ABB Network Partner AB

RXVK 2H and RAVK Thermal overcurrent relay and protection assemblies

User´s Guide
1MRK 509 003-UEN
Version 1
October 1997

General

When the load current exceeds the permitted continuous current there is a risk that conductors and insulations will be damaged due to overheating. The thermal overcurrent protection RAVK effectively prevents such damage and, at the same time, allows full utilization of the protected object.

The COMBIFLEX® thermal protection RAVK is primarily used for thermal protection of motors, generators, transformers, cables and reactors. However, it is designed to meet the requirements for thermal protections in most power system applications. For the general thermal application a very wide setting ranges is available with this relay, obviating the need to specify different versions depending on the protective applications.

RAVK is available as single-phase, two-phase and three-phase thermal protection with one measuring relay RXVK 2H per phase. Rated current is 1 A or 5 A. RXVK 2H is a micro-processor based relay with one thermal overload and one time-overcurrent stage. Setting range for the thermal stage is 0,05-1,5 times rated current and thermal time constant T=2-62 minutes. For the time-overcurrent stage the setting range is 0,05-20 times rated current and 0,03 - 5 s.

All RAVK protections are:
- mounted in the COMBIFLEX® modularised system
- available with or without test switch
- available with or without DC-DC converter
- available with or without additional heavy duty tripping relay

List of contents

1 Application

All electrical conductors have a certain resistance, which gives rise to an active power loss $I^2 \cdot r$, where I is the rms value of the current and r is the resistance of the conductor. Hence the active power loss is proportional to the square of the current and inversely proportional to the crossectional area of the conductor.

The phase current conductors in cables, motors, generators, transformers, reactors etc. are surrounded by insulating material which deteriorates rapidly if the temperature exceeds the design limit value. As a rule of the thumb, the useful life time of the insulation material will be reduced to the half of the design value for each continuous increment of the temperature of the conductor by 7 degrees centigrade above rated value.

The temperature rise of a body which is heated from a source of constant energy is according to the equation:

$$\theta(t) = \theta_s - (\theta_s - \theta_b)e^{-t/T} \qquad \text{equation 1}$$

When the heat energy is decreased, the following is valid:

$$\theta(t) = \theta_{s2} + (\theta_0 - \theta_{s2})e^{-t/T} \qquad \text{equation 2}$$

where θ(t) = the temperature rise of the body as a function of time

θ_s = the final, steady state temperature rise

θ_b= the temperature rise at the moment when the power is increased

θ_0 = the temperature rise at the moment when the power is reduced

θ_{s2} = the final, steady-state temperature rise corresponding to the reduced power

τ = the thermal time constant

Fig. 1 shows the temperature rise as function of time when a conductor carries current which gives a final temperature rise of θ_s. Fig. 2 shows the corresponding rise of temperature when the conductor carries a load = 1,5 times this current.

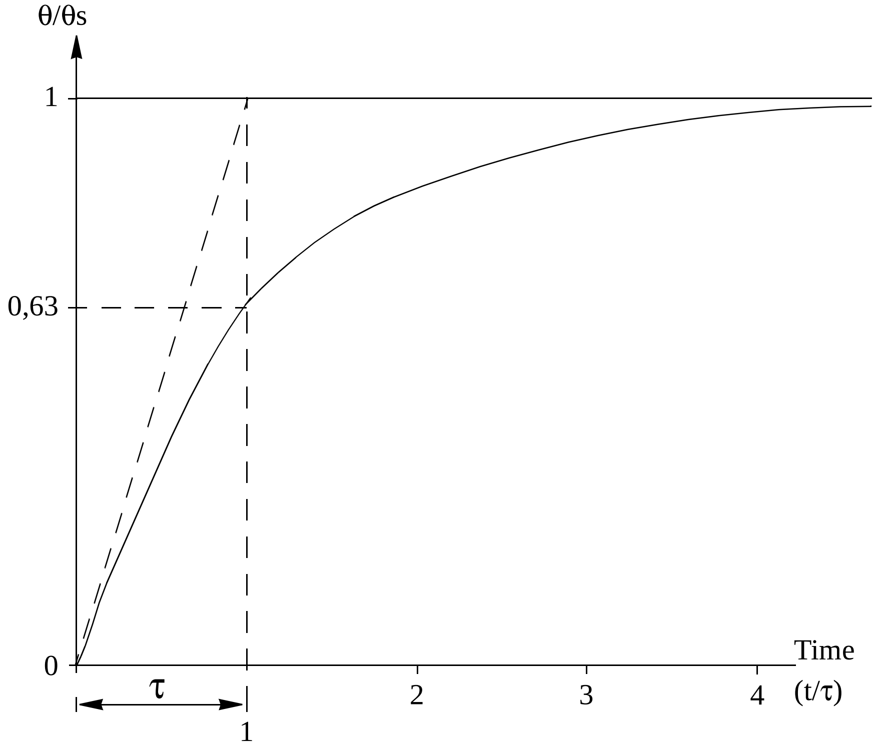


Fig. 1 Temperature rise at rated current

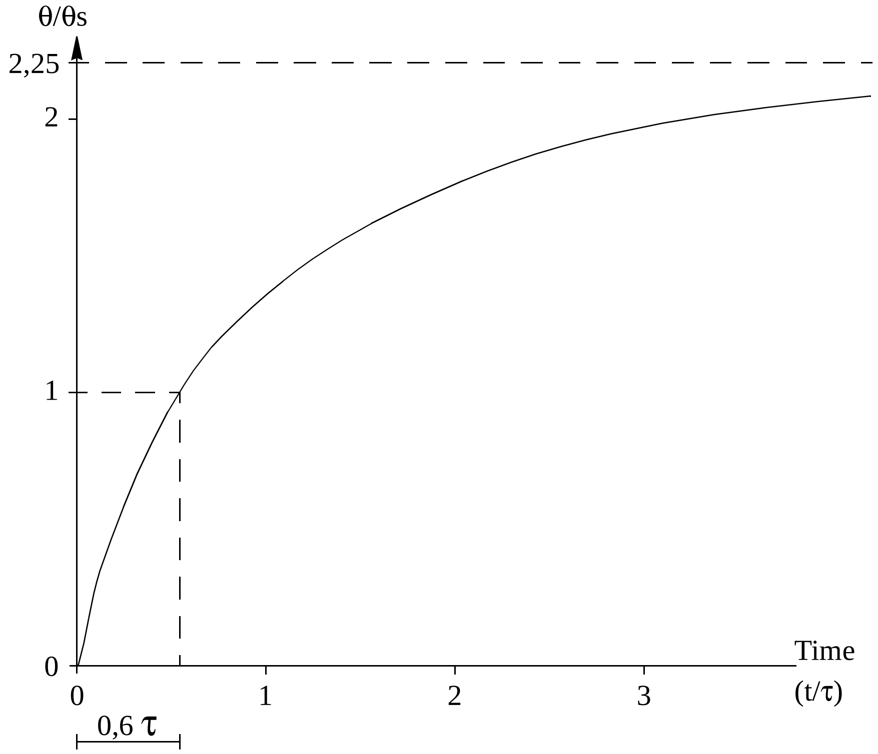


Fig. 2 Temperature rise at 1,5 x rated current

Overloads up to 1,4 times rated current are normally not detected by the short-circuit overcurrent or impedance relays. A sustained overload of 1,2 times rated current gives a temperature increase of $1{,}2^2 = 1{,}44$ times the temperature increase at rated current. For large generators, motors, transformers and reactors, thermal overloading of the windings will be detected by temperature monitors. For apparatuses without thermal detectors, an accurate thermal relay with operating characteristics giving a thermal replica of the winding will provide a thermal overload protection. For apparatuses with thermal detectors, a thermal overcurrent relay will provide a back-up function.

Electrical cables which can be loaded up to the permissible thermal load current should be provided with both thermal and short-circuit protection. For cables surrounded by air, the thermal time constant τ can vary from some few minutes for 10 kV cables with cross-sectional area 25 mm^2 to one hour for 30 kV cables with cross-sectional area > 185 mm^2.

The shorter time constant valid for cables placed in air will normally be decisive, since some part of the cable normally will be surrounded by air.

1.1 Settings

The thermal overcurrent relay RXVK 2H has time-current characteristics which follows the equation:

$$t = \tau \cdot \ln \frac{I^2 - I_p^{\ 2}}{I^2 - (k^2 \cdot I_b^{\ 2})}$$

where I = overload current

I_p = current previous to the overload, assuming sufficient long time to reach steady-state temperature

I_b = rated current

k = security factor = 1,01

The security factor means that the start current I_b of the relay can be set equal to the maximum permissible continuous load current. If no security factor were included, the relay would trip for rated current after long time.

It should be observed, that the start relay for the thermal stage operates at $1{,}01 \cdot I_b$ and that a final, steady-state temperature giving tripping is obtained for a continuous current equal to $1{,}01 \cdot I_b$.

The current-time operate characteristics of the relay is identical to equations 1 and 2 above when the final temperature increase θ_s is set to correspond to a current equal to $1{,}01 \cdot I_b$.

The current-time curves in Fig. 3 show the operate time for currents which are given as multiples of the set start current I_b.

