Voltage Protection Relay REU 610

Product Guide

Contents

1. Description

The voltage protection relay REU 610 is part of the RE_ 610 series of numerical relays for the protection and supervision of utility substations, industrial switchgear and their equipment.

The relay is primarily designed for the overvoltage protection of power system components, such as busbars, feeders, power transformers and capacitor batteries. It is also used for the general power system earth-fault supervision. Further, the relay can be used for undervoltage protection of motors and overvoltage protection of capacitor batteries, for initialization of automatic busbar changeover and disconnecting small power units from the network in case of a major network disturbance.

The relay supports a wide range of standard communication protocols, among them the IEC 61850, IEC 60870-5-103, Modbus, Profibus and DNP.

2. Protection functions

The relay offers integrated protection functions including two-stage overvoltage and undervoltage protection, two-stage residual overvoltage protection, as well as single-stage negative phase-sequence overvoltage protection and single-stage positive phase-sequence undervoltage protection.

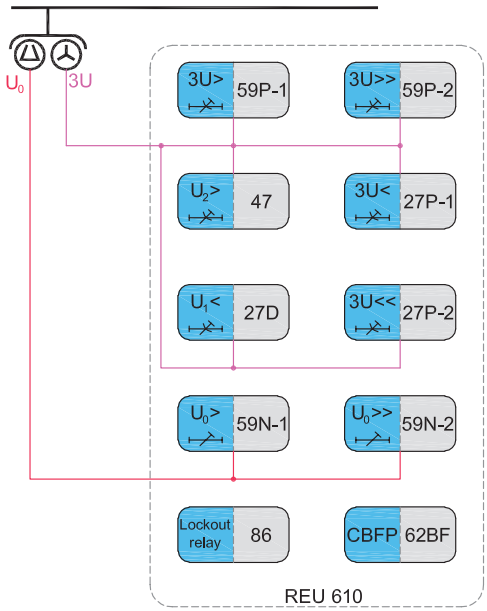

Fig. 1 Protection function overview of REU 610

Protection functions of REU 610

Function / Description	IEC	ANSI
Overvoltage protection, low-set stage	3U>	59P-1
Overvoltage protection, high-set stage [a]	3U>>	59P-2
Negative phase-sequence overvoltage protection [a]	U_2>	47
Undervoltage protection, low-set stage	3U<	27P-1
Undervoltage protection, high-set stage [b]	3U<<	27P-2
Positive phase-sequence undervoltage protection [b]	U_1<	27D
Residual overvoltage protection, low-set stage	U_0>	59N-1
Residual overvoltage protection, high-set stage	U_0>>	59N-2
Circuit-breaker failure protection	CBFP	62CB
Lockout relay function		86

[a] Mutually exclusive functions
[b] Mutually exclusive functions

3. Measurement

The relay physically measures the three phase-to-phase voltages and the residual voltage of the power system. Further, from the phase-to-phase voltages the relay calculates the positive and negative phase-sequence voltages, the one-minute average phase-to-phase voltage, the average phase-to-phase voltage for a user-specifiable time frame, the maximum value of the one-minute average voltage, and the maximum and minimum phase-to-phase voltage value since last reset.

The values of the voltages measured or calculated can be accessed locally via the user interface on the relay's front panel, or remotely via the serial communication interface on the rear panel of the relay.

4. Disturbance recorder

The relay is provided with a built-in battery backed-up digital disturbance recorder for four analog signal channels and eight digital signal channels. The analog channels can be set to record the curve form of the voltages measured. The digital channels can be set to record external or internal relay signals, e.g. the start or trip signals of relay stages, external blocking or control signals. Any digital relay signal such as a protection start or trip signal, or an external relay control signal can be set to trigger the recording. The recordings are stored in a non-volatile memory from which the data can be uploaded for subsequent fault analysis.

5. Event recorder

To provide network control and monitoring systems with substation level event logs, the relay incorporates a non-volatile memory with capacity of storing 100 event codes including the time stamps. The non-volatile memory retains its data also in case the relay temporarily loses its auxiliary supply. The event log facilitates detailed pre- and post-fault analyses of the power system and network disturbances.

6. Trip-circuit supervision

The trip-circuit supervision continuously monitors the availability and operability of the trip circuit. It provides open circuit monitoring both when the circuit breaker is in its closed and in its open position. It also detects the loss of circuit-breaker control voltage.

7. Self-supervision

The relay's built-in self-supervision system continuously monitors the state of the relay hardware and the operation of the relay software. Any fault or malfunction detected will be used for alerting the operator. When a permanent relay fault is detected, the protection functions of the relay will be completely blocked to prevent any incorrect relay operation.

