WOODWARD

XRI1-ER – Earth fault relay for isolated and compensated mains

(December 2003)

Manual XRI1-ER (Revision New)

Contents

1. Introduction and application

The XRI1-ER of the PROFESSIONAL LINE is an all-purpose protection against earth faults, used for electrical machines, lines and isolated or compensated systems; it is mainly used in radial networks.
Relay variant XRI1-ER with directional current sensing is a selective earth-fault protection and is normally used in ring systems, networks with parallel feeders and in complex meshed systems.

Very often the XRI1-ER can be found as backup protection at the central earthing point of the system. It detects all earth faults occuring in the system. In this case the trip delay selected must exceed the longest time delay setting of any other earthing protection used in the system.

2. Features and characteristics

- Digital filtering of the measured values by using discrete Fourier analysis to suppress the high frequence harmonics and DC components induced by faults or system operations.
- High set overcurrent unit with instantaneous or definite time function
- Sensitive earth fault current measuring with directional earth current measuring (XR-type).
- Numerical display of setting values, actual measured values and their active, reactive components, memorized fault data, etc.
- Withdrawable modules with automatic short circuit of C.T. inputs when modules are withdrawn.
- Blocking function of both earth current steps
- Switch failure protection.
- Free assignment of output relays.
- Serial data exchange via RS485 interface possible; alternatively with SEG RS485 Pro-Open Data Protocol and Modbus Protocol.
- Suppression of indication after an activation (LED flash).

3. Design

3.1 Connections se även punkt 4.4 i manualen

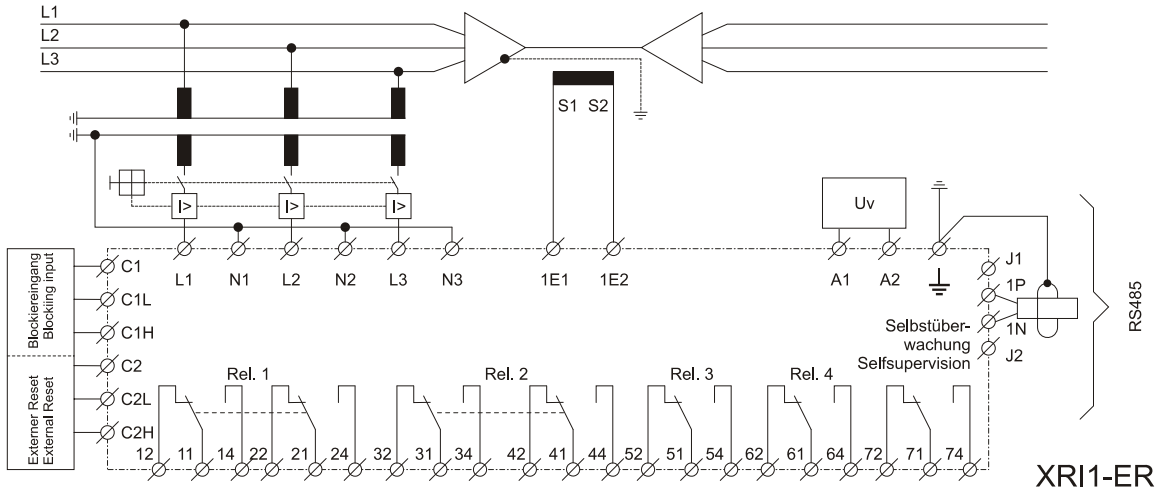


Figure 3.1: Connection diagram XRI1-ER

3.1.1 Analog input circuits

The protection unit receives the analog input signals of the earth currents IE (1E1-1E2), phase voltages U1 (L1-N1), U2 (L2-N2), U3 (L3-N3) each via separate input transformers. The neutral is bridged externally. The constantly detected measuring values are galvanically decoupled, filtered and finally fed to the analog/digital converter.

3.1.2 Blocking input

The blocking functions adjusted before will be blocked if an auxiliary voltage is connected to (terminals) C1/C1L or C1/C1H. (See chapter 6.2.12)

3.1.3 External reset input

By applying the aux. voltage C2/C2L or C2/C2H, indication and output relays are reset. (see chapter 6.3)

3.1.4 Output relays

The XRI1-ER is equipped with 5 output relays. Apart from the relay for self-supervision, all protective functions can be optionally assigned:

- Relay 1: C1, D1, E1 and C2, D2, E2
- Relay 2: C3, D3, E3 and C4, D4, E4
- Relay 3: C5, D5, E5
- Relay 4: C6, D6, E6
- Self-supervision C7, D7, E7

All trip and alarm relays are working current relays, the relay for self supervision is an idle current relay.
Except the self-supervision, all relays can be assigned to different functions. (see chapter 6.1.12).

3.1.5 Data communication

For data communication with a central control system the XRI1-ER relay is provided with a serial interface RS485. Simplified and fast reading and changing of parameters and measuring values can be achieved by HTL/PL-Soft4, which will be provided on request together with the relay.

The XRI1-ER can be connected to other units of
PROFESSIONAL LINE via interface. If there is more than 1 relay in the system, the last relay of the chain has to be provided with a resistor line termination.

