# Combined overcurrent & earth-fault relay

## Type SPAJ 140 C

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- ✓ Unparalleled domain competence
- ✓ Global experience
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- ✓ Large installed base
- ✓ Environment-friendly technologies

# Combined overcurrent & earth-fault relay type SPAJ 140 C

## Features

- Phase and neutral overcurrent protection relay for distribution feeders
- Three-phase, high-set and low-set phase over- current protection
- Sensitive non-directional high-set and low-set earth-fault protection
- Integrated circuit-breaker failure protection
- Four standardized inverse definite minimum time (IDMT) time-current curves as per IEC and BS
- Definite time operation
- Two special-type inverse-time characteristics called RI and RXIDG
- Numerical design for stable time-current curves, high accuracy and reliable operation
- Fault records, event records and diagnostic data can be read remotely via the serial port and locally
- High immunity to electrical interference and robust aluminum case to class IP54
- Improved system reliability supported by a built-in self-supervision system with auto diagnosis
- Serial communication capability for extensive exchange of data between the protection relay and the substation control level
- Powerful optional PC tool for reading, setting and recording relay data and parameters

## Application

The combined phase and neutral overcurrent relays of the SPAJ 140 series are used for the selective short-circuit and time overcurrent protection of radial feeders in distribution networks. The relays are also used for feeder earth-fault protection in isolated neutral networks and networks with resistively earthed neutral. Both the overcurrent unit and the earth-fault unit feature two stages: a high-set stage and a low-set stage. Further, the SPAJ 140 series relays include an integrated circuit breaker failure protection function.

The relays include a local man-machine interface for setting relay parameters and for interrogating measured and recorded parameters. The relays also include a serial port which connects to the fibre-optic SPA bus and substation control systems. Further, a personal computer with a suitable software can be connected to the serial port, facilitating reading, setting and recording of relay data.

The combined overcurrent and earth-fault relays of the SPAJ 140 series are members of the SPACOM product family, which is compatible with PYRAMID™, the coordinated protection and control concept of ABB.

## Design and principle

The combined overcurrent and earth-fault relay is a secondary relay to be connected to the current trans-formers of the protected object. The three-phase overcurrent unit and the earth-fault unit continuously measure the phase currents and the neutral current of the protected object. On detection of a fault the relay starts, trips the circuit breaker, initiates auto-reclosing, provides alarm, records fault data etc. in accordance with the application and the configured relay functions.

When the phase current exceeds the set start current of the low-set stage I>, the overcurrent unit starts delivering a start signal after a preset ~60 ms start time. When the set operate time at definite time operation or the calculated operate time at inverse time operation elapses, the overcurrent unit operates. In the same way the high-set stage I>> of the overcurrent unit starts delivering a start signal after a preset ~40 ms start time, when the set start current is exceeded. When the set operate time elapses, the overcurrent unit operates.

When the earth-fault current exceeds the set start current of the low-set stage Io>, the earth-fault unit starts delivering a start signal after a preset ~60 ms start time. When the set operate time at definite time operation or the calculated operate time at inverse time operation elapses, the earth-fault unit operates. In the same way the high-set stage Io>> of the earth-fault unit starts delivering a start signal after a preset ~40 ms start time, when the set start current is exceeded. When the set operate time elapses, the earth-fault unit operates.

The low-set stage of the overcurrent unit and the low-set stage of the earth-fault unit may be given definite time or inverse definite minimum time (IDMT) chara- cteristic. When the IDMT characteristic is chosen, six time/current curves are available. Four of the curves comply with the BS 142 and IEC 255 and are named “Normal inverse”, “Very inverse”, “Extremely inverse” and “Long-time inverse”. The two additional inverse time curves called the “RI-curve” and the “RXIDG-curve” are also provided.

By appropriate configuration of the output relay matrix, the start signals of the overcurrent and earth-fault units are obtained as contact functions. The start signals can be used for blocking co-operating protection relays, for signalling and initiating auto-reclosing.

The relay includes one external binary input, which is controlled by an external control voltage. The func-tion of the control input is determined by selector switches in the protection relay module. The control input can be used for blocking the operation of one or more protection stages, for resetting a latched output relay in the manual reset mode or for enforcing a new set of relay setting parameters by remote control.

