Restricted earth-fault and residual earth-fault relay

SPAJ 115 C

1MRS 750353-MBG

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Data subject to change without notice



Features

- Sensitive restricted earth-fault protection stage for fast, selective earth-fault protection
- Sensitive definite time or inverse time earth-fault stage for back-up residual earth-fault protection
- Output relay functions freely configurable for desired relay operations
- Flexible adaptation of the relay to different types of application
- Local numerical display of setting values, measured values and recorded fault values
- Serial interface for two-way data communication over fibre-optic bus between relay level and superior system levels
- Accurate settings and stable functions due to fully digital relay design
- High immunity to electrical interference and robust aluminum case to class IP54
- Continuous self-supervision of hardware and software, including auto-diagnostics
- Powerful optional software support for setting, reading, copying and recording relay parameters
- Member of the SPACOM product family and ABB's Substation Automation system
- CE marking according to the EC directive for EMC

Application

The combined restricted earth-fault and residual earth-fault relay SPAJ 115 C is intended to be used for the earth-fault protection of power generators, motors and transformers.

The relay contains two energizing input circuits, that is, a differential earth-fault current circuit and a residual earth-fault current circuit.

Design

The combined restricted earth-fault and residual earth-fault relay SPAJ 115 C is a secondary relay which measures two energizing currents: the differential current ΔI_0 and the residual current I_0. When an earth fault is detected the relay operates, alarms and trips the circuit breaker, according to the configuration of the relay.

The differential current is formed with an external circuit, for instance, the one shown in “Block diagram”.

The main earth-fault protection is provided by the restricted earth-fault current stage ΔI_0, which operates instantaneously, when the differential current exceeds the set start value of the restricted earth-fault stage. The restricted earth-fault stage operates exclusively on earth faults inside the area of protection. The area of protection is limited by the phase current transformers and the current transformer of the neutral earthing circuit. The operation of the restricted earth-fault stage on faults outside the area of protection is prevented by a stabilizing resistor, which is connected in series with the matching transformer of the relay, see paragraph “Block diagram”.

The restricted earth-fault stage operating exclusively on faults inside the area of protection is based on the fact, that the impedance of a transformer decreases as the transformer is saturated. The reactance of the excitation circuit of a fully saturated transformer is zero and then the impedance is composed purely of the resistance of the coil. Under the influence of the stabilizing resistor in the differential current circuit the secondary current of the non-saturated transformer is forced to flow through the secondary circuit of the saturated transformer. The start current of the restricted earth-fault stage is set so high, that the stage cannot operate on currents caused by external faults into the differential current circuit.

When an earth fault appears inside the area of protection, both transformers tend to feed current into the differential current circuit and the stage operates. To keep the resistance of the secondary circuit as low as possible, the summing point for the currents should be located as close to the current transformers as possible.

Data communication

The relay is provided with a serial interface on the rear panel. By means of a bus connection module type SPA-ZC 17 or SPA-ZC 21 the relay can be connected to the fibre-optic SPA bus. The bus connection module type SPA-ZC 21 is powered from the host relay, whereas the bus connection module SPA-ZC 17 is provided with a built-in power unit, which can be fed from an external secured power source. The relay communicates with higher-level data acquisition and control systems over the SPA bus.

Self-supervision

The relay incorporates a sophisticated self-supervision system with auto-diagnosis, which increases the availability of the relay and the reliability of the system. The self-supervision system continuously monitors the hardware and the software of the relay. The system also supervises the operation of the auxiliary supply module and the voltages generated by the module.

When the self-supervision system detects a permanent internal relay fault, the IRF indicator on the relay front panel is lit. At the same time the output relay of the self-supervision system operates and a fault message is transmitted to the higher-level system over the serial bus. Further, in most fault situations, a fault code is shown in the display of the protection relay module. The fault code indicates the type of the fault that has been detected.

Auxiliary supply voltage

The auxiliary supply of the relay is obtained from an internal plug-in type power supply module. Two auxiliary power module versions are available: type SPTU 240S1 for the supply voltage range 80…265 V ac/dc and type SPTU 48S1 for the supply voltage range 18…80 V dc. The power supply module forms the internal voltages required by the protection relay and the I/O module.

