SEG power protection

WIC1 – CT Powered Time Overcurrent and Earth Current Relay

CE

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1 Introduction

SEG protection relays of the WI-LINE are offering time overcurrent protective functions and earth fault protective functions in the well-proven technique for CT powered protection relays. As combination of a compact protection relay and related core-type transformer, the *WIC1* system was especially developed for compact MV switchboards with circuit breakers (CTs).

1.1 How to use this instruction

In this instruction the technical description of all *WIC1* versions is included. The user is given a comprehensive insight into the various applications, the selection, installation, setting of parameters and putting into operation of the *WIC1*.

This instruction is divided into the following sections:

Chapter 1;	Introduction
Chapter 2;	Handling, installation and outside dimensions
Chapter 3;	Operating instructions
Chapter 4;	Technical specification
Chapter 5;	Description of application
Chapter 6;	Commissioning and maintenance
Annex;	Connection diagram, Commissioning protocol

1.2 Introductory remarks on the *WIC1*

The requirements on MS distribution stations with circuit breakers call for a robust protection relay which is optimised accordingly and an integral part of the respective switchboard. The *WIC1* is a time overcurrent relay SEG has developed specifically for such requirements.
The *WIC1* is a CT-powered protection relay with minimal space requirement which complies with the highest demands on a digital protection device. Simple but safe wiring, high electromagnetic interference immunity, uncomplicated adjustment and the ability to scale to different power quantities of the switchboard, helping the switchgear manufacturer to minimise costs. By developing the *WIC1* we are also able to present a protective system with a guaranteed maintenance-free period of 25 years, the same as for the switchboard.

1.3 Product description

The *WIC1* is a CT-powered protection relay with inverse time and definite time protection characteristics and is specifically designed for switchboards with CBs and small rated output currents.

Together the specific CTs and the *WIC1* form a joint protective system. A low-energy coil is needed for realising trip of the CB.

Parameter setting can be done in different user-friendly ways. By means of casting all electronic components incl. the housing are safely protected against climatic and mechanic influences.

In the *WIC1* the following protection functions are realised:

- 3 phase definite time overcurrent and short-circuit protection with variable tripping times (ANSI 50/51)
- 3 phase overcurrent protection with selectable inverse time characteristics and definite time short-circuit current element (ANSI 50/51)
- definite time earth overcurrent protection by internal calculation (ANSI 50N/51N)

2 Handling, Installation and Outside Dimensions

2.1 General information

2.1.1 Upkeep of the relay

As a rule protection relays are of robust construction and the *WIC1* in particular allows operation under extreme environmental conditions. But despite these facts, the *WIC1* should be handled with the necessary care during installation and commissioning. Immediately after receipt of the relay it should be checked for possible damage inflicted during transportation. Any transport damage has to be notified to the transport firm handling the consignment.

Those relays which are not installed immediately should be stored in their original package (styrofoam).

2.1.2 Storage

If the relay is not used directly it has to be stored in its original packing. Permissible temperatures during storing are –40°C up to +85°C. The storage place should be dry.

2.1.3 Electrostatic discharge

The electronic components used in the relay react very sensitive to electrostatic discharge but they are absolute safely placed inside the plastic housing. Additionally all electronic components are well protected by means of casting. Hence it is practical impossible that components are damaged by ESD.

There are no setting or calibrating appliances inside the housing, which would call for opening the device by the user. The housing is hermetically sealed and cannot be opened without causing damage.

2.2 Installation of the relay

By using the three 7mmØ drill holes, the relay is directly mounted onto the mounting plate. Detailed drawing with all measurements can be found under 8.1.

2.3 Outside dimensions

All *WIC1* types are of standardised design.

Weight:	700g
Dimensions: (B×H×T)	125×170×40mm

3 Operating instructions

3.1 General information on the *WIC1*

All available versions of the *WIC1* relay are a high-tech and cost-optimised protection for MV switchboards. Specifically in compact switchboards, the *WIC1* protection system in combination with a circuit breaker can replace the combination of load-break-switch with HV fuses. When power distribution networks are extended more and more high powered transformers are used and here HV fuses are inadmissible. For such applications the *WIC1* protection system is an optimal replacement.

All *WIC1* versions are provided with three analogue measuring inputs (3x phase current). The current measuring inputs are specially adjusted to the CTs allocated to the *WIC1* protection system. There are 4 different CT ratios available for the protection system *WIC1* which are conditional on the rated system current. The successive development towards the application time overcurrent protection makes the system very user friendly. Setting of parameters as well as reading of tripping values is done via the integrated interface. For this the user has one PC adapter and the software "WIC-Soft1" at hand. The software is available in two versions, i.e. for installation on a WINDOWS PC and also for standard Palm Top Computers.

As an alternative to the adjustment via interface it is also possible to do this by means of DIP switches (for relay version WIC1-2) or by HEX switches (for relay version WIC1-3).

Cumulative current formation for earth current detection is programmed in the relay. The earth current is calculated from the three phase currents.

The *WIC1* is provided with an input for remote tripping to which 115 VAC or 230 VAC can be connected. Tripping is realised via the electric impulse output after max. 1s.

A mechanical flag indicator can be installed for optical signalling occurrence of trip conditions.

Furthermore it is possible to signal a trip event potentially free via the flag indicator SZ5. For this purpose the flag indicator is equipped with two changeover contacts.

For versions WIC1-2/-3 activation of the relay is signalled by a LED which is above the switches and protected by the clear plastic cover.

In order to simplify protective tests, the *WIC1* has test sockets for connection of measuring lines of a three-phase testing device which are used for feeding the CT test winding. Through this the entire protection system (CTs, protection devices, tripping coil) incl. the wiring can be tested.

3.2 User interface

3.2.1 WIC1-1

Pursuant to the intended maintenance-free design and for reducing cost there is no user interface with LED indicators and display. The setting values of the protective functions can be recorded directly at the protection relay.

For the basic version WIC1-1 the adjustment of protective functions can only be done via the communication interface which is placed above the terminal blocks at the left of the device.

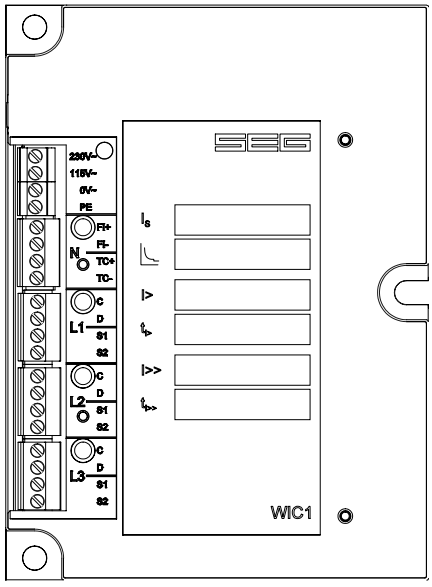


Figure 3.1: WIC1-1

Note!
For the operating software "WIC-Soft1" a separate description is available.

3.2.2 WIC1-2

For the relay version WIC1-2 the adjustment of protective functions can be done via DIP switches; there are 4 DIP switches for binary coded setting of one protective parameter.

Because there are only 16 steps available for setting the individual protective parameters, scaling is more coarse than this is the case with parameter setting via software.

For the relay version WIC1-2 setting of parameters via interface is not possible any more, but it is possible to read-out the stored fault values as well as the setting values of the *WIC1*.

The interface for this version can be found at the left of the relay and additionally above the DIP switch block.

Switch block; Switch No.	Setting parameter
1; 1-4	I_S: Rated CT current dependent on the primary operating current
1; 5-8	Choice of characteristics
2; 1-4	I>: Pick-up value of the definite time overcurrent element or start value of the inverse time characteristic.
2; 5–8	$t_{I>}$: Tripping time of the definite time overcurrent element or factor "a" of the inverse time characteristic
3; 1-4	I>>: Pick-up value of the short-circuit element
3; 5-8	$t_{I>>}$: Tripping time of the short-circuit element
4; 1-4	$I_{e>}$: Pick-up value of the definite time earth overcurrent element
4; 5-8	$t_{Ie>}$: Tripping time of the definite time earth overcurrent element.

