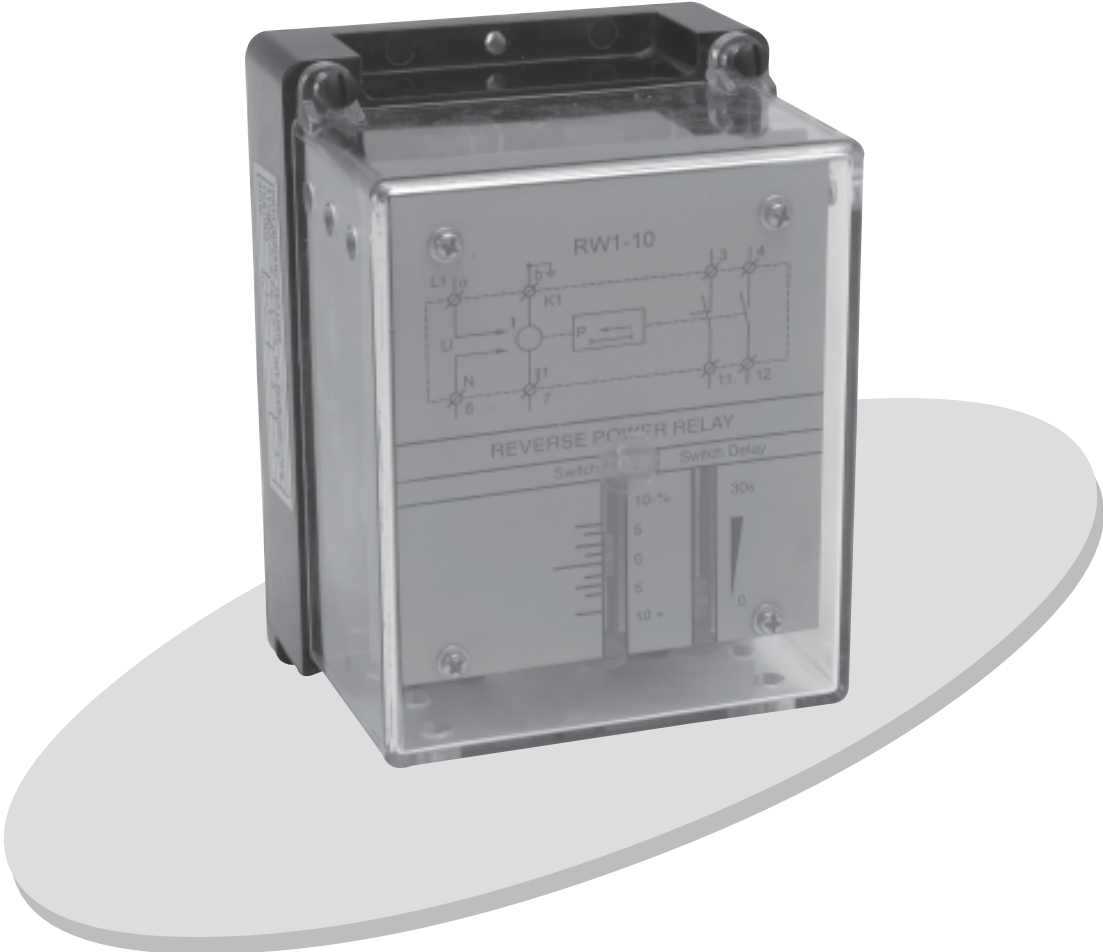


Functional Range

RW1 : Reverse Power Relay



C&S Protection & Control Ltd.

