

Relion® 605 series

Self-powered feeder protection REJ603 Product Guide

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Self-powered feeder protection	1MDB07217-YN
REJ603	
Product version: 3.0	Issued: 2015-09-04
	Revision: B

1. Description

REJ603 is a self-powered feeder protection relay, intended for the protection of utility substations and industrial power systems, in secondary distribution networks. REJ603 is a member of ABB's Relion® product family and part of its 605 series.

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.

Relay has add-on optional function of remote trip through binary input with selection of auxiliary power version.

2. Relay functions

The relay provides an optimized composition of protection and monitoring functionality in one unit, with the best performance usability in its class and are based on ABB's in-depth knowledge of protection and numerical technology.

REJ603 offers pre-configured functionality which facilitates easy and fast commissioning of switchgear.

To emphasize the simplicity of relay's usage, only application specific parameters needs to set within the relay's intended area of application.

The relay also has short power up time which ensures fast operation during switch on to fault.

The relay is available in two alternative application configurations, as indicated in Table 1.

Table 1. Standard configurations

Description	Relay type
Self-powered feeder protection	REJ603

Table 2. Application configurations and supported functions

Functionality	ANSI	IEC	B
Protections			
Non-directional overcurrent protection, low-set stage	51	3I>	•
Non-directional overcurrent protection, high-set stage	50-1	3I>>	•
Non-directional overcurrent protection, instantaneous stage	50-2	3I>>>	•
Earth-fault protection, low-set stage	51N	I0>	•
Earth-fault protection, high-set stage	50N	I0>>	•
Three phase transformer inrush detector	68	3I2f>	•
Three-phase thermal protection for feeders, cables and distribution transformers	49	3Ith>	•
Two setting group			•
External remote trip input with power supply			0

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Table 3. Application configurations and supported functions, continued

Functionality	ANSI	IEC	D
Measurement			
Three-phase current measurement	3I	3I	•
Residual current measurement	I _n	I ₀	•
Thermal level	ϑ	ϑ	•
Disturbance recorder			•

• = Included, o = Optional at the time of ordering

3. Protection functions

REJ603 offers three-stage overcurrent and two-stage earth-fault protection functions. The transformer inrush detector function is incorporated to prevent unwanted tripping's due to energizing of transformers.

The low-set stages for overcurrent and earth-fault protection are equipped with selectable characteristics – Definite time (DT) and Inverse definite minimum time (IDMT). The relay features standard IDMT characteristics according IEC 61255-3, Normal Inverse (NI), Very Inverse (VI), Extremely Inverse (EI), Long-time Inverse (LI)

and IDMT characteristics as per ANSI C37.112 Moderate inverse, Normal Inverse, Very inverse, Extremely inverse. The relay also has special characteristics like RI, HR and FR fuse, which allows better co-ordination with the rest of the network.

Further relay offers thermal overload protection for feeder, cable and transformer.