8. Inputs/Outputs

- Four voltage inputs
- Two digital inputs
- Three additional digital inputs on an optional I/0 module
- Three normally open heavy duty output contacts
- Two change-over signal output contacts
- One dedicated IRF contact
- Input/output contacts freely configurable

9. Application

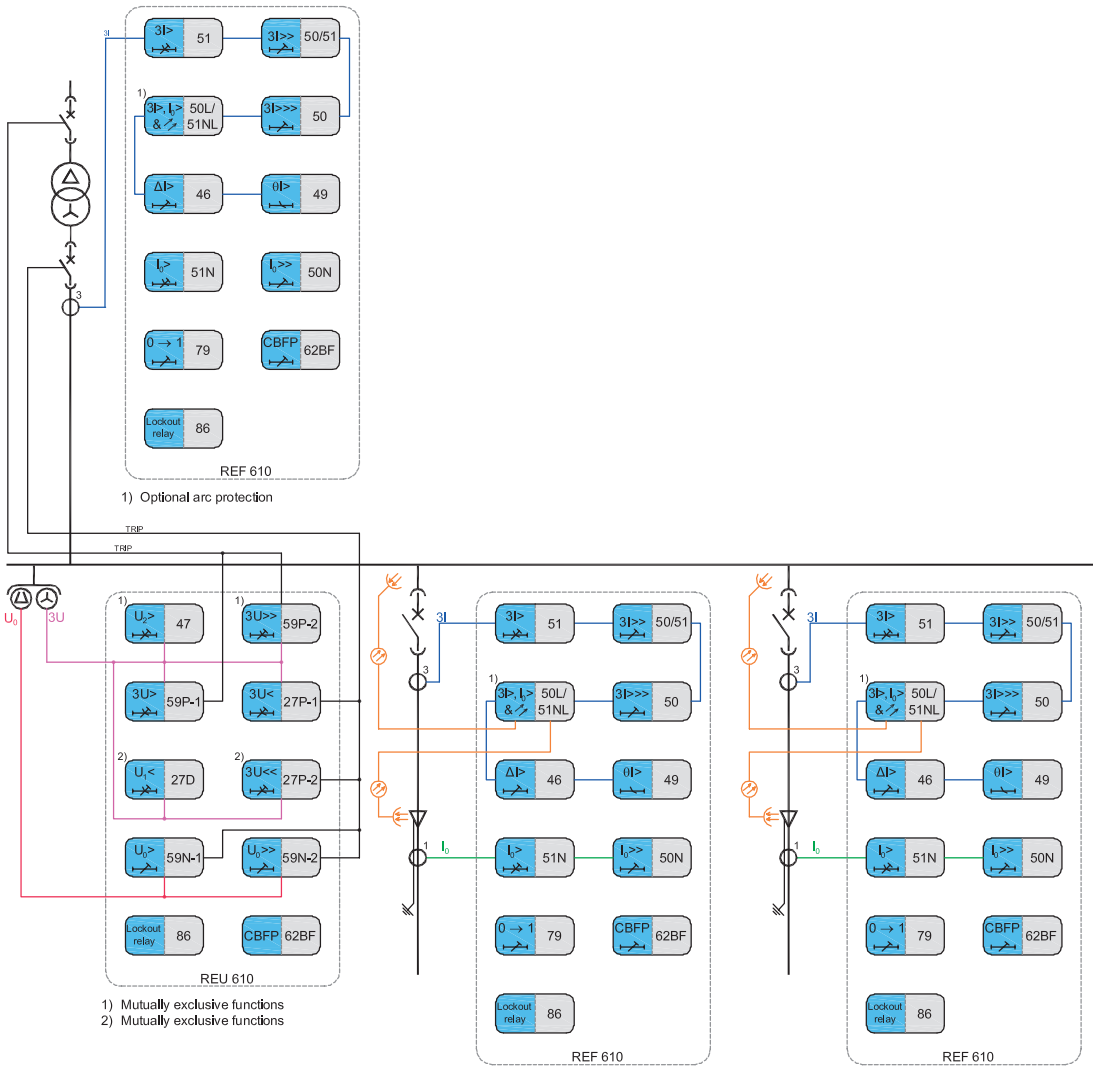

Fig 2. REU 610 providing two-stage busbar overvoltage protection, two-stage busbar undervoltage protection and two-stage residual overvoltage protection. The two undervoltage stages trip the LV side CB of the infeeder. The two residual overvoltage stages offer back-up earth-fault protection for the outgoing feeders and main earth-fault protection for the infeeder and the busbar system. The three-phase overvoltage stages trip the HV side CB, thus providing overexcitation protection for the power transformer.

