



Relion® 605 series

# Feeder protection and control REF601 and REJ601 ANSI Product guide

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## 1. Description

The REF601 is a dedicated feeder protection and control relay. The REJ601 is an overcurrent protection relay without breaker control. These relays are intended for the protection of utility substations and industrial power systems within primary and secondary distribution networks. They are members of ABB's Relion® product family and part of its 605 series.

These relays, provide an optimized composition of protection, monitoring and control 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.

**Table 1. Standard configurations**

Description	Relay type
Feeder protection and control	REF601
Overcurrent/Feeder protection	REJ601

**Table 2. Application configurations and supported functions**

Functionality			REJ601/ REF601	REJ601/ REF601	REF601
	ANSI	IEC	B	C	D
<b>Protection</b>					
Non-directional overcurrent protection, low-set stage	51P	3I>	•	•	•
Non-directional overcurrent protection, high-set stage	50P-1	3I>>	•	•	•
Non-directional overcurrent protection, instantaneous stage	50P-2	3I>>>	•	•	•
Ground-fault protection, low-set stage	51N	Io>	•	•	•
Ground-fault protection, high-set stage	50N	Io>>	•	•	•
Three-phase transformer inrush detector	68	3I2f>	•	•	•
Three-phase thermal overload protection for feeders, cables and distribution transformers	49	3Ith>	-	•	•
Phase discontinuity protection	46PD	I2/I1>	-	•	•
Negative-sequence overcurrent protection	46	I2>	-	-	•
Circuit breaker failure protection	50BF/50NBF	3I>BF/ Io>BF	-	•	•
Master trip	94/86	Master Trip	•	•	•
Two setting groups			•	•	•
<b>Control (Function only available in REF601)</b>					
Breaker control functionality	52CB	I <-> O CB	•	•	•
Auto-reclosing, 4 shots	79	O -> I	-	-	•
<b>Condition monitoring</b>					
Trip circuit supervision	TCM	TCS	•	•	•
<b>Measurement</b>					
Three-phase current measurement	3I	3I	•	•	•
Residual current measurement	IN	Io	•	•	•
Negative phase sequence current	I2	I2	-	-	•
Thermal level	θ	θ	-	•	•
Operation counter	-	-	-	•	•

• = Included

## 2. Relay functions

The REF601 and REJ601 can be pre-configured which facilitates easy and fast commissioning of switchgear.

To emphasize the simplicity of using these relays, only application specific parameters need to be set within the relay's intended area of application. The standard signal configuration can be altered by LHMI (local human-machine interface).

The relays are available in three alternative application configurations, as indicated in Table 2.

### 3. Protection functions

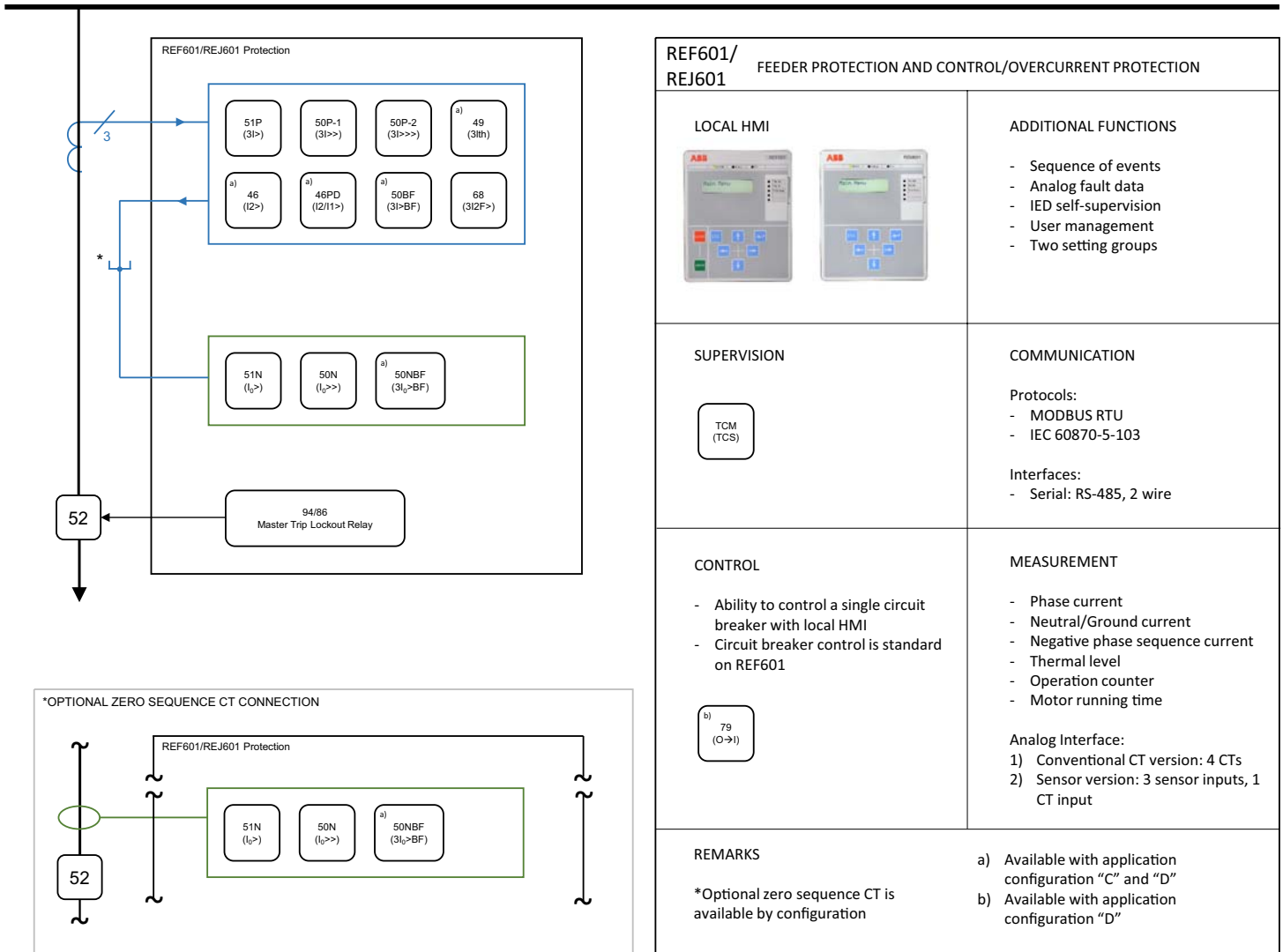
The REF601 and REJ601 offer three-stage overcurrent and two-stage ground-fault protection functions. The transformer inrush detector function is incorporated to prevent unwanted tripping due to energizing of transformers.