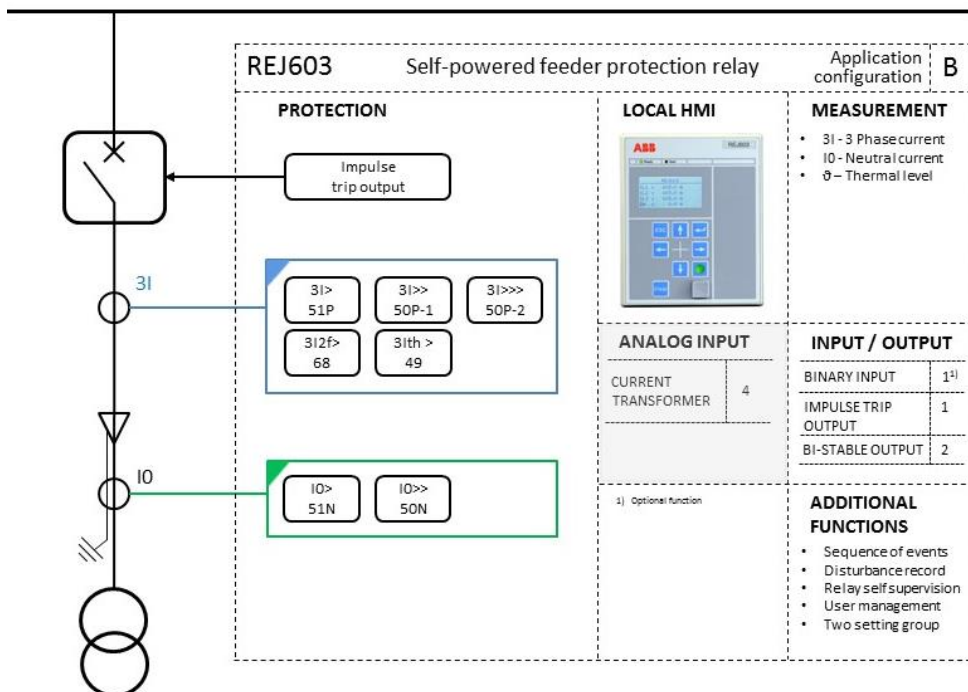


Figure 1. Functionality overview for REJ603

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4. Application

The REJ603 is a protection relay aimed at selective short-circuit and earth-fault protection of feeders in secondary distribution networks and for protection of transformers in utilities and industries.

The inrush current stabilization function allows the relay to be used as main protection of distribution transformers.

The relay is powered up through current transformer if current is above energizing level of relay, front USB power or through auxiliary supply (optional feature).

The relay offers, non-directional over current and earth-fault protection. The residual current for the earth-fault protection is derived from the phase currents. When applicable, the core-balance current transformers can be used for measuring the residual current, especially when sensitive earth-fault protection is required.

The relay additionally offers thermal overload protection for feeders, cables and transformers.

There is optional provision of remote trip through binary input with external auxiliary power supply. The remote trip signals like transformer trouble output (Buchholz, Oil temperature, Winding temperature trip) or an external trip can be wired to binary input. The remote trip function works even in CT-powered mode when auxiliary supply is not available but enough CT current is available to power-up the relay.

5. Measurement

The relay continuously measures phase currents and earth current. Earth current can be measured using external core balance current transformer or can be calculated internally.

The relay has provision to display measured three phase current and earth current in primary and secondary terms. During service, the default view of display shows three phase current and the earth current in secondary terms. The values measured can be accessed locally via the user interface on the relay or remotely via the communication interface of the relay.

The relay continuously measures thermal level.

6. Event log

To collect sequence – of – events (SoE) information, the relay incorporates a non-volatile memory with a capacity of storing 250 events with associated time stamps with resolution of 1 ms. Event log includes protection operation status, binary I/O status and relay fault code. The event logs are stored sequentially, the most recent being first and so on. The non-volatile memory retains its data also in case the relay temporarily loses its auxiliary supply.

The event log facilitates detailed post-fault analysis of feeder faults and disturbances. The SoE information can be accessed locally via the user interface on the relay front panel.

7. Disturbance recorder

The relay is provided with the feature of disturbance recorder featuring up to 4 analog signals and 8 binary signal channels. The analog channels are set to record the current waveform. The triggering of disturbance record can be done through external or internal relay signals like protection start, trip, and remote trip etc. There is provision of manual triggering of the recording. The disturbance recording is also possible in CT-powered mode. The recorded information is stored in a non-volatile memory and can be uploaded from front USB port for subsequent fault analysis.

8. Self-supervision and test function

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. A permanent relay fault will block the protection functions of the relay to prevent incorrect relay operation.

The relay supports a built-in test mode which enables user to test the relay protection functions, HMI and binary outputs. The test function is enabled through USB power which facilitates the testing of entire scheme including relay and activation of bistable trip output.

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9. Access control

To protect the relay from unauthorized access and to maintain the integrity of information, the relay is armed with a three-level, role-based user authentication system with an individual password for the operator, engineer and administrator levels. There is an availability of 2 different password protection, one which is a combination of different navigation keys, which is by default and other with an alpha-numeric password. User can select either of the passwords depending on his/her requirement.

10. Local HMI

Local HMI of relay contains LCD display, LED indicators and navigation keys. The measurement, events, setting can be viewed in display.

