Overcurrent and earth-fault relay

REJ 525

1MRS 751205-MBG

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Features

- Three-phase low-set overcurrent stage with definite-time or inverse definite minimum time (IDMT) characteristic
- Three-phase high-set overcurrent stage with instantaneous or definite-time characteristic
- Phase discontinuity protection
- Low-set non-directional earth-fault stage with definite-time or IDMT characteristic
- High-set non-directional earth-fault stage with instantaneous or definite-time characteristic
- Circuit-breaker failure protection (CBFP)
- Disturbance recorder:
  - recording time up to 10 seconds
  - triggering by a start or a trip signal from any protection stage and/or by a binary input signal
  - records four analogue channels and up to eight user-selectable digital channels
  - adjustable sampling rate
- Non-volatile memory for
  - up to 60 event codes
  - setting values
  - disturbance recorder data
  - recorded data of the five last events with time stamp
  - number of starts for each stage
  - alarm indication messages and LEDs showing the status at the moment of power failure
  - maximum pick-up currents
- Galvanically isolated binary input with a wide input voltage range
- All settings can be modified with a personal computer
- HMI with an alphanumeric LCD and manoeuvring buttons
- IEC 60870-5-103 and SPA bus communication protocols
- Two normally open power output contacts
- Two change-over signal output contacts
- Output contact functions freely configurable for desired operation
- Optical PC-connector for two-way data communication (front)
- RS-485 connector (rear) for system communication
- Continuous self-supervision of electronics and software. At an internal relay fault (IRF), all protection stages and outputs are blocked.
- User-selectable rated frequency 50/60 Hz
- User-selectable password protection for the HMI
- Display of primary current values
- Demand values
- Multi-language support

Application

The combined overcurrent and earth-fault relay REJ 525 is a secondary relay which is connected to the current transformers of the object to be protected. The overcurrent unit and the earth-fault unit continuously measure the phase currents and the neutral current of the object. On detection of a fault, the relay will start, trip the circuit breaker, provide alarms, record fault data, etc., in accordance with the application and the configured relay functions.

The overcurrent unit includes low-set stage I> and high-set stage I>> and the earth-fault unit low-set stage I_0> and high-set stage I_0>>.

If the high-set stage is given a setting value within the lower part of the setting range, the relay module will have two nearly identical stages. In this case, the relay can be used in two-stage load shedding applications.

The protection functions are independent of each other and have their own setting groups and data recordings. The overcurrent protection function uses conventional current transformer measurement.

An output contact matrix allows start or trip signals from the protection stages to be routed to the desired output contact.

Design

The relay includes of a high-set and low-set overcurrent unit, a high-set and low-set earth-fault unit, a phase discontinuity unit and a circuit-breaker failure protection unit. Further, the relay includes an HMI module, a self-supervision system and a disturbance recorder.

Overcurrent unit

When the phase currents exceed the set start value of low-set stage I>, the overcurrent unit will start to deliver a start signal after a ~ 55 ms' start time. When the set operate time at definite-time characteristic or the calculated operate time at inverse definite minimum time (IDMT) characteristic elapses, the overcurrent unit will deliver a trip signal.

When the phase currents exceed the set start value of high-set stage I>>, the overcurrent unit will start to deliver a start signal after a ~30 ms' start time. When the set operate time elapses, the overcurrent unit will deliver a trip signal.

It is possible to block the start and the tripping of an overcurrent stage by applying an external binary input signal to the relay.

The low-set stage of the overcurrent unit can be given either a definite-time or an IDMT characteristic. At IDMT characteristic, six time/current curve groups are available, of which four comply with the IEC 60255 standard: the normal inverse, very inverse, extremely inverse and long-time inverse. The two additional inverse-time curve groups, referred to as RI and RD, are special curve groups according to ABB praxis.

The inverse-time function of stage I> can be set to be inhibited when stage I>> starts. In this case the operate time will be determined by stage I>>.

The high-set stage can be set out of operation. This state will be indicated by dashes on the LCD and by "999" when the set start value is read via serial communication.

The set start value of stage I>>, I>>/I_n, can be automatically doubled in a start situation, e.g. when the object to be protected is connected to a distribution network. Thus a set start value below the connection inrush current level can be selected for stage I>>. A start situation is defined as a situation where the phase current rises from a value below 0.12 x I> to a value above 1.5 x I> in less than 60 ms. The start situation ends when the current falls below 1.25 x I>.

Phase discontinuity unit

The phase discontinuity protection function monitors the minimum and maximum phase currents and calculates the difference between them.

