Compact breaker failure relay and protection assemblies

RXHB 411 and RAHB 411

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Features

- **Three-phase compact numerical breaker failure relay**
- **Single- and three-phase breaker failure protection**
  - Single-phase, three-phase and three-phase unconditional start
  - Selectable current detection criteria
  - A patented adaptable current detector principle improves time coordination
  - Single-phase, three-phase and three-phase unconditional relay functions, all have different settable time delays for different types of faults
  - Re-trip function for faulted circuit-breaker
  - Instantaneous back-up trip is enabled when protected circuit-breaker is out-of-order
  - Additional back-up trip stage
  - Suitable for one and a half breaker systems
- **Pole-disagreement protection**
  - Phase current measuring, under and overcurrent detection levels
  - External blocking via binary input
  - Internal blocking during single-phase reclosing
- **General relay characteristics**
  - Setting parameters settable and readable via HMI
  - English or Swedish dialog
  - Two binary inputs for selected functions
  - Five binary output relays
  - Service values (primary/secondary) and disturbance information
  - Service value recording
  - Start and trip presentation via HMI and LED’s
  - Self-supervision with output error signal
  - Testing of output relays and operation of binary inputs via HMI
  - RAHB 411 can serve as a cost effective back-up protection to a REL 5xx line terminal in transmission systems
  - RAHB 411 can replace earlier breaker failure relays for example RAICA
- **Options**
  - Phase overcurrent protection with two stages and definite time delay. Possibility to use different delays for single- and multi-phase faults
  - Earth-fault protection with two stages and definite time delay
  - 4 additional inputs and 4 additional outputs

General

Compact current relay RXHB 411

The compact current relay RXHB 411 has a wide application range as an important part of the back-up protection for feeders and lines, transformers, capacitor banks, electric boilers as well as for generators and motors.

Functions

Breaker failure protection

Application

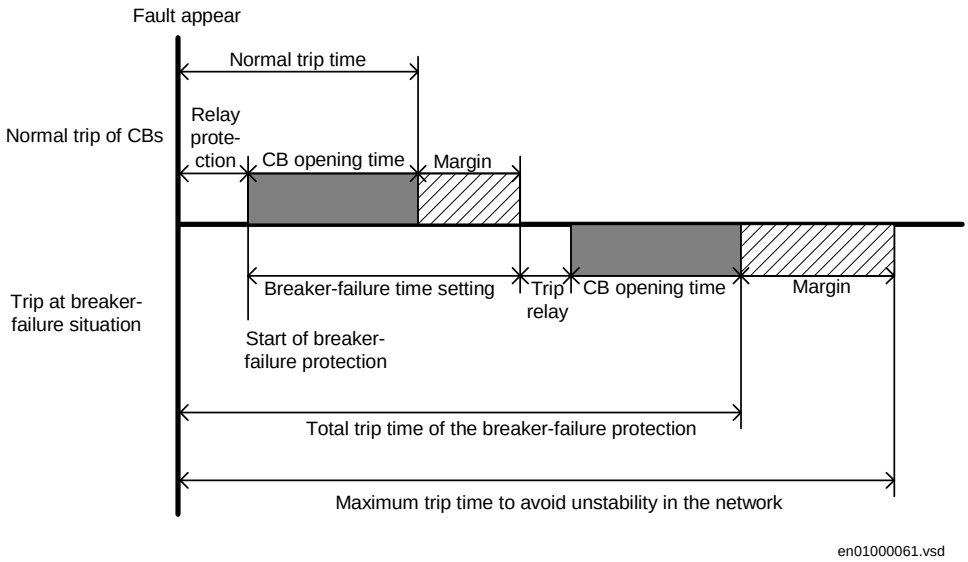

Figure 1: Operating diagram for the breaker failure situations.

Breaker failure protections are used in local back-up protection schemes. Breaker failure protection is required to give a rapid back-up protection when the primary circuit-breaker does not break properly at for example a short-circuit in the network. In such a case all adjacent circuit-breakers are tripped by the breaker failure protection. A simple and reliable way to secure the isolation of a fault is to check the appearance of fault current a selected time after the trip command. The time should be set long enough to permit the circuit-breaker to operate.

The timer setting of the back-up protection function should be selected with a certain margin to allow variation in the normal fault clearing time. The properties of the breaker failure protection allows the user to use smaller margins. Figure 1 shows the fault clearance time for the breaker failure situations.

Design

The breaker failure function can be activated from external protection functions via a binary input used for starting and seal-in of starting, as well as from internal protection functions trip. The breaker failure protection function may be one of the most important back-up protection functions in many cases and may be used separately or in combination with the phase and residual overcurrent functions. The combined breaker failure and overcurrent back-up protection RXHB 411 can therefor be used together with for example the 500 series products for an efficiently combined total protection terminal.

The operate values for the phase-current measuring elements and the neutral current element of the breaker failure function are separately set over the wide scale-range available. The use of the neutral current measuring element allows a more sensitive breaker failure setting for earth-faults. The phase-elements can also be set below rated current as they are not initiated during normal system operation. Thus a breaker failure relay operation can be obtained even though the fault current levels may be lower than rated line current during some fault conditions. The setting range is 0,1-1,0 times basic current. This basic current is settable between 1,0 - 10,0 times the rated current of the relay.

In case of a saturated current transformer there is a “false” DC-current in the secondary CT circuit. Also after a normal breaker trip operation there is a “false” DC-current in the secondary CT circuit. The measurement is therefor stabilised against the DC-transient that otherwise could cause unwanted operation. The use of a patented adaptable current detector reset function permits a short breaker failure margin time and a good critical system clearing time coordination. With the new technology used, the maximum reset time for current detection is below 10 ms even if there is a superimposed DC-current in the secondary CT circuit and also regardless of the magnitude of the current. Different time delay settings for different type of faults is possible to set, for example single-phase start versus three-phase start of the breaker failure protection. But the time delay setting is the same for the phase and neutral current measuring elements. The timer output is arranged to operate the trip logic for adjacent circuit-breakers and may also initiate transferred tripping.