Phase as well earth fault trip indication is provided through hand-reset electromechanical flag which ensures availability of relay operation indication even in absence of primary CT current.

Display supports built in multiple languages.

The relay has additionally two LED indications on LHMI, the green color 'ready' LED is provided to indicate the relay in operation when minimum current required for operation is available and for indicating internal relay failure. The yellow colored 'start' LED is provided to indicate the protection pick up.

11. Inputs and outputs

The relay is equipped with four 1A analog current inputs, three for phase current and one for earth current measurements.

The relay has optional one binary input. The binary input is configured for remote trip.

The relay has a one capacitor discharge impulse output (24V DC, 100 mJ) for tripping circuit breaker with sensitive trip coil. Additionally two bi-stable signal outputs are available for protection start / trip and remote trip indications to an external system.

The bi-stable output contacts are pre-configured according to default configuration, however can be easily reconfigured for protection start, protection trip and remote trip indication by using the LHMI menu.

12. Application warning

In case the relay REJ603 (optional functionality with external power supply) is supplied with UPS step-wave or square-wave, an interposing transformer is needed to keep the supply voltage (peak voltage) below the upper limit of the relay.

These are the recommended transformer characteristics:

- Nominal Power: 7.5 VA
- Secondary voltage: in the range 30...150 V AC

Table 4. Input/output overview

Relay type	Analog input	Binary inputs	Binary outputs
	CT	BI	BO
REJ603	4	1 (optional)	1 (Impulse trip) 2 (Bi-stable signaling)

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13. Technical data

Table 5. Dimensions

Relay type Description	Value	
Width	frame	132.5 mm
	case	121.5 mm
Height	frame	167.0 mm
	case	137.0 mm
Depth	case	182.5 mm
Weight	relay	2.96 kg

Table 6. Power supply for remote trip function (optional functionality with external power supply)

Description	Value
Uaux nominal	24...240 V AC, 50 and 60 Hz
	24...240 V DC
Uaux variation	85...110% of Uaux (20.4...264 V AC)
	80...120% of Uaux (19.2...288 V DC)
Burden of auxiliary voltage supply under quiescent (Pq)/operating condition	< 2.0 W
Ripple in the DC auxiliary voltage	Max 15% of the DC value (at frequency of 100 Hz)

Table 7. Energizing inputs

Description		Value	
Rated frequency		50/60 Hz	
Current inputs	Rated current, In	1 A	
	Thermal withstand capability:		
	• Continuous	4 A	20 A
	• For 1 s	100 A	500 A
	• For 10 s	20 A	100 A
Input burden in CT powered circuit		2.5 VA	2.5 VA
Input impedance for measuring input		< 100 m Ω	< 20 m Ω

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Table 8. Binary input (optional functionality with external power supply)

Description	Value
Rated voltage	24...240 V AC, 50 and 60 Hz
	24...240 V DC
Operating range	85...110% of Uaux (20.4...264 V AC)
	80...120% of Uaux (19.2...288 V DC)
Current drain	2...20 mA
Power consumption/input	< 0.5 W
Input sensing time	25 ms

Table 9. Impulse voltage trip output

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

Table 10. Bistable power output relay

Description	Value
Rated voltage	240 V AC/DC
Continuous contact carry	2 A
Make and carry for 3.0 s	4 A
Make and carry for 0.5 s	6 A
Breaking capacity when the control-circuit time constant $L/R < 40$ ms, at 24 / 110 / 220 V DC	1.5 A / 0.25 A / 0.1A
Minimum contact load	100 mA at 24 V AC/DC

Table 11. Degree of protection of relay

Description	Value
Front side	IP 54B
Rear side, connection terminals	IP 20

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Table 12. Environmental conditions

Description	Value
Operating temperature range	-25...+55°C
Short-time service temperature range	-40...+85°C (<16 h) Display viewable range : above -20 °C up to +70 °C
Relative humidity	< 93%, non-condensing
Atmospheric pressure	86...106 kPa
Altitude	up to 2000 m
Transport and storage temperature range	-40...+85°C

