

RXFK 2H and RAFK

Time over/underfrequency relay with protection assemblies

1MRK 509 009-BEN

Page 1
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(SE970104)



(SE970108)

Features

- Micro-processor based dual set point time-over/underfrequency relay with continuous settings for start and trip functions
- Two variants, with wide setting ranges in two measuring stages
- The two setting points are usable for over- or underfrequency independently of each other
- Settable rated frequency 50 or 60 Hz
- Two variants ± 4 Hz and ± 10 Hz
- Setting range for ± 4 Hz variant
 - 46-54 Hz or 56-64 Hz
- Setting range for ± 10 Hz variant
 - Stage 1 (f_1) for 45-55 Hz or 55-65 Hz
 - Stage 2 (f_2) for 40-60 Hz or 50-70 Hz
 - Stage 2 can also be used for rate-of change of frequency (df/dt)
- Combines frequency, rate-of-change (df/dt) and time delay functions in one module
- Absolute value df/dt or negative df/dt only
- Measuring voltage range 20 - 320 V ac
- Time delay settable up to 20 s
- Load shedding and restoration application

Application

Frequency relays are used whenever deviations from nominal system frequency need to be detected. Frequency deviations can be harmful to connected objects, such as generators and motors, or when abnormal frequency creates inconvenience for power consumers and may cause failures of electrical apparatuses. Frequency relays are also used where detection of high or low frequency indicates system abnormalities, such as faults in speed regulation units or system overload.

Underfrequency relays should be considered for applications where the detection of underspeed conditions for synchronous motors and condensers is required. On lines where reclosing of the source breaker is utilized, damage to large synchronous motors can be avoided by disconnecting the motors from the system. Likewise, disconnection of synchronous condensers can be initiated upon loss of power supply.

The overfrequency relay is generally utilized for the protection of ac machines from possible damage due to overspeed conditions. These conditions can occur, for example, on machines with no mechanical governor or on those with the machine shaft linked to a prime mover or to another machine, either one of which could accelerate the combination to a hazardous overspeed condition (e.g. a hydro generator).

Another application is typical to large industrial plants which have some local generation. Normally, they depend on a tie line with a utility for some portion of their power needs. If the tie breaker at the utility end should open, the generator in the plant would be overloaded, especially if it also tries to pick up utility load on the tie line. The overload then causes an underfrequency condition on the industrial system. The RXFK 2H relay can be used to open the tie to the utility system and disconnect nonessential load.

Essential loads can then be maintained to the limit of the generator capability.

In local, independent power producer network applications, a typical protection scheme may include a two-step frequency relay with one under- and one overfrequency function (RXFK 2H) and another relay providing an under- and an overvoltage function (RXEDK 2H).

In general, higher requirements are imposed on accuracy of setting and measuring capabilities in load-shedding and load restoration applications than in power system object protection applications. Two versions of the RXFK 2H relay exist for the different requirements of these applications.

The frequency relay type RXFK 2H is able to measure both the absolute frequency and its rate-of-change with great accuracy. The accuracy of the relay permits settings close to the system frequency and permits close steps between relay settings in a load shedding program.

Complete load shedding and load restoration schemes have been developed using several different frequency set points and time delays. A custom application can thus be tailored to the needs of the power system using standard COMBIFLEX modules.

Design

The frequency relay assemblies with RXFK 2H can be delivered in several variants for over- or underfrequency protection with different output circuits.

The RXFK 2H relay requires a separate dc-dc converter for auxiliary supply (± 24 V). One RXTUG converter can supply up to nine relays.

Note: When the RXFK 2H relay or the dc-dc converter RXTUG is plugged into or withdrawn from a terminal base, the auxiliary voltage supply must be interrupted. Neither is it allowed to open wiring on plus or minus supply with unit in service.

RXFK 2H measuring relay

The over/underfrequency relay, type RXFK 2H, is a static microprocessor based relay with two delayed stages. The relay consists mainly of an input voltage transformer, filter circuits, micropro-

cessor, MMI, LEDs for start, trip indications and three output units which provide separate change-over contacts for start indication of stages 1 and 2, trip of stage 1 and trip of stage 2. The relay has also one binary input for reset LED.