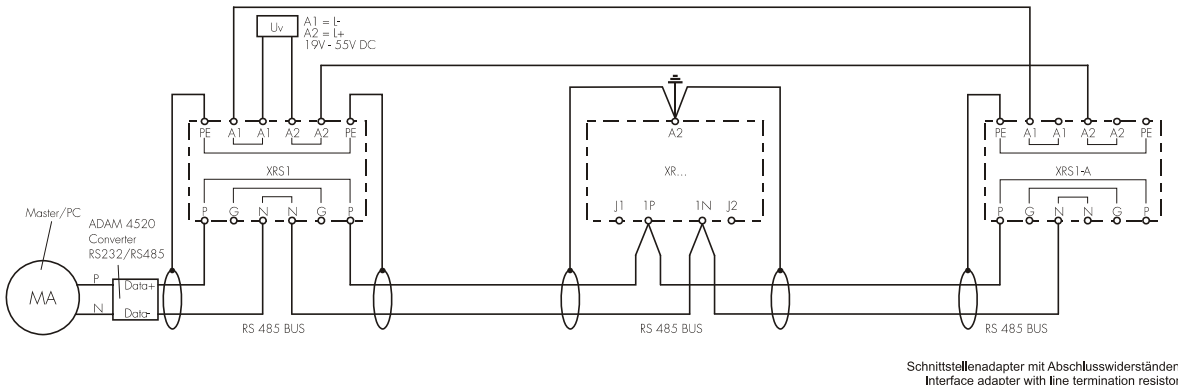


Figure 3.2: Connection example with 3 users, XR ... as linked device

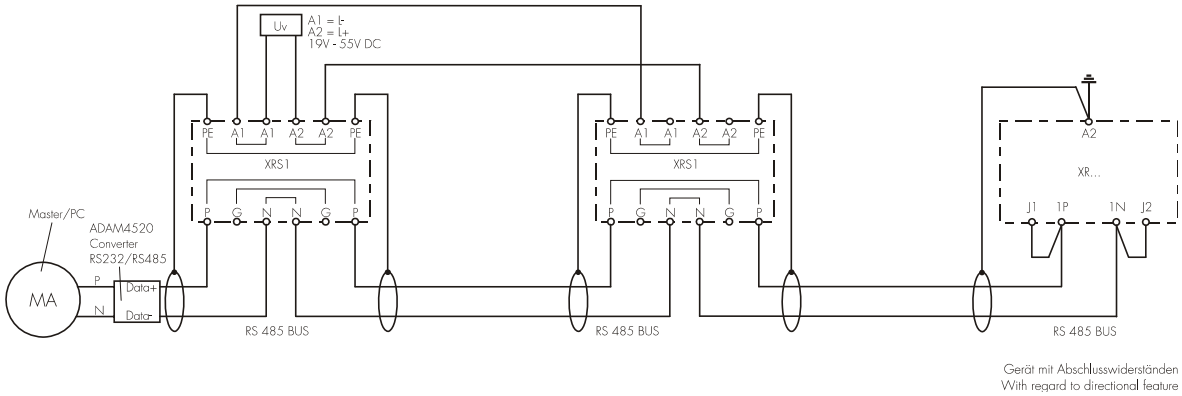


Figure 3.3: Connection example with 3 users, XR ... as last device

3.2 Front plate

3.2.1 Indication and operation elements

The front plate of protection relays comprises the following operation and indication elements:

- Alphanumerical display (4 Digits)
- Push buttons for setting and other operations
- LEDs for measured value indication and setting

