Motor Protection Relay REM 610

Product Guide

Contents

1. Description

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

The motor protection relay REM 610 is primarily targeted at protecting large asynchronous low-voltage motors and small and medium-sized high-voltage asynchronous motors. REM 610 handles electrical fault conditions during motor start up, normal operation, idling, and cooling down at standstill, e.g. in pump, fan, mill or crusher applications.

2. Protection functions

The relay offers many integrated protection functions for the protection of motors. The thermal overload protection, cumulative motor start up supervision, running stall protection, earth-fault protection and loss-of-phase are the key functions of this relay. The coverage of the thermal overload protection can be further enhanced by means of an optional RTD module for direct temperature measurement.

The relay can be used with both circuit-breaker controlled and contactor-controlled drives. REM 610 can also be used for the protection of cables' feeders and distribution transformers that require thermal overload protection besides overcurrent, earth-fault and phase unbalance protection.

The numerical motor protection relays of the RE_ 610 series support a wide range of standard communication protocols, among them the IEC 61850, IEC 60870-5-103, Modbus and Profibus.

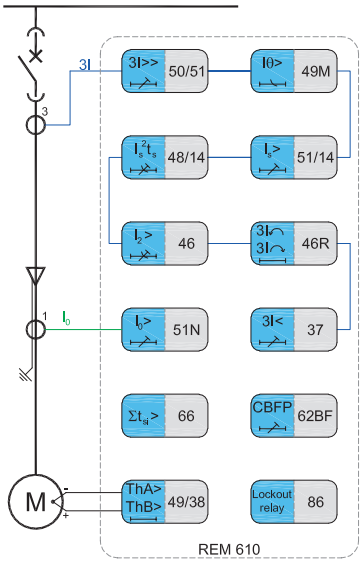

Fig. 1 Protection function overview of REM 610

Protection functions of REM 610

Function / Description	IEC	ANSI
Three-phase thermal overload protection	Θ>	49M
Motor start-up supervision based on thermal stress calculation [a)]	$I_s^2t_s$	48/14
Three-phase definite time overcurrent protection, low-set stage [a)]	I_s>	51/14
Three-phase instantaneous or definite time short circuit protection, high-set stage	3I>>	50/51
Inverse-time unbalance protection based on the negative phase sequence current	I_2>	46
Phase reversal protection	REV	46R
Definite-time undercurrent (loss of load) protection	31<	66
Instantaneous or definite-time earth-fault protection	I_0>	50N/51N
Cumulative start-up time counter and restart inhibit function	Σ t_{si}	37
Temperature protection using RTD sensors or thermistors	ThA>, ThB>	49/38
Circuit-breaker failure protection	CBFP	62BF
Lockout relay function		86

[a)] Mutually exclusive functions

3. Measurement

The relay physically measures the phase currents and the residual current. From the phase currents, the relay calculates the thermal overload and the negative-phase-sequence current of the protected motor or generator. REM 610 also measures a number of characteristic currents of the protected object during start-up and duty operation. Further, by means of an optional measurement card, the relay can directly measure up to eight temperatures via six RTD and two thermistor type sensors.

The values measured can be accessed locally via the user interface on the relay 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 currents 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 bay 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 faults and 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 current transformers
- Two digital inputs
- Three additional digital inputs on an optional RTD 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

