

Installation and commissioning manual

RXHB 411 and RAHB 411

Compact breaker failure relay and protection assemblies



About this manual

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Chapter 1 Introduction

About this chapter

This chapter introduces the user to the content in the manual. The intended use of the manual and the intended audience is described. The introduction chapter also contains references to other documents.

1 Introduction to the installation and commissioning manual

1.1 About this manual

This manual contains instructions on how to install, commission and maintain the compact breaker failure relay and protection assemblies. The manual covers procedures for mechanical and electrical installation, setting and configuration, secondary injection testing, preventive and corrective maintenance. The chapters and sections are organised in the chronological order the protection should be installed and commissioned.

The installation and commissioning manual contains the following chapters:

- The *safety information* chapter presents warning and note signs, which the user should draw attention to.
- The *installation* chapter contains instructions on how to install the protection.
- The *commissioning* chapter contains instructions on how to commission the protection.
- The *operations during commissioning and maintenance* chapter contains instructions on frequently performed operations during commissioning and maintenance, such as reading off primary and secondary service values and disturbance information.
- The *maintenance* chapter contains instructions on how to maintain the protection.
- The *protection assemblies and diagrams* chapter contains descriptions over the protection and assembly variants.
- The *test records* chapter contains test records which could be used for documentation purposes.

1.2 Intended audience

1.2.1 General

The installation and commissioning manual is addressing the installation, commissioning and maintenance personnel responsible for taking the protection into normal service and out of service.

1.2.2 Requirements

The installation personnel must have a basic knowledge in using protection equipment. The commissioning and maintenance personnel must be well experienced in using protection equipment, protection functions and the configured functional logics in the protection.

1.3 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

1.4 Revisions

Revision	Description
-	Initial version

Chapter 2 Safety information

About this chapter

This chapter contains safety information. Warning and note signs are presented which attend the user to be careful during certain operations in order to avoid human injuries or damage to equipment.

1 Safety signs

1.1 Description of safety signs

1.1.1 The warning sign

The warning sign informs the user that certain operations should be avoided in order to prevent human injuries or damage to equipment.

1.1.2 The note sign

The note sign informs the user to be careful when using the product in certain situations and notifies the user to facts that could be of special interest during certain operations.

1.2 Warning signs



Warning!

Never plug or withdraw a relay from the terminal base without blocking the output circuits or interrupting the auxiliary DC supply. Otherwise there is a risk of unwanted operations.



Warning!

Always avoid to touch the circuitry when the plastic cover, which covers the relay, is removed. The product contains electronic circuitries which can be damaged if exposed to static electricity (ESD). The electronic circuitries also contain high voltage which is lethal to humans.



Warning!

Never disconnect a wire in a current circuit. Always be sure to short-circuit the secondary phase terminals of the current transformers to neutral before the circuit is opened. An opened current circuit will produce an extremely high voltage which is lethal to humans.

1.3

Note signs

**Note!**

The protection assembly is designed for a maximum continuous current of four times rated value.

**Note!**

The length of the functional-earth connection must be as short as possible when connecting to EMC-earth. Withstand against electrical disturbances could otherwise be hazarded.

**Note!**

When the excitation characteristic of the CT is to be verified, the primary side of the CT must be an open-circuit and the secondary side disconnected from the relay protection.

**Note!**

If the LED's are flashing or the green 'In service' LED is dark, an internal fault has occurred. Read the self supervision section in the technical reference manual for further information.

Chapter 3 Installation

About this chapter

This chapter contains instructions on how the protection should be installed regarding mechanical and electrical installation. The different instruction sections in this chapter are organized in the order the installation work should be performed.

1

Overview

Before you can start the installation work you must be aware of the application of the protection assembly.

The mechanical and electrical environmental conditions at the installation site must be within the permissible range according to at the data sheets of the protection assembly. Dusty, damp places, places liable to rapid temperature variations, powerful vibrations and shocks, surge voltages of high amplitude and fast rise time, strong induced magnetic fields or similar extreme conditions should be avoided.

Sufficient space must be available in front of and at rear of the protection assembly to allow access for maintenance and future modifications.

When the instructions in this chapter are covered the protection assembly will be ready for commissioning as described in the commissioning chapter.

The installation work starts with unpacking and checking that the items included are according to delivery documents. The mechanical installation includes plugging the relay into a terminal base, which should be fixed on an apparatus bar. The protection assembly is then mounted into a case. The electrical installation means connecting the cables from the transformers, binary I/O and auxiliary voltage.



Warning!

Always avoid to touch the circuitry when the plastic cover, which covers the relay, is removed. The product contains electronic circuitries which can be damaged if exposed to static electricity (ESD). The electronic circuitries also contain high voltage which is lethal to humans.

2 Preparations

2.1 Receiving, unpacking and checking

Procedure

1. **Remove the protection package from the transport case and perform a visual inspection of any possible transport damages.**
2. **Check that all units are included in accordance with the delivery documents.**

In case of transport damages, appropriate action must be taken against the last carrier and the nearest ABB office or agent should be informed. ABB should be notified immediately if there are any discrepancies in relation to the delivery documents.

3. **Check that the protection assembly has the correct identity markings on the front.**

The check should confirm that the terminal type, markings and serial number corresponds to what has been ordered.

4. **Check that all screws are firmly tightened and all relay elements are securely fastened.**

2.2 Storage

If the protection must be stored before installation. This must be done in a dry and dust-free place, preferably in the original transport case.

3 Mechanical installation

This section contains instructions for the mechanical installation.

Before you can start the mechanical installation you must purchase terminal bases, apparatus bars and an appropriate case. These items are all needed when performing the mechanical installation.

The mechanical installation starts by fixing the terminal bases and the COMBITEST test switch, when included, on the apparatus bars. Then the COMBIFLEX[®] units are plugged into the COMBIFLEX[®] terminal bases. The protection assembly can then be mounted into a frame or case. The following frames and cases are available:

- 19" equipment frame.
- RHGX case.
- RHGS case.

See the technical reference manual for description over the available cases.

All internal protection connections are made and the protection assembly is tested before delivery from factory.



Note!

The length of the functional-earth connection must be as short as possible when connecting to EMC-earth. Withstand against electrical disturbances could otherwise be hazarded.

Procedure

- 1. Fix the terminal bases on an apparatus bar to make up the protection assembly.**
- 2. Plug the COMBIFLEX[®] units into the terminal bases.**

Consult the circuit diagram to find out where the units should be plugged. The circuit diagram also gives the height and the width of the protection assembly.

- 3. Mount the protection assembly into a desired case.**

There are three available cases; RHGS, RHGX and 19" equipment frame. The protection assembly is inserted and fastened with screws at the backplane of the case.

4. Connect the functional-earth connection on required units.

Connect one part of the functional-earth cable at the backplane of the case with a screw, connect a 10 A COMBIFLEX socket on the other part and connect it into the terminal base.

4 Electrical installation

This section contains instructions for the electrical installation.

Before the user can start working the valid circuit diagrams must be available in order to decide how the connections should be made. See the chapter “Protection assemblies and diagrams”. The user must also have the COMBIFLEX[®] crimping tool and leads with 10 and 20 A COMBIFLEX[®] sockets available.

The wiring from the cubicle terminals to the COMBIFLEX[®] terminals on the rear side of the protection assembly must be made in accordance with the established guidelines for this type of equipment. The wires for binary inputs and outputs and the auxiliary supply should be laid separated from the current and voltage transformer cables between the cubicle terminals and the protection terminals.

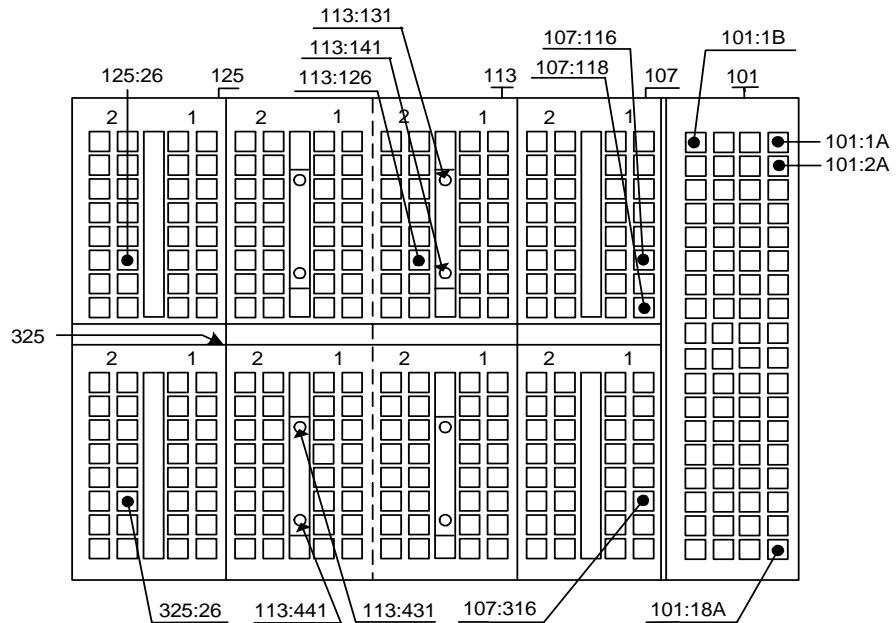
The external connections to the COMBIFLEX[®] terminals of the protection assembly shall be made in accordance with the valid terminal diagram. The cables from the transformers should be identified with regards to phases and connected to the proper COMBIFLEX[®] terminals.

If the protection assembly is provided with a COMBITEST test switch, COMBIFLEX[®] wires are used for both internal and external connections. Connections to and from the test switch are made with leads with 20A COMBIFLEX[®] sockets. Leads for internal terminal bases with 10A COMBIFLEX[®] sockets.

Example

Figure 1 shows an example of the rear of a protection assembly with COMBITEST test switch. Terminal positions are used for internal and external connections.

Each unit in the protection assembly has a unique item designation. The item designations are based on the COMBIFLEX[®] coordinate system of U and C modules, where the first figure stands for the U module position starting from the top, and the next two figures stand for the C module position, starting from the left-hand side seen from the front side of the protection assembly.



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Figure 1: Terminal locations at the rear of a protection assembly.

Procedure

1. **Connect the RTXP test switch to the valid connector with 20 A sockets.**
2. **Connect the external connector to the terminal bases with 10 A sockets.**

See the chapter “Protection assemblies and diagrams” for valid terminal diagrams.

Chapter 4 Commissioning

About this chapter

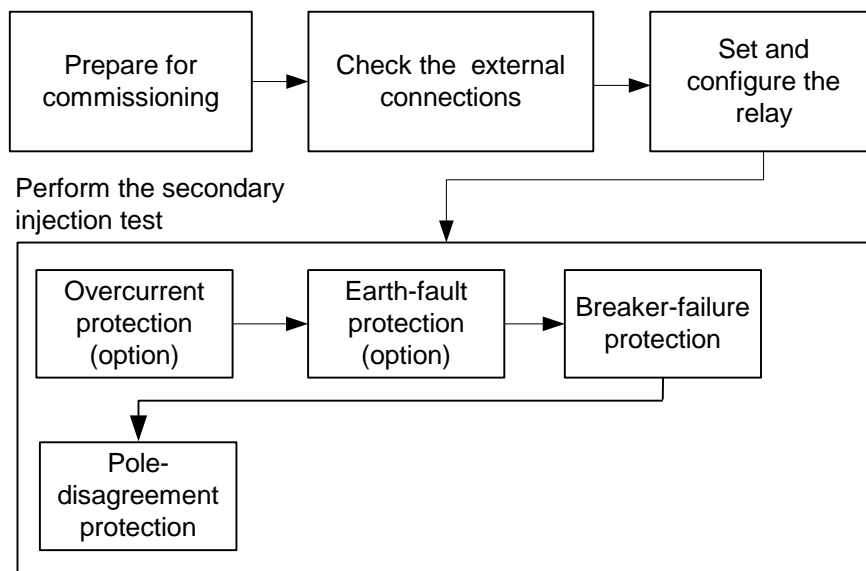
This chapter contains instructions on how the commissioning of the protection is performed. That is checking external connections, setting and configuring the relay and secondary injection testing. The different instruction sections in this chapter are organized in the order the commissioning work should be performed.

1

Overview

The commissioning work starts by preparing the site for commissioning. A check of the external connections must then be carried out, which includes checking of external circuits and associated equipment, such as transformers, circuit-breakers and signalling equipment. The general relay parameters, the basic protection parameters and each protection function parameter have to be set. The binary I/O signals for the relay must also be configured. All settings must be made through the local human-machine-interface (HMI). Secondary injection testing of the protection assembly is made to verify that all protection functions operate in accordance with the relay setting plan. The commissioning work must also be properly documented for future reference. The test records available in this manual can be used.

Figure 2 shows the major procedures during the commissioning:



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Figure 2: Overview over the major procedures during commissioning.