The REF601 and REJ601 offer three-stage overcurrent and two-stage ground fault protection functions. The low-set stages for overcurrent and ground fault protection are equipped with selectable characteristics – Definite Time (DT) and Inverse Definite Minimum Time (IDMT). The relays feature standard IDMT characteristics according IEC 61255-3 - Normal Inverse, Very

Inverse, Extremely Inverse, Long-time Inverse. They also feature characteristics according to ANSI C37.112 - Moderate Inverse, Normal Inverse, Very Inverse, and Extremely Inverse. The relays also have a special characteristic RI Inverse (RI) for better coordination with the rest of the network. Additionally the relays also support two setting groups.

The REF601 and REJ601 also offer thermal overload protection for feeders, cables and transformers. Other protections include negative phase sequence protection, phase discontinuity protection and circuit breaker failure protection. The relays also have an auto-recloser option for overhead line feeders.

Figure 1. Function overview of REF601 and REJ601 Application Configurations



#### 4. Application

The REF601 and REJ601 are protection relays aimed at protection and control of incoming and outgoing feeders in MV distribution substations. They can be applied for short-circuit, overcurrent and ground-fault protection of overhead lines and cable feeders of distribution and sub-distribution networks. The inrush current stabilization function allows the relays to be used as the main protection for distribution transformers.

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

The application configuration C adds thermal overload protection for feeders, cables and transformers, phase discontinuity protection and circuit breaker failure protection.

The application configuration D provides the highest functionality with incorporation of negative phase sequence protection and a multi-shot auto-recloser function making the relay suitable for overhead line feeders.

#### 5. Optimized for limited space

With their compact size and unique technical features, the REF601 and REJ601 are ideal for retrofits, compact switchgear and switchgear with limited space. These relays have a small mounting depth and do not have any loose mounting accessories. Uniquely, the REF601 and REJ601 use a press-fit mounting arrangement, suitable for quick and easy installation on switchgear.

#### 6. Control

The REF601 features control of one circuit breaker with dedicated push-buttons and guidance on local HMI for opening and closing. It includes two dedicated outputs for breaker control. The breaker control is also possible through optional MODBUS RTU or IEC 60870-5-103 communication.

#### 7. Measurement

All versions of the relay continuously measure phase currents and ground current. Ground current can be measured using an external zero sequence current transformer or can be calculated internally.

During operation, the default view of display shows the highest loaded phase current in primary terms (Amps) and the ground current. The values measured can be accessed locally via the user interface on the relay or remotely via the communication interface of the relay.

These relays continuously measure negative sequence current, thermal level and counter values if these functions are supported as per application configurations.

#### 8. Event log

To collect sequence of events (SoE) information, the relays incorporate non-volatile memory with a storage capacity of 100 events with associated time stamps and a resolution of 1 ms. The event log includes trip circuit monitoring status, 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 in the event of temporary auxiliary supply loss.

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 or remotely via the communication interface of the relay.