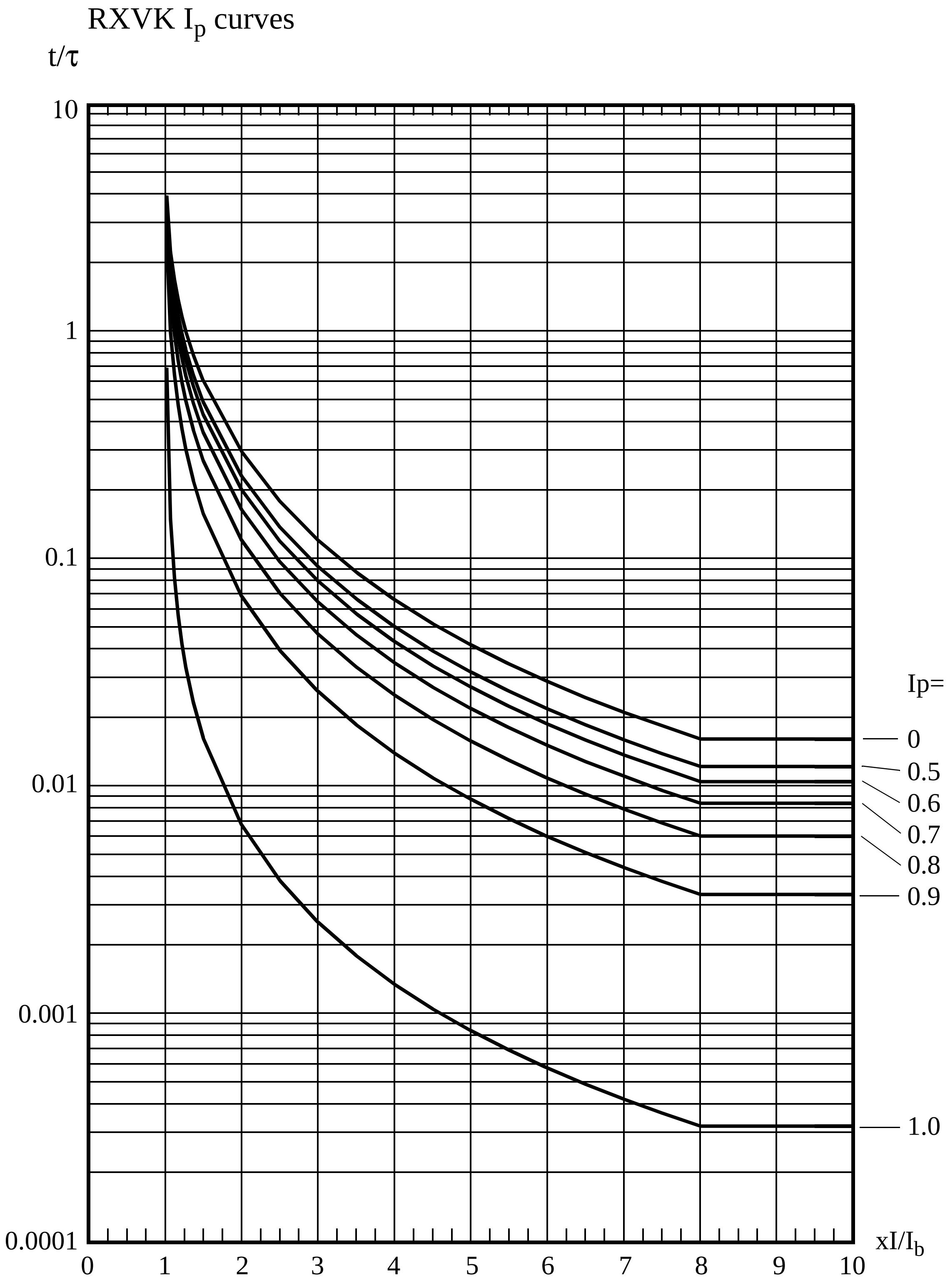


Fig. 3 Operate-time curves of thermal protection RAVK.

1.2 Determining the time constant

In some cases, the current-time capability curve is given instead of the thermal time constant τ. A suitable τ–setting then must be decided by comparing some points on the capability curve with the operate-time curves of RAVK. If the capability curve deviates from the relay operate curve, the lowest value of τ is selected.

Example: The thermal overload curve for a cold motor shows that 1,5 times rated load current is permissible for 18 minutes and 5 times rated current is permissible for 1 minute. From the relay operate curve, it is seen that the operate time is 0,6 · τ at 1,5 times and 0,04 · τ at 5 times rated current for a cold motor.

Hence, the τ calculated from those two points would be 18min/0,6 = 30 minutes respectively 1 minute/0,04 = 25 minutes. The lowest value should be selected for the relay.

The accurate values can be calculated from the formula given in Section 1.1.

2 Measurement principles

The RXVK 2H relay constitutes the measuring unit of RAVK. For setting of operate values and the functions of the output relays and the LEDs, see *Section 4*.

The functional diagram in fig. 4 illustrates the mode of operating of the RXVK 2H relay.

To provide a suitable voltage for the electronic measurement circuit, the relay is provided with an input transformer. The output current of the transformer is shunted via dip-switches before it is filtered with a 4th order bandpass filter with a centre frequency of 55 Hz. The relay can also be ordered with a filter for suppressing frequency dependence 40-2000 Hz, see Section 5.

The voltage is rectified before it is sampled with a sample rate of 1000 samples/s. The voltage ripple is reduced with a moving average filter.

The thermal stage operates when the accumulated thermal content (θ) has reached the set operate thermal value $(I_b \text{ x } k)^2$ where k is equal to 1,01. The accumulated thermal content increases or decreases with $(I^2 - \theta)/(\tau \text{ x } 60)$ per second. The thermal content is updated every 12 ms. The resulting operate characteristic in accordance with the equation:

$$t = \tau \cdot \ln \frac{I^2 - I_p^{\,2}}{I^2 - (I_b \cdot k)^2}$$

where I_p is the preload current before overload.

The over-current stage I> operates when the current reaches the set operate current. The I> stage is provided with a definite-time delay.

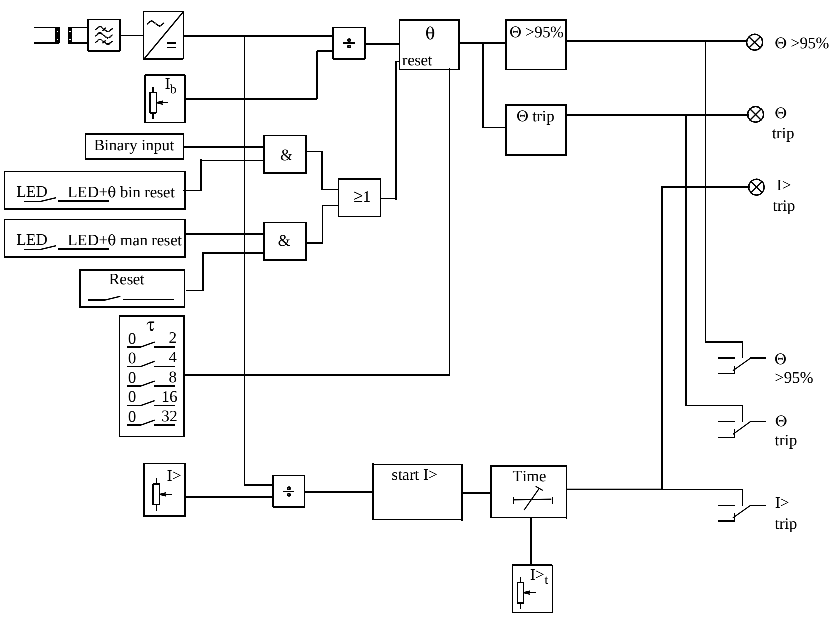


Fig. 4 Functional diagram illustrating the mode of operating of the RXVK 2H relay

Resetting of the thermal content can be made with either the reset button or the binary input. When switch 9 is set to “LED+θ man reset” the reset button resets the thermal content when it is depressed. When switch 10 is set to “LED+θ bin reset” the binary input resets the thermal content when activated. The binary input is galvanically separated from the electronic measurement circuits with an opto-coupler.

The reset button also resets the LEDs and makes it possible for the operator to check the LEDs. When the button is depressed, the “θ > 95%”, “θ Trip” and “I> Trip” LEDs are lit and the “In serv.” LED is switched off, in order to check the LEDs. When the button is released, the “θ > 95%”, “θ Trip” and “I> Trip” LEDs are reset to show the actual status and the “In serv.” LED is relit. If the reset button is depressed while the “θ Trip” function is operating and the thermal content is decreasing, the “θ Trip” LED will be reset when the thermal content is below 80%.

When the processor starts it executes a self test sequence. If the processor fails to start in a proper way the LEDs will indicate by flashing according to fig. 5 or the “In serv.” LED will not be lit. The program in the microprocessor is executed in a fixed loop with a constant loop time. The loop is supervised by an internal watchdog which initiates a program restart if the program malfunctions.

Test sequence:	**Test error indication:**
Config. registers	All LEDs flash in clockwise rotation.
RAM	“θ Trip” flashes.
ROM	“I> Trip” flashes.
A/D	“θ Trip” and “I> Trip” flash.

Fig. 5 Self test error indication of the RXVK 2H relay

3 Design

The thermal overcurrent protection RAVK is designed in a number of variants for one-, two- or three-phase application. Each protection is available with or without test switch RTXP 18, DC-DC converter RXTUG 22H or tripping relay RXME 18.

All the protections are built up by modules in the COMBIFLEX® modular system mounted on apparatus bars. The connections to the protections are done by COMBIFLEX® socket equipped leads.

The type of modules and their physical position and the modular size of the protection are shown in the *Buyer´s Guide* and in the *Circuit Diagram* of respective protection. The following modules can be included.

3.1 Test switch

The test switch RTXP 18 is a part of the COMBITEST testing system described in the *Buyer´s Guide*, document No. 1MRK 512 001-BEN. A complete secondary testing of the protection can be performed by using a test-plug handle RTXH 18, connected to a test set. When the test-plug handle is inserted into the test switch, preparations for testing are automatically carried out in a proper sequence, i.e. blocking of tripping circuits, short-circuiting of current circuits, opening of voltage circuits and making the protection terminals available for secondary testing. Test switch RTXP 18 has the modular dimensions 4U 6C.

All input currents can be measured by a test plug RTXM connected to an ammeter. The tripping circuits can be blocked by a trip-block plug RTXB and the protection can be totally blocked by a block-plug handle RTXF 18.

3.2 DC-DC converter

The DC-DC converter RXTUG 22H converts the applied battery voltage to an alternating voltage which is then transformed, rectified, smoothed and in this application regulated to ± 24 V DC. The auxiliary voltage is in that way adapted to the measuring relays. In addition, the input and output voltages will be galvanically separated, which contributes to damping of possible transients in the auxiliary voltage supply to the measuring relays. The converter has a built-in signal relay and a green LED for supervision of the output voltage.

RXTUG 22H has the modular dimensions 4U 6C. It is described in the *Buyer´s Guide*, document No. 1MRK 513 001-BEN.