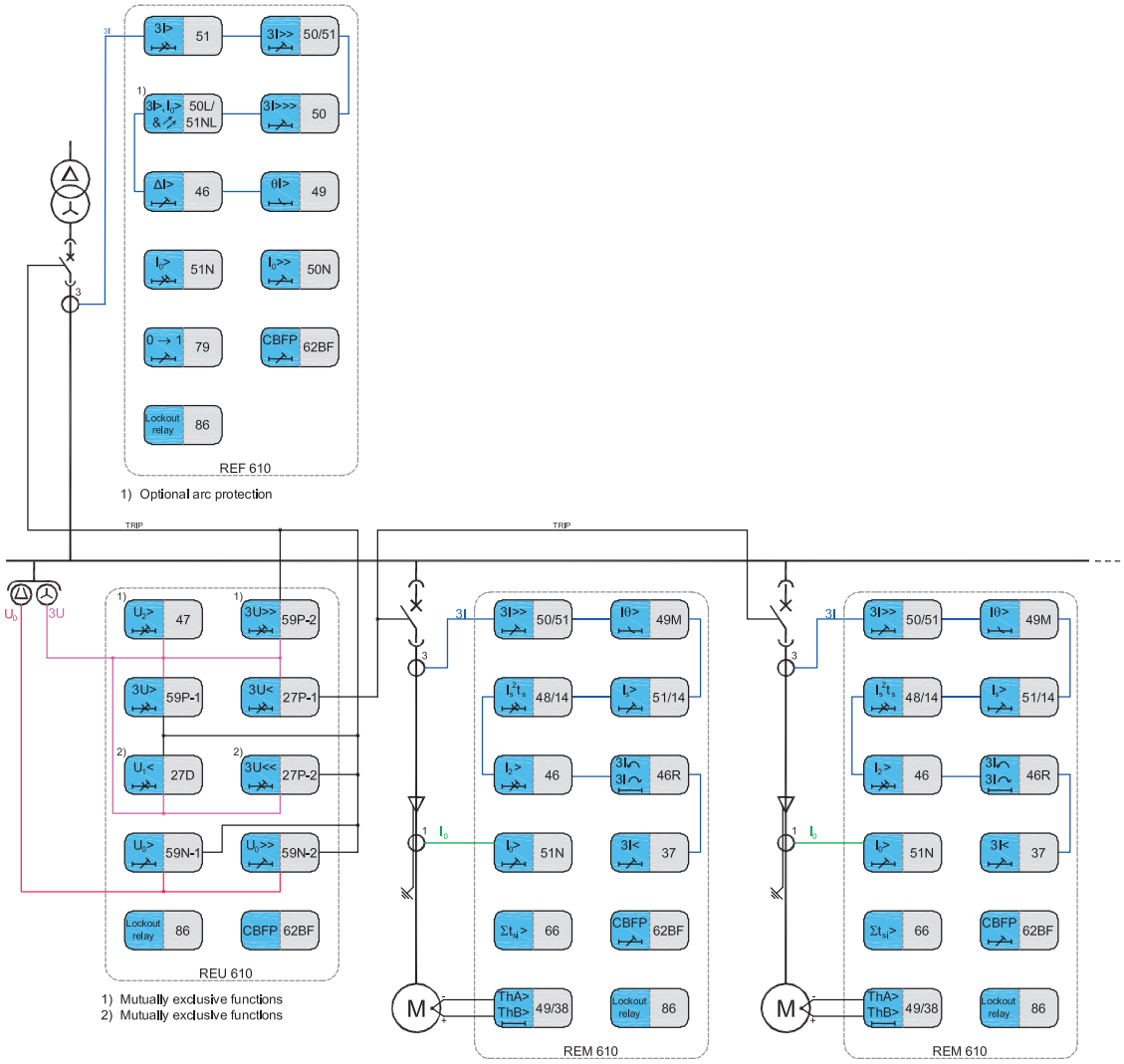

Fig. 3 REU 610 providing busbar overvoltage and undervoltage protection, and residual overvoltage protection. Both the three-phase overvoltage stages, the high-set three-phase undervoltage stage and residual overvoltage stages all trip the CB of the incoming feeder. The low-set stage of the three-phase undervoltage stage trips the CBs of the motor feeders, preventing the motors and drives from automatically starting on return of the power supply.

10. Communication

The protection relays are connected to the fibre-optic communication bus directly or via bus connection modules and gateways. The bus connection module converts the relay's electrical signals to optical signals for the communication bus and, vice versa, the communication bus' optical signals to electrical signals for the relay.

Optional communication modules and protocols

Protocol	Plastic fibre	Plastic/Glass fibre	RS-485	RS-485DNP	Bus connection modules and gateways
SPA	X	X	X	-	 IED
DNP 3.0	-	-	-	X	
IEC 60870-5-103	X	X	X	-	
Modbus (RTU and ASCII)	X	X	X	-	
IEC 61850	X	X	-	-	  IED + SPA-ZC 402
LON	-	-	X	-	  IED + SPA-ZC 102
	X	X	-	-	   IED + SPA-ZC 21 + SPA-ZC 102
Profibus	-	-	X	-	  IED + SPA-ZC 302

11. Technical data

Dimensions

Width	frame case	177 mm, 164 mm
Height	frame case	177 (4U), 160 mm
Depth	case	149.3 mm
Weight	relay spare unit	3.5 kg 1.8 kg

Power Supply

Type:	REU 610CVVHxxx	REU 610CVVLxxx
U_{aux} rated	U_r = 100/110/120/220/240 V AC U_r = 110/125/220/250 V DC	U_r = 24/48/60 V DC
U_{aux} variation (temporary)	85...110% x U_r (AC) 80...120% x U_r (DC)	80...120% x U_r (DC)
Burden of auxiliary voltage supply under quiescent (P_q)/operating condition	<9 W/13 W	
Ripple in DC auxiliary voltage	Max 12% of the DC value (at frequency of 100 Hz)	
Interruption time in the auxiliary DC voltage without resetting the relay	<50 ms at U_{aux} rated	
Time to trip from switching on the auxiliary voltage [a)]	<350 ms	
Internal over temperature limit	+100 °C	
Fuse type	T2A/250 V	

[a)] Time to trip of stages U>>.