#### 9. Recorded data

The relays store fault records of analog values for the last five trip events in non-volatile memory. The fault recording is triggered by the trip signal of a protection function. Each fault record includes the current values for three phases and ground current along with a time stamp. These records enable the user to analyze the five most recent power system events.

The relays record the number of phase and ground fault trip events into dedicated trip counters. These trip counters cannot be reset by the user and are stored in non-volatile memory. The recorded information can be accessed locally via the user interface on the relay front panel and can be uploaded for subsequent fault analysis.

#### 10. 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 signal an alert for the operator. A permanent relay fault will block the protection functions of the relay to prevent incorrect relay operation.

The relays support a built-in test mode which enables the user to test the relay HMI and binary outputs.

#### 11. Trip-circuit monitoring

The trip-circuit monitoring 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 loss of circuit-breaker control voltage.

#### 12. Access control

To protect from unauthorized access and to maintain the integrity of information, the relays are armed with a three level, role-based user authentication system with individual passwords for operator, engineer and administrator levels. There are two alternative password protection options. The default is a combination of different navigation keys. The alternative is an alpha-numeric password. The user can select the password option based on their requirement.

### 13. Local HMI

The local HMI features an alpha-numeric LCD display, LED indicators and navigation keys. Measurements, recorded data, events and settings can be viewed on the display. The relays have six LED indicators on the LHMI which are preconfigured for normal/IRF condition, pickup, trip, phase fault trip, ground fault trip and trip circuit fault indications. Support for multiple languages is built-in to the REF601 and REJ601.

### 14. Inputs and outputs

All configurations are offered with conventional CTs and are equipped with four 1A or 5A analog current inputs. Three are for phase current and one for ground current measurement.

The relays all have four standard binary inputs. The binary inputs can be configured for various functions like blocking, protection reset, breaker position, breaker control and trip circuit supervision. These signals can be mapped to binary outputs and LEDs for indications. Individual inputs can be configured either as “Inverted” or “Non Inverted”.

The REF601 and REJ601 both have six output contacts. Of these, two are power outputs and four are signaling outputs. The output contacts can be configured for different functions like routing of protection start/trip signals, external trip/open, external close command, and trip circuit monitoring status, etc. One dedicated output contact is available for normal condition/IRF status indication.

All binary input and output contacts are preconfigured according to the default configuration. However, they can be easily reconfigured by using the LHMI menu.

### 15. Communication

The relays are available with an optional communication feature with Modbus RTU protocol or IEC 60870-5-103 on RS-485 bus with two wire connection. This allows the relays to connect to a control and monitoring system through serial communication for remote monitoring. The communication card may be added at any time.

### 16. Application warning

In the case that the relay 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: 20 VA
- Secondary voltage: in the range 30...150 V AC

Table 3. Input/output overview

Relay type	Analog input	Binary inputs	Binary outputs
	CT	BI	BO
REJ601	4	4	6
REF601	4	4	6

## 17. Technical data

**Table 4. Dimensions**

Relay type description	Value	
Width	Frame	5.12 inches (130.0 mm)
	Case	4.78 inches (121.5 mm)
Height	Frame	6.39 inches (160.0 mm)
	Case	5.96 inches (151.5 mm)
Depth		5.96 inches (151.5 mm)
Weight		3.2 lbs (1.43 kg)

**Table 5. Power supply**

Description	Value	
V nominal ( $V_n$ )	24...240 V AC, 50 and 60 Hz	
	24...240 V DC	
$V_n$ variation	85...110% of $V_n$ (20.4...264 V AC)	
	70...120% of $V_n$ (16.8...288 V DC)	
Burden of auxiliary voltage supply under quiescent ( $P_q$ )/operating condition	< 5.0 VA	
Ripple in the DC auxiliary voltage	Max 12% of the DC value (at frequency of 100 Hz)	
Maximum interruption time in the auxiliary DC voltage without resetting the relay	50 ms at nominal voltage	

**Table 6. Energizing inputs (conventional CT)**

Description	Value		
Rated frequency	50/60 Hz		
Current inputs	Rated current, $I_n$	1 A <sup>1)</sup>	5 A <sup>1)</sup>
	Thermal withstand capability:		
	· Continuously	4 A	20 A
	· For 1 s	100 A	500 A
Dynamic current withstand	· Half-wave value	250A	1250A
	Input impedance	< 100 m $\Omega$	< 20 m $\Omega$

<sup>1)</sup> Ordering option for current input

**Table 7. Binary input**

Description	Value
Rated voltage	24...240 V AC/DC
Operating range	85...110% of $V_n$ for AC and
	70...120% of $V_n$ for DC
Current drain	2...20 mA
Power consumption/input	< 500 mW
Input sensing time	25 ms
Trip-circuit monitoring (TCM): (BI2)	
Control voltage range	48...250 V AC/DC
Current drain through the supervision circuit	~ 1.5 mA
Minimum voltage over the TCS contact	20 V AC/DC (15...20 V)

