

Restricted Earth-fault Relay

SPAJ 115 C

Product Guide



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 Distribution 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 $L/R \leq 40$ 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 |

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 $\Delta I_{0>}$ | Restricted earth-fault current $\Delta I_{0>}$, setting range | | |
| 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 μ s, 0.5 J |
| | Insulation resistance (IEC 60255-5) | >100 M Ω , 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 and IEC 61000-4-4), power supply inputs | 4 kV, 5/50 ns |
| | Fast transients (IEC 60255-22-4 and IEC 61000-4-4), other inputs | 2 kV, 5/50 ns |
| | Electrostatic discharge (IEC 60255-22-2 and IEC 61000-4-2I), air discharge | 8 kV |
| | Electrostatic discharge (IEC 60255-22-2 and IEC 61000-4-2), 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

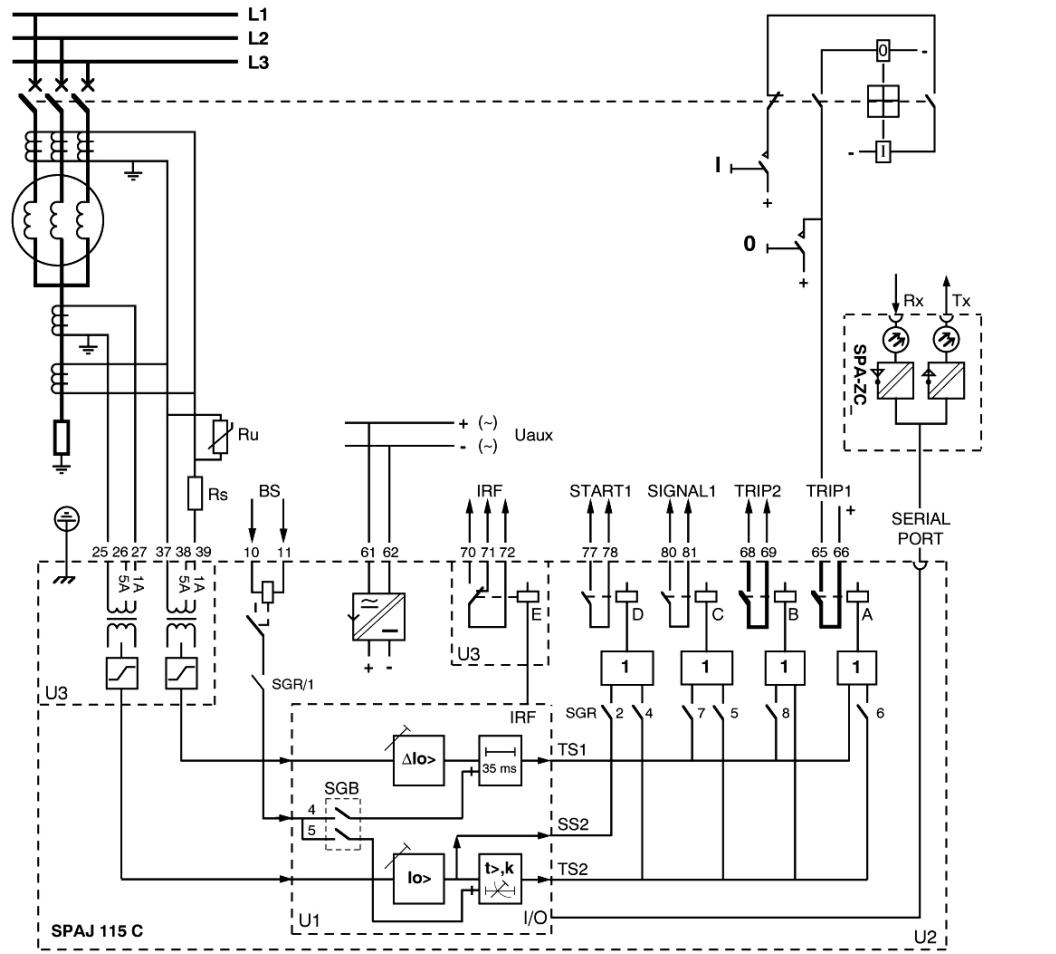


Fig. 1 Block diagram and sample connection diagram

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Mounting and dimensions

Flush mounting

