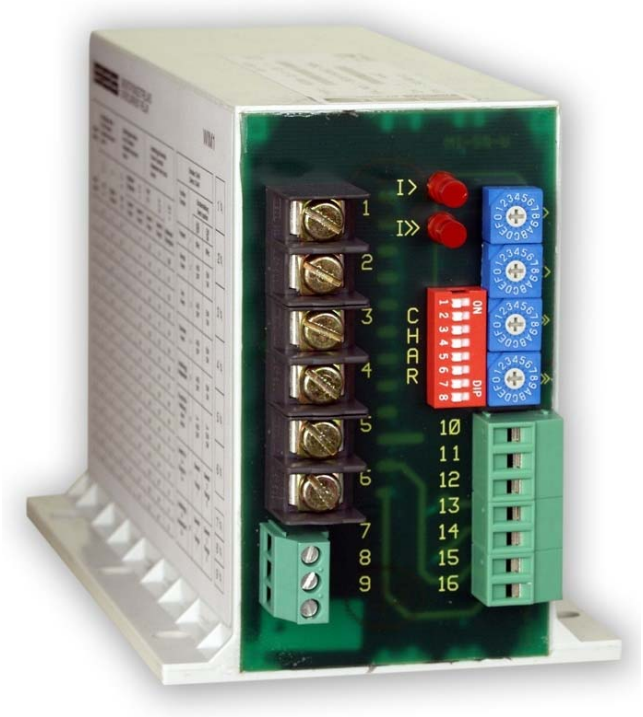
WOODWARD



WIM1 – Time overcurrent relay with multi-characteristic

Manual WIM1 (Revision A)

Content

1. General

The WIM1 is an overcurrent time relay with multi-characteristics designed for the tripping of current trans-formers. Definite time and inverse time tripping characteristics can be adjusted. By the use of cast resin impregnation, the WIM1 is optimally protected against climatic influences. The WIM1 does not require an auxiliary voltage, consequently it can also be used for switchboards without built-in batteries. It derives its power supply energy from the current transformer circuits from which, for special applications, it can also store the energy that is necessary to give the tripping impulse to the circuit breaker. Due to its wide setting ranges, the tripping characteristic can be adjusted to protect a wide variety of different equipment.

2. Characteristics and Features

- Auxiliary voltage is not required
- User-friendly setting procedure with wide setting ranges
- Four 16-position setting switches for tripping current and trip delay
- 8-pole DIP - switch to adjust the tripping characteristic, ranges and frequency
- High measuring accuracy through an efficient microprocessor and digital processing of the
- measuring values
- High operating reliability through internal self-supervision (watchdog)
- Protective functions selectable:
  - definite time overcurrent protection (DMT) and
  - inverse time overcurrent protection (IDMT)
- Selectable INVERSE - tripping characteristics according to BS 142 resp. IEC 255-4:
  - normal inverse
  - very inverse
  - extremely inverse
- Remote tripping via external voltage
- Tripping output optionally available as power impulse output for the direct triggering of the circuit breaker or as potential-free change-over contacts
- Tripping indication via external flag indicator with mechanical reset
- Compact construction
- Insensitive to extreme environmental conditions
- High-accuracy components and over-rating guarantee precision, reliability and a long service life
- In accordance with the specified technical data, it complies with the requirements of VDE - regulation 0435-303, IEC 255, VDE 0843

3. Working Principle

The alternating currents induced by the mains current transformers provide the WIM1's supply energy and form the measuring value.
The measuring currents are galvanically isolated via the input transformers, decoupled from high-frequency interferences by analog RC-filters and then converted into current proportional voltages. These voltages are rectified and the rectified mean value is calculated by the microprocessor.

The A/D converter sampling frequency for the detection of the rectification mean value is 1600 Hz (every 0.625 ms) at 50 Hz and 1920 Hz (every 0.521 ms) at 60 Hz. Depending on the rectified mean value and the adjusted tripping characteristic, the tripping delay, if activated, is calculated by means of a time optimized protective program. An integrated watchdog supervises this protective program.