# Technical data

| Energizing quantities, rated values and limits | |
|---|---|
| **Type designation** | **SPAJ 140 C** |
| Energizing inputs | |
| Overcurrent unit | |
| Rated current In | 1 A/5 A |
| Thermal withstand | |
| - Continuously | 4 A/20 A |
| - for 1 second | 100 A/500 A |
| Dynamic current withstand | |
| half-wave value | 250 A/1250 A |
| Input impedance | <100 mΩ/<20 mΩ |
| Earth-fault unit | |
| Rated current In | 1 A/5 A |
| Thermal withstand | |
| - Continuously | 4 A/20 A |
| - for 1 second | 100 A/500 A |
| Dynamic current withstand | |
| half-wave value | 250 A/1250 A |
| Input impedance | <100 mΩ/<20 mΩ |
| Rated frequency fn | 50 Hz or 60 Hz |
| Rated auxiliary voltage | |
| Type SPTU 240 R1 | 80...265 V DC/AC |
| Type SPTU 48 R1 | 18...80 V DC |
| Power consumption under | |
| quiescent / operating conditions | ~4 W / ~6 W |
| Specified service temperature range | $-10^{0}$C...$55^{0}$C |
| Mass of relay | ~3.5 kg |

| Overcurrent and earth-fault relay module | |
|---|---|
| | **SPCJ 4D29** |
| Low-set overcurrent stage I> | |
| Start current | |
| - definite time characteristic | 0.50...5.0 x In |
| - inverse time characteristic *) | 0.50...2.5 x In |
| Operation characteristic | |
| - definite time | |
| - operate time t> | 0.05...300 s |
| - inverse definite minimum time | |
| (IDMT)as per IEC 255-4, BS 142 | Extremely inverse<br>Very inverse<br>Standard inverse<br>Long-time inverse |
| - special characteristic according | |
| to ABB practice | RI-type inverse<br>RXIDG-type<br>inverse |
| - time multiplier k | 0.05...1.0 |
| High-set overcurrent stage I>> | |
| Start current | 0.5...40 x In or∞ |
| Operate time t>> | 0.04...300 s |
| Suppression of harmonics | 20 dB at f = 3 x fn |
| Low-set earth-fault stage Io> | |
| Start current | 0.1...0.8 x In |

*) Note! The relay allows settings above 2.5 x In, but regards any setting > 2.5 x In as being equal to 2.5 x In

| Overcurrent and earth-fault relay unit | |
|---|---|
| | **SPCJ 4D29** |
| Operation characteristic | |
| - definite time | |
| - operate time to> | 0.05...300 s |
| -Inverse definite minimum time | |
| (IDMT) as per IEC 255-4, BS142 | Extremely inverse<br>Very inverse<br>Normal inverse<br>Long-time inverse |
| -special characteristic according to ABB practice | |
| - time multiplier ko | RI-type inverse RXIDG-type inverse<br>0.05...1.0 |
| High-set earth-fault stage Io>> | |
| Start current | 0.1...10.0 x In or∞ |
| Operate time to>> | 0.05...300 s |
| Suppression of harmonics | 14 dB at f = 3 x $f_n$ |

| Output contact ratings | |
|---|---|
| **Tripping contacts** | |
| Terminals | 65-66, 74-75 |
| Rated voltage | 250 V DC/AC |
| Continuous carry | 5 A |
| Make and carry for 0.5 s | 30 A |
| Make and carry for 3.0 s | 15 A |
| Breaking capacity for DC, | |
| when the control circuit | |
| time-constant L/R ≤ 40 ms, | |
| at 48/110/220 V DC | 5 A/3 A/1 A |
| Contact material | $AgCdO_2$ |
| **Signalling contacts** | |
| Terminals | 70-71-72, 68-69, |
| | 77-78, 80-81 |
| Rated voltage | 250 V DC/AC |
| Rated current | 5 A |
| Make and carry for 0.5 s | 10 A |
| Make and carry for 3.0 s | 8 A |
| Breaking capacity for DC, | |
| when the signalling circuit | |
| time-constant L/R # 40 ms, | |
| at 48/110/220 V dc | 1 A/0.25 A/0.15 A |
| Contact material | $AgCdO_2$ |
| **External control inputs** | |
| Blocking, remote reset | |
| or remote setting input | 10-11 |
| External control voltage level | 18...80 V DC or |
| | 80...265 V AC / DC |
| Control current at activated | |
| input | 2...20 mA |
| **Data transmission** | |
| Transmission mode | Fibre-optic<br>serial with optional bus<br>connection module |
| Data code | ASCII |
| Data transfer rate | 4800 Bd or 9600 Bd |

