below the preset limit value, the voltage is continuously monitored. At the same time the processor will compute the thermal model of the different resistive elements so that the elements are kept from overloading and the entire system becomes more reliable.

Signalling & Control

Using the indicators listed below, the automatics signals the operational states of the protection:

- READY/ERROR - a diagnostics LED diode informing on the performance of the entire equipment;
- BLOCK - a LED diode signalling that the resistor is blocked and cannot be therefore connected;
- R ON - a LED diode indicating the connected status of the resistor;

The automatics is fitted with a RESET button intended to reset the control microprocessor; the button can only be handled with a special tool.

Parameterization

The automatics is furnished with an USB communication interface designed for comprehensive parameterization of functions. Using the parameterizing software installed on a PC, a notebook computer, or a PDA device, the system can be set to connect / disconnect different patterns of resistive elements in consideration of different criteria; it can adjust the comparative levels and time delays; read the values recorded, and more....

Technical parameters of ARS 01

Power supply

Supply voltage:	85 to 264 V AC, 110 to 375 V DC, optionally 24 to 100 V DC
Network frequency:	50 / 60 Hz
Input power:	6 W
On-board fuse:	T 1A / 250 V
Insulation strength	3 kV

Current inputs

Number of channels	1
Rated current ranges (**In**)	0 to 1 A or 0 to 5 A
Overloading capacity of the inputs	1.2 In - permanently
Sampling frequency	2.4 kHz
Measurement accuracy	< 0.5 %, 12 bit ADC
Galvanic isolation level	4 kV
Input resistance	< 0.001 Ω

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Voltage measuring inputs

Number of channels	1
Rated voltage range (**Un**)	0 to 500 V AC, 50 Hz
Permanent overloading capacity	1.2 Un
Sampling frequency	2.4 kHz
Measurement accuracy	< 0.5 %, 12 bit ADC
Galvanic isolation level	4 kV
Input resistance	100 k Ω

Binary inputs

Number of channels	4
Logical "1":	230 V AC, optionally 24 / 60 / 110 / 220 V DC
Logical "0":	< 30% out of the logical "1"
Consumption per one channel:	typical 2 mA, maximum 4 mA
Galvanic isolation level:	4 kV
Time verification:	10 ms to 10 s for DC; 60 ms to 10 s for AC

Binary outputs

Number of channels	5 + 3
Dry (*galvanic*) relay contact:	Single-pole NO contact
Voltage switched:	250 V ADC / 8 A
Switching capacity:	6 A AC, 0.3 A DC
Galvanic isolation level:	5 kV

Analog inputs

Number of channels	2 AI parameterized independently as current / voltage inputs;
Input quantity:	current input: 0/4 to 20 mA DC; voltage input: 0 to 10 V DC
Input resistance:	500 Ω
Measurement accuracy	< 0.025 %, 1(2 bit DAC)
Resolution capability:	5 µA / 2.5 mV
Galvanic isolation level:	4 kV
Parameterizing capability:	converted quantity; dynamic metering range; type of conversion characteristic (linear, linear angled, logarithmic, ...)

Analog outputs

Number of channels:	2 current outputs 0/4 to 20 mA DC
Input resistance:	500 Ω
Measurement accuracy	< 0.025 %, 1(2 bit DAC)
Resolution capability:	5 µA
Galvanic isolation level:	4 kV
Parameterizing capability:	converted quantity; dynamic metering range; type of conversion characteristic (linear, linear angled, logarithmic, ...)

Environment conditions

Range of working temperatures	-25 ℃ ÷ +70 ℃
Range of storage temperatures	-40 ℃ ÷ +100 ℃
Relative humidity	up to 95%, non-condensing

Design

Instrumentation box	aluminium galvanized profile
Mounting	to the DIN rail or alternatively onto a panel
Connectors	disconnectable, fixed with screws
- threaded terminals	Cu wires up to 4 mm^2, 400 V / 20 A
Dimensions (connectors connected) (h x w x l)	70 x 105 x 220 mm
Weight	1 kg

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