If there is no earth fault function, the DIP switch block 4 is not incorporated.

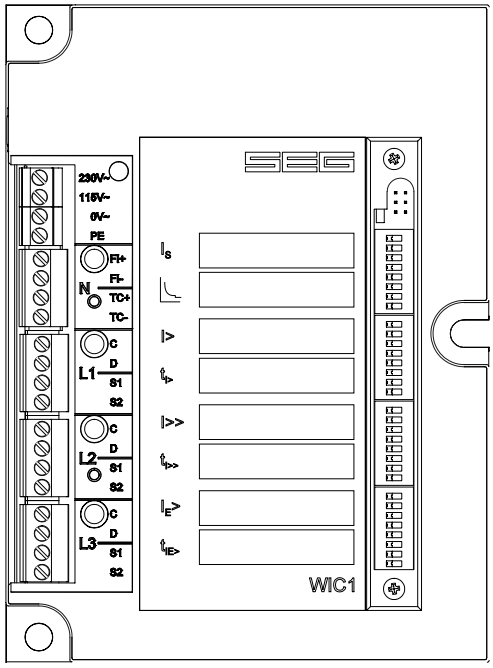


Figure 3.2: WIC1-2

3.2.3 WIC1-3

For the relay version WIC1-3 the adjustment of protective functions can be done via HEX switches at the protection relay.

Because there are only 16 steps available for setting the individual protective parameters, scaling is more coarse than this is the case with parameter setting via software.

For the relay version WIC1-3 setting of parameters via interface is not possible any more, but it is possible to read-out the stored fault values as well as the setting values of the *WIC1*.

The interface for this version can be found at the left of the relay and additionally above the HEX switch block. The following parameters can be set for the relay version with integrated earth fault protection function.

Switch	Setting parameter
1	I_S: Rated CT current dependent on the primary operating current
2	Choice of characteristics
3	I>: Pick-up value of the definite time overcurrent element or start value of the inverse time characteristic
4	$t_{I>}$: Tripping time of the definite time overcurrent element or time factor "a" of the inverse time characteristic
5	I>>: Pick-up value of the short-circuit element
6	$t_{I>>}$: Tripping time of the short-circuit element
7	$I_{e>}$: Pick-up value of the definite time earth overcurrent element
8	$t_{Ie>}$: Tripping time of the definite time earth overcurrent element

If there is no earth fault function, the HEX switches 7 and 8 are not incorporated.

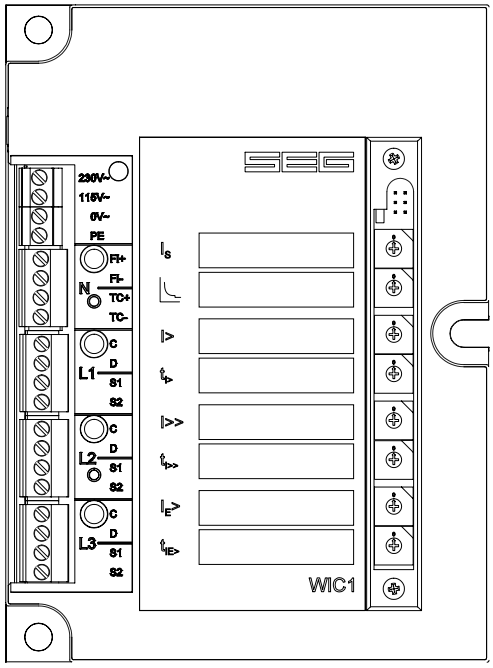


Figure 3.3: WIC1-3

3.3 CTs for the *WIC1*

There are 4 different wide-range CTs for the protection system *WIC1*. Dependent on the rated primary power and voltage of the system, the following CTs can be offered:

CT Type	Rated primary current range
WIC1-WE2	16 – 56 A
WIC1-W2	16 – 56 A
WIC1-W3	32 – 112 A
WIC1-W4	64 – 224 A
WIC1-W5	128 – 448 A

The protection relay can be set to the respective operating current of the switchboard by parameter I_s. Reference on the calculation of the protective setting values resulting from this is made in chapter "Description of Application".

4 Technical Data, Characteristics and Features

4.1 Protective functions

4.1.1 Minimal operating current and rated primary current

In order to operated reliably, the *WIC1* - as all CT-powered protection relays - needs a minimal current flowing constantly in one of the phases. This minimal current is the smallest primary current of the CT x 0,9 listed in table.

The real rated current of the operating component to be protected is adjusted by parameter I_s. Depending on the CT type, an adjustment for relay version WIC1-1 is possible in the following scaling :

CT Type	Step
WIC1-WE2	0.2 A
WIC1-W2	0.2 A
WIC1-W3	0.4 A
WIC1-W4	0.8 A
WIC1-W5	1.6 A

For relay versions WIC1-2 and WIC1-3 the following rated primary currents are adjustable either by DIP switches 1-4 (switch block 1) or HEX switch 1:

DIP 1-1	OFF	ON	OFF	ON	OFF	ON	OFF	ON	OFF	ON	OFF	ON	OFF	ON	OFF	ON
DIP 1-2	OFF	OFF	ON	ON	OFF	OFF	ON	ON	OFF	OFF	ON	ON	OFF	OFF	ON	ON
DIP 1-3	OFF	OFF	OFF	OFF	ON	ON	ON	ON	OFF	OFF	OFF	OFF	ON	ON	ON	ON
DIP 1-4	OFF	OFF	OFF	OFF	OFF	OFF	OFF	OFF	ON	ON	ON	ON	ON	ON	ON	ON
HEX 1	0	1	2	3	4	5	6	7	8	9	A	B	C	D	E	F
WIC1-W2	**16**	**18**	**20**	**22**	**24**	**26**	**28**	**30**	**32**	**34**	**36**	**40**	**44**	**48**	**52**	**56**
WIC1-W3	**32**	**36**	**40**	**44**	**48**	**52**	**56**	**60**	**64**	**68**	**72**	**80**	**88**	**96**	**104**	**112**
WIC1-W4	**64**	**72**	**80**	**88**	**96**	**104**	**112**	**120**	**128**	**136**	**144**	**160**	**176**	**192**	**208**	**224**
WIC1-W5	**128**	**144**	**160**	**176**	**192**	**208**	**224**	**240**	**256**	**272**	**288**	**320**	**352**	**384**	**416**	**448**

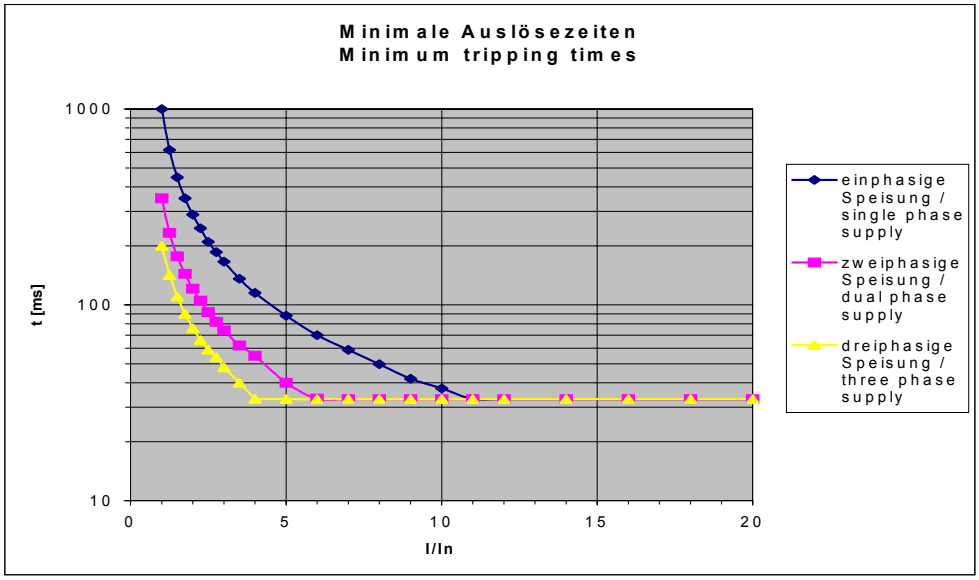
*Note: All values are primary values in Ampere