3.3 Measuring relay

The thermal overcurrent relay RXVK 2H is a static microprocessor based relay with one thermal stage and one definite time delayed overcurrent stage. The relay consists mainly of an input transformer for current adaptation and isolation, filter circuits, analog-digital converter, microprocessor, MMI consisting of a programming switch and potentiometers for setting and LEDs for start, trip and in service indications, and three output relays, each with a change-over contact. The output relays operate for thermal overload, overcurrent and when the thermal content exceeds 95 % of set thermal operate value. The relay has also a binary input for remote resetting of the LEDs or the LEDs and the thermal content.

There are two variants of the relay with regard to rated currents and two variants with regard to frequency characteristics. Operate values of the thermal and the overcurrent functions are set by potentiometers and programming switches in the front.

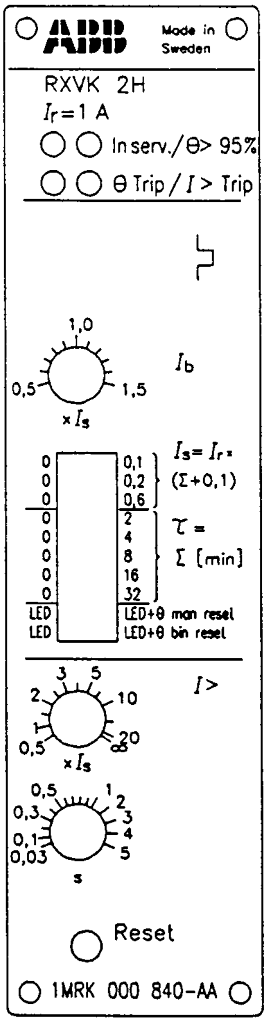
RXVK 2H has the modular dimensions 4U 6C.

3.4 Tripping relay

The auxiliary relay RXME 18 is used as a tripping relay. It has two heavy duty make contacts and a red flag. The flag will be visible when the armature picks-up and is manually reset by a knob in the front of the relay. Typical operate time is 35 ms.

RXME 18 has the modular dimensions 2U 6C. The relay is described in the *Buyer´s Guide*, document No. 1MRK 508 015-BEN.

4 Setting and connection



1MRK 000 117-38

Fig. 6 Front layout

Rated current of the relay, Ir (available variants: 1 A or 5 A)

LED indicators:
In serv. (green): indicates relay in service.
Start (yellow): indicates operation of Θ>95% (no time delay).
Θ Trip (red): indicates operation of Θ after the set time delay.
I> Trip(red): indicates operation of I> after the set time delay.

(Thermal stage):

Potentiometer (P1) for setting of the thermal stage base current I_b.

10-pole programming switch (S1) for setting of the scale-constant I_S, time constant τ and the binary input function.

I> (Overcurrent stage):

Potentiometer (P2) for setting of the operate value for the function I>.

Potentiometer (P3) for setting of the definite time-delay t for the function I>.

Reset push-button.

4.1 Connection

The RXVK 2H relay requires a dc-dc converter type RXTUG for auxiliary voltage supply ±24 V. Connection of voltage RL shall be made only when the binary input is used.

The relay is delivered with a short-circuiting connector RTXK for mounting on the rear of the terminal base. This connector will automatically short-circuit the current input when the relay is removed from its terminal base.

NOTE! The auxiliary voltage supply should be interrupted or the output circuits should be blocked to avoid the risk of unwanted alarm or tripping, before the relay is plugged into or withdrawn from its terminal base.

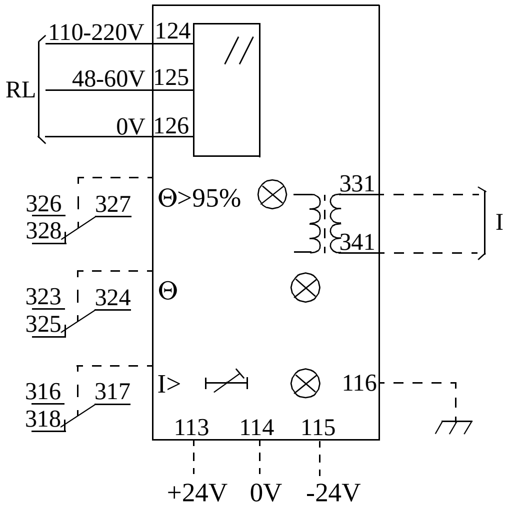


Fig. 7 Terminal diagram

4.2 Settings

All settings can be changed while the relay is in normal service.

1. Setting of the scale-constant I_S.

I_S is common for both the thermal stage and the overcurrent stage I>.

It is set with the programming switches S1:1, S1:2 and S1:3, from 0,1 to 1,0 × the rated current I_r.

2 Setting of the thermal stage base current I_b.

The base current is set with potentiometer P1 according to $I_b = P1 \times I_s$.

3. The thermal stage time constant.

The thermal stage time constant, τ, is programmable from 2 to 62 minutes in steps of two minutes on the programming switches S1:4 to S1:8. (τ = Σ (min)). The operate time is determined by the setting of the base current I_b and the selected time constant τ.

4. Setting of the overcurrent stage I> operate value.

The operate value is set with potentiometer P2 according to $I> = P2 \times I_s$.

This function can be blocked by setting potentiometer P2 to ”∞".

5. The overcurrent stage time delay.

The time delay for the overcurrent stage (I>) has definite-time characteristic. The minimum value is 30 ms and the maximum value is 5 s. The setting is done with potentiometer P3.

6. The binary input.

The binary input is programmable for either remote reset of the LED indicators, or remote reset of the LED indicators and the thermal content of the relay. The function is activated when a voltage RL is applied to the binary input. The setting is done on the programming switch S1:10.

7. Manual reset.

The reset push-button is programmable for either reset of the LED indicators, or reset of the LED indicators and the thermal content of the relay. This setting is done on the programming switch S1:9.

4.3 Indication

There are four LED indicators. The trip indicators seal-in and are reset manually by the ”Reset” push-button or electrically via the binary input, while the start indicator resets automatically when the relay resets.

When the ”Reset” push-button is depressed during normal operating conditions, all LEDs except "In serv." will light up.

When connecting RXVK 2H to the auxiliary voltage, the relay performs a self test. The ”In serv.” LED is alight, after performing the self test and when the relay is ready for operation. In case of a fault, the LEDs will start flashing.

4.4 Tripping and start outputs

The RXVK 2H relay has one start and one tripping output for the thermal stage, and one trip output for the overcurrent stage. Each output is provided with one change-over contact. All outputs reset automatically when the current decreases to a value below the resetting value of the relay.

4.5 ESD

The relay contains electronic circuits which can be damaged if exposed to static electricity. Always avoid to touch the circuit board when the relay cover is removed during the setting procedure.

5 Technical data for thermal overcurrent relay RXVK 2H

Current input

Rated current I_r	1 or 5 A
Scale constant I_s	(0,1 0,2 0,4 and 1,0) x I_r
Scale range 1 A Variant I_b $I>$ 5 A Variant I_b $I>$	 0,05-1,5 A 0,05-20 A and ∞ 0,25-7,5 A 0,25-100 A and ∞
Effective current range	(0,75-65) x I_s
Rated frequency f_r Frequency characteristics Frequency range	50-60 Hz Filter options: 50-60 Hz, flat (standard variant) see figure 8. 40-2000 Hz, flat, see figure 9. 40-2000 Hz
Power consumption 1 A variant $I = I_s = 0{,}1$ A $I = I_s = 1$ A 5 A variant $I = I_s = 0{,}5$ A $I = I_s = 5$ A	 0,5 mVA 50 mVA 1 mVA 100 mVA
Over load capacity 1 A variant continuously 5 A variant continuously 1 A during 1 s 5 A during 1 s	 4 A 20 A 100 A 350 A

Thermal function

Thermal content	Θ
Operate current	k x I_b
Constant k	1,01
Basic current I_b	Settable (0,5-1,5) x I_s
Alarm level	95% of Θ for trip operation
Operating range	(0-8) x I_b
Thermal time constant τ	2-62 min, settable in steps of 2 min
Operate time	Equation according to IEC 255-8, 1990 $t = \tau \cdot \ln\frac{I^2 - I_p^2}{I^2 - I_b^2 \cdot k^2}$ t = operate time k = constant = 1,01 I_p = load current before the overload occurs I_b = set basic current τ = set thermal time constant
Accuracy on the operate value	I= ± 1% k = ± 0,01 t= ± ($t_{theoretical}$ x 0,01 + 50 ms)
Reset value, Alarm Trip Consistency	Θ < 95 % Θ < 80 % < 0,5 %
Influence of harmonics: 100/120 Hz, 10% 150/180 Hz, 10% 250/300 Hz, 10%	 < 3% < 3% < 3%

Over-current function

RXVK 2H	50-60 Hz, standard filter	40-2000 Hz, flat filter
Setting range I >	(0,5-20) x Is and ∞	
Setting range for time delay Accuracy	0,03-5 s 1% and ±10 ms	
Operate time (typical) I = 0 => 1,3 x I> I = 0 => 3 x I> I = 0 => 10 x I>	Time delay = 0,03 s 35 ms 25 ms 20 ms	
Reset time (typical) I = 3 => 0 x I> I = 20 => 0 x I>	 35 ms 60 ms	
Reset ratio (typical) Consistency	95% < 1,5%	
Transient over-reach L/R=10, 50 and 100 ms	< 5 %	< 20 %
Operate value at 150 Hz	App. 1,5 x set op. value	–
Operate value within the range 40-2000 Hz	–	< 1,1 x set op. value
Overshoot time	< 20 ms	
Recovery time at I = 3 x I>	< 40 ms	
Influence of harmonics: 100/120 Hz, 10% 150/180 Hz, 10% 250/300 Hz, 10%	 < 3% < 3% < 3%	 – – –

Auxiliary DC voltage supply

Auxiliary voltage EL for RXTUG 22H Auxiliary voltage to the relay	24-250 V DC, ±20% ±24 V (from RXTUG 22H)
Power consumption at RXTUG 22H input 24-250 V before operation after operation without RXTUG 22H ±24 V before operation after operation	Standard other filter Max. 4,5 W Max. 5,5 W Max. 6,0 W Max. 6,5 W Max. 1,3 W Max. 2,0 W Max. 3,0 W Max. 3,0 W