The phase discontinuity protection stage will start when the current difference exceeds the start value, ΔI, of the protection stage. Should the phase discontinuity situation last longer than the set operate time, the protection stage will deliver a trip signal which can be routed to the desired output relay contact. It is possible to block the start and the tripping of the protection stage by applying an external binary input signal to the relay. When the values of the measured currents fall below 0.1 x In, the function will no longer be in use.

The phase discontinuity function can be set out of operation. This state will be indicated by dashes on the LCD and "999" when the set start current value is read via serial communication.

Earth-fault unit

When the earth-fault current exceeds the set start value of low-set stage I_0>, the earth-fault unit will start to deliver a start signal after a ~ 60 ms' start time. When the set operate time at definite-time characteristic or the calculated operate time at IDMT characteristic elapses, the earth-fault unit will deliver a trip signal.

When the earth fault current exceeds the set start value of high-set stage I_0>>, the earth-fault unit will start to deliver a start signal after a ~ 40 ms' start time. When the set operate time elapses, the earth-fault unit will deliver a trip signal.

It is possible to block the start and the tripping of an earth-fault stage by applying an external binary input signal to the relay.

The low-set stage of the earth-fault unit can be given either a definite-time or an IDMT characteristic. At IDMT characteristic, six time/current curve groups are available, of which four comply with the IEC 60255 standard: the normal inverse, very inverse, extremely inverse and long-time inverse. The two additional inverse-time curve groups, referred to as RI and RD are special curve groups according to ABB praxis.

The inverse-time function of stage I_0> can be set to be inhibited when stage I_0>> starts. In this case, the operate time will be determined by stage I_0>>.

The high-set stage can be set out of operation. This state will be indicated by dashes on the LCD and by "999" when the set start value is read via serial communication.

The set start valueof stage I_0>>, I_0>>/I_n, can be automatically doubled in a start situation, e.g. when the object to be protected is connected to a distribution network. Thus a set start value below the connection inrush current level may be selected for stage I_0>>. A start situation is defined as a situation where the earth-fault current rises from a value below 0.12 x I_0> to a value above 1.5 x I_0> in less than 60 ms. The start situation ends when the current falls below 1.25 x I_0>.

Circuit breaker failure protection (CBFP) unit

The CBFP unit will generate a trip signal via power output 2 (PO2) if the fault has not been cleared on expiration of the set operate time 0.10 s...1.00 s.

Normally, the CBFP unit controls the upstream circuit breaker. It can also be used for tripping via redundant trip circuits of the same circuit breaker. The CBFP unit is activated with a soft-ware switch.

Disturbance recorder

The REJ 525 includes an internal disturbance recorder which records the momentary measured values, or the RMS curves of the measured signals, and up to eight user-selectable digital signals: the external binary input signal and the states of the internal protection stages. The disturbance recorder can be set to be triggered by a start or a trip signal from any protection stage and/or by an external binary input signal, and either on the falling or rising triggering edge. The ratio of the pre- and post-triggering of the recording can be set.

The recording length varies according to the selected sampling frequency. The RMS curve is recorded by selecting the sampling frequency to be the same as the nominal frequency of the relay. See the table below for details:

Nominal frequency Hz	Sampling frequency Hz	Recording length s
50	800	0.64
50	400	1.28
50	50	10.24
60	960	0.53
60	480	1.06
60	60	8.53

HMI module

The HMI of the REJ 525 is equipped with six push-buttons and an alphanumeric 2 x 16 characters' LCD. The push-buttons are used for navigating in the menu structure and for adjusting set values.

An HMI password can be set to protect all user-changeable values from being changed by an unauthorised person.

The REJ 525 offers you multi-language support. The following languages are available for the HMI menu: English, German, French, Spanish, Italian, Swedish and Finnish.

Self-supervision (IRF) unit

The REJ 525 is provided with an extensive self-supervision system which continuously supervises the software and the electronics of the relay. It manages run-time fault situations and informs the user about an existing fault via a LED on the HMI and a text message on the LCD.

Communication capabilities

The REJ 525 can be connected to a substation automation or monitoring system using either the SPA bus communication protocol or the IEC 60870-5-103 remote communication protocol. Both protocols are supported in the same device.

The SPA bus communication protocol is an asynchronous serial communication protocol (1 start bit, 7 data bits + even parity, and 1 stop bit) with a selectable data transfer rate (default 9.6 kbps). It is a master/slave protocol supporting one master device and several slave devices. The SPA bus protocol can be used to transfer data, e.g. measured currents, registered values, events, and relay settings, between the master and the slave device.