Table 13. Environmental tests

Description	Type test value	Reference
Dry heat test (humidity < 50%) • Working • Storing	96 h at +70°C 96 h at +85°C	IEC 60068-2-2
Dry cold test • Working • Storing	96 h at -25°C 96 h at -40°C	IEC 60068-2-1
Damp heat test, cyclic	2 cycles (12 h + 12 h) at +25°C...+55°C, Rh > 93%	IEC 60068-2-30
Change of temperature test	Cyclic : 3 hours at -25°C + 3 hours at +55°C , Number of cycles : 5	IEC 60068-2-14

Table 14. Electromagnetic compatibility tests

Description	Type test value	Reference
1 MHz/100 kHz burst disturbance test: • Common mode • Differential mode	2.5 kV, 400/40 pulses/s 1.0 kV, 400/40 pulses/s	IEC 61000-4-18, class III IEC 60255-26
Electrostatic discharge test: • Contact discharge • Air discharge	4 kV, 150 pF/330 Ω 6 kV, 150 pF/330 Ω	IEC 60255-26
Conducted radio frequency interference tests:	10 V f=150 KHz...80 Mhz	IEC 60255-26 IEC 61000-4-6
Fast transient disturbance tests: • All ports	4 kV, 5.0 kHz	IEC 60255-26, class A IEC 61000-4-4

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Table 15. Electromagnetic compatibility tests, continued

Description	Type test value	Reference
Radiated, electro-magnetic field immunity test	10 V/m f=80-1000 MHz, 1.4-2.7 GHz 10 V/m f=80, 160, 380, 450, 900 MHz, 1850 MHz, 2150 MHz 900 MHz PM, 1.89 GHz PM	IEC 60255-26, class III IEC 61000-4-3
Surge immunity test:		IEC 60255-26 IEC 61000-4-5
<ul style="list-style-type: none"> Common mode Differential mode 	4.0 kV, 1.2/50 μ s 2.0 kV, 1.2/50 μ s (bistable O/P) 2.0 kV, 1.2/50 μ s 1.0 kV, 1.2/50 μ s (bistable O/P)	
Power frequency magnetic field immunity test:		IEC 60255-26 IEC 61000-4-8
<ul style="list-style-type: none"> Continuous Short duration (3 s) 	100 A/m 300 A/m	
Power frequency immunity test:		IEC 60255-26 IEC 61000-4-16
<ul style="list-style-type: none"> Common mode Differential mode 	300 V rms 150 V rms	
Pulse magnetic field immunity tests:	1000 A/m, 6.4/16 μ s	IEC 61000-4-9
Emission tests:		IEC 60255-26 EN 55011-CISPR 11, 22
Conducted		
150 kHz-0.5 MHz	< 66 dB (μ V/m)	
0.5 MHz-30 MHz	< 60 dB (μ V/m)	
Radiated		
30-230 MHz	< 40 dB (μ V/m)	
230-1000 MHz	< 47 dB (μ V/m)	

Table 16. Insulation tests

Description	Type test value	Reference
Dielectric test		IEC 60255-27
<ul style="list-style-type: none"> Test voltage 	2 kV, 50 Hz, 1 min	
Impulse voltage test		IEC 60255-27
<ul style="list-style-type: none"> Test voltage 	5 kV, 1.2/50 μ s, 0.5 J	
Insulation resistance test		IEC 60255-27
<ul style="list-style-type: none"> Isolation resistance 	> 100 M Ω at 500 V DC	
Protective bonding test		IEC 60255-27
<ul style="list-style-type: none"> Resistance 	<0.1 Ω , 4 A, 60 s	

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Table 17. Mechanical tests

Description	Type test value	Reference
Vibration tests <ul style="list-style-type: none"> Response Endurance / Withstand 	10...150 Hz, 0.075 mm / 1.0g, 1 sweep / axis 10...150 Hz, 2.0 g, 20 sweeps / axis	IEC 60255-21-1, class II
Shock tests <ul style="list-style-type: none"> Response Endurance / Withstand 	5 g, 3 pulses in each direction 15 g, 3 pulses in each direction	IEC 60255-21-2, class I
Bump tests	10 g, 1000 bumps in each direction	IEC 60255-21-2, class I