**Table 8. Double-pole power output (XK2 : BO2)**

Description	Value
Rated voltage	240 V AC/DC
Continuous contact carry	8 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 (two contacts connected in series)	5 A/3 A/1 A
Minimum contact load	100 mA at 24 V AC/DC

**Table 9. Single-pole power output relay (XK10 : BO1)**

Description	Value
Rated voltage	240 V AC/DC
Continuous contact carry	8 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 35 / 220 V DC	5 A/0.2 A
Minimum contact load	100 mA at 24 V AC/DC

**Table 10. Signal output and IRF output (XK2 : BO3, BO4, BO5, BO6)**

Description	Value
Rated voltage	240 V AC/DC
Continuous contact carry	6 A
Make and carry for 3.0 s	8 A
Make and carry for 0.5 s	10 A
Breaking capacity when the control-circuit time constant L/R<40 ms, at 35 / 220 V DC	4 A/0.15 A
Minimum contact load	100 mA at 24 V AC/DC

**Table 11. Degree of protection of relay**

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

**Table 12. Environmental conditions**

Description	Value
Operating temperature range	-25...+55 °C
Service temperature range	-25...+70 °C (<16 h)
Relative humidity	< 93%, non-condensing
Atmospheric pressure	86...106 kPa
Altitude	Up to 6561 ft (2000 m)
Transport and storage temperature range	-40...+85 °C



**Table 13. Environmental tests**

Description	Type test value	Reference
Dry heat test (humidity < 50%)	· 96 h at +70 °C	IEC 60068-2-2
· Working	· 96 h at +85 °C	IEC 60068-2-48
· Storing		
Dry cold test	· 96 h at -25 °C	IEC 60068-2-1
· Working	· 96 h at -40 °C	IEC 60068-2-48
· Storing		
Damp heat test, cyclic	· 2 cycles (12 h + 12 h) at +25°C...+55 °C, Rh > 93%	IEC 60068-2-30
Damp heat test, steady state	· 96 h at +40 °C, humidity, Rh > 93%	IEC 60068-2-78

**Table 14. Electromagnetic compatibility tests**

Description	Type test value	Reference
1 MHz/100 kHz burst disturbance test:		IEC 61000-4-12, class III IEC 60255-22-1
- Common mode	2.5 kV, 1MHz, 400 pulses/s	
- Differential mode	1.0 kV, 1MHz, 400 pulses/s	
Electrostatic discharge test:		IEC 60255-22-2, class III IEC 61000-4-2
- Contact discharge	6 kV, 150 pF/330 Ω	
- Air discharge	8 kV, 150 pF/330 Ω	
Radiated, electromagnetic field immunity test	10 V/m f=80-1000 MHz, 1.4-2.7 GHz	IEC 60255-22-3, class III IEC 61000-4-3
	10 V/m f=80, 160, 450, 900 MHz, 900 PM, 1850 PM, 2150 PM	
Fast transient disturbance tests:		IEC 60255-22-4, class A IEC 61000-4-4
- All ports	4 kV, 5.0 kHz, 4 kV, 5.0 kHz	
Surge immunity test:	4.0 kV, 1.2/50 μs	IEC 60255-22-5
- Common mode	2.0 kV, 1.2/50 μs	IEC 61000-4-5
- Differential mode		
Power frequency magnetic field immunity test:		IEC 61000-4-8
- Continuous	100 A/m	
- Short duration (1 s)	1000 A/m	
Conducted radio frequency interference tests:	10 V f=150 KHz...80 Mhz	IEC 60255-22-6, class III IEC 61000-4-6
AC Voltage dips and short interruptions:	30% / 25 period 60% / 10 periods 100% / 2.5 periods 100% / 250 periods	IEC 61000-4-11
DC Voltage dips and short interruptions	30% / 500 ms 60% / 200 ms 100% / 50 ms 100% / 5000 ms	IEC 61000-4-29
Power frequency immunity test:		IEC 60255-22-7, Class A
· Common mode	300 V rms	
· Differential mode	150 V rms	
Pulse magnetic field immunity tests:	1000 A/m, 6.4/16 μs	IEC 61000-4-9

**Table 14. Electromagnetic compatibility tests (continued)**

Description	Type test value	Reference
Emission tests:		IEC 60255-25 EN 55011-CISPR II
Conducted		
150 kHz-0.5 MHz	< 66 dB ( $\mu$ V/m)	
0.5 MHz-30 MHz	< 60 dB ( $\mu$ V/m)	
Radiated		
30-230 MHz	< 40 dB ( $\mu$ V/m)	
230-1000 MHz	< 47 dB ( $\mu$ V/m)	