The REJ 525 supports the IEC 60870-5-103 remote communication protocol in the unbalanced transmission mode with a data transfer rate of 9.6 kbps. The IEC 60870-5-103 protocol is used to transfer mesurand and status data from the slave to the master. Disturbance recorder data, however, cannot be transferred using this protocol.

The REJ 525 is provided with two serial communication ports, one on the rear panel and the other on the front panel.

The REJ 525 is interfaced with a fibre-optic bus by means of the bus connection module RER 103 via the D9S-type RS-485 connector on the rear panel of the device. The RER 103 enables the use of either the SPA bus or the IEC 60870-5-103 communication protocol. The use of the IEC 60870-5-103 protocol normally requires the fibre-optic star coupler RER 125.

The optical PC-connector on the front panel is used to connect the relay to the CAP 501/505 setting and configuration tools. The front interface uses the SPA bus protocol. The optical PC-connector galvanically isolates the PC from the relay. Since this connector is standardized for ABB relay products, only one connecting cable (ABB art. No 1MKC-950001-1) will be required.

The REJ 525 can also be connected to the Lon bus using a LON-SPA Gateway.

Auxiliary supply voltage

The REJ 525 requires a secured auxiliary voltage supply to operate. The internal power supply of the relay forms the voltages required by the relay electronics. The power supply is a galvanically isolated (flyback-type) DC/DC converter. When the auxiliary voltage is connected, the READY indicator LED on the front panel will be on.

The primary side of the power supply is protected with a fuse located on the PCB of the relay. The fuse size is 3.15 A (slow).

Technical data

Table 1: Dimensions

Width	frame 111.4 mm, box 94 mm
Height	frame 265.9 mm (6U), box 249.8 mm
Depth	235 mm (245.1 mm with a protective rear cover, available as an option)
Enclosure size	1/4 (x 19")
Weight of the relay	~3.3 kg

Table 2: Auxiliary supply voltage

U_{aux} rated	Ur =110/120/220/240 V ac Ur =48/60/110/125/220 V dc
U_{aux} variation	80...265 V ac 38...265 V dc
Relay power start-up time, typical	300 ms
Burden of auxiliary voltage under quiescent/operating condition	~ 5 W/~10 W
Ripple in dc auxiliary voltage	Max 12% of the dc value
Interruption time in the auxiliary dc voltage without resetting the relay	< 30 ms at 48 V dc < 100 ms at 110 V dc < 500 ms at 220 V dc

Table 3: Energizing inputs

Rated frequency	50/60 Hz ±5 Hz		
Rated current, I_n	0.2 A	1 A	5 A
Thermal withstand capability			
Continuously	1.5 A	4 A	20 A
For 1 s	20 A	100 A	500 A
Dynamic current withstand			
Half-wave value	50 A	250 A	1250 A
Input impedance	< 750 mΩ	< 100 mΩ	< 20 mΩ

Table 4: Measuring ranges

Measured currents on phases L1, L2 and L3 as multiples of the rated currents of the energizing inputs	0...50 x I_n
Earth-fault current as a multiple of the rated current of the energizing input	0...8 x I_n

Table 5: Binary input

Operating range	18...265 V dc
Rated voltage	24/48/60/110/220 V dc
Current drain	~ 2...25 mA
Power consumption	< 0.8 W

Table 6: Signal outputs (SO1, SO2) and self-supervision (IRF) output

Rated voltage	250 V ac/dc
Continuous carry	5 A
Make and carry for 3.0 s	8 A
Make and carry for 0.5 s	10 A
Breaking capacity when the control circuit time-constant L/R < 40 ms, at 48/110/220 V dc	1 A/0.25 A/0.15 A
Minimum contact load	100 mA at 24 V ac/dc

Table 7: Power outputs (PO1, PO2)

Rated voltage	250 V ac/dc
Continuous carry	5 A
Make and carry for 3.0 s	15 A
Make and carry for 0.5 s	30 A
Breaking capacity when the control circuit time-constant L/R < 40 ms, at 48/110/220 V dc	5 A/3 A/1 A
Minimum contact load	100 mA at 24 V ac/dc

Table 8: Enclosure class

Front side	IP 54 (flush-mounted)
Rear side, connection terminals	IP 20
Note! A rear protective cover (accessory part) can be used to protect and shield the rear of the case.	