Table 18. Power supply module test

Description	Type test value	Reference
Gradual shutdown and start up	Shut-down ramp: 60 s Power off period: 300 s Start-up ramp: 60 s	IEC 60255-26

Table 19. Product safety

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

Table 20. EMC compliance

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

Table 21. RoHS compliance

Description
Complies with RoHS directive 2002/95/IEC

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14. Protection functions

Table 22. Low-set phase overcurrent protection, stage I> / 51

Parameter	Value (Range)
Setting range of pick-up current 'I >'	0.1 ¹⁾ ...2.5 x I _n in steps 0.001, infinite
Operation accuracy	± 3.0% x I _n for value < 1.2 I _n , ± 3.0% x I for value ≥ 1.2 I _n
Operate time delay (DMT) 't >'	0.04...64 s in steps of 0.01
Operation time accuracy definite mode	± 2.0% of set value or ± 30 ms
Operating curve type	IEC 60255-3: Normal inverse, Very inverse, Extremely inverse, Long-time inverse ANSI C37.112: Moderate inverse, Normal Inverse, Very inverse, Extremely inverse Special curves: RI inverse, HR fuse, FR fuse
Time multiplier setting 'k'	0.02...1.6, in steps of 0.01
Operation time accuracy	
• IEC,ANSI, HR & FR characteristics	class E(5) or ± 30 ms, class E(7.5) or ± 30 ms of theoretical value for I> set value < 0.2
• RI characteristics	± 5.0% of set value or ± 30 ms
Reset ratio	IDMT : 0.96 and DT : 0.98

1) The relay's minimum powering current is 0.07 x I_n when currents in three phase and 0.18 x I_n when current in a single phase.

Table 23. High-set phase overcurrent protection, stage I>> / 50-1

Parameter	Value (Range)
Setting range of pick-up current 'I >>'	0.2...32.0 x I _n in steps 0.001, infinite for CT variant
Operation accuracy	± 3.0% x I _n for value < 1.2 I _n , ± 3.0% x I for value ≥ 1.2 I _n
Operation mode	Definite time, Instantaneous
Operate time delay (DMT) 't >>'	0.04...64 s in steps of 0.01
Operation time accuracy	± 2.0% of set value or ± 30 ms
Reset ratio	0.98

Table 24. Very high-set phase overcurrent protection, stage I>>> / 50-2

Parameter	Value (Range)
Setting range of pick-up current 'I >>>'	0.2...32.0 x I _n in steps 0.001, infinite for CT variant
Operation accuracy	± 3.0% x I _n for value < 1.2 I _n , ± 3.0% x I for value ≥ 1.2 I _n
Operation mode	Definite time, Instantaneous
Operate time delay (DMT) 't >>>'	0.04...64 s in steps of 0.01
Operation time accuracy	± 2.0% of set value or ± 30 ms
Reset ratio	0.98

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Table 25. Low-set earth-fault protection, stage I0> / 51N

Parameter	Value (Range)
Setting range of pick-up current 'I0 >'	External earth measurement : 0.01...2.0 x In in steps 0.01, infinite Internal earth measurement : 0.1...2.0 x In in steps 0.01, infinite
Operation accuracy	External earth measurement : ± 3.0% x In for value < 1.2 In , ± 3.0% x I for value ≥ 1.2 In Internal earth measurement : ± 9.0% x In for value < 1.2 In , ± 9.0% x I for value ≥ 1.2 In
Operate time delay (DMT) 't0 >'	0.04...64 s in steps of 0.01
Operation time accuracy	External earth measurement : ± 2.0% of set value or ± 30 ms Internal earth measurement : ± 10.0% of set value or ± 30 ms
Operating curve type	IEC 60255-3: Normal inverse, Very inverse, Extremely inverse, Long-time inverse ANSI C37.112: Moderate inverse, Normal Inverse, Very inverse, Extremely inverse Special curves: RI inverse, HR fuse, FR fuse
Time multiplier setting 'k0'	0.02...1.6, in steps of 0.01
Operation time accuracy <ul style="list-style-type: none"> • IEC,ANSI, HR & FR characteristics • RI characteristics • IEC,ANSI, HR & FR characteristics • RI characteristics 	External earth measurement : class E(5) or ± 30 ms External earth measurement : class E(7.5) or ± 30 ms Internal earth measurement : ± 5.0% of set value or ± 30 ms Internal earth measurement : ± 10.0% of set value or ± 30 ms
Reset ratio	IDMT : 0.96 and DT : 0.98