Pole-disagreement protection

Application

There is a risk that the circuit-breaker will malfunction during normal switching operations (open and close), when there is no primary fault in the power system. The circuit-breaker can get different states for the poles (one pole closed and two poles open or two poles closed and one pole open). In such cases the breaker failure protection function is not activated. The situation with unsymmetrical, due to this circuit-breaker malfunction, can not be accepted. To detect such events a pole-disagreement protection can be used. This protection initiate a trip of the circuit-breaker in case of pole-disagreement.

The principle has advantages compared to protection functions using auxiliary contacts in the circuit-breaker, as those contacts can give misleading information in case of a mechanical fault within the circuit-breaker.

Design

The pole-disagreement protection is always active. The three phase currents through the circuit-breaker is supervised. The protection function has two sets of current level detectors. If all the three-phase currents are below the low current setting, or above the high current setting, there is no pole-disagreement. If any of the phase currents are below the low current setting at the same time as at least one of the other phase currents are above the high current setting, this is the criterion for pole-disagreement.

Overcurrent protection (option)

Application

In radially fed power networks the phase overcurrent function can be used as main or back-up short-circuit protection for lines, transformers and other equipment.

In combination with impedance relays or line differential protections, the phase overcurrent protection can serve as back-up short-circuit protection for the lines in meshed power systems. The time delay of such an overcurrent back-up protection must be chosen so that the selectivity of the main protections is not jeopardized.

For shunt capacitors, shunt reactors, motors and other similar equipment phase overcurrent protection can serve as main or back-up short-circuit protection.

A special application is to use the phase overcurrent protection as a detecting short-circuits between the line circuit-breaker and line CT in a line bay, in order to sent a trip signal to the remote line end. Such a fault is detected by the busbar protection but that protection does not normally trip the line circuit-breaker at the remote line end.

Design

The phase overcurrent protection function in RXHB 411 measures the three phase currents. The phase overcurrent protection has a low and a high set stage, both with definite time delayed function. The stages has also an option to use different trip delay for single- and multi-phase faults. The setting range for phase-faults is 0,1-4,0 times basic current. This basic current, which also is the base for the breaker failure protection function, is settable 1,0 - 10,0 times the rated current of the relay. This allows settings within a wide range

The phase overcurrent protection has also an option to use different trip delay for single- and multi-phase faults. This can be used for some different reasons, for example to assure transient stability in power systems where multi-phase faults (especially three-phase faults) should be tripped faster than single-phase fault or in a protection systems where phase to phase faults and phase to earth faults are separated. The time delay for trip of single-phase faults is often longer than for multi-phase faults. To coordinate with the other protections in the system different time delays are needed.

Earth-fault protection (option)

Application

The earth-fault protection is based on a measurement of the residual current. It can be used in high impedance grounded and isolated networks as well as in solidly grounded networks. The rated input current of the residual current (IN_r) is chosen according to the system grounding.

Earth-faults with high fault resistance can be detected by measuring the residual current. This type of protection provides maximum sensitivity to high resistive earth-faults in high impedance grounded systems as well as in solidly grounded systems.

In radially fed power networks the residual overcurrent function can be used as main or back-up earth-fault protection for lines, transformers and other equipment.

In combination with impedance relays or line differential protections, the residual overcurrent protection can serve as back-up earth-fault protection for the lines in meshed power systems. The time delay of such a residual overcurrent back-up protection must be chosen so that the selectivity of the main protections is not jeopardized.

For shunt capacitors, shunt reactors, motors and other similar equipment the residual overcurrent protection can serve as main or back-up earth-fault protection.

A special application is to use the residual overcurrent protection as a detecting earth-faults between the line circuit-breaker and line CT in a line bay, in order to sent a trip signal to the remote line end. Such a fault is detected by the busbar protection but that protection does not normally trip the line circuit-breaker at the remote line end.

Design

The residual overcurrent protection has a low and a high set stage both with definite time delayed function. The setting range for phase-faults is 0,1-4,0 times basic current. This basic current, which also is the base for the breaker failure protection function, is settable 1,0 - 10,0 times the rated current of the relay. This allows settings within a wide range.

A very low influence of harmonics superimposed on fault currents permits use also in otherwise demanding applications.

Miscellaneous

Self-supervision

Application
The self-supervision function includes the following functions;

- Checksum verification of ROM contents during start-up.
- RAM verification during start-up.
- Normal micro-processor watchdog function, continuously.
- Internal communication error handler, continuously.

An output error signal from the function is available to configure to a binary output.

Additional binary I/O (option)

Application
In applications where single-phase trips are performed this option has to be included to perform a single-phase start of the breaker failure protection. The additional binary I/O option can also be useful; for example if the overcurrent and earth-fault option is included. With this option included the relay will be provided with 4 additional binary inputs and 4 additional binary outputs.

Local HMI

Application
The local HMI (Human-Machine-Interface) serves as an information unit, presenting service values and information from the last two recorded disturbances. The current status of all binary input signals are also available.

Service value recording

Application
In applications where this new relay operates together with older relays service value recording function can be of interests. At power system faults the older relays can send a binary-input signal to the function for recording of the primary service values and use them as primary trip values. The values are presented in the local HMI.

The recorded service values are always from the last recording.

Trip value recording

Application
At power system faults the relay records the primary trip values and the values are presented in the local HMI.

The recorded trip values are always from the last disturbance.

Design description

Compact breaker failure relay RXHB 411

The compact breaker failure relay RXHB 411 constitutes the measuring relay of RAHB 411 and is available in four different versions.

The compact breaker failure relay RXHB 411 is a protective class II equipment in which protection against electric shock does not rely on basic insulation only, but in which additional safety precaution such as double insulation or reinforced insulation are provided.

RXHB 411 is a three-phase numerical, micro-processor-based relay with four input current transformers for galvanic insulation. The input signals are connected to D/A-converters and then filtered. The signals are sampled in the A/D-converter and read into the micro-processor. The unfiltered input signals are also connected to zero crossing detectors and read into the microprocessor. All settings of the relay will be done in the local HMI.

The relay is provided with three LED’s; one for start, one for trip and one for “in service”. The relay is provided with two or six binary inputs and five or nine binary outputs, the binary inputs are galvanically separated from the electronics with opto-couplers. The binary outputs consist of electromechanical relays, each with one change over contact.