Technical data

Table 1: Energizing inputs

Terminals		25-27, 37-39	25-26, 37-38
Rated current I_n		1 A	5 A
Thermal withstand capability	continuously	4 A	20 A
	for 10 s	25 A	100 A
	for 1 s	100 A	500 A
Dynamic current withstand capability	Half-wave value	250 A	1250 A
Input impedance		<100 mΩ	<20 mΩ
Rated frequency f_n, according to order		50 Hz or 60 Hz	

Table 2: Output contact ratings

Type of contact		Tripping	Signalling
Terminals		65-66, 68-69	70-71-72, 77-78, 80-81
Rated voltage		250 V ac/dc	
Thermal withstand capability	Carry continuously	5 A	5 A
	Make and carry for 0.5 s	30 A	10 A
	Make and carry for 3 s	15 A	8 A
Breaking capacity for dc, when the control/ signalling circuit time constant L/R ≤ 40 ms, at the control voltages	220 V dc	1 A	0.15 A
	110 V dc	3 A	0.25 A
	48 V dc	5 A	1 A
Contact material		$AgCdO_2$	

Table 3: Control, communication and power supply

External control input	Terminals		10-11
	Control voltage level		18…265 V dc or 80…265 V ac
	Power consumption when input activated		2…20 mA
Data communication	Transmission mode		Fibre-optic serial bus
	Data code		ASCII
	Selectable data transfer rates		300, 1200, 2400, 4800 or 9600 Bd
	Fibre-optic bus connection module, powered from the host relay	for plastic fibre cables	SPA-ZC 21BB
		for glass fibre cables	SPA-ZC 21MM
	Fibre-optic bus connection module with a built-in power supply unit	for plastic fibre cables	SPA-ZC 17BB
		for glass fibre cables	SPA-ZC 17MM
Auxiliary supply modules	Power supply and I/O modules and voltage ranges	SPTU 240S1	80…265 V ac/dc
		SPTU 48S1	18…80 V dc
	Power consumption	under quiescent conditions	~4 W
		under operating conditions	~6 W

Technical data (cont'd)

Table 4: Restricted earth-fault and neutral current relay module SPCJ 2C30

Residual earth-fault current stage I_0>	Start current I_0>, setting range			5…40% of I_n
	Selectable operation characteristic	Definite time characteristic	Operate time t_0>	0.1…100 s
		Inverse definite minimum time (IDMT) characteristic	Curve sets acc. to IEC 255-4 and BS 142	Normal inverse Very inverse Extremely inverse Long-time inverse
			Time multiplier k	0.05…1.00
	Reset time, typically			60 ms
	Drop-off/pick-up ratio, typically			0.96
	Operation time accuracy			±2% of set value or ±25 ms
	Operation time accuracy class E at IDMT mode of operation			5
	Operation accuracy			±3% of set value
Restricted earth-fault current stage ΔI_0>	Restricted earth-fault current ΔI_0>, setting range			0.5…5% of I_n
	Operate time, typically			35 ms
	Reset time, typically			60 ms
	Drop-off/pick-up ratio, typically			0.97
	Operate time accuracy			±25 ms
	Operation accuracy		in setting range 0.5…1.5% of I_n	±5% of set value
			in setting range 1.5…5% of I_n	±3% of set value

Table 5: Tests and standards

Test voltages	Dielectric test voltage (IEC 60255-5)	2.0 kV, 50 Hz, 1 min
	Impulse test voltage (IEC 60255-5)	5 kV, 1.2/50 μs, 0.5 J
	Insulation resistance (IEC 60255-5)	>100 MΩ, 500 V dc
Interference tests	High-frequency (1 MHz) disturbance test (IEC 60255-22-1), common mode	2.5 kV
	High-frequency (1 MHz) disturbance test (IEC 60255-22-1), differential mode	1.0 kV
	Fast transients (IEC 60255-22-4, class III and IEC 60801-4, level 4), power supply inputs	4 kV, 5/50 ns
	Fast transients (IEC 60255-22-4, class III and IEC 60801-4, level 4), other inputs	2 kV, 5/50 ns
	Electrostatic discharge (IEC 60255-22-2 and IEC 60801-2, class III), air discharge	8 kV
	Electrostatic discharge (IEC 60255-22-2 and IEC 60801-2, class III), contact discharge	6 kV
Environmental conditions	Service temperature range	-10…+55°C
	Transport and storage temperature range (IEC 60068-2-8)	-40…+70°C
	Damp heat test (IEC 60068-2-3)	<95%, +40°C, 96 h
	Relative humidity (IEC 60068-2-30)	93…95%, +55°C, 6 cycles
	Degree of protection by enclosure when panel mounted	IP 54
	Weight	3 kg