Table 26. High- set earth-fault protection, stage I0>> / 50N

Parameter	Value (Range)
Setting range of pick-up current 'I0 >>'	External earth measurement : 0.05...12.5 x In in steps 0.001, infinite Internal earth measurement : 0.5...12.5 x In in steps 0.001, infinite
Operation accuracy	External earth measurement : ± 3.0% x In for value < 1.2 In , ± 3.0% x I for value ≥ 1.2 In Internal earth measurement : ± 9.0% x In for value < 1.2 In , ± 9.0% x I for value ≥ 1.2 In
Operation mode	Definite time, Instantaneous
Operate time delay (DMT) 't0 >>'	0.04...64 s in steps of 0.01
Operation time accuracy	External earth measurement : ± 2.0% of set value or ± 30 ms Internal earth measurement : ± 10.0% of set value or ± 30 ms
Reset ratio	0.98

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Table 27. Transformer inrush detection, 3I2f> / 68

Parameter	Value (Range)
Inrush threshold value	0.2...32 x I _n , in steps of 0.01
Ratio Setting	30%...50%, in steps of 5%

Table 28. Thermal overload protection, 3Ith> / 49

Parameter	Value (Range)
Initial thermal level of apparatus ϑ_0	0.0...100%, in steps of 1%
Reference current leading to thermal calculation "I _b "	0.1 ... 1.5 x I _n , in steps of 0.1
Heating time constant of object 'τ'	1.0...300 min, in steps of 1.0
Cooling time constant of object 'τ _{cs} '	1.0...300 min, in steps of 1.0
Alarm value, ϑ_{alm}	50...200%, in steps of 1%
Operate value, ϑ_{trip}	50...200%, in steps of 1%
Options for calculating thermal value during power interruption, $\vartheta_{powerOFF}$	1...4 ¹⁾
Operation time accuracy	3% of 5time constant or ± 30s
Reset ratio	0.98

¹⁾ Options for calculating thermal image during power interruption shall be as below

- 1 = On restoration of power, new value of current after power on will be considered to calculate new value of thermal image for interruption period Δt.
- 2 = On restoration of power, new value of thermal image is calculated for interruption period Δt considering that current has remained constant value during power interruption.
- 3 = Power interruption of the relay assumes no change of thermal image during interruption period.
- 4 = Power interruption of the relay resets the thermal image to the set value defined by setting ϑ_0 .

Table 29. Switch-On To Fault (SOTF) 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 ms

15. Dimensions and mounting

The REJ603 have been supplied with mounting clamps facilitating the easy flush mounting on the panel.

With appropriate mounting accessories the REJ603 can also be mounted on the secondary circuit breakers and Ring Main Units.

The panel cut-out for flush mounting:

- Height : 137.0 ± 1.0 mm
- Width : 121.5 ± 1.0 mm
- Thickness of panel : 1.5 – 4.0 mm