RXHB 411 requires a DC/DC-converter for the auxiliary voltage supply +/-24 V; RXTUG 22H is recommended. The relay is delivered with 4-short-circuiting connectors RTXK for mounting on the rear of the terminal base. The connectors will automatically short-circuit the input currents when the relay is removed from the terminal base.

RXHB 411	Basic version, terminal diagram figure 2
RXHB 411	Basic version together with overcurrent and earth-fault protection, terminal diagram figure 2
RXHB 411	Basic version together with binary I/O option, terminal diagram figure 3
RXHB 411	Basic version together with overcurrent and earth-fault protection and binary I/O option, terminal diagram figure 3

Terminal diagrams

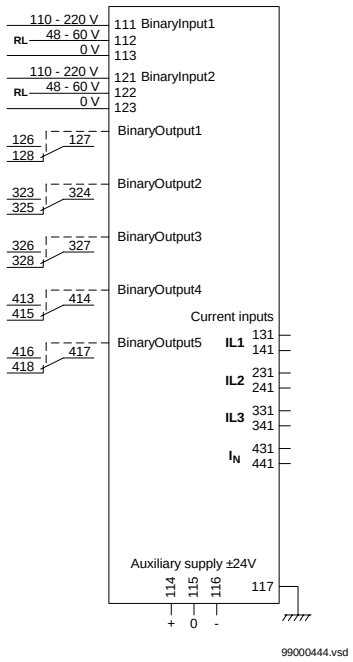

Figure 2: RXHB 411 basic version

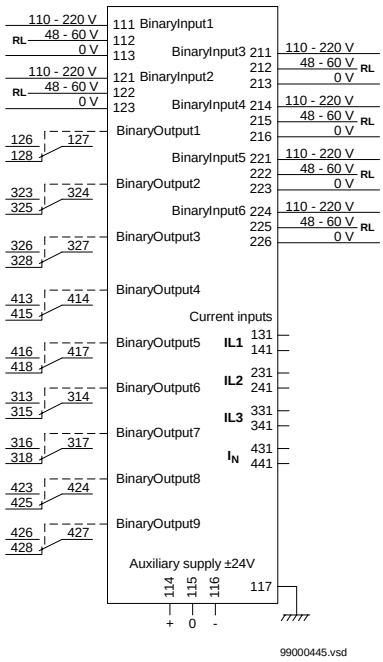

Figure 3: RXHB 411 with binary I/O option

Frequency characteristic

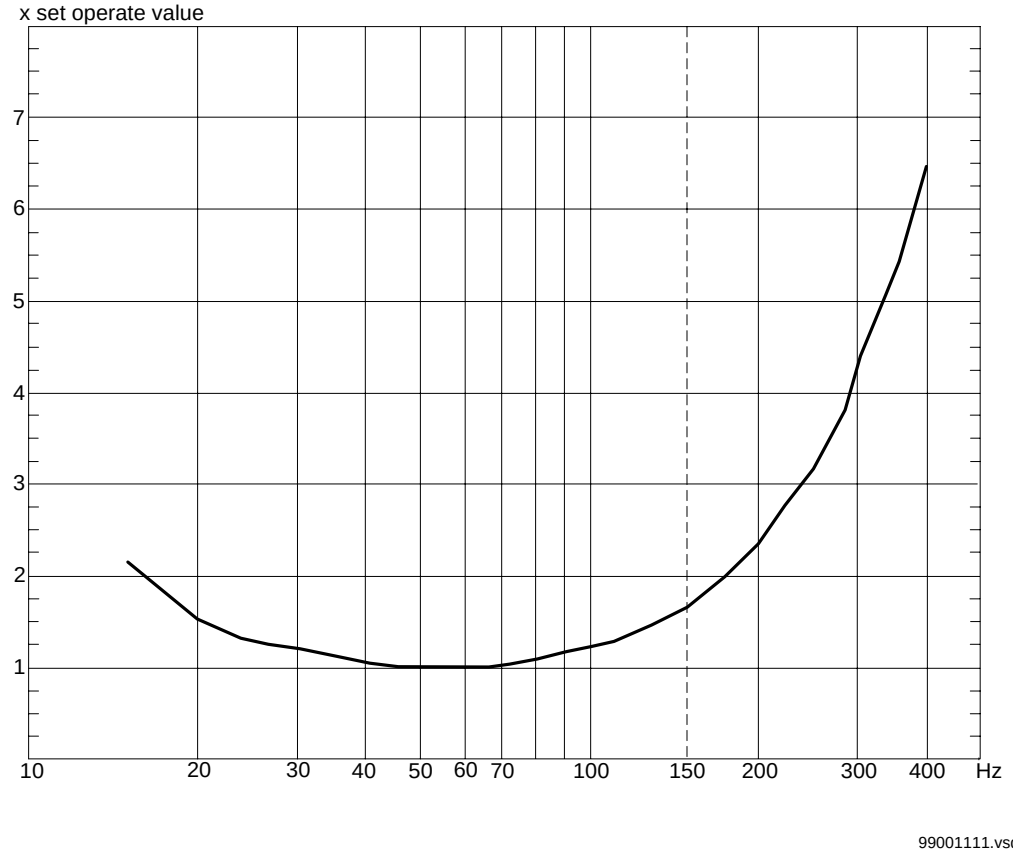

Figure 4: Frequency characteristic

Technical data

Table 1: Current inputs

Rated phase current I_r		1 A or 5 A
Rated neutral current IN_r	For I_r = 1 A	30 mA, 0.1 A or 1 A
	For I_r = 5 A	30 mA, 0.1 A, 1 A or 5 A
Setting range basic current	Phase I_b	1.0-10 x I_r
	Neutral I_{Nb}	1.0-10 x IN_r
Setting range breaker failure protection	Phase current, BF>	0.1-1.0 x I_b
	Neutral current, BF_N>	0.1-1.0 x I_{Nb}
Setting range pole-disagreement protection	Undercurrent, I<	0.1-0.15 x I_b
	Overcurrent, I>	0.2-0.5 x I_b
Setting range overcurrent protection (option)	Stage I>	0.1-4.0 x I_b
	Stage I>>	0.1-4.0 x I_b
Setting range earth-fault protection (option)	Stage I_N>	0.1-4.0 x I_{Nb}
	Stage I_N>>	0.1-4.0 x I_{Nb}
Effective phase current range		0.1-40 x I_r
Effective neutral current range		0.1-40 x IN_r
Rated frequency f_r		50 and 60 Hz
Frequency range		40-60 Hz/50-70 Hz
Power consumption, per phase at rated current	I_r = 1 A	< 30 mVA
	I_r = 5 A	< 150 mVA
Power consumption, at rated neutral current	IN_r = 30 mA	< 10 mVA
	IN_r = 0.1 A	< 15 mVA
	IN_r = 1 A	< 30 mVA
	IN_r = 5 A	< 150 mVA
Overload capacity for phase current input	I_r = 1 A continuously	4 A
	I_r = 5 A continuously	20 A
	I_r = 1 A during 1 s	100 A
	I_r = 5 A during 1 s	350 A

Overload capacity for neutral current input	IN_r = 30 mA continuously	0.4 A
	IN_r = 0.1 A continuously	0.4 A
	IN_r = 1 A continuously	4 A
	IN_r = 5 A continuously	20 A
	IN_r = 30 mA during 1 s	10 A
	IN_r = 0.1 A during 1 s	10 A
	IN_r = 1 A during 1 s	100 A
	IN_r = 5 A during 1 s	350 A

Table 2: Binary inputs

Inputs			**Rated values**
Binary inputs	Basic version		2
	Basic version with binary I/O option		6
Binary input voltage RL	Low		48-60 V DC, -20% to +10%
	High		110-220 V DC, -20% to +10%
Power consumption	Low	48 V DC	< 0.15 W / input
		60 V DC	< 0.3 W / input
	High	110 V DC	< 0.3 W / input
		220 V DC	< 0.8 W / input

Table 3: Output relays

Outputs			**Rated values**
Contacts	Basic version		5 change-over
	Basic version with binary I/O option		9 change-over
Maximum system voltage			250 V AC/DC
Current carrying capacity		Continuous	5 A
		During 1 s	15 A
Making capacity at inductive load with L/R >10 ms		During 200 ms	30 A