Operate values for both stage 1 and 2, are set with the potentiometers and programming switches marked with U_s . Both measuring stages can independently be programmed for over- or underfrequency functions. Operation occurs for a frequency equal to or larger/lower than the set scale value and the selected scale constant.

The start function output is energized immediately after the measured value exceeds or falls below the set start frequency level.

Both measuring stages can be set for definite time delay.

Technical Data

Below data is for measuring relays RXFK 2H. For data of total assemblies please also refer to catalogues for other included relays.

Table 1: Voltage input

Rated voltage U_r	100/200 V
Set voltage U_s	$(0,1-0,8) \times U_r$ (in steps of 0,1)
Setting range U_s $U_r = 100$ V	10-80 V in step of 10 V
Setting range U_s $U_r = 200$ V	20-160 V in step of 20 V
Effective voltage range U	$(1-4) \times U_s$
Voltage block	$U < U_s$
Rated frequency f_r	50/60 Hz
Operate frequency range	40-70 Hz
Power consumption at $U_r = 100$ V	
U = lowest U_s	2 mVA
U = highest U_s	210 mVA
Overload capacity continuously	3,5 x U_r (Max. 500 V AC for COMBIFLEX)
during 10 s	4,0 x U_r (Max. 500 V AC for COMBIFLEX)

Table 2: Start function (Variant -AA)

Frequency function	Stage f_1 and f_2 (Frequency measuring)	Stage f_2 df/dt (Rate-of-change of frequency)
Setting range	$f_1 = 45\text{--}55\text{ Hz alt. } 55\text{--}65\text{ Hz}$ $f_2 = 40\text{--}60\text{ Hz alt. } 50\text{--}70\text{ Hz}$	$ 0,5\text{--}10 \text{ Hz/s alt.}$ $-(0,5\text{--}10) \text{ Hz/s}$
Measuring mode	Over or under frequency	Abs. or negative df/dt
Operate time at 50 Hz (typical) Hz = 0 $\Rightarrow$ 1,001 x operate value Hz = 0,99 $\Rightarrow$ 1,001 x operate value Operate time at 50 and 60 Hz at a simultaneous change of voltage and frequency. Start frequency 50 Hz (typical) Hz/s = 0 $\Rightarrow$ 1,10 x operate value Hz/s = 0 $\Rightarrow$ 1,50 x operate value	Start function 1045 ms (Voltage block for 1 s) 55 ms 35-80 ms Independent of voltage level	Start function df/dt set to: 0,5 Hz/s 1,0 Hz/s 310 ms 285 ms 245 ms 230 ms
Consistency of operate value	< 10 mHz	0,5 Hz/s < 5% 1,0 Hz/s < 3% 5,0 Hz/s < 3% 10 Hz/s < 2%
Reset value	70-100 mHz lower or higher than the set operate value (over/under)	
Harmonics: 100 / 120 Hz, 20% 150 / 180 Hz, 20% 250 / 300 Hz, 20%	No influence on the operate value No influence on the operate value No influence on the operate value	

Table 3: Trip function (Variant -AA)

Frequency function	Stage f_1 and f_2 (Frequency measuring)
Time-delay	Definite time
Setting range	$t = (0)\text{--}20 \text{ s}$
Accuracy at 50 Hz	1% and $\pm 10 \text{ ms}$
Reset time at 50 Hz (typical) Hz = 1,05 $\Rightarrow$ 0,99 x operate value	55 ms

Table 4: Trip function (Variant -AA, df/dt)