2

Preparations

Be sure that all necessary documentation and test equipment are available at site before the commissioning work is started up.

Necessary documentation and equipment for commissioning includes:

- Operator's manual if needed. The operator's manual includes general instructions on how to handle the human-machine-interface.
- Valid circuit diagrams and test records are available in this manual.
- Parameter settings values.
- Test equipment with a variable phase current and a time measuring function, SVERKER or similar is recommended.
- Two multimeters or ammeters with class 0.5 or better.
- Two resistors 10 Ω and 50 Ω , 300 W or an adjustable resistor.
- One resistor 100 Ω , 100 W.

3 Checking the external connections

3.1 Checking the CT circuits

The CT's must be connected in accordance with the circuit diagram provided with the protection assembly, both with regards to phases and polarity. The following tests are recommended:



Note!

When the excitation characteristic of the CT is to be verified, the primary side of the CT must be an open-circuit and the secondary side disconnected from the relay protection.

- Primary injection test to verify the current ratio and the correct wiring up to the protection assembly for all current transformers and phases.
- Polarity check.
- Check of the ground connection of the CT circuits.
- Check the excitation characteristic of the CT's secondary windings which will verify the data for saturation voltage and hence the performance of the CT.

CT circuits must be properly connected to the station ground and only at one electrical point.

When core balanced CTs are used for measuring the earth-fault current the screen must be ground connected outside the transformer, as shown in figure 3.

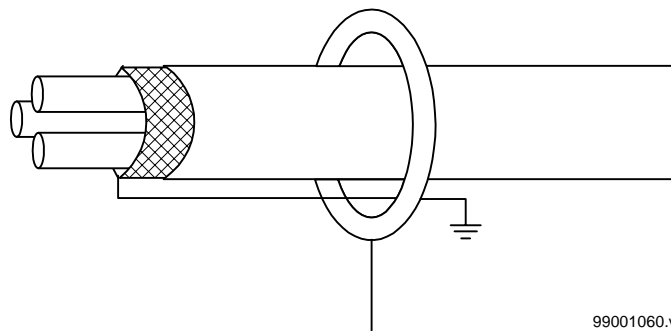


Figure 3: Core balanced CT.

3.2 Checking the auxiliary voltage circuits

Check that the auxiliary voltage supplied to the DC/DC-converter is in accordance with the data for the protection assembly and that the voltage has correct polarity.

3.3 Checking the binary input circuits

The user can separately test the internal and external cable connections for the binary inputs via the 'Test' menu in the local HMI.

Check the connections to the digital inputs so that both input levels and polarity are in accordance with protection assembly specifications. Verify a binary input by energizing it and overview the status through the 'Test' menu.

Parameter	Standard	With binary I/O	Let you...
Inputs	1 - 2	1 - 6	Verify the binary input signal, the figure will be filled when the input is energized.

3.4 Checking the binary output circuits

The user can separately test the internal and external cable connections for the binary outputs via the 'Test' menu in the local HMI.

Check the connections to the digital outputs so that both output loads and polarity are in accordance with protection assembly specifications. Verify the function of a binary output signal by triggering the selected output in the 'Test' menu and overview the output contact status.

Parameter	Standard	With binary I/O	Let you...
Outputs	1 - 5	1 - 9	Verify the triggering of selected output (relay) by pressing the E button.

3.5 Checking the trip circuits and circuit-breakers

The trip circuits are tested as part of the secondary injection test.

4 Retrieving general relay data

This section describes how the user can retrieve data about the relay, such as the article number, rated current and version number.

Procedure

1. Browse to the 'Information' menu.
2. Select one of the following information items.

Table 1: Information items about the relay

Information	Description
1MRK XXX XXX-XX	Article number, relay.
I _r : XA	Rated current.
IN _r : XA	Rated neutral current.
Opt: OC EF	Overcurrent and earth-fault protection option is included.
Opt: Bin/O	Binary I/O option is included.
VerNo: X.X-X	Version number of the relay.
SerNo: PXXXXXX	Serial number of the relay.

3. Leave the menu by pushing the 'C' button.

5 Setting the general relay parameters

5.1 Selecting HMI language

This section describes how to change the language appearing on the local human-machine-interface (HMI).

You can change the language appearing on the local-HMI by using the 'Lang/Språk' menu.

Procedure

1. Browse to the 'Lang/Språk' menu.

The 'Lang/Språk' menu is available in the local HMI under:

Lang/Språk

2. Select language.

Table 2: Setting parameter, language

Parameter	Range	Unit	Default	Let you...
Language	English, Svenska	-	English	Select HMI language

3. Leave the menu and confirm your setting.

5.2 Changing the HMI appearance

This section describes how you can change the appearance of the display and the behavior of the LED's on the local human-machine-interface (HMI).

You can change the contrast and time-out for the display (30 min). You can also change function for the LED's.

5.2.1 Changing the appearance of the display

Procedure

1. Browse to the 'Display' menu.

The 'Display' menu is available in the local HMI under:

HMI

Display

2. Change the parameter value.

Use the left or right arrow-button to define a value. The following values have to be set:

Table 3: Setting parameters, contrast of the HMI

Parameter	Range	Unit	Default	Let you...
Contr	0 - 100	%	50 %	Select the display contrast, 0 - 100 %
Show	Limit/ Unlimit	-	Limit	Select display time-out limit (30 min) or unlimited

3. Leave the menu and confirm your settings.

5.2.2

Select function for the LED's

Procedure

1. Browse to the 'Indications' menu.

The 'Indications' menu is available in the local HMI under:

HMI

Indications

2. Change the parameter value.

Use the left or right arrow-button to define a value. The following values have to be set:

Table 4: Setting parameters, function of the LED's

Parameter	Range	Unit	Default	Let you...
Start	Remain, Return	-	Return	Select start LED to remain or not (return).
Trip	Remain, Return	-	Remain	Select trip LED to remain or not (return).

3. Leave the menu and confirm your settings.

6 Setting the basic protection parameters

6.1 Setting the basic current for the protection functions

The basic current for the protection functions is set through the 'BasicCurrent' menu in the local human-machine-interface (HMI).

Procedure

1. Browse to the 'BasicCurrent' menu.

The 'BasicCurrent' menu is available in the local HMI under:

Settings

BasicSetting

BasicCurrent

2. Enter the basic current values for the protection functions.

Table 5: Setting parameters, basic current

Parameter	Range	Unit	Default	Let you...
I_b	1.00-10.0 x I_r	A	1.00 x I_r	Set the basic phase current level for all protection functions.
I_{Nb}	1.00-10.0 x I_{Nr}	A	1.00 x I_{Nr}	Set the basic neutral current level for all protection functions.

3. Leave the menu and confirm your setting.

6.2 Setting the rated system frequency

The rated frequency for the relay is set through the 'BasicSetting' menu in the local human-machine-interface (HMI).

Procedure

1. Browse to the 'Frequency' menu.

The 'Frequency' menu is available in the local HMI under:

Settings
BasicSetting
Frequency

2. Enter the rated frequency for the relay.

Table 6: Setting parameter, rated system frequency

Parameter	Range	Unit	Default	Let you...
Freq	50/60	Hz	50 Hz	Select the rated frequency.

3. Leave the menu and confirm your setting.

6.3

Setting the main phase CT Ratio

The current ratio of the main phase CT's are set through the 'MainPhaCTRatio' menu in the local human-machine-interface (HMI).

Procedure

1. Browse to the 'MainPhaCTRatio' menu.

The primary and the secondary current value of the main phase CT's is available in the local HMI under:

Settings
BasicSetting
MainPhaCTRatio

2. Enter the primary and secondary current values of the main phase CT's.

Table 7: Setting parameters, main phase CT ratio

Parameter	Range	Unit	Default	Let you...
Primary	1.00 - 999	A	1.00 A	Set the primary rated value of the phase CT's.
	1.00 - 100	kA	-	
Secondary	0.40 - 10.0	A	1.00 A	Set the secondary rated value of the phase CT's.

3. Leave the menu and confirm your setting.

6.4**Setting the main earth CT Ratio**

The current ratio of the main earth CT is set through the 'MainEthCTRatio' menu in the local human-machine-interface (HMI).

Procedure**1. Browse to the 'MainEthCTRatio' menu.**

The primary and the secondary current value of the main earth CT is available in the local HMI under:

Settings**BasicSetting****MainEthCTRatio****2. Enter the primary and secondary current values of the main earth CT.****Table 8: Setting parameters, main earth CT ratio**

Parameter	Range	Unit	Default	Let you...
Primary	1.00 - 999	A	1.00 A	Set the primary rated value of the neutral CT.
	1.00 - 100	kA	-	
Secondary	0.40 - 10.0	A	1.00 A	Set the secondary rated value of the neural CT.

3. Leave the menu and confirm your setting.

7 Setting the protection function parameters

7.1 Overcurrent protection (option)

The setting parameter values for the overcurrent protection are set through the 'Over-Current' menu in the local human-machine-interface (HMI).

Procedure

1. Browse to the 'OverCurrent' menu.

The 'OverCurrent' menu is available in the local HMI under:

Settings

Functions

OverCurrent

2. Enter a value for each parameter.

Use the left or right arrow-button to define a parameter value. The following values have to be set:

Table 9: Setting parameters, overcurrent protection (option)

Parameter	Range	Unit	Default	Let you...
I>	On - Off	-	On	Select low set overcurrent stage I> to be active or not.
I>	0.10 - 4.00 x I _b	A	0.10 x I _b	Set operate level.
Time	0.00 - 20.0	s	0.00 s	Set definite time delay for single-phase fault or for single-, two and three-phase fault, when multi-phase logic below is set to 1/2/3.
MultiPh	1/2/3 - 2/3	-	1/2/3	Select multi-phase logic for single-, two- and three-phase fault or for two- and three-phase fault.
Time2/3	0.00 - 20.0, Not used	s	Not used	Set definite time delay for two and three-phase fault, when multi-phase logic above is set to 2/3.
I>>	On - Off	-	On	Select high set overcurrent stage I>> to be active or not.
I>>	0.10 - 4.00 x I _b	A	0.10 x I _b	Set operate level.

Parameter	Range	Unit	Default	Let you...
Time	0.00 - 20.0	s	0.00 s	Set definite time delay for single-phase fault or for single-, two and three-phase fault, when multi-phase logic below is set to 1/2/3.
MultiPh	1/2/3 - 2/3	-	1/2/3	Select multi-phase logic for single-, two- and three-phase fault or for two- and three-phase fault.
Time2/3	0.00 - 20.0, Not used	s	Not used	Set definite time delay for two and three-phase fault, when multi-phase logic above is set to 2/3.

3. Leave the menu and confirm your settings.

7.2

Earth-fault protection (option)

The setting parameter values for the earth-fault protection are set through the 'Earth-Fault' menu in the local human-machine-interface (HMI).

Procedure

1. Browse to the 'EarthFault' menu.

The 'EarthFault' menu is available in the local HMI under:

Settings

Functions

EarthFault

2. Enter a value for each parameter.

Use the left or right arrow-button to define a value. The following parameter values have to be set:

Table 10: Setting parameters, earth-fault protection (option)

Parameter	Range	Unit	Default	Let you...
$I_{N>}$	On - Off	-	On	Select low set earth-fault stage $I_{N>}$ to be active or not.
$I_{N>}$	0.10 - 4.00 x I_{Nb}	A	0.10 x I_{Nb}	Set operate level.
Time	0.00 - 20.0	s	0.00 s	Set definite time delay.

Parameter	Range	Unit	Default	Let you...
$I_{N>>}$	On - Off	-	On	Select high set earth-fault stage $I_{N>>}$ to be active or not.
$I_{N>>}$	0.10 - 4.00 x I_{Nb}	A	0.10 x I_{Nb}	Set operate level.
Time	0.00 - 20.0	s	0.00 s	Set definite time delay.

3. Leave the menu and confirm your setting.

7.3

Breaker failure protection

The setting parameter values for the breaker failure protection are divided in one common menu with basic setting parameters and in three separated menus related to selected start criteria, single-phase, three-phase or three-phase unconditional function. All these menus are set through the 'BreakerFailure' menu in the local human-machine-interface (HMI).

Procedure

1. Browse to the 'BasSetBrkFail' menu.

The 'BasSetBrkFail' menu is available in the local HMI under:

Settings

Functions

BreakerFailure

BasSetBrkFail

2. Enter a value for each parameter.

Use the left or right arrow-button to define a value. The following parameter values have to be set:

Table 11: Setting parameters, general for breaker failure protection

Parameter	Range	Unit	Default	Let you...
BF>	0.10 - 1.00 $\times I_b$	A	0.10 $\times I_b$	Set the detection level for the phase current on the breaker failure protection.
BF _N >	0.10 - 1.00 $\times I_{Nb}$	A	0.10 $\times I_{Nb}$	Set the detection level for the neutral current on the breaker failure protection.
CurCrit	1:4 - 2:4	-	1:4	Select the three-phase current criteria to be 1 out of 4 or 2 out of 4 above the current detection levels.
BkUpTr2	On - Off	-	Off	Select back-up trip 2 to be active or not.
Δ Time	0.00 - 0.50	-	0.00 s	Set the additional time delay between back-up trip 1 and 2.
TrPulse	0.02 - 0.50	s	0.25 s	Set the minimum length of the trip pulse.