		During 1 s	10 A
Breaking capacity	AC, cos φ> 0.4	Max. 250 V	8 A
	DC, L/R < 40 ms	48 V	1 A
		110 V	0.4 A
		220 V	0.2 A
		250 V	0.15 A

Table 4: Auxiliary DC voltage supply

Power consumption			**Rated values**
Auxiliary voltage EL for RXTUG 22H			24-250 V DC, +/-20%
Auxiliary voltage for the relay			+/-24 V (from RXTUG 22H)
Power consumption with back-light on basic version	With RXTUG 22H, input 24-250 V	Before operation	< 5.0 W
		After operation	< 7.0 W
	Without RXTUG 22H, +/-24 V	Before operation	< 2.7 W
		After operation	< 4.3 W
Power consumption with back-light on basic version with binary I/O option	With RXTUG 22H, input 24-250 V	Before operation	< 5.5 W
		After operation	< 8.5 W
	Without RXTUG 22H, +/-24 V	Before operation	< 3.0 W
		After operation	< 5.5 W
Power consumption, back-light.			Approximately 0.5 W

Table 5: Electromagnetic compatibility (EMC), immunity tests

All tests are performed together with the DC/DC-converter, RXTUG 22H			
Test		**Severity**	**Standard**
Surge		1 and 2 kV	IEC 61000-4-5, class 3
AC injection		500 V AC	SS 436 15 03, PL 4
Power frequency magnetic field		1000 A/m	IEC 61000-4-8
1 MHz burst		2.5 kV	IEC 60255-22-1, class 3
Spark		4-8 kV	SS 436 15 03, PL 4
Fast transient		4 kV	IEC 60255-22-4, class 4
Electrostatic discharge at normal service with cover on		6 kV (contact)	IEC 60255-22-2, class 3
		8 kV (air)	IEC 60255-22-2, class 3
		6 kV, indirect application	IEC 61000-4-2, class 3
Radiated electromagnetic field, sweep		10 V/m, 80-1000 MHz	IEC 60255-22-3
Radiated electromagnetic field, pulse		10 V/m, 900 MHz	IEC 60255-22-3
Radiated electromagnetic field, spot		10 V/m, 80, 160, 450 and 900 MHz	IEC 60255-22-3
Conducted electromagnetic		10 V, 0.15-80 MHz	IEC 61000-4-6, Level 3
Interruptions in auxiliary voltage		2-200 ms	IEC 60255-11
No reset for inter-ruptions	24 V DC	< 20 ms	
	110 V DC	< 70 ms	
	250 V DC	< 300 ms	

Table 6: Electromagnetic compatibility (EMC), emission tests

All tests are performed together with the DC/DC-converter, RXTUG 22H		
Test	**Severity**	**Standard**
Conducted	0.15-30 MHz	IEC 60255-25
Radiated	30-1000 MHz	IEC 60255-25

Table 7: CE-demand

Test	**Reference standard**
Immunity	EN 50263
Emission	EN 50263
Low voltage directive	EN 50178

Table 8: Insulation tests

Test		**Severity**	**Standard**
Dielectric	Current circuit to circuit and current circuit to earth	2.5 kV AC, 1 min	IEC 60255-5
	Circuit to circuit and circuit to earth	2.0 kV AC, 1 min	
	Over open contact	1.0 kV AC, 1 min	
Impulse voltage		5 kV, 1.2/50 μs, 0.5 J	IEC 60255-5
Insulation resistance		> 100 MΩ at 500 V DC	IEC 60255-5

Table 9: Mechanical test

Test	**Severity**	**Standard**
Vibration	Response: 1 g, 1-150-10 Hz	IEC 60255-21-1, class 2
	Endurance: 1 g, 10-150-10 Hz, 20 sweeps	IEC 60255-21-1, class 1
Shock	Response: 5 g, 11 ms, 3 pulses	IEC 60255-21-2, class 1
	Withstand: 15 g, 11 ms, 3 pulses	
Bump	Withstand: 10 g, 16 ms, 1000 pulses	IEC 60255-21-2, class 1
Seismic	X-axis: 3 g, 1-50-1 Hz	IEC 60255-21-3, class 2, extended (Method A)
	Y-axis: 3 g, 1-50-1 Hz	
	Z-axis: 2 g, 1-50-1 Hz	

