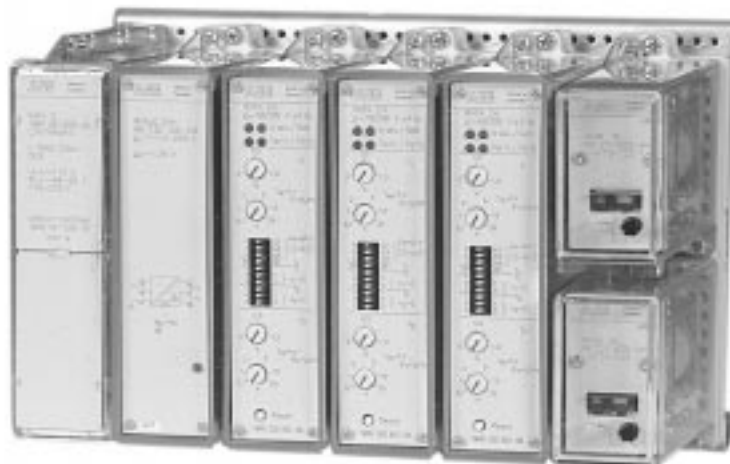




(SE970104)



(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  $\pm 4$  Hz and  $\pm 10$  Hz
- Setting range for  $\pm 4$  Hz variant
  - 46-54 Hz or 56-64 Hz
- Setting range for  $\pm 10$  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 under-speed 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).

## Application (cont'd)

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 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 ( $\pm 24$  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, microprocessor, HMI, 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 Setting range $U_s$ $U_r = 200$ V	10-80 V in step of 10 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 $U = \text{lowest } U_s$ $U = \text{highest } U_s$	2 mVA 210 mVA
Overload capacity      continuously during 10 s	$3,5 \times U_r$ (Max. 500 V AC for COMBIFLEX) $4,0 \times U_r$ (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	$f_1 = 45-55$ Hz alt. 55-65 Hz $f_2 = 40-60$ Hz alt. 50-70 Hz	$ 0,5-10 $ Hz/s alt. $-(0,5-10)$ 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

Technical Data (cont'd)

**Table 3: Trip function (Variant -AA)**

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 $\pm 10$ 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	$t = (0)$ to 20 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	$t = 2$ to 20 s df/dt set to: 0,5 Hz/s $t \pm (1\%+40 \text{ ms})$ $t \pm (1\%+20 \text{ ms})$ 1,0 Hz/s $t \pm (1\%+30 \text{ ms})$ $t \pm (1\%+20 \text{ ms})$
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 235 ms 1,0 Hz/s 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	$t \pm (1\%+10 \text{ ms})$
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, $\pm 20\%$ $\pm 24$ V (from RXTUG 22H)
Power consumption at RXTUG 22H input 24-250 V before operation after operation without RXTUG 22H $\pm 24$ 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, $\cos \varphi > 0,4$ 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

**Table 10: Electromagnetic compatibility (EMC), immunity tests**

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

Test	Severity	Standard
Surge immunity	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 field immunity	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 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	10 V/m, 26-1000 MHz	IEC 61000-4-3, Level 3
Conducted electromagnetic	10 V, 0,15-80 MHz	IEC 61000-4-3, Level 3
Interruptions in auxiliary voltage 110 V DC, no resetting for interruptions	2-200 ms < 40 ms	IEC 60255-11

Technical Data (cont'd)

**Table 11: Electromagnetic compatibility (EMC), 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 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	5 kV, 1,2/50 µs, 0,5 J	IEC 60255-5
Insulation resistance	> 100 MΩ 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 dimensions**