Table 4.1

4.1.2 Phase time overcurrent protection

Current	Arithmetic averages measurement	
Threshold values	I>	0.9 to 2.5 × Is in steps of 0.05 × I_s when adjusting via interface
	I>>	1 to 20 × Is in steps of 0.1 × I_s when adjusting via interface
Tripping time for the definite time overcurrent element t_I>	0.04s to 300s in the following steps when adjusting via interface 0.04 - 1s in 0.01 s steps 1 - 5s in 0.1s steps 5s - 20s in 0.5s steps 20s – 100s in 2s steps 100s - 300s in 5s steps	
IMT characteristics:	Normal Inverse (NINV) Very Inverse (VINV) Extremely Inverse (EINV) Long Time Inverse (LINV) RI-Inverse (RIINV) Fuse characteristic of a HV fuse	
Time factor	0.05 to 10 in steps of 0.05 when adjusting via interface	
Tripping times for the definite time short-circuit element t_I>>	0.04s to 3s in the following steps when adjusting via interface 0.04s - 1s in 0.01 s steps 1s - 3s in 0.02 s steps	

Note:
The min. tripping time when switched off due to a failure is subject to the fault current level. See the following diagram.



With the *WIC1* protection system minimal tripping times of 40 ms can be achieved.

Time correction	of current 0	≤ 45ms
	of current > Imin	≥ 35ms
Disengaging time	< 30ms	

For relay versions **WIC1-2** and **WIC1-3** the adjustment of values is done according to the tables listed below:

Characteristic curve = Hex-Switch 2 / DIP-Switch 1 (5 - 6)

DIP 1-5	OFF	ON	OFF	ON	OFF	ON	OFF	ON	OFF	ON	OFF	ON	OFF	ON	OFF	ON
DIP 1-6	OFF	OFF	ON	ON	OFF	OFF	ON	ON	OFF	OFF	ON	ON	OFF	OFF	ON	ON
DIP 1-7	OFF	OFF	OFF	OFF	ON	ON	ON	ON	OFF	OFF	OFF	OFF	ON	ON	ON	ON
DIP 1-8	OFF	OFF	OFF	OFF	OFF	OFF	OFF	OFF	ON	ON	ON	ON	ON	ON	ON	ON
HEX 2	0	1	2	3	4	5	6	7	8	9	A	B	C	D	E	F
Characteristic	DEFT	N-INV	V-INV	E-INV	LI-INV	RI-INV	HV-fuse	X	X	X	X	X	X	X	X	X

I> = Hex-Switch 3 / DIP-Switch 2 (1 - 4)

DIP 2-1	OFF	ON	OFF	ON	OFF	ON	OFF	ON	OFF	ON	OFF	ON	OFF	ON	OFF	ON
DIP 2-2	OFF	OFF	ON	ON	OFF	OFF	ON	ON	OFF	OFF	ON	ON	OFF	OFF	ON	ON
DIP 2-3	OFF	OFF	OFF	OFF	ON	ON	ON	ON	OFF	OFF	OFF	OFF	ON	ON	ON	ON
DIP 2-4	OFF	OFF	OFF	OFF	OFF	OFF	OFF	OFF	ON	ON	ON	ON	ON	ON	ON	ON
HEX 3	0	1	2	3	4	5	6	7	8	9	A	B	C	D	E	F
× Is	0.9	0.95	1	1.05	1.1	1.15	1.2	1.3	1.4	1.5	1.6	1.8	2	2.25	2.5	Exit

$t_{I>}$ = Hex-Switch 4 / DIP-Switch 2 (5 - 8)

DIP 2-5	OFF	ON	OFF	ON	OFF	ON	OFF	ON	OFF	ON	OFF	ON	OFF	ON	OFF	ON
DIP 2-6	OFF	OFF	ON	ON	OFF	OFF	ON	ON	OFF	OFF	ON	ON	OFF	OFF	ON	ON
DIP 2-7	OFF	OFF	OFF	OFF	ON	ON	ON	ON	OFF	OFF	OFF	OFF	ON	ON	ON	ON
DIP 2-8	OFF	OFF	OFF	OFF	OFF	OFF	OFF	OFF	ON	ON	ON	ON	ON	ON	ON	ON
HEX 4	0	1	2	3	4	5	6	7	8	9	A	B	C	D	E	F
time (s)	0.04	1	2	3	4	5	6	8	10	15	30	60	120	180	240	300
Factor "a"	0.05	0.1	0.2	0.3	0.4	0.5	0.6	0.8	1	2	3	4	5	6	8	10

I>> = Hex-Switch 5 / DIP-Switch 3 (1 – 4)

DIP 3-1	OFF	ON	OFF	ON	OFF	ON	OFF	ON	OFF	ON	OFF	ON	OFF	ON	OFF	ON
DIP 3-2	OFF	OFF	ON	ON	OFF	OFF	ON	ON	OFF	OFF	ON	ON	OFF	OFF	ON	ON
DIP 3-3	OFF	OFF	OFF	OFF	ON	ON	ON	ON	OFF	OFF	OFF	OFF	ON	ON	ON	ON
DIP 3-4	OFF	OFF	OFF	OFF	OFF	OFF	OFF	OFF	ON	ON	ON	ON	ON	ON	ON	ON
HEX 5	0	1	2	3	4	5	6	7	8	9	A	B	C	D	E	F
× Is	1	2	3	4	5	6	7	8	9	10	12	14	16	18	20	Exit

$t_{I>>}$ = Hex-Switch 6 / DIP-Switch 3 (5 - 8)

DIP 3-5	OFF	ON	OFF	ON	OFF	ON	OFF	ON	OFF	ON	OFF	ON	OFF	ON	OFF	ON
DIP 3-6	OFF	OFF	ON	ON	OFF	OFF	ON	ON	OFF	OFF	ON	ON	OFF	OFF	ON	ON
DIP 3-7	OFF	OFF	OFF	OFF	ON	ON	ON	ON	OFF	OFF	OFF	OFF	ON	ON	ON	ON
DIP 3-8	OFF	OFF	OFF	OFF	OFF	OFF	OFF	OFF	ON	ON	ON	ON	ON	ON	ON	ON
HEX 6	0	1	2	3	4	5	6	7	8	9	A	B	C	D	E	F
time (s)	0.04	0.07	0.1	0.15	0.2	0.25	0.3	0.4	0.6	0.8	1.0	1.4	1.8	2.2	2.6	3.0

4.1.3 Earth current protection

Current	Internal calculated cumulative current formation	
	$I_E>$	0.2 to 2.5 × Is in steps of 0.05 × I_s when adjusting via the interface
Tripping time	$t_{Ie>}$	0.1 to 20s in steps of 0.01 when adjusting via the interface

$I_{E>}$ = Hex-Switch 7 / DIP-Switch 4 (1 - 4)

DIP 4-1	OFF	ON	OFF	ON	OFF	ON	OFF	ON	OFF	ON	OFF	ON	OFF	ON	OFF	ON
DIP 4-2	OFF	OFF	ON	ON	OFF	OFF	ON	ON	OFF	OFF	ON	ON	OFF	OFF	ON	ON
DIP 4-3	OFF	OFF	OFF	OFF	ON	ON	ON	ON	OFF	OFF	OFF	OFF	ON	ON	ON	ON
DIP 4-4	OFF	OFF	OFF	OFF	OFF	OFF	OFF	OFF	ON	ON	ON	ON	ON	ON	ON	ON
HEX 7	0	1	2	3	4	5	6	7	8	9	A	B	C	D	E	F
× Is	0.2	0.3	0.4	0.5	0.6	0.7	0.8	0.9	1.0	1.2	1.4	1.6	1.8	2.0	2.5	Exit

$t_{IE>}$ = Hex-Switch 8 / DIP-Switch 4 (5 – 8)

DIP 4-5	OFF	ON	OFF	ON	OFF	ON	OFF	ON	OFF	ON	OFF	ON	OFF	ON	OFF	ON
DIP 4-6	OFF	OFF	ON	ON	OFF	OFF	ON	ON	OFF	OFF	ON	ON	OFF	OFF	ON	ON
DIP 4-7	OFF	OFF	OFF	OFF	ON	ON	ON	ON	OFF	OFF	OFF	OFF	ON	ON	ON	ON
DIP 4-8	OFF	OFF	OFF	OFF	OFF	OFF	OFF	OFF	ON	ON	ON	ON	ON	ON	ON	ON
HEX 8	0	1	2	3	4	5	6	7	8	9	A	B	C	D	E	F
time (s)	0.1	0.2	0.4	0.6	0.8	1	1.5	2	2.5	3	3.5	4	6	8	10	20

4.2 Routine safety check

In case of misadjustment of the relay, e.g. selection of non-assigned switch positions, the relay operates with the following setting values.