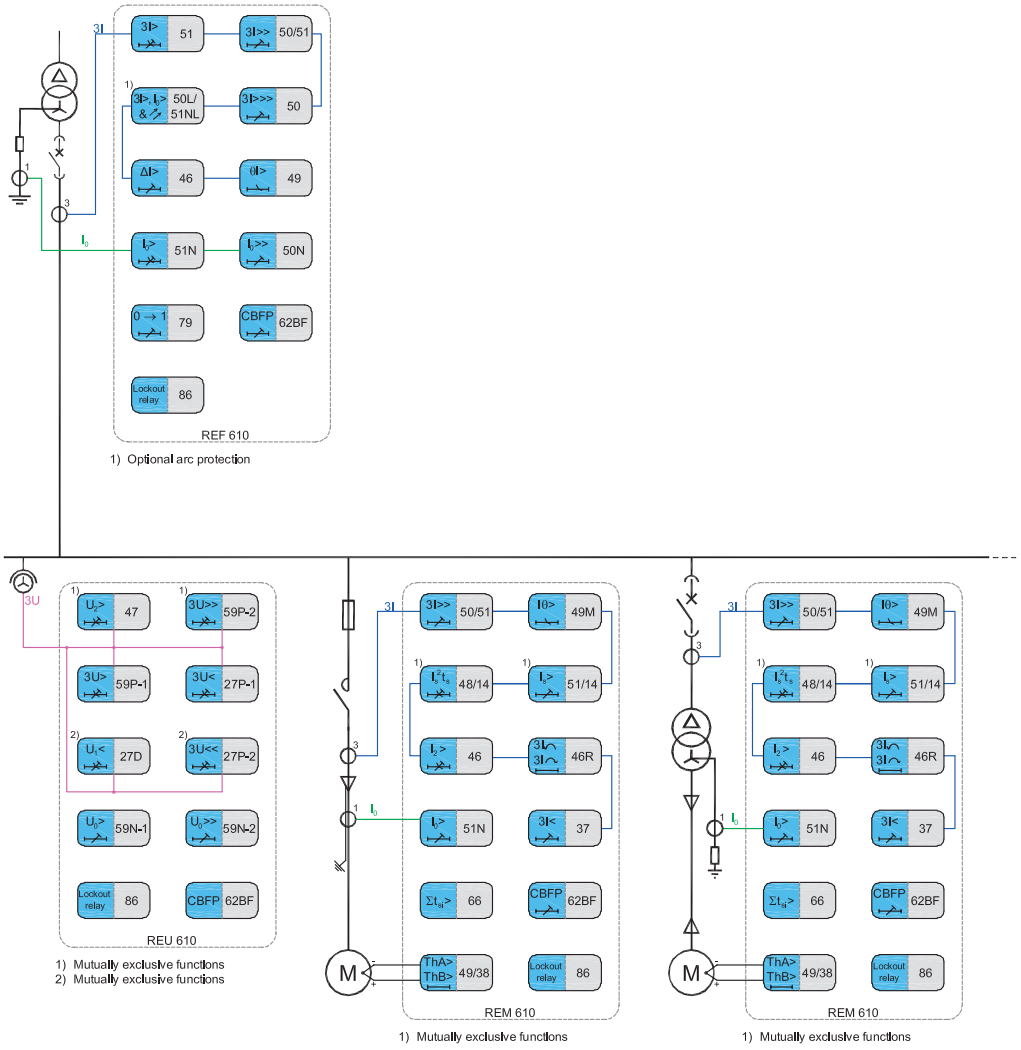

Fig 2. REM 610 can be used for the protection of both circuit-breaker controlled and contactor controlled motor drives. In the contactor controlled motor drive application, the protection also covers the feeder cable and the cable box. The CB controlled application features a transformer and motor drive application. The load side of the transformer is earthed via a resistor, which enables current measuring earth-fault protection to be used. In both applications, the critical motor temperatures are supervised through direct temperature measurement via embedded sensors.

