

# Earth-Fault Relay

# REJ 521

## Product Guide





## Features

- Low-set non-directional earth-fault stage with definite-time or inverse definite minimum time (IDMT) characteristic
- High-set non-directional earth-fault stage with instantaneous or definite-time characteristic
- Circuit-breaker failure protection unit (CBFP)
- Disturbance recorder
  - recording time up to 28 seconds
  - triggering by a start or a trip signal from either of the two protection stages and/or by a binary input signal
  - records the analogue channel and five 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
- 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), both 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
- Multi-language support

## Application

The earth-fault relay REJ 521 is a secondary relay which is connected to the current transformers of the object to be protected. The earth-fault unit continuously measures 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 earth-fault unit includes 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 earth-fault 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 a high-set and low-set earth-fault unit and a circuit-breaker failure protection unit. Further, the relay includes an HMI module, a self-supervision system and a disturbance recorder.

### 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 inverse definite minimum time (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 value of 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 can be selected for stage  $I_{0>>}$ . A start situation is defined as a situation where the earth-fault current rises from a value below  $0.12 \times I_{0>}$  to a value above  $1.5 \times I_{0>}$  in less than 60 ms. The start situation ends when the current falls below  $1.25 \times I_{0>}$ .

### 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 software switch.

### Disturbance recorder

The REJ 521 includes an internal disturbance recorder which records the momentary measured values, or the RMS curve of the measured signal, and five 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	1.8
50	400	3.6
50	50	28.8
60	960	1.5
60	480	3.0
60	60	24.0

### HMI module

The HMI of the REJ 521 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 521 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 521 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 521 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 proto-

col 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 521 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 521 is provided with two serial communication ports, one on the rear panel and the other on the front panel.

The REJ 521 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 521 can also be connected to the Lon bus using a LON-SPA Gateway.

### Auxiliary supply voltage

The REJ 521 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	~2.8 kg

**Table 2: Auxiliary supply voltage**

U <sub>aux</sub> rated	Ur =110/120/220/240 V ac Ur =48/60/110/125/220 V dc
U <sub>aux</sub> 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 <sub>n</sub>	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 range**

Earth-fault current as a multiple of the rated current of the energizing input	0...8 x I <sub>n</sub>
--	------------------------

**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)**

Continuous carry	5 A
Rated voltage	250 V ac/dc
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	IP20
<p>Note! A rear protective cover (accessory part) can be used to protect and shield the rear of the case.</p>	

**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 Radiated, amplitude-modulated Radiated, pulse-modulated Radiated, test with a portable transmitter	According to the IEC 61000-4-6 and IEC 60255-22-6 (2000) 10 V (rms), f=150 kHz...80 MHz According to the IEC 61000-4-3 and IEC 60255-22-3 (2000) 10 V/m (rms), f=80...1000 MHz According to the ENV 50204 and IEC 60255-22-3 (2000) 10 V/m, f=900 MHz According to the IEC 60255-22-3 (1989), method C; f = 77.2 MHz, P = 6 W; f = 72.25 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

**Table 10: Electromagnetic compatibility tests**

Surge immunity test power supply, line-to-earth line-to-line I/O ports, line-to-earth line-to-line	According to the IEC 61000-4-5 4 kV 2 kV 2 kV 1 kV
Power frequency (50 Hz) magnetic field	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 > 95%/5000 ms
Electromagnetic emission tests conducted, RF-emission (Mains terminal) radiated RF-emission	According to the EN 55011 and EN 50081-2 EN 55011, class A, IEC 60255-25 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**

<b>Insulation tests</b>	
Dielectric tests test voltage	According to the IEC 60255-5 2 kV, 50 Hz, 1 min
Impulse voltage test test voltage	According to the IEC 60255-5 5 kV, unipolar impulses, waveform 1.2/50 $\mu$ s, source energy 0.5 J
Insulation resistance measurements isolation resistance	According to the IEC 60255-5 > 100 M $\Omega$ , 500 V dc
<b>Mechanical tests</b>	
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