	Page No.
1. Application	2
2. Mode of operation	2-3
3. Instructions for Adjustment	3-4
4. Functional Check	5
5. Technical data	5-7
6. Order form	8

1. Application

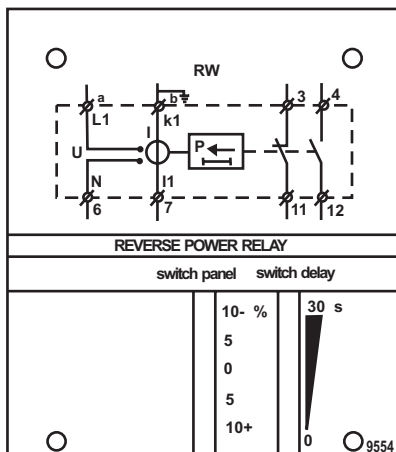
During parallel operation of a generator with a grid or with another generating system, it is necessary to supervise the power direction. Should, for instance, the driving unit fails, the generator acts as a motor by taking power from the grid and driving the unit. The reverse power relay **RW1** detects the reversal of power direction and disconnects the generator in case of fault. By there power losses as well as dangerous conditions the driving unit **RW1** is also suitable as a minimum load monitoring relay.

Two variants of the relay are available. Type **RW1-10** is used in low tension installations and type **RW1-12** in medium tension installation.

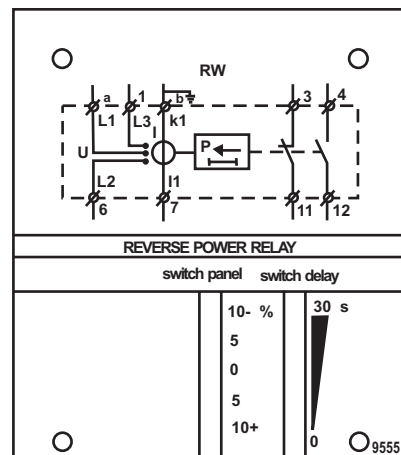
Versions available

- Active Power Relay
- Reactive Power Relay (available only in 3 phase, 3 wire connection type **RW1-12**)

Front plate RW1-10



Front plate RW1-12

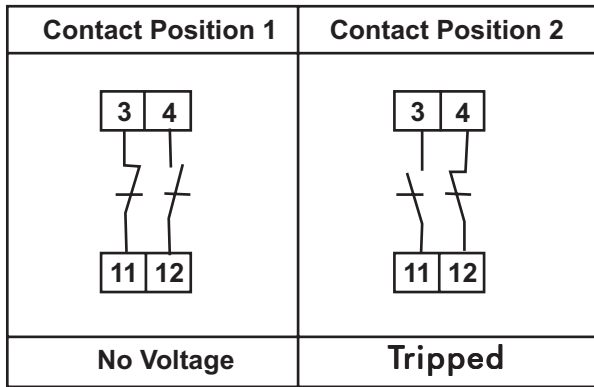


2 Mode at Operation

The reverse power relay **RW1** consists of an electronic power-measuring circuit and a freely adjustable time circuit for a switching-delay and a time circuit for connection time log. The power measuring circuit determines the magnitude and direction of the 3-phase power and causes a change-over of the relay from contact position 1 to the contact position 2 (see Fig. 1) in case of the percentage-value selected by the user.

If a negative percentage-value is adjusted, then the power monitor responds to the reverse power. By adjusting a positive value, it can also be used as a minimum-load monitor. Diagram 1 illustrates as to when the reverse-power relay remains in contacts position 1 or switches over to contact position 2.

