Relion® 605 series

Self-Powered Feeder Protection REJ603 Product Guide

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Self-Powered Feeder Protection	
REJ603	
Product version: 1.5	

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1. Description

The feeder protection relay REJ603 is part of the feeder protection series of relays, intended for the protection of secondary distribution network in utilities and industries.

The feeder protection relay REJ603 is designed to be a part of Ring Main Units (RMU) and secondary distribution switchgears. The REJ603 relay is a self-powered numerical relay, which receives power from the main current transformers. This way REJ603 is an ideal choice for installations where an auxiliary supplies are not available and hence is suitable for unmanned distribution substations having no auxiliary supplies.

2. Protection functions

The relay principally offers two stage each of, three phase non-directional overcurrent and non-directional earth-fault protection. Low-set stage has selectable definite time / inverse characteristics. Apart from four standard inverse characteristics - Normal inverse, Very Iinverse, Extremely inverse and Long time inverse, relay also has special characteristics like RI, HR and FR fuse, which allows better co-ordination with the entire network. High-set stage has selectable definite time / Instantaneous element. The relay also has short power up time which ensures fast operation during switch on to fault. The REJ603 employs the most proven technique of blocking based on measured value of second harmonic content to make the protection immune to magnetizing inrush.

Table 1. Protection Functions of REJ603

Protection	IEC	ANSI
Non-directional overcurrent protection, low-set stage	3I>	51
Non-directional overcurrent protection, high-set stage	3I>>	50
Earth-fault protection, low-set stage	Io>	51N
Earth-fault protection, high-set stage	Io>>	50N
Three phase transformer inrush detector	3I2>	68

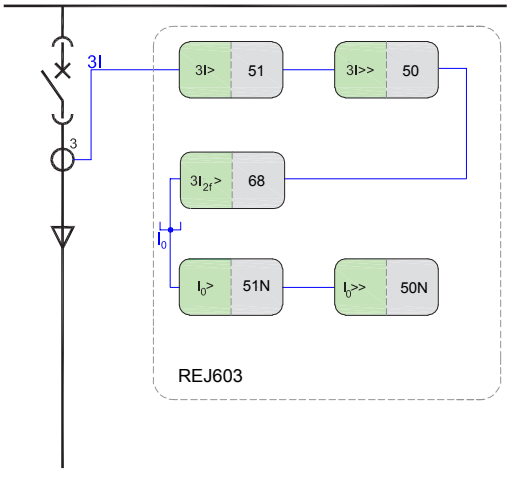

Figure 1. Protection function overview of REJ603 with earth current measurement by internal calculation

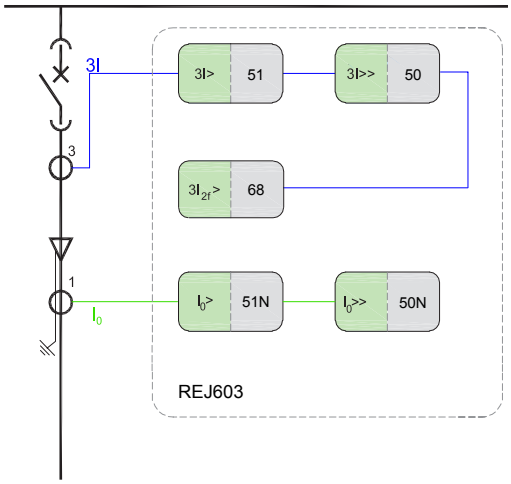

Figure 2. Protection function overview of REJ603 with earth current measurement by external core-balance current transformer

3. Application

The feeder protection relay REJ603 is a member of ABB's Relion® protection and control product family and its 605 series. REJ603 is intended to be used for the selective short-circuit and earth-fault protection of feeders in secondary distribution networks and for protection of transformers in utilities and industries. The relay is a self-powered numerical relay, which does not require an external auxiliary supply voltage, making it an ideal choice for installation even in remote locations where auxiliary supplies are not available. The relay receives power for its operation from the main current transformers. REJ603 is primarily used in Ring Main Units (RMU) and secondary distribution switchgears within distribution network.

Relay provides earth current measurement through internal calculation or has the provision for measuring it from the external core balance current transformer (CBCT).