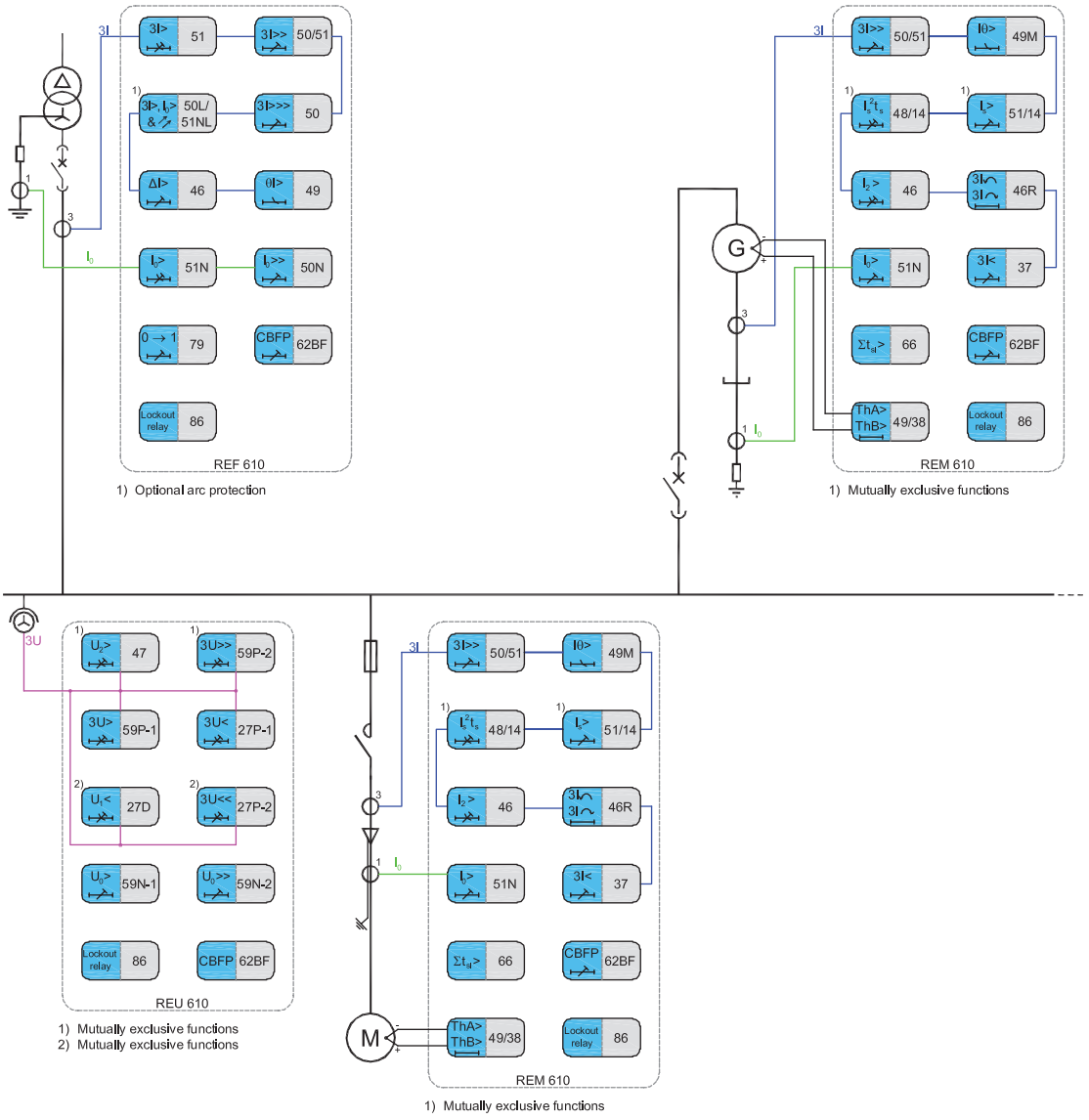

Fig. 3 REM 610 provides a full range of protection functions for the large low-voltage motors and from small to medium sized high-voltage motors. REM 610 is also used for the protection of small asynchronous power generators, for which the relay offers short-circuit and time overcurrent protection, thermal overload protection, phase unbalance and stall protection, and stator earth-fault protection. Further, the relay features direct temperature measurement via embedded sensors in the generator winding or bearings.

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	Bus connection modules and gateways
SPA	X	X	X	 IED
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:	**REM 610CxxHxxx**	**REM 610CxxLxxx**
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 I>>.

Energizing inputs

Rated frequency	50/60 Hz ± 5 Hz	
Rated current, I_n	1 A	5 A
Thermal withstand capability: • continuously • for 1 s • for 10 s	 4 A 100 A 25 A	 20 A 500 A 100 A
Dynamic current withstand: • half-wave value	 250 A	 1250 A
Input impedance	<100 mΩ	<20 mΩ

Measuring range

Measured currents on phases I_{L1}, I_{L2} and I_{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

Digital Inputs

Rated voltage	DI1...DI2	DI3...DI5 (optional)
• REM 610BxxHxxx Activating threshold	110/125/220/250 V DC Max. 88 V DC (110 V DC -20%)	
• REM 610BxxLxxx Activating threshold	24/48/60/110/125/220/250 V DC	
• REM 610BxxxxMx Activating threshold	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%)
Operating range		±20% of the rated voltage
Current drain		2...18 mA
Power consumption/ input		<0.9 W

Signal output SO1

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
Minimum contact load	100 mA at 24 V AC/DC

Signal output SO2 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	35 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 a 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