Block diagram

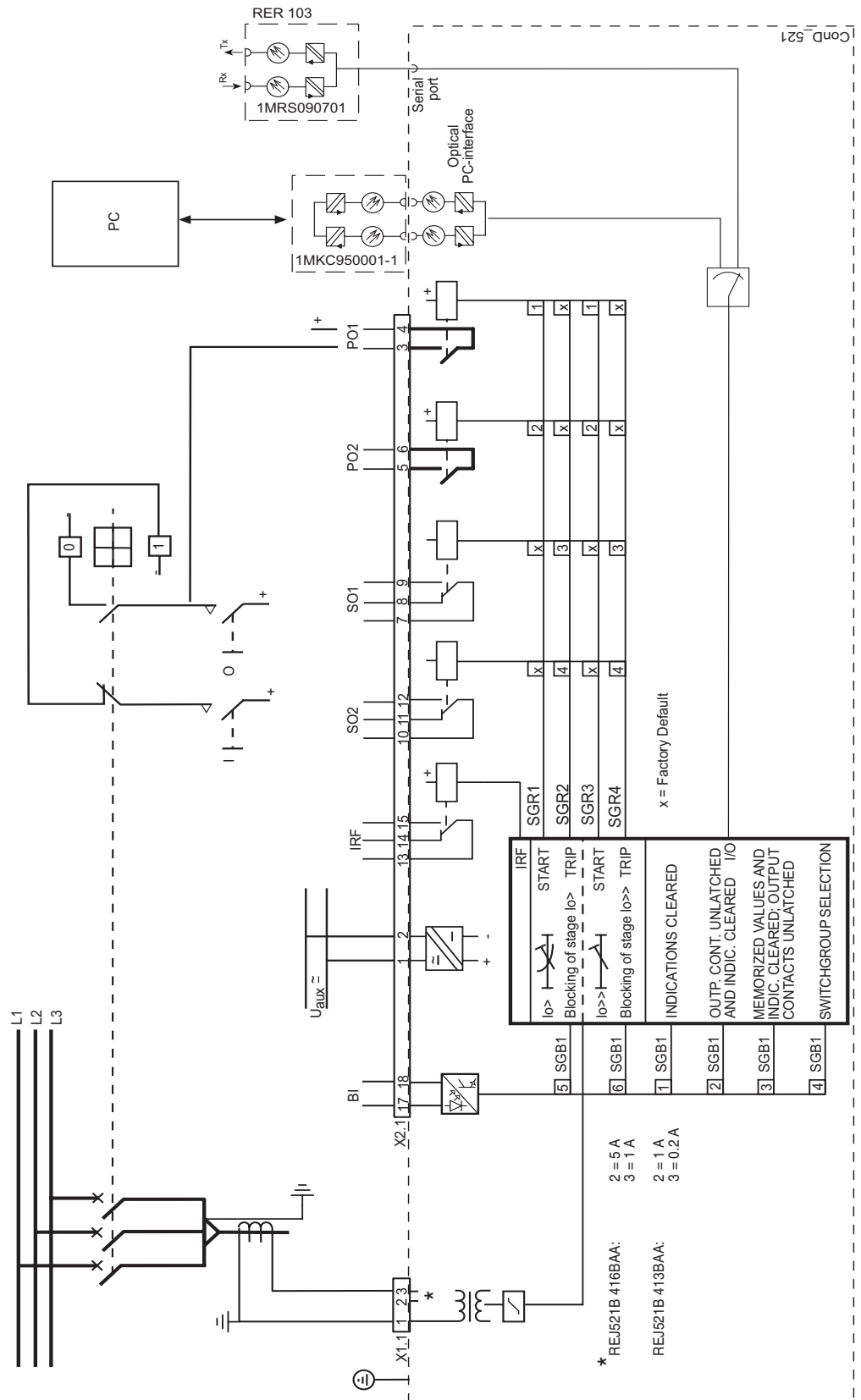


Fig. 1 Connection diagram of the earth-fault relay

---

**Ordering**

The order number identifies the hardware as described below.

This number is labelled on the marking strip on the front panel.

**Basic unit:**

Order number (I<sub>0</sub> inputs 0.2 A/1 A)

REJ521B 413BAA  
(Article nr:1MRS091413-BAA)

Order number (I<sub>0</sub> inputs 1 A/5 A)

REJ521B 416BAA  
(Article nr:1MRS091416-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 521 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**

RE\_5\_\_ Installation Manual

1MRS750526-MUM

REJ 521 Technical Reference Manual

1MRS750939-MUM

REJ 521 Operator's Manual

1MRS752179-MUM





**ABB Oy**  
Distribution Automation  
P.O. Box 699  
FI-65101 Vaasa, FINLAND  
Tel +358 10 22 11  
Fax +358 10 224 1094  
[www.abb.com/substationautomation](http://www.abb.com/substationautomation)