Energizing inputs

Rated frequency	50/60 Hz ± 5 Hz
Rated voltage, U_n	100/110/115/120 V
Thermal withstand capability: • Continuously • For 10 s	 2 x U_n (240 V) 3 x U_n (360 V)
Burden at rated voltage	<0.5 VA

Measuring range

Measured phase-to-phase voltages U_{12}, U_{23} and U_{31} as multiples of the rated voltages of the energizing inputs	0... 2 x U_n
Measured residual voltage (U_0) as a multiple of the rated voltage of the energizing input	0... 2 x U_n

Digital Inputs

Rated voltage	DI1...DI2	DI3...DI5 (optional)
• REU610CVVHxxx Activating threshold • REU610CVVLxxx Activating threshold • REU610CVVxxLx Activating threshold • REU610CVVxxHx Activating threshold	110/125/220/250 V DC Max. 88 V DC (110 V DC -20%) 24/48/60/110/125/220/250 V DC Max. 19,2 V DC (24 V DC -20%)	24/48/60/110/125/220/250 V DC Max. 19,2 V DC (24 V DC -20%) 110/125/220/250 V DC Max. 88 V DC (110 V DC -20%)
Operating range		±20% of the rated voltage
Current drain		2...18 mA
Power consumption /input		<0.9 W

Signal output SO1 and optional SO4, SO5

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	1 A/0.25 A/0.15 A (5 A/3 A/1 A for series connection of SO4 and SO5)
Minimum contact load	100 mA at 24 V AC/DC

Signal output SO2, optional SO3 and IRF output

Rated voltage	250 V AC/DC
Continuous carry	5 A
Make and carry for 3.0 s	10 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	1 A/0.25 A/0.15 A
Minimum contact load	100 mA at 24 V AC/DC

Power outputs PO1, PO2 and PO3

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 (PO1 with both contacts connected in series)	5 A/3 A/1 A
Minimum contact load	100 mA at 24 V AC/DC
Trip-circuit supervision (TCS): • Control voltage range • Current drain through the supervision circuit • Minimum voltage over contact	 20...265 V AC/DC ~1.5 mA 20 V AC/DC (15...20 V)

Enclosure class of the flush-mounted relay

Front side	IP 54
Rear side, top of the relay	IP 40
Rear side, connection terminals	IP 20

Environmental tests and conditions

Recommended service temperature range (continuous)	-10...+55°C
Humidity	<95% RH
Limit temperature range (short-term)	-40...+70°C
Transport and storage temperature range	-40...+85°C according to IEC 60068-2-48
Dry heat test (humidity <50%)	According to IEC 60068-2-2
Dry cold test	According to IEC 60068-2-1
Damp heat test, cyclic (humidity >93%)	According to IEC 60068-2-30
Atmospheric pressure	86...106 kPa

Electromagnetic compatibility tests

The EMC immunity test level meets the requirements listed below:	
1 MHz burst disturbance test, class III: • Common mode • Differential mode	According to IEC 60255-22-1 2.5 kV 1.0 kV
Electrostatic discharge test, class IV: • For contact discharge • For air discharge	According to IEC 61000-4-2, IEC 60255-22-2 and ANSI 37.90.3-2001 8 kV 15 kV
Radio frequency interference tests: • Conducted, common mode • Radiated, amplitude-modulated • Radiated, pulse-modulated	 According to IEC 61000-4-6 and IEC 60255-22-6 (2000) 10 V (rms), f = 150 kHz...80 MHz According to 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
Fast transient disturbance tests: • Power outputs, energizing inputs, power supply • I/O ports	According to IEC 60255-22-4, and IEC 61000-4-4 4 kV 2 kV
Surge immunity test: • Power outputs, energizing inputs, power supply • I/O ports	According to IEC 61000-4-5 4 kV, line-to-earth, 2 kV, line-to-line 2 kV, line-to-earth, 1 kV, line-to-line

(continued)

Power frequency (50 Hz) magnetic field IEC 6100-4-8	300 A/m continuous
Voltage dips and short interruptions	According to IEC 61000-4-11 30%/10 ms 60%/100 ms 60%/1000 ms >95%/5000 ms
Electromagnetic emission tests: • Conducted, RF emission (Mains terminal) • Radiated RF emission	According to the EN 55011 EN 55011, class A, IEC 60255-25 EN 55011, class A, IEC 60255-25
CE compliance	Complies with the EMC directive 89/336/EEC