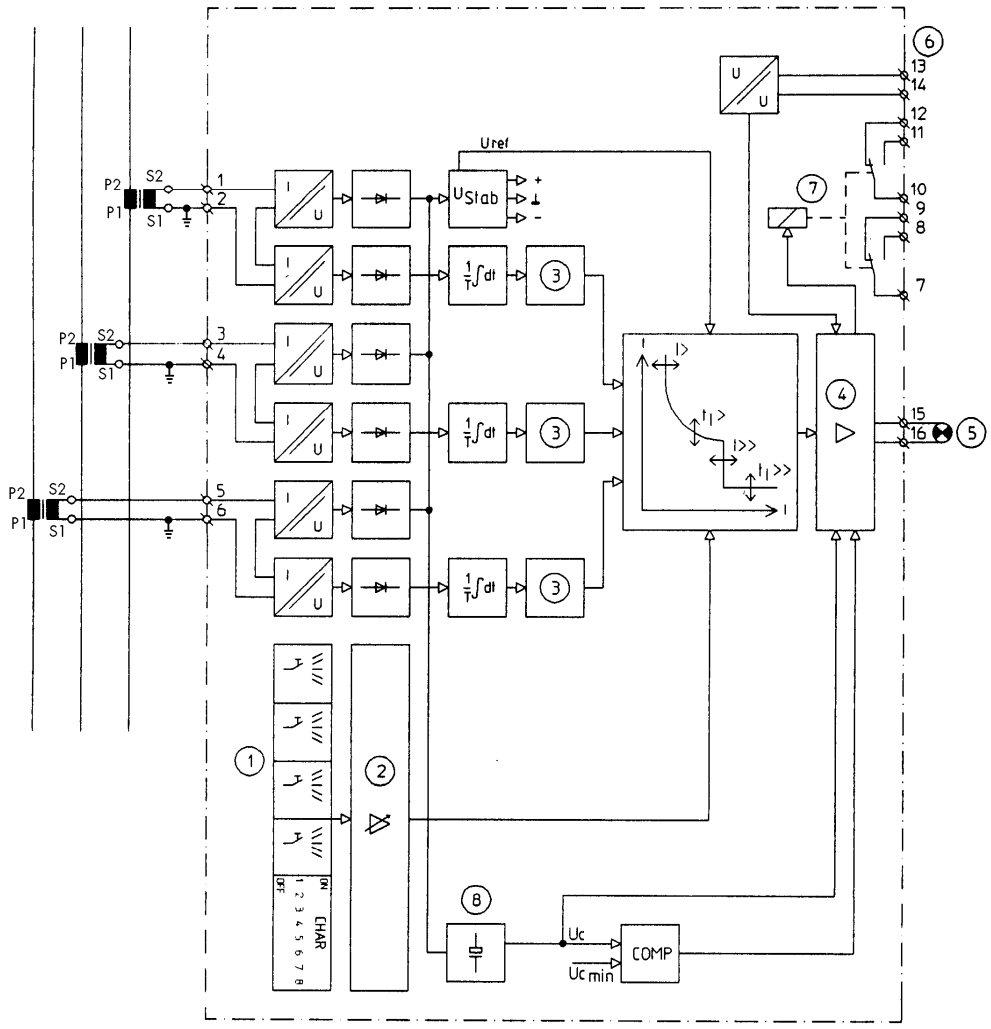


Figure 3.1: Block Diagram

① = Setting switch for tripping characteristic
② = Decoder
③ = Measuring value storage
④ = Tripping amplifier
⑤ = Flag indicator
⑥ = Remote tripping
⑦ = Tripping coil
⑧ = Energy store

3.1 Summary of the different unit types

All relay types are available for secondary transformer nominal currents of 1 A or 5 A. In general, there are two types of tripping outputs, and therefore several distinct versions are available. The first is the EL version with electro-impulse output. Type, WIM1-C-X-EL-X has been specially developed for use in MV switchboards which do not have an auxiliary voltage available for c.b. tripping.
The version C is suitable for mounting to circuit breakers and can, in the version WIM1-C-X-RM-X, also be sup-plied with a relay contact output.
The third unit type, WIM1-S-X-RM-X, has been designed for switchboard installation and is mostly used for generator protection switchboards and feeders.
Version S is only available with a relay contact output. All units have an identical housing design and dimensions.

3.1.1 Tripping outputs

a) Output for direct tripping of the circuit breaker from unit type WIM-1-C-EL-1:

Via this output, it is possible to send power pulses (10 W for 50 ms) directly to the tripping coil of the c.b. (terminals 10 and 11). To store the tripping energy (approx. 0.5 W) the WIM1 is equipped with an energy store. Through a special electronic circuit, this store takes the charging energy direct from the measuring current and charges until a peak voltage of approx. 24 V is reached. The tripping pulses are repeated until the circuit breaker switches off.

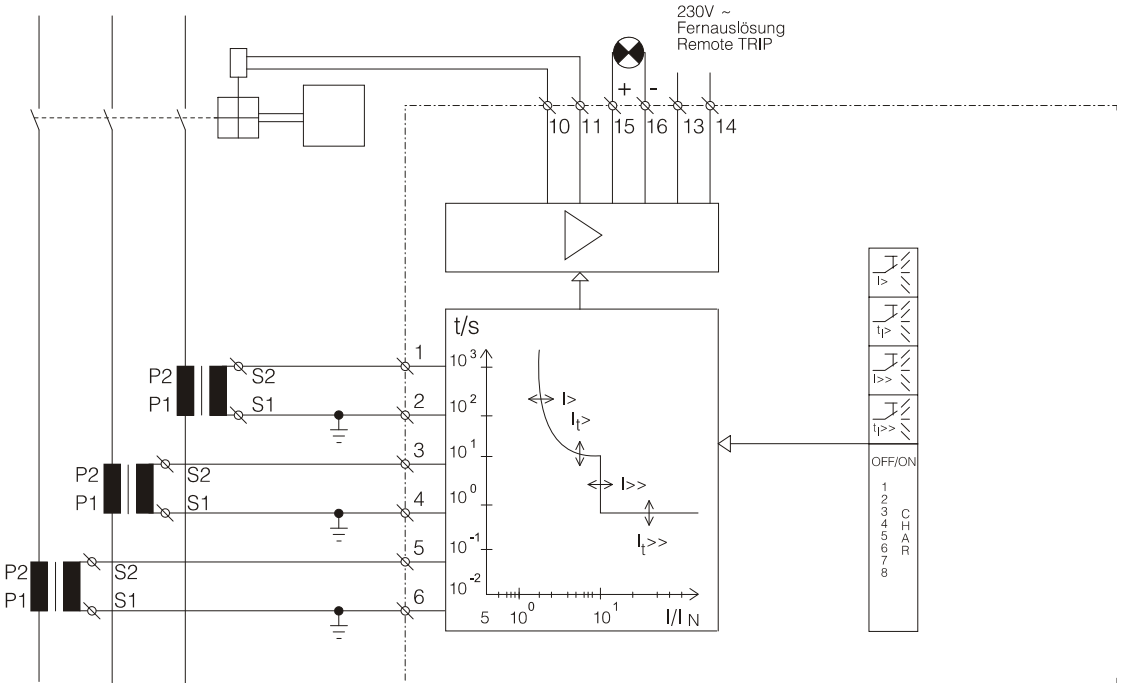


Figure 3.2: Connection diagram of the WIM1-C-X-EL-1

For other applications, i.e. with separate auxiliary volt-ages, the WIM1 - relay can be supplied with potential-free relay contact outputs.

b) Relay contact output from unit type
WIM1-C-X-RM-1:

This unit type has one output relay with two potential-free change-over contacts for the overcurrent and short-circuit element.