Fig. 1 Contact Positions

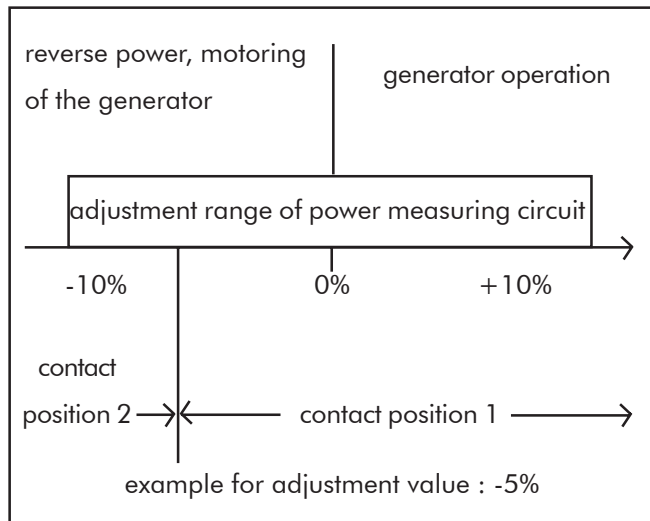


Should, for instance, the setting be in the negative range (-10% to 0%), then the relay remains in the contact position 1 if:

- the reverse power is smaller than the adjusted value.
- the power is equal to zero or positive.

A change-over to the contact position 2 takes place if the reverse power is greater than the adjusted value. Besides the adjustment value for the power-measuring circuit, a switching delay between 0s and 30s can be selected in order to by-pass the dynamic reactions. The delay is required, for instance, in case of which drives where a back feed in caused by the customers at times.

Diagram 1



3 Instructions for Adjustment

The reverse-power relay **RW1** has a spindle potentiometer for the adjustment of the switching point (in %) and the switching delay (in seconds).

3.1 Adjustment of the switching Point of the Power-measuring Circuit

Should the relay respond, for instance, at a generator reverse power of 10%, it does not mean that the adjustment value of RW1 amounts to 10%. The adjustment value of the switching point must first be calculated because of the ratio of the transformers.

Calculation of the adjustment value Necessary Data :

P_{GEN} [kW] Active power of the generator in kW it is calculated from the apparent power of the generator S_{GEN} according to $P_{GEN} = S_{GEN} \cos\phi$

$PRW1$ [kW] Reference power of the RW1 in kW
It is calculated from I_N Normal current of relay, U_N Nominal voltage of the relay, n_1 Ratio of the current transformer n_u Ratio of the voltage transformer for **4 wire system** (unit **RW1-10**) according to $PRW10 = 3 \times I_N \times U_N \times n_1 \times n_u$;

for **3 wire system** (unit **RW1 - 12**) according to
 $PRW12 = (\sqrt{3}) \times I_N \times U_N \times n_1 \times n_u$

If P_{REV} [%] is the desired reverse power value in % referring to the acting power of the generator, then the value to be adjusted on the relay is calculated as per following formula :

$$\text{Adjustment value in \%} = \frac{P_{GEN} \text{ [kW]}}{P_{RW1} \text{ [kW]}} \times P_{REV} \text{ [%]}$$

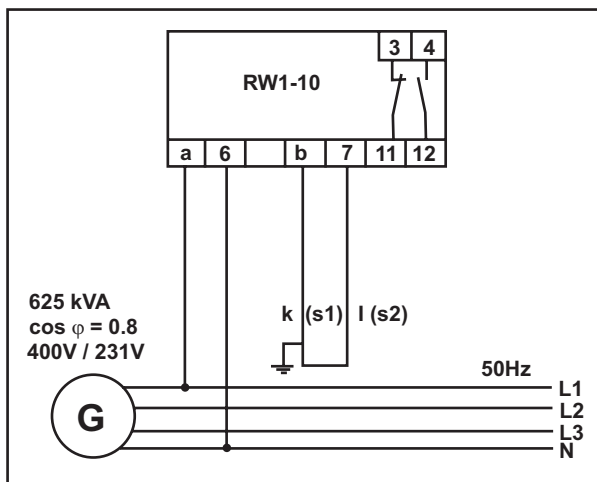
Calculation-example 1

Low tension installation, unit RW1-10, diesel generator

Circuit example :

$$*PRW10 = 3 \times I_N \times \frac{UN}{\sqrt{3}} \times n_1 \times n_u$$

3 phase, 4 wire with current transformer



NOTE :

- While connecting the relay it is to be observed that the current transformer terminals k(s1) and l(s2) are connected as shown.
- Further the current and voltage measurement must be done on the same phase.