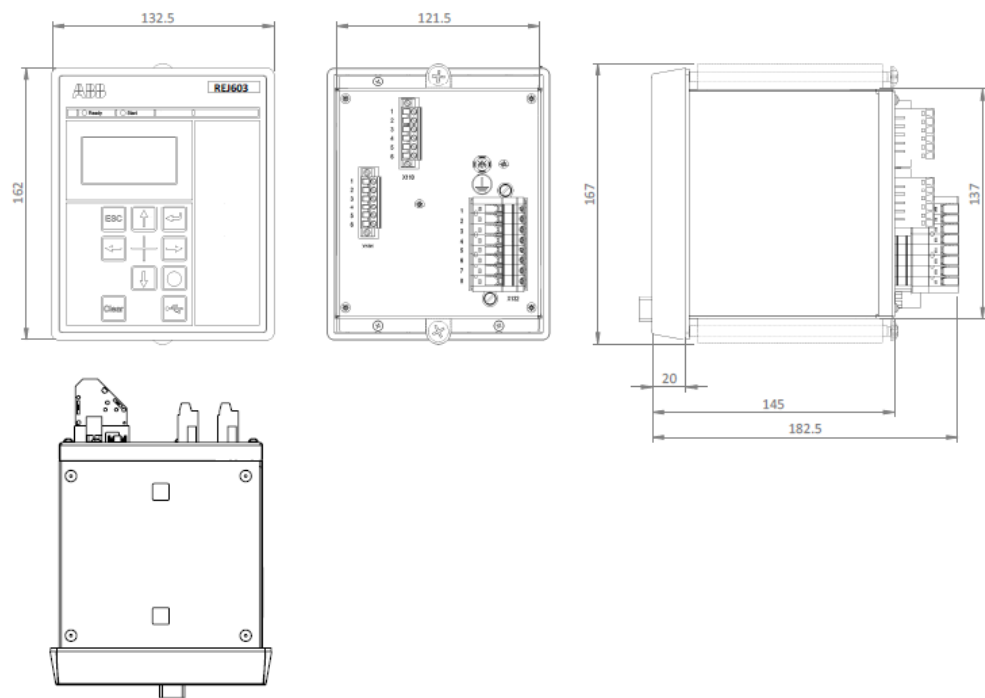


Figure 2. Dimension of REJ603 – Flush mounting

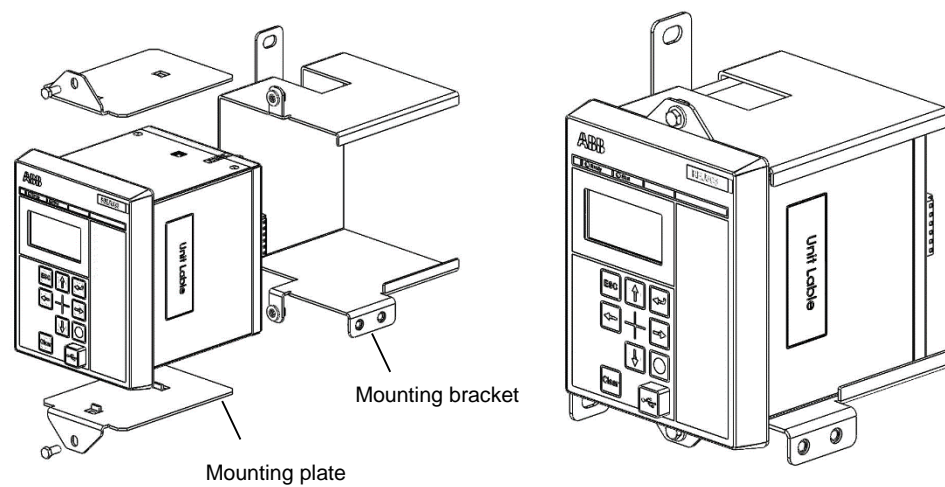


Figure 3. Typical mounting of relay in RMU (Mounting plate and bracket not supplied along with relay)

16. Selection and ordering data

The relay type and serial number label identifies the protection relay. An order number label is placed on the side of the relay. The order number consists of a string of codes generated from hardware and software modules of the

relay. The serial number and order number label is placed on side of the relay.

Use the ordering key information in Fig. 4 to generate the order number when ordering complete protection relay.

Example code

REJ 603 B 1 N N 1 N B 3 4 N N J

#	Description	
1-3	Relay type	
	Feeder overcurrent protection	REJ
4-6	Relay series identity	
	Self-powered or dual powered relay	603
7	Standard	
	IEC	B
8	Analog input / output	
	Phase and Earth current input – 1A	1
	Phase and Earth current input – 5A	2
9	Spare	
	None	N
10	Binary input / output slot 2	
	None	N
11	Binary input / output slot 1	
	None	N
	1 Binary Input including power supply 24-240V AC/DC (1VA) ¹⁾	1
12	Communication	
	None	N
13	Application configuration	
	Configuration B	B
14	Power supply	
	Self-supplied	3
	Dual-powered with 24-250V AC/DC (1VA) ¹⁾	4
15	Housing configuration	
	Midsized housing for REJ603	4
16	Configuration	
	None	N
	Ring lug terminals	2
17	For future use	N
18	Version	
	Product version 3.0	J