Table 10: Climatic conditions

Climatic condition	Partially weather protected locations, switch-gear environment, class 3K3
Storage	-40° C to +70° C
Permitted ambient temperature	-5° C to +55° C

Table 11: Weight and dimensions

Equipment	Weight	Height	Width
Relay without RXTUG 22H	Approximately 1.3 kg	4U	12C

Table 12: Service values

Service values			Range	Accuracy
Currents	Secondary	Phase	0.1-4.0 x I_b	< 3%
		Neutral	0.1-4.0 x I_{Nb}	< 3%
	Primary	Phase	0.1-250 000 x secondary value	< 3%
		Neutral	0.1-250 000 x secondary value	< 3%
Frequency	Frequency	f_r = 50 Hz	40-60 Hz	0.1 Hz
		f_r = 60 Hz	50-70 Hz	0.1 Hz

Table 13: Breaker failure protection, general

Breaker failure protection, general		Setting range
Setting range, basic current detection	Phase current, BF>	(0.10-1.0) x I_b
	Neutral current, BF_N>	(0.10-1.0) x I_{Nb}
Limiting errors of set operate value for current measuring 50/60 Hz	I_r = IN_r = 1 A and 5 A	< 3%
	IN_r = 0.1 A	< 3% or 1 mA up to 30 mA
	IN_r = 30 mA	< 3% or 0.5 mA up to 10 mA
Consistency of set operate value 50/60 Hz		< 1%
Typical reset ratio		95%
Current criteria for detection		1 out of 4 or 2 out of 4
Delta time delay between back-up trip 1 and 2		0-0.5 s
Minimum trip pulse length		0.02-0.5 s
Operate time for current reset detection		Max. 10 ms
Overshoot time[a)]		< 40 ms

Breaker failure protection, general		Setting range
Accuracy, time delays	External start	± 10 ms
	Internal start (option)	-25 ms and ± 10 ms
Temperature dependence within range -5° C to +55° C		< 2%
[a] Minimum time between circuit-breaker time and set time delay		

Table 14: Single-phase function

Single-phase function		Setting range
Start of single-phase function	External start	Via binary inputs
	Internal start (option)	Via overcurrent protection
Re-trip function		Off, current criteria or unconditional
Re-trip time delay		0.00-1.0 s
Back-up trip 1 time delay		0.05-1.0 s
Accuracy, time delays	External start	± 10 ms
	Internal start (option)	-25 ms and ± 10 ms

Table 15: Three-phase function

Three-phase function		Setting range
Start of three-phase function	External start	Via binary inputs
	Internal start (option)	Via overcurrent and earth-fault protection
Re-trip function		Off, current criteria or unconditional
Re-trip time delay		0.00-1.0 s
Back-up trip 1 time delay		0.05-1.0 s
Accuracy, time delays	External start	± 10 ms
	Internal start (option)	-25 ms and ± 10 ms

Table 16: Three-phase unconditional function

Three-phase unconditional function	Setting range
Start of three-phase unconditional function	External start via binary inputs
Re-trip function	Off or unconditional
Re-trip time delay	0.00-1.0 s
Back-up trip 1 time delay	0.05-1.0 s
Accuracy, time delays	± 10 ms

Table 17: Pole-disagreement protection

Pole-disagreement protection		**Setting range**
Setting range	Undercurrent, I<	(0.10-0.15) x I_b
	Overcurrent, I>	(0.20-0.50) x I_b
Limiting errors of set operate value for current measuring 50/60 Hz		< 3%
Consistency of set operate value 50/60 Hz		< 1%
Typical reset ratio	Undercurrent, I<	105%
	Overcurrent, I>	95%
Typical operate time I = 0 = 2 x set operate value		60 ms
Typical reset time I = 2 = 0 x set operate value		60 ms
Definite time delay		0-20 s
Reset time delay		0-10 s
Accuracy, time delays		± 30 ms
Temperature dependence within range -5° C to +55° C		< 2%

Table 18: Overcurrent protection (option)

Overcurrent protection		**Stage I> and I>>**
Setting range		(0.1-4.0) x I_b
Limiting errors of set operate value for current measuring 50/60 Hz		< 3%
Consistency of set operate value 50/60 Hz		< 1%
Typical reset ratio		95%
Typical operate time I = 0 => 3 x set operate value		40 ms
Typical reset time I = 3 => 0 x set operate value		45 ms
Transient over-reach L/R = 50 ms		< 5%
Typical overshoot time		30 ms
Recovery time at I = 3 x set operate value		< 55 ms
Frequency dependency	F_r = 50 Hz (45-55 Hz)	< 5%
	F_r = 60 Hz (54-66 Hz)	< 5%
	150/180 Hz	Typical 1.5/2.0 x set operate value
	250/300 Hz	Typical 3.0/4.0 x set operate value

Overcurrent protection		Stage I> and I>>
Influence of harmonics	100/120 Hz, 10%	< 2%
	150/180 Hz, 20%	< 6%
	250/300 Hz, 20%	< 3%
Temperature dependence within range -5° C to +55° C		< 2%

Table 19: Time functions for overcurrent protection (option)

Time function		Stage I> and I>>
Setting range, definite time delay	Single-phase fault	0-20 s
	Multi-phase fault	0-20 s
Accuracy, definite time		± 30 ms

Table 20: Earth-fault protection (option)