Binary input

Binary input voltage RL	48-60 V and 110-220 V DC, -20% to +10%
Power consumption 48-60 V 110-220 V	Max. 0,3 W Max. 1,5 W

Output relays

Contacts	3 change-over
Maximum system voltage	250 V AC / DC.
Current carrying capacity continuous during 1 s	 5 A 15 A
Making capacity at inductive load with L/R >10 ms during 200 ms during 1 s	 30 A 10 A
Breaking capacity AC, max. 250 V, cos φ > 0,4 DC, with L/R < 40 ms 48 V 110 V 220 V 250 V	 8 A 1 A 0,4 A 0,2 A 0,15 A

Electromagnetic compatibility (EMC), immunity tests

All tests are done together with the DC/DC-converter, RXTUG 22H

Test	Severity	Standard
Surge	1 and 2 kV, normal service 2 and 4 kV, destructive test	IEC 61000-4-5, class 3 IEC 61000-4-5, class 4
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 In normal service with cover on	 8 kV (contact) 15 kV (air) 8 kV, indirect application	 IEC 60255-22-2, class 4 IEC 60255-22-2, class 4 IEC 61000-4-2, class 4
Radiated electromagnetic field	10 V/m, 26-1000 MHz	IEC 61000-4-3, level 3
Conducted electromagnetic	10 V, 0,15-80 MHz	IEC 61000-4-6, level 3
Interruptions in auxiliary voltage 110 V DC, no resetting for interrup-tions	2-200 ms < 40 ms	IEC 60255-11

Electromagnetic compatibility (EMC), emission tests

Test	Severity	Standard
Conducted	0,15-30 MHz, class A	EN 50081- 2
Radiated	30-1000 MHz, class A	EN 50081- 2

Insulation tests

Test	Severity	Standard
Dielectric current circuit other circuits over open contact	 2,5 kV AC, 1 min 2,0 kV AC, 1 min 1,0 kV AC, 1 min	 IEC 60255-5
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

Mechanical tests

Test	Severity		Standard
Vibration	Response: Endurance:	2,0 g, 10-150-10 Hz 1,0 g, 10-150-10 Hz, 20 sweeps	IEC 60255-21-1, class 2 IEC 60255-21-1, class 1
Shock	Response: Withstand:	5 g, 11 ms, 3 pulses 15 g, 11 ms, 3 pulses	IEC 60255-21-2, class 1
Bump	Withstand:	10 g, 16 ms, 1000 pulses	IEC 60255-21-2, class 1
Seismic	X axis: Y axis: Z axis:	3,0 g, 1-35-1 Hz 3,0 g, 1-35-1 Hz 2,0 g, 1-35-1 Hz	IEC 60255-21-3, class 2, extended (Method A)

Temperature range

Storage	-20 °C to +70 °C
Permitted ambient temperature	-5 °C to +55 °C

Weight and dimensions

Equipment	Weight	Height	Width
RXVK 2H without RXTUG 22H	0,7 kg	4U	6C

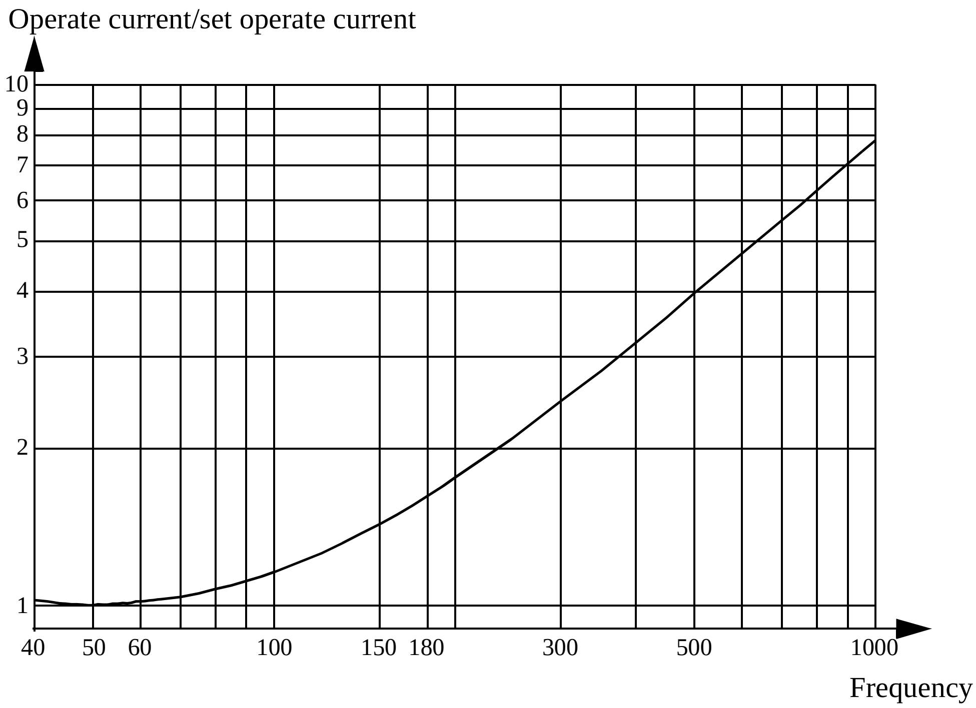


Fig. 8 Typical frequency characteristic for RXVK 50-60 Hz, standard, valid for valid for I ≤ 65 x Is.

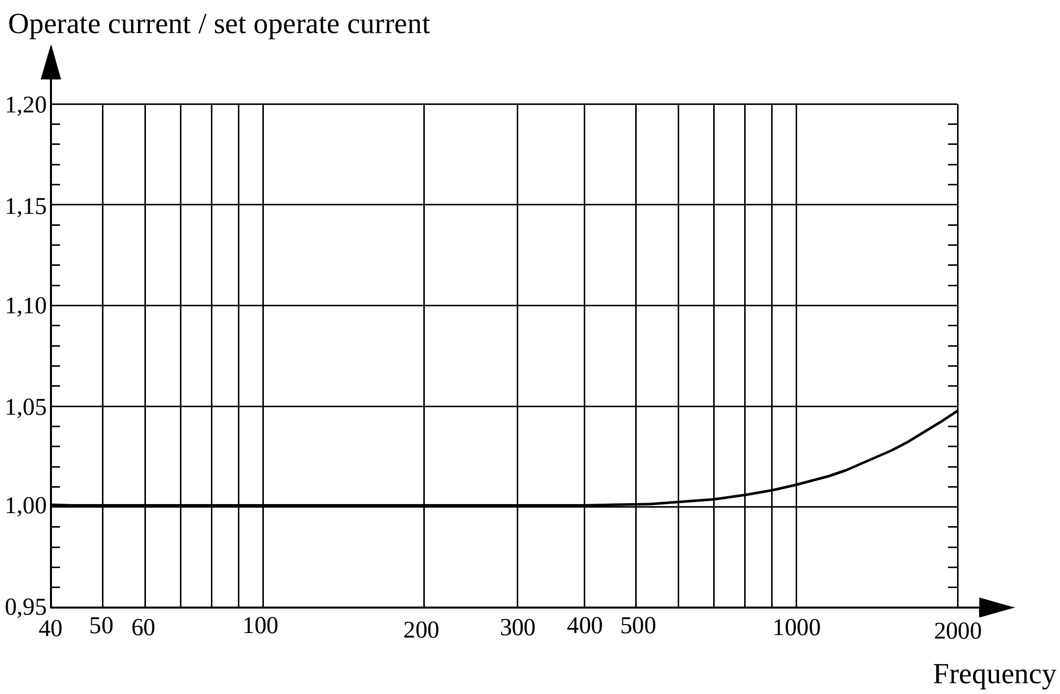


Fig. 9 Typical frequency characteristic for RXVK 40-2000 Hz, flat, valid for valid for I ≤ 65 x Is.

6 Receiving, Handling and Storage

6.1 Receiving and Handling

Remove the protection package from the transport case and make a visual inspection for transport damages. Check that all screws are firmly tightened and all relay elements are securely fastened.

Check that all units are included in accordance with the apparatus list.

Normal ESD (Electrostatic Discharge) precautions for microprocessor relays should be observed when handling the relays.

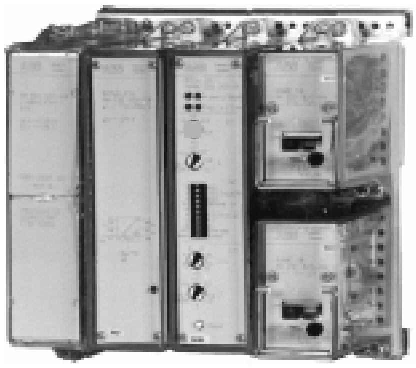
6.2 Storage

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

7 Installation, Testing and Commissioning

7.1 Installation

The relays and the RXTUG 22H DC-DC converter are plugged into COMBIFLEX® terminal bases type RX 4 or RX 2H. The terminal bases and the RTXT test switch, when included, are fixed on apparatus bars to make up the protection assembly.



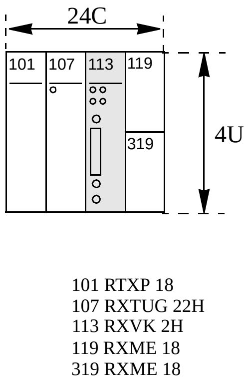


Fig. 10 RAVK single-phase thermal overcurrent protection acc. to Circuit diagram 1MRK 001 018-EA

The protection assembly can be mounted in the following ways:

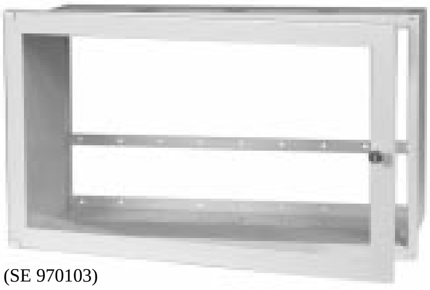
- on apparatus bars
- in a 19” equipment frame
- in RHGX case
- in RHGS case

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.

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

Equipment frames and relay cases.
Detailed information on the COMBIFLEX® connection and installation components is given in Catalogue 1MRK 513 003-BEN. Information on the relay mounting system is given in Catalogue 1MRK 514 001-BEN.