Frequency function	Stage f_2 df/dt (Rate-of-change of frequency)	
Time-delay	Definite time	
Setting range	$t = (0) \text{ to } 20 \text{ s}$	
Start frequency 50 Hz Hz/s = 0 $\Rightarrow$ 1,10 x operate value Hz/s = 0 $\Rightarrow$ 1,50 x operate value	$t = (0)$ (typical) df/dt set to: 1,0 Hz/s 285 ms 230 ms	$t = 2 \text{ to } 20 \text{ s}$ df/dt set to: 0,5 Hz/s 1,0 Hz/s 1% and $\pm 40 \text{ ms}$ 1% and $\pm 30 \text{ ms}$ 1% and $\pm 20 \text{ ms}$ 1% and $\pm 20 \text{ ms}$
Reset time Start frequency 50 Hz Hz/s = 1,05 $\Rightarrow$ 0 x operate value	df/dt set to: 1,0 Hz/s 220 ms	df/dt set to: 0,5 Hz/s 1,0 Hz/s 235 ms 220 ms

Table 5: Start function (Variant -BA)

Frequency function	Stage f_1 and f_2 (Frequency measuring)
Setting range	f_1 and f_2 = 46-54 Hz alt. 56-64 Hz
Frequency measuring	Over or under frequency
Operate time at 50 Hz (typical) Hz = 0 $\Rightarrow$ 1,001 x operate value Hz = 0,99 $\Rightarrow$ 1,001 x operate value Operate time at 50 and 60 Hz at a simultaneous change of voltage and frequency.	Start function 1035 ms (Voltage block for 1 s) 70 ms 50 - 90 ms, Independent of voltage level
Consistency of operate value	< 10 mHz
Reset value	80-100 mHz lower or higher than the set operate value (over/under)
Harmonics: 100 / 120 Hz, 20% 150 / 180 Hz, 20% 250 / 300 Hz, 20%	No influence on the operate value No influence on the operate value No influence on the operate value

Table 6: Trip function (Variant -BA)

Frequency function	Stage f_1 and f_2 (Frequency measuring)
Time-delay	Definite time
Setting range	t = (0)-20 s
Accuracy at 50 Hz	1% and ± 10 ms
Reset time at 50 Hz (typical) Hz = 1,05 $\Rightarrow$ 0,99 x operate value	70 ms

Table 7: Auxiliary DC voltage supply

Auxiliary voltage EL for RXTUG 22H Auxiliary voltage to the relay	24-250 V DC, $\pm 20\%$ ± 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	Max. 5,5 W Max. 6,5 W Max. 2,0 W Max. 3,0 W

Table 8: 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

Table 9: 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	8 A 1 A 0,4 A 0,2 A 0,15 A

Table 10: Electromagnetic disturbance tests

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

Test	Severity	Standard
Surge immunity test	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 test	500 V, AC	SS 436 15 03, PL 4
Power frequency field immunity test	1000 A/m	IEC 61000-4-8
1 MHz burst test	2,5 kV	IEC 60255-22-1, class 3
Spark test	4-8 kV	SS 436 15 03, PL 4
Fast transient test	4 kV	IEC 60255-22-4, class 4
Electrostatic discharge test 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 test	10 V/m, 26-1000 MHz	IEC 61000-4-3, Level 3
Conducted electromagnetic test	10 V, 0,15-80 MHz	IEC 61000-4-3, Level 3
Interruptions in auxiliary voltage 110 VDC, no resetting for interruptions	2-200 ms < 40 ms	IEC 60255-11

Table 11: Electromagnetic emission tests

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

Table 12: Insulation tests

Test	Severity	Standard
Dielectric test Circuit to circuit and circuit to earth Over open contact	2,0 kV AC, 1 min 1,0 kV AC, 1 min	IEC 60255-5
Impulse voltage test	5 kV, 1,2/50 μ s, 0,5 J	IEC 60255-5
Insulation resistance	> 100 M Ω at 500 V DC	IEC 60255-5