Earth-fault protection		Stage I_N> and I_N>>
Setting range		(0.1-4.0) x I_{Nb}
Limiting errors of set operate value for current measuring 50/60 Hz	IN_r = 1 A and 5 A	< 3%
	IN_r = 0.1 A	< 3% or 1 mA up to 30 mA
	IN_r = 30 mA	< 3% or 0.5 mA up to 10 mA
Consistency of set operate value 50/60 Hz		< 1%
Typical reset ratio		95%
Typical operate time I = 0 => 3 x set operate value		40 ms
Typical reset time I = 3 => 0 x set operate value		45 ms
Transient over-reach L/R = 50 ms		< 5%
Typical overshoot time		30 ms
Recovery time at I = 3 x set operate value		< 55 ms
Frequency dependency	F_r = 50 Hz (45-55 Hz)	< 5%
	F_r = 60 Hz (54-66 Hz)	< 5%
	150/180 Hz	Typical 1.5/2.0 x set operate value
	250/300 Hz	Typical 3.0/4.0 x set operate value
Influence of harmonics	100/120 Hz, 10%	< 2%
	150/180 Hz, 20%	< 6%
	250/300 Hz, 20%	< 3%
Temperature dependence within range -5° C to +55° C		< 2%

Table 21: Time functions for earth-fault protection (option)

Time function	Stage I_N> and I_N>>
Setting range, definite time delay	0-20 s
Accuracy, definite time	± 30 ms

Protection assemblies

Compact breaker failure protection assembly RAHB 411

The protection assemblies are of protective class I equipment in which protection against electric shock does not rely on basic insulation only, but which includes additional safety precautions in such a way that accessible conductive parts are connected to protective earth. The protections are based on the compact breaker failure relay RXHB 411. Test device RTXP 8, RTXP 18 and DC/DC-converter RXTUG 22H can also be included for specific application requirements. Test device, RTXP 8 and RTXP 18 are tools for relay testing. DC/DC-converter RXTUG 22H can be used either separately for a single protection or to feed other protections of the same relay family. With RXTUG 22H all requirements concerning emission and immunity disturbances with this protection assembly will be met.

The basic version of the measuring relay has 2 binary inputs and 5 binary outputs. The binary I/O option includes 4 additional inputs and 4 additional outputs. Protections are normally available with output logic with heavy duty contacts, relay RXME 18 with indicating flag, and can upon request be completed with an output logic of free choice. Output relays are connected to separate auxiliary voltage. The interface voltage for enable or block impulses can be connected to either 48-60 V DC or 110-220 V DC by connecting the voltage circuit to separate terminals. At delivery all relays are connected for 110-220 V DC.

All the protections in the COMBIFLEX® modular system are mounted on apparatus bars. The connections to the protections are done by COMBIFLEX® socket equipped leads. All internal connections are made and the protection assembly is tested before delivery from factory. The type of modules and their physical position and the modular size of the protection are shown in the diagrams of the respective protection. Figure 5 shows an example of a protection assembly.

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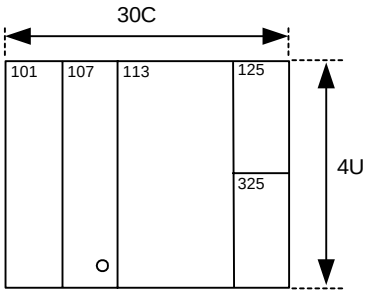
Figure 5: Protection assembly example



101 RTXP 18
107 RXTUG 22H
113 RXHB 411
125 RXME 18
325 RXME 18

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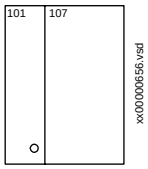
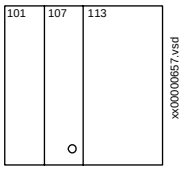
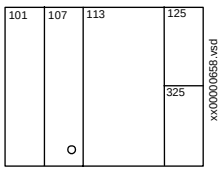
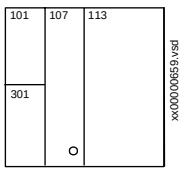
The height and width of the protection assembly are given in the circuit diagram with height (U) and width (C) modules, where U = 44.45 mm and C = 7 mm. The depth of the protection assembly, including space for the connection wires, is approximately 200 mm.

Protection assemblies

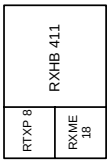
The table below shows the different versions of the compact breaker failure relay RXHB 411 in protection assemblies type RAHB 411.

RAHB 411 protection assembly variants	Ordering No.	RXHB 411 options	Circuit diagram	Terminal diagram	Available diagrams
 101 RXTUG 22H 107 RXHB 411	1MRK 002 028-AA	Basic version	1MRK 002 029-AA	1MRK 002 029-AAA	On request
		With binary I/O option	1MRK 002 029-AB	1MRK 002 029-ABA	On request
 101 RTXP 18 107 RXTUG 22H 113 RXHB 411	1MRK 002 028-BA	Basic version	1MRK 002 029-BA	1MRK 002 029-BAA	On request
		With binary I/O option	1MRK 002 029-BB	1MRK 002 029-BBA	On request
 101 RTXP 18 107 RXTUG 22H 113 RXHB 411 125 RXME 18 325 RXME 18	1MRK 002 028-CA	Basic version	1MRK 002 029-CA	1MRK002 029-CAA a)	b)
		With binary I/O option	1MRK 002 029-CB	1MRK 002 029-CBA a)	b)
 101 RTXP 8 107 RXTUG 22H 113 RXHB 411 301 RXME 18	1MRK 002 028-DA	Basic version	1MRK 002 029-DA	1MRK 002 029-DAA	On request
	1MRK 002 028-EA c)		1MRK 002 029-EA c)	1MRK 002 029-EAA c)	b)
		With binary I/O option	1MRK 002 029-DB	1MRK 002 029-DBA	On request
			1MRK 002 029-EB c)	1MRK 002 029-EBA c)	b)

a) Terminal diagrams available in technical overview brochure for RXHB 411 and RAHB 411
b) Terminal and circuit diagrams available in installation and commissioning manual for RXHB 411 and RAHB 411
c) Selection of phase and neutral rated currents must be the same, $I_r = IN_r = 1$ A or $I_r = IN_r = 5$ A

Mounting alternatives

The RAHB 411 protection assemblies described in the table above can be supplied in RHGX or RHGS cases. The layouts below show alternative packaging into three different sizes of RHGS cases. The RHGS cases are 6U tall which is the same as for the 500 series.



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Mounting of RXHB 411 in RHGS 6.

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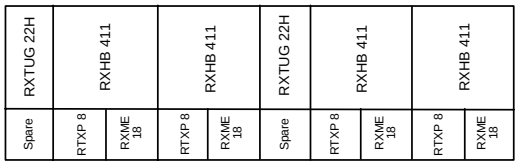
Mounting of RXHB 411 in RHGS 12.