3. Leave the menu and confirm your settings.

Procedure

1. Browse to the '1-PhaseBF' menu.

The '1-PhaseBF' menu is available in the local HMI under:

Settings

Functions

BreakerFailure

1-PhaseBF

2. Enter a value for each parameter.

Use the left or right arrow-button to define a value. The following parameter values have to be set:

Table 12: Setting parameters, single-phase breaker failure function

Parameter	Range	Unit	Default	Let you...
1-PhBF	On - Off	-	Off	Select the single-phase breaker failure function to be active or not.
ReTrip	Off, I>Check, UncndBF	-	I>Check	Select the re-trip criteria: off, current check or unconditional.
Time	0.00 - 1.00	s	0.00 s	Set the time delay for re-trip function.
BkUpTr1	0.05 - 1.00	s	0.05 s	Set the time delay for back-up trip 1.
I>	On - Off	-	Off	Select activation or not for trip signal of the low overcurrent set stage I> (option).
I>>	On - Off	-	Off	Select activation or not for trip signal of the high overcurrent set stage I>> (option).

3. Leave the menu and confirm your settings.

Procedure

1. Browse to the '3-PhaseBF' menu.

The '3-PhaseBF' menu is available in the local HMI under:

Settings

Functions

BreakerFailure

3-PhaseBF

2. Enter a value for each parameter.

Use the left or right arrow-button to define a value. The following parameter values have to be set:

Table 13: Setting parameters, three-phase breaker failure function

Parameter	Range	Unit	Default	Let you...
3-PhBF	On - Off	-	On	Select the three-phase breaker failure function to be active or not.
ReTrip	Off, I>Check, UncndBF	-	I>Check	Select the re-trip criteria: off, current check or unconditional.
Time	0.00 - 1.00	s	0.00 s	Set the time delay for re-trip function.
BkUpTr1	0.05 - 1.00	s	0.05 s	Set the time delay for back-up trip 1.
I>	On - Off	-	On	Select activation or not for trip signal of the low overcurrent set stage I> (option).
I>>	On - Off	-	On	Select activation or not for trip signal of the high overcurrent set stage I>> (option).
I _N >	On - Off	-	On	Select activation or not for trip signal of the low earth-fault set stage I _N > (option).
I _N >>	On - Off	-	On	Select activation or not for trip signal of the high earth-fault set stage I _N >> (option).

3. Leave the menu and confirm your settings.

Procedure

1. Browse to the '3-PhaseUncndBF' menu.

The '3-PhaseUncndBF' menu is available in the local HMI under:

Settings

Functions

BreakerFailure

3-PhaseUncndBF

2. Enter a value for each parameter.

Use the left or right arrow-button to define a value. The following parameter values have to be set:

Table 14: Setting parameters, three-phase unconditional breaker failure function

Parameter	Range	Unit	Default	Let you...
UncndBF	On - Off	-	Off	Select the three-phase unconditional breaker failure function to be active or not.
ReTrip	Off, UncndBF	-	UncndBF	Select the re-trip criteria: off or unconditional.
Time	0.00 - 1.00	s	0.00 s	Set the time delay for re-trip function.
BkUpTr1	0.05 - 1.00	s	0.05 s	Set the time delay for back-up trip 1.

3. Leave the menu and confirm your settings.

7.4

Pole-disagreement protection

The setting parameter values for the pole-disagreement protection are set through the 'PolDisagreemnt' menu in the local human-machine-interface (HMI).

Procedure

1. Browse to the 'PolDisagreemnt' menu.

The 'PolDisagreemnt' menu is available in the local HMI under:

Settings

Functions

PolDisagreemnt

2. Enter a value for each parameter.

Use the left or right arrow-button to define a value. The following parameter values have to be set:

Table 15: Setting parameters, pole-disagreement protection

Parameter	Range	Unit	Default	Let you...
PoleDis	On - Off	-	Off	Select pole-disagreement protection to be active or not.
I<	0.10 - 0.15 x I _b	A	0.10 x I _b	Set undercurrent level.
I>	0.20 - 0.50 x I _b	A	0.20 x I _b	Set overcurrent level.

Parameter	Range	Unit	Default	Let you...
Time	0.00 - 20.0	s	0.00 s	Set definite time delay.
1PhBlk	On - Off	-	Off	Select block of pole-disagreement protection at a single-phase start of breaker failure protection (internal logic) or not.
ResetT	0.00 - 10.0	s	0.00 s	Set reset time delay after an internal single-phase blocking. The reset time shall be coordinated to the dead-time for a single-phase reclosing.

3. Leave the menu and confirm your setting.

8 Configuring the relay

8.1 Configure the binary input and output signals

This section describes how the configuration menu is used when configuring the parameters for the binary input and output signals.

8.1.1 Binary input signals

Procedure

1. Browse to the 'BinaryInputs' menu.

The 'BinaryInputs' menu is available in the local HMI under:

Configuration

BinaryInputs

2. Select binary input for function signals.

Use the left or right arrow button to mark a binary input.

Table 16: Input signals, overcurrent protection (option)

Signal	Default	Description
I> Block/Enable	-	Active signal blocks or enables the low set overcurrent stage I>.
I>> Block/Enable	-	Active signal blocks or enables the high set overcurrent stage I>>.

Table 17: Input signals, earth-fault protection (option)

Signal	Default	Description
I _N > Block/Enable	-	Active signal blocks or enables the low set earth-fault stage I _N >.
I _N >> Block/Enable	-	Active signal blocks or enables the high set earth-fault stage I _N >>.

Table 18: Input signals, breaker failure protection

Signal	Default	Description
BFStL1	-	Active signal starts the single-phase breaker failure function in phase IL1.
BFStL2	-	Active signal starts the single-phase breaker failure function in phase IL2.
BFStL3	-	Active signal starts the single-phase breaker failure function in phase IL3.
BFSt	Input 1	Active signal starts the three-phase breaker failure function.
BFStUncnd	-	Active signal starts the three-phase unconditional breaker failure function.
CBFail	-	Active signal generates an instantaneous back-up trip 1 function in a case of a breaker failure start.
BFBlock	-	Active signal blocks the breaker failure protection.

Table 19: Input signals, pole-disagreement protection

Signal	Default	Description
PoleDisBlk	-	Active signal blocks the pole-disagreement protection.

Table 20: Input signal, indications

Signal	Default	Description
StoreSerVal	-	Active signal records actual service values.
ResetLED	-	Active signal resets LED's, clears recorded disturbances and trip values.

3. Leave the menu and confirm your settings.

8.1.2

Binary output signals

Procedure

1. Browse to the 'BinaryOutputs' menu.

The 'BinaryOutputs' menu is available in the local HMI under:

Configuration

BinaryOutputs

2. Select binary output for function signals.

Use the left or right arrow-button to mark a binary output.

Table 21: Output signals, overcurrent protection (option)

Signal	Default	Description
I>StL1	-	Low set stage I>, start signal on phase IL1.
I>TrL1	-	Low set stage I>, trip signal on phase IL1.
I>StL2	-	Low set stage I>, start signal on phase IL2.
I>TrL2	-	Low set stage I>, trip signal on phase IL2.
I>StL3	-	Low set stage I>, start signal on phase IL3.
I>TrL3	-	Low set stage I>, trip signal on phase IL3.
I>St	Relay 1	Low set stage I>, start signal multi-phase faults.
I>Tr	Relay 2	Low set stage I>, trip signal multi-phase faults.
I>>StL1	-	High set stage I>>, start signal on phase IL1.
I>>TrL1	-	High set stage I>>, trip signal on phase IL1.
I>>StL2	-	High set stage I>>, start signal on phase IL2.
I>>TrL2	-	High set stage I>>, trip signal on phase IL2.
I>>StL3	-	High set stage I>>, start signal on phase IL3.
I>>TrL3	-	High set stage I>>, trip signal on phase IL3.
I>>St	Relay 1	High set stage I>>, start signal multi-phase faults.
I>>Tr	Relay 2	High set stage I>>, trip signal multi-phase faults.

Table 22: Output signals, earth-fault protection (option)

Signal	Default	Description
I _N >St	Relay 1	Low set stage I _N >, start signal.
I _N >Tr	Relay 2	Low set stage I _N >, trip signal.
I _N >>St	Relay 1	High set stage I _N >>, start signal.
I _N >>Tr	Relay 2	High set stage I _N >>, trip signal.

Table 23: Output signals, breaker failure protection

Signal	Default	Description
ReTrL1	-	Re-trip signal, single-phase IL1.
ReTrL2	-	Re-trip signal, single-phase IL2.
ReTrL3	-	Re-trip signal, single-phase IL3.
ReTr	Relay 2	Re-trip signal, three-phase.
BckUpTr1	Relay 3	Back-up trip 1 signal to adjacent circuit-breakers.
BckUpTr2	-	Back-up trip 2 signal to adjacent circuit-breakers.

Table 24: Output signal, pole-disagreement protection

Signal	Default	Description
PoleDisSt	-	Pole-disagreement, start signal.
PoleDisTr	-	Pole-disagreement, trip signal.

Table 25: Output signal, self-supervision function

Signal	Default	Description
InService	Relay 5	Active signal when relay is in normal service.

3. Leave the menu and confirm your settings.

9 Secondary injection testing

9.1 Overview

The testing requires a good understanding of the protection functions and the configured functional logic in the relay. The relay must be properly set and configured according to previous sections before any of these instructions could be carried out. The plastic cover which covers the relay must also be removed.

Secondary injection testing is a normal part of the commissioning work. The operating values for all protection functions, the output to the proper trip and alarm contacts and the operation of digital input signals are checked and documented for future reference. The test records available in this manual can be used. See the chapter “Test records”.

The connection of the test set to the protection assembly is greatly simplified if the RTXP 18 test switch is included. When the test handle RTXH 18 is inserted in the test switch, preparations for testing are automatically carried out in the proper sequence, that is blocking of the tripping circuits, short-circuiting of the current circuits on the transformer side, opening of the current transformer circuits and making relay accessible from the terminals on the test plug handle.

If the protection assembly is not provided with a test switch the protection must be tested via the external circuit terminals. Make sure that the instrument transformers are isolated from the circuits connected to the test set.

A secondary test instruction is given for each type of protection function. The testing is performed in a sequence which secures that the blocked stage is enabled and tested. Blocking and enabling of stages are made in the setting menu and can be done in the local human-machine-interface (HMI).

Blocking or enabling of protection functions from digital input(s) shall, when included, be checked as a part of the secondary testing of the individual protection functions.



Warning!

Never plug or withdraw a relay from the terminal base without blocking the output circuits or interrupting the auxiliary DC supply. Otherwise there is a risk of unwanted operations.

**Note!**

The protection assembly is designed for a maximum continuous current of four times rated value.

9.2 Checking the trip circuits

Check that the circuit-breakers of the protective object operates when the tripping relays are activated. The trip relays are conveniently activated by secondary injection to activate a suitable protection function.

9.3 Overcurrent protection (option)**9.3.1 Overcurrent protection configured for three-pole tripping.****Procedure**

1. Connect the test set for injection of a current in phase IL1.
2. Increase the current in phase IL1 until the low set stage operates.
3. Decrease the current slowly and measure the reset value.
4. Block high set stage (I>>) if the injected current will activate the high set stage when testing the low set stage according to below.
5. Connect multi-phase trip output contact to the timer.
6. Set the current to 130% of the operate value for the low set stage, switch on the current and check the time delay.
7. Check that start and trip contacts operate according to the configuration logic.
8. Check the indications menu which is provided with information about operated functions and also the stored primary trip currents.

Check that no unwanted operations have occurred.

9. Check in the same way the function for the other phases (step 1-8 above).
10. Block I> and enable the blocking of the high set stage (I>>).
11. Check the operate and reset value and the time delay for the high set stage in the same way as for the low set stage (step 1-9 above).

12. Enable the blocking of the low stage according to configuration logic.

9.3.2

Overcurrent protection configured for single-pole tripping.

Procedure

1. Connect the test set for injection of a current in phase IL1.
2. Increase the current in phase IL1 until the low set stage operates.
3. Decrease the current slowly and measure the reset value.
4. Block high set stage (I>>) if the injected current will activate the high set stage when testing the low set stage according to below.
5. Connect trip L1 output contact to the timer.
6. Set the current to 130% of the operate value for the low set stage, switch on the current and check the time delay.
7. Check that start and trip contacts operate according to the configuration logic.
8. Check the indications menu which is provided with information about operated functions and also the stored primary trip currents.