RHGS 30



(SE 970103)

Fig. 11 RHGS case

RHGS cases for 19” cubicle mounting or surface mounting
This type of case can be used for all common ways of mounting. The RHGS cases are available in three different sizes, which can be combined with mounting accessories to get maximum flexibility. The cases can also be combined together with the protections in the 500 range.

RHGX 8

(SE 81702)

Fig. 12 RHGX case

RHGX cases for flush- or semi-flush panel mounting
The RHGX cases are available in five sizes. The case, a metal box open at the back, has a flange (with a rubber sealing strip) at the front which acts as a stop when the case is inserted into a front panel opening. At the front of the case there is a door with a window and a rubber seal.

Size: 4U 19”

(SE 96399)

Fig. 13 19” equipment frame

19” equipment frames
These types of equipment frames are used for cubicle mounting or panel mounting of plug-in units in the COMBIFLEX® range. The frames are available in 3 sizes:

4U (17” x 19”)

8U (14” x 19”)

12U (21” x 19”)

for mounting 20, 40 and 60 module seats respectively.

Connections

The external connections (dotted lines on the terminal and circuit diagrams) are made with leads with 20 A COMBIFLEX® sockets to the RTXP 18 test switch and with 10 A sockets to the relay terminal bases.

Each unit in the protection assembly has a unique item designation. The item designations are based on a 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. The RTXP test switch in Fig. 14 has item designation 101, where the first figure stands for the U module position and the next two figures stand for the C module designation.

The terminal designations include the item designation number of the unit followed by the terminal number marked on the rear of the terminal socket.

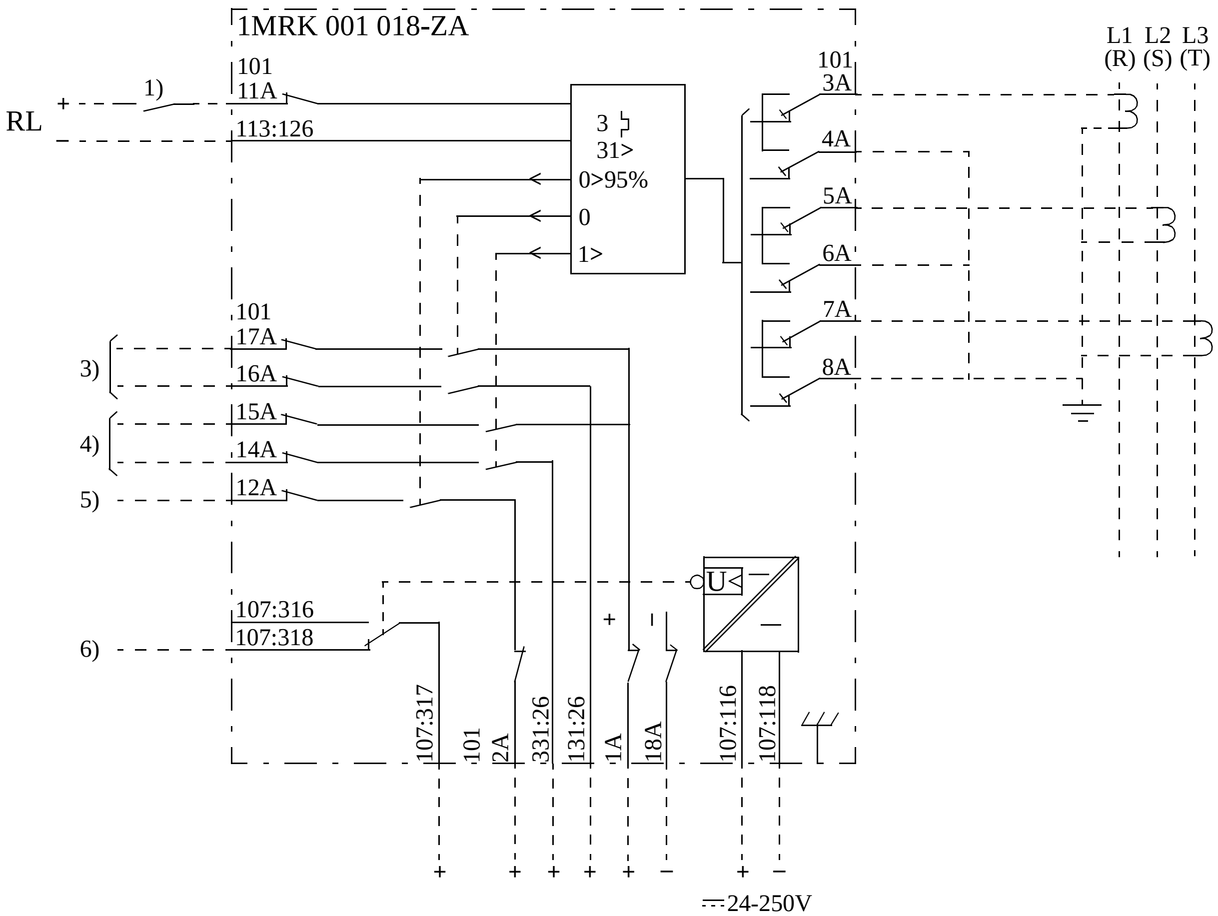


Fig. 14 Terminal diagram 1MRK 001 017-ZAA

For plug-in units size 2H an additional figure 1 or 3 defines if the terminal is in the upper resp. lower part of the assembly. Compare terminal designations 107:118 and 107:318 in Fig. 15.

Fig. 15 shows the rear of protection assembly RAVK, Order No. 1MRK 001 017-ZA. The position of the terminals, which are used for external connections according to connection diagram 1MRK 001 017-ZAA, is shown.

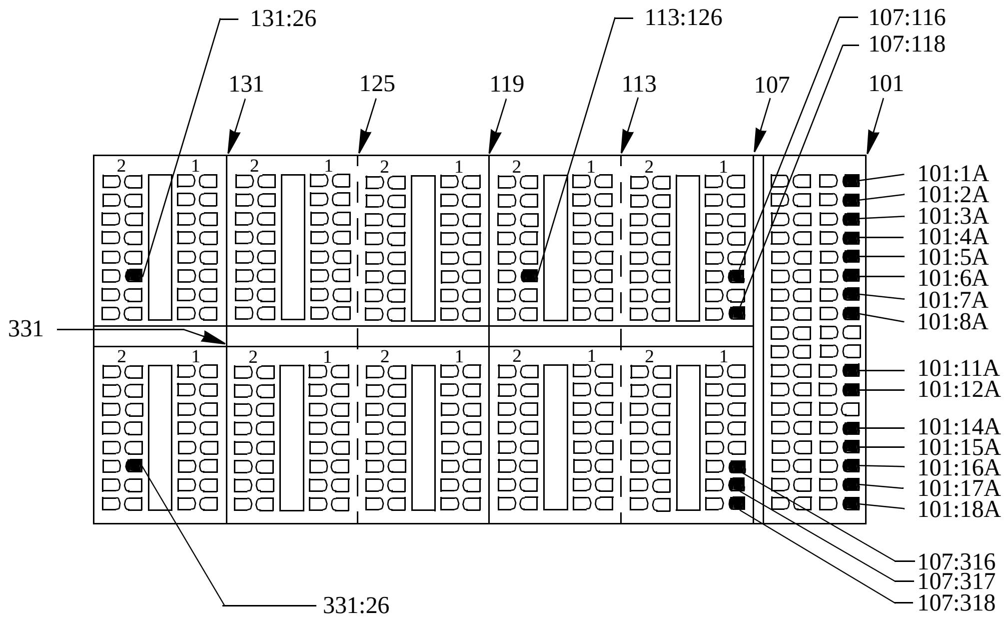


Fig. 15 Location of the terminals shown on diagram 1MRK 001 017-ZAA

7.2 Testing

Secondary injection testing

The standard relays (Order No's 1MRK 001 0xx-xA) are provided with the COMBITEST test switch type RTXP 18.

When the test-plug handle RTXH 18 is inserted in the test switch, preparations for testing are automatically carried out in the proper sequence, i.e. blocking of the tripping circuits, short-circuiting of the current transformers, opening of external circuits to the relay and making relay terminals accessible for testing from the terminals on the test-plug handle.

When the test handle is in the intermediate position, only the tripping circuits are opened. When the test-plug handle is fully inserted, the relay is completely disconnected from the current transformers and ready for secondary injection testing. Test terminals 1 and 18 are not open when the test-plug handle is inserted.

Relays not provided with test switches have to be tested in the proper way from external circuit terminals.

The RAVK two- and threephase protection is provided with separate measuring element RXVK 2H for each phase. It can be conveniently tested with a single-phase test set, e.g. the SVERKER test set with built-in timer.

Suitable test equipment:

- Test set SVERKER
- Multimeter or ammeter, Class 0,5 or better
- RTXH 18 test plug handle with test leads

Fig. 16 shows as an example the connection of test set SVERKER for secondary testing of the three-phase thermal protection RAVK, Connection Diagram 1MRK 001 018-ZAA. When testing, the actual circuit diagram of the protection, which shows the internal connections, should also be available.