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Mounting of RXHB 411 in RHGS 30 with dual power supplies RXTUG 22H, individual test switches and optional tripping relays.

RHGP cases offer compact and low cost panel mounting alternatives. RHGP sizes 4, 4B are suitable for housing RXHB 411 only. The RHGP 8 can be used when for example test switch and power supply is needed in addition to the compact breaker failure relay RXHB 411 for example with protection assemblies with ordering number 1MRK 002 028-BA, -DA or -EA. The RHGP cases are specified for separate purchase in document 1MRK 513 013-BEN.

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Example of a panel mounting alternative.

Diagrams

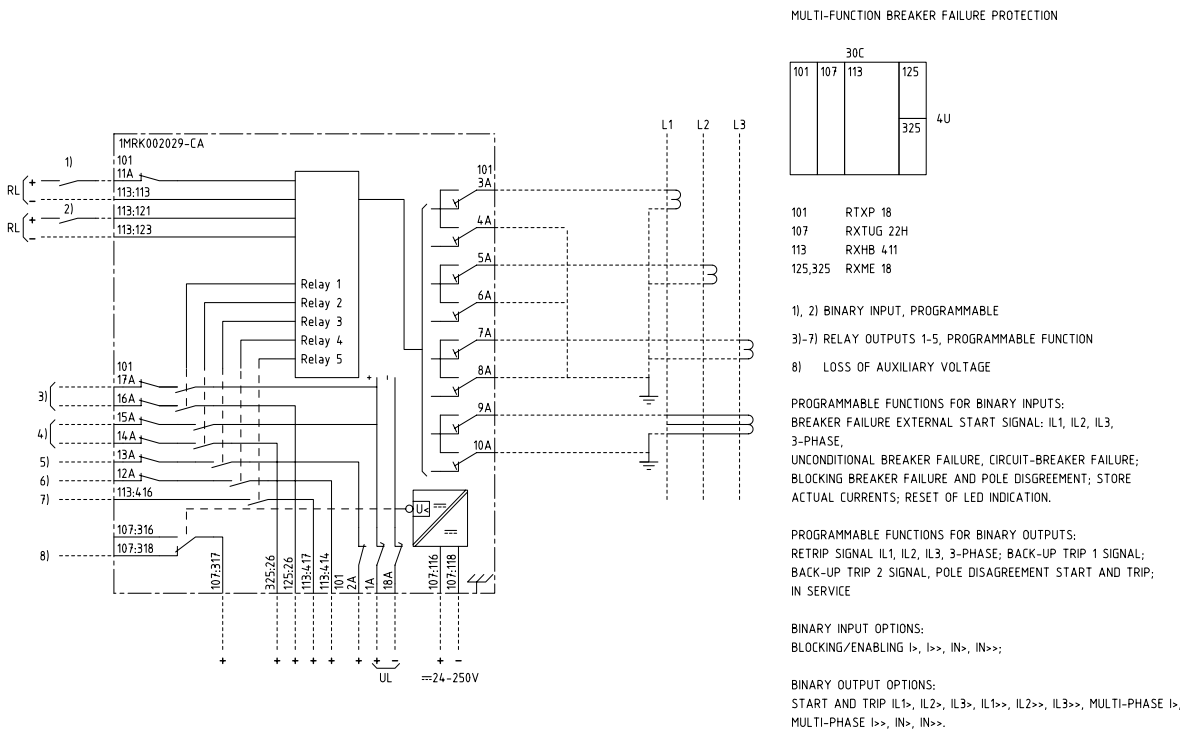

Figure 6: Terminal diagram 1MRK 002 029-CAA

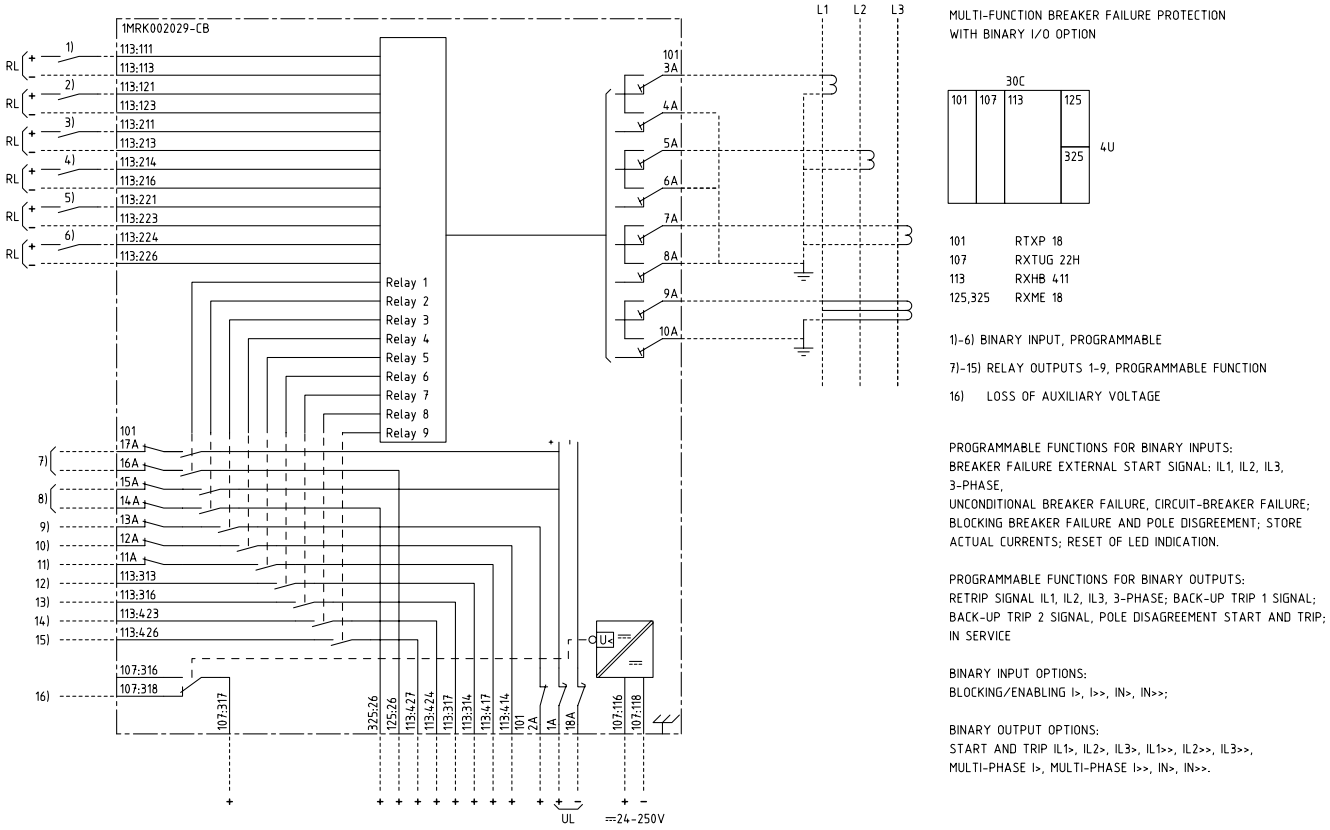

Figure 7: Terminal diagram 1MRK 002 029-CBA

Ordering of RAHB 411 protections

Basic data to specify

RAHB 411 protection Quantity: ☐ 1MRK 002 028- ____

Desired wording on the lower half of the test switch max. 13 lines with 14 characters per line.

Rated AC inputs

Phase I_r = 1 A, neutral IN_r = 30 mA	☐	1MRK 000 322-HC
Phase I_r = 1 A, neutral IN_r = 0,1 A	☐	1MRK 000 322-HD
Phase I_r = 1 A, neutral IN_r = 1 A	☐	1MRK 000 322-HE
Phase I_r = 5 A, neutral IN_r = 30 mA	☐	1MRK 000 322-HF
Phase I_r = 5 A, neutral IN_r = 0,1 A	☐	1MRK 000 322-HG
Phase I_r = 5 A, neutral IN_r = 1 A	☐	1MRK 000 322-HH
Phase I_r = 5 A, neutral IN_r = 5 A	☐	1MRK 000 322-HK

Options

Functions

Overcurrent and earth-fault protection	☐	1MRK 002 027-AA
Additional binary I/O (inputs 4/outputs 4)	☐	1MRK 000 322-ET

Auxiliary voltage for included auxiliary relay

RXME 18, 24 V DC	☐	RK 221 825-AD
RXME 18, 48-55 V DC	☐	RK 221 825-AH
RXME 18, 110-125 V DC	☐	RK 221 825-AN
RXME 18, 220-250 V DC	☐	RK 221 825-AS

Mounting alternatives	**Size**		
Apparatus bars (always included)			
Equipment frame without door	4U 19”	☐	1MRK 000 137-GA
Equipment frame with door	4U 19”	☐	1MRK 000 137-KA
RHGX 8	4U 24C	☐	RK 927 002-AB
RHGX 12	4U 36C	☐	RK 927 003-AB

RHGX 20	4U 60C	☐	RK 927 004-AB
RHGS 30	6U x 1/1 19” rack	☐	1MRK 000 315-A
RHGS 12	6U x 1/2 19” rack	☐	1MRK 000 315-B

Accessories