4. 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. When a relay fault is detected, the IRF LED will glow red. In the event of a critical relay failure, all the protection functions of the relay will be completely blocked to prevent any incorrect relay operation.

Additionally, the relay offers user selectable fail safe trip in the combined event of critical internal relay failure and phase currents exceeding twenty times the maximum nominal current value.

5. Inputs and Outputs

The relay is equipped with three phase current inputs and one residual-current input which can be connected to core balance current transformer (CBCT). The relay is having one capacitor discharge impulse output (24V DC, 100 mJ) for tripping circuit breaker with sensitive trip coil. Additional one signal output is available for trip indication to external system.

6. Testing

The special CT's for REJ603 have a test winding to simulate primary current for testing of complete protection scheme including current transformer, relay, and trip coil. The test winding is directly accessible from relay ensuring safety while testing the relay.

7. LED and flag indications

Phase as well earth fault trip indication is provided through hand-reset mechanical flag which ensures availability of relay operation indication even in absence of primary CT current. The green colour 'ready' LED is provided to indicate the relay in operation when minimum current required for operation is available. For indicating internal relay failure red coloured 'IRF' LED is provided on relay front.

8. Optional HMI

As a primary user interface, the REJ603 has DIP switches, two LEDs and a electromechanical flag for trip indication. Although this interface is sufficient for basic self-powered protection applications, certain installations may require a interface like conventional auxiliary powered relays. Such requirement can be fulfilled with the optional battery powered HMI (Human Machine Interface) which features a unique touch screen display. The available functionality with HMI, includes segregated trip indication, events with time stamp, fault record, display of primary values, fault codes etc., which helps in post fault analysis. The HMI also overcomes the limitation of setting resolution posed by DIP switches and allows finer settings as well as setting of additional parameters.

9. Technical data

Table 2. Dimensions

Description	Value
Width	96 mm
Height	160 mm
Depth	150 mm
Weight	~ 0.8 Kg (without HMI) / ~ 0.9 Kg (with HMI)

Table 3. Energizing inputs

Description		Value
Rated frequency		50/60 Hz ± 5 Hz
Phase sensor inputs	Nominal primary current :	
	CT type	Setting range of reference current I_s (I_{smin} - I_{smax})
	REJ603 - CT1	8 - 28 A
	REJ603 - CT2	16 - 56 A
	REJ603 - CT3	32 - 112 A
	REJ603 - CT4	64 - 224 A
	REJ603 - CT5	128 - 448 A
	Thermal withstand capability:	
	• Continuously	2.5 x I_{smax}
	• For 1 sec	25 kA primary current
	• For 3 sec	20 kA primary current
	Dynamic current withstand:	
	• Half-wave	62.5 kA primary current
Earth current inputs	Rated current, I_n	1 A
	Thermal withstand capability:	
	• Continuously	4 A
	• For 1 sec	100 A
	Dynamic current withstand:	
	• Half-wave value	250 A
	Input impedance	< 100 m Ω

Table 4. Impulse voltage trip output

Description	Value
Rated output voltage	24 V
Pulse duration	50 msec
Energy	100 mJ

Table 5. Signal output (solid state)

Description	Value
Rated voltage	48 V DC
Maximum current	5 mA
Pulse duration	60 msec

Table 6. Degree of protection of relay

Description	Value
Front portion with cover	IP 54
Side with terminal connector	IP 20

Table 7. Environmental conditions

Description	Value
Operating temperature range	-25...+55°C
Short-time service temperature range	-40...+70°C (<16 h)
Relative humidity	< 93%, non-condensing
Atmospheric pressure	86...106 kPa
Altitude	up to 2000 m
Transport and storage temperature range	-40...+70°C

Table 8. Environmental conditions

Description	Type test value	Reference
Dry heat test (humidity < 50%) • Working • Storing	 • 96 h at +70°C • 96 h at +70°C	IEC 60068-2-2 IEC 60068-2-48
Dry cold test • Working • Storing	 • 96 h at -25°C • 96 h at -40°C	IEC 60068-2-1 IEC 60068-2-48
Damp heat test, cyclic	• 2 cycles at +25°C…+ 55°C, humidity > 93%	IEC 60068-2-30
Damp heat test, steady state	• 96 h at +40°C, humidity > 93%	IEC 60068-2-78