Is = upper rated CT current
Characteristic = UMZ
I> = EXIT
tI> = 0.04 s
I>> = 20 x Is
TI>> = 0.04 s
With earth fault element
IE> = 2.5 x Is
tIE> = 0.1 s

A circuitry is integrated to give an additional back-up protection in case of processor or storage errors. By this circuitry a short-circuit protection with the following trip values is guaranteed :

I>> = 20 times higher than the rated CT current
tI>> = 40 ms

4.3 Fault value memory

A fault value memory is integrated in the *WIC1* where data of the latest fault occurrence is stored. The stored information can only be read out via the PC interface. The following fault references are available:

- the protective element causing the trip or an externally triggered trip
- values of the trip current in the individual phases or earth fault currents (with E type)

4.4 Communication

4.4.1 Communication via PC adapter

For connection to the RS 232 interface of a PC or Palm Top with integrated battery supply, an adapter WIC1-PC is needed. Through this adapter the galvanic isolation between protection device and PC/Palm Top is reached and it supplies the *WIC1* with the necessary energy. For communication a proprietary SEG protocol is used.

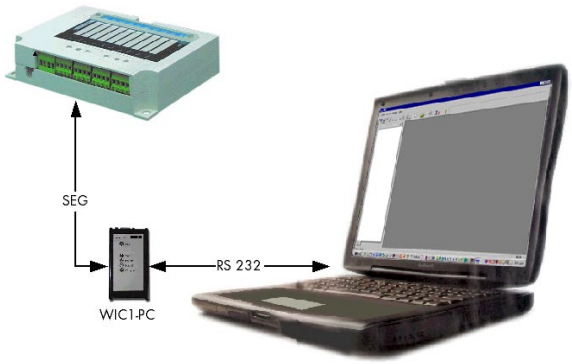


Figure 4.1: WIC1, WIC1-PC and Laptop

To connect the WIC1-PC to a serial interface, a 9-pole standard zero-modem-cable is needed.
The lockable opening at the housing of *WIC1* and the 6-pole plug are of matching design.

A 9V battery is integrated in the PC adapter. The battery charging level is indicated by 2 LEDs on the PC adapter. As soon as the adapter is connected with the PC and the battery charging level is high enough, the LED "Battery OK" lights up. Dropping of the battery voltage is indicated by LED "Low Battery". The data exchange between PC / Palm Top and *WIC1* is signalled by lighting up of the two LEDs "Tx" and "Rx". During reading out and writing of parameters the *WIC1* is fed by the PC adapter, indicated by LED "WIC Power".

4.4.2 Communication via a Palm Top Computer

For connection of a Palm Top Computer to the *WIC1* the same hardware components are used as needed for PC communication.

Relay data which was set via a Palm Top can be transferred to a PC by use of the WIC-Soft1.

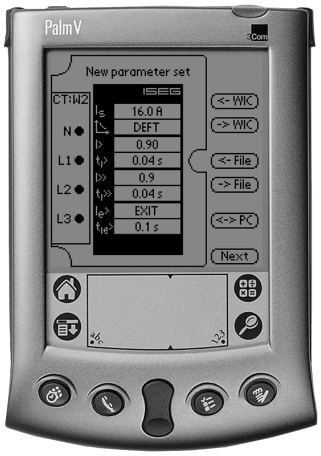


Figure 4.2: Palm-Top with Software

4.5 Inputs and outputs

The terminals for connection of the CT, the tripping coil of the external trip input as well as the flag indicator output are provided at the left side of the *WIC1*. Dependent on the relay type either screw-type terminals or screw-type plug-in terminals in 4-block arrangement are used. Make of both terminal types is Phönix.
A cover serves as protection against accidental contact and prevents unintended loosening of the terminal connections. Terminal marking is durable embossed in the housing.

4.5.1 Remote trip input

To the four terminals of the top terminal block 230V~; 115V~; OV~ and PE the relevant aux. voltage for the remote trip input is connected. This input is electrically isolated.
Terminal PE is the central earthing point for the protective system.

Technical Data:

Input voltage range:	230 V ± 15%
	115 V ± 15%
Tripping delay:	≤ 1 s

4.5.2 Impulse output for the tripping coil

To Terminals 1 and 2 of the 2nd terminal block (TC+, TC-) the low-energy tripping coil of the CB can be connected. The trip energy is provided by a capacitor store integrated in the protection relay. Length of the trip impulse is 50ms; the pause between the individual pulses depends on the impedance of the tripping coil and the current level. Pulsing is continued until the activation threshold is undershot.

Technical Data:

Trip energy:	E ≥ 0.1 Ws
Voltage:	≥ 24 V DC

4.5.3 Earthing

The fourth terminal (PE) of the top terminal block is the central earth connection point of the protection system.

4.5.4 Impulse output for the relay

To Terminals 3 and 4 of the 2nd terminal block (FI+, FI-) the flag indicator for CB signalling can be connected. The trip energy is provided by a capacitor store integrated in the protection relay. Length of the trip impulse is 50ms; the pause between the individual pulses depends on the impedance of the flag indicator and the current level. Pulsing is continued until the activation threshold is undershot.

Technical Data:

Energy:	E ≥ 0.01 Ws
Voltage:	≥ 24 V DC

4.5.5 Measuring inputs for the CTs

The measuring inputs of the *WIC1* protection system are matching the allocated CTs. Also the power requirement of the relay and the CT output power match.

The connection of common CTs with secondary currants of 1 A or 5 A is inadmissible!

4.6 Technical Data

4.6.1 Common Data

Frequency:	45 – 65 Hz	
Nominal:	50/60 Hz	
Thermal load capacity:	Permanently:	2.5 x highest rated CT current
	1s	25 kA CT primary current
	3s	20 kA CT primary current
Dynamic load capacity:		62.5 kA CT primary current

4.6.2 Accuracy

Tripping times:	DMT:	±1% of the setting value absolutely ±10 ms
	IMT:	dependent on the current level and chosen characteristic, absolutely ±10 ms

Measuring accuracy for:
CT WE2, W3, W4, W5

≤ 5 % in the temperature range 0° - 50°C
≤ 7.5 % in the temperature range 40° - 85°C

Measuring accuracy for CT W2:

at 0 – 50°C
≤ 12.5 % bei 14.4 A
≤ 7.5 % bei 20 A
≤ 5 % bei 28.8 A

at -40° - 85°C
≤ 15 % bei 14.4 A
≤ 10 % bei 20 A
≤ 7.5 % bei 28.8 A

The accuracies apply to all CT types available from the smallest adjustable primary currents up to a primary current of 20 x the highest primary current selectable.