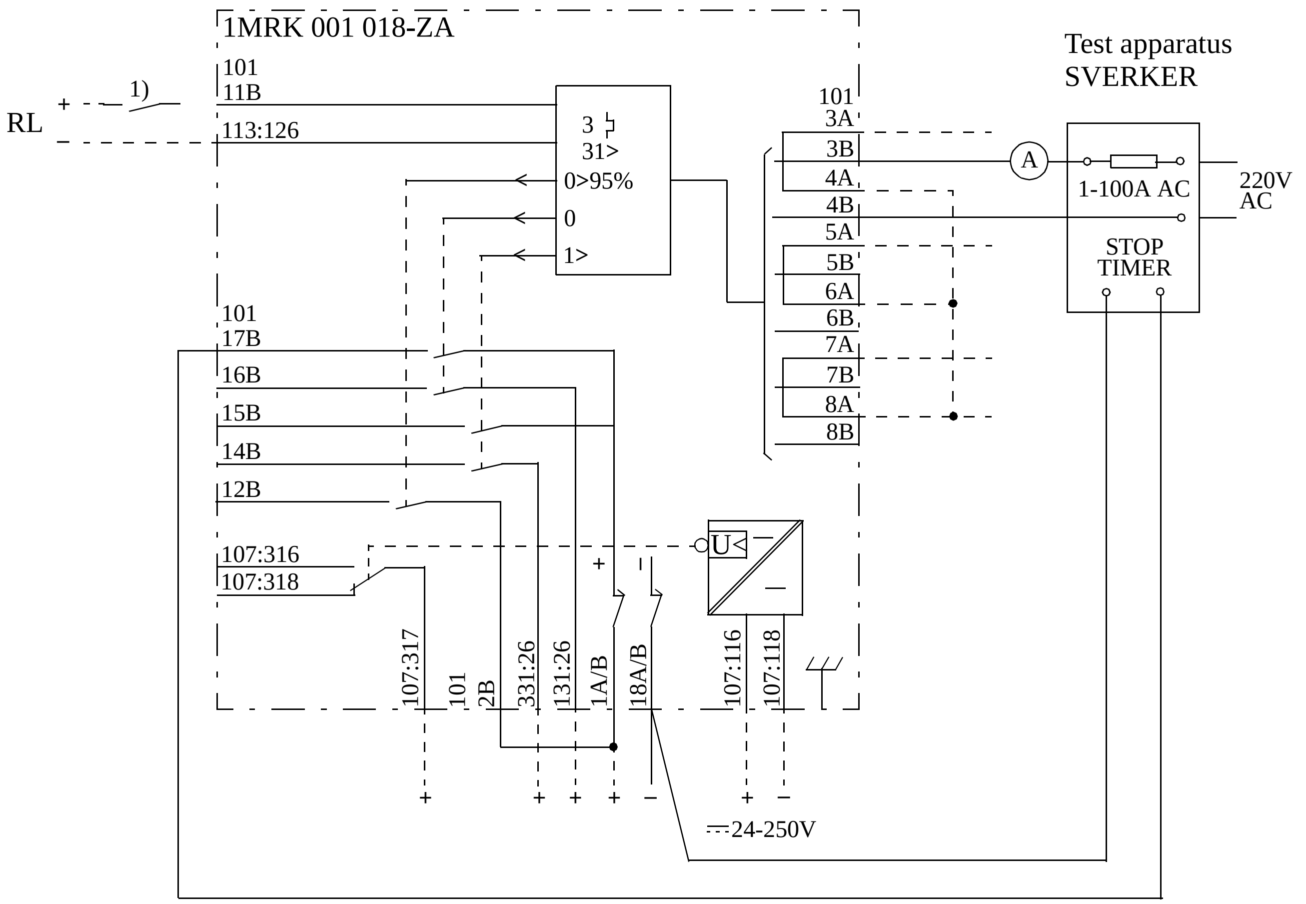


Fig. 16 Connection of test apparatus to RAVK for testing of phase L1. Test handle RTXH 18 inserted.

1. Insert the test-plug handle into the test switch. Connect the test set and the ammeter acc to Fig.16. Check that auxiliary voltage is connected to terminals 101:1A and 101:18A. Interconnect terminals 1 and 2 on the test handle to get output voltage to test terminal 12 when the 95 % alarm function output relay is activated.

2. Make the appropriate settings of the start current for the thermal function and the over-current stage I>. Set the switch S1:9 to position “Reset“. Guide for the setting of the switches and potentiometers on the front of the RXVK 2H relay is given in Section 4, “Setting and connection”.

3. Set the time constant τ temporarily to zero to get instant function of the thermal stage when the set start current is injected. Increase slowly the injection current. The thermal function shall operate at 1,01 x the set (basic) current I_b.

4. Set the time constant τ to the correct value. Adjust the injection current to 3 · I_b. Switch off the injection current and depress the “ Reset “ push-button to empty the thermal memory of the relay. Switch on the current and check that the operate time is 0,12 · τ. Check in the same way another point on the curve, e.g. at 1,5 · I_b (t = 0,6 · τ). The operate- time curves of the relay are shown in Section 1.1. Check that the LED indicators for 95% and thermal trip operate.

5. Move the timer stop wire to test terminal 16 and check that trip output is obtained when the thermal stage operates and voltage is supplied to terminal 131:26. Switch off the injection current instantly when the thermal stage has operated and check that the output relay resets after a time equal to about 0,22 · τ (80 % thermal content).

6. Empty the thermal memory of the relay. Move the timer stop wire to test terminal 12 and check that the operate time for the 95 % alarm stage is about 0,11· τ when the injection current is 3 · I_b.

7. Move the timer stop wire to test terminal 15. Set the timer for I> temporarily to min. value and check the start current. Check the reset value. Set the timer to the correct value, and check the time delay when injecting 1,5· set start current.

8. Move the timer stop wire to test terminal 14 and check that trip output is obtained when over-current stage operates and voltage is supplied to terminal 331:26.

9. Set the binary input switch to the correct position and check the binary input by connecting voltage +RL to test terminal 11.

10. Check the relays for phases L2 and L3 in the same way as described above for phase L1.

11. Remove the test handle and check that all indicating LEDs and flags are reset. Insert the plastic plug in the hole of the resetting push-button.

7.3 Commissioning

The commissioning work includes a check of all external circuits connected to the protection and check of the current ratio for the current transformers.

The DC circuits and tripping circuits should be checked, including operation of the circuit-breaker(s).

8 Maintenance

Under normal conditions, the over-current thermal protection relays require no special maintenance. The covers should be mounted correctly in position and the holes for the resetting knobs sealed with plastic plugs.

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

Under normal operating conditions and when the surrounding atmosphere is of non-corrosive nature, it is recommended that the relays be routine tested every four to five years.

9 Circuit and terminal diagrams

The table below shows the different variants of the thermal overcurrent protection RAVK**.**

Type	Function	Test switch	DC-DC con-verter	Tripping relays	Ordering No. 1MRK 001	Circuit Diagram 1MRK 001	Terminal diagram 1MRK 001	Diagram
RAVK 1	1 (Θ +I >)	x			017-BA	018-BA	018-BAA	On request
RAVK 1	1 (Θ +I >)		x		017-CA	018-CA	018-CAA	On request
RAVK 1	1 (Θ +I >)	x	x		017-DA	018-DA	018-DAA	On request
RAVK 1	1 (Θ +I >)	x	x	x	017-EA	018-EA	018-EAA	Fig. 17, 18
RAVK 2	2 (Θ +I >)	x			017-GA	018-GA	018-GAA	On request
RAVK 2	2 (Θ +I >)		x		017-HA	018-HA	018-HAA	On request
RAVK 2	2 (Θ +I >)	x	x		017-KA	018-KA	018-KAA	On request
RAVK 2	2 (Θ +I >)	x	x	x	017-LA	018-LA	018-LAA	Fig. 19, 20
RAVK 3	3 (Θ +I >)	x			017-NA	018-NA	018-NAA	On request
RAVK 3	3 (Θ +I >)		x		017-YA	018-YA	018-YAA	On request
RAVK 3	3 (Θ +I >)	x	x		017-PA	018-PA	018-PAA	On request
RAVK 3	3 (Θ +I >)	x	x	x	017-ZA	018-ZA	018-ZAA	Fig. 21, 22

