Combined Overvoltage and Undervoltage Relay

REU 523

Product Guide

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Features

- Single or three-phase use
- High-set overvoltage stage with definite-time or inverse definite minimum time (IDMT) characteristic
- Low-set overvoltage stage with definite-time or IDMT characteristic
- High-set undervoltage stage with definite-time or IDMT characteristic
- Low-set undervoltage stage with definite-time or IDMT characteristic
- Positive-phase-sequence protection
- Ajustable drop-off/pick-up ratio for the low-set stages
- Circuit-breaker failure protection (CBFP)
- Disturbance recorder
  - recording time up to 12 seconds
  - triggering by a start or a trip signal from a protection stage and/or by a binary input signal
  - records three analogue channels and eight 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), all protection stages and outputs are blocked.
- User-selectable rated frequency 50/60 Hz
- User-selectable password protection for the HMI
- User-selectable nominal voltage 100/110/115/120 V
- Display of primary voltage values
- Demand values
- Multi-language support

Application

The over and undervoltage relay REU 523 is a secondary relay which is connected to the voltage transformers of the object to be protected. The over and the undervoltage unit continuously measure the fundamental wave of the phase-to-phase voltages 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 overvoltage unit includes low-set stage U> and high-set stage U>> and the undervoltage unit low-set stage U< and high-set stage U<<. The high-set undervoltage stage can alternatively be set to evaluate the positive-phase-sequence voltage. In addition, the high-set undervoltage stage can be configured to evaluate only one instead of three phase-to-phase voltages.

The protection functions are independent of each other and have their own setting groups and data recordings. The over and undervoltage functions use conventional voltage 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 overvoltage unit, a high-set and low-set undervoltage unit and a circuit-breaker failure protection unit. Further, the relay includes an HMI module, a self-supervision system and a disturbance recorder.

Overvoltage unit

When the voltage values exceed the set start value of low-set stage U>, the overvoltage 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 overvoltage unit will deliver a trip signal.

When the voltage values exceed the set start value of high-set stage U>>, the overvoltage unit will start to deliver a start signal after a ~50 ms’ start time. When the set operate time at definite-time characteristic or the calculated operate time at IDMT characteristic elapses, the overvoltage unit will deliver a trip signal.

The low-set and the high-set stage of the overvoltage unit can be given either a definite-time or an IDMT characteristic. At IDMT characteristic, two time/voltage curve groups, A and B, are available.

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

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.

Undervoltage unit

When the voltage values fall below the set start value of low-set stage U<, the undervoltage unit will start to deliver a start signal after a ~ 80 ms’ start time. When the set operate time at definite-time characteristic or the calculated operate time at IDMT characteristic elapses, the undervoltage unit will deliver a trip signal.

The high-set undervoltage stage, U<<, can be set to start and trip either based on conventional undervoltage measurement or on the calculated positive-phase-sequence voltage, U_{1s}. Selecting either of these two will automatically deseclect the other.

When the conventional protection mode has been selected and the voltage values fall below the set start value of the high-set stage, the undervoltage unit will start to deliver a start signal after a ~50 ms’ start time.

When the positive-phase-sequence protection mode has been selected and the calculated positive-phase-sequence voltage value, U_{1s}, falls below the set start value of the high-set stage, the undervoltage unit will start to deliver a start signal after a ~50 ms’ start time. When the set operate time at definite-time characteristic or the calculated operate time at IDMT characteristic elapses, the undervoltage unit will deliver a trip signal.

The low-set and the high-set stage of the undervoltage unit can be given either a definite-time or an IDMT characteristic. At IDMT characteristic, one time/voltage curve group, C, is available.

The start and the tripping of an undervoltage stage can be set to be internally blocked when the measured value falls below 0.2 x U_n. In addition, the tripping of stage U< can be set to be blocked by the start of stage U<<. The tripping of an undervoltage stage can also be blocked by applying an external binary input signal to the relay.

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.

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 up-stream circuit breaker. It can also be used for tripping via redundant trip circuits of the same circuit breaker. The CBFP unit is acti-vated with a soft-ware switch.

Disturbance recorder

The REU 523 includes an internal distur-bance recorder which records the momentary measured values, or the RMS curves of the measured signals, and eight digital signals: the external binary input signal and the states of the internal protection stages. The distur-bance 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 fre-quency to be the same as the nominal fre-quency of the relay. See the table below for details:

Nominal frequency Hz	Sampling frequency Hz	Recording length s
50	800	0.60
50	400	1.20
50	50	9.60
60	960	1.00
60	480	2.00
60	60	16.00

HMI module

The HMI of the REU 523 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 REU 523 offers you multi-language sup-port. The following languages are available for the HMI menu: English, German, French, Spanish, Italian, Swedish and Finnish.