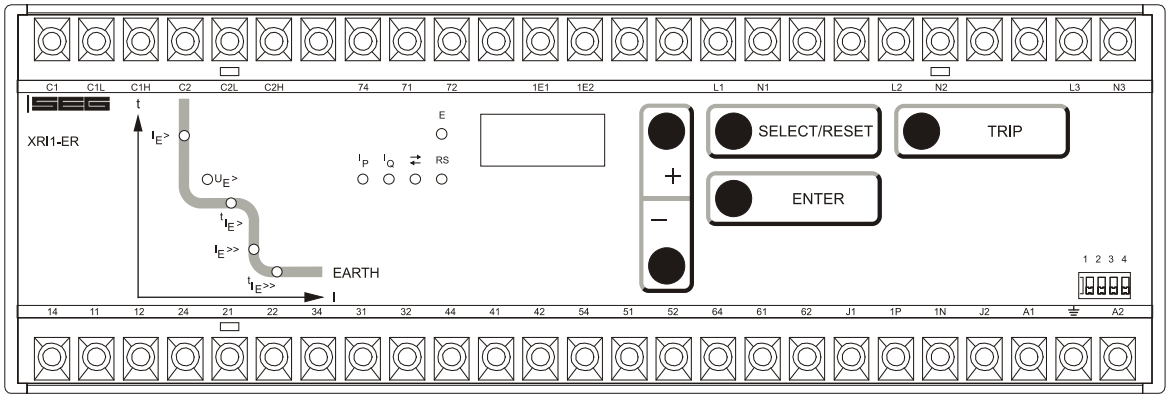


Figure 3.4: Front plate XRI1-ER

3.2.2 Display

Function	Display shows	Pressed push button	Corresponding LED
Normal operation	SEG		
Measured operating values	Actual measured values,	<SELECT/RESET> one time for each	E I_P/I_Q with regard to directional feature
Measuring range overflow	max.	<SELECT/RESET>	E
Setting values: ($I_{E>}$; $U_{E>}$; $t_{IE>}$; $I_{E>>}$; $t_{IE>>}$)	Current settings Trip delay Characteristics	<SELECT/RESET> one time for each parameter	$I_{E>}$; $t_{IE>}$; $I_{E>>}$; $t_{IE>>}$; LED →←
Warning or Trip at earth fault measuring (E- and ER/XR-types)	TRIP WARN	<SELECT/RESET><+><->	$I_{E>}$
Measured method of the residual voltage UE	3 PHA ; E-N ; 1:1	<SELECT/RESET><+><->	$U_{E>}$
residual voltage setting	voltage in volts	<SELECT/RESET><+><->	$U_{E>}$
changeover of isolated (sin φ) or compensated (cos φ) networks	SIN COS	<SELECT/RESET><+><->	
Tripping protection switch failure protection	CBFP	After fault tripping	
Nominal frequency	f=50 / f=60	<SELECT/RESET><+><->	
Switch-over LED flash No LED flash	FLSH NOFL	<SELECT/RESET><+><->	
Blocking of function	EXIT	<+> until max. setting value	LED of blocked parameter
Slave address of serial interface	1 - 32	<SELECT/RESET><+><->	RS
Recorded fault data	Tripping currents and other fault data	<SELECT/RESET> one time for each phase	L1, L2, L3, E $I_{E>}$, $I_{E>>}$, $U_{E>}$
Save parameter?	SAV?	<ENTER>	
Save parameter!	SAV!	<ENTER> for about 3 s	
Software version	First part (e.g. D01-) Sec. part (e.g. 8.00)	<TRIP> one time for each part	
Manual trip	TRI?	<TRIP> three times	
Inquire password	PSW?	<TRIP><ENTER>	
Relay tripped	TRIP	<TRIP> or after fault tripping	
Secret password input	XXXX	<SELECT/RESET><+><-><ENTER>	
System reset	SEG	<SELECT/RESET> for about 3 s	

Table 3.1: Possible indication messages on the display

3.2.3 LEDs

The LED left from the display, E is partially bi-colored, the green indicating measuring, and the red fault indication.

XRI1-ER with directional feature have a LED (green- and red arrow) for the directional display. At pickup/trip and parameter setting the green LED lights up to indicate the forward direction, the red LED indicates the reverse direction.

The LED marked with letters RS lights up during setting of the slave address of the device for serial data communication.

The LEDs arranged at the characteristic points on the setting curves support the comfortable setting menu selection. In accordance with the display 5 LEDs for earth fault overcurrent indicate the corresponding menu point selected.

3.2.4 Parameter settings (see chapter 6)

Short overview

Relay type XRI1-ER	Unit	Setting range
1:1/3pha/e-n		
$U_{E>}$; 3pha/e-n	V	1-70; 2-160; 5-300*
$U_{E>}$;1:1	V	1-120; 2-300; 5-500*
$I_{E>}$ ER-type XR-type	x I_N %	0.01 – 0.45 0.1 – 4.5
WARN/TRIP		
$t_{IE>V}/t_{IE>R}$	s	0.05 - 260
$I_{E>>}$ ER-type XR-type	x I_N %	0.01 – 0.45 0.1 – 4.5
$t_{IE>>V}/t_{IE>>R}$	s	0.05 – 2.00 s
SIN/COS		
t_{CBFP}	s	0.1 – 2 s
50/60 Hz		
FLSH/NOFL		
RS485/Slave		
Baud rate**		1200, 2400, 4800, 9600
Parity**		even, add, no
Blockage function		
Assignment of the relays		

* Setting is depended on rated voltage
** only with Modbus Protocol

Table 3.2: Parameter values

4. Working principle

4.1 Analog circuits

The incoming current from the main current transformer on the protected object is converted to voltage signals in proportion to the currents via the input transformers 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. The analog signals are sampled at 50 Hz (60 Hz) with a sampling frequency of 800 Hz (960 Hz), namely, a sampling rate of 1.25 ms (1.04 ms) for every measuring quantity. (16 scans per period).

4.2 Digital circuits

The essential part of the XRI1-ER relay is a powerful microcontroller. All of the operations, from the analog digital conversion to the relay trip decision, are carried out by the microcontroller digitally. The relay program is located in an EPROM (Electrically-Programmable-Read-Only-Memory). With this program the CPU of the microcontroller calculates the three phase currents and ground current in order to detect a possible fault situation in the protected object.
For the calculation of the current value an efficient digital filter based on the Fourier Transformation (DFFT - Discrete Fast Fourier Transformation) is applied to sup-press high frequency harmonics and DC components caused by fault-induced transients or other system disturbances.