Insulation test

Dielectric tests: • Test voltage	According to IEC 60255-5 2 kV, 50 Hz, 1 min
Impulse voltage test: • Test voltage	According to IEC 60255-5 5 kV, unipolar impulses, waveform 1.2/50 µs, source energy 0.5 J
Insulation resistance measurements • Isolation resistance	According to IEC 60255-5 >100 MΩ, 500 V DC

Mechanical tests

Vibration tests (sinusoidal)	According to IEC 60255-21-1, class I
Shock and bump test	According to IEC 60255-21-2, class I

Data communication

Front interface:
- Optical connection (infrared) via the front communication cable (1MRS050698)
- SPA bus protocol
- 9.6 or 4.8 kbps (9.6 kbps with front communication cable)

Protection functions

Stages U>, U>> and U_2>

Feature	Stage U>	Stage U>>	Stage U_2>
Set start value U>, U>> and U_2> • At definite-time characteristic • At IDMT characteristic	 0.60...1.40 x U_n 0.60...1.25 x U_n a)	 0.80...1.60 x U_n 0.80...1.25 x U_n	 0.05...1.00 x U_n 0.05...1.00 x U_n
Start time, typical	60 ms	50 ms	50 ms
Time/voltage characteristic • Definite-time operate time, t>, t>> • IDMT	 0.06...600 s curve A curve B	 0.05...600 s curve A curve B	 0.05...600 s curve A curve B

a) Because of the maximum measured voltage (2 x Un), the setting value 1.25 is used for the IDMT calculation if the set value is greater than 1.25. This makes the operate time faster than the theoretical IDMT curve. However, the stage always starts according to the set value.

(continued)

Feature	Stage U>	Stage U>>	Stage U_2>
Time multiplier, k>, k>>	0.05...2.00	0.05...2.00	0.05...2.00
Resetting time, typical/maximum	70/80 ms [b]	70/80 ms	70/80 ms
Retardation time, typical	30 ms	30 ms	50 ms
Set resetting time, t_r>	0.07...60.0	-	-
Drop-off/pick-up ratio, D/P>	0.95...0.99	0.95...0.99	0.96
Operate time accuracy • At definite-time characteristic • At IDMT characteristic	 ±2% of the set operate time or ±25 ms ±25 ms or the accuracy appearing when the measured voltage varies ±3%	 ±2% of the set operate time or ±25 ms ±25 ms or the accuracy appearing when the measured voltage varies ±3%	 ±2% of the set operate time or ±25 ms ±25 ms or the accuracy appearing when the measured voltage varies ±3%
Operation accuracy • 0.05...0.15 x U_n • 0.15...1.00 x U_n	±1.5% of the set start value - -	±1.5% of the set start value - -	- ±10% of the set start value ±5% of the set start value

b) Resetting time of the trip signal.

Stage U>> and stage U_2> cannot be used at the same time.

Stages U<, U<< and U_1<

Feature	Stage U<	Stage U<<	Stage U_1<
Set start value U<, U<< and U_1< • At definite-time characteristic • At IDMT characteristic	 0.02...1.20 x U_n 0.02...1.20 x U_n	 0.02...1.20 x U_n 0.02...1.20 x U_n	 0.02...1.20 x U_n 0.02...1.20 x U_n
Start time, typical	80 ms	50 ms	50 ms
Time/voltage characteristic • At definite operate time, t<, t<< • IDMT	 0.10...600 s curve C	 0.10...600 s curve C	 0.10...600 s curve C
Time multiplier, k<, k<<	0.10...2.00	0.10...2.00	0.10...2.00
Resetting time, typical/maximum	70/80 ms	70/80 ms	70/80 ms
Retardation time, typical	30 ms	30 ms	50 ms
Set resetting time, t_r>	0.07...60.0 [a]		
Drop-off/pick-up ratio, D/P>	1.01...1.05	1.01...1.05	1.04

a) Because of the maximum measured voltage (2 x U_n) the setting value 1.25 is used for the IDMT calculation if the set value is greater than 1.25. This makes the operate time faster than the theoretical IDMT curve. However, the stage always starts according to the set value.

(continued)

Feature	Stage U<	Stage U<<	Stage U_1<
Operate time accuracy • At definite-time characteristic	±2% of the set operate time or ±25 ms	±2% of the set operate time or ±25 ms	±2% of the set operate time or ±25 ms
• At IDMT characteristic	±25 ms or the accuracy appearing when the measured voltage varies ±3%	±25 ms or the accuracy appearing when the measured voltage varies ±3%	±25 ms or the accuracy appearing when the measured voltage varies ±3%
Operation accuracy	±1.5% of the set start value	±1.5% of the set start value	±5% of the set start value

a) Resetting time of the trip signal.

Stage U<< and stage U1< cannot be used at the same time.