Table 9. Electromagnetic compatibility tests

Description	Type test value	Reference
1 MHz burst disturbance test:		IEC 61000-4-12 IEC 60255-22-1, class III
• Common mode • Differential mode	2.5 kV, 1MHz, 400 pulses/sec 1.0 kV, 1MHz, 400 pulses/sec	
Electrostatic discharge test:		IEC 60255-22-2, class III IEC 61000-4-2
• Contact discharge • Air discharge	6 kV, 150 pF/330 Ω 8 kV, 150 pF/330 Ω	
Radio frequency, electro-magnetic field immunity test:	10 V/m f=80-1000 MHz	IEC 60255-22-3, class III IEC 61000-4-3
Fast transient disturbance test: • All ports	4 kV, 5.0 kHz	IEC 60255-22-4, class A IEC 61000-4-4
Surge immunity test:		IEC 60255-22-5 IEC 61000-4-5
• Common mode • Differential mode	2.0 kV, 1.2/50 µs 1.0 kV, 1.2/50 µs	
Power frequency magnetic field immunity test:		IEC 61000-4-8
• Continuous • Short duration (1 sec)	100 A/m 1000 A/m	
Immunity to conducted disturbance induced by RF:	10 V (Unmod, RMS) f=150 KHz...80 Mhz 10 V f=27, 68 Mhz (Spot frequency)	IEC 60255-22-6, class III IEC 61000-4-6
Pulse magnetic field immunity test:	1000 A/m, 6.4/16 µs	IEC 61000-4-9

Table 9. Electromagnetic compatibility tests, continued

Description	Type test value	Reference
Emission tests: • Radiated 30-230 MHz 230-1000 MHz	 < 40 dB (µV/m) < 47 dB (µV/m)	IEC 60255-25 EN 55011-CISPR II

Table 10. Insulation tests

Description	Type test value	Reference
Dielectric test • Test voltage	 2 kV, 50 Hz, 1 min	IEC 60255-5 IEC 60255-27
Impulse voltage test • Test voltage	 5 kV, 1.2/50 µs, 0.5 J	IEC 60255-5 IEC 60255-27
Insulation resistance test • Isolation resistance	 > 100 M Ω at 500 V DC	IEC 60255-5 IEC 60255-27

Table 11. Mechanical tests

Description	Type test value	Reference
Vibration tests • Response • Endurance	 10...150 Hz, 0.035 mm / 1.0 g, 1 sweep / axis 10...150 Hz, 2.0 g, 20 sweeps / axis	IEC 60255-21-1, class II
Shock tests • Response • Endurance / Withstand	 10 g, 3 pulses in each direction 30 g, 3 pulses in each direction	IEC 60255-21-2, class II
Bump tests	 20 g, 1000 bumps in each direction	IEC 60255-21-2, class II

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Table 12. Product safety

Description	Type test value
LV directive	2006/95/IEC
Standard	EN 60255-27 (2005) EN 60255-1 (2009)

Table 13. EMC compliance

Description	Type test value
EMC directive	2004/108/IEC
Standard	EN 50263 (2000) EN 60255-26 (2007)

Table 14. RoHS compliance

Description
Complies with RoHS directive 2002/95/IEC

10. Protection functions

Table 15. Setting possibility of reference current I_s

REJ603 - CT1	8	9	10	11	12	13	14	15	16	17	18	20	22	24	26	28
REJ603 - CT2	16	18	20	22	24	26	28	30	32	34	36	40	44	48	52	56
REJ603 - CT3	32	36	40	44	48	52	56	60	64	68	72	80	88	96	104	112
REJ603 - CT4	64	72	80	88	96	104	112	120	128	136	144	160	176	192	208	224
REJ603 - CT5	128	144	160	176	192	208	224	240	256	272	288	320	352	384	416	448