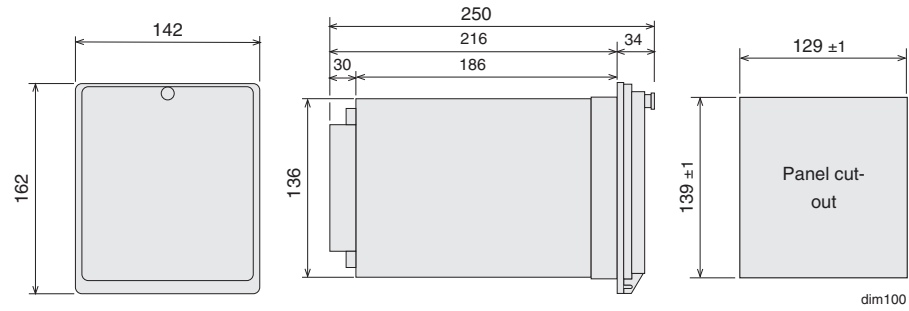


Fig. 2 Flush-mounting relay case (dimensions in mm)

Semi-flush mounting

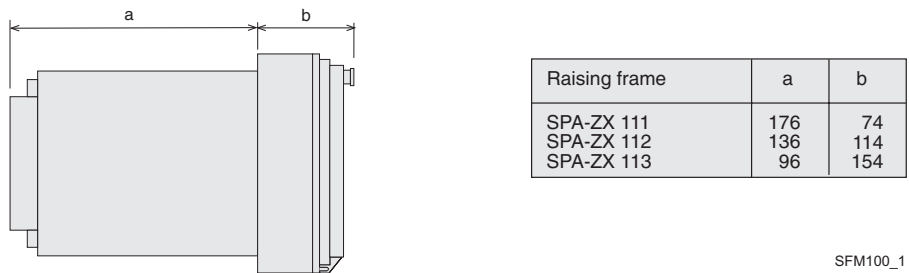


Fig. 3 Semi-flush mounting relay case (dimensions in mm)

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.

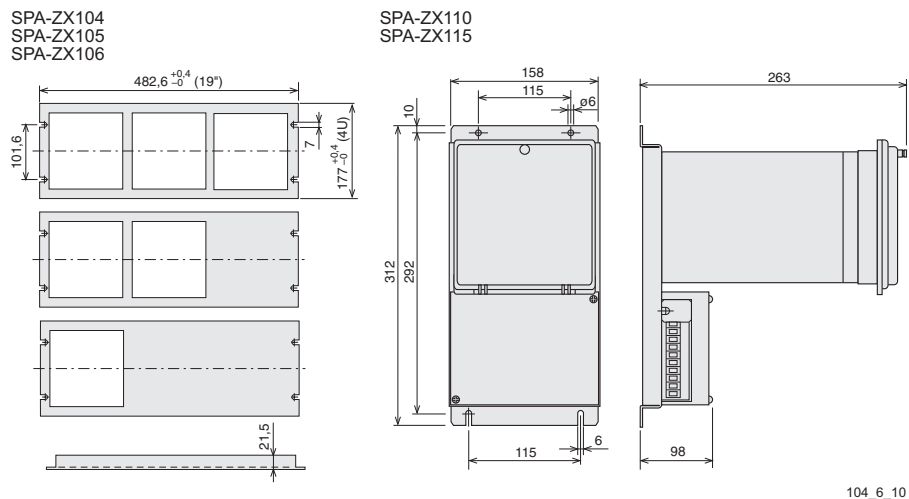


Fig. 4 Mounting cabinets and frames as well as projecting mounting (dimensions in mm)

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 | $I_n=5\text{ A}$, $f_n=50\text{ Hz}$ |
| 4. Auxiliary voltage | $U_{aux}=110\text{ V dc}$ |
| 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 $f_n = 50\text{ Hz}$ and $U_{aux} = 80\dots265\text{ V ac/dc}$ |
| | CA equals $f_n = 50\text{ Hz}$ and $U_{aux} = 18\dots80\text{ V dc}$ |
| | DA equals $f_n = 60\text{ Hz}$ and $U_{aux} = 80\dots265\text{ V ac/dc}$ |
| | FA equals $f_n = 60\text{ Hz}$ and $U_{aux} = 18\dots80\text{ V dc}$ |

References

Additional information

| | |
|--|--------------------|
| Manual "Combined restricted earth-fault and residual earth-fault relay SPAJ 115 C" | 1MRS 750658-MUM EN |
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