| Electrical tests | |
|---|---|
| Insulation test according to | IEC 60255-5 |
| Dielectric test | 2 kV, 50 Hz, 1 min |
| Impulse test | 5 kV, 1.2/50 µs, 0.5 J |
| Insulation resistance | >100 MΩ at 500 V DC |
| Power supply tests according to IEC 60255-11, IEC 61000-4-11 | |
| Interruption of DC voltage | 40 ms/80 V, 10ms/18V |
| Interruption of AC voltage | 70 ms/80 V |
| Ripple in DC voltage | max. 12% of DC value |
| 1 MHz burst disturbance test according to | |
| IEC 60255-22-1 | class III |
| -common mode | 2.5 kV, 1MHz, |
| | 400 pulses/sec. |
| -differential mode | 1kV, 1MHz, |
| | 400 pulses/sec. |
| Electrostatic discharge test according to | |
| IEC 60255-22-2 | class III |
| -contact discharge | 6kV |
| -air discharge | 8kV |
| Radiated, radio frequency, electromagnetic field | |
| immunity test according to IEC 60255-22-3, | |
| IEC 61000-4-3 | 10 V/m, f = 80..1000MHz |
| Fast transient disturbance test according to | |
| IEC 60255-22-4, IEC 61000-4-4 | |
| -Power supply ports | 4 kV, 5/50 ns, 50 Ω |
| -I/O ports | 2 kV, 5/50 ns, 50 Ω |
| Surge immunity test according to IEC 60255-22-5, IEC 61000-4-5 | |
| -common mode | 2 kV, 1.2/50 µs, 12 Ω |
| -differential mode | 1 kV, 1.2/50 µs, 2 Ω |
| Immunity to conducted disturbances induced by radio frequency fields according to IEC 60255-22-6, IEC 61000-4-6 10 V, f =150kHz...80MHz | |

| | | | |
|---|---|---|---|
| Conducted and Radiated radio-frequency emission | | Earth-quake | 0.50...5.25 g |
| tests according to IEC 60255-25, EN55011-CISPRII | | -Safe shut-down | |
| -conducted emission (mains) | class A | earth-quake | 0.50...7.5 g |
| -radiated emission | class A | Degree of protection by enclosure when panel | |
| Power frequency magnetic field immunity test | | mounted (front side) according to IEC 60529 | |
| according to IEC 61000-4-8 | | Protection | IP 54 |
| -continuous | 100 A/m | Dry heat test according to IEC 60068-22-2 | |
| -short duration | 300 A/m | Temperature | +55° C/+70° C |
| **Environmental tests** | | Dry cold test according to IEC 60068-2-1 | |
| Vibration response and endurance test as per | | Temperature | -10° C/-25° C |
| IEC 60255-21-1 | class 1, 10...150Hz | Storage temperature test according to | |
| Shock response and endurance test as per | | IEC 60068-2-48 | |
| IEC 60255-21-2 | class 1, 11ms | Temperature | -40° C/+70° C |
| Bump test as per | | Damp heat test, cyclic (12+12 hour cycle) | |
| IEC 60255-21-2 | 20 g,1000 bumps/dir | according to IEC 60068-2-30 | |
| Seismic tests as per ANSI/IEEE C37.98 1987 | | Condition | 96% RH, 6 days |
| -Operating basis | | Corrosion test | Battelle-test |