Check that no unwanted operations have occurred.

9. Check in the same way the function for the other phases (step 1-8 above).
10. Block I> and enable the blocking of the high set stage (I>>).
11. Check the operate and reset value and the time delay for the high set stage in the same way as for the low set stage (step 1-9 above).
12. Enable the blocking of the low stage according to configuration logic.

9.3.3

Additional procedure if multi-phase logic is used at single-pole tripping.

Procedure

1. Connect the test set for injection of a current in phase IL1.
2. Block high set stage (I>>) if the injected current will activate the high set stage when testing the low set stage according to below.
3. Connect trip L1 output contact to the timer.

4. **Set the current to 130% of the operate value for the low set stage, switch on the current and check the time delay.**
5. **Check that start and trip contacts operate according to the configuration logic.**
6. **Check the indications menu which is provided with information about operated functions and also the stored primary trip values.**

Check that no unwanted operations have occurred.

7. **Connect the test set for injection of a current in phase IL1, IL2 and IL3.**
8. **Connect multi-phase trip output contact to the timer.**
9. **Set the currents to 130% of the operate value for the low set stage, switch on the currents and check the time delay.**

For two- and three-phase fault a shorter time delay is measured.

10. **Check that start and trip contacts operate according to the configuration logic.**
11. **Check the indications menu which is provided with information about operated functions and also the stored primary trip values.**

Check that no unwanted operations have occurred.

12. **Block I> and enable the blocking of the high set stage (I>>).**
13. **Check the operate and reset value and the time delay for the high set stage in the same way as for the low set stage (step 1-11 above).**
14. **Enable the blocking of the low stage according to configuration logic.**

9.4

Earth-fault protection (option)

Procedure

1. **Connect the test set for injection of a current in I_N .**
2. **Increase the current in I_N until the low set stage operates.**
3. **Decrease the current slowly and measure the reset value.**
4. **Block high set stage ($I_N>>$) if the injected current will activate the high set stage when testing the low set stage according to below.**
5. **Connect a trip output contact to the timer.**

6. Set the current to 130% of the operate value for the low set stage, switch on the current and check the time delay.
7. Check that start and trip contacts operate according to the configuration logic.
8. Check the indications menu which is provided with information about operated functions and also the stored primary trip currents.

Check that no unwanted operations have occurred.

9. Block $I_N>$ and enable the blocking of the high set stage ($I_N>>$).
10. Check the operate and reset value and the time delay for the high set stage in the same way as for the low set stage (step 2-8 above).
11. Enable the blocking of the low stage according to configuration logic.

9.5 Breaker failure protection

9.5.1 Single-phase breaker failure function

External start of the single-phase breaker failure function.

Procedure

1. Connect the test set for injection of a current in phase IL1 and a DC voltage on binary input BFStL1.
2. Connect the re-trip L1 output contact to the timer.
3. Energize a current equal to 120% of BF>.
4. Switch on the binary input and check the time delay for the re-trip signal.
5. Check that re-trip contact operate according to the configuration logic.
6. Check the indications menu which is provided with information about operated functions.

Check that no unwanted operation have occurred.

7. Check in the same way the back-up trip signals (step 2-5 above).

If the current criteria is to 2 out of 4, energize at the same time a current in neutral equal to 120% of $BF_N>$.

8. Energize a current equal to 80% of BF>.

9. **Switch on the binary input and check that no back-up trip signals are generated.**

Re-trip signal generates if unconditional criteria is selected.

10. **Check in the same way the function for the other phases (1-9).**

Internal start of the single-phase breaker failure function (option).

Procedure

1. **Connect the test set for injection of a current in phase IL1.**
2. **Connect the re-trip L1 output contact to the timer.**
3. **Set the current to 110% of the operate value for the function which activates the single-phase breaker failure function, switch on the current and check the time delay for the re-trip.**

Measured time includes also trip time from the function which started the single-phase breaker failure function.

4. **Check that re-trip contact operate according to the configuration logic.**
5. **Check the indications menu which is provided with information about operated functions.**

Check that no unwanted operation have occurred.

6. **Check in the same way the back-up trip signals (step 2-5 above).**

If the current criteria is to 2 out of 4, energize at the same time a current in neutral equal to 120% of BF_N .

7. **Check in the same way that the function can be activated from all selected internal inputs (step 1-6 above).**
8. **Check in the same way the function for the other phases (step 1-7 above).**

9.5.2

Three-phase breaker failure function

External start of the three-phase breaker failure function.

Procedure

1. **Connect the test set for injection of a current in phase IL1, IL2 and IL3, connect also and a DC voltage on binary input BFSt.**
2. **Connect the re-trip output contact to the timer.**
3. **Energize a current equal to 120% of BF .**

4. **Switch on the binary input and check the time delay for the re-trip signal.**
5. **Check that re-trip contact operate according to the configuration logic.**
6. **Check the indications menu which is provided with information about operated functions.**

Check that no unwanted operation have occurred.

7. **Check in the same way the back-up trip signals (step 2-6 above).**
8. **Energize a current equal to 80% of BF>.**
9. **Switch on the binary input and check that no back-up trip signals are generated.**

Re-trip signal generates if unconditional criteria is selected.

Internal start of the three-phase breaker failure function (option).

Procedure

1. **Connect the test set for injection of a current in phase IL1, IL2 and IL3.**
2. **Connect the re-trip output contact to the timer.**
3. **Set the current to 110% of the operate value for the function which activates the single-phase breaker failure function, switch on the current and check the time delay for the re-trip.**

Measured time includes also trip time from the function which started the single-phase breaker failure function.

4. **Check that re-trip contact operate according to the configuration logic.**
5. **Check the indications menu which is provided with information about operated functions.**

Check that no unwanted operation have occurred.

6. **Check in the same way the back-up trip signals (step 2-5 above).**
7. **Check in the same way that the function can be activated from all selected internal inputs (step 1-6 above).**

9.5.3

Three-phase unconditional breaker failure function.**External start of the unconditional breaker failure protection.****Procedure**

1. **Connect the test set for injection of a DC voltage on binary input BFStUncnd.**
2. **Connect a re-trip output contact to the timer.**
3. **Switch on the binary input and check the time delay for the re-trip signal.**
4. **Check that re-trip contact operate according to the configuration logic.**
5. **Check the indications menu which is provided with information about operated functions.**

Check that no unwanted operation have occurred.

6. **Check in the same way the back-up trip signals (step 2-5 above).**
7. **Check that no back-up trip signals are generated when a short start pulse (minimum 50 ms) is applied to the binary input.**

Back-up trip signals are generated if the time delay is shorter than the applied start pulse.

9.6

Pole-disagreement protection

Figure 4 shows a recommended test set-up for testing the undercurrent level of the pole-disagreement protection. The adjustable resistor sets to a lower value when the current ratio between the undercurrent level and the overcurrent level is large, otherwise the adjustable resistor sets to a higher value.

If the protection system use single-pole tripping the pole-disagreement protection has to be blocked via a binary input or internally when the single-phase breaker failure function starts.

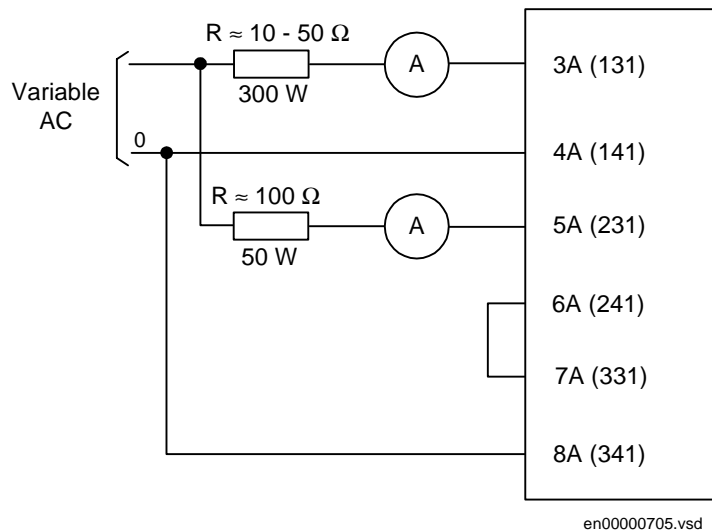


Figure 4: Test set-up for checking the undercurrent level of the pole-disagreement protection.

9.6.1

General procedures for the pole-disagreement protection.

Procedure

1. Connect the test set according to figure 4, energize a current in phase IL2 and IL3 equal to 200% of $I_{>}$.
2. Decrease the current in phase IL1 until the pole-disagreement protection operates ($I_{<}$).
3. Increase the current slowly and note the reset value.
4. Check in the same way the function for the other phases (step 1-3 above).
5. Connect the test set for injection of a current in phase IL1.
6. Increase the current in phase IL1 until the pole-disagreement protection operates ($I_{>}$).
7. Decrease the current slowly and note the reset value.
8. Connect a trip output contact to the timer.
9. Set the current to 130% of the overcurrent value ($I_{>}$), switch on the current and check the time delay.
10. Check that start and trip contacts operate according to the configuration logic.

-
- 11. Check the indications menu which is provided with information about operated functions and also the stored primary trip values.**

Check that no unwanted operations have occurred.

- 12. Check in the same way the function for the other phases (step 5-11 above).**

9.6.2

Additional procedure if internal block is used at single-pole tripping.

Procedure

- 1. Connect the test set for injection of a current in phase IL1 and a DC voltage on binary input BFStL1.**
- 2. Connect a trip output contact to the timer.**
- 3. Set the current to 130% of the over-current operate value ($I_{>}$), switch on the current and the voltage.**
- 4. Check that no start or trip contacts operate.**
- 5. Check the indications menu which is provided with information about operated functions.**

Check that no unwanted operations have occurred.

- 6. Switch off the DC voltage, check the operate time.**

The measured operate time includes reset time and trip time delay.

Chapter 5 Operations during commissioning and maintenance

About this chapter

This chapter contains instructions on operations during commissioning and maintenance, such as reading off service values and disturbance information.

1**Overview**

The relay must be properly set and configured according to previous chapters before any of these instructions could be carried out. The plastic cover which covers the relay must also be removed.

The operations during commissioning and maintenance involve reading off service values, function status and recorded disturbances caused by current injections provided from test equipment.

2 Using the service values menu

2.1 Reading service values

This section describes how to read primary and secondary service values and how to use the service value menu during commissioning and maintenance of the relay.

Press any button except the 'C' button to view the main menu. If the 'C' button is pressed and a disturbance has been recorded the indication menu will be presented.

2.1.1 Primary service values

Procedure

1. **Browse to the 'Primary' menu from the main menu.**

The 'Primary' menu is available in the local HMI under:

ServiceValues

Primary

2. **Choose 'Primary' menu and then press the 'E' button.**

The display will present the first set of service values.

3. **Press any button on the local HMI to present the second set of service values.**
4. **Press any button on the local HMI to return to the 'Primary' menu.**

2.1.2 Secondary service values

Procedure

1. **Browse to the 'Secondary' menu from the main menu.**

The 'Secondary' menu is available in the local HMI under:

ServiceValues

Secondary

2. **Choose 'Secondary' menu and then press the 'E' button.**

The display will present the first set of service values.

3. **Press any button on the local HMI to present the second set of service values.**

-
4. Press any button on the local HMI to return to the 'Secondary' menu.

2.2

Service values menu

The following values are presented when the service value menu is viewed:

Service values	Provides information about
IL1	The actual phase-1 current
IL2	The actual phase-2 current
IL3	The actual phase-3 current
I_N	The actual neutral current
Freq	The actual frequency

Out-of-range (OOR) is presented if a secondary current value is over four times the set basic current level.

3 Using the indications menu

3.1 Reading disturbance information

This section described how to read recorded disturbances during commissioning and maintenance of the relay.

The user can use the 'Indications' menu to read off function status, recorded primary trip values if a disturbance has occurred.

Procedure

1. Browse to the 'Indications' menu from the main menu.

The display will present the status of the overcurrent functions (option).

2. Press any button on the local HMI.

The display presents the remaining status of the overcurrent functions (option).

3. Press any button on the local HMI to display the status of the earth-fault protections (option).

4. Press any button on the local HMI to present the status of the breaker failure functions.

5. Press any button on the local HMI to present the status of the breaker failure re-trip functions.

6. Press any button on the local HMI to present the status of the breaker failure back-up trip functions and the pole-disagreement function.

7. Press any button on the local HMI to present the recorded primary trip values (option).

8. Press any button on the local HMI to present the externally recorded service values.

9. Press any button on the local HMI and the display will present the clearing dialog box.

Here the recorded disturbances can be cleared or not.