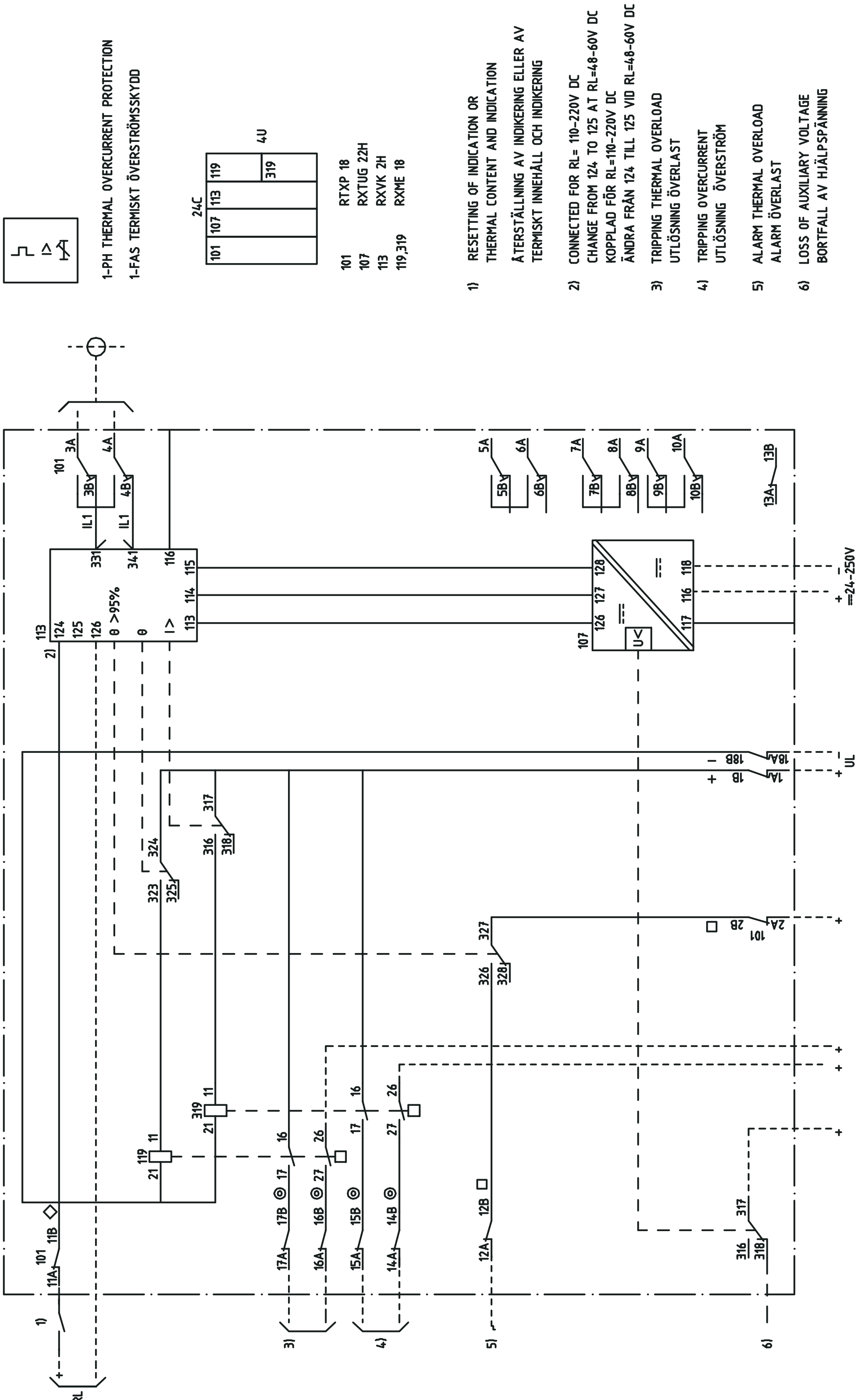


Fig. 17 Circuit diagram 1MRK 001 018-EA

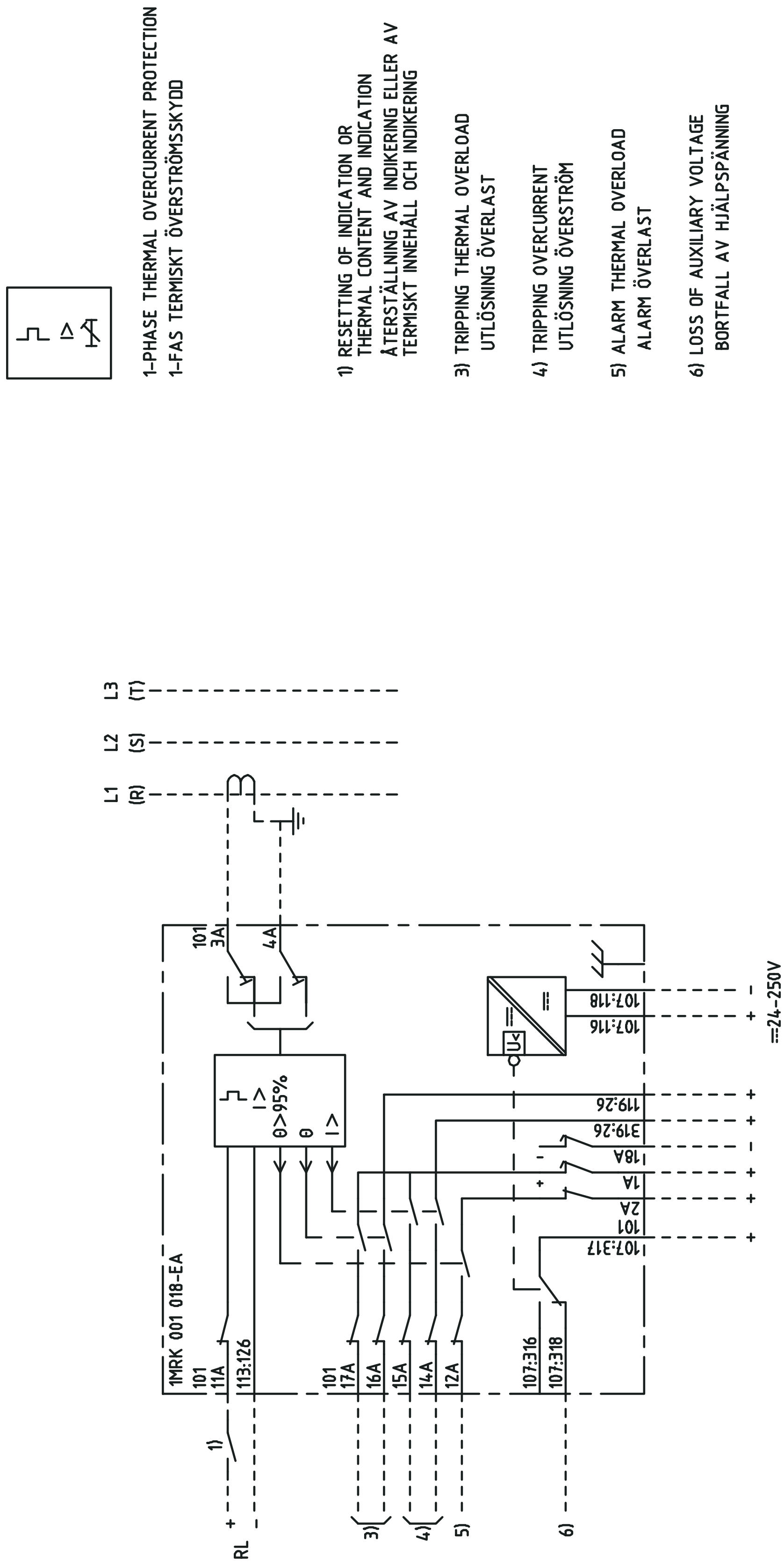


Fig. 18 Terminal diagram 1MRK 001 018-EAA

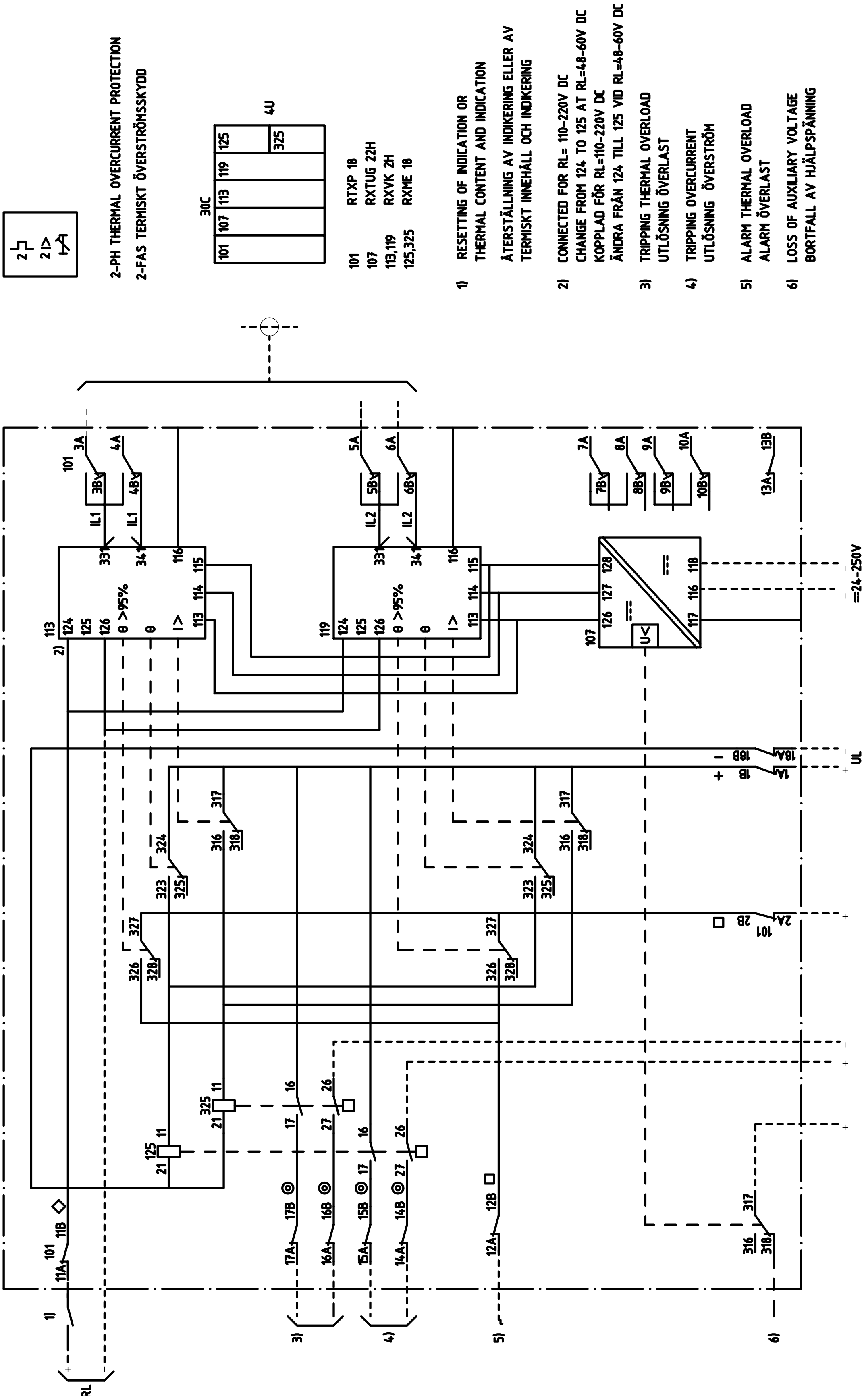


Fig. 19 Circuit diagram 1MRK 001 018-LA

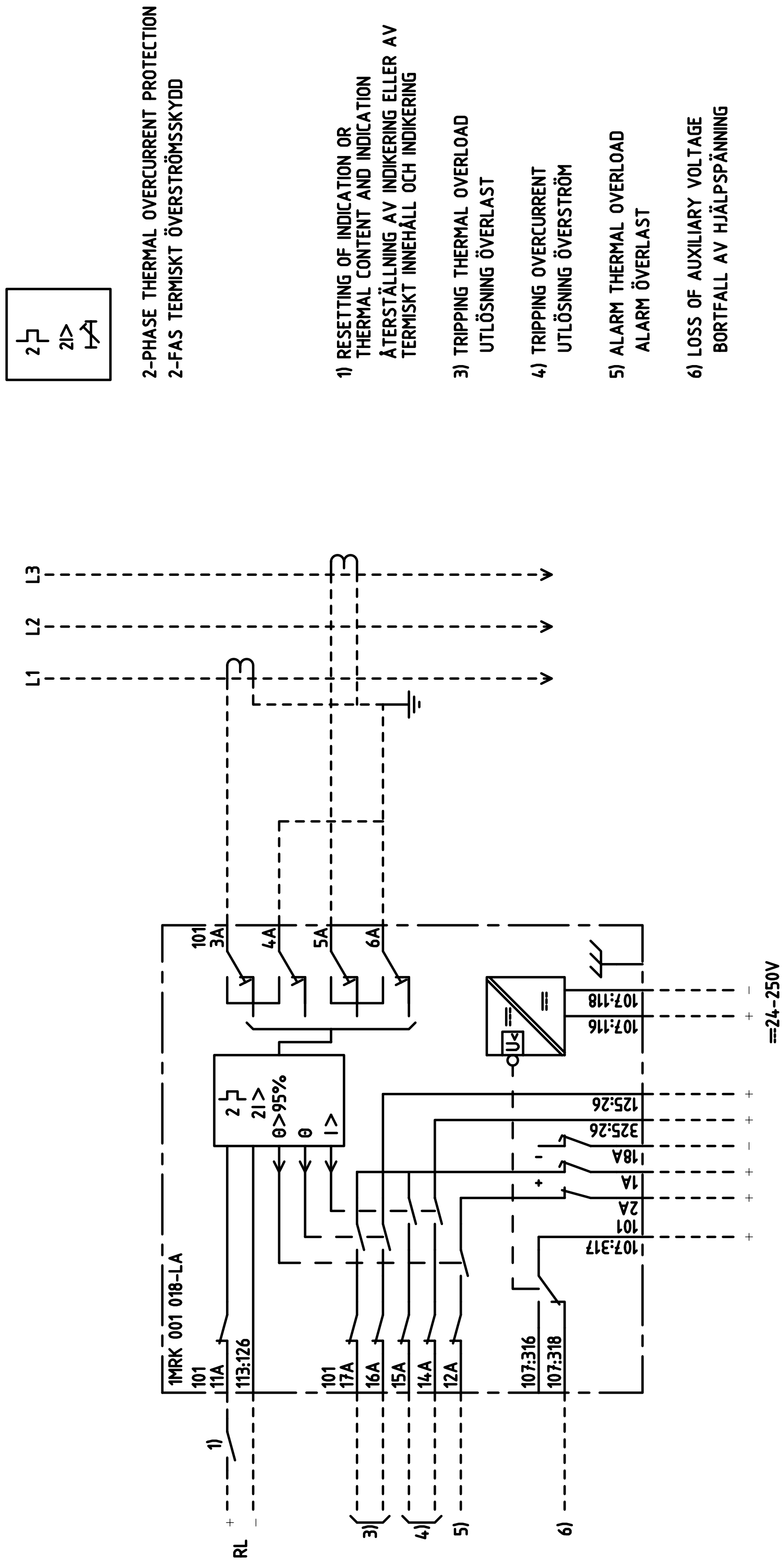