CT Type	Applying Accuracy Measuring Range
WIC1-WE2	14.4 – 20 x 57.6 A
WIC1-W2	14.4 – 20 x 57.6 A
WIC1-W3	28.8 – 20 x 115.2A
WIC1-W4	57.6 – 20 x 230.4 A
WIC1-W5	115.2 – 20 x 460.8 A

4.6.3 Insulation voltage withstand

Test of withstand alternating voltage for 1 min:	IEC 60 255-5	2.5 kV
Test of lightning surge voltage 1.2/50 µs, 0.5 J	IEC 60 255-5	5 kV

4.6.4 EMV

Interference immunity against discharges of static electricity

DIN EN 60255-22-2 [05/97] DIN EN 61000-4-2 [03/96] Class 3	Air discharge contact discharge	8kV 6kV

Interference immunity against high-speed transient interference quantities

DIN IEC 60255-22-4 [10/93] DIN EN 61000-4-4 [03/96] Class 4	power supply, mains inputs other inputs and outputs	±4kV, 2.5kHz ±2kV, 5kHz

Interference immunity against high-frequent electromagnetic fields

DIN EN 61000-4-3 [08/97] Class 3		10V/m

Interference immunity against magnetic fields of energy based frequency

DIN EN 61000-4-8 [05/94] Class 5	continuously 3 sec.	100A/m 1000A/m

Interference immunity against line conducted interference quantities induced by high-frequent fields

DIN EN 61000-4-6 [04/97] Class 3 (0.15-230 MHz)		10V/m

Interference immunity against surge voltage

DIN EN 61000-4-5 [09/96] Class 4	within a current circuit current circuit to earth	2kV 4kV

Measuring of the radio interference voltage

DIN EN 55011 [10/97]	Limit. value class B

Measuring of the radio interference radiation

DIN EN 55011 [10/97]	Limit. value class B

4.6.5 Ambient conditions

Vibration and continuous vibration test		
DIN EN 60255-21-1 [05/96] Class 2		1/2 gn
Shock and continuous shock test		
DIN EN 60255-21-2 [05/96] Class 2		10/20 gn
Earthquake test		
DIN EN 60255-21-3 [11/95] Class 2		2 gn
Classification		
DIN EN 60068-1 [03/95]	Climate category	40/085/56
Test Ad: Cold		
DIN EN 60068-2-1 [03/95]	Temperature Period of stress	-40°C 16h
Test Bd: Dry heat		
DIN EN 60068-2-2 [08/94]	Temperature Rel. humidity Period of stress	+85°C <50% 72h
Test Ca: Humid heat (constantly)		
DIN IEC 60068-2-3 [12/86]	Temperature Rel. humidity Period of stress	+40°C 93% 56d
Test Db :Humid heat (cyclic)		
DIN IEC 60068-2-30 [09/86]	Temperature Rel. humidity Cyclen (12 + 12-hours)	+85°C 95% 2
Class of protection		
	Relay housing Electronics Terminals	IP 40 IP 65 IP 20

4.6.6 Outside dimension of CTs

The structual forms of the CTs depend on the switchboard construction, i.e. they are in compliance with specific customer needs. We have various standard designs. For further information please contact your sales partner.