RTD/analogue inputs

Supported RTD sensors	100 Ω platinum 250 Ω platinum 1000 Ω platinum 100 Ω nickel 120 Ω nickel 120 Ω nickel (US) 10 Ω copper	TCR 0.00385 (DIN 43760) TCR 0.00385 TCR 0.00385 TCR 0.00618 (DIN 43760) TCR 0.00618 TCR 0.00672 TCR 0.00427
Supported PTC thermistor range	0...20 kΩ	
Maximum lead resistance (three-wire measurement)	200 Ω per lead	
Isolation	2 kV (inputs to protective earth)	
Sampling frequency	5 Hz	
Response time	<8 s	
RTD/resistance sensing current	Maximum 4.2 mA rms 6.2 mA rms for 10 Ω copper	

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:	According to IEC 60255-22-1
• Common mode • Differential mode	2.5 kV 1.0 kV
Electrostatic discharge test, class IV:	According to IEC 61000-4-2, IEC 60255-22-2 and ANSI 37.90.3-2001
• For contact discharge • For air discharge	8 kV 15 kV
Radio frequency interference tests:	
• Conducted, common mode	According to IEC 61000-4-6 and IEC 60255-22-6 (2000) 10 V (rms), f = 150 kHz...80 MHz
• Radiated, amplitude-modulated	According to 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

(continued)

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
Power frequency (50 Hz) magnetic field	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 Ms, 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

Stage θ>

Feature	Value
Set safe stall time, t_{6x}	2..0...120 s [a]
Set ambient temperature, T_{amb}	0...70 °C
Set restart inhibit level, θi>	20...80%
Set prior alarm level, θ_a>	50...100%
Trip level, θ_t>	100%
Time constant multiplier, K_c	1...64
Weighting factor, p	20...100%
Operate time accuracy: • >1.2 x In	 ±5% of the set operate time or ±1 s

a) The setting step is 0.5.

Stages Is>

Feature	Value
Set start value, I_s> • At definite-time characteristic	 1.00...10.0 x I_n
Start time, typical	55 ms
Time/current characteristics • Definite time operate time, t_s>	 0.30...80.0 s
Resetting time, typical/maximum	35/50 ms
Retardation time	30 ms
Drop-off/start ratio, typical	0.96
Operate time accuracy • At definite-time characteristic	 ±2% of the set operate time or ±25 ms
Operation accuracy	±3% of the start value

Stage $I_s^2 x\ t_s$ and stage I_s> cannot be used at the same time.

Stage Is_2x ts

Feature	Value
Set start-up current motor, $I_s>$	1.00...10.0 x I_n
Start time, typical • At start criterion $I_L>I_s$	 100 ms
Set start-up time for motor, $t_s>$	0.30...80.0s
Resetting time, typical/maximum	180/250 ms
Drop-off/pick-up ratio, typical • At start criterion $I_L>I_s$	 0.96
Operation accuracy	±10% of the calculated operate time ±0.2 s
Shortest possible operate time	300 ms

Stage I_s^2x t_s and stage $I_s>$ cannot be used at the same time.

Stage I>>

Feature	Value
Set start value, I>> • At definite-time characteristic	 0.50...20.0 x I_n
Start time, typical	50 ms
Time/current characteristic • Definite time operate time, t0>	 0.05...300 s
Resetting time, typical/maximum	40/50 ms
Retardation time	30 ms
Drop-off/pick-up ratio, typical	0.96
Operate time accuracy at • Definite-time characteristic	 ±2% of the set operate time or ±25 ms
Operation accuracy	±3% of the set start value

Stage I<

Feature	Value
Set start value, I< • At definite-time characteristic	 30...80% I_n
Start time, typical	300 ms
Time/current characteristic • Definite time operate time, t<	 2...600 s
Resetting time, typical/maximum	300/350 ms
Drop-off/pick-up ratio, typical	1.1
Inhibitation of I<	<12% I_n
Operate time accuracy • At definite-time characteristic	 ±3% of the set operate time or 100 ms
Operation accuracy	±3% of the set start value or +0.5% I_n

Stage I_0>

Feature	Value
Set start value, I_0> • At definite-time characteristic	 1.0...100% I_n
Start time, typical	50 ms
Time/current characteristic • Definite time operate time, t<	 0.05...300 s
Resetting time, typical/maximum	40/50 ms
Retardation time	30 ms
Drop-off/pick-up ratio, typical	0.96
Operate time accuracy • At definite-time characteristic	 ±2% of the set operate time or ±25 ms
Operation accuracy • 1.0...10.0% I_n • 1.0...100% I_n	 ±5% of the set start value ±3% of the set start value