The calculated actual current values are compared with the relay settings. If a phase current exceeds the pickup value, an alarm is given and after the set trip delay has elapsed, the corresponding trip relay is activated.
The relay setting values for all parameters are stored in a parameter memory (EEPROM - Electrically Erasable Programmable Read-only Memory), so that the actual relay settings cannot be lost, even if the power supply is interrupted.
The microprocessor is supervised by a built-in "watch-dog" timer. In case of a failure the watchdog timer re-sets the microprocessor and gives an alarm signal, via the output relay "self supervision".

4.3 Earth fault protection

4.3.1 Generator stator earth fault protection

With the generator neutral point earthed as shown in figure 4.1 the XRI1-ER picks up only to phase earth faults between the generator and the location of the current transformers supplying the relay. Earth faults beyond the current transformers, i.e. on the consumer or line side, will not be detected.

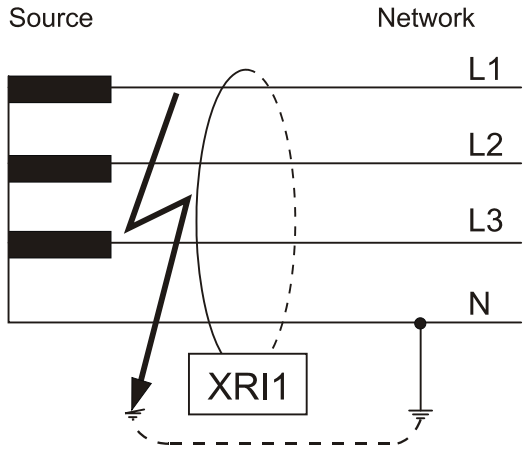


Figure 4.1: Generator stator earth fault protection

4.3.2 System earth fault protection

With the generator neutral point earthed as shown in figure 4.2, the XRI1-ER picks up only to earth faults in the power system connected to the generator. It does not pick up to earth faults on the generator terminals or in generator stator.

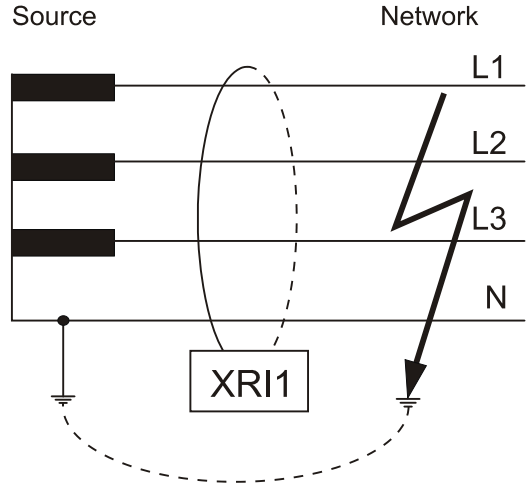


Figure 4.2: System earth fault protection

4.4 Earth-fault directional feature

A built-in earth-fault directional element is available for applications to power networks with isolated or with arc suppressing coil compensated neutral point.

For earth-fault direction detection it is mainly the question to evaluate the power flow direction in zero sequence system. Both the residual voltage and neutral (residual) current on the protected line are evaluated to ensure a correct direction decision.

In isolated or compensated systems, measurement of reactive or active power is decisive for earth-fault detection. It is therefore necessary to set the relays to measure according to sin φ or cos φ methods, depending on the neutral-point connection method.

The residual voltage U_E required for determining earth fault direction can be measured in three different ways, depending on the voltage transformer connections. (refer to Table 4.1:)

Total current can be measured by connecting the unit to a ring core C.T.

The pick-up values $I_{E>}$ and $I_{E>>}$ (active or reactive cur-rent component for cos φ or sin φ method) for relays can be adjusted from 0.01 to 0.45 x I_N. For Sweden relay type XRI1-X1R1M these pick-up values can be adjusted from 0.1 to 4.5 % IN.

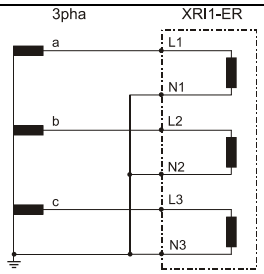
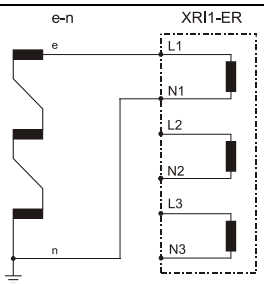
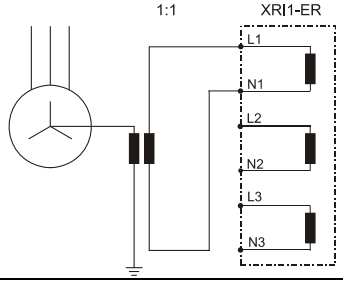
Adjustment possibility	Application	Voltage transformer connections	Measured voltage at earth fault	Correction factor for residual voltage
"3pha"	3-phase voltage transformer connected to terminals L1, L2, L3, N1, N2, N3		$\sqrt{3}$ x U_N = 3 x U_{1N}	K = 1/3
"e-n"	e-n winding connected to terminals L1, N1		$U_N = \sqrt{3}$ x U_{1N}	K = $1/\sqrt{3}$
"1:1"	Neutral-point voltage (= residual voltage) terminals L1, N		$U_{1N} = U_{NE}$	K = 1