Table 13: Mechanical tests

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

Table 14: Temperature range

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

Table 15: Weight and dimentions

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

Diagrams

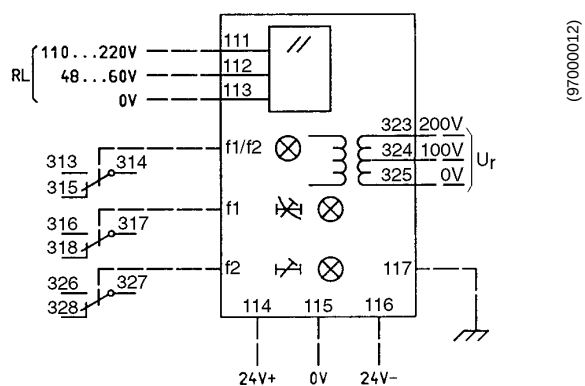


Fig. 1 Terminal diagram RXFK 2H

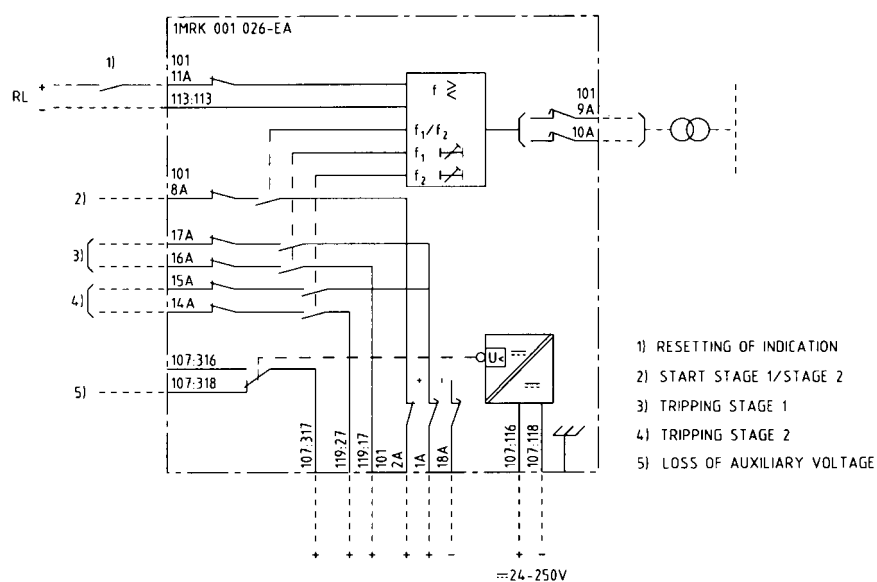
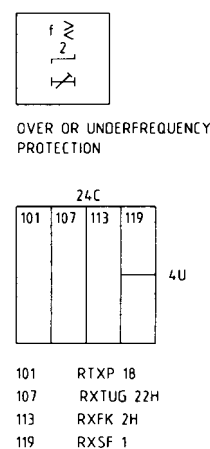