Self-supervision (IRF)

The REU 523 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 REU 523 can be connected to a substa-tion automation or monitoring system using either the SPA bus communication protocol or the IEC 60870-5-103 remote communica-tion 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 REU 523 supports the IEC 60870-5-103 remote communication protocol in the unbal-anced transmission mode with a data transfer rate of 9.6 kbps. The IEC 60870-5-103 proto-col 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 REU 523 is provided with two serial communication ports, one on the rear panel and the other on the front panel.

The REU 523 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 REU 523 can also be connected to the Lon bus using a LON-SPA Gateway.

Auxiliary Supply Voltage

The REU 523 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).

Setting values

Table 1: Setting values

Setting	Description	Setting range	Default setting
$U>/U_n$	Set start value of stage U> as a multiple of the rated voltage of the energizing input definite and inverse time	0.60...1.40 x U_n	1.20 x U_n
t>	Operate time of stage U> in seconds at definite-time characteristic	0.06...600 s	0.06 s
k>	Time multiplier k> of stage U> at IDMT characteristic	0.05...2.00	0.05
D/P>, D/P>>	Drop-off/pick-up ratio for U>	0.95...0.99	0.97
$U>>/U_n$	Set start value of stage U>> as a multiple of the rated voltage of the energizing input definite and inverse time	0.80...1.60 x U_n [1)]	1.20 x U_n
t>>	Operate time of stage U>> in seconds	0.05...600 s	0.05 s
k>>	Time multiplier k>> of stage U>> at IDMT characteristic	0.05...2.00	0.05
$U</U_n$	Set start value of stage U< as a multiple of the rated voltage of the energizing input definite and inverse time	0.30...1.20 x U_n	0.30 x U_n
t<	Operate time of stage U< in seconds at definite-time characteristic	0.10...600 s	0.10 s
k<	Time multiplier k< of stage U< at IDMT characteristic	0.10...2.00	0.10
D/P<, D/P<<	Drop-off/pick-up ratio of U<	1.01...1.05	1.03
$U<</U_n$	Set start value of stage U<< as a multiple of the rated voltage of the energizing input definite and inverse time	0.30...1.20 x U_n [1)]	0.30 x U_n
t<<	Operate time of stage U<< in seconds at definite-time characteristic.	0.10...600 s	0.10 s
k<<	Time multiplier k<< of stage U<< at IDMT characteristic.	0.10...2.00	0.10
CBFP	Circuit-breaker failure protection	0.10...1.00 s	0.10 s

[1)] The stage can be set out of operation in SGF. This state will be indicated by dashes on the LCD and by “999” when parameters are read via the SPA bus.

Technical data

Table 2: Energizing inputs

Rated frequency	50/60 Hz ±5 Hz
Rated voltage, U_n	100/110/115/120 V
Maximum input voltage - continuously - for 10 s	 2 x U_n 3 x U_n
Power consumption at U_n	< 0.1 VA (typical 0.03 VA)
Thermal withstand capability	
- continuously	2 x U_n
- for 10 s	3 x U_n
Input impedance	> 4.7 MΩ

Table 3: Measuring range

Measured voltages on phases U_{12}, U_{23} and U_{31} as multiples of the rated voltages of the energizing inputs	0…2 x U_n
Measuring accuracy (f_n ±5 Hz) at 0.20...2.00 x U_n	±1.5%

Table 4: Binary input

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

Table 5: Power outputs (PO1 and 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 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: 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

Table 8: 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 supply under quiescent/operating condition	~ 4 W/~ 10 W
Ripple in the 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 9: Enclosure class

Front side	IP 54 (flush-mounted)
Rear side, connection terminals	IP20
Note! A rear protective cover (accessory part) can be used to protect and shield the rear of the case.	