Active power of the generator

$$P_{GEN} = 625 \text{ kVA} \times 0.8 = 500 \text{ kW}$$

Nominal current of RW1 $I_N = 5 \text{ A}$

Nominal voltage of RW1 $U_N = 230 \text{ V}$

Ratio of the current transformer $n_i = 1000 \text{ A}/5 \text{ A}$

Transformer = 200

Reference power of the unit

$$P_{RW10} = (3) \times 5 \text{ A} \times 230 \text{ V} \times 200 = 690 \text{ kW}$$

If the relay should respond at a reverse power of 5% (referred to the active power of the generator), then $P_{REV} = -5\%$ and the adjustment value can be calculated in the following way :

$$\text{Adjustment value (\% of scale)} = \frac{500 \text{ kW}}{690 \text{ kW}} \times (-5\%) = -3.6\%$$

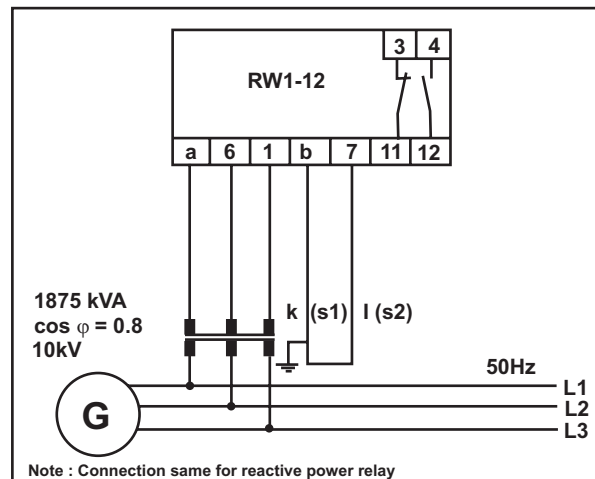
In the foregoing example the relay RW1 is to be adjusted to -3.6%, so that it responds to a generator reverse power of 5% (corresponds to 25 kW in case of generator active power of 500 kW).

Calculation-example 2

Medium tension installation, unit RW1-12, generator for turboset

circuit example :

3 phase, 3wire, current and voltage transformer.



Note : Connection same for reactive power relay

Note :

- The proper connection of k(s1) and l(s2) is to be observed
- L1, L2 and L3 are to be connected as shown.
- The current measurement must be done here from phase L1.

Active power of the generator

$$P_{GEN} = 1875 \text{ kVA} \times 0.8 = 1500 \text{ kW}$$

Nominal current of RW1 $I_N = 5 \text{ A}$

Nominal voltage of RW1 $U_N = 100 \text{ V}$

Ratio the current transformer $n_i = 150 \text{ A}/5 \text{ A} = 30$

The voltage transformer $n_u = 10 \text{ kV}/100 \text{ V} = 100$

Reference voltage of the unit

$$PRW12 = (\sqrt{3}) \times 5 \text{ A} \times 100 \text{ V} \times 30 \times 100 = 2598 \text{ kW}$$

If the relay should respond at a reverse power of 3% (referred to the active power of the generator), then $P_{REV} = -3\%$ and the adjustment value can be calculated in the following way :

$$\text{Adjustment value (\% of scale)} = \frac{1500\text{kW}}{2598\text{kW}} \times (-3\%) = -2\%$$

In the foregoing example the relay **RW1** is to be adjusted to -2%, so that it responds to a generator reverse-power of 3% (corresponds to 45 kW in case of generator active power of 1500 kW)

3.2 Determination of the Switching Point by Specific Tripping

If the relay should respond at a reverse power of 5%, for instance, the adjustment value of the **RW1** can also be located by simulating a reverse power of 5% and turning the setting element of the **RW1** from the highest value down until the relay responds.