Table 9: Environmental tests

Specified service temperature range	-10...+55 °C
Transport and storage temperature range	-40...+70 °C According to the IEC 60068-2-48
Dry heat test	According to the IEC 60068-2-2
Dry cold test	According to the IEC 60068-2-1
Damp heat test, cyclic	According to the IEC 60068-2-30

Table 10: Electromagnetic compatibility tests

EMC immunity test level requirements consider the demands in the generic standard EN 50082-2.	
1 MHz burst disturbance test, class III Common mode Differential mode	According to the IEC 60255-22-1 2.5 kV 1.0 kV
Electrostatic discharge test, class III For contact discharge For air discharge	According to the IEC 61000-4-2 and IEC 60255-22-2 6 kV 8 kV
Radio frequency interference tests	
Conducted, common mode	According to the IEC 61000-4-6, IEC 60255-22-6 (2000) 10 V (rms), f = 150 kHz...80 MHz
Radiated, amplitude-modulated	According to the IEC 61000-4-3 and IEC 60255-22-3 (2000) 10 V/m (rms), f = 80...1000 MHz
Radiated, pulse-modulated	According to the ENV 50204 and IEC 60255-22-3 (2000) 10 V/m, f = 900 MHz
Radiated, test with a portable transmitter	According to the IEC 60255-22-3 (1989), method C; f = 77.2 MHz, P = 6 W; f = 172.25 MHz, P = 5W
Fast transient disturbance tests Binary input Other terminals	According to the IEC 60255-22-4 and IEC 61000-4-4 2 kV 4 kV
Surge immunity test Power supply I/O ports	According to the IEC 61000-4-5 4 kV, line-to-earth, 2 kV, line-to-line 2 kV, line-to-earth, 1 kV, line-to-line
Power frequency (50 Hz) magnetic field	According to the IEC 61000-4-8 100 A/m continuous

Voltage dips and short interruptions	According to the IEC 61000-4-11 30%/10 ms 60%/100 ms 60%/1000 ms > 95%/5000 ms
Electromagnetic emission tests	According to the EN 55011 and EN 50081-2
Conducted, RF-emission (Mains terminal)	EN 55011, class A, IEC 60255-25
Radiated RF-emission	EN 55011, class A, IEC 60255-25
CE approval	Complies with the EMC directive 89/336/EEC and the LV directive 73/23/EEC

Table 11: Standard tests

Insulation tests	
Dielectric tests	According to the IEC 60255-5
Test voltage	2 kV, 50 Hz, 1 min
Impulse voltage test	According to the IEC 60255-5
Test voltage	5 kV, unipolar impulses, waveform 1.2/50 µs, source energy 0.5 J
Insulation resistance measurements	According to the IEC 60255-5
Isolation resistance	> 100 MΩ, 500 V dc
Mechanical tests	
Vibration tests (sinusoidal)	According to the IEC 60255-21-1, class I
Shock and bump test	According to the IEC 60255-21-2, class I
Seismic test	According to the IEC 60255-21-3, class 2

Table 12: Data communication

Rear interface, connector X2.2 RS-485 connection for the fibre-optic interface module RER 103 SPA bus or IEC 60870-5-103 protocol 4.8 or 9.6 kbps
Front interface Optical RS-232 connection for opto-cable 1MKC 950001-1 SPA bus protocol 4.8 or 9.6 kbps

Connection diagram

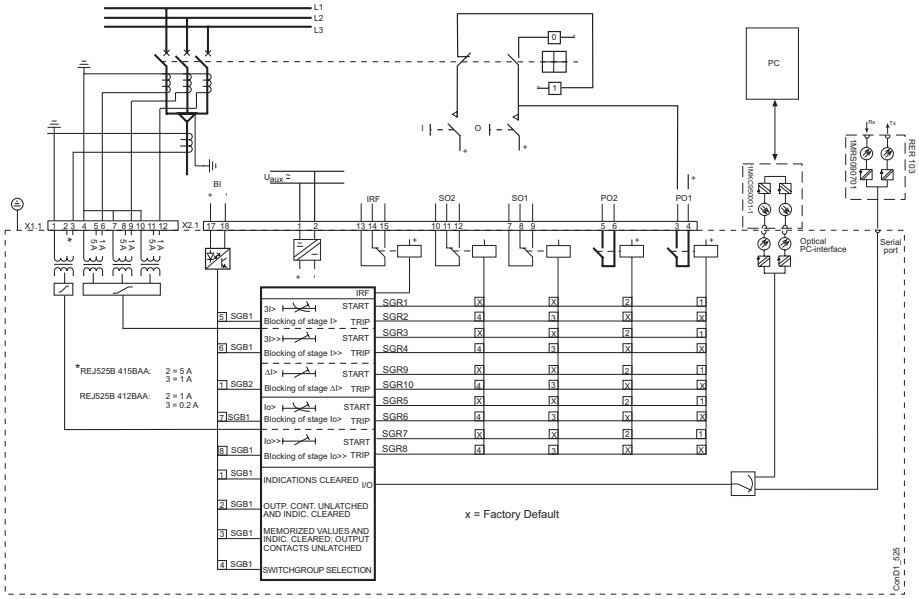


Fig. 1 Connection diagram of the combined overcurrent and earth-fault relay. The residual current is measured via a core-balance current transformer.