Stages U_0> and U_0>>

Feature	Stage U_0>	Stage U_0>>
Set start value U_0> and U_0>> • At definite-time characteristic	2.0...80% U_n	2.0...80% U_n
Start time, typical	70 ms	60 ms
Time/voltage characteristic • Definite-time operate time, t_0>, t_0>>	0.10...600 s	0.10...600 s
Resetting time, typical/maximum	30/50 ms [a)]	30/50 ms [a)]
Retardation time, typical	30 ms	30 ms
Set resetting time, t_{0r}>	0.07...60.0 s	100 ms
Drop-off/pick-up ratio, typical	0.96	0.96
Operate time accuracy • At definite-time characteristic	±2% of the set operate time or ±25 ms	±2% of the set operate time or ±25 ms
Operation accuracy	±1.5% of the set start value or ±0.05% U_n	±1.5% of the set start value or ±0.05% U_n

a) Resetting time to the trip signal.

CBFP

Feature	Value
Set operate time	0.10...60.0 s
Phase-to phase voltage threshold for external triggering of the CBFP • Pick-up/drop-off	0.15/0.10 x U_n

12. Mounting methods

Using the appropriate mounting accessories, the standard relay case for the RE_ 610 series relays can be flush mounted, semi-flush mounted or wall mounted. The flush mounted and wall mounted relay cases can also be mounted in a tilted position (25°) by using special accessories. Further, the relays can be mounted in any standard 19" instrument cabinet by means of 19" mounting panels available with cut-outs for one or two relays. Alternatively, the relays can be mounted in 19" instrument cabinets by means of 4U Combiflex equipment frames. For the routine testing purposes, the relay cases can be equipped with test switches, type RTXP 18, which can be mounted side by side with the relay cases.

Mounting methods:

- Flush mounting
- Semi-flush mounting
- Semi-flush mounting in a 25° angle
- Rack mounting
- Wall mounting
- Mounting to a 19" equipment frame
- Mounting with a RTXP 18 test switch to a 19" rack

13. Relay case and relay plug-in unit

As a safety measure, the relay cases for the current measuring relays are provided with automatically acting contacts for short-circuiting the CT secondaries, when a relay plug-in unit is withdrawn from the relay case. In addition, the relay case is provided with a mechanical coding system to prevent the current measuring relay plug-in units from being inserted into a case for a voltage relay unit and vice versa, i.e. the relay cases are associated to a certain type of relay plug-in unit.

There is, however, a universal relay case available, which is not associated to a certain plug-in unit type. When a relay plug-in unit is plugged into such a relay case for the first time, the relay case will automatically adapt to that particular relay type, i.e. the short-circuiting contacts will be activated as well as the mechanical blocking system. Hereafter, the relay case is permanently associated to a certain relay type.

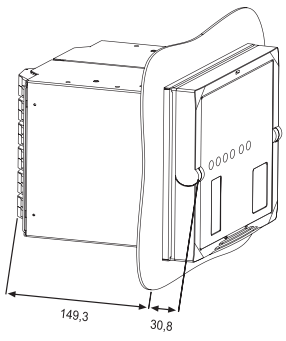

Fig. 4 Flush mounting

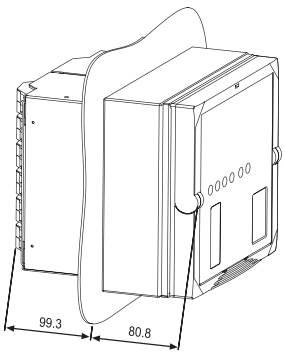

Fig. 5 Semi-flush mounting

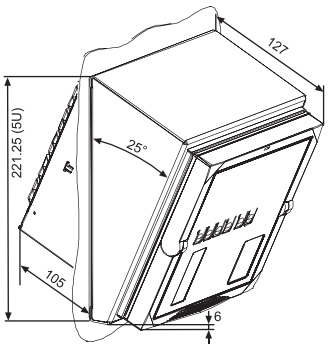

Fig. 6 Semi-flush mounting in a 25° angle

14. Selection and ordering data

When ordering protection relays and/or accessories, please specify the following information: order number, HMI language set number and quantity. The order number identifies the protection relay type and hardware and is labelled on the marking strip under the lower handle of the relay.

Use the ordering key information in Fig. 7 to generate the order number when ordering complete protection relays.

REU610 □□□□C□□.□□

Revision		
Current revision		C
Phase-to-phase voltage inputs:		
V =	rated voltages (100/110/115/120 V)	V
Residual voltage input:		
V =	rated voltages (100/110/115/120 V)	V
Power supply:		
H =	100-240 V AC/110-250 V DC, 2xDI (110/125/220/250 V DC), 3xPO 2xSO	H
L =	24-60 V DC, 2xDI (24/48/60/110/125/220/250 V DC), 3xPO, 2xSO	L
I/O extension module:		
H =	3xSO and 3xDI (110/125/220/250 V DC)	H
L =	3xSO and 3xDI (24/48/60/110/125/220/250 V DC)	L
N =	none	N
Communication module:		
P =	plastic fiber	P
G =	plastic and glass fiber	G
R =	RS-485	R
D =	RS-485 including DNP 3.0 protocol	D
N =	none	N
Language set:		
01 =	(IEC) English, Svenska, Suomi	01
02 =	(IEC) English, Deutsch, Francais, Italiano, Español, Polski	02
11 =	(ANSI) English, Español, Portugese	11

Fig. 7 Ordering key for complete relays

Use the ordering key information in Fig. 8 to generate the order number when ordering spare units.