1. Change-over contact, terminals 7, 8 and 9
2. Change-over contact, terminals 10, 11 and 12

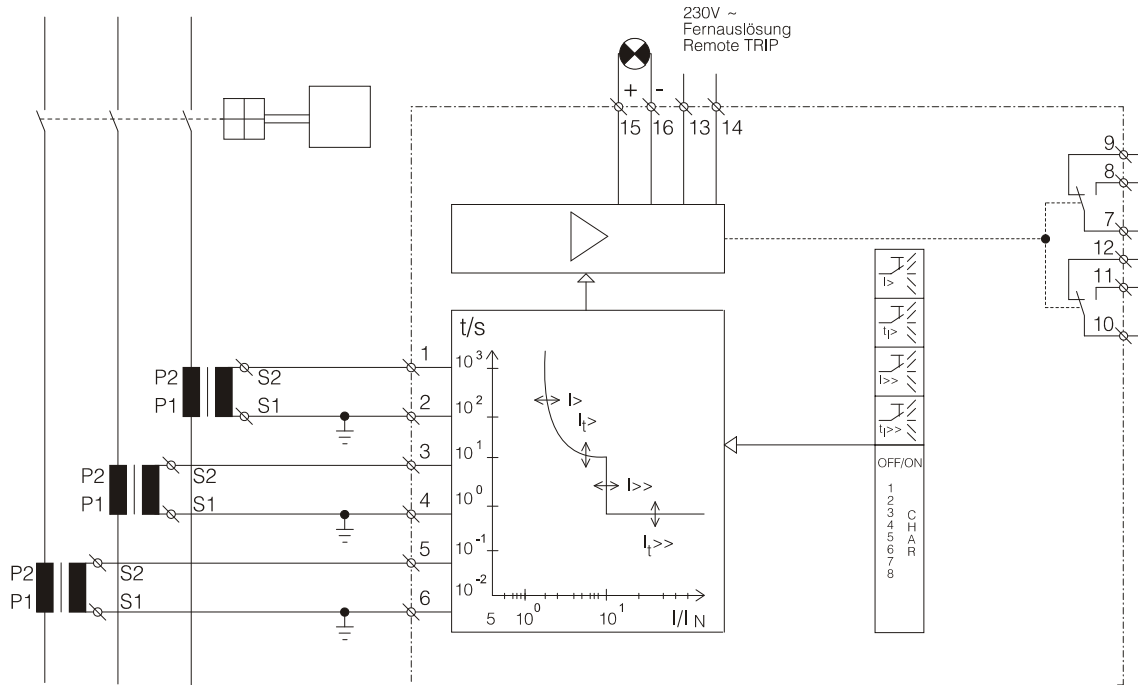


Figure 3.3: Connection diagram of the WIM1-C-X-RM-1

c) Relay contact output from unit type WIM1-S-X-RM-1:

This unit type has three potential-free change-over contacts.

1st. change-over contact, tripping I>>, terminals 7, 8 and 9:
This change-over contact is only activated during trip-ping of the short-circuit element.

2nd. change-over contact, tripping I> and I>> terminals 10, 11 and 12:
This change-over contact is activated during tripping of the overcurrent or of the short-circuit element.

3rd. change-over contact, signal I> terminals 13, 14, 15:
This change-over contact is only used as signal output during pickup of the overcurrent element.

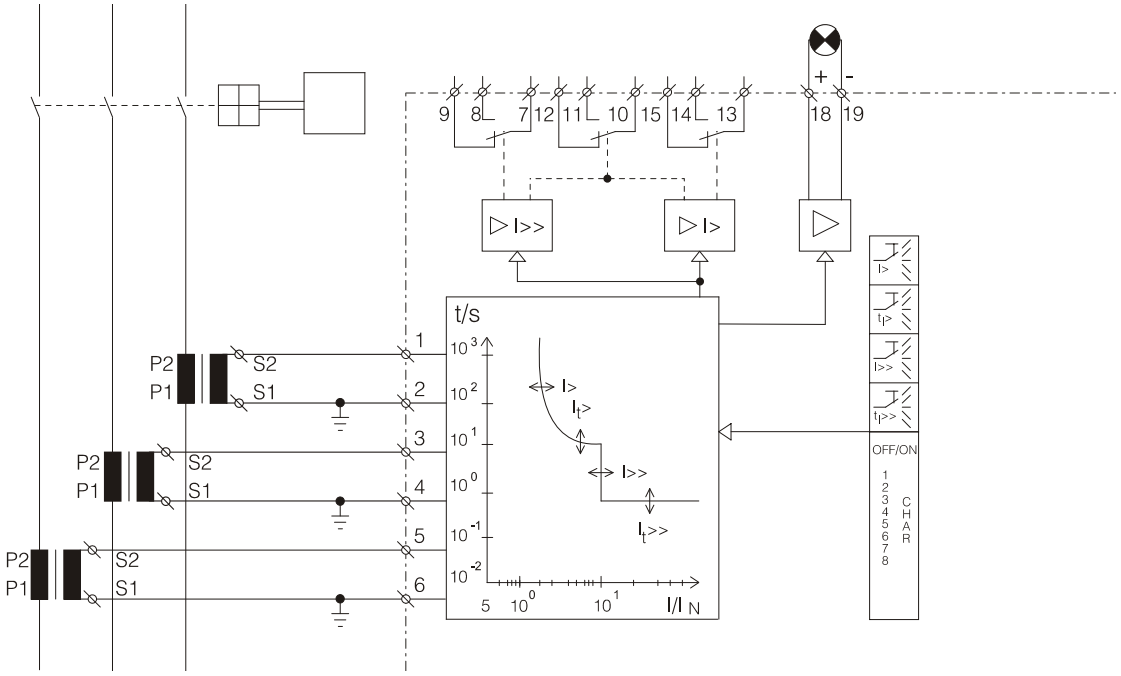


Figure 3.4: Connection Diagram of the WIM1-S-X-RM-X

3.2 Setting of the relay

All switches for the relay setting are located on the front plate of the WIM1. The function designation is indicated next to the switches. To adjust the values be-low, four 16-position BCD switches are available:

I> Overcurrent pickup value
I>> Short-circuit current tripping value
tI> Tripping delay for the overcurrent element
tI>> Tripping delay for the short-circuit element

To select the tripping characteristic and the nominal frequency, there is a DIP switch set consisting of 8 switches. This set is designated CHAR.

Two LEDs signalize pickup of the overcurrent element I> and the short-circuit element I>>.