The simulation of reverse power of 5% is achieved if k(s1) and l(s2) are interchanged at the current transformer and the generator to be monitored is operated at 5% of its active power. The response of the relay can be noticed by disconnecting of the generator.

As soon as the switching point (i.e. the adjustment value) has been found, k(s1) and l(s2) must be properly connected again in order to operate the **RW1** as a reverse power relay.

3.3 Examples of reverse power values and switching delay

Examples of reverse-power values

- for turbines approx. 2-4%
- for gas engine approx. 4-6%
- for diesel generator approx. 6-8%

Examples of the adjustment of time delay

- generator in parallel operation with large grid approx. 5-10s
- generator in parallel operation with other generators in an isolated system approx. 10-20s
- generator in parallel operation with other generators when reverse power is caused occasionally by the consumer approx. 20-30s.

4. Functional Check

With the help of following functional check it can be tested whether the device **RW1** is properly connected.

The generator to be protected is operated at a small (positive) power. If the single potentiometer for the power measuring circuit is now turned in the positive range, the relay must switch over from contact position 1 to contact position 2 at a specific positive adjustment value (see Fig. 1) and cause a disconnection of the generator. In this case the **RW1** is properly connected. It is now adjusted to the desired adjustment value for use as a reverse-power relay.

If the relay does not respond, then the following questions are to be clarified :

- Are k(s1) and l(s2) properly connected on the secondary side of the current transformer
- Are L1 and N (in case of device **RW1-10**) or L1, L2 and L3 (in case of **RW1-12**) properly connected
- Is the current and voltage measurement in the same phase L1

5. Technical Data

RW1 - Reverse Power Relay

General Data

Type	:	RW1-10 for 3 phase, 4 wire system RW1-12 for 3 phase, 3 wire system
Design	:	Static protection unit
Maintenance	:	None
Permissible Operating Time	:	Continuous operation
Fitting Position	:	Operation independent on fitting position, panel mounted

Measuring Circuit

Rated Voltage	:	230V, 3x110V, 3x415V
Overvoltage Withstand	:	50% for approx. 2s
Rated Current	:	1 A, 5A
Rated Frequency	:	50-60Hz
Own Consumption in Standstill Condition	:	Current measuring circuit 2 VA Voltage measuring Circuit 5 VA

Setting Ranges

● power setting	:	-10% upto +10%
● switching delay	:	0 upto 30 s
● tripping hysteresis	:	0.5%

Auxiliary Voltage

Not Required

Output Circuit

Contacts	:	Potential free, 1 NC, 1 NO
Contact Capacity	:	1000 VA at 250 V/AC or 2 A at 24 V/DC
Contact Switch Life	:	10 ⁶ switching operations
Terminals	:	M4, wire termination, max. 2.5 mm ²