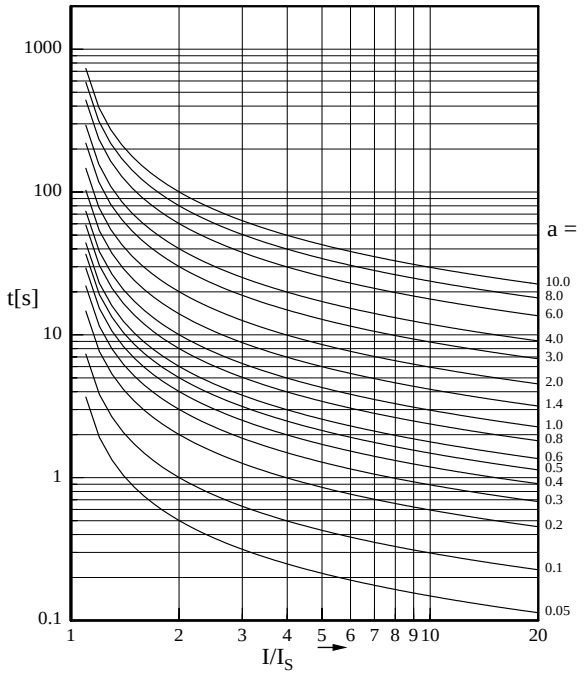


Figure 4.3: Normal Inverse

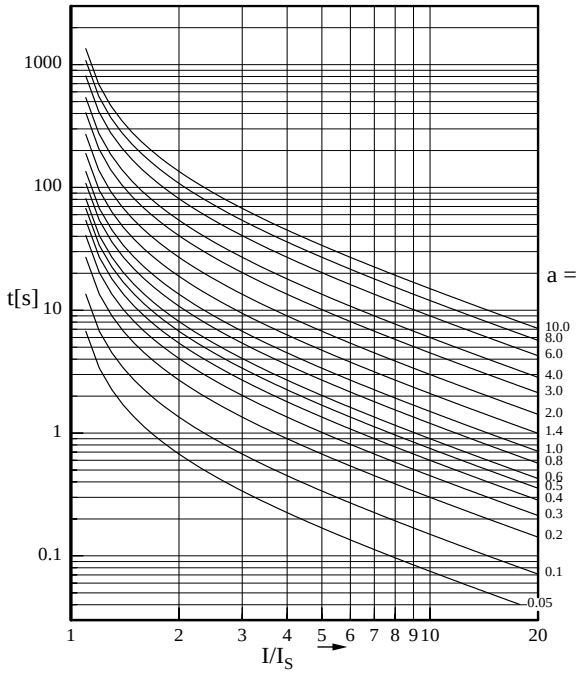


Figure 4.4: Very Inverse

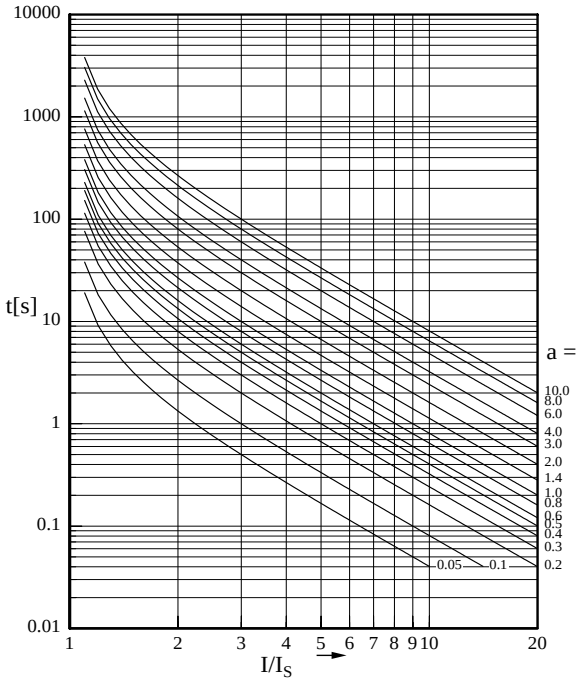


Figure 4.5: Extremely Inverse

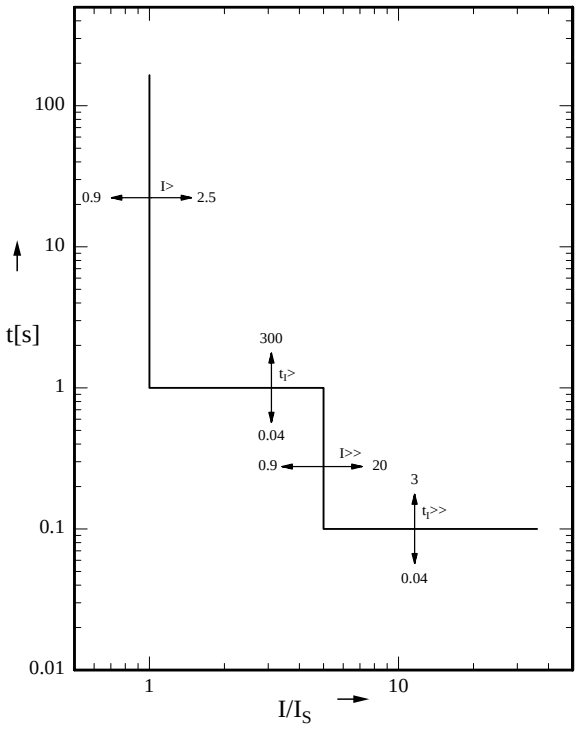


Figure 4.6: Definite Time

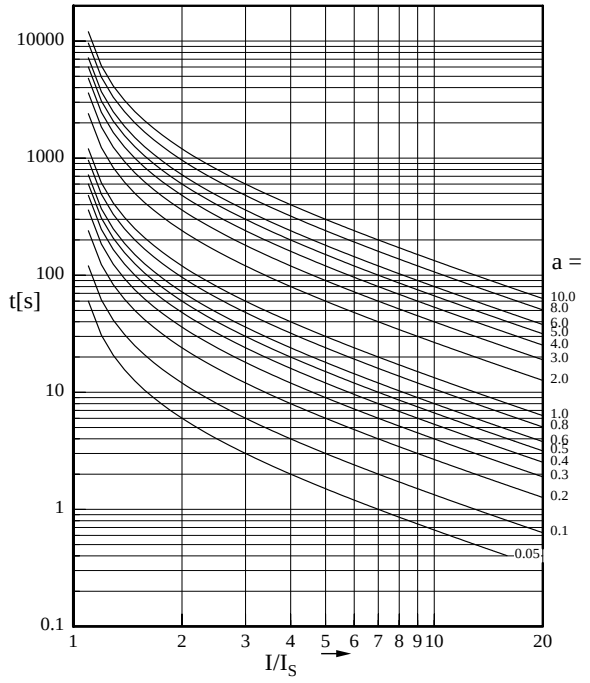


Figure 4.7: Long time inverse

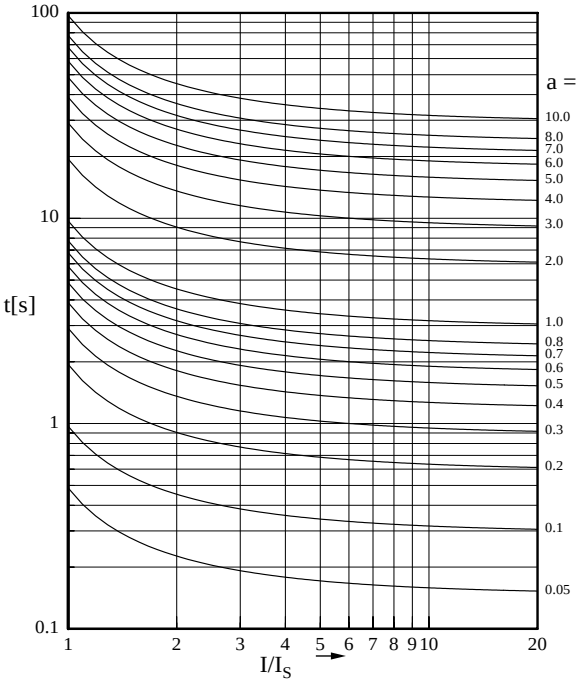


Figure 4.9: RI-Inverse

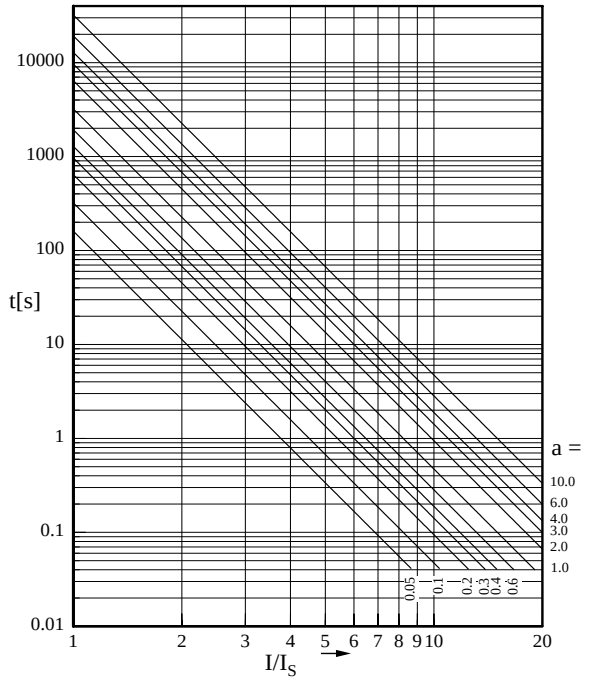


Figure 4.8: HV fuse

4.7.1 Calculation formula for IMT characteristics

Normal Inverse:

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

Very Inverse:

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

Extremely Inverse:

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

Long time inverse:

$$t = \frac{120}{\left(\frac{I}{I_S}\right) - 1} \cdot a[s]$$

RI-Inverse Time:

$$t = \frac{1}{0.339 - \frac{0.236}{\left(\frac{I}{I_S}\right)}} \cdot a[s]$$

HV-Fuse:

$$t = 10^{\left(\log\left(2 \cdot \frac{I}{I_S}\right) \cdot (-3.832) + 3.66\right)} \cdot \frac{a}{0.1}[s]$$

5 Description of application

5.1 Foreword

As CT-powered protection relay the *WIC1* is mainly used in MV switchboards with circuit breakers, protecting distribution transformers in local and industrial networks. Due to its small size the *WIC1* is very well suited for the use in gas-insulated switchboards.

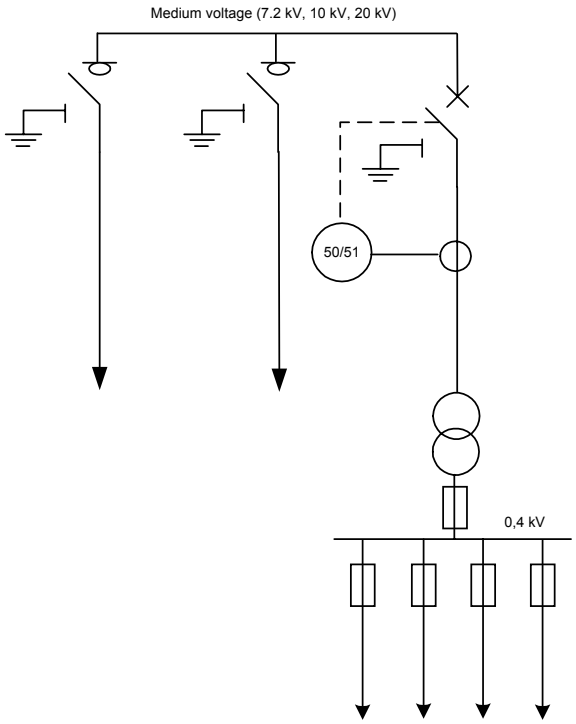


Figure 5.1: Basic circuit diagram of a standard switchboard with 2 feeders and 1 outgoing transformer panel

The ability of the protection system *WIC1* to adapt to different primary currents makes it possible that it is used for all standard rated transformer loads and the different MV operational voltages.

5.2 Selection of the CT transformation voltage ratio

Selection of the CT suitable for the *WIC1* depends on the rated current of the transformer to be protected and is calculated acc. to the following formula:

$$I_N = \frac{S_N}{\sqrt{3} \cdot U_N}$$

Example:
S_N = 1600 kVA
U_N = 10 kV
→ I_N = 92.5 A

CTs WIC1-W3 and WIC1-4 are suitable for this rated current.

With parameter 1 the calculated rated current is preset in the protection relay.

According to Table 1 currents of 88A can be adjusted for both CT types in relay versions WIC1-2 and WIC1-3.

In the example shown below, the transformer can be operated of 1.1 the rated current for 10s. The setting value for I> is calculated as follows :

WIC1-1:

I> = 1.1xIs

WIC1-2 and WIC1-3:

$$I>= \frac{1.1 \cdot I_{NT}}{I_S} = \frac{1.1 \cdot 92.5A}{88A} = 1.16 \cdot I_S$$

By means of the switches, however, only 1.15 x Is or 1.2 x Is can be set for parameter I>. Therefore it is up to the user to choose either 1.15 x Is or 1.2 x Is

The different rated primary currents of all standard transformer sizes at various rated mains voltages are compiled in the annex.

6 Commissioning and Maintenance

6.1 Accessories for commissioning work

For commissioning of the protection system the following accessories should be available:

- For WIC1-1 a –WIC1-PC adapter and a PC or Palm Top with software
- Secondary testing system with 1A rated output current
- Screwdriver; cross slot type, size 1; 3mm slot
- Setting parameters

6.2 Checks during commissioning

When putting into operation, the wiring and setting of the protection relay should be checked. Here the person doing the commissioning work is assisted by the integrated test windings of the *WIC1* protection system, which are on the front of the relay. Hence any wiring jobs as well as actions in the cable connection area can be disregarded.