Table 4.1:

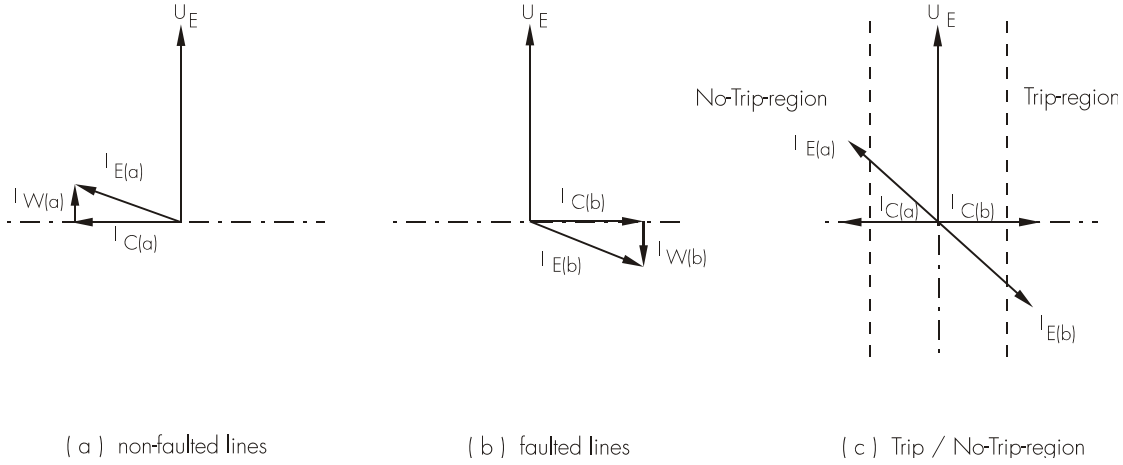


Figure 4.3: Phase position between the residual voltage and zero sequence current for faulted and non-faulted lines in case of isolated systems (sin φ)

U_E - residual voltage
I_E - zero sequence current
I_C - capacitive component of zero sequence current
I_W - resistive component of zero sequence current

By calculating the reactive current component (sin φ adjustment) and then comparing the phase angle in relation to the residual voltage U_E, the ER/XR-relay type determines whether the line to be protected is earth-faulted.
On non-earth-faulted lines, the capacitive component $I_{c(a)}$ of the total current precedes the residual voltage by an angle of 90°. In case of a faulty line the capacity current $I_{C(b)}$ lags behind the residual voltage at 90°.

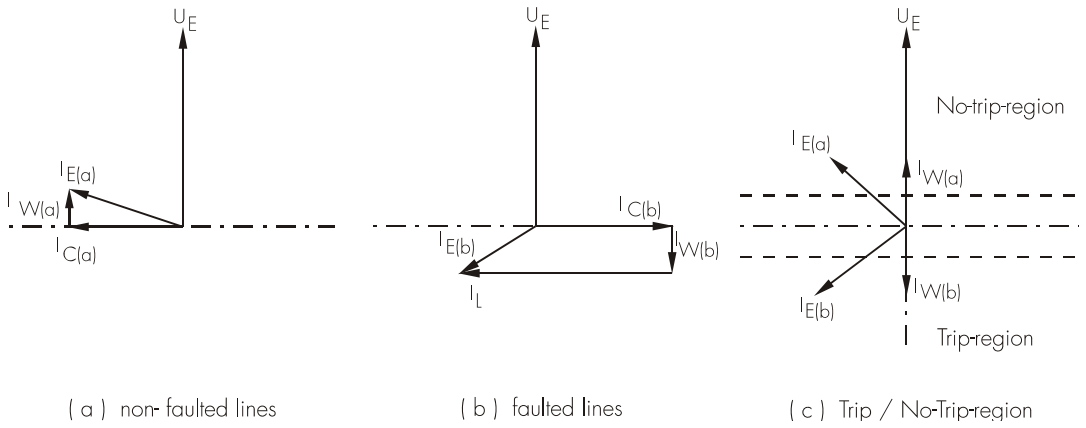


Figure 4.4: Phase position between the residual voltage and zero sequence current for faulted and non-faulted lines in case of compensated systems (cos φ)

U_E - residual voltage
I_E - zero sequence current
I_L - inductive component of zero sequence current (caused by Petersen coil)
I_C - capacitive component of zero sequence current
I_W - resistive component of zero sequence current

In compensated mains the earth fault direction cannot be determined from the reactive current components because the reactive part of the earth current depends upon the compensation level of the mains. The ohmic component of the total current (calculated by cos φ adjustment) is used in order to determine the direction.
The resistive component in the non-faulted line is in phase with the residual voltage, while the resistive component in the faulted line is opposite in phase with the residual voltage.

By means of an efficient digital filter harmonics and fault transients in the fault current are suppressed. Thus, the uneven harmonics which, for instance, are caused an electric arc fault, do not impair the protective function.

5. General operations and settings

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.