¹⁾ With binary input = 1, dual powered option = 4 needs to be selected

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Example order code: REJ603 B 1 N N 1 N B 3 4 N N J

Your ordering code:

Digit (#)	1-3	4-6	7	8	9	10	11	12	13	14	15	16	17	18
Code														

Figure 4. Ordering key for complete relay

17. Terminal diagram

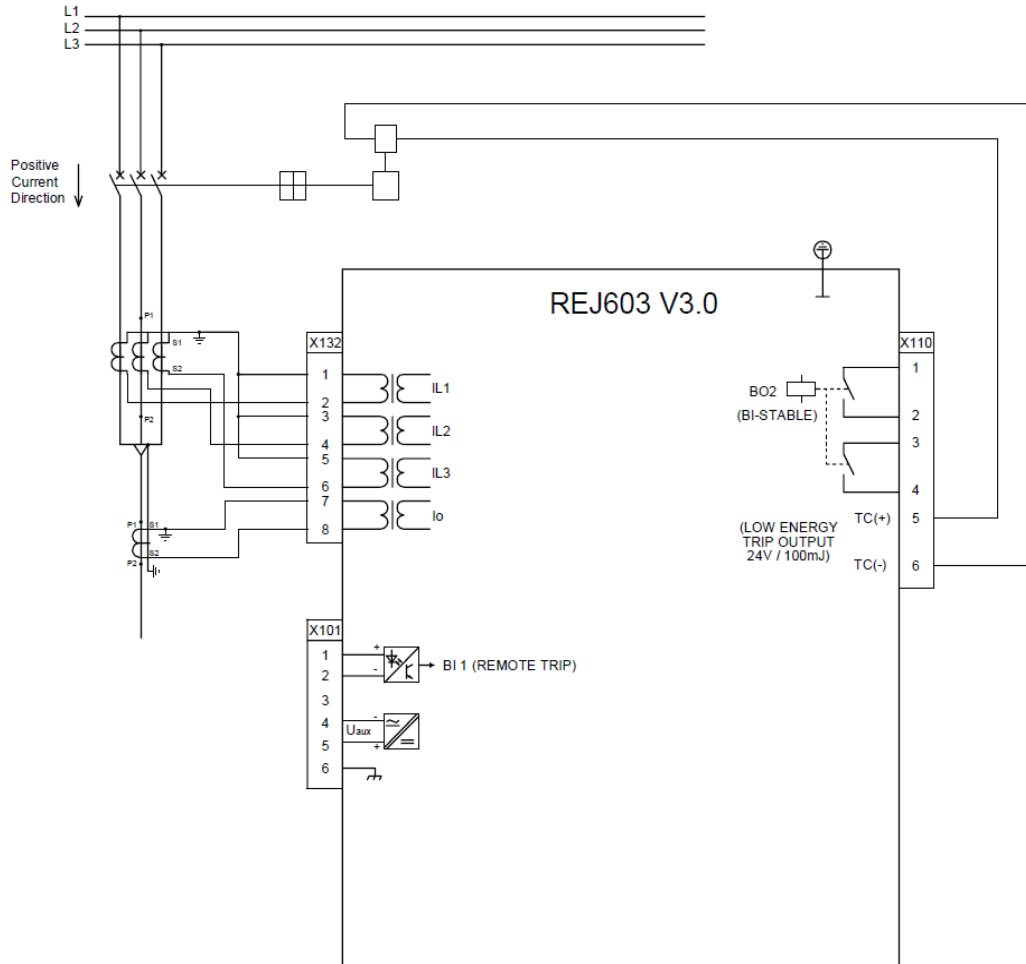


Figure 5. Terminal diagram of REJ603 V3.0

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18. 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 application manual, technical presentation 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.

19. Document revision history

Document revision / Date	Product version	History
A/2015-06-06	3.0	Self-powered feeder protection REJ603 V3.0 release with support of conventional CT support
B/2015-09-04	3.0	Content updated

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