Table 16. Low-set phase overcurrent protection, stage I>

Parameter	Value (Range)
Measuring range	0.9 x I_{smin}...20 x I_{smax}
Setting range of pick-up current 'I >'	0.9...2.5 x I_s
Setting resolution (steps)	I_s x 0.9...2.5 (31 steps) with DIP switches, infinite Fine resolution 0.05 through HMI (optional)
Operation accuracy	± 5.0% of set value in the temperature range 0...70°C ± 7.5% of set value in the temperature range -40...70°C
Operate time delay (DMT) 't >'	0.05...3.0 sec
Setting resolution (steps)	0.05, 0.07, 0.1, 0.15, 0.2, 0.25, 0.3, 0.4, 0.6, 0.8, 1.0, 1.4, 1.8, 2.2, 2.6, 3.0 Fine resolution 0.01 through HMI (optional)
Operation time accuracy	± 1.0% or 10 msec, which ever is greater
Operating curve type	IEC 60255-3: Normal inverse, Very inverse, Extremely inverse, Long-time inverse Special curves: RI inverse, HR-fuse, FR-fuse
Time multiplier setting 'k'	0.05...3.0 sec
Setting resolution (steps)	0.05, 0.07, 0.1, 0.15, 0.2, 0.25, 0.3, 0.4, 0.6, 0.8, 1.0, 1.4, 1.8, 2.2, 2.6, 3.0 Fine resolution 0.01 through HMI (optional)
Operation time accuracy IEC and RI characteristics HR-fuse, FR-fuse characteristics	 class E(5) or ± 35 msec, whichever is greater ± 20% of set value or ± 35 msec, whichever is greater

Table 17. High-set phase overcurrent protection, stage I>>

Parameter	Value (Range)
Setting range of pick-up current 'I>>'	1...20 x I_s
Setting resolution (steps)	I_s x 1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 12, 14, 16, 18, 20, infinite Fine resolution 1.0 through HMI (optional)
Operation accuracy	± 5.0% of set value in the temperature range 0...70°C ± 7.5% of set value in the temperature range -40...70°C
Operate time delay (DMT) 't >>'	0.04...3.0 sec
Setting resolution (steps)	0.04, 0.07, 0.1, 0.15, 0.2, 0.25, 0.3, 0.4, 0.6, 0.8, 1.0, 1.4, 1.8, 2.2, 2.6, 3.0 Fine resolution 0.01 through HMI (optional)
Operation time accuracy	± 1.0% or 10 msec, which ever is greater

Table 18. Low-set earth-fault protection, stage Io>

Parameter	Value (Range)
Nominal value of earth current • Internal measurement • External measurement	 I_s I_n : 1A
Measuring range	0.9 x I_{smin}...20 x I_{smax} / 0.1...20 x I_n
Setting range of pick-up current 'Io >'	0.1...1.0 x I_s / 0.1...1.0 x I_n
Setting resolution (steps)	I_s x 0.9...2.5 (31 steps) with DIP switches, infinite Fine resolution 0.025 through HMI (optional)
Operation accuracy Internal measurement External measurement	 ± 3.0% of set value in the temperature range 0...70°C ± 7.5% of set value in the temperature range -40...70°C ± 5.0% of set value in the temperature range 0...70°C ± 20% of set value in the temperature range -40...70°C
Operate time delay (DMT) 'to >'	0.05...3.0 sec
Setting resolution (steps)	0.05, 0.07, 0.1, 0.15, 0.2, 0.25, 0.3, 0.4, 0.6, 0.8, 1.0, 1.4, 1.8, 2.2, 2.6, 3.0 Fine resolution 0.01 through HMI (optional)
Operation time accuracy	± 1.0% or 10 msec, which ever is greater
Operating curve type	IEC 60255-3: Normal inverse, Very inverse, Extremely inverse, Long-time inverse Special curves: RI inverse, HR-fuse, FR-fuse
Time multiplier setting 'k'	0.05...3.0 sec
Setting resolution (steps)	0.05, 0.07, 0.1, 0.15, 0.2, 0.25, 0.3, 0.4, 0.6, 0.8, 1.0, 1.4, 1.8, 2.2, 2.6, 3.0 Fine resolution 0.01 through HMI (optional)

Table 18. Low-set earth-fault protection, stage Io>, continued

Parameter	Value (Range)
Operation time accuracy	
IEC and RI characteristics	class E(5) or ± 35 msec, whichever is greater
HR-fuse, FR-fuse characteristics	± 20% of set value or ± 35 msec, whichever is greater