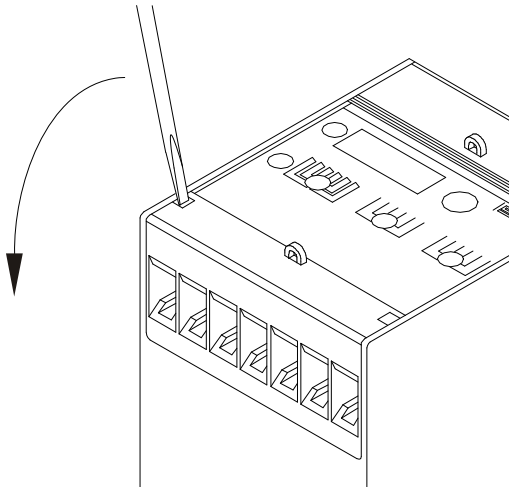


Figure 5.1: How to open the transparent cover

5.1 Push buttons

Push buttons are used for calling up the parameters to be processed, for selection of measuring parameters to be indicated and for changing and storing the parameters.

The individual setting and measuring values can be selected one after another by pressing push button <SELECT/RESET>. This push button is also used for re-setting the display by pressing approx. 3s.

As for an individual case (relay version D) the push button can also be operated when the front cover of the relay is closed and sealed with lead.

Push buttons <+> <-> are used for in-/decrementing of the parameter indicated on the display. They can be pressed step-by-step or continuously.

After the selected parameter is set by the <+> <-> push button it may be stored using the <ENTER> push button.

Through the push button <ENTER> the set value indicated on the display will be transferred to the internal parameter memory. An unintented or unauthorized change of the selected parameter is avoided by means of a password identification (see 5.4.2).

The <TRIP>-push button is used to test the output relay circuits both for tripping and signaling. During normal operation it is also interlocked by means of the pass-word identification.

5.1.1 Indication of measuring values and fault data

Indication in faultless condition
In normal operation the display always shows SEG. After pressing the push button <SELECT/RESET> the display switches cyclically to the next measuring value. After the measuring values had been indicated the set-ting parameters are displayed. Hereby the LEDs in the upper section signalize which measured value is indicated, the LEDs in the lower section signalize which setting parameter is indicated on the display. Longer actuating the push button resets the relay and the display changes into normal operation (SEG).

Indication after pickup/tripping
All of the faults detected by the relay are indicated on the front plate optically. Here not only the faults are indicated but also the faulty phase(s) and the protection function in operation. At pickup the LEDs are flashing, after tripping this changes to continuous light.
In tripped condition "TRIP" appears on the display and the LEDs of the operating measuring data light up red together with the LEDs of the tripping parameter. All operating data, which were measured at the moment of tripping, can now be called one after another by pressing push button <SELECT/RESET>. If in this condition setting parameters are to be indicated, push but-ton <ENTER> has to be pressed.

The graphic below shows again the difference between the different display modes.

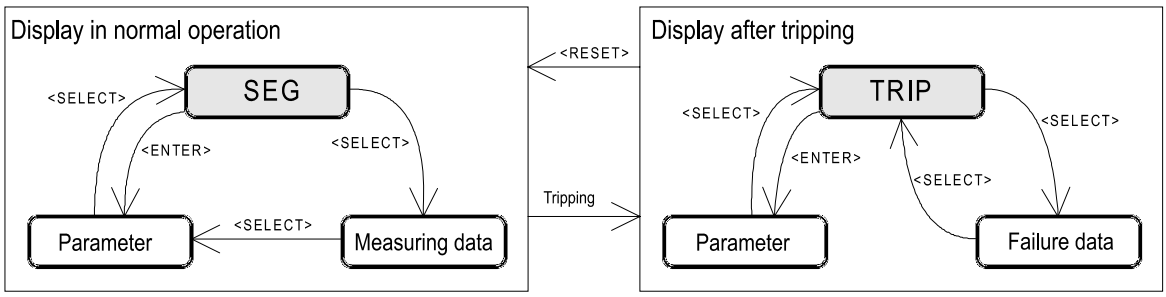


Figure 5.2: Switching over of the display in dependence of the operating mode

5.2 Dip switches

Behind the front plate of the XRI-ER relay there is one dip switch to preset the following functions:
- Password programming
- Output relay functions

The following table 5.1 shows the position and designation of the code jumpers:

5.2.1 Function of the output relays

The alarm relays are activated according to the preset-ting:

Dip switch 1 OFF
The actual password is active.

Dip switch 1 ON:
After switch on the supply voltage the password can be correct. (see chapter 5.4)

Dip switch 3 OFF:
All output relays will be reset automatically after the fault has been cleared, (e.g. when the fault current is interrupted).

Dip switch 3 ON:
All output relays remains activated and must be reset after fault clearance.
- Manually: By pressing push button <SELECT/RESET>
- External: By connecting aux. voltage to C2/C2L or C2/C2H
- Via RS 485 interface

To let the parameter change take effect, the auxiliary voltage has to be switched on and off again after the dip switches are plugged or unplugged.