Ambient temperature Limits

for storage	:	-40°C upto + 80°C
for operating	:	-25°C upto + 60°C

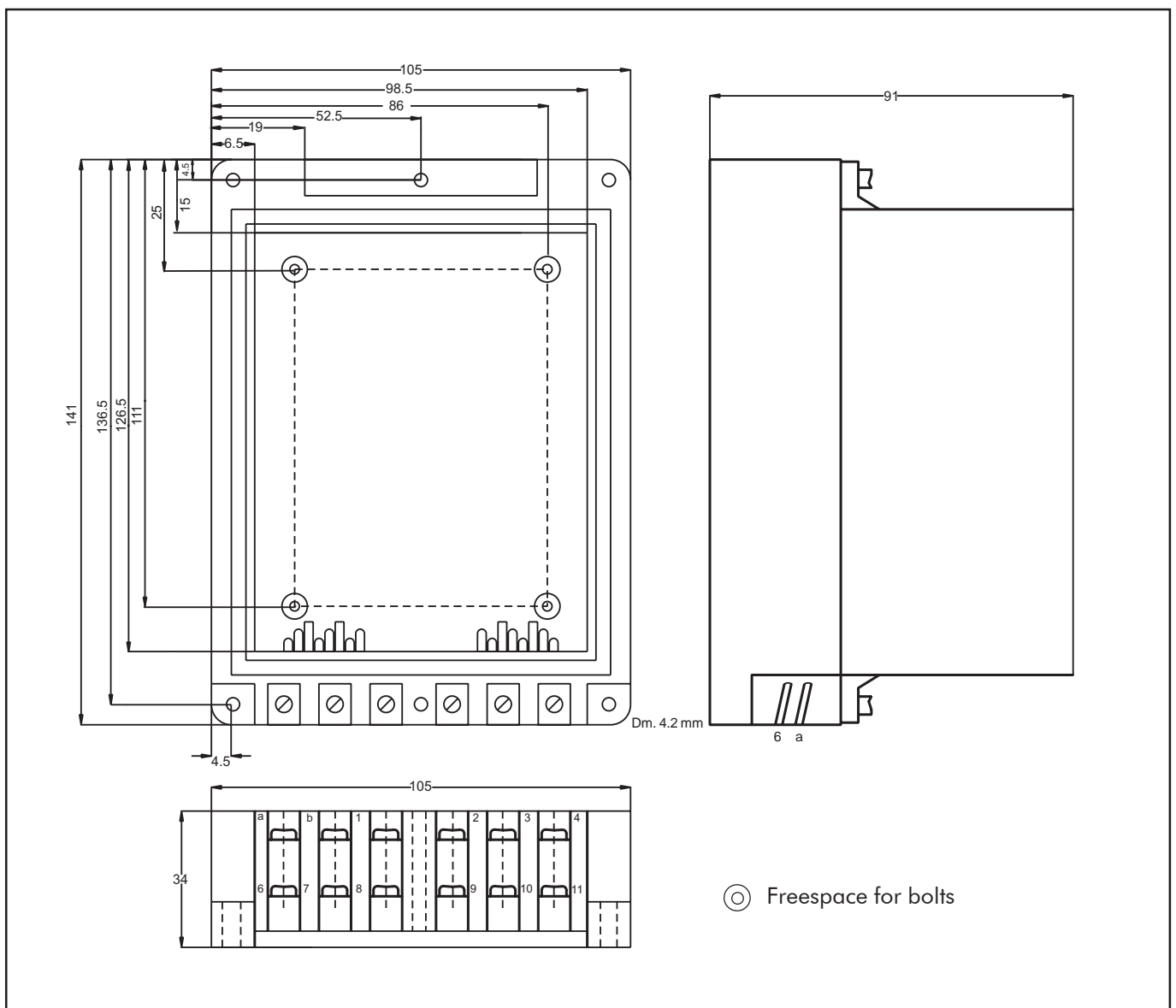
Tests

Effect of temperature	:	<1% of adjusted value at 0°C to 60°C
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Case, Dimensions, Weight and Fitting

Case	:	CSPC standard case
Material	:	Track-resistant moulded base and transparent cover
Height x Width x Depth	:	142 x 105 x 91 mm
Fitting Positions	:	Independent
Weight	:	Approx. 0.78 kg
Mounting	:	Flush mounting
Protection Class	:	Case IP20
		Terminals IP00

Dimensions (in mm)



6. Information required with Order

When placing an order, please fill in the form

Reverse Power Relay		RW1										
for the detection of	RW1	<input type="text"/>	-	<input type="text"/>	-	<input type="text"/>	-	<input type="text"/>	-	<input type="text"/>	-	<input type="text"/>
power direction		↑		↑		↑		↑		↑		↑
for 1 -phase/N-voltage connection		10										
for 3-phase voltage connection		12										
Active Power Relay				A								
Reactive Power Relay (available only in 3 phase version)				R								
Measuring voltage AC	1-phase				230/240							
	3-phase						110					
							400/415					
Rated frequency	50/60 Hz							50				
Rated Current											1	
												5

For further information, please contact :



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