Table 19. High-set earth-fault protection, stage Io>>

Parameter	Value (Range)
Setting range of pick-up current 'Io>>'	1...20 x I_s / 1...20 x I_n
Setting resolution (steps)	I_s or I_n x 1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 12, 14, 16, 18, 20, infinite Fine resolution 1.0 through HMI (optional)
Operation accuracy	
Internal measurement	± 3.0% of set value in the temperature range 0...70°C ± 7.5% of set value in the temperature range -40...70°C
External measurement	± 5.0% of set value in the temperature range 0...70°C ± 20% of set value in the temperature range -40...70°C
Operate time delay (DMT) 't >>'	0.04...3.0 sec
Setting resolution (steps)	0.04, 0.07, 0.1, 0.15, 0.2, 0.25, 0.3, 0.4, 0.6, 0.8, 1.0, 1.4, 1.8, 2.2, 2.6, 3.0 Fine resolution 0.01 through HMI (optional)
Operation time accuracy	± 1.0% or 10 msec, which ever is greater

Table 20. Three-phase inrush detection, stage $3I_{2f}$>

Parameter	Value (Range)
Start value (Ratio of the 2nd to the 1st harmonic leading to restraint)	5%...50% in steps of 5%

Table 21. Switch-on to fault characteristics

Parameter	Value (Range)
At minimum value of pick-up current and minimum operate time, minimum value of tripping time when switch-on to fault	80 msec

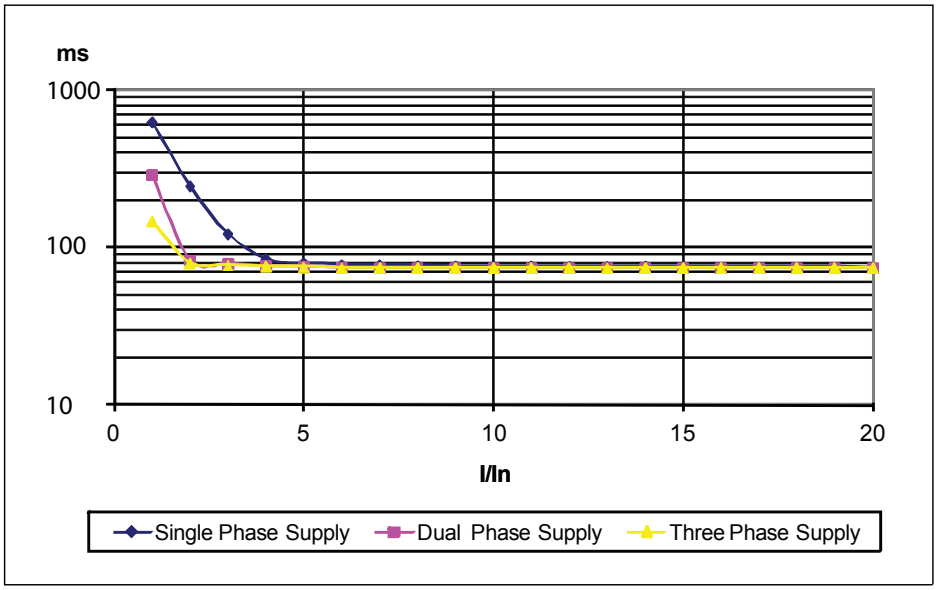


Figure 3. Switch-on to fault characteristics of REJ603 V1.5

Table 22. HMI display

Character display
Touch screen display (128 x 64 pixels)

11. Dimensions and mounting

The REJ603 have been equipped with mounting arrangments that suits to wall mounting. Using appropriate mounting screws REJ603 can be directly mounted on the mounting plate inside ring main unit.