6.2.1 Wiring checks

Wiring has to be checked with the circuitry shown in the diagram below.

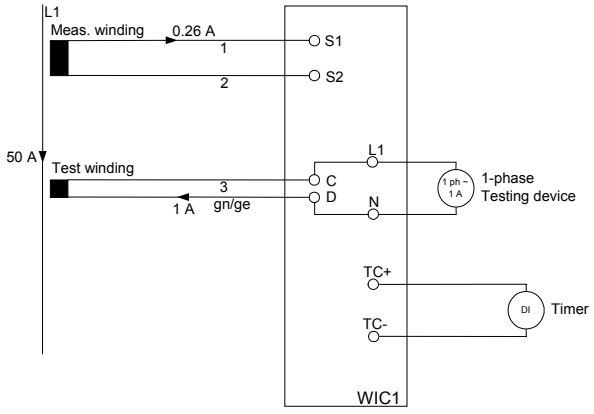


Figure 6.1: Connection of a single-phase testing device (phase L1) with CT WIC1-W2

The testing current is fed via sockets L1, L2, L3 and N. The test winding is rated such that the fed current of 1A balances a primary current of 50A (CT type WIC1-W2). If a low-energy tripping coil is connected to terminals TC+ and TC- instead of a timer, a full check of the protection system is possible with the tripping circuit.
For timing purposes the output of the flag indicator FI+, FI- can be used.

6.2.2 *WIC1* adjustment

The protection parameters are to be adjusted according to chapter 4 of this instruction. The set parameters can be registred directly on the sticker affixed on the relay.

6.2.3 Important note

Putting into operation and the relevant tests should only be carried out by skilled personnel. We do not accept any liability for damage caused by improper handling of the protection system, or of the primary side of the equipment.

6.2.4 Inductance test

By inducing test currents into the test winding of the protection system, the test currents for the protection relay are as follows.

CT Type	Induced Current	Primary Current
WIC1-WE2	1 A	50 A
WIC1-W2	1 A	50 A
WIC1-W3	1 A	100 A
WIC1-W4	1 A	200 A
WIC1-W5	1 A	400 A

The supply energy for the *WIC1* comes from the measuring circuits and for this the test burden is changed periodical.

This, however, can influence the supplying source, i.e. the relay indicates higher values than there are in reality. By an aux. inductance connected in series this effect can be reduced.

6.2.5 Commissioning form

List of adjustments for *WIC1*

Project: _____ Order No.: _____

Functional group: _____ Location: _____ Component Identification: _____

Relay Function: _____ Date: _____

Parameter Setting

Function		Unit	Default Setting	Actual Setting
	CT Type		W2	
I_S	Primary current	A	16	
Char	Trip characteristic		DEFT	
I>	Trip value f. DMT characteristic or start value of the IMT characteristic	xI_S	0.9	
$t_{I>}$	Trip delay f. DMT characteristic	s	0.04	
a	Multiplicator f. IMT characteristic	s	–	
I>>	Trip value f. short-circuit element	xI_S	1	
$t_{I>>}$	Trip delay f. short-circuit element	s	0.04	
$I_{E>}$	Trip value f. earth fault element (only type E)	xI_S	0.2	
$t_{IE>}$	Trip delay f. earth fault element	s	0.1	

Signature Checker: _____ Signature customer: _____

6.3 Maintenance

The entire protection system *WIC1* is designed for a maintenance-free period of 25 years, hence there are no specific jobs necessary to be done during the operating life of the relays. Very often, through, a periodical check of the protective adjustments are required by the enduser. Such checks are left to the choice of the user and can be carried out as described under 6.2.

6.3.1 Faults

Should, however, faults occur despite the special design of the protection system and the comprehensive quality control, the possibility for fault clearance is only limited. For possible faults and their clearance please see the following table:

Fault	Cause of failure	Abhilfe
Wrong measuring and tripping values	Test winding short-circuited	Secondary side of test winding always to be operated openly (except when relays are tested)
Wrong measuring and tripping values	Earthing of a winding termination of the measuring winding	No winding termination of the measuring winding to be earthed! Earthing is done internally and brought out at terminal PE
Low-energy tripping coil does not trip	Coil polarised with permanent magnet connected to TC+ and TC-	Wiring to be checked

6.3.2 Repair work

The *WIC1* is a hermetically sealed relay and so it is not possible to do any repair work at your end.
Due to the optimised cost structure, however, repair in our works is also not beneficial. During the warranty period the protection relay is exchanged by us free of charge, provided the failure was not caused by external influences. Should such a situation occur, please contact our local sales agent.

7 Product Specific Features

7.1 Assignment of terminals

The protection relay is equipped with 20 screw-type terminals, make Phoenix and 4 test sockets. The 2 different relay versions are defined by the kind of terminal used:
WIC1-xP plug-in terminals for connection of CTs and trip circuits
WIC1-xS fixed terminals for connection of CTs and trip circuits.

Terminal Type	Description
230 V	Remote trip input for auxiliary voltage 230 V AC
115 V	Remote trip input for auxiliary voltage 115 V AC
N	Remote trip input N (earth)
PE	Centre earthing point *WIC1*
TC+	Electric pulse output +pole
TC-	Electric pulse output, -pole
FI+	Flag indicator output, +pole
FI-	Flag indicator output, -pole
S1	CT measuring winding connection L1
S2	CT measuring winding connection L1
C	CT test winding connection L1
D	CT test winding connection L1
S1	CT measuring winding connection L2
S2	CT measuring winding connection L2
C	CT test winding connection L2
D	CT test winding connection L2
S1	CT measuring winding connection L3
S2	CT measuring winding connection L3
C	CT test winding connection L3
D	CT test winding connection L3
Socket L1	Connection for input test current L1
Socket L2	Connection for input test current L2
Socket L3	Connection for input test current L3
Socket N	Connection for input test current N (earth)

For both relay versions the e´terminals 230 V, 115 V, N and PE are provided as fixed terminals.

7.1.1 Earthing

For earthing the WIC connection terminal PE is used.

The measuring winding (terminals S1and S2) of the CTs must not be earthed, otherwise the measurement results are distorted, ensuring in erratic behaviour of the relay. Connection D of the respective test winding can externally be connected with terminal PE.

7.2 Current transformer

Listed CT ranges in relation to the transformer rated currents

	3.00	3.30	4.20	5.50	6.00	6.60	10.00	11.00	12.00	13.80	15.00	15.50	17.50	20.00	21.00	22.00	24.00	U[kV]
50.00										**WIC1-W2**								
75.00	14.43																	
100.00	19.25	17.50																
125.00	24.06	21.87	17.18															
160.00	30.79	27.99	21.99	16.80	15.40													
200.00	38.49	34.99	27.49	20.99	19.25	17.50												
250.00	48.11	43.74	34.37	26.24	24.06	21.87	14.43											
315.00	60.62	55.11	43.30	33.07	30.31	27.56	18.19	16.53	15.16									
400.00	76.98	69.98	54.99	41.99	38.49	34.99	23.09	20.99	19.25	16.73	15.40	14.90						
500.00	96.23	87.48	68.73	52.49	48.11	43.74	28.87	26.24	24.06	20.92	19.25	18.62	16.50	14.43				
630.00	121.24	110.22	86.60	66.13	60.62	55.11	36.37	33.07	30.31	26.36	24.25	23.47	20.78	18.19	17.32	16.53	15.16	
800.00		139.96	109.97	83.98	76.98	69.98	46.19	41.99	38.49	33.47	30.79	29.80	26.39	23.09	21.99	20.99	19.25	
1000.00			137.46	104.97	96.23	87.48	57.74	52.49	48.11	41.84	38.49	37.25	32.99	28.87	27.49	26.24	24.06	
1250.00				131.22	120.28	109.35	72.17	65.61	60.14	52.30	48.11	46.56	41.24	36.08	34.37	32.80	30.07	
1600.00						139.96	92.38	83.98	76.98	66.94	61.58	59.60	52.79	46.19	43.99	41.99	38.49	
2000.00							115.47	104.97	96.23	83.67	76.98	74.50	65.98	57.74	54.99	52.49	48.11	
2500.00								131.22	120.28	104.59	96.23	93.12	82.48	72.17	68.73	65.61	60.14	
3150.00										131.79	121.24	117.33	103.92	90.93	86.60	82.67	75.78	
5000.00													131.97	115.47	109.97	104.97	96.23	
S[kVA]																		