Stage I_2>

Feature	Value
Set start value, I_2> • At IDMT characteristic	 0.10...0.50 x I_n
Start time, typical	100 ms
Time/current characteristic • IDMT time constant, K_2	 5...100
Resetting time, typical/maximum	130/200 ms
Drop-off/pick-up ratio, typical	0.95
Operate time accuracy • I2> + 0.065...4.0 x I_n	 ±5% of the calculated operate time or ±100 ms
Operation accuracy	±5% of the set start value
Inhibitation of I_2>	I < 0.12 x I_n or I > 4.0 x I_n

Stage REV

Feature	Value
Trip value	NPS ≥75% of the maximum phase current
Time/current characteristic • Definite time operate time	 220 ms ±50 ms
Resetting time, typical	100...200 ms
Drop-off/pick-up ratio, typical	0.95

Stage Σ_{tsi}

Feature	Value
Set restart inhibit value, Σ_{tsi}	5...500 s
Countdown rate of start-up time counter, $\Delta\Sigma_{ts}/\Delta t$	2...250 s/h

Stages ThA> and ThB>

Feature	Value
Operate time accuracy at definite-time characteristic	±3% of the set operate time or 200 ms [a)]
RTD sensors	
Set alarm value, Ta1...6>	0...200 °C
Operate time, ta1...6>	1...100 s
Set trip value, Tp1...6>	0...200 °C
Operate time, tp1...6>	1...100 s
Hysteresis	5 °C
Operation accuracy	±1 °C (±3 °C for Cu10)
Thermistors	
Set trip value, Thp1> and Thp2>	0.1...15.0 kΩ
Operate time	2 s
Operation accuracy	±1% of the setting range

a) Note the response time of the RTD card (<8s).

CBFP

Feature	Value
Set operate time	0.10...60.0 s
Phase-current threshold for external triggering of the CBFP • Pick-up/drop-off	 0.13/0.11 x I_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.

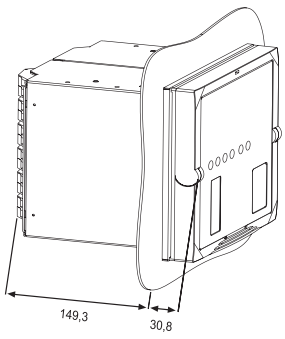

Fig. 4 Flush mounting

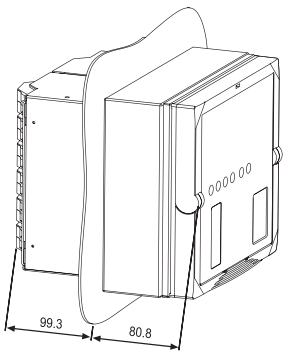

Fig. 5 Semi-flush mounting

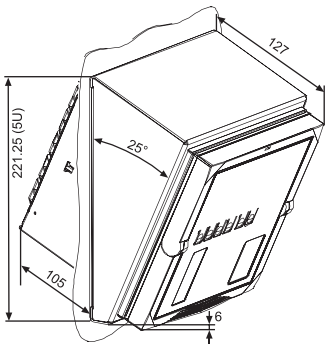

Fig. 6 Semi-flush mounting in a 25° angle

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.

REM610□□□□C□□ □□

Revision		
Current revision		C
Phase-current inputs:		
5 =	5A	5
1 =	1A	1
Earth-fault current input:		
5 =	5A	5
1 =	1A	1
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
RTD/Thermistor module:		
M =	included	M
N =	none	N
Communication module:		
P =	plastic fiber	P
G =	plastic and glass fiber	G
R =	RS-485	R
N =	none	N
Language set:		
01 =	(IEC) English, Swedish, Finnish	01
02 =	(IEC) English, German, French, Italian, Spanish, Polish	02
11 =	(ANSI) English, Spanish, Portuguese	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.

REM610□□□□S□S□□

Revision		
Current revision		C
Phase-current inputs:		
5 =	5A	5
1 =	1A	1
Earth-fault current input:		
5 =	5A	5
1 =	1A	1
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
RTD/Thermistor module:		
M =	included	M
N =	none	N
Language set:		
01 =	(IEC) English, Swedish, Finnish	01
02 =	(IEC) English, German, French, Italian, Spanish, Polish	02
11 =	(ANSI) English, Spanish, Portuguese	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
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