**Table 15. Insulation tests**

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

**Table 16. Mechanical tests**

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

**Table 17. Product safety**

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

**Table 18. EMC compliance**

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

**Table 19. RoHS compliance**

Description
Complies with the RoHS directive 2002/95/EC

**Table 20. Data communication (optional)**

Description	Type test value
Protocol	MODBUS RTU or IEC 60870-5-103
Communication port	RS485, 2 wire

## Protection functions

**Table 21. Low-set three-phase overcurrent protection, stage I> / 51P**

Parameter	Value (Range)
Setting range of pick-up current 'I>/51P'	0.1...2.5 x I <sub>n</sub> in steps 0.001, infinite
Operation accuracy	± 5.0% of set value, ± 10.0% of set value for set value < 0.2
Operate time delay (DMT) 't >'	0.04...64 s in steps of 0.01
Operation time accuracy	± 5.0% 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
Time multiplier setting 'k'	0.02...1.6, in steps of 0.01
Operation time accuracy	
- IEC and ANSI characteristics	class E(5) or ± 30 ms, class E(7.5) or ± 30 ms for set value < 0.2
- RI characteristics	± 5.0% of set value or ± 30 ms
Reset ratio	IDMT : 0.96 and DT : 0.98

**Table 22. High-set three-phase overcurrent protection, stage I>> / 50P-1**

Parameter	Value (Range)
Setting range of pick-up current 'I>>/50P-1'	0.2...25.0 x I <sub>n</sub> in steps 0.001, infinite for CT variant
Operation accuracy	± 5.0% of set
Operation mode	Definite time, Instantaneous
Operate time delay (DMT) 't >>'	0.04...64 s in steps of 0.01
Operation time accuracy	± 5.0% of set value or ± 30 ms
Reset ratio	0.98

**Table 23. Very high-set three-phase overcurrent protection, stage I>>> / 50P-2**

Parameter	Value (Range)
Setting range of pick-up current 'I>>>/50P-2'	0.2...25.0 x I <sub>n</sub> in steps 0.001, infinite for CT variant
Operation accuracy	± 5.0% of set
Operation mode	Definite time, Instantaneous
Operate time delay (DMT) 't >>>'	0.03...64 s in steps of 0.01
Operation time accuracy	± 5.0% of set value or ± 15 ms
Reset ratio	0.98

**Table 24. Low-set ground fault protection, stage Io> / 51N**

Parameter	Value (Range)
Setting range of pick-up current 'Io>/51N'	External ground measurement : 0.01...2.0 x In in steps 0.001, infinite Internal ground measurement : 0.1...2.0 x In in steps 0.001, infinite
Operation accuracy	External ground measurement : ± 5.0% of set value External ground measurement : ± 10.0% of set value, for set value < 0.05 Internal ground measurement : ± 15.0% of set value
Operate time delay (DMT) 't >'	0.04...64 s in steps of 0.01
Operation time accuracy	External ground measurement : ± 5.0% of set value or ± 30 ms Internal ground 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
Time multiplier setting 'k'	0.02...1.6, in steps of 0.01
Operation time accuracy	
- IEC and ANSI characteristics	External ground measurement : class E(5) or ± 30 ms
- RI characteristics	External ground measurement : class E(7.5) or ± 30 ms
- IEC and ANSI characteristics	Internal ground measurement : ± 5.0% of set value or ± 30 ms
- RI characteristics	Internal ground measurement : ± 10.0% of set value or ± 30 ms
Reset ratio	IDMT : 0.96 and DT : 0.98

**Table 25. High-set ground fault protection, stage Io>> / 50N**

Parameter	Value (Range)
Setting range of pick-up current 'Io>>/50N'	External ground measurement : 0.05...12.5 x In in steps 0.001, infinite Internal ground measurement : 0.5...12.5 x In in steps 0.001, infinite
Operation accuracy	External ground measurement : ± 5.0% of set value Internal ground measurement : ± 15.0% of set value
Operation mode	Definite time, Instantaneous
Operate time delay (DMT) 'to >>'	0.04...64 s in steps of 0.01
Operation time accuracy	External ground measurement : ± 5.0% of set value or ± 30 ms Internal ground measurement : ± 10.0% of set value or ± 30 ms
Reset ratio	0.98

**Table 26. Transformer inrush detection, 3I2f> / 68**

Parameter	Value (Range)
Inrush threshold value	0.2...25 x In, in steps of 0.01
Ratio Setting	30%...50%, in steps of 5%

**Table 27. Phase discontinuity protection, I2/I1> / 46PD**

Parameter	Value (Range)
Initial thermal level of apparatus $\vartheta_0$	0.0...100%, in steps of 1%
Reference current leading to thermal calculation "Ib"	0.1 ... 1.5 x In, in steps of 0.1
Heating time constant of object 't'	1.0...300 min, in steps of 1.0
Cooling time constant of object 'τ↓'	1.0...300 min, in steps of 1.0
Alarm value, $\vartheta_{alm}/49\_A$	50...200%, in steps of 1%
Operate value, $\vartheta_{trip}/49T$	50...200%, in steps of 1%
Start inhibit value, $\vartheta_{startinhibit}/49$ Block	50...200%, in steps of 1%
Options for calculating thermal value during power interruption, $\vartheta_{powerOFF}$	1...4 <sup>1)</sup>
Operation time accuracy	3% of 5 time constant or ± 30s
Reset ratio	0.98

<sup>1)</sup> 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  $\Delta t$ .