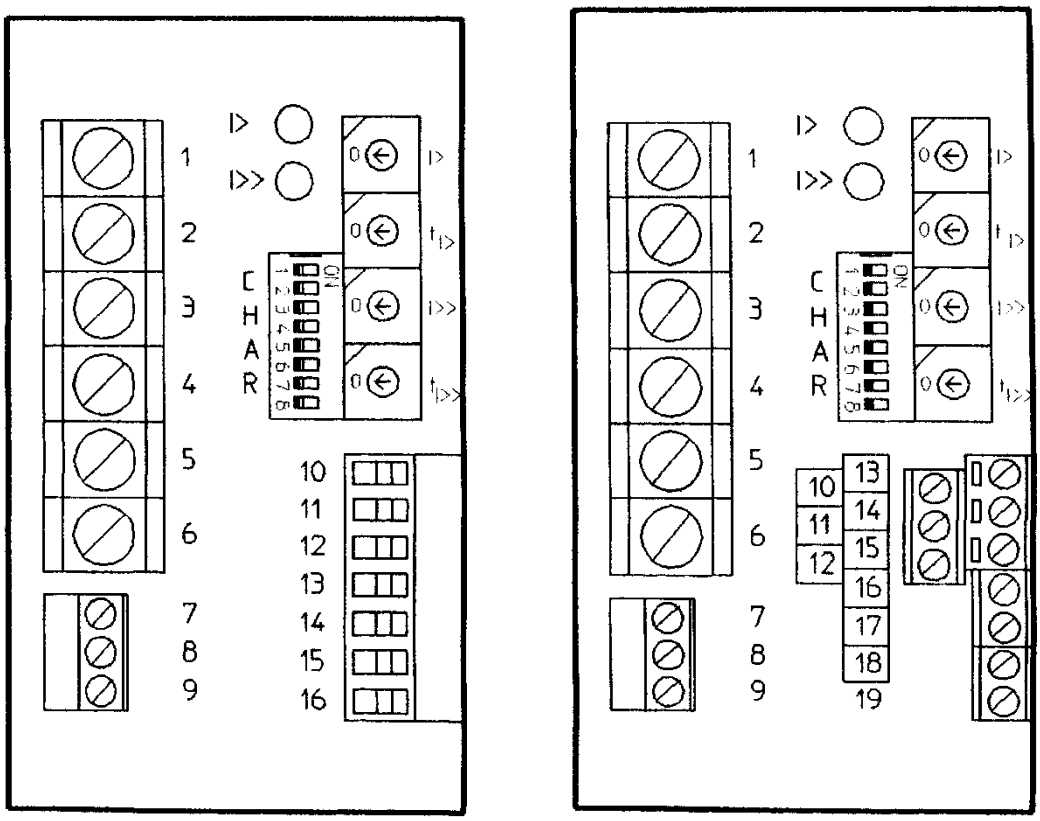


Figure 3.5: Front views left side WIM1-C-X-RM1. WIM1-C-X-EL-1 and right side WIM1-S-X-RM-1

3.2.1 Setting of the switches

Before commissioning, it is essential to select the nominal frequency, tripping characteristic and tripping ranges (CHAR switches 1-8). Furthermore, the selector switches I>, tI>, I>>, tI>> have to be adjusted to the appropriate tripping currents and periods.

3.2.2 Settings at the CHAR - switch

The functions of the individual DIP - switches are de-tailed in the following table:

3.3 Overcurrent tripping

By means of DIP - switches 2 - 5, it is possible to select either one of the three definite time or inverse time trip-ping characteristics.
The possible families of characteristics are shown on page 11, in four diagrams.
The equations on which the characteristics are based are detailed on page 13, paragraph "dependent overcurrent time protection". The following table shows the set values for the appropriate switch positions of switches I> and tI>

Switch No.	OFF position	ON position
1	nominal frequency 50 Hz	nominal frequency 60 Hz
2	-	characteristic „inverse“ DMT
3	-	characteristic „very inverse“ DMT
4	-	characteristic „extremely inverse“ DMT
5	-	characteristic „definite time“ IDMT
6	short-circuit step not activated	short-circuit element activated
7	range 1 for I>>	range 2 for I>>
8	range 1 for tI> (DMT)	range 2 for tI> (DMT)

Table 3.1: Functions of the CHAR - switch

Switch position	DMT		IDMT				
	RM- and EL-version		RM- and EL-version	RM-version		EL-Version	
	Is = I_N x	tI> time factor	Is = I_N x	tI> [s]		tI> [s]	
				range 1	range 2	range 1	range 2
0	0.8	0.1	0.8	0.5	10	2.0	18.0
1	0.9	0.2	0.9	1.0	12	3.0	19.0
2	1.0	0.3	1.0	1.5	14	4.0	20.0
3	1.1	0.4	1.1	2.0	16	5.0	21.0
4	1.2	0.5	1.2	2.5	18	6.0	22.0
5	1.3	0.6	1.3	3.0	20	7.0	23.0
6	1.4	0.7	1.4	3.5	22	8.0	24.0
7	1.5	0.8	1.5	4.0	24	9.0	25.0
8	1.6	0.9	1.6	4.5	26	10.0	26.0
9	1.7	1.0	1.7	5.0	28	11.0	27.0
A	1.8	1.1	1.8	5.5	30	12.0	28.0
B	1.9	1.2	1.9	6.0	32	13.0	29.0
C	2.0	1.3	2.0	6.5	34	14.0	30.0
D	2.1	1.4	2.1	7.0	36	15.0	31.0
E	2.2	1.5	2.2	7.5	38	16.0	32.0
F	2.3	1.6	2.3	8.0	40	17.0	33.0

Table 3.2: Setting values for the overcurrent step

3.4 Instantaneous short-circuit tripping

In addition to the definite time or inverse time overcurrent tripping, it is possible to adjust an instantaneous short-circuit tripping. It has two setting ranges for the short-circuit current (see the following table). The short-circuit element always has a definite time characteristic.