User documentation RXHB 411 and RAHB 411

Operator’s manual	Quantity:	▭	1MRK 509 071-UEN
Technical reference manual	Quantity:	▭	1MRK 509 072-UEN
Installation and commissioning manual	Quantity:	▭	1MRK 509 073-UEN

Ordering of RXHB 411 relays

Included functions in basic version

Single- and three-phase breaker failure protection

Pole-disagreement protection

Local Human Machine Interface (HMI)

Service value reading (primary or secondary values)

Basic data to specify

RXHB 411, includes basic functions	Quantity:	▭	1MRK 001 982-AA

Rated AC inputs

Phase I_r = 1 A, neutral IN_r = 30 mA	☐	1MRK 000 322-HC
Phase I_r = 1 A, neutral IN_r = 0,1 A	☐	1MRK 000 322-HD
Phase I_r = 1 A, neutral IN_r = 1 A	☐	1MRK 000 322-HE
Phase I_r = 5 A, neutral IN_r = 30 mA	☐	1MRK 000 322-HF
Phase I_r = 5 A, neutral IN_r = 0,1 A	☐	1MRK 000 322-HG
Phase I_r = 5 A, neutral IN_r = 1 A	☐	1MRK 000 322-HH
Phase I_r = 5 A, neutral IN_r = 5 A	☐	1MRK 000 322-HK

Options

Functions

Overcurrent and earth-fault protection	☐	1MRK 002 027-AA
Additional binary I/O (inputs 4/outputs 4)	☐	1MRK 000 322-ET

Accessories

User documentation RXHB 411 and RAHB 411

Operator’s manual	Quantity:	▭	1MRK 509 071-UEN
Technical reference manual	Quantity:	▭	1MRK 509 072-UEN
Installation and commissioning manual	Quantity:	▭	1MRK 509 073-UEN

Related documents

Document related to COMBIFLEX© assemblies	Identity number
Buyer's guide, Connection and installation components in COMBIFLEX©	1MRK 513 003-BEN
Buyer's guide, Panel mounting cases for COMBIFLEX© relays	1MRK 513 013-BEN
Buyer's guide, Relay accessories and components	1MRK 513 004-BEN
Buyer's guide, Test system COMBITEST	1MRK 512 001-BEN
Buyer's guide, DC-DC converter	1MRK 513 001-BEN
Buyer's guide, Auxiliary relays	1MRK 508 015-BEN

Documents related to RXHB 411 and RAHB 411	Identity number
Technical overview brochure	1MRK 509 070-BEN
Connection and setting guide (only RXHB 411)	1MRK 509 070-WEN
Operator's manual	1MRK 509 071-UEN
Technical reference manual	1MRK 509 072-UEN
Installation and commissioning manual	1MRK 509 073-UEN

Manufacturer

ABB Automation Products AB

Substation Automation Division

S-721 59 Västerås

Sweden

Tel: +46 (0) 21 34 20 00

Fax: +46 (0) 21 14 69 18