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

Fig. 2 Terminal diagram 1MRK 001 026-EAA

## Diagrams (cont'd)

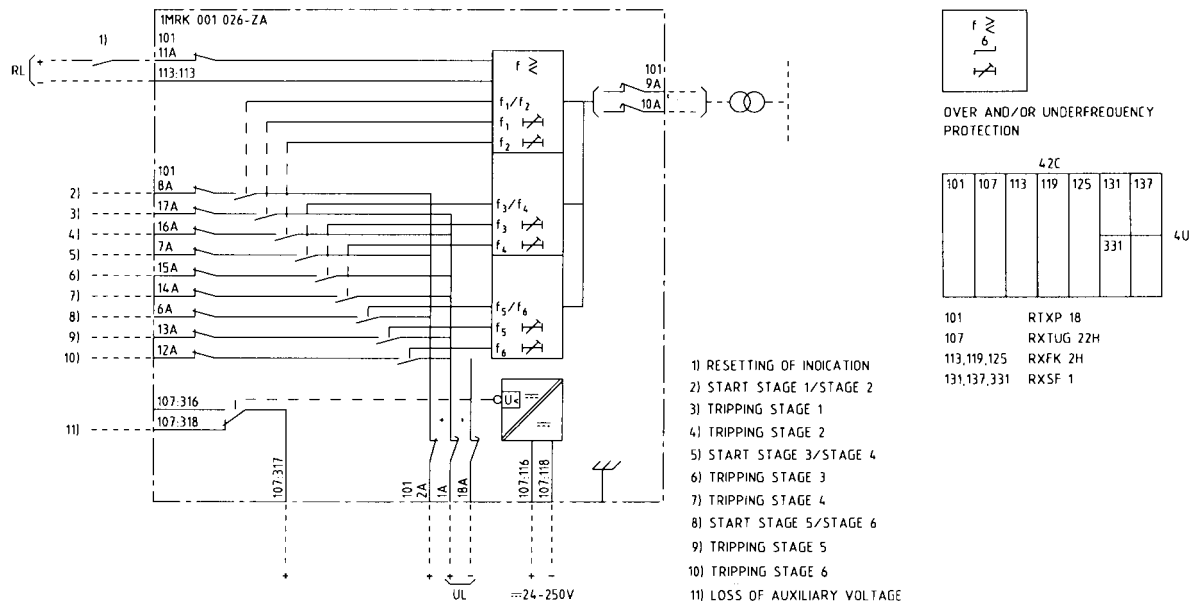


Fig. 3 Terminal diagram 1MRK 001 026-ZAA

## Protection assemblies

### RAFK

Protection assemblies are built up based upon time frequency relay RXFK 2H. Test device RXP 18 and dc/dc-converter RXTUG 22H can also be included for specific application requirements. Test device RXP 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 available with output logic with heavy

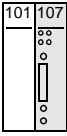
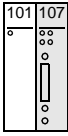
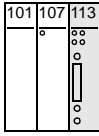
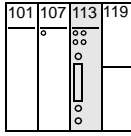
duty relay RXME 18 (RK 221 825-XX) with indicating flag and can upon request be completed with an output logic of free choice. Output relays are connected to separate auxiliary voltage.

The extremely flexible mounting system COMBIFLEX together with a modern CAD-system enables us to present a unique flexibility for designing assemblies upon the customers requests.

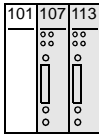
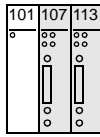
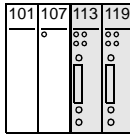
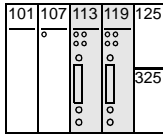
The interface voltage for enable or block impulses can be connected to either 48-60 V dc or 110-220 V dc by connecting the voltage circuit to separate terminals. At delivery all relays are connected for 110-220 V dc.



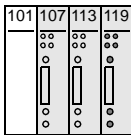
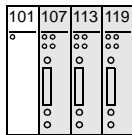
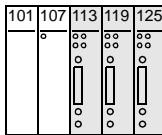
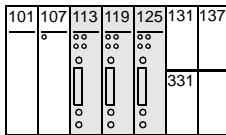
## RAFK 1 Two steps frequency protection

$f \geq 2$ $[1 \Rightarrow 0]$				
	101 RXP 18 107 RXFK 2H	101 RXTUG 22H 107 RXFK 2H	101 RXP 18 107 RXTUG 22H 113 RXFK 2H	101 RXP 18 107 RXTUG 22H 113 RXFK 2H 119 RXSF 1
	Order No.    Circuit diagram 1MRK        1MRK 001 025-BA   001 026-BA	Order No.    Circuit diagram 1MRK        1MRK 001 025-CA   001 026-CA	Order No.    Circuit diagram 1MRK        1MRK 001 025-DA   001 026-DA	Order No.    Circuit diagram 1MRK        1MRK 001 025-EA   001 026-EA

## RAFK 2 Four steps frequency protection

$2f \geq 4$ $[1 \Rightarrow 0]$				
	101 RXP 18 107 RXFK 2H 113 RXFK 2H	101 RXTUG 22H 107 RXFK 2H 113 RXFK 2H	101 RXP 18 107 RXTUG 22H 113 RXFK 2H 119 RXFK 2H	101 RXP 18 107 RXTUG 22H 113 RXFK 2H 119 RXFK 2H 125 RXSF 1 325 RXSF 1
	Order No.    Circuit diagram 1MRK        1MRK 001 025-GA   001 026-GA	Order No.    Circuit diagram 1MRK        1MRK 001 025-HA   001 026-HA	Order No.    Circuit diagram 1MRK        1MRK 001 025-KA   001 026-KA	Order No.    Circuit diagram 1MRK        1MRK 001 025-LA   001 026-LA

## RAFK 3 Six steps frequency protection

$3f \geq 6$ $[1 \Rightarrow 0]$				
	101 RXP 18 107 RXFK 2H 113 RXFK 2H 119 RXFK 2H	101 RXTUG 22H 107 RXFK 2H 113 RXFK 2H 119 RXFK 2H	101 RXP 18 107 RXTUG 22H 113 RXFK 2H 119 RXFK 2H 125 RXFK 2H	101 RXP 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        1MRK 001 025-NA   001 026-NA	Order No.    Circuit diagram 1MRK        1MRK 001 025-YA   001 026-YA	Order No.    Circuit diagram 1MRK        1MRK 001 025-PA   001 026-PA	Order No.    Circuit diagram 1MRK        1MRK 001 025-ZA   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	<input type="checkbox"/> C1
RXFK 2H	100/200 V $\pm 4$ Hz	BA	1MRK 000 842-BA	<input type="checkbox"/> C2

### Auxiliary voltage

For included auxiliary relays

	Code
24 V dc	<input type="checkbox"/> H5
48-55 V dc	<input type="checkbox"/> H6
110-125 V dc	<input type="checkbox"/> H7
220-250 V dc	<input type="checkbox"/> H8

### Mounting

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

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## 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

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