Dimensions of relay base plate for mounting:

- Height : 160 mm
- Width : 96 mm

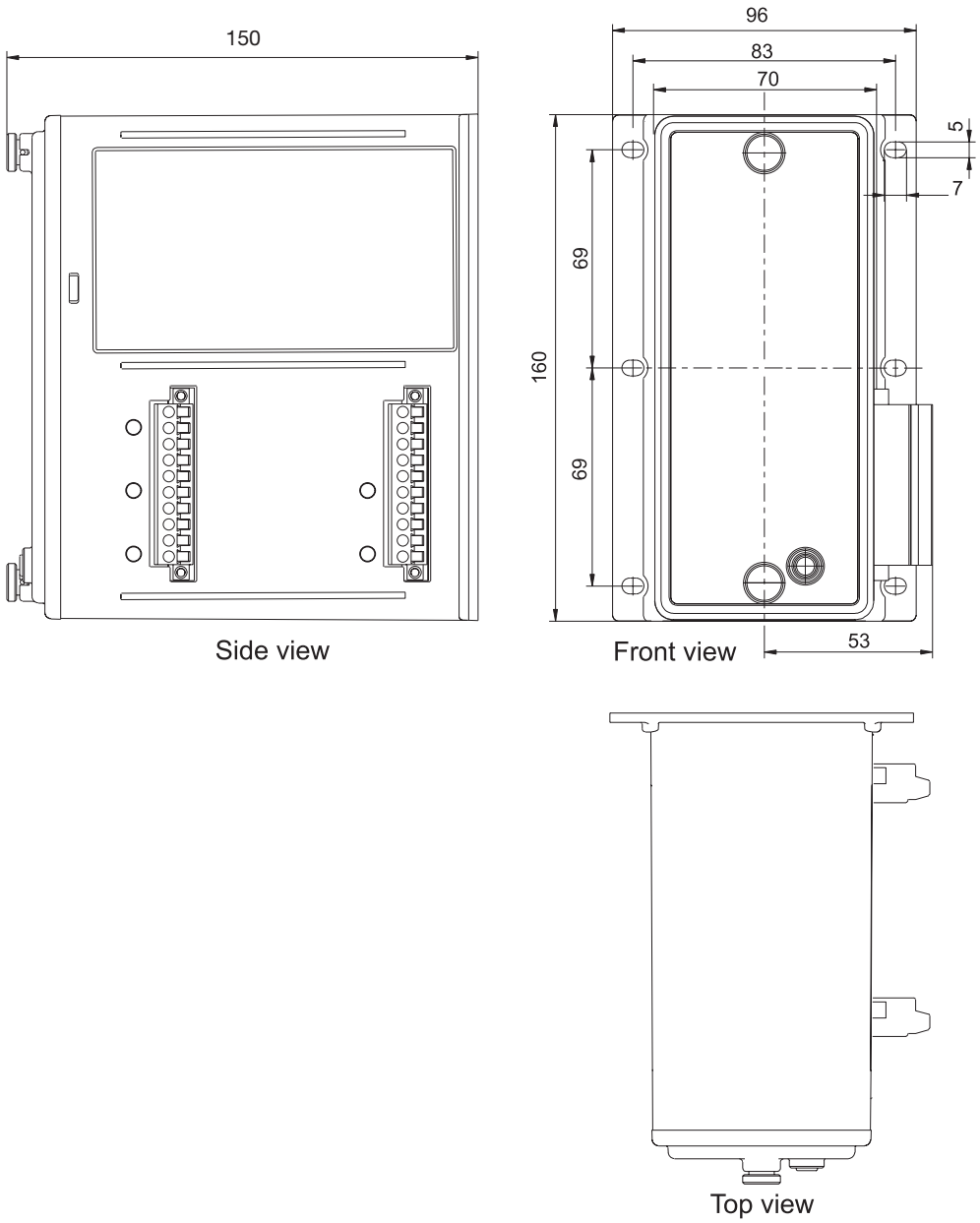


Figure 4. Terminal diagram of REJ603 without HMI

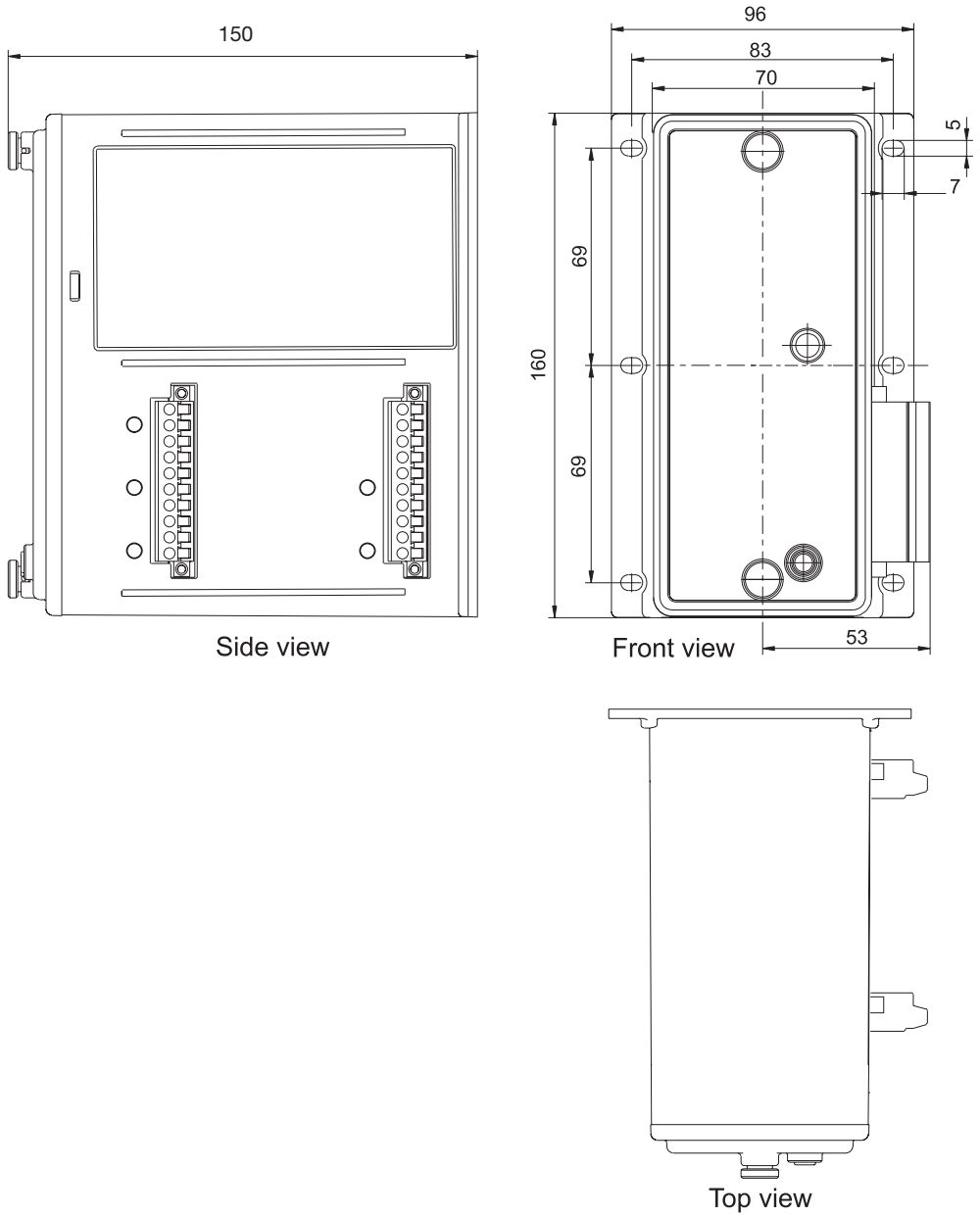


Figure 5. Terminal diagram of REJ603 with HMI

12. Selection and ordering data

The IED type and serial number label identifies the protection IED. The serial number and order number label is placed on top of relay.

The order number consists of a string of codes generated from the relays hardware and software modules.

Order Codes :

For REJ603 with HMI : REJ603BB401NN31E

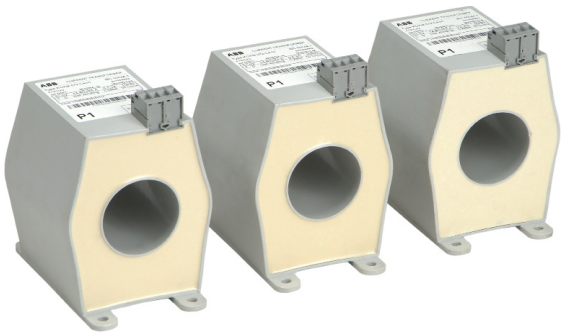
For REJ603 without HMI : REJ603BB401NN3XE

For Add-on HMI kit : REJ603BNNNNNNBZA

Current transformer

Note: The REJ603 requires specific ring CT's to be used for phase current measurement. It is not compatible with conventional 1 A/ 5 A CT's. The primary current setting range is adequately covered by following 5 variants of CT's .