## Block schematic diagram

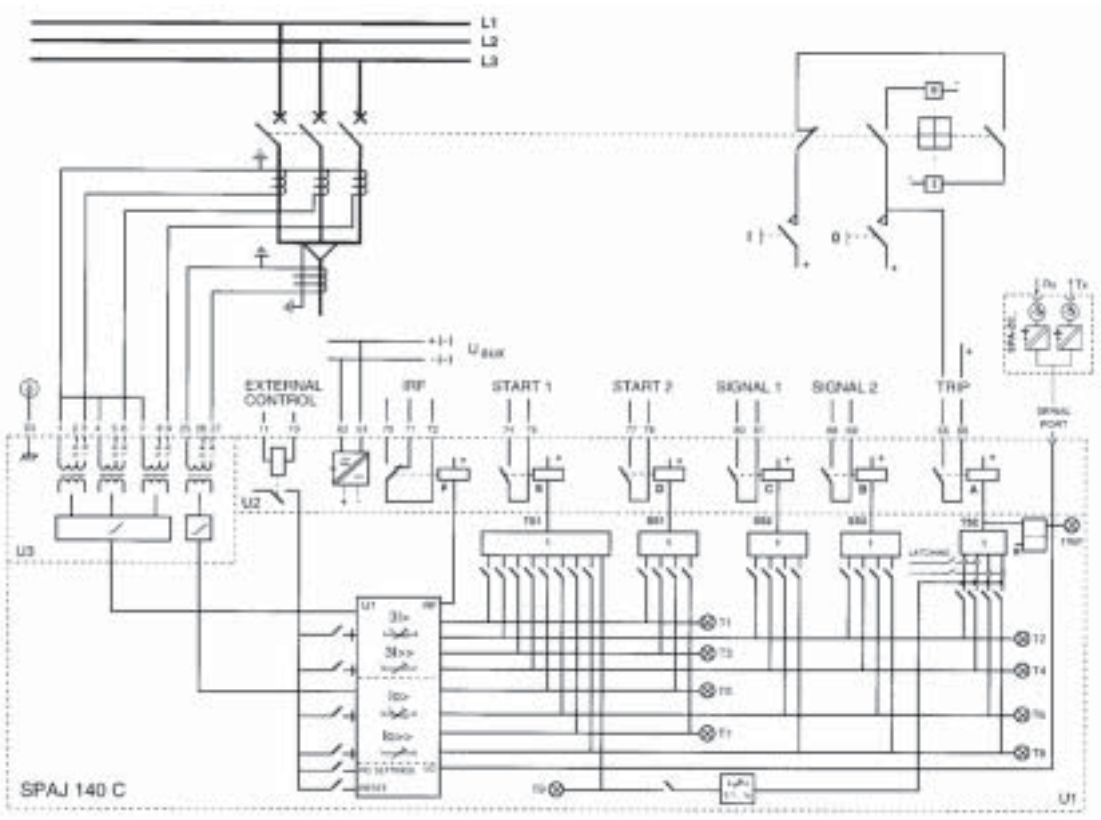
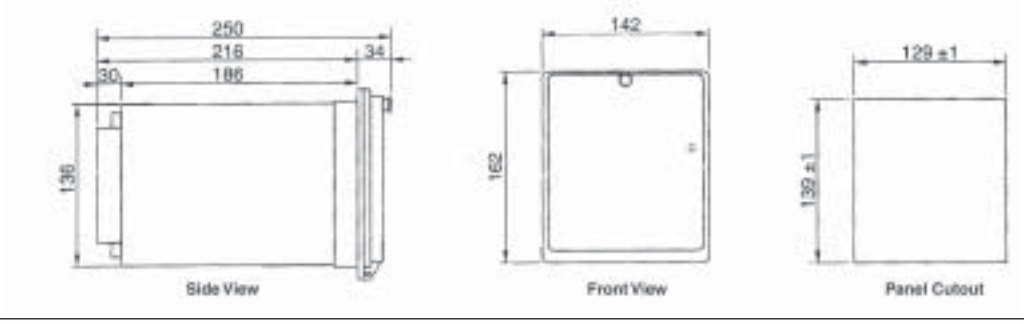



Fig.1- Block schematic diagram and typical connection diagram for the relay SPAJ 140 C. The low-set stages of the overcurrent and the earth-fault units feature definite time or inverse-time characteristic.

## Mounting and dimensional details

Flush mounting relay case (dimensions in millimeters)




## Ordering details

| | | | | |
|---|---|---|---|---|
| Item No. .... | | Qty | | |
| Type | : | SPAJ 140C | Case size : | 100 |
| Application | : | Over current and Earth fault protection of feeder, capacitor, transformer etc. | Mounting : | Flush |
| Aux Votage | : | 18 - 80 V DC ☐ | Type designation explanation | |
| | | 80 - 265 V AC/DC ☐ | SPA...Substation Protection apparatus | |
| CT Secondary | : | 1A/5A selectable | J...Current Operated | |
| | | Normal inverse | 1...100 size case | |
| (Selectable at site) | : | Very inverse | 40...Mechanical Design | |
| | | Extremely inverse | C...Communicable | |
| | | Long time inverse | | |
| | | RI characteristic | | |
| | | RXIDG ch. | | |
| Contacts | : | 2 N/O (Heavy duty)+ | | |
| | | 3 N/O (Light duty)+ | | |
| | | 1 C/O (for IRF) | | |

* Kindly furnish above mentioned details along with your order by ticking (✓) appropriate boxes

ABB Limited
Distribution Automation
Maneja,
Vadodara 390 013, India.
Tel: +91 265 2604384/5/6
+91 265 2604397
Fax: +91 265 2638922
E-mail: aicds@in.abb.com

Regional Marketing Offices:

**North**

No.14, Mathura Road
P.O. Amar Nagar
Faridabad 121 003
Tel: +91 129 2275592,
2279627, 5049000
Fax: +91 129 2279692/5019

**West**

ABB House
Dr. S B Path
Ballard Estate
Mumbai 400 038
Tel: +91 22 56318231 – 39
Fax: +91 22 56318276/77

**South**

Embassy Star, 1st Floor
No. 8, Palace Road
Vasanth Nagar
Bangalore 560 052
Tel: +91 80 22949779
Fax: +91 80 22949808

Century Plaza
No. 3C, 3D & 3F, 3rd Floor
561 / 562, Anna Salai
Teynampet (Mount Road)
Chennai 600 018
Tel: +91 44 24340201
Fax: +91 44 24340282

**East**

4th Floor
No. 9
Elgin Road
Kolkata 700 020
Tel: +91 33 22832906/8
Fax: +91 33 22832990

**Central**

Vandana House
1st Floor
G E Road, Ramkund
Raipur 492 001
Tel: +91 771 5060816-8
Fax: +91 771 5053391

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