2 = On restoration of power, new value of thermal image is calculated for interruption period  $\Delta t$  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  $\vartheta_0$ .

**Table 28. Phase discontinuity protection, I2/I1> / 46PD**

Parameter	Value (Range)
Pickup value, 'I2/I1>/46PD'	10...100%, in steps of 1%
Operate delay time, 'tI2/I1>/Time'	0.1 ... 64 s, in steps of 0.1
Block the phase discontinuity protection	0 = No, 1 = Yes
Operation accuracy	± 5.0% of set value
Operation time accuracy	3% of set or ± 30 ms
Reset ratio	0.98

**Table 29. Negative sequence overcurrent protection, I2> / 46**

Parameter	Value (Range)
Start value, 'I2>/46'	0.1...1.5 x In, in steps of 0.01
Operate delay time, 'tI2>/Time'	0.1 ... 300 s, in steps of 0.1
Block the negative phase sequence protection	0 = No, 1 = Yes
Operation accuracy	± 5.0% of set value
Operation time accuracy	3% of set value or ± 30ms
Reset ratio	0.98

**Table 30. Circuit breaker failure protection, 3I>BF/Io>BF / 50BF/50NBF**

Parameter	Value (Range)
Operating phase current, 'ICBFP/Iph_pu'	0.2...2.0 x In, in steps of 0.1
Operating neutral current, 'IoCBFP/IN_pu'	0.1...2.0 x In, in steps of 0.1
Time delay for retrip, 'tretrip'	0.06...0.5 s, in steps of 0.01
Time delay for backup protection, 'tbackup'	0.06...0.5 s, in steps of 0.01
Block the circuit breaker failure protection	0 = No, 1 = Yes
Operation accuracy	± 5.0% of set value
Operation time accuracy	3% of set value or ± 30ms
Reset ratio	0.98

**Table 31. Autoreclosing, O -> I / 79**

Parameter	Value (Range)
Auto reclose initialization mode, 'AR start mode'	1 = Trip, 2 = Gen. start and trip
Type of CB ready signal available, 'CB ready'	1 = OCO, 2 = CO
Number of Auto reclose shots, 'Shot' (0 = Auto-reclose not in use)	0...4
Activate t	0.1...5 s, in steps of 0.1
Auto reclose pulse time, 'Pulse tp'	0.2...20 s, in steps of 0.1
Dead time for first auto reclose shot, 'Cycle t1'	0.2...300 s, in steps of 0.01
Dead time for second auto reclose shot, 'Cycle t2'	0.2...300 s, in steps of 0.01
Dead time for third auto reclose shot, 'Cycle t3'	0.2...300 s, in steps of 0.01
Dead time for fourth auto reclose shot, 'Cycle t4'	0.2...300 s, in steps of 0.01
Reclaim time, 'Reclaim tr'	1...300 s, in steps of 1
Auto reclosure block time, 'Block tb'	1...300 s, in steps of 1
Operation time accuracy	3% of set value or $\pm 30$ ms

**Table 32. Counter**

Parameter	Value (Range)
Initial value of the counter at the start of IED, 'Value'	0...65535, in steps of 1
Binary input configured at PULSE_INPUT, 'Blconf'	1...4 (1=BI1, 2=BI2, 3=BI3, 4=BI4) '-' no selection if counter selection not needed