Dip switches	Function	Code jumper position	Operation mode
1	Password	**OFF**	Normal position
		ON	Password programming
2	none		
3	Reset	**OFF**	Output relays will be reset automatically
		ON	Output relays will be reset manual/external/via software
4	none		

Table 5.1: Summary of coding possibilities

5.3 Reset

Manual reset
By pressing push button <RESET/SELECT> for some time (about 3 s).

External reset-input C2/C2L or C2/C2H
The external reset input has the same function as the <SELECT/RESET> push button on the front plate. Connecting auxiliary voltage to this input, the unit can be reset, provided that the fault is removed.

Software reset via serial interface RS 485
Software reset has the same function as push button <SELECT/RESET>. Please refer to open data protocol of RS 485 interface named RS485-PRO.

5.4 Password

5.4.1 Password programming

The XRI1-ER-relay is delivered with the preset password "++++", it can be programmed new with dip switch 1:
Switch on dip switch 1. After power on and pressing any push button, the relay XRI1-ER inquires for a new password. The text "PSW?" appears on the display. The new password is entered by any combination of the push buttons <SELECT> <-> <+> <ENTER>. After the new password is given, the dip switch 1 must be switched off.

5.4.2 Using the password

Step by step, a new relay setting is made according to the following sequence:
- After the present setting value is changed with <+><-> push button, <ENTER> push button should be pressed.
- A message "SAV?" appears on the display to inquire if the new setting value is really wanted to be stored.
- After pressing the <ENTER> push button again, the password will be inquired by means of the message "PSW?" on the display.
- After the password is given correctly, which is prompted by message "SAV!" on the display, the new setting value can be stored by pressing the <ENTER> push button for about 3 seconds.
- The new setting value for the selected parameter appears on the display again.

A password consists of four push button operations. The pressed push buttons and their sequences define the password.

<SELECT/RESET>	=	S
<->	=	-
<+>	=	+
<ENTER>	=	E

then a password "-E+S" means pressing push buttons according to the following sequence:
<-> <ENTER> <+> <SELECT/RESET>

After the password is given correctly, parameter setting is permitted for five minutes. This means: For a subsequent parameter setting, as long as it is made within five minutes after the password input, a renewed password input is not required. Moreover, the valid period for parameter setting is automatically extended to further 5 minutes after each new push button operation.

If no push button operation follows within the five minute period after password input, the validity for parameter setting will be suspended.

For entering further parameters the password is then called up again. During the validity for parameter set-ting a new set value, after having acknowledged "SAV" two times, is stored by just pressing push button <ENTER> for some time.

As to parameter setting via RS 485 interface: see open data protocol.

5.5 Relay setting principle

By pressing push button <ENTER>, the parameter menu can be called up. By pressing push button <SELECT/RESET> the parameter to be set is reached. The corresponding LED lights up. The actual set value of the selected parameter is indicated on the display. The indicated set value can then be changed by pressing push buttons <+><-> (in-/decrementing) see figure 5.1).

The selected set value is stored by pressing push button <ENTER> and by input of the authority code (password) which means the adjustment of the unit is only possible after the password had been put in. (see 5.4.2)

After a trip the push button <SELECT/RESET> is re-served for the indication of fault data. Now new parameter setting by means of push button <SELECT/RESET> is only possible by pressing <ENTER> first.

5.5.1 Setting of default parameters

Setting of the XRI1-ER default parameters can be done as follows:

- switch off the auxiliary voltage supply
- press simultaneously push buttons <+><-> and <SELECT/RESET> and
- switch on the auxiliary voltage supply again.

5.5.2 Blocking the protection function

The blocking function of the XRI1-ER-relays can be set according to requirement. When pressing push buttons <ENTER> and <TRIP> at the same time the blocking mode is entered.

5.5.3 Assignment of the signal relays

The parameters for the blocking function are followed by the parameters for the assignment of the output relays.

5.6 Display of software version and test-TRIP

By pressing push button <TRIP> the first part of the software version is displayed, the second part appears when this push button is pressed again. When push button <TRIP> is pressed repeatedly, the test trip routine starts.

By entering the password the display shows "TRI?". After pressing <TRIP> again all output relays will be energized one after the other with a time delay of 1 s.

All relays stay energized until manual reset. The protection functions are not affected.

5.7 Low/high range of functions blocking and reset

The XRI1-ER have a wide-range power supply unit al-lowing to choose a suitable supply voltage. The operating threshold of the blocking and reset inputs, however, has to be defined by taking the supply voltage into account. The following two different operating thresholds can be adjusted:

- Low-range threshold $U_{ON} \geq 10$ V; $U_{OFF} \leq 8$ V
- High-range threshold $U_{ON} \geq 70$ V; $U_{OFF} \leq 60$ V

Connection terminals

- Low-range blockage input terminal C1/C1L
- Low-range reset input terminal C2/C2L
- High-range blockage input terminal C1/C1H
- High-range reset input terminal C2/C2H

6. Operations and settings

6.1 Setting procedure

After push button <SELECT/RESET> has been pressed, always the next measuring value is indicated. Firstly the operating measuring values are indicated and then the setting parameters. By pressing the <ENTER> push button the setting values can directly be called up and changed.