10. Press and hold down the 'C' button for more than two seconds to clear the disturbances or press any button shortly to not clear the disturbances.

If the user choose to clear the disturbances the saved values and LED's will be cleared and the display returns to the main menu.

3.2

Indications menu

The following indications are presented when the indications menu is entered. Through this menu also primary recorded trip values and externally recorded service values are presented. The recorded primary trip values are always from the last disturbance.

Indications	Start	Trip	Option	Function description, status for
I>L1	<input type="checkbox"/>	<input type="checkbox"/>	Yes	Low set overcurrent stage, single-phase IL1.
I>L2	<input type="checkbox"/>	<input type="checkbox"/>	Yes	Low set overcurrent stage, single-phase IL2.
I>L3	<input type="checkbox"/>	<input type="checkbox"/>	Yes	Low set overcurrent stage, single-phase IL3.
I>	<input type="checkbox"/>	<input type="checkbox"/>	Yes	Low set overcurrent stage, multi-phase faults.
I>>L1	<input type="checkbox"/>	<input type="checkbox"/>	Yes	High set overcurrent stage, single-phase IL1.
I>>L2	<input type="checkbox"/>	<input type="checkbox"/>	Yes	High set overcurrent stage, single-phase IL2.
I>>L3	<input type="checkbox"/>	<input type="checkbox"/>	Yes	High set overcurrent stage, single-phase IL3.
I>>	<input type="checkbox"/>	<input type="checkbox"/>	Yes	High set overcurrent stage, multi-phase faults.
I _N >	<input type="checkbox"/>	<input type="checkbox"/>	Yes	Low set earth-fault stage.
I _N >>	<input type="checkbox"/>	<input type="checkbox"/>	Yes	High set earth-fault stage.
1-PhBF	<input type="checkbox"/>			Single-phase start of breaker failure.
		L123		Phase indication which caused single-phase start.
3-PhBF	<input type="checkbox"/>			Three-phase start of breaker failure.
UncndBF	<input type="checkbox"/>			Three-phase unconditional start of breaker failure.
ReTrL1		<input type="checkbox"/>		Re-trip function, single-phase IL1.
ReTrL2		<input type="checkbox"/>		Re-trip function, single-phase IL2.
ReTrL3		<input type="checkbox"/>		Re-trip function, single-phase IL3.
ReTrip		<input type="checkbox"/>		Re-trip function, three-phase.
BkUpTr1		<input type="checkbox"/>		Back-up trip 1 function, three-phase.
BkUpTr2		<input type="checkbox"/>		Back-up trip 2 function, three-phase.
PoleDis	<input type="checkbox"/>	<input type="checkbox"/>		Pole-disagreement function.

All start functions are connected to the yellow LED and all trip functions are connected to the red LED. The appearance of the boxes in the local HMI describes the status of the function.

Appearance of indication boxes	Provides information about
Filled (black)	Latest recorded event.
Grayed	Previous recorded event.
Blank	No recorded event (since last clearing).
Criteria for a new event: All started functions has to be reset before the relay can treat a new disturbance as a new event.	

Recorded trip values (option)	Provides information about
IL1	The recorded phase-1 current.
IL2	The recorded phase-2 current.
IL3	The recorded phase-3 current.
I_N	The recorded neutral current.

Externally recorded service values	Provides information about
ExtIL1	The recorded phase-1 current.
ExtIL2	The recorded phase-2 current.
ExtIL3	The recorded phase-3 current.
Ext I_N	The recorded neutral current.

Out-of-range (OOR) is presented if a recorded current in secondary value is over four times the set basic current level.

Chapter 6 Maintenance

About this chapter

This chapter contains instructions on how the preventive and corrective maintenance is performed. A check-list is provided to facilitate troubleshooting the protection.

1

Overview

Before any of these instructions could be carried out the plastic cover which covers the relay has to be removed.

Under normal operating conditions and when the surrounding atmosphere is of non-corrosive nature no special maintenance is required. Preventive maintenance test of the protection assembly is recommended to be performed every four to five years. The tests can be performed more or less detailed. Instructions from utility power network company and other maintenance directives, valid for maintenance of the power system, must be followed.

Corrective maintenance is required if the protection should be suspected to have made an unwanted operation or, missed to clear a fault situation. In a case of an unwanted or missed fault clearing operation, the check list may help the user to recognize the wrong behavior of the protection assembly. If the check list below does not help, please contact the local ABB office for further technical support.

The measuring relay is provided with self-supervision and require less maintenance than earlier designed relays. The internal self-supervision function with error alarm output supervises:

- Software execution flow by the internal watchdog.
- ROM cell's by the checksum program.
- RAM cell's by RAM cell program.



Warning!

Never plug or withdraw a relay from the terminal base without blocking the output circuits or interrupting the auxiliary DC supply. Otherwise there is a risk of unwanted operations.



Note!

If the LED's are flashing or the green 'In service' LED is dark, an internal fault has occurred. Read the self supervision section in the technical reference manual for further information.

2 Preventive maintenance

2.1 Checking the disturbance information

The indications menu should be checked to identify if any disturbance has occurred. If any fault occurs frequently, some actions may be taken.

2.2 Performing a start-up check

Switch-off and on the auxiliary DC supply to the protection. During the start-up sequence the relay verifies the ROM and RAM cell's. When the green LED lights-up all internal checks are completed and the relay is in normal service again.

2.3 Checking the service values

Verify the presented service values in the local HMI and compare them with the known system values. If they are as expected, the external circuits and the internal measuring in the relay work properly. By using this information the user also is informed about the condition of the measuring transformers.

2.4 Testing the binary inputs

Verify the operation of the binary inputs. In the 'Test' menu the user can overview the status when the input is energized. See chapter "Commissioning" in this manual.

2.5 Testing the binary outputs

Verify the operation of the binary output relays. In the 'Test' menu the user can change the state of the selected output. See chapter "Commissioning" in this manual.

2.6 Dressing burned contacts on the auxiliary tripping relays

In exceptional cases, burned contacts on the auxiliary output relays can be dressed with a diamond file.

2.7 Performing additional tests

Additional tests can be selected from the secondary injection tests. See chapter "commissioning" in this manual.

3 Corrective maintenance

This section contains instructions on how the user can investigate a missed fault clearance or an unwanted operation of the protection assembly.

3.1 Check the green “in service” LED on RXTUG 22H

If the “in service” LED is dark, the self supervision in the DC/DC-converter has recognized an internal fault.

Procedure

1. **Check the connection and polarity of the auxiliary input cables.**
2. **Disconnect the output load from the DC/DC-converter.**
3. **Measure both the input (24-250V DC) and output (+/-24V DC) voltages from the DC/DC-converter.**

3.2 Check the green “in service” LED on the measuring relay

If the “in service” LED is dark or any of the other LED’s are flashing the self supervision in the relay has recognize an internal fault. In the technical reference manual further information about the self supervision function is stated.

Procedure

1. **Check the internal connections between the DC/DC-converter and the measuring relay (+/-24V DC).**

3.3 Check the indications

3.3.1 If the expected protection function has not operated correctly

Procedure

1. **Check the service values in the local HMI.**

If the service values are not of the right magnitude check that all screws in the COMBIFLEX[®] relay socket are tightly fastened and also check the internal and external cable connections to the transformers.

2. **Test the binary inputs.**

Check the connection and polarity of the involved binary inputs. Energize it and overview it by the ‘Test’ menu.

3. Check the configuration

Check that all binary inputs and outputs are correctly configured in the relay according to the relay system plan.

4. Check the settings

Check that all protection settings are correctly implemented in the relay according to the relay system plan.

5. Check the setting calculations

Verify the calculated setting values for the relay according to the network conditions.

3.3.2**If the expected protection function has operated correctly****Procedure****1. Test the binary outputs.**

Check the internal connections between the binary output relay and the auxiliary output tripping relay. Check also the external connections from the tripping relay to the circuit-breaker coil.

Chapter 7 Protection assemblies and diagrams

About this chapter

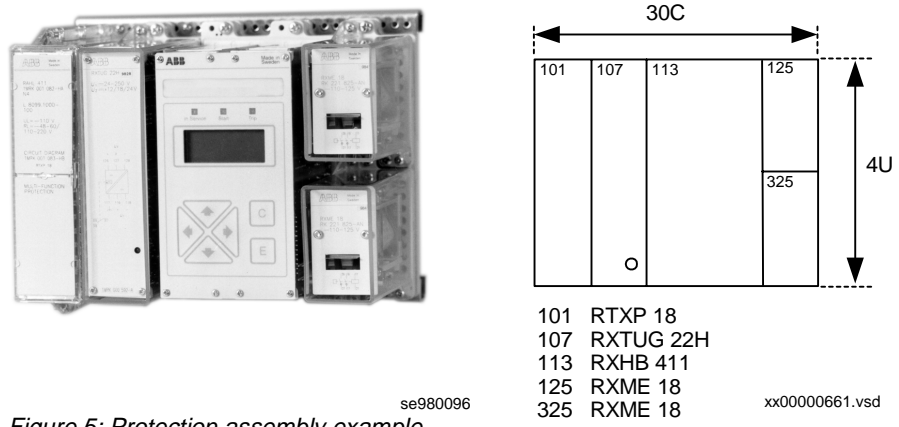
This chapter contains a general description of the protection assemblies. The chapter also contains different terminal and circuit diagrams for the protection assembly.

1 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.

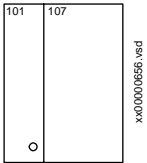
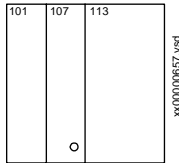
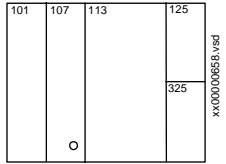
All the protections in the COMBIFLEX[®] modular system are mounted on apparatus bars. The connections to the protections are done by COMBIFLEX[®] socket equipped leads. All internal connections are made and the protection assembly is tested before delivery from factory. The type of modules and their 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.

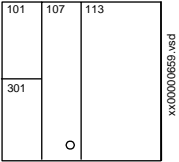


The height and width of the protection assembly are given in the circuit diagram with height (U) and width (C) modules, where $U = 44.45$ mm and $C = 7$ mm. The depth of the protection assembly, including space for the connection wires, is approximately 200 mm.

2 Protection assemblies

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

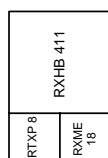
RAHB 411 protection assembly variants	Ordering No.	RXHB 411 options	Circuit diagram	Terminal diagram	Available diagrams
 <p>101 RXTUG 22H 107 RXHB 411</p>	1MRK 002 028-AA	Basic version	1MRK 002 029-AA	1MRK 002 029-AAA	On request
		With binary I/O option	1MRK 002 029-AB	1MRK 002 029-ABA	On request
 <p>101 RTXP 18 107 RXTUG 22H 113 RXHB 411</p>	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
 <p>101 RTXP 18 107 RXTUG 22H 113 RXHB 411 125 RXME 18 325 RXME 18</p>	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)}	

RAHB 411 protection assembly variants	Ordering No.	RXHB 411 options	Circuit diagram	Terminal diagram	Available diagrams
 <p>101 RTXP 8 107 RXTUG 22H 113 RXHB 411 301 RXME 18</p>	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, $I_r = I_{N_r} = 1\text{ A}$ or $I_r = I_{N_r} = 5\text{ A}$

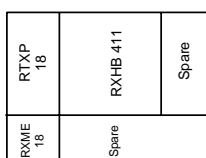
2.1 Mounting alternatives

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.



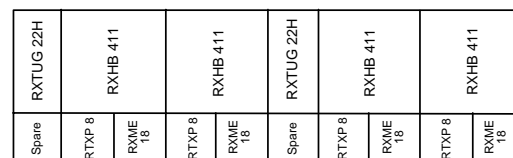
xx00000653.vsd

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.



xx00000630

Example of a panel mounting alternative.