Fig. 20 Terminal diagram 1MRK 001 018-LAA

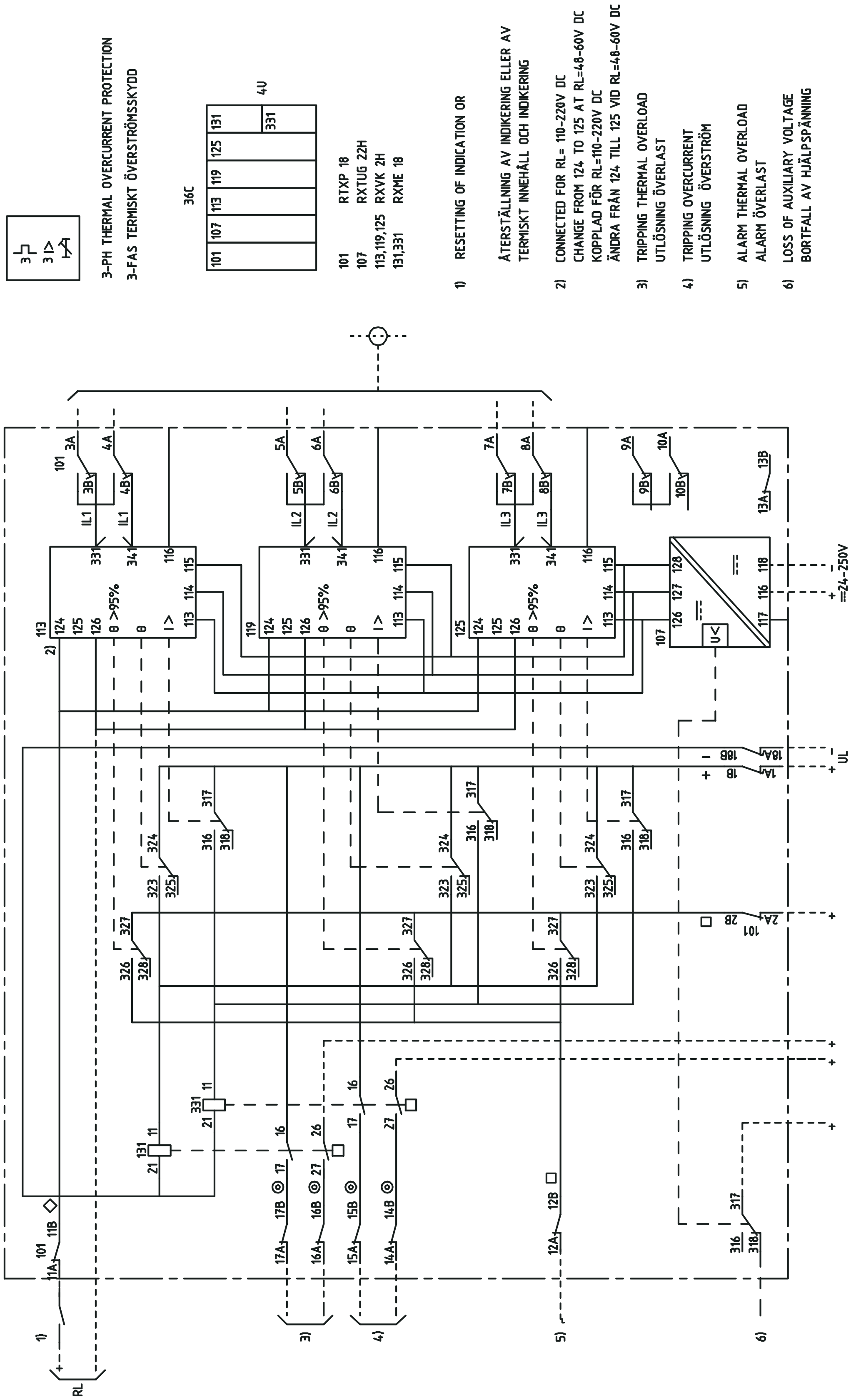


Fig. 21 Circuit diagram 1MRK 001 018-ZA

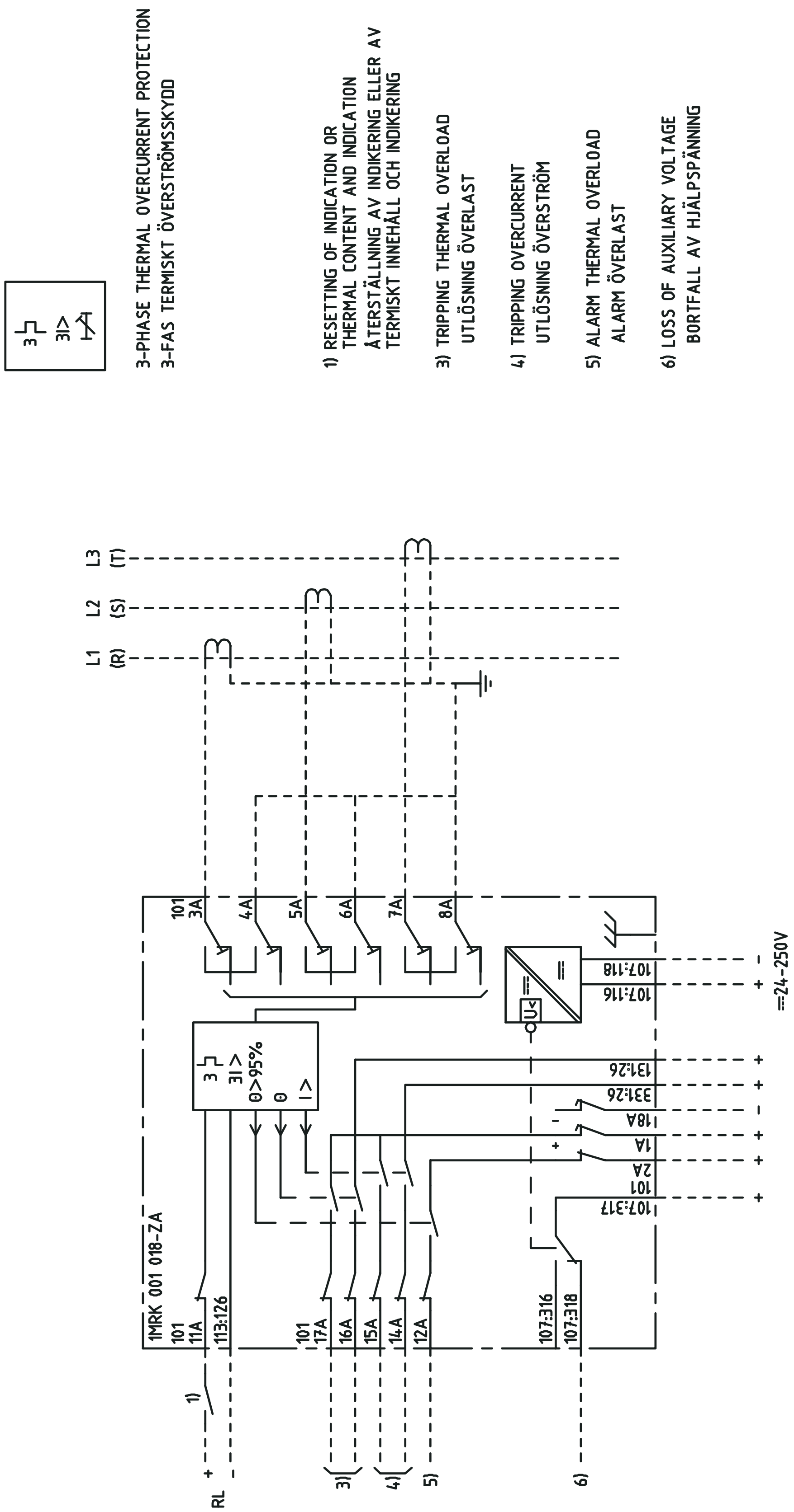


Fig. 22 Terminal diagram 1MRK 001 018-ZAA

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