CT type	Setting range of reference current "Is"
REJ603-CT1	8 - 28A
REJ603-CT2	16 - 56 A
REJ603-CT3	32 - 112 A
REJ603-CT4	64 - 224 A
REJ603-CT5	128 - 448 A



For further technical information on current transformers and ordering information, please refer to the datasheet of CT reference no. 1YMA583791R0001-4.

13. Terminal diagram

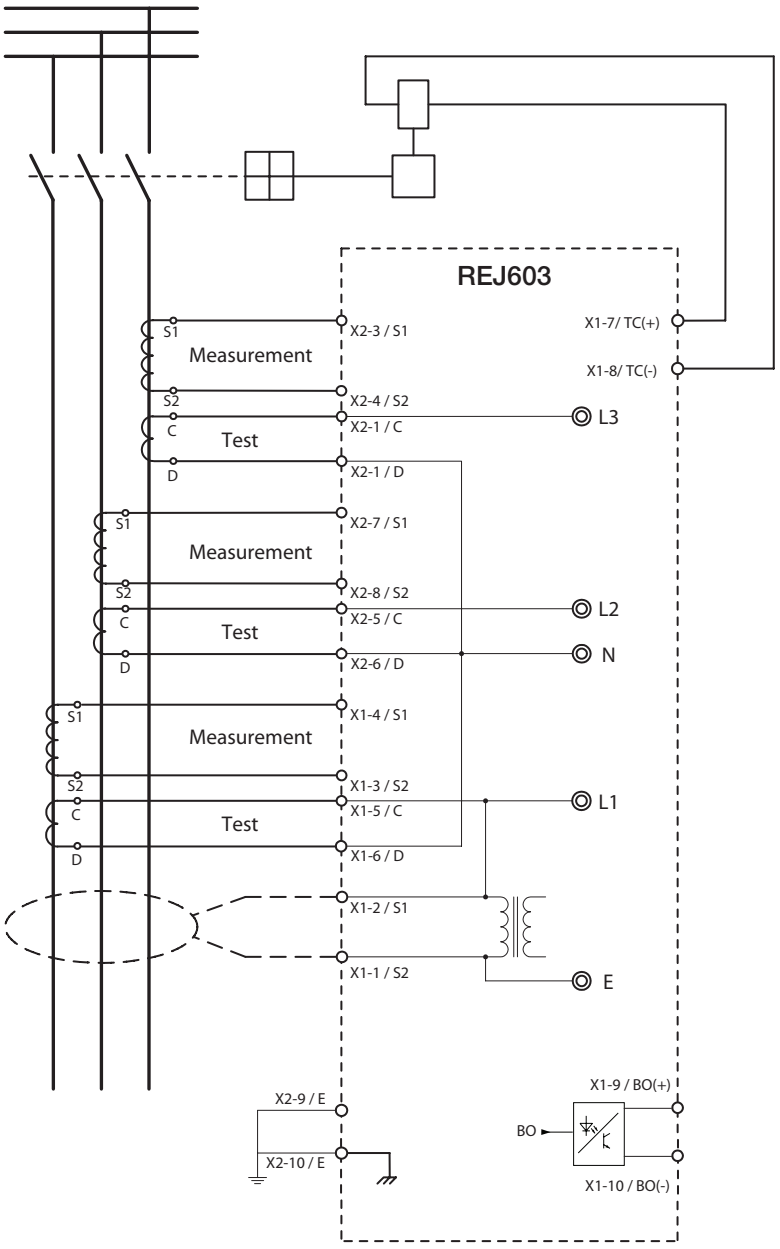


Figure 6. Terminal diagram of REJ603

14. 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 REJ603 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, and so on. 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.

15. Document revision history

Document revision/date	Product version	History
A/2007-12-20	1.0	First release
B/2008-02-22	1.1	Content updated to correspond to the product version.
C/2008-06-20	1.1	Content updated
D/2012-04-04	1.5	Content updated to correspond to the product version

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