3

Terminal and circuit diagrams

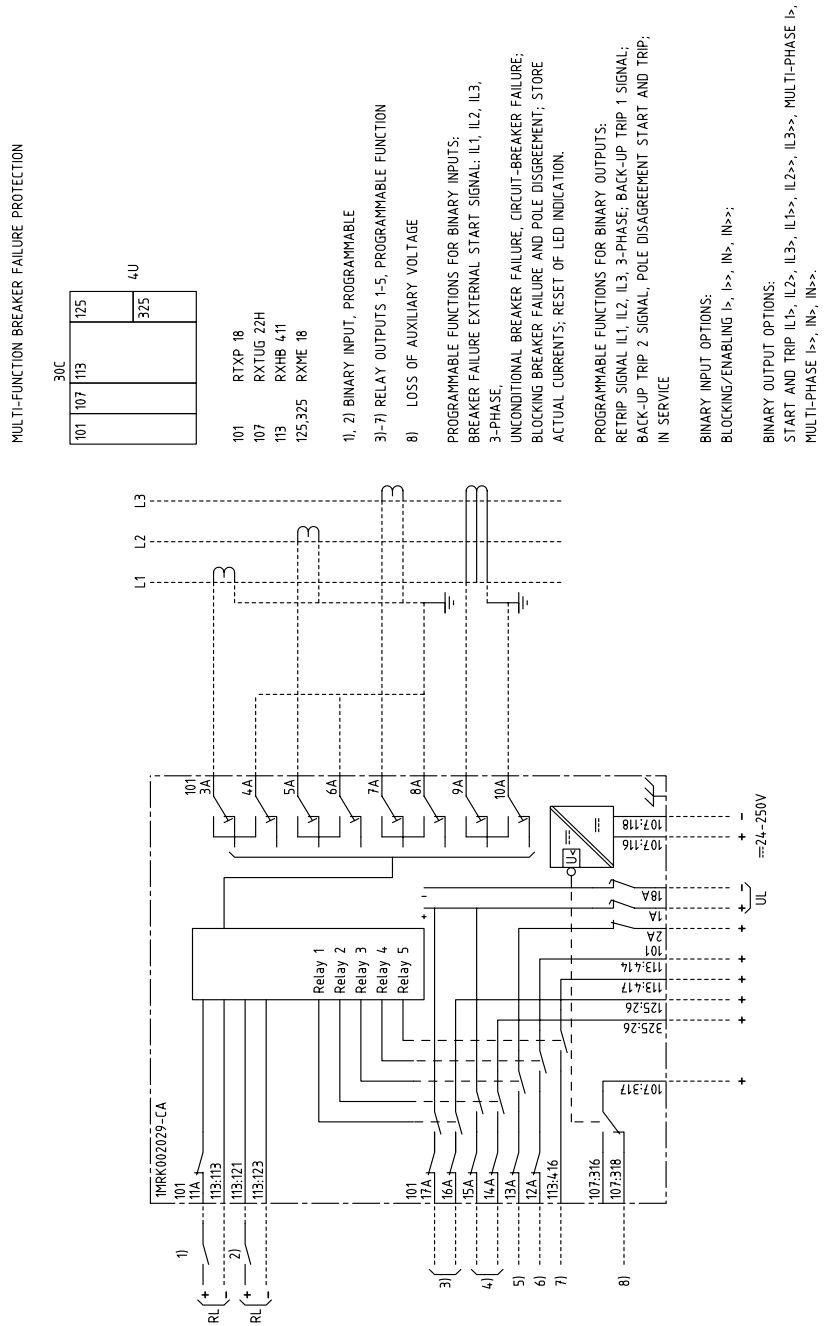


Figure 6: Terminal diagram IMRK 002 029-CAA

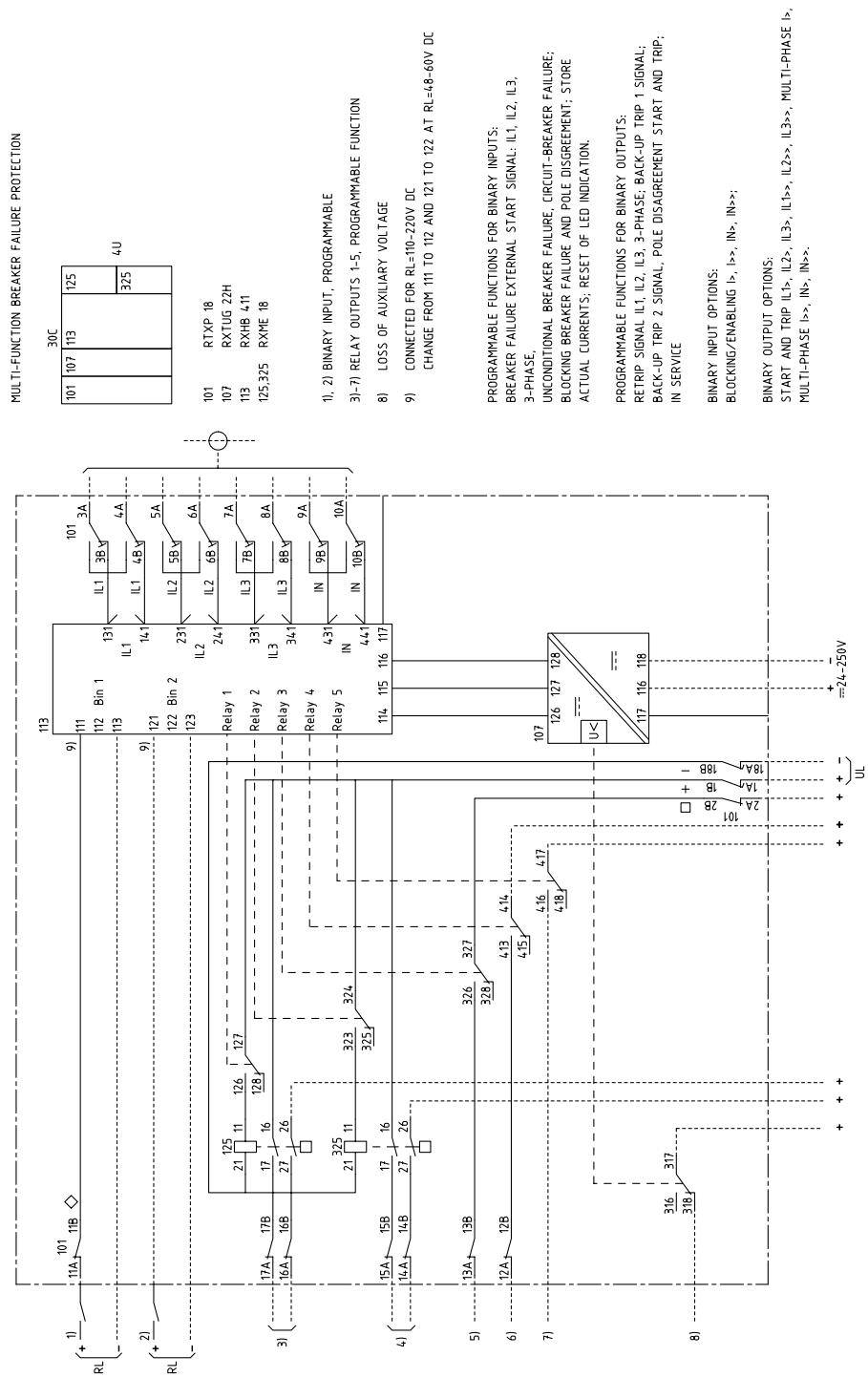


Figure 7: Circuit diagram IMRK 002 029-CA

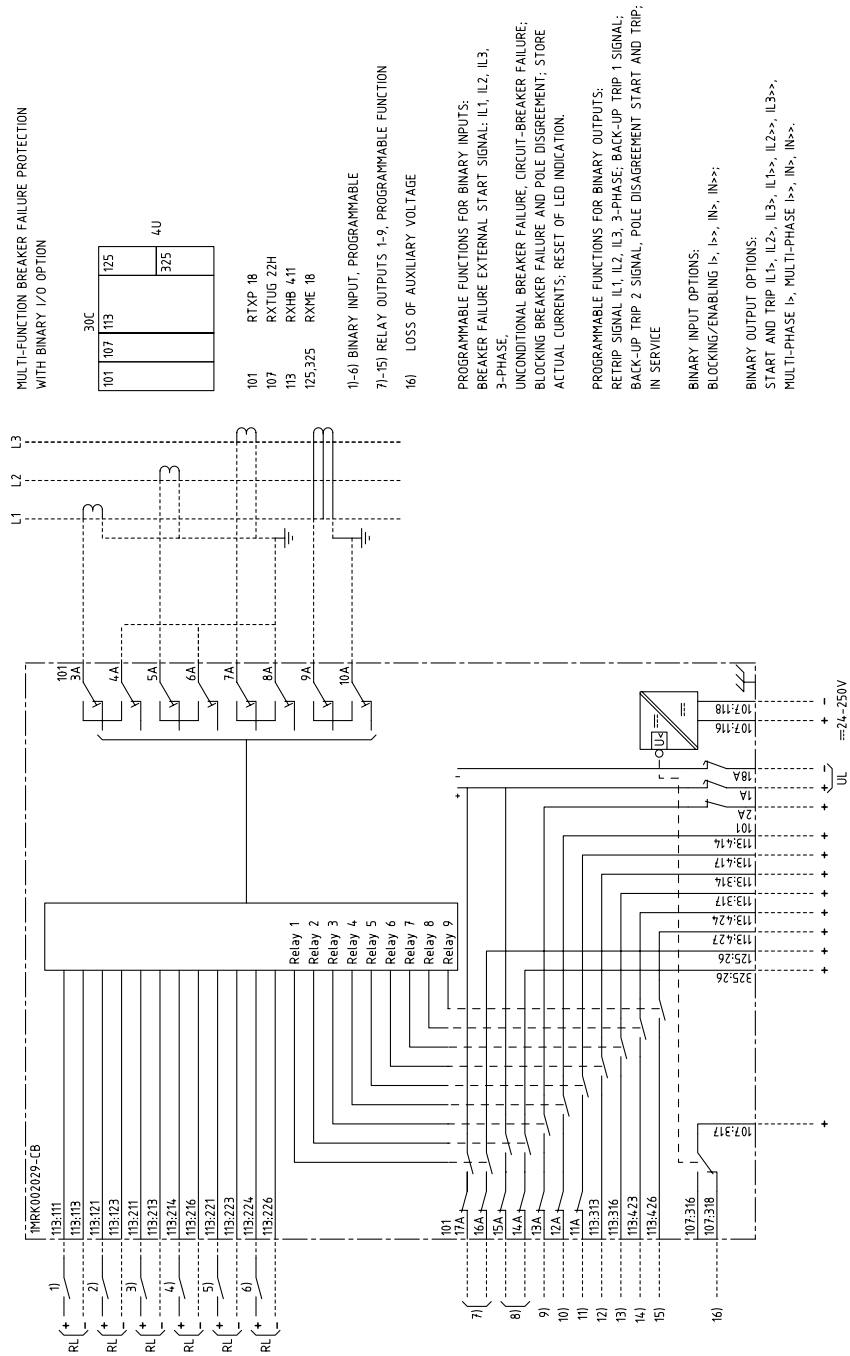
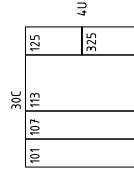


Figure 8: Terminal diagram IMRK 002 029-CBA

MULTI-FUNCTION BREAKER FAILURE PROTECTION WITH BINARY I/O OPTION



- 101 RTXP 18
- 107 RXTUG ZPH
- 113 RXHB 4.11
- 125,325 RXME 18

11-6) BINARY INPUT, PROGRAMMABLE

7)-15) RELAY OUTPUTS 1-9, PROGRAMMABLE FUNCTION

16) LOSS OF AUXILIARY VOLTAGE

17) CONNECTED FOR RL=110-220 V DC AT RL=48-60 V DC, CHANGE FROM 111 TO 112 AND 121 TO 122 211 TO 212 AND 214 TO 215 221 TO 222 AND 224 TO 225

PROGRAMMABLE FUNCTIONS FOR BINARY INPUTS:
BREAKER FAILURE EXTERNAL START SIGNAL: IL1, IL2, IL3, 3-PHASE.

UNCONDITIONAL BREAKER FAILURE, CIRCUIT-BREAKER FAILURE; BLOCKING BREAKER FAILURE AND POLE DISAGREEMENT; STORE ACTUAL CURRENTS; RESET OF LED INDICATION.