Table 10: Dimensions

Width	Frame 111.4 mm, box 94.0 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	~3.2 kg

Table 11: Environmental tests

Specified service temperature range	-10...+55 °C
Storage temperature tests	-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 12: Standard tests

Insulation tests	
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 μs, source energy 0.5 J
Insulation resistance measurements Isolation resistance	According to the IEC 60255-5 > 100 MΩ, 500 V dc
Mechanical tests	
Vibration tests (sinusoidal) Shock and bump test	According to the IEC 60255-21-1, class I According to the IEC 60255-21-2, class I
Seismic test	According to the IEC 60255-21-3, class 2

Table 13: 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, IEC 60255-22-6 (2000) 10 V (rms), f = 150 kHz…80 MHz According to the IEC 61000-4-3 IEC 60255-22-3 (2000) 10 V/m (rms), f = 80…1000 MHz According to the ENV 50204 IEC 60255-22-3 (2000) 10 V/m, f = 900 MHz According to the IEC 60255-22-3, method C; f =77.2 MHz, P=6 W; f =172.25 MHz, P=5W
Fast transient disturbance tests - other terminals - binary input	According to the IEC 60255-22-4 and IEC 61000-4-4 4 kV 2 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

Table 13: Electromagnetic compatibility tests

Power frequency (50 Hz) magnetic field IEC 61000-4-8	100 A/m
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

Connection diagram

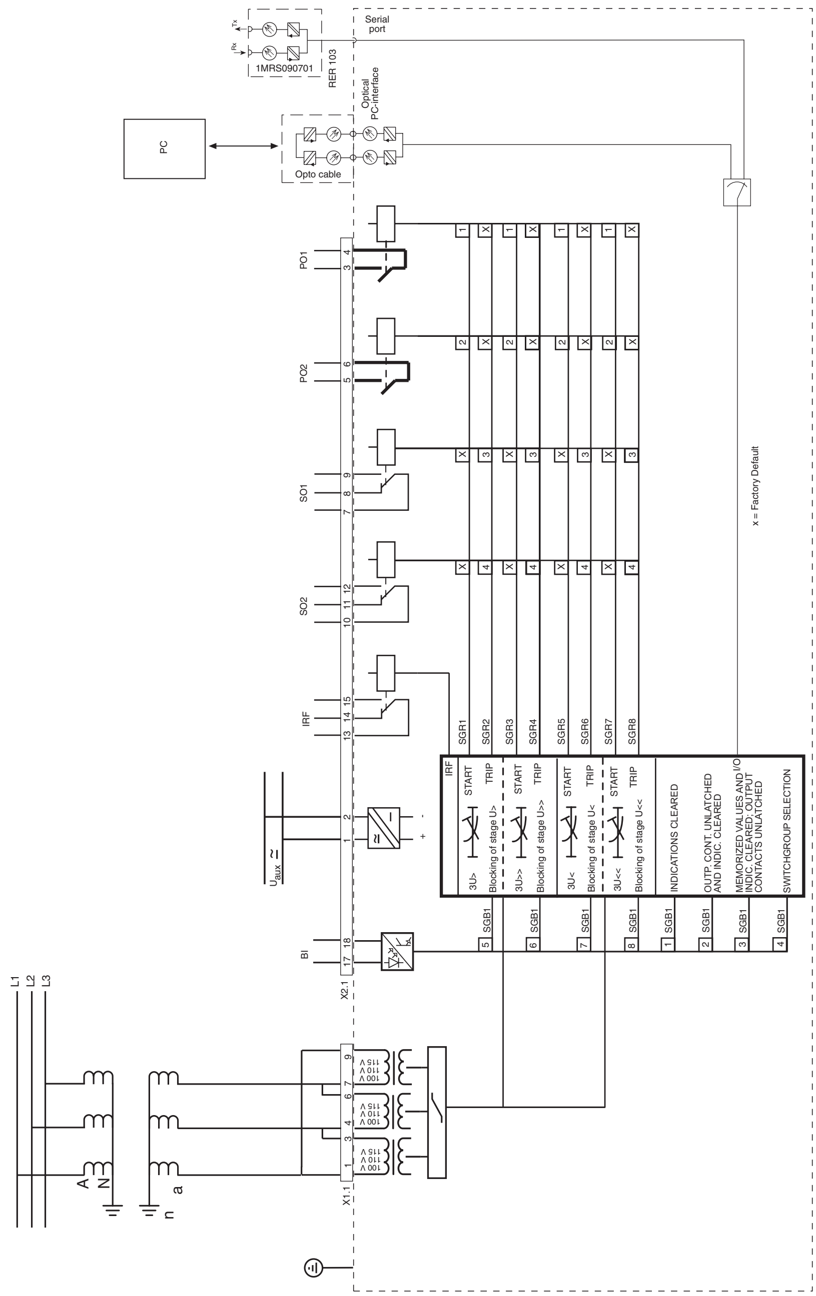

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Fig. 1 Connection diagram of the combined overvoltage and undervoltage relay

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	REU523B 409BAA (Article nr:1MRS091409-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 REU 523 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

Technical Reference Manual	1MRS 750942-MUM
Operator's Manual	1MRS 751057-MUM
Installation Manual	1MRS 750526-MUM

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