Fig. 2 Terminal diagram 1MRK 001 026-EAA



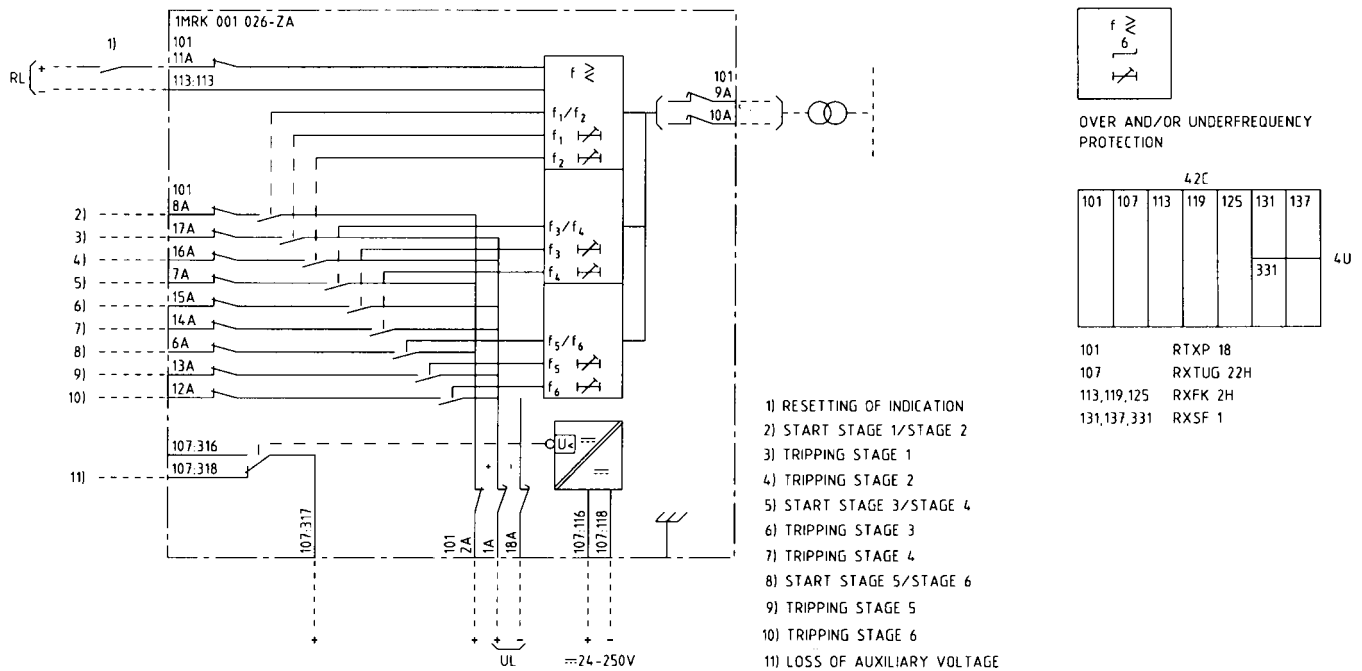


Fig. 3 Terminal diagram 1MRK 001 026-ZAA

Protection assemblies

RAFK

Protection assemblies are built up based upon time frequency relay RXFK 2H. Test device RXTP 18 and dc/dc-converter RXTUG 22H can also be included for specific application requirements. Test device RTXP 18 is a tool for relay testing.

DC/DC-converter RXTUG 22H can be used either separately for a single protection or to feed also other protections with up to 9 units of the same relay family. With RXTUG 22H all requirements concerning disturbance emission and immunity with this protection assembly will be met.

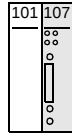
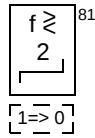
The assemblies have output contacts as specified for the relay RXFK 2H, which in most cases are fully sufficient. Protections are normally avail-

lable with output logic with heavy duty relay RXME 18 (RK 221 825-XX) 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 extremely flexible mounting system COMBI-FLEX together with a modern CAD-system enables us to present a unique flexibility for designing assemblies upon the customers requests.

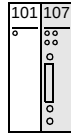
The interface voltage for enable or block impulses can be connected to either 48-60 V dc or 110-220 V dc by connecting the voltage circuit to separate terminals. At delivery all relays are connected for 110-220 V dc.

RAFK 1 Two steps frequency protection



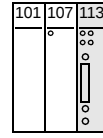
101 RTXP 18
107 RXFK 2H

Order No.	Circuit diagram
1MRK 001 025-BA	1MRK 001 026-BA



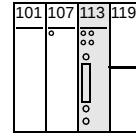
101 RXTUG 22H
107 RXFK 2H

Order No.	Circuit diagram
1MRK 001 025-CA	1MRK 001 026-CA



101 RTXP 18
107 RXTUG 22H
113 RXFK 2H

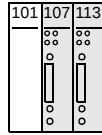
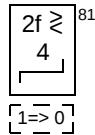
Order No.	Circuit diagram
1MRK 001 025-DA	1MRK 001 026-DA



101 RTXP 18
107 RXTUG 22H
113 RXFK 2H
119 RXSF 1

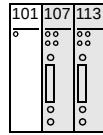
Order No.	Circuit diagram
1MRK 001 025-EA	1MRK 001 026-EA