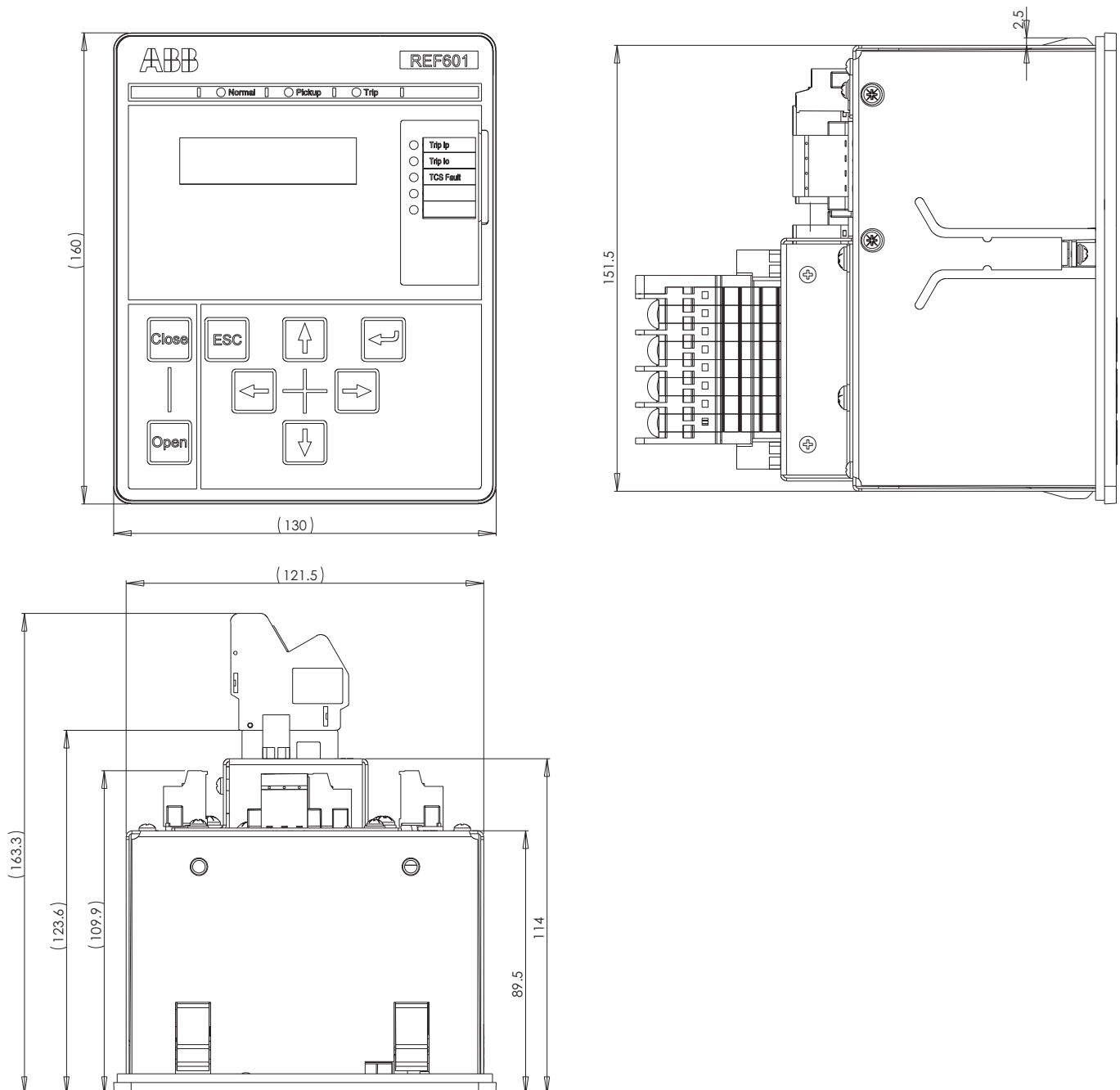
## 18. Dimensions and mounting

The REF601 and REJ601 have been equipped with a press-fit panel mounting mechanism. Without using any additional mounting accessories, the relays can be easily flush mounted on the panel.

With appropriate mounting accessories the REF601 and REJ601 can be mounted on circuit breakers of types VD4 or HD4. The dimensions are listed below for the panel cut-out for flush mounting:

- Height : 5.96"  $\pm$  0.02" (151.5  $\pm$  0.5 mm)
- Width : 4.78"  $\pm$  0.02" (121.5  $\pm$  0.5 mm)
- Thickness of panel 0.0787" – 0.1181" (2.0 – 3.0 mm)

Figure 2. Dimension of REF601/REJ601 – Flush mounting CT variant





## 19. 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 relay.

Use the ordering key information in Fig. 5 to generate the order number when ordering the protection relay.

Example code		REF601	A	E4	46	B	D	1	B	H
#	Description									
1	<b>Relay type</b>									
	Feeder protection with breaker control	REF601								
	Overcurrent protection (no control)	REJ601								
2	<b>Standard</b>									
	ANSI	A								
	IEC	B								
3,4	<b>Analog input / output</b>									
	Phase and Ground current input – 1A	D4								
	Phase and Ground current input – 5A	E4								
5,6	<b>Binary input / output</b>									
	4 BI + 6 BO	46								
7	<b>Serial communication</b>									
	MODBUS RTU with RS485 two wire	B								
	IEC60870-5-103 with RS485 two wire	C								
	None	N								
8	<b>Application configuration</b>									
	Non-directional overcurrent and ground fault protection	B								
	Thermal overload, phase discontinuity, and CB failure protection plus features from B	C								
	REF601 only – negative phase sequence protection and auto-recloser plus features from C	D								
9	<b>Power supply</b>									
	24...240V AC / DC	1								
10	<b>Configuration</b>									
	Ring lug terminals	B								
11	<b>Version</b>									
	Product version 2.2 FP1	H								