REU610 □□□□S□ S □□

Revision		
Current revision		C
Phase-to-phase voltage inputs:		
V =	rated voltages (100/110/115/120 V)	V
Residual voltage input:		
V =	rated voltages (100/110/115/120 V)	V
Power supply:		
H =	100-240 V AC/110-250 V DC, 2xDI (110/125/220/250 V DC), 3xPO 2xSO	H
L =	24-60 V DC, 2xDI (24/48/60/110/125/220/250 V DC), 3xPO, 2xSO	L
I/O extension module:		
H =	3xSO and 3xDI (110/125/220/250 V DC)	H
L =	3xSO and 3xDI (24/48/60/110/125/220/250 V DC)	L
N =	none	N
Language set:		
01 =	(IEC) English, Svenska, Suomi	01
02 =	(IEC) English, Deutsch, Francais, Italiano, Español, Polski	02
11 =	(ANSI) English, Español, Portugese	11

Fig. 8 Ordering key for spare units

15. Accessories and tools

Item	Order nr
Cables:	
Front communication cable	1MRS050698
Mounting accessories:	
Semi-flush mounting kit	1MRS050696
Inclined semi-flush mounting kit	1MRS050831
19 ” rack mounting kit with cutout for one relay	1MRS050694
19 ” rack mounting kit with cutout for two relays	1MRS050695
Surface mounting frame	1MRS050697
Mounting bracket for RTXP 18	1MRS061207
Mounting bracket for 4U high Combiflex equipment frame	1MRS061208
Test switches:	
Test switch RTXP 18	1MRS050783
Optional communication cards:	
Plastic fibre	1MRS050889
RS-485	1MRS050892
Plastic and glass fibre	1MRS050891
RS-485 including DNP 3.0 protocol	1MRS050887
RE_ 610 universal cases:	
Empty universal relay case for RE_ 610	1MRS050904

Configuration, setting and SA system tools	Version
CAP 501 Relay Setting Tool CAP 50	v. 2.4.0-1 or later
CAP 505 Relay Setting Tool CAP 50	v. 2.4.0-1 or later
SMS 510 Substation Monitoring System	SMS 510 v.1.2.0-1 or later
LIB 510 Library for MicroSCADA v. 8.4.4	LIB 510 v. 4.0.5-3 or later