Block diagram

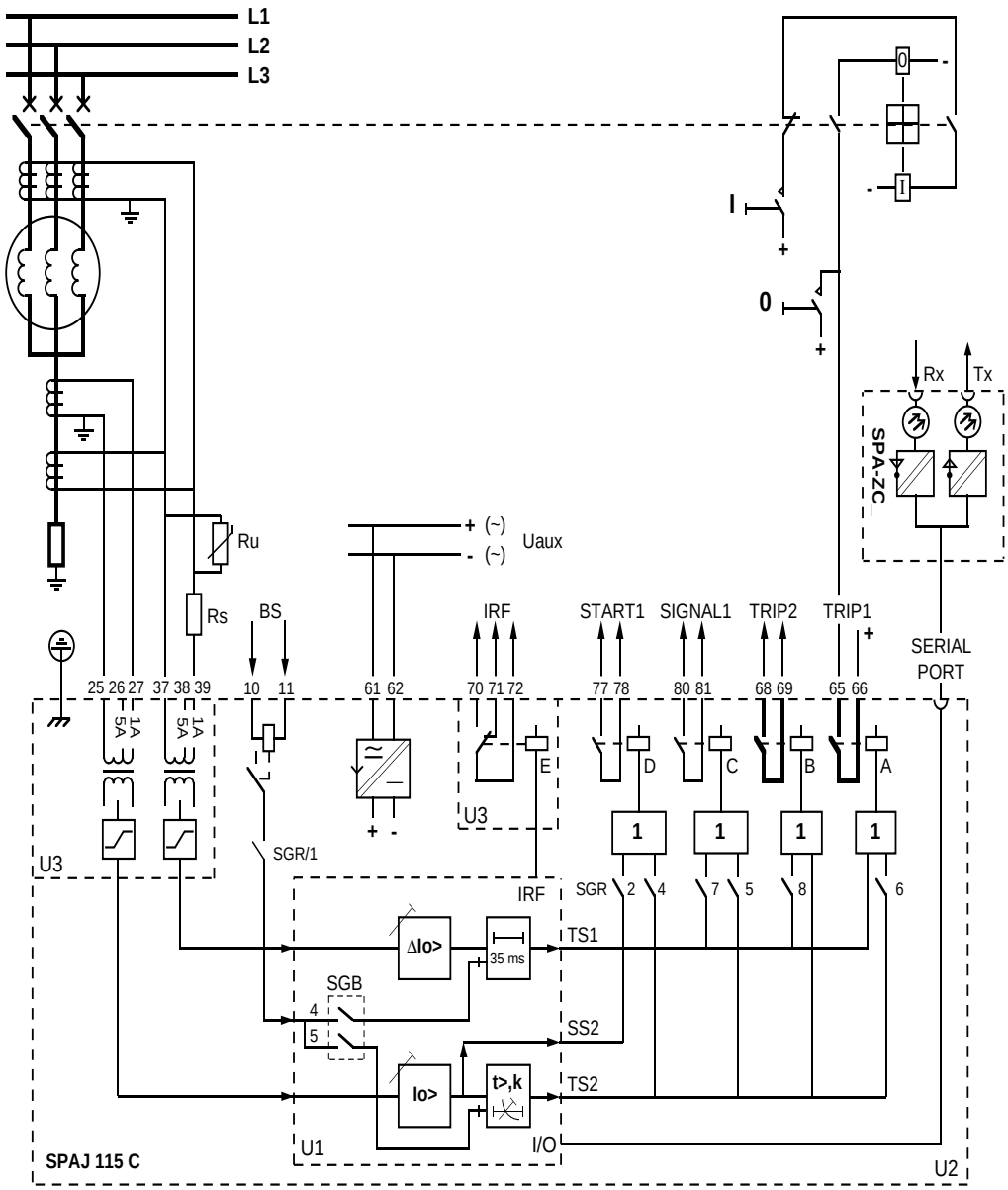


Fig. 1 Block diagram and sample connection diagram

Mounting and dimensions

Flush mounting

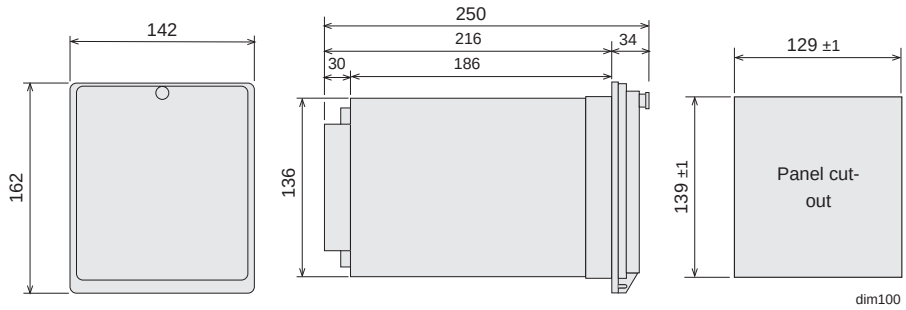
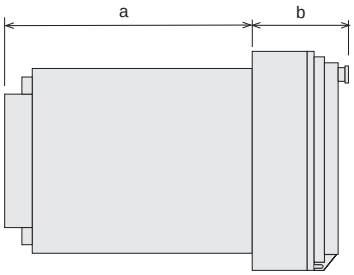


Fig. 2 Flush-mounting relay case (dimensions in mm)

Semi-flush mounting



Raising frame	a	b
SPA-ZX 111	176	74
SPA-ZX 112	136	114
SPA-ZX 113	96	154

Fig. 3 Semi-flush mounting relay case (dimensions in mm)

Mounting in 19 inch cabinets and frames

An ancillary mounting plate, height 4U (~177 mm), is recommended to be used when the protection relays are to be mounted in 19 inch frames or cabinets. The ancillary mounting plate type SPA-ZX 104 accommodates three relays, type SPA-ZX 105 two relays and type SPA-ZX 106 one relay.

Projecting mounting

When projecting mounting is preferred, a relay case type SPA-ZX 110 is used. The relay case for projecting mounting is provided with front connectors.

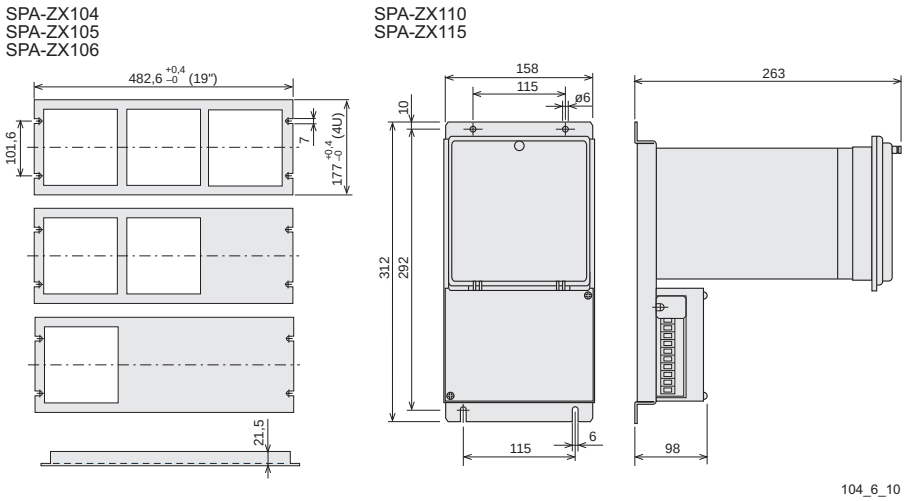


Fig. 4 Mounting cabinets and frames as well as projecting mounting (dimensions in mm)

Ordering

When ordering, please specify:

Ordering information	Ordering example
1. Type designation and quantity	SPAJ 115 C, 5 pieces
2. Order number	RS 421 012-AA
3. Rated values	I_n=5 A, f_n=50 Hz
4. Auxiliary voltage	U_{aux} =110 V dc
5. Accessories	-
6. Special requirements	-

Order numbers

Combined restricted earth-fault and residual earth-fault relay SPAJ 115 C without test adapter	RS 421 012-AA, CA, DA, FA
Combined restricted earth-fault and residual earth-fault relay SPAJ 115 C including test adapter RTXP 18	RS 421 212-AA, CA, DA, FA
The last two letters of the order number indicate the rated frequency f_n and the auxiliary voltage U_{aux} of the relay as follows:	AA equals f_n = 50 Hz and U_{aux} = 80…265 V ac/dc
	CA equals f_n = 50 Hz and U_{aux} = 18…80 V dc
	DA equals f_n = 60 Hz and U_{aux} = 80…265 V ac/dc
	FA equals f_n = 60 Hz and U_{aux} = 18…80 V dc

References

Additional information

Brochure “Voltage and current measuring relays”	1MRS 750270-MDS EN
Manual “Combined restricted earth-fault and residual earth-fault relay SPAJ 115 C”	1MRS 750658-MUM EN



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