PROGRAMMABLE FUNCTIONS FOR BINARY OUTPUTS:
RETRIP SIGNAL IL1, IL2, IL3, 3-PHASE; BACK-UP TRIP 1 SIGNAL; BACK-UP TRIP 2 SIGNAL, POLE DISAGREEMENT START AND TRIP; IN SERVICE

BINARY INPUT OPTIONS:

BLOCKING/ENABLING I₁, I₂, I₃, I_N, I_N>

BINARY OUTPUT OPTIONS:

START AND TRIP I₁>, I₂>, I₃>, I_N>, I_N>>, I₃>>

MULTI-PHASE I₁>, MULTI-PHASE I₂>, I₃>

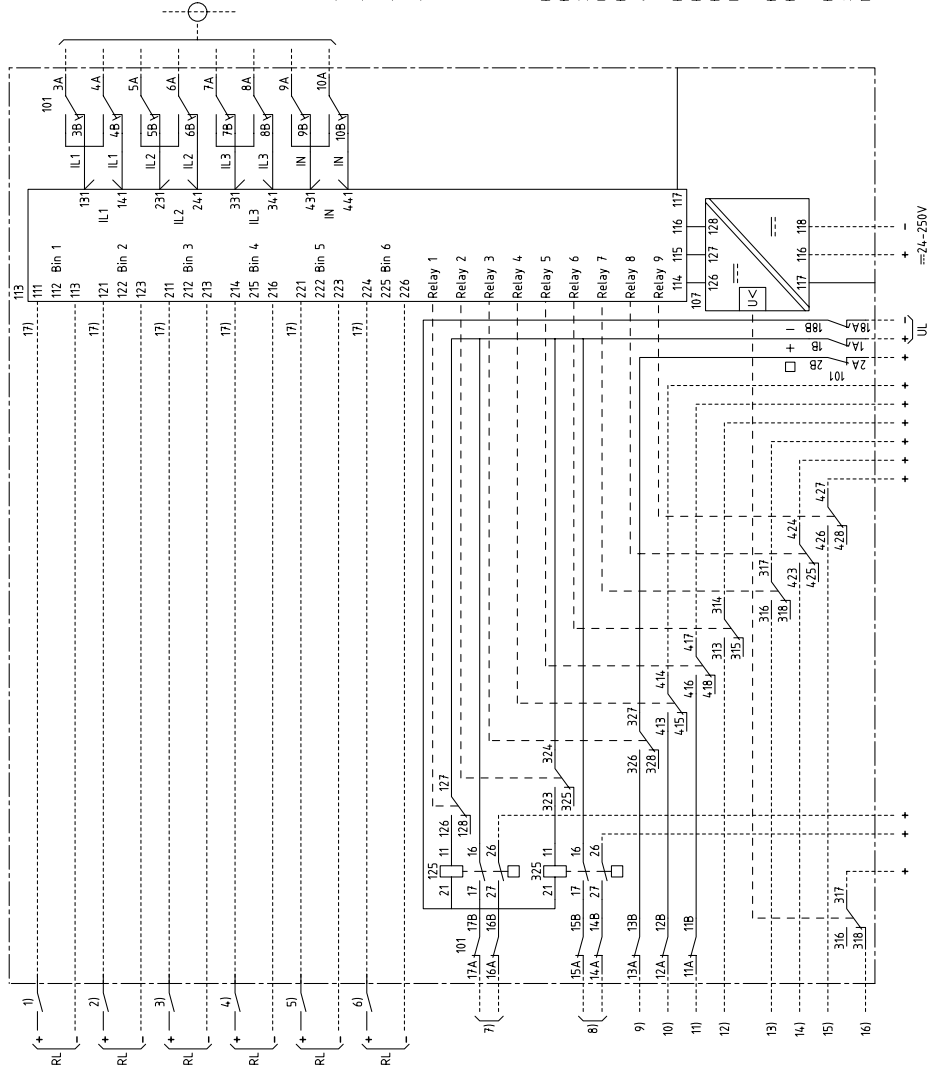


Figure 9: Circuit diagram IMRK 002 029-CB

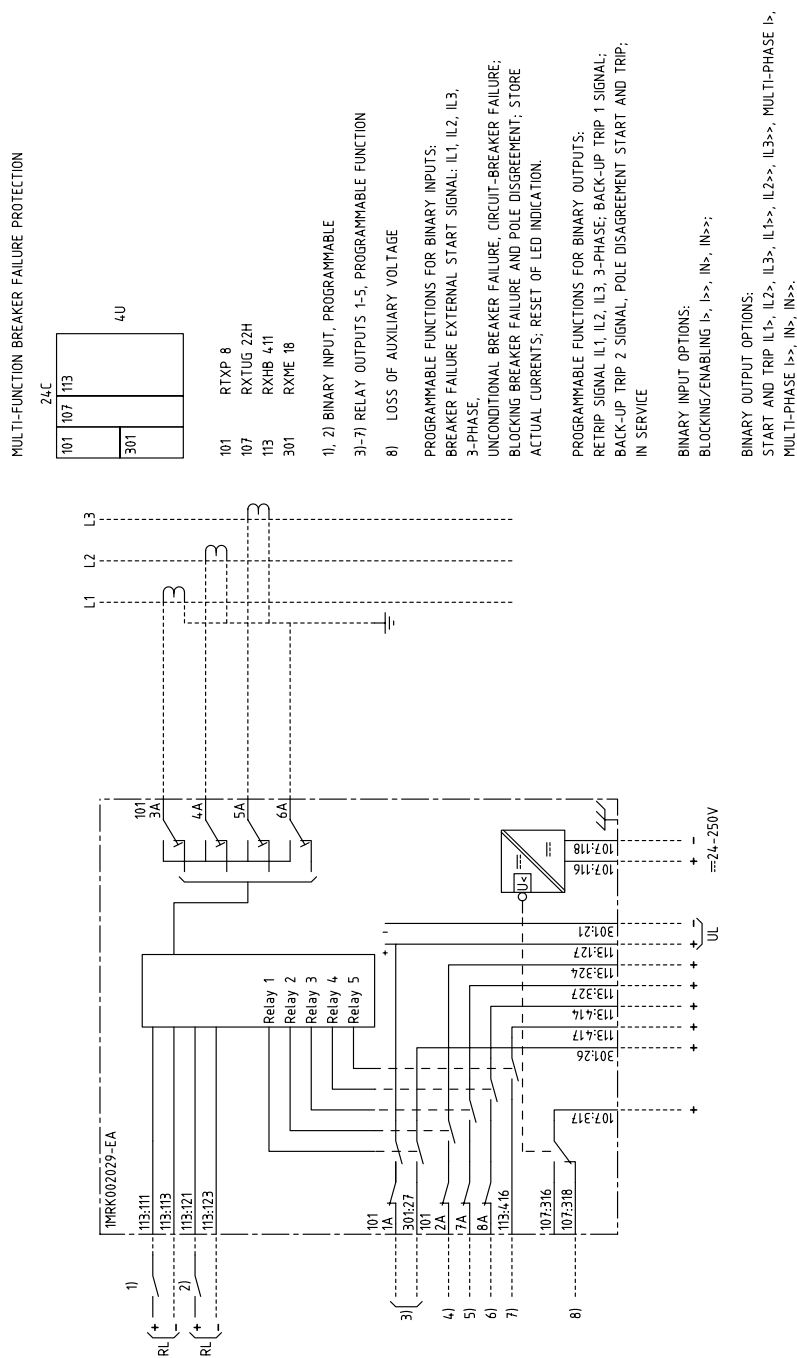


Figure 10: Terminal diagram IMRK 002 029-EAA

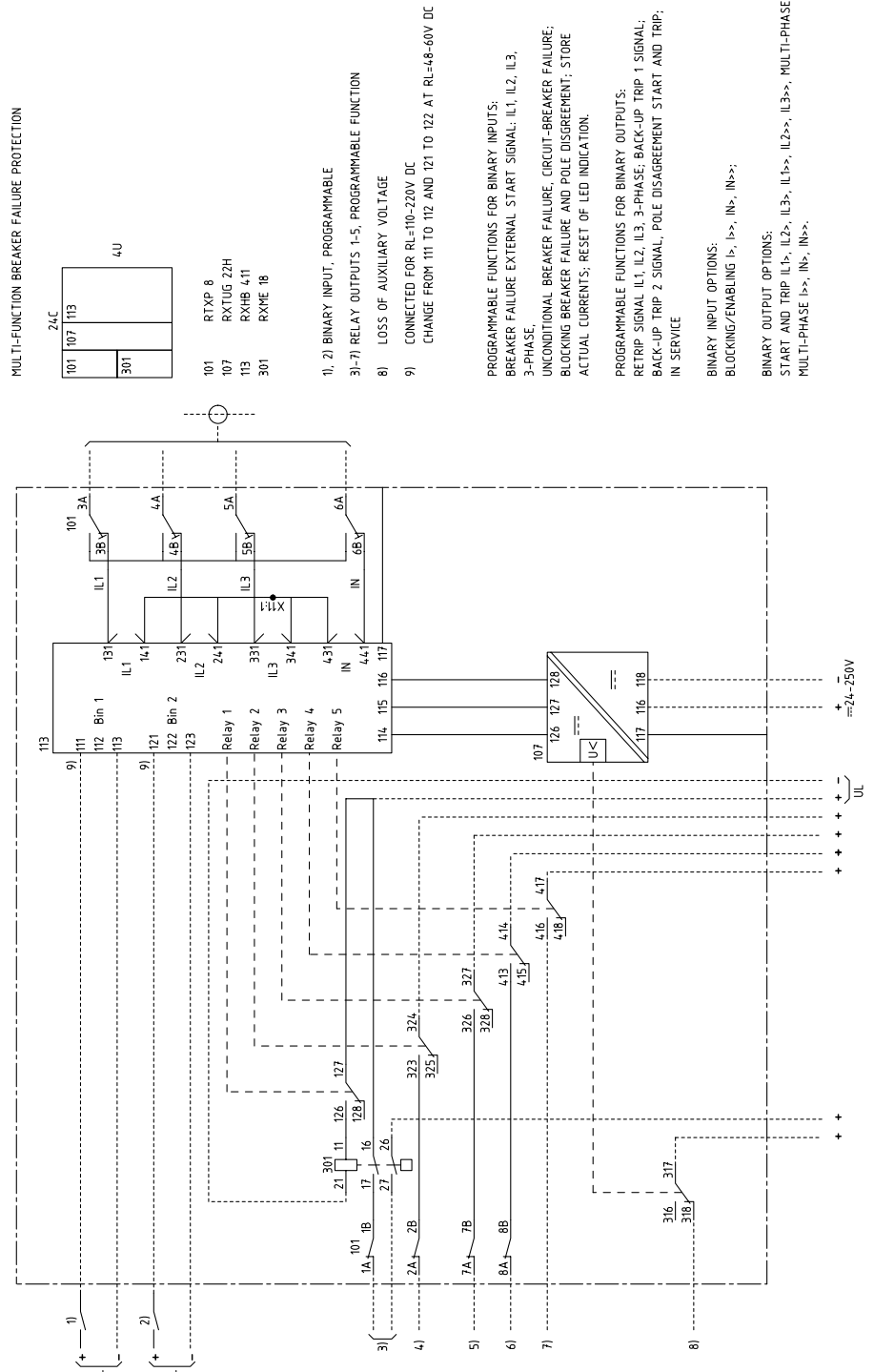


Figure 11: Circuit diagram IMRK 002 029-EA

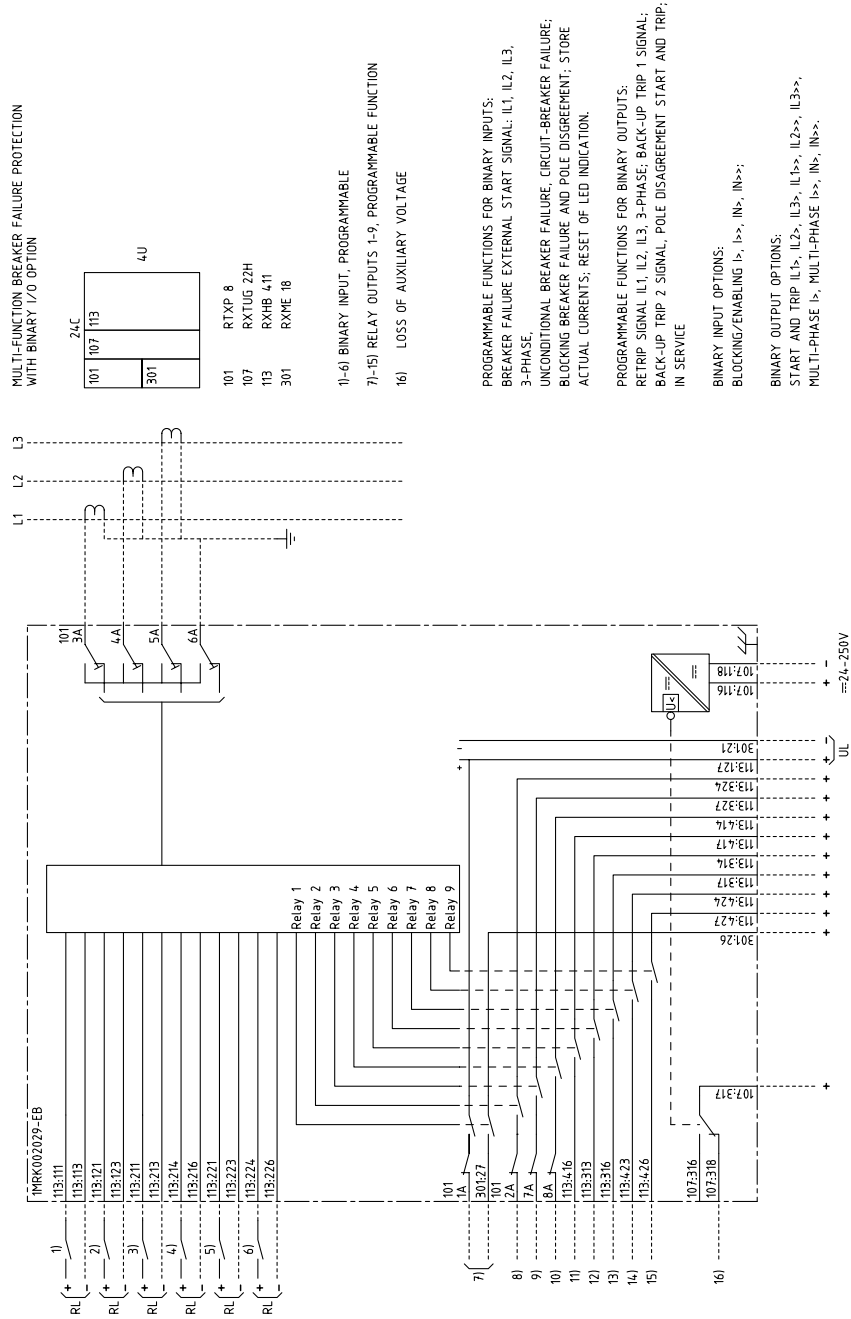


Figure 12: Circuit diagram 1MRK 002 029-EBA

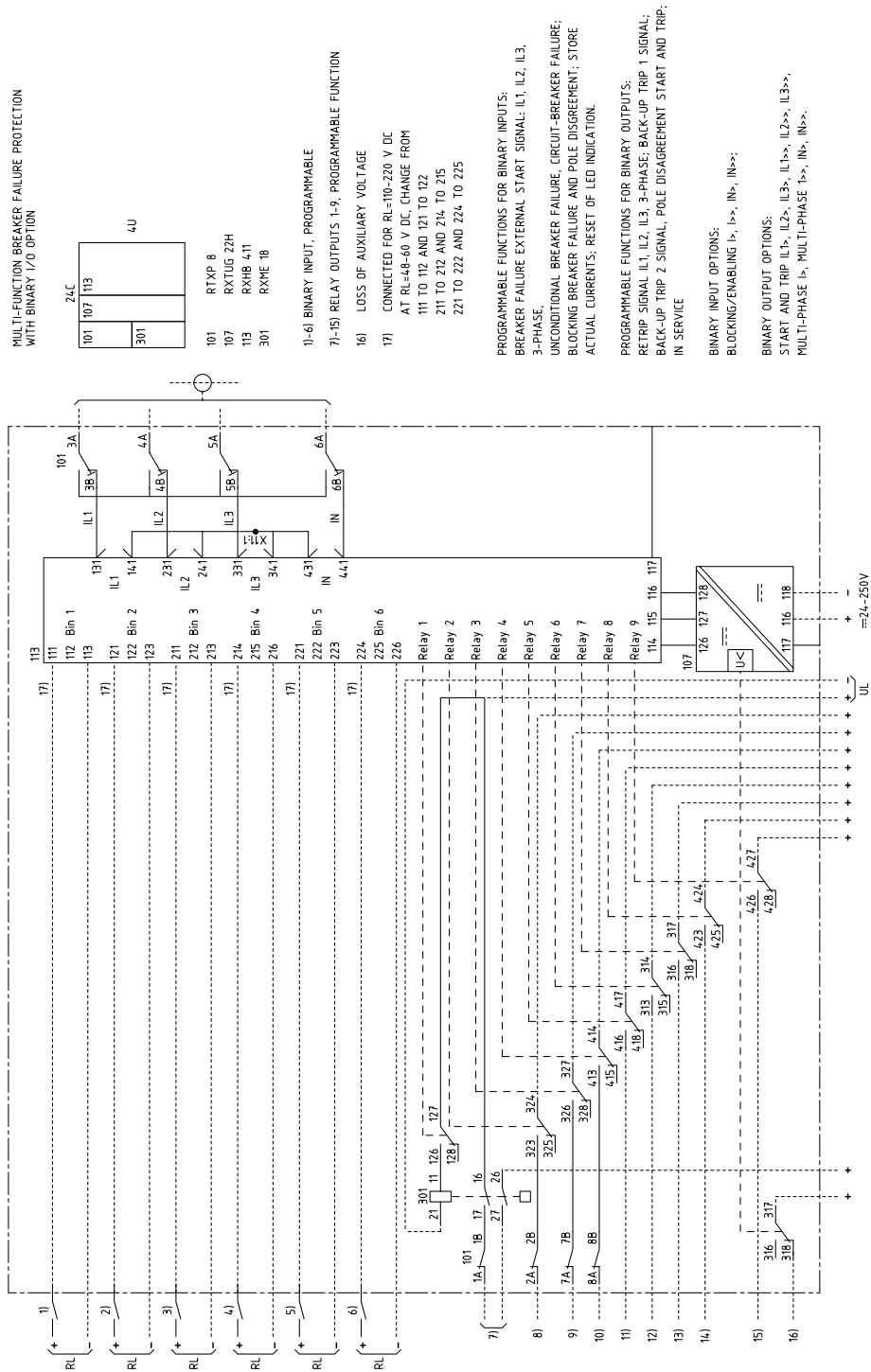


Figure 13: Circuit diagram IMRK 002 029-EB

Chapter 8 Test records

About this chapter

This chapter contains test records which could be used during commissioning of the protection. There is one test record for each protection function available in the relay.

1 Compact breaker failure relay RXHB 411

Table 26: General information

Customer:

Station:

Tested by: Date:

Approved by: Date:

Table 27: General station information

Protected object :

Relay position :

CT-ratio, phase :

CT-ratio, neutral :

Table 28: General relay data

Order number :

Rated phase current I_r :

Rated neutral current I_{Nr} :

Included options Opt :

Version number VerNo :

Serial number SerNo :

Table 29: Basic protection settings

Basic current I_b :

I_{Nb} :

Rated frequency F_r :

Main CT-ratio, phases Prim :

Sec :

Main CT-ratio, neutral Prim :

Sec :

Table 30: Service value check

	Actual injected value:	Primary value:	Secondary value:
Phase IL1	:	:	:
Phase IL2	:	:	:
Phase IL3	:	:	:
Neutral I_N	:	:	:

Table 31: Functional check

Testhandle checked in all positions	:
Trip circuit checked	:
Alarm circuits checked	:

2 Overcurrent protection (option)

2.1 Protection settings

Table 32: Protection settings

		Setting
Low set stage, I>	Active	:
	Operate level	:
	Time delay	:
	Multi-phase	:
	Time delay 2/3	:
High set stage, I>>	Active	:
	Operate level	:
	Time delay	:
	Multi-phase	:
	Time delay 2/3	:

2.2 Protection configurations

Table 33: Protection configurations

	Block/Enable	Binary input
Block/Enable I>	:	:
Block/Enable I>>	:	:
	Binary output	
I>start L1	:	
I>trip L1	:	
I>start L2	:	
I>trip L2	:	
I>start L3	:	
I>trip L3	:	
I>start	:	
I>trip	:	

I>>start L1 :
 I>>trip L1 :
 I>>start L2 :
 I>>trip L2 :
 I>>start L3 :
 I>>trip L3 :
 I>>start :
 I>>trip :

2.3

Operate and reset values

Table 34: Low set stage, I>

Phase IL1		Phase IL2		Phase IL3	
Pick-up	Drop-out	Pick-up	Drop-out	Pick-up	Drop-out
.....

Table 35: High set stage, I>>

Phase IL1		Phase IL2		Phase IL3	
Pick-up	Drop-out	Pick-up	Drop-out	Pick-up	Drop-out
.....

2.4

Time measurements

Table 36: Definite time delay, injected current 1.3 x set operate value

Function		Phase IL1	Phase IL2	Phase IL3
Low set stage, I>	Single-phase	:	:	:
	Multi-phase	:	:	:
High set stage, I>>	Single-phase	:	:	:
	Multi-phase	:	:	:

3 Earth-fault protection (option)

3.1 Protection settings

Table 37: Protection settings

		Setting
Low set stage, $I_{N>}$	Active	:
	Operate level	:
	Time delay	:
High set stage, $I_{N>>}$	Active	:
	Operate level	:
	Time delay	:

3.2 Protection configurations

Table 38: Protection configurations

	Block/Enable	Binary input
Block/Enable $I_{N>}$:	:
Block/Enable $I_{N>>}$:	:
Binary output		
$I_{N>}$ start	:	
$I_{N>}$ trip	:	
$I_{N>>}$ start	:	
$I_{N>>}$ trip	:	

3.3 Operate and reset values

Table 39: Operate and reset values

Function	Pick-up	Drop-out
Low set stage $I_{N>}$:	:
High set stage $I_{N>>}$:	:

3.4**Time measurements****Table 40: Definite time delay, injected current 1.3 x set operate value**