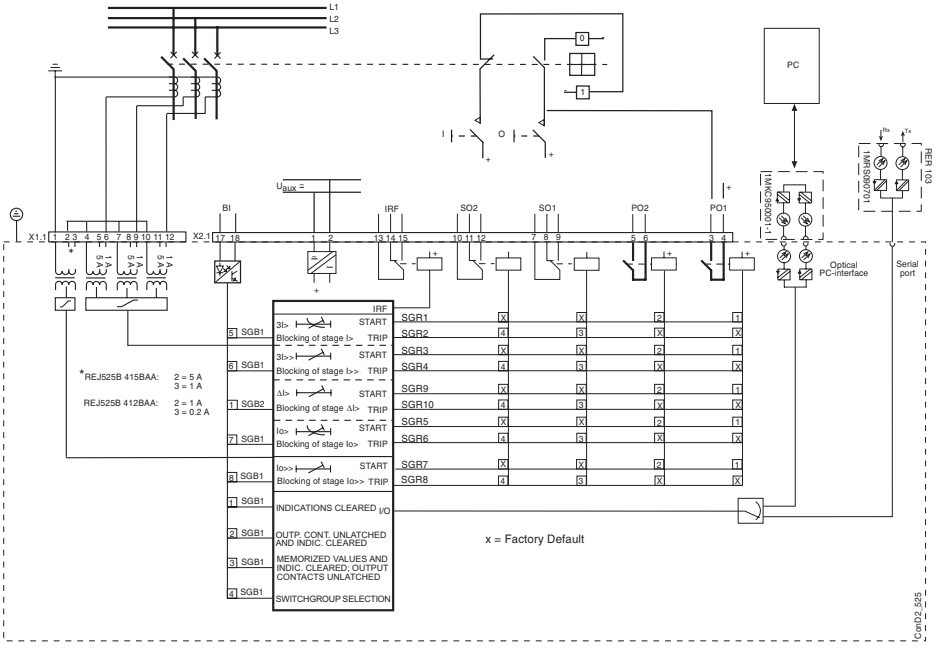


Fig. 2 Connection diagram of the combined overcurrent and earth-fault relay. The residual current is measured via a summation connection of the phase current transformers.

Ordering

The order number identifies the hardware version of the relay as described below. This number is labelled on the marking strip on the front panel.

Basic units:

Order number (I_0 inputs 0.2 A/1 A)	REJ525B 412BAA (Article nr:1MRS091412-BAA)
Order number (I_0 inputs 1 A/5 A)	REJ525B 415BAA (Article nr:1MRS091415-BAA)

Accessories:

Protective cover for rear connectors	1MRS060132
Flush mounting kit	1MRS050209
Semi-flush mounting kit	1MRS050253
Wall mounting kit	1MRS050240
Side-by-side mounting kit	1MRS050241
19" Rack mounting kit	1MRS050257
Optic bus connection module RER 103	1MRS090701
Opto-cable	1MKC950001-1

Configuration, setting and SA system tools

The following tool versions are needed to support the new functions and features of REJ 525 Release B:

- CAP 505 Relay Product Engineering Tools; CAP 505 v. 2.1.1, or later
- CAP 501 Relay Setting Tools; CAP 501 v. 2.1.1, or later
- LIB 510 Library for MicroSCADA; LIB 510 v. 4.0.3-1, or later
- SMS 510 Substation Monitoring System; SMS 510 v. 1.0.0-3, or later

References

Additional information

Other available manuals:

Technical Reference Manual REJ 525	1MRS 750941-MUM
Operator's Manual REJ 525	1MRS 752137-MUM
Installation Manual RE_5__	1MRS 750526-MUM



ABB Oy
Substation Automation
P.O. Box 699
FIN-65101 Vaasa, Finland
Tel +358 10 22 11
Fax +358 10 224 1094
www.abb.com/substationautomation