switch position	$I>>/I_N$			$t_I>>$ [s]
	range 1		range 2	EL- and RM-version
	EL-version	RM-version	EL- and RM-version	
0	3.5	2.0	10	0.05
1	4.0	2.5	12	0.1
2	4.5	3.0	14	0.2
3	5.0	3.5	16	0.3
4	5.5	4.0	18	0.4
5	6.0	4.5	20	0.5
6	6.5	5.0	22	0.6
7	7.0	5.5	24	0.7
8	7.5	6.0	26	0.8
9	8.0	6.5	28	0.9
A	8.5	7.0	30	1.0
B	9.0	7.5	32	1.1
C	9.5	8.0	34	1.2
D	10.0	8.5	36	1.3
E	10.5	9.0	38	1.4
F	110	9.5	40	1.5

Table 3.3: Setting values for the short-circuit element

3.5 Integrated safety routine

In case of incorrect adjustment, for example if no, two, or several characteristics have been selected, the WIM1 runs in a safety routine providing the lowest tripping values. To avoid damage, the relay automatically selects the following safety setting in this mode:

Value	EL-version	RM-version
I>	$I_S = 0.8 \times I_N$	$I_S = 0.8 \times I_N$
tI>	2.0 s	0.5 s
I>>	$3.5 \times I_N$	$2.0 \times I_N$
tI>>	0.05 s	0.05 s

Table 3.4: Automatic safety setting (DEFINITE TIME characteristic)

3.6 Setting example

The tripping characteristic as shown below is to be adjusted. Its sections consist of one inverse time characteristic (normal inverse) for the overcurrent tripping (section 1) and one definite time characteristic for the instantaneous short-circuit tripping (section 2). The unit is a WIM1-C-1-EL-1 relay, the nominal frequency is 50 Hz. The following settings must be made:

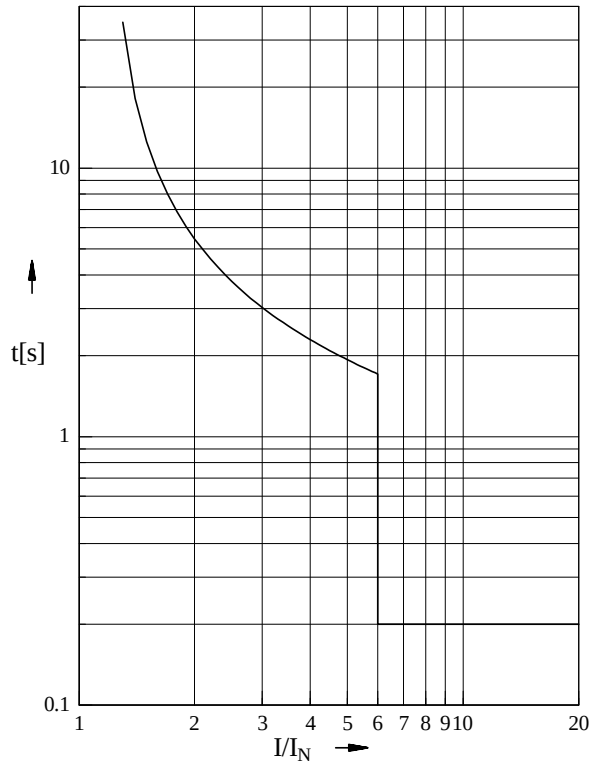


Figure 3.6: Example of a characteristic

DIP-switch	OFF	ON	Function
1	x		nominal frequency 50 Hz
2		x	characteristic normal inverse
3	x		characteristic very inverse
4	x		characteristic extremely inverse
5	x		definite time characteristic
6		x	Short circuit element active
7	x		range 1 for I>>
8	x		switch position optional (only for definite time overcurrent tripping)

Table 3.5: CHAR-switch

Switch	Switch position	Setting value
I>	4	1.2 A
tI>	3	0.4
I>>	5	6.0 A
tI>>	2	0.2 s

Table 3.6: Step switches

3.7 Remote tripping (only for the version C)

The input "remote tripping" (terminals 13 and 14) allows tripping by an external alternating voltage, i.e. by a thermal tripping coil, a Buchholz protection or other remote tripping commands. Bypassing the measuring circuits, this input has a direct effect on the tripping circuit. A signal 230 V/AC may only be fed for a maximal period of 20 minutes. The tripping time depends on the input voltage (see technical data). The input terminals are galvanically isolated from the electronic part of the relay.

3.8 Overcurrent - short-circuit indications

At the front plate there are two LEDs to indicate pickup of the relay. If the adjusted pickup value of the overcurrent element I> is exceeded (activated state), the LED I> will flash and a calculated time delay elapses until the relay trips. LED I>> flashes if the short-circuit tripping has been selected and the additionally adjusted threshold for I>> has been exceeded.

3.8.1 Tripping indication by means of flag indicator

A tripping can be indicated mechanically through the flag indicators WI1-SZ2 and WI1-SZ4 which are optionally available. After tripping, they have to be reset manually. For the connection of the flag indicators, see the connection diagrams.