16. Terminal diagram

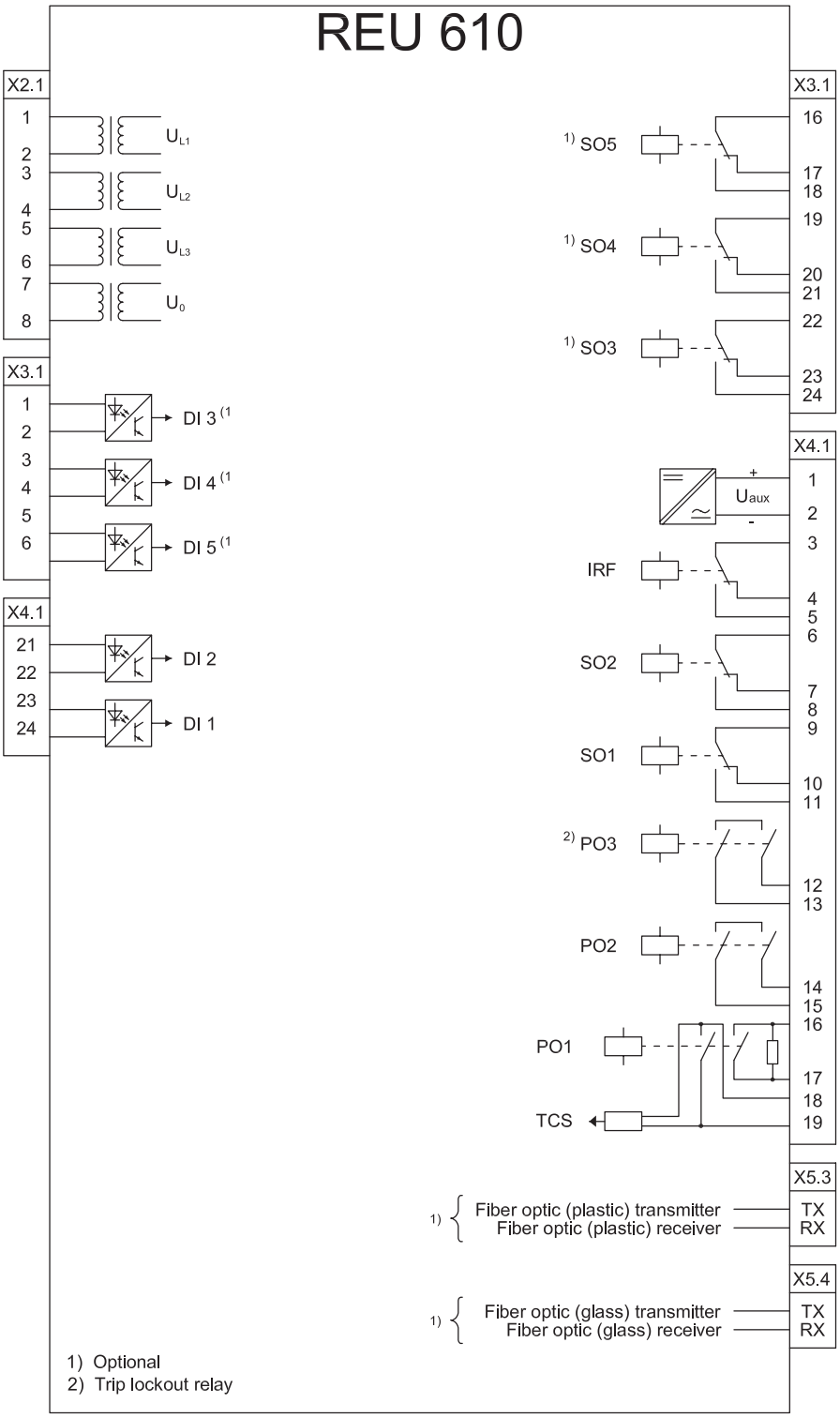

Fig. 9 Terminal diagram of REU 610

17. References

The www.abb.com/substationautomation portal offers you information about the distribution automation product and service range.

You will find the latest relevant information on the REU 610 protection relay on the product page.

The download area on the right hand side of the web page contains the latest product documentation, such as technical reference manual, installation manual, operators manual, etc. The selection tool on the web page helps you find the documents by the document category and language.

The Features and Application tabs contain product related information in a compact format.

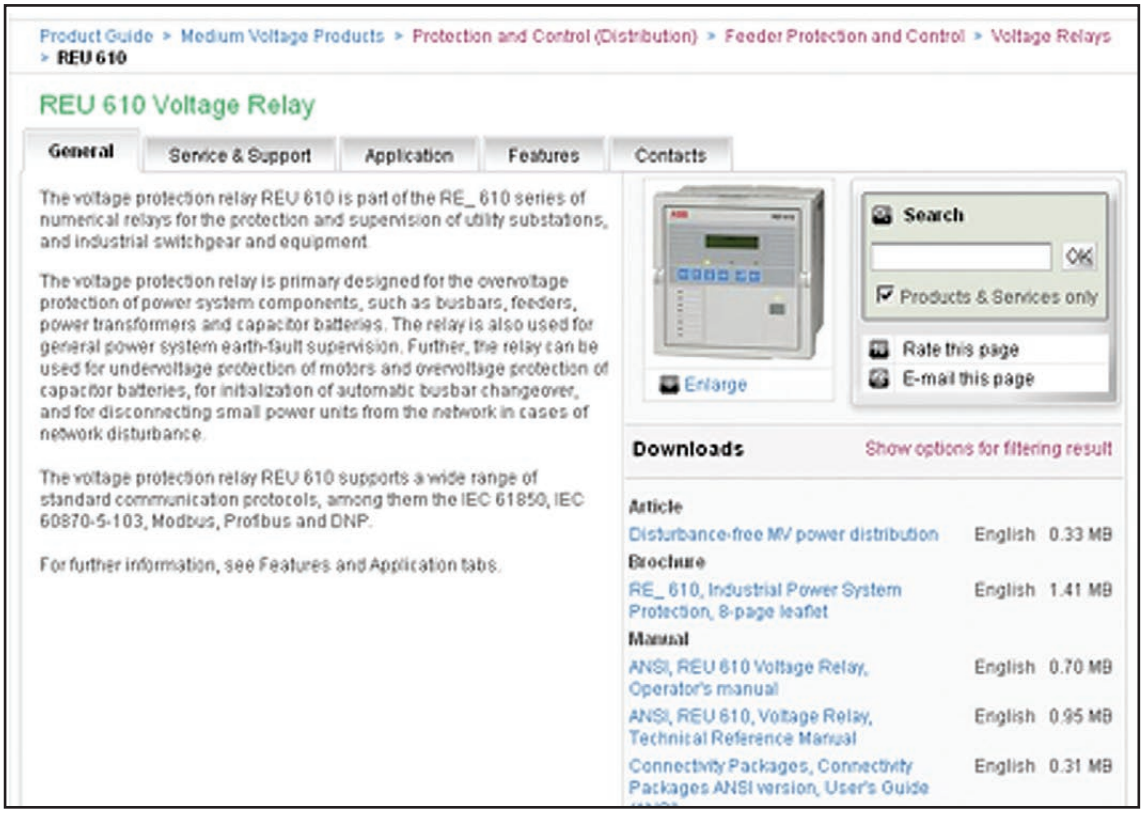

Fig. 10 Product page

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