RAFK 2 Four steps frequency protection



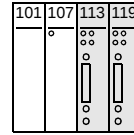
101 RTXP 18
107 RXFK 2H
113 RXFK 2H

Order No.	Circuit diagram
1MRK 001 025-GA	1MRK 001 026-GA



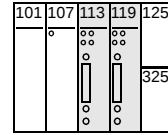
101 RXTUG 22H
107 RXFK 2H
113 RXFK 2H

Order No.	Circuit diagram
1MRK 001 025-HA	1MRK 001 026-HA



101 RTXP 18
107 RXTUG 22H
113 RXFK 2H
119 RXFK 2H

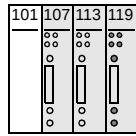
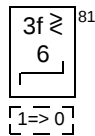
Order No.	Circuit diagram
1MRK 001 025-KA	1MRK 001 026-KA



101 RTXP 18
107 RXTUG 22H
113 RXFK 2H
119 RXFK 2H
125 RXSF 1
325 RXSF 1

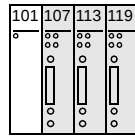
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1MRK 001 025-LA	1MRK 001 026-LA

RAFK 3 Six steps frequency protection



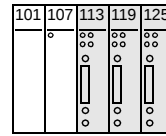
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107 RXFK 2H
113 RXFK 2H
119 RXFK 2H

Order No.	Circuit diagram
1MRK 001 025-NA	1MRK 001 026-NA



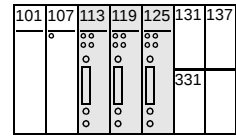
101 RXTUG 22H
107 RXFK 2H
113 RXFK 2H
119 RXFK 2H

Order No.	Circuit diagram
1MRK 001 025-YA	1MRK 001 026-YA



101 RTXP 18
107 RXTUG 22H
113 RXFK 2H
119 RXFK 2H
125 RXFK 2H

Order No.	Circuit diagram
1MRK 001 025-PA	1MRK 001 026-PA



101 RTXP 18
107 RXTUG 22H
113 RXFK 2H
119 RXFK 2H
125 RXFK 2H
131 RXSF 1
331 RXSF 1
137 RXSF 1

Order No.	Circuit diagram
1MRK 001 025-ZA	1MRK 001 026-ZA

Mounting alternatives

All assemblies can be delivered in the following mounting alternatives:

- on apparatus bar
- in equipment frame 60C
- in RHGS
- in RHGX

Ordering

Specify RAFK (Protection):

- Quantity
- Ordering number
- Code C, H, M
- Desired wording on the lower half of the test switch face plate max. 13 lines with 14 characters per line.

Specify RXFK (Loose Relay):

- Quantity
- Ordering number

Time over/undervoltage relay

Type	Voltage	Variant	Article No.	Code
RXFK 2H	100/200 V $\pm$ 10 Hz	AA	1MRK 000 842-AA	☐ C1
RXFK 2H	100/200 V $\pm$ 4 Hz	BA	1MRK 000 842-BA	☐ C2

Auxiliary voltage

For included auxiliary relays

	Code
24 V dc	☐ H5
48-55 V dc	☐ H6
110-125 V dc	☐ H7
220-250 V dc	☐ H8

Mounting

Mounting alternatives	Size	Article No.	Code
Apparatus bars			☐ M10
Equipment frame without door	4U 19"	1MRK 000 137-GA	☐ M11
Equipment frame with door	4U 19"	1MRK 000 137-KA	☐ M12
RHGX 4	4U 12C	RK 927 001-AB	☐ M71
RHGX 8	4U 24C	RK 927 002-AB	☐ M72
RHGX 12	4U 36C	RK 927 003-AB	☐ M73
RHGX 20	4U 60C	RK 927 004-AB	☐ M74
RHGS 30	6U x 1/1 19" rack	1MRK 000 315-A	☐ M81
RHGS 12	6U x 1/2 19" rack	1MRK 000 315-B	☐ M82
RHGS 6	6U x 1/4 19" rack	1MRK 000 315-C	☐ M83

References

Connection and installation components in COMBIFLEX

1MRK 513 003-BEN

Relay accessories COMBIFLEX

1MRK 513 004-BEN

User's Guide RXFK 2H

1MRK 509 009-UEN