3.9 Tripping characteristics

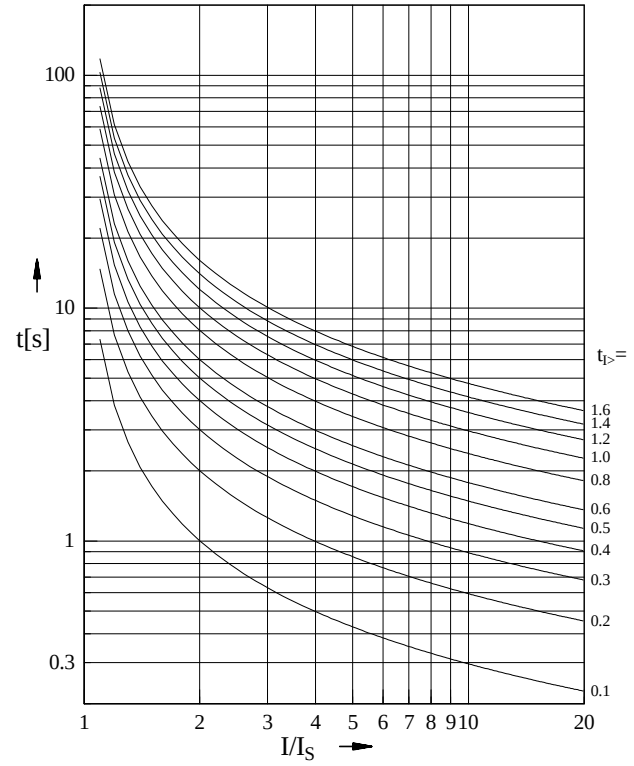


Figure 3.7: Normal inverse

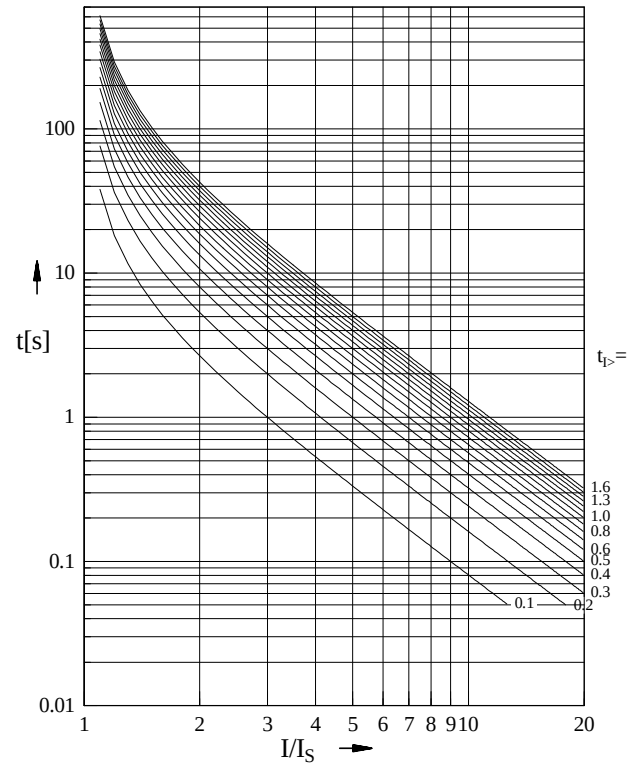


Figure 3.8: Extremely inverse

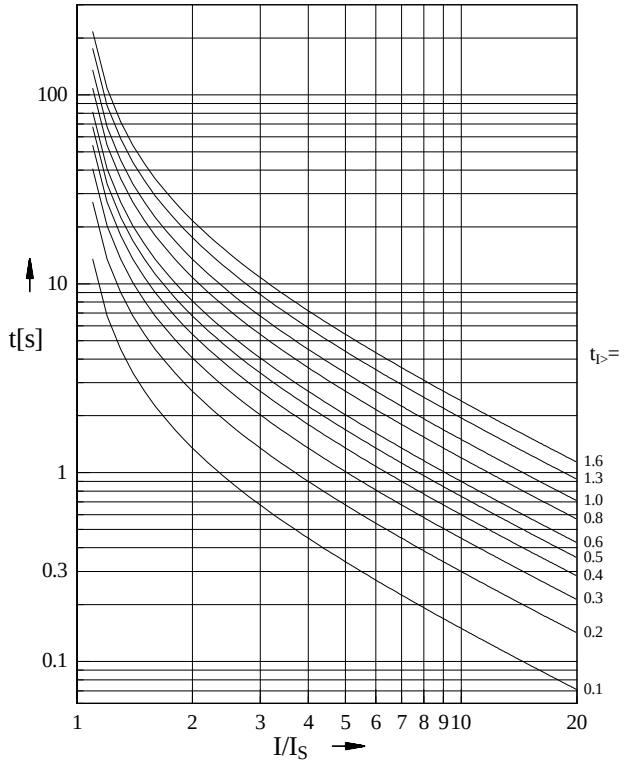


Figure 3.9: Very inverse

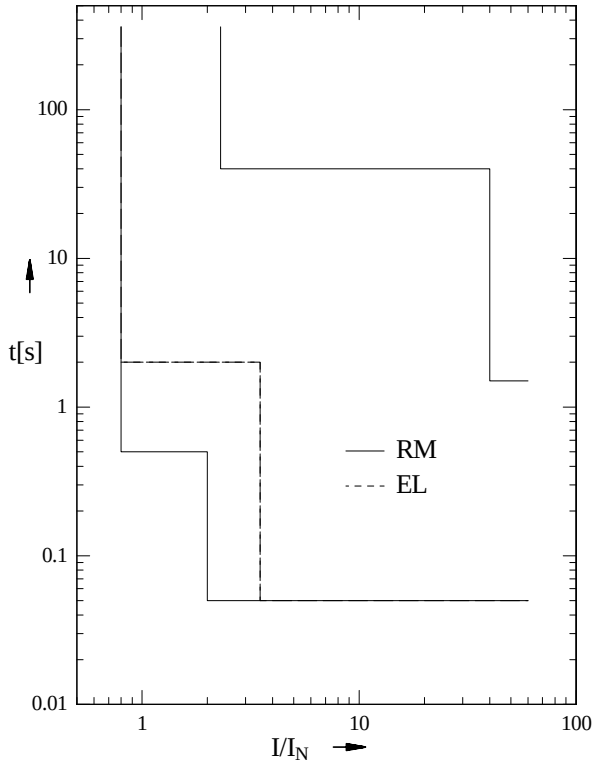


Figure 3.10: Definite time

4. Technical Data

Unit types: WIM1-X-X-XX-1

Measuring input

Nominal data:	nominal current In 1A or 5A, nominal frequency 50/60 Hz adjustable	
Power consumption in current circuit:	1.0 x I_N, S = 3.7 VA	
Thermal withstand capability of the current circuit:	rated surge current for one half-cycle	135 x I_N
	rated short-period current for 1 s	54 x I_N
	short-period load carrying capacity for 10 s	17 x I_N
	permanent load carrying capacity	2.3 x I_N

Input for the remote tripping

Nominal voltage:	230 V/AC, max. 20 min. min. 180 V/AC, max. 60 min. max. 250 V/AC, max. 15 min. Burden 6 VA/200 V
Tripping time:	dependent on the input voltage; U = 230 V t_{MAX} = 0.6 s U = 180 V t_{MAX} = 5.0 s
Tripping:	periodically for the input voltage range from U = 180 V to U = 210 V; frequency dependent on U; constant tripping at U ≥210 V

Accuracy

Basic accuracy (related to the current):	±5%
Basic accuracy of the tripping time:	±3% or ±10 ms
Influence of frequency:	in the range of 5% of the nominal frequency the current deviation is 0.5% per Hz
Influence of temperature:	1.5% at - 40°C to 55°C

Specified ambient service

Temperature range for storage:	- 40°C to + 85°C
Temperature range for operation:	- 40°C to + 55°C

General data

Drop-out to pickup ratio:	97%
Returning time:	20 ms
Minimal response time:	50 ms
Time lag error class index E:	10 ms

Definite time overcurrent protection

		range 1; steps	range 2; steps
I> RM-version EL-version	I t_I> t_I>	0.8 - 2.3 x I_N; 0.1 x I_N 0.5 - 8.0 s; 0.5 s 2.0 - 17 s; 1.0 s	 10.0 - 40.0 s; 2.0 s 18.0 - 33.0 s; 1.0 s
RM-version I>>	I t_I>	2.0 - 9.5 x I_N; 0.5 x I_N 0.05 - 1.5 s; 0.1 s	10.0 - 40.0 x I_N; 2.0 x I_N
EL-version I>>	I t_I>	3.5 - 11 x I_N; 0.5 x I_N 0.05 - 1.5 s; 0.1 s	10.0 - 40.0 x I_N; 2.0 x I_N

Inverse time overcurrent protection

Tripping characteristics according to IEC255-4 (BS 142):

Normal Inverse

$$t = \frac{0.14}{\left(\frac{I}{I_S}\right)^{0.02} - 1} \cdot t_I > [s]$$

Very Inverse

$$t = \frac{13.5}{\left(\frac{I}{I_S}\right) - 1} \cdot t_I > [s]$$

Extremely Inverse

$$t = \frac{80}{\left(\frac{I}{I_S}\right)^{2} - 1} \cdot t_I > [s]$$

with: t = tripping time
t_I> = time multiplier
I = fault current
I_S = set value of the current

		range 1; steps	range 2; steps
I>	Is t_I>	0.8 - 2.3 x I_N; 0.1 x I_N 0.1 - 1.6 s; 0.1 s	
RM-Typ I>>	I t_I>>	2.0 - 9.5 x I_N; 0.5 x I_N 0.05 - 1.5 s; 0.1 s	10.0 - 40.0 x I_N; 2.0 x I_N
EL-Typ I>>	I t_I>>	3.5 - 11 x I_N; 0.5 x I_N 0.05 - 1.5 s; 0.1 s	10.0 - 40.0 x I_N; 2.0 x I_N

Outputs

Relay contact output

Number of output relays:	version C: 1 relay version S: 2 relays version C: 2 change-over contacts version S: 1 change-over contact for I>, 1 change-over contact for I>> 1 common change-over contact for I and I>>
Max. switching capacity:	resistive load: 1250 VA/DC, 150 W inductive load: (cos = 0.4) 500 VA DC (L/R = 7 ms) 90 W
Max. nominal current:	5 A
Current at make (16 ms):	20 A
Contact material:	Ag/AgNi
Contact life span:	10^5 operations at max. switching capacity

Electro-impulse output

Output voltage:	24 V ±2 V
Output power:	approx. 10 W for 50 ms, periodic impulse tripping, frequency dependent on transformer current
Tripping energy:	0.5 W per tripping impulse

Indication elements

Overcurrent indication:	LED I>
Short-circuit current indication:	LED I>>
Flag, optionally:	external flag, with mechanical reset function for the indication of a tripping

Type tests

Regulations:	VDE 0435, part 303, IEC 255-4, BS 142, VDE 843 part 2, 3, 4 high voltage tests according to VDE 0435, part 303
Insulation voltage test:	2.5 KV / 50 Hz; 1 min.
Surge voltage test:	5 KV / 1.2 / 50 µs, 0.5 J
High frequency test:	2.5 KV / 1 MHz
Immunity from disturbance by electro-static discharge (ESD) acc. to VDE 0843 part 2 resp. IEC 801-2:	severity level 4 test voltage 15 kV
Electrical fast transient (Burst) test acc. to VDE 0843 part 4 resp. IEC 801-4:	severity level 4 test voltage 4 kV burst duration 1 - 15 ms spike frequency 1; 2.5; 5 KHz
Radio interference suppression test as per DIN VDE 57871:	limit value class B
Radiated electromagnetic field test as per VDE 0843 part 3:	field strength 10 V/m

Mechanical tests

Shock:	class 1, DIN IEC 41 B (CO) 38
Vibration:	class 1, DIN IEC 41 B (CO) 35

Enclosure, housing, installation

Protection class:	electronics: IP67 signal and control terminals: IP20 transformer connection terminals: IP00
Material:	Macrolon 6030, self-extinguishing
Width, height, depths:	see dimensional drawings
Fastening type:	with screws
Weight:	1.8 kg
Installation position:	optional

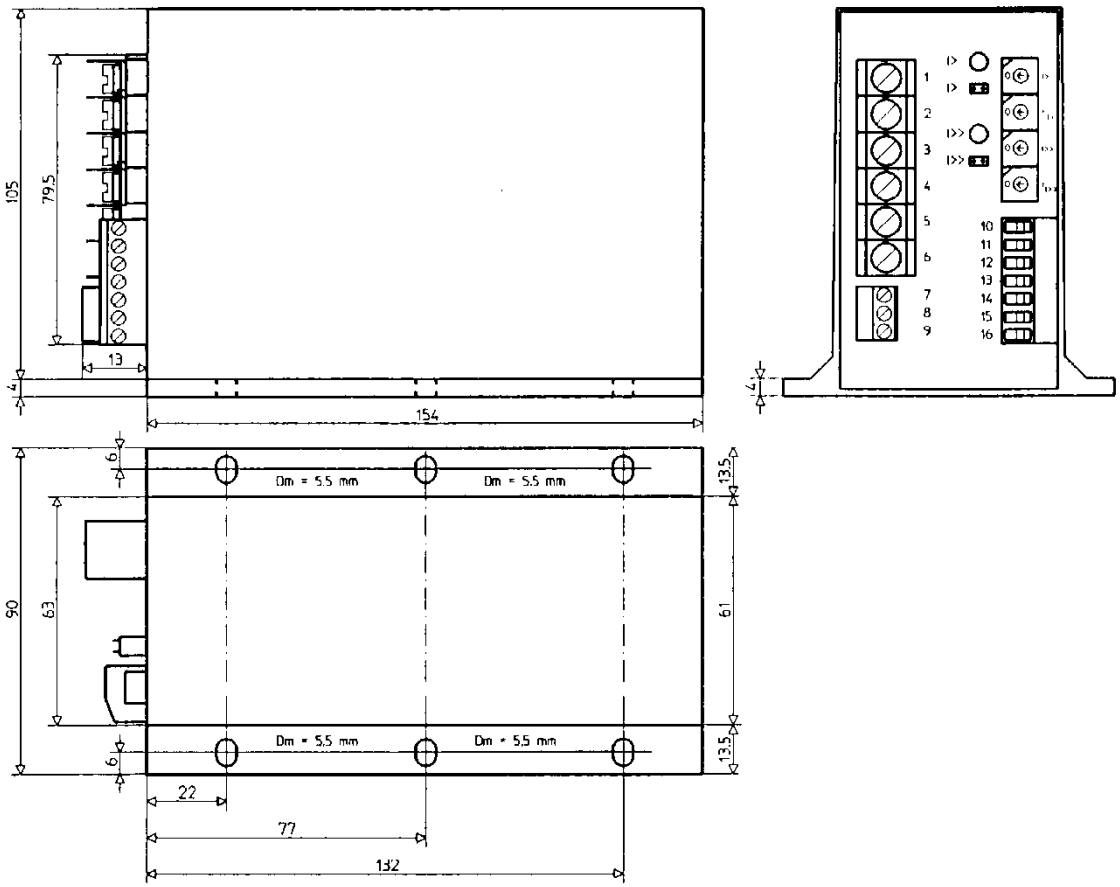


Figure 4.1: WIM1 housing

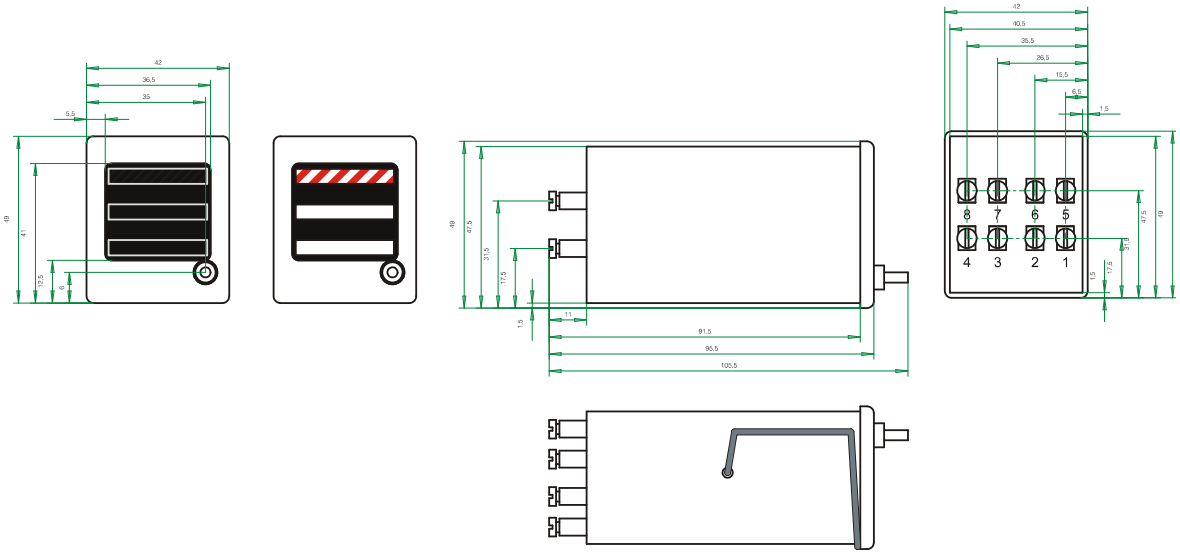


Figure 4.2: Flag indicator WIZ-SZ2

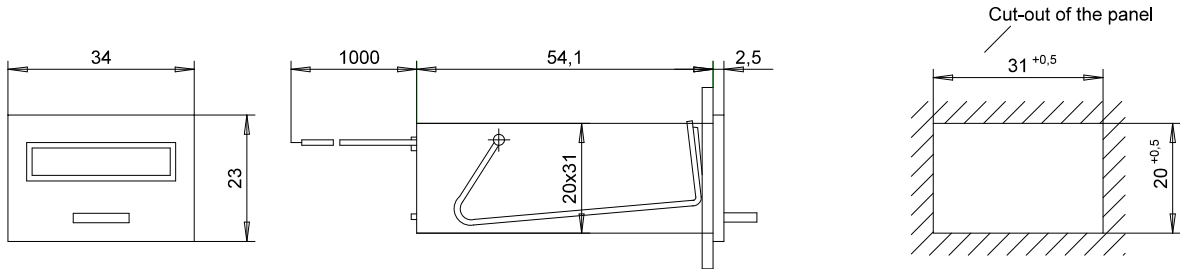


Figure 4.3: Flag indicator WIZ-SZ4

5. Order form

Three phase inverse time overcurrent relay (multi-characteristic, self powered)	***WIM1***			**1**
Remote tripping, flag indicator output, 1 relay contact output with 2 change-over contacts or electric impulse output	**C**			
Flag indicator output, 1 change-over contact overcurrent tripping, 1 change-over contact short circuit current tripping, 1 change-over contact as common relay contact output for tripping of overcurrent and short circuit current	**S**			
Rated current 1 A		**1**		
5 A		**5**		
Electro impulse output with long tripping time $t_{I>}$ 5 s to 20 s			**EL**	
Relay contact output for ranges see technical description			**RM**	
Back panel mounting				

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