Example order code: REF601 A E4 46 B D 1 B H

Your ordering code:

Digit (#)	1	2	3 4	5 6	7	8	9	10	11
Code									

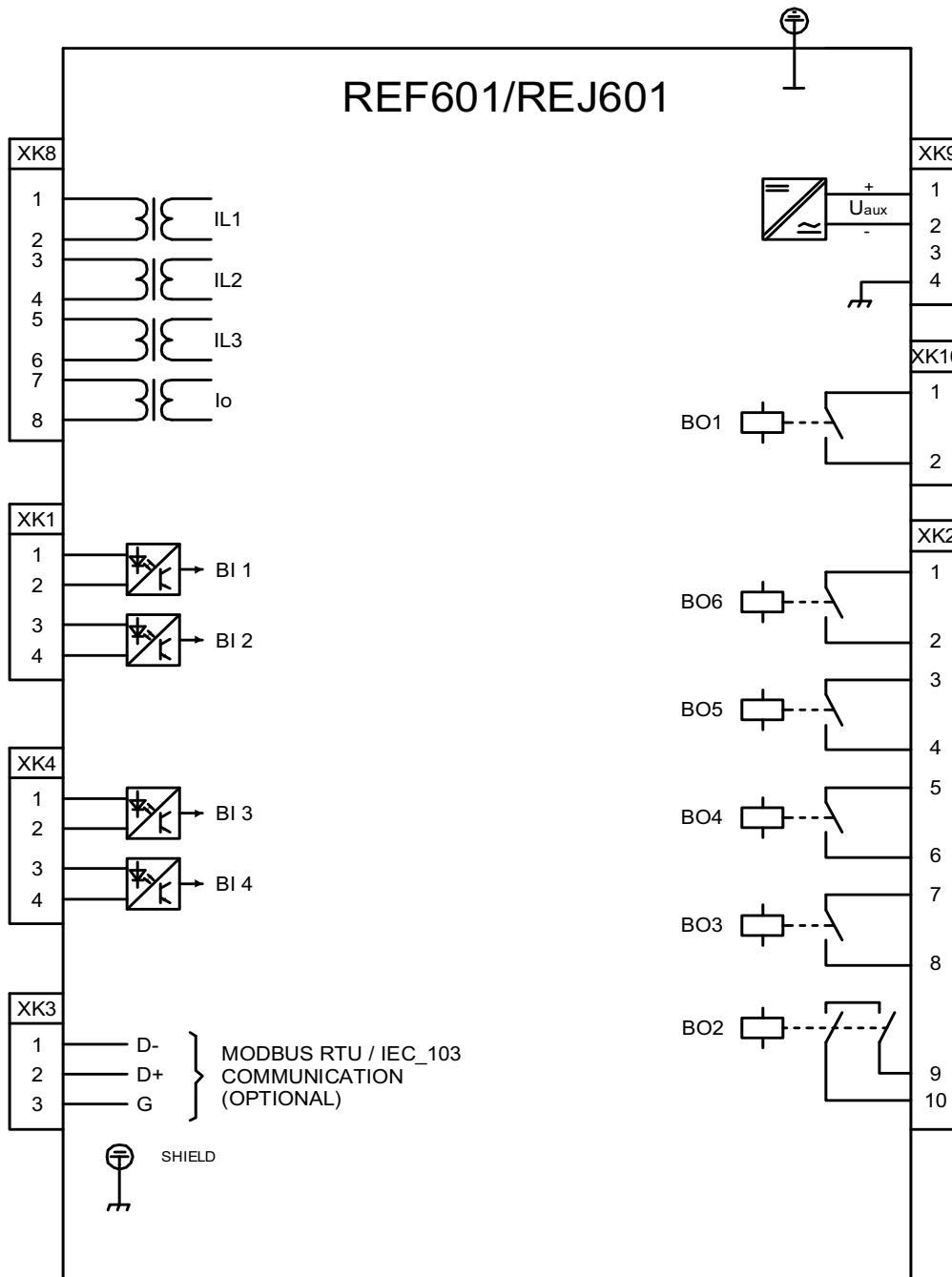
## 20. Accessories and ordering data

Table 33. Accessories

Item	Order number
RE_601 communication card	CIM601BNNNNBANXG

## 21. Terminal diagram

Figure 3. Terminal diagram of REF601/REJ601 for CT variant



## 22. References

The [www.abb.com/substationautomation](http://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 REF601 and REJ601 protection relays on the product page.

The download area on the right hand side of the webpage contains the latest product documentation, such as technical reference manuals, technical presentations and so on. The selection tool on the webpage helps you find the documents by the document category and language.

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

## 23. Document revision history

Document revision/date	Product version	History
A / June 2015	V1.0	New document created for ANSI market

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