Function	Injected current	Neutral I_N
Low set stage, $I_N >$:	:
High set stage, $I_N >>$:	:

4 Breaker failure protection

4.1 Protection settings

Table 41: Protection settings, general breaker failure protection

		Setting
General breaker failure protection	Current level, phase	:
	Current level, neutral	:
	Current criteria	:
	Back-up trip 2, active	:
	Delta time delay	:
	Minimum trip pulse length	:

Table 42: Protection settings, single-phase function

		Setting
Single-phase function	Active	:
	Re-trip criteria	:
	Time delay, re-trip	:
	Time delay, back-up trip 1	:
	Internal start for I> trip	:
	Internal start for I>> trip	:

Table 43: Protection settings, three-phase function

		Setting
Three-phase function	Active	:
	Re-trip criteria	:
	Time delay, re-trip	:
	Time delay, back-up trip 1	:
	Internal start for I> trip	:

	Setting
Internal start for I>> trip	:
Internal start for I _N > trip	:
Internal start for I _N >> trip	:

Table 44: Protection settings, three-phase unconditional function

	Setting
Active	:
Three-phase unconditional function	Re-trip criteria :
	Time delay, re-trip :
	Time delay, back-up trip 1 :

4.2

Protection configurations

Table 45: Protection configurations

	Binary input
Single-phase start L1	:
Single-phase start L2	:
Single-phase start L3	:
Three-phase start	:
Three-phase unconditional start	:
Circuit-breaker fail	:
Block breaker failure	:
	Binary output
Single-phase re-trip L1	:
Single-phase re-trip L2	:
Single-phase re-trip L3	:

Three-phase re-trip :
 Back-up trip 1 :
 Back-up trip 2 :

4.3

Single-phase breaker failure function

Table 46: External start of single-phase breaker failure function

Energized current		Re-trip	Back-up trip 1	Back-up trip 2
120% of set level	1-ph start L1	:	:	:
	1-ph start L2	:	:	:
	1-ph start L3	:	:	:
80% of set level	1-ph start L1	:	:	:
	1-ph start L2	:	:	:
	1-ph start L3	:	:	:

Table 47: Internal start of single-phase breaker failure function (option)

Energized current		Re-trip	Back-up trip 1	Back-up trip 2
110% of set level	I> trip L1	:	:	:
	I> trip L2	:	:	:
	I> trip L3	:	:	:
	I>> trip L1	:	:	:
	I>> trip L2	:	:	:
	I>> trip L3	:	:	:

4.4 Three-phase breaker failure function

Table 48: External start of three-phase breaker failure function

Energized current		Re-trip	Back-up trip 1	Back-up trip 2
120% of set level	3-ph start	:	:	:
80% of set level	3-ph start	:	:	:

Table 49: Internal start of three-phase breaker failure function (option)

Energized current		Re-trip	Back-up trip 1	Back-up trip 2
110% of set level	I > trip	:	:	:
	I >> trip	:	:	:

4.5 Three-phase unconditional breaker failure function

Table 50: External start of three-phase unconditional breaker failure function

	Re-trip	Back-up trip 1	Back-up trip 2
3-ph unconditional start	:	:	:
3-ph unconditional start, short pulse	:	:	:

5 Pole-disagreement protection

5.1 Protection settings

Table 51: Protection settings

		Setting
Pole-disagreement	Active	:
	Undercurrent level, $I_{<}$:
	Overcurrent level, $I_{>}$:
	Time delay	:
	Single-phase block	:
	Reset time	:

5.2 Protection configurations

Table 52: Protection configurations

		Binary inputs
Block pole-disagreement		:
		Binary output
Pole-disagreement trip		:

5.3 Operate and reset values

Table 53: Undercurrent level, $I_{<}$

Phase IL1		Phase IL2		Phase IL3	
Pick-up	Drop-out	Pick-up	Drop-out	Pick-up	Drop-out
.....

Table 54: Overcurrent level, $I_{>}$

Phase IL1		Phase IL2		Phase IL3	
Pick-up	Drop-out	Pick-up	Drop-out	Pick-up	Drop-out
.....

5.4**Time measurements****Table 55: Definite time delay, injected current 1.3 x set operate value**

Function	Phase IL1	Phase IL2	Phase IL3
Pole-disagreement trip	:	:	:

Table 56: Reset time block delay at single-pole tripping

Function	Phase IL1
Pole-disagreement trip	:

