MANUAL

Professional Line | PROTECTION TECHNOLOGY MADE SIMPLE

XI1I | TIME OVERCURRENT RELAY

TIME OVERCURRENT RELAY

Original document

English

Revision: C

Contents

1. Applications and features

As an universal time overcurrent protection, the XI1-I relay of the PROFESSIONAL LINE is generally used in radial and meshed systems. Among other, it is applied as:

- selective overload and short-circuit protection relay for electr. machines, lines and networks or for
- load dependent connection and disconnection of consumers and electric power generators.

It is possible to select from the following tripping characteristics:

- Definite time overcurrent protection (DMT)
- Inverse time overcurrent protection (IDMT) with selectable tripping characteristics
  - Normal Inverse
  - Very Inverse
  - Extremely Inverse

Furthermore, the XI1-I can be employed as a back-up protection for differential and distance protection relays.

When compared to the conventional protection equipment all relays of the PROFESSIONAL LINE reflect the superiority of digital protection techniques with the following features:

- High measuring accuracy by digital data processing
- Fault indication via LEDs
- Extremely wide operating ranges of the supply voltage by universal wide-range power supply
- Very fine graded wide setting ranges
- Data exchange with process management system by serial interface adapter XRS1 which can be retrofitted
- RMS measurement
- Extremely short response time
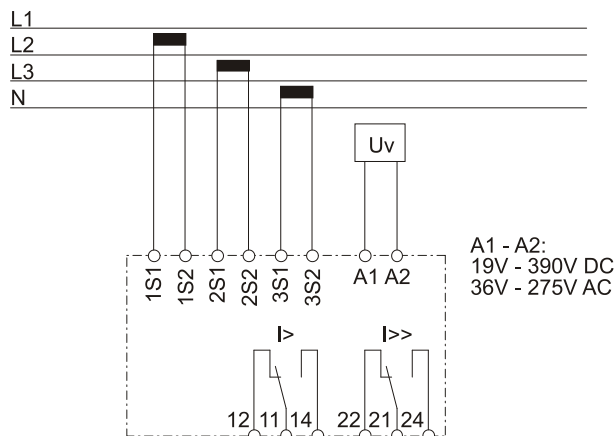- Compact design by SMD-technology

2. Design

Figure 2.1: Connections

Analog inputs

The analog input signals are connected to the protection device via terminals 1S1 - 1S2, 2S1 - 2S2 and 3S1 - 3S2.

Auxiliary voltage supply

Unit XI1 needs a separate auxiliary voltage supply. Therefore a DC or AC voltage must be used. Unit XI1 has an integrated wide range power supply. Voltages in the range from 19 - 390 V DC or 36 - 275 V AC can be applied at connection terminals A1 and A2.
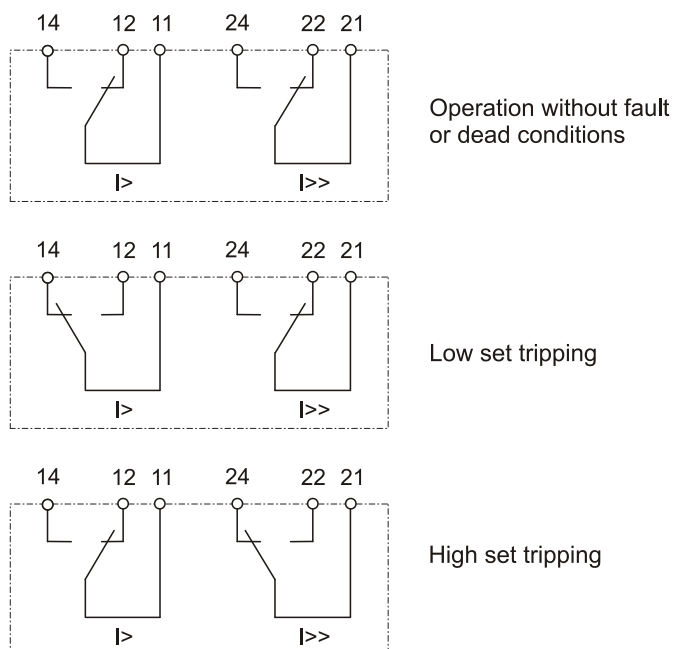
Contact positions

Figure 2.2: Contact positions of the output relays

Note:

In case of both the tripping contacts of I> and I>> should cause the tripping coil of the C.B. to trip, they have to be interconnected.

3. Function

The incoming currents from the main current transformers of the protected objects are converted to voltage signals in proportion to the currents via the input trans-formers and burden. The noise signals caused by inductive and capacitive coupling are suppressed by an analog R-C filter circuit. The analog voltage signals are fed to the A/D-converter of the microprocessor and transformed to digital signals through Sample and Hold circuits. All the processing is carried out on these digitized values. The measuring values are detected with a sampling frequency of 800 Hz (960 Hz), and a sampling rate of 1.25 ms (1.11 ms) for each measurement (at 50 Hz (60 Hz)).
A pickup of a supervision circuit is indicated by flashing of the corresponding LED. At tripping the flashing light changes to steady light.

3.1 Requirements for the main current transformers

The current transformers have to be rated in such a way, that a saturation should not occur within the fol-lowing operating current ranges:

Independent time overcurrent function K1 = 2
Inverse time overcurrent function K1 = 20
High-set function K1 = 20

K1 = Current factor related to set value with the current transformer not yet operating in the saturation range.

Moreover, the current transformers have to be rated according to the maximum expected short-circuit currents of the network or the object to be protected.

The low consumption of the XI1, i.e. < 0.1 VA has a positive effect on the rating of the current transformers. It implies that, if an electromechanical relay is replaced by XI1, a high accuracy limit factor is automatically obtained by using the same current transformer.

4. Operation and settings

All operating elements needed for setting parameters are located on the front plate of the XI1 as well as all display elements.

Because of this all adjustments of the unit can be made or changed without disconnecting the unit off the DIN-rail.
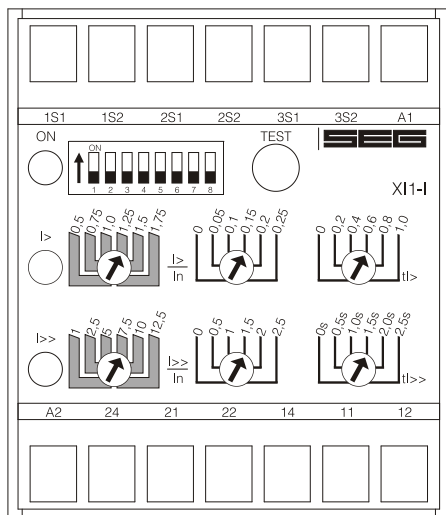

Figure 4.1: Front plate

For adjustment of the unit the transparent cover has to be opened as illustrated. Do not use force! The trans-parent cover has two inserts for labels.
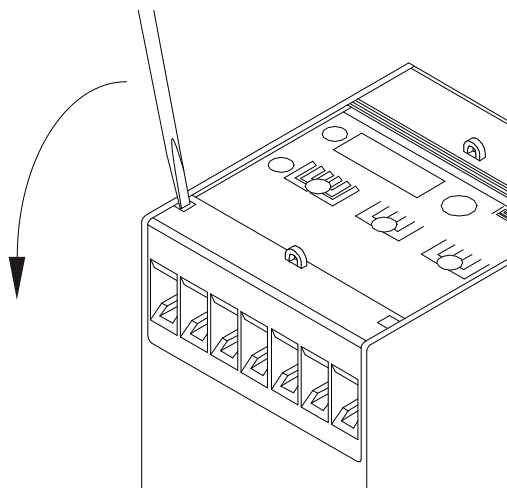
Figure 4.2: How to open the transparent cover

LEDs

LED „ON" is used for display of the readiness for ser-vice (at applied auxiliary voltage Uv). LED I> and I>> signal pickup (flashing) or tripping (steady light) of the corresponding function.

Test push button

This push button is used for test tripping of the unit and when pressed for 5 s a check-up of the hardware takes place. Both output relays are tripped and all tripping LEDs light up.

4.1   Setting of DIP-switches

The DIP-switch block on the front plate of the XI1 is used for adjustment of the nominal values and setting of function parameters:

DIP-switch	OFF	ON	Function
1*	DEFT	NINV	Adjustment of the tripping characteristic
2*	DEFT	VINV	
3*	DEFT	EINV	
4	not blocked	blocked	Blocking of the I> element
5	not blocked	blocked	Blocking of the I>> element
6	50 Hz	60 Hz	Adjustment of the rated frequency
7*	x1 s (x1)	x10 s (x2)	Time multiplier DEFT for tI> (the multipliers for inverse time characteristic are indicated in brackets)
8*	x1 s	x100 s	Time multiplier DEFT for tI>

Table 4.1: Functions of DIP-switches

*Only one of the DIP-switches 1 - 3 or 7 - 8 shall be in „ON"-position at the same time.

Blocking of the low set element (I>)
The low set element can be blocked with the aid of DIP-switch 4 (position „ON").

Tripping characteristic
The required tripping characteristic for the time over-current protection can be adjusted with the aid of DIP--switches 1 - 3. It must be ensured that only one of the three DIP-switches is switched on. Wrong adjustment (e.g. 2 DIP-switches „ON") leads to instant tripping.
For the adjustment of the tripping characteristics, the following DIP-switch configurations are allowed:
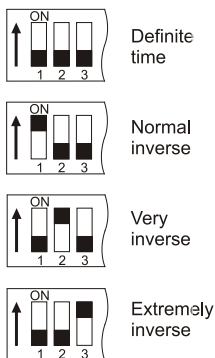

Figure 4.3: Setting the tripping characteristics

Blocking of the high set element (I>>)
When the DIP-switch 5 is in position „ON", the high set element of the relay is blocked.

Rated frequency
With the aid of DIP-switch 6 the rated frequency can be set to 50 or 60 Hz, depending upon the given mains characteristics.

4.2   Setting of the tripping values

The PROFESSIONAL LINE units have the unique possibility of high accuracy fine adjustments. For this, two potentiometers are used. The course setting potentiometer can be set in discrete steps of 0.25 or 2.5 x In. A second fine adjustment potentiometer is then used for continuously variable setting of the final. Adding of the two values results in the precise tripping value.

Low set element
The tripping value can be set in the range from
0.5 - 2 x In with the aid of the potentiometer illustrated on the following diagram.

Example:
A tripping value of 1.4 x In is to be set. The set value of the right potentiometer is just added to the value of the coarse setting potentiometer. (The arrow of the coarse setting potentiometer must be inside of the marked bar, otherwise no defined setting value).
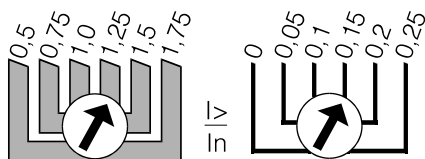

Figure 4.4: Adjustment example

Trip delay for the low set element
The time delay for the low set element (DEFT) can be adjusted in the range from 0 - 100 s.
For inverse time characteristics (NINV, VINV or EINV) the time multiplier is adjustable in the range from 0 - 2.

High set element
The high set element can be adjusted in the range from 1 - 15 x In. This adjustment is done similar to the low set element adjustment.

Trip delay for high set element
The time delay for the high set element is adjustable in the range from 0 - 2.5 s.

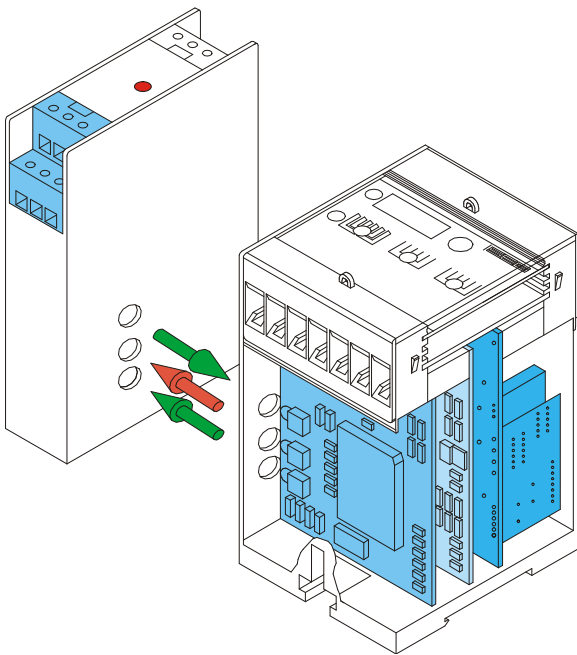## 4.2   Communication via serial interface adapter XRS1

Figure 4.5: Communication principle

For communication of the units among each other and with a superior management system, the interface adapter XRS1 is available for data transmission, including operating software for our relays. This adapter can easily be retrofitted at the side of relay. Screw terminals simplify its installation. Optical transmission of this adapter makes galvanic isolation of the relay possible. Aided by the software, actual measured values can be processed, relay parameters set and protection functions programmed at the output relays. Information about unit XRS1 in de-tail can be taken from the description of this unit.

5. Relay case and technical data

5.1 Relay case

Relay XI1 is designed to be fastened onto a DIN-rail acc. to DIN EN 50022, the same as all units of the PROFESSIONAL LINE.
The front plate of the relay is protected with a sealable transparent cover (IP40).
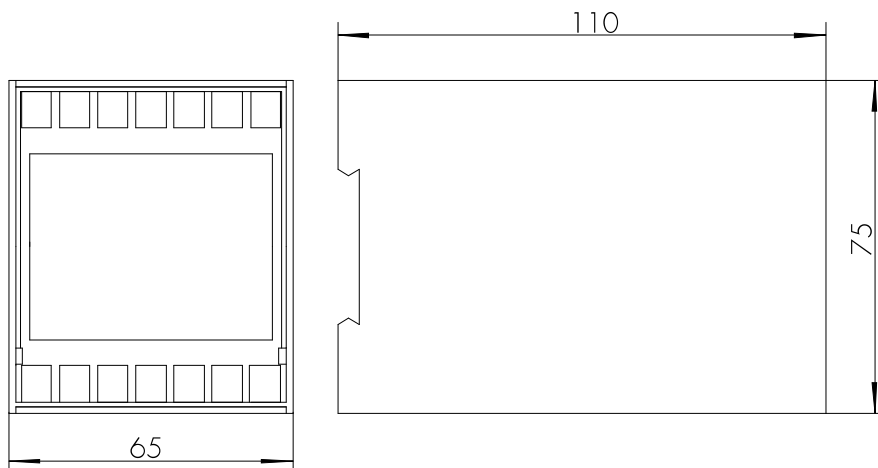
Figure 5.1: Dimensional drawing

Connection terminals
The connection of up to a maximum 2 x 2.5 mm² cross-section conductors is possible. For this the transparent cover of the unit has to be removed (see para. 4).

5.2   Technical data

Measuring input circuits
Rated frequency fn: 50/60 Hz
Thermal withstand capability
in current circuits: dynamic current withstand (half wave)   250 x In
                                       for 1 s   100 x In
                                       for 10 s   30 x In
                                       continuously   4 x In
Power consumption   at In = 1 A   0.1 VA
in current circuit   at In = 5 A   0.1 VA
Max. 300 V AC against ground (earth)

Auxiliary voltage
Auxiliary voltage range /
Power consumption: 19 - 390 V DC or 36 - 275 V AC (f = 40 - 70 Hz) /
                                       4 W (terminals A1 and A2)

Common data
Dropout to pickup ratio: > 97 %
Resetting time from pickup: <50 ms
Returning time from trip: 200 ms
Minimum initialization time after
supply voltage has applied: 100 ms
Minimum response time
when supply voltage is available: 50 ms

Output relay
Number of relays: 2
Contacts: 1 changeover contact for each trip relay
Maximum breaking capacity: ohmic 1250 VA / AC resp. 120 W / DC
                                       inductive 500VA / AC resp. 75 W / DC
Max. rated voltage: 250 V AC
                                       220 V DC   ohmic load Imax. = 0,2 A
                                                       inductive load Imax. = 0,1 A at L/R ≤ 50 ms
                                       24 V DC   inductive load Imax. = 5 A
Minimum load: 1 W / 1 VA at Umin ≥ 10 V
Maximum rated current: 5 A
Making current (16ms):   20 A
Contact life span: 10^5 operations at max. breaking capacity
Contact material: AgCdO

System data
Design standard: VDE 0435, VDE 0843 Part 1-4, VDE 0871, EN 50178:1998

Temperature range at storage
and operation: - 25°C to + 70°C

Constant climate class F
acc. DIN 40040 and
DIN IEC 68, part 2-3:   more than 56 days at 40°C and 95 % relative humidity

High voltage test acc. to VDE 0435, part 303
Voltage test: 2.5 kV (eff.)/50 Hz; 1 min
Surge voltage test: 5 kV; 1.2/50 µs, 0.5 J
High frequency test: 2.5 kV/1 MHz

Electrostatic discharge (ESD)
acc. to IEC 0801, part 2:   8 kV

Radiated electromagnetic field
test acc. to IEC 0801, part 3:   10 V/m

Electrical fast transient (burst)
acc. to IEC 0801, part 4:   4 kV/2.5kHz, 15 ms

Radio interference suppression test
as per DIN 57871 and VDE 0871:   limit value class A
Repeat accuracy: 1 %
Basic time delay accuracy: 0.5 % or ±25 ms

Basic accuracy of current: ±3 % of the setting value

Accuracy of time delay in
the range of 2 - 20 x I_S: 2 % DEFT/5 % NINV and VINV/7,5 % EINV/or 25 ms

Transient overreach at
instaneous operation: ≤ 5 % Temperature effect: 0.02 % per K
Frequency effect: 0.5 % per K deviation from rated value

Mechanical test:
Shock: class 1 acc. to DIN IEC 255-21-2
Vibration: class 1 acc. to DIN IEC 255-21-1

Degree of protection
Front plate: IP40 at closed front cover
Weight: approx. 0.7 kg
Mounting position: any
Relay case material: self-extinguishing

5.3   Definite time overcurrent protection

Parameter	Setting range	Graduation
I>	0.5 - 2 x In	Continuously variable
I>>	1 - 15 x In	Continuously variable
tI>	0 - 1s/0 - 10s/0 - 100s	Continuously variable
tI>>	0 - 2.5 s	Continuously variable

Table 5.11: Setting ranges and graduation

5.4   Inverse time overcurrent protection

Tripping characteristics according to IEC 255-4 or BS 142

Normal Inverse

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

Very Inverse

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

Extremely Inverse

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

Where: t   =   tripping time
           tI>   =   time multiplier
           I   =   fault current
           I>   =   setting value of the current

Parameter	Setting range	Graduation
I>	0.5 - 2 x IN	Continuously variable
I>>	1 - 15 x IN	Continuously variable
tI>	0.1 - 2	Continuously variable
tI>>	0 - 2.5 s	Continuously variable

Table 5.2: Setting ranges and graduation

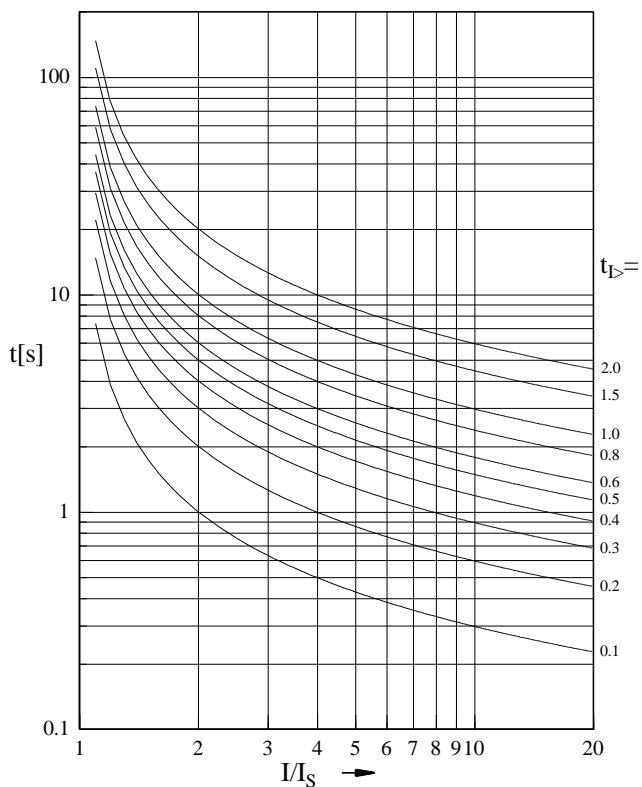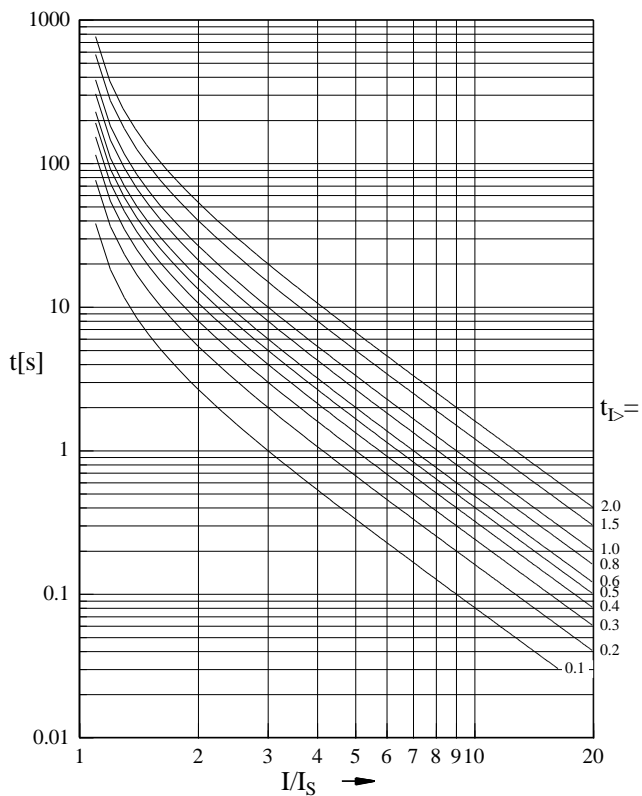## 5.5   Tripping characteristics
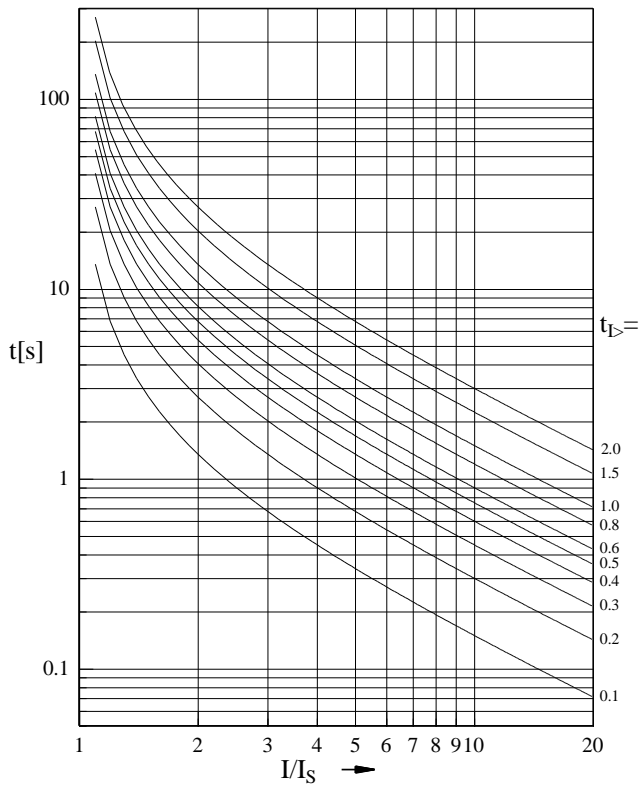
Figure 5.2: Normal inverse

Figure 5.3: Extremely inverse

Figure 5.4: Very inverse
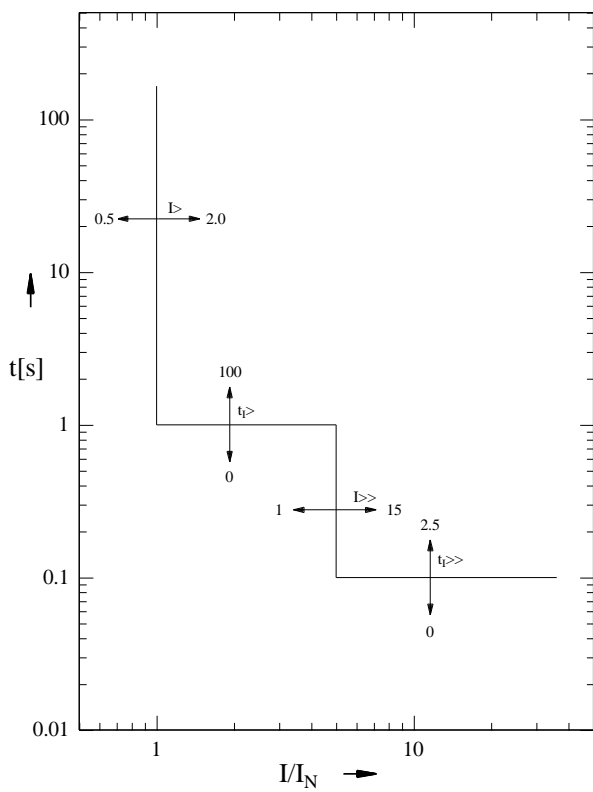
Figure 5.5: Definite time

6. Order form

Time overcurrent relay		*XI1-I-*	
Rated current:	1 A		**1**
	5 A		**5**

Technical data subject to change without notice!

Setting-list XI1-I

Project: _____SEG Electronics GmbH job.-no.: _____ .

Function group: = _____Location: + _____Relay code: - _____

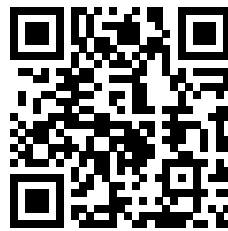Relay functions: _____Date: _____

Setting of parameters

Function		Unit	Default settings	Actual settings
I>	Overcurrent low set element	x In	0.5	
I>>	Overcurrent high set element	x In	1	
tI>	Trip delay for overcurrent low set element (DEFT)	s	0	
tI>	Time multiplier for inverse time tripping characteristic			
tI>>	Trip delay for overcurrent set element	s	0	

DIP-switch	Function	Default settings	Actual settings
1*		DEFT	
2*	Adjustment of the tripping characteristic	DEFT	
3*		DEFT	
4	Blocking of the I> element	not blocked	
5	Blocking of the I>> element	not blocked	
6	Adjustment of the rated frequency	50 Hz	
7*	Time multiplier DEFT for tI> (the multipliers for inverse time characteristic are indicated in brackets)	x 1s (x 1)	
8*	Time multiplier DEFT for tI>	x 1s	

*Only one of the DIP-switches 1 - 3 or 7 - 8 shall be in „ON"-position at the same time.

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