	3.00	3.30	4.20	5.50	6.00	6.60	10.00	11.00	12.00	13.80	15.00	15.50	17.50	20.00	21.00	22.00	24.00	U[kV]
125.00										**WIC1-W3**								
160.00	30.79																	
200.00	38.49	34.99																
250.00	48.11	43.74	34.37															
315.00	60.62	55.11	43.30	33.07	30.31													
400.00	76.98	69.98	54.99	41.99	38.49	34.99												
500.00	96.23	87.48	68.73	52.49	48.11	43.74	28.87											
630.00	121.24	110.22	86.60	66.13	60.62	55.11	36.37	33.07	30.31									
800.00	153.96	139.96	109.97	83.98	76.98	69.98	46.19	41.99	38.49	33.47	30.79	29.80						
1000.00	192.45	174.95	137.46	104.97	96.23	87.48	57.74	52.49	48.11	41.84	38.49	37.25	32.99	28.87				
1250.00	249.56	218.69	171.83	131.22	120.28	109.35	72.17	65.61	60.14	52.30	48.11	46.56	41.24	36.08	34.37	32.80	30.07	
1600.00		279.93	219.94	167.96	153.96	139.96	92.38	83.98	76.98	66.94	61.58	59.60	52.79	46.19	43.99	41.99	38.49	
2000.00			274.93	209.95	192.45	174.95	115.47	104.97	96.23	83.67	76.98	74.50	65.98	57.74	54.99	52.49	48.11	
2500.00				262.43	240.56	218.69	144.34	131.22	120.28	104.59	96.23	93.12	82.48	72.17	68.73	65.61	60.14	
3150.00						275.55	181.87	165.33	151.55	131.79	121.24	117.33	103.92	90.93	86.60	82.67	75.78	
4000.00							230.94	209.95	192.45	167.35	153.96	148.99	131.97	115.47	109.97	104.97	96.23	
S[kVA]																		

	3.00	3.30	4.20	5.50	6.00	6.60	10.00	11.00	12.00	13.80	15.00	15.50	17.50	20.00	21.00	22.00	24.00	U[kV]
250.00										**WIC1-W4**								
315.00	60.62																	
400.00	76.98	69.98																
500.00	96.23	87.48	68.73															
630.00	121.24	110.22	86.60	66.13	60.62													
800.00	153.96	139.96	109.97	83.98	76.98	69.98												
1000.00	192.45	174.95	137.46	104.97	96.23	87.48	57.74											
1250.00	240.56	218.69	171.83	131.22	120.28	109.35	72.17	65.61	60.14									
1600.00	307.92	279.93	219.94	167.96	153.96	139.96	92.38	83.98	76.98	66.94	61.58	59.60						
2000.00	384.90	349.91	274.93	209.95	192.45	174.95	115.47	104.97	96.23	83.67	76.98	74.50	65.98	57.74				
2500.00	481.13	437.39	343.66	262.43	240.56	218.69	144.34	131.22	120.28	104.59	96.23	93.12	82.48	72.17	68.73	65.61	60.14	
3150.00		551.11	433.01	330.66	303.11	275.55	181.87	165.33	151.55	131.79	121.24	117.33	103.92	90.93	86.60	82.67	75.78	
4000.00			549.86	419.89	384.90	349.91	230.94	209.95	192.45	167.35	153.96	148.99	131.97	115.47	109.97	104.97	96.23	
S[kVA]																		

	3.00	3.30	4.20	5.50	6.00	6.60	10.00	11.00	12.00	13.80	15.00	15.50	17.50	20.00	21.00	22.00	24.00	U[kV]
500.00										**WIC1-W5**								
630.00	121.24																	
800.00	153.96	139.96																
1000.00	192.45	174.95	137.46															
1250.00	240.56	218.69	171.83	131.22	120.28													
1600.00	307.92	279.93	219.94	167.96	153.96	139.96												
2000.00	384.90	349.91	274.93	209.95	192.45	174.95	115.47											
2500.00	481.13	437.39	343.66	262.43	240.56	218.69	144.34	131.22	120.28									
3150.00	606.22	551.11	433.01	330.66	303.11	275.55	181.87	165.33	151.55	131.79	121.24	117.33						
4000.00	769.80	699.82	549.86	419.89	384.90	349.91	230.94	209.95	192.45	167.35	153.96	148.99	131.97	115.47				
S[kVA]																		

8 Annex

8.1 Connection Diagram

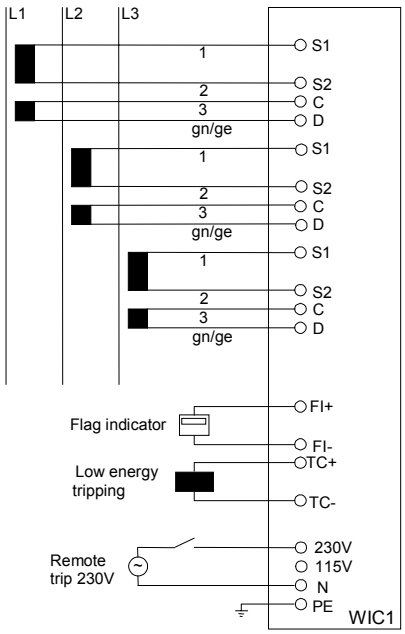


Figure 8.1: Connection diagramm

8.2 Dimensional drawing

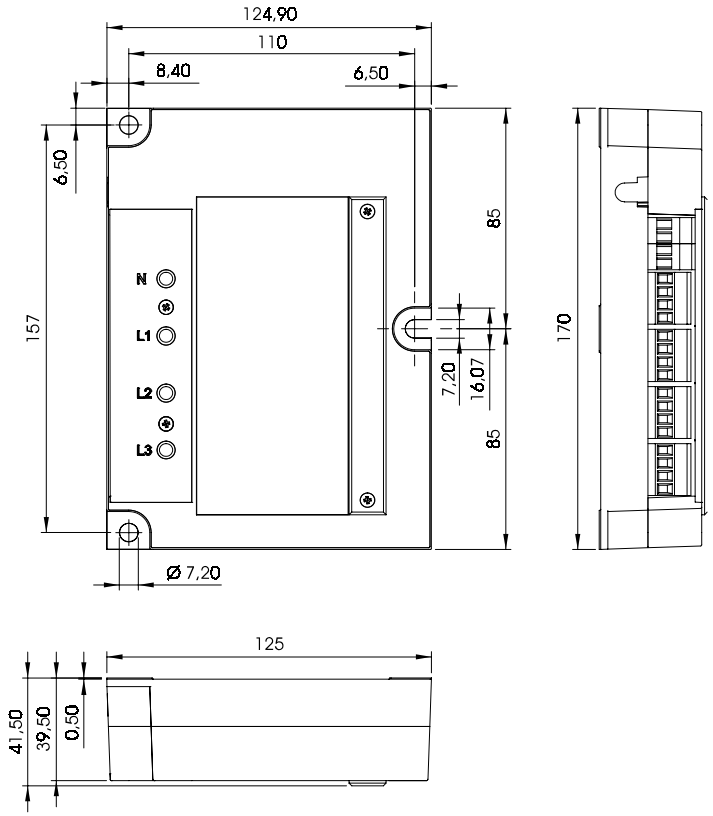


Figure 8.2: Dimensional drawing

9 Order form

Multi characteristic time overcurrent relay	***WIC1-***		
3-phase current measuring I>;I>>; self powered			
– parameter setting via serial interface	**1**		
– parameter setting via DIP switches	**2**		
– parameter setting via HEX switches	**3**		
Connection mode			
– srew terminal		**S**	
– plug in screw terminal		**P**	
With additional earth current measuring [1] $I_{E>}$			*
– standard 0.2 bis 2.5 x In			**E**
– sensitive 0.05 bis 2.5 x In			**X**

* Please leave box empty if option is not desired

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