6.1.1 Voltage transformer connection for residual voltage measuring (3pha/e-n/1:1)

Depending on the connection of the voltage transformer of relays three possibilities of the residual voltage measurement can be chosen (see chapter 4.4).

6.1.2 Pickup value for residual voltage U_E

Regardless of the preset earth current, an earth fault is only identified if the residual voltage exceeds the set reference value. This value is indicated in volt.

6.1.3 WARN/TRIP changeover

A detected earth fault can be parameterized as follows:
a) "warn" only the alarm relay trips
b) "TRIP" the trip relay trips and tripping values are stored.

6.1.4 Pickup current for earth fault element ($I_{E>}$)

The setting value for this parameter that appears on the display is related to the nominal current (IN) of the relay.
This means: pickup current (Is) = displayed value x nominal current (I_N) e.g. displayed value = 0.20 then, Is = 0.2 x I_N. The pickup value of the device XRI1-XR refer

6.1.5 Tripping time for the earth overcurrent stage ($t_{IE>}$)

When the "Definite Time" tripping characteristic is adjusted, the independent tripping time will be shown on the display in seconds (e.g. 0.35 = 0.35 seconds). This value can be adjusted in steps by means of keys <+><->.

If the tripping time is set to infinite (the display shows the text "EXIT"), tripping of the earth overcurrent stage of the relay will be blocked. The WARN/Alarm relay stays active, however.

The function of determining the direction permits different adjustment of the tripping time for forward and reverse faults.
For this purpose, the display first shows the monetary tripping time for forward faults. The LED marked with two arrows lights up green. This forward adjustment value can then be changed by means of keys <+><-> and saved with the key <ENTER>. After that the display shows the momentary adjustment value for reverse faults if the key <SELECT> is pressed. The LED marked with two arrows lights up red. This reverse adjustment value should be set higher than the forward adjustment value so that the protection device can operate selectively in case of forward faults. If the tripping times for forward and reverse faults are set to the same values, the device will trip with the same time delay in both cases, i.e. without determination of the direction.

6.1.6 Pickup value for high set element ($I_{E>>}$)

The current setting value of this parameter appearing on the display is related to the nominal current of the relay.

This means: I>> = displayed value x I_N.

When the current setting for high set element is set out of range (on display appears "EXIT"), the high set element of the overcurrent relay is blocked.
The high set element can be blocked via terminals C1/C1L or C1/C1H if the corresponding blocking parameter is set to bloc (refer to chapter 6.1.14).

6.1.7 Trip delay for high set element ($t_{IE>>}$)

Independent from the chosen tripping characteristic for I>, the high set element I>> has always a definite-time tripping characteristic. An indication value in seconds appears on the display.

The setting procedure for forward or backward faults, described in chapter 6.1.5, is also valid for the tripping time of the high set element.

6.1.8 Nominal frequency

The adapted FFT-algorithm requires the nominal frequency as a parameter for correct digital sampling and filtering of the input currents.

By pressing <SELECT> the display shows "f=50" or "f=60". The desired nominal frequency can be adjusted by <+> or <-> and then stored with <ENTER>.

6.1.9 Circuit breaker failure protection t_{CBFP}

The CB failure protection is based on supervision of phase currents during tripping events. Only after tripping this protective function becomes active. The test in this case by supervision of the earth current criterion is whether earth currents are dropped to <1% x IN within the time t_{CBFP} (Circuit Breaker Failure Protection, adjustable between 0.1 - 2.0 s). If the earth current haven't dropped to <1% x I_N within this time, CB failure is detected and the related relay activated. The CB failure protection function is deactivated again as soon as the current have dropped to <1% x I_N within t_{CBFP}

6.1.10 Display of the activation storage (FLSH/NOFL)

If after an activation the existing current drops again below the pickup value, e.g. $I_{E>}$, without a trip has been initiated, LED I> signals that an activation has occurred by flashing fast. The LED keeps flashing until it is reset again (push button <RESET>). Flashing can be suppressed when the parameter is set to NOFL.

6.1.11 Adjustment of the slave address

Pressing push buttons <+> and <-> the slave address can be set in range of 1-32.

6.1.12 Setting of Baud-rate (applies for Modbus Protocol only)

Different transmission rates (Baud rate) can be set for data transmission via Modbus protocol. The rate can be changed by push buttons <+> and <-> and saved by pressing <ENTER>.

6.1.13 Setting of parity (applies for Modbus Protocol only)

The following three parity settings are possible:

- "EVN" = even
- "ODD" = odd
- "NO" = no parity check

The setting can be changed by push buttons <+> and <-> and saved by pressing <ENTER>.

6.1.14 Blocking the protection functions and assignment of the output relays

Blocking the protection functions:
The blocking function of the XRI1-ER can be set according to requirement. By applying the aux. voltage to D8/E8, the functions chosen by the user are blocked. Setting of the parameter should be done as follows:

- When pressing push buttons <ENTER> and <TRIP> at the same time, message "BLOC" is displayed (i.e. the respective function is blocked) or "NO_B" (i.e. the respective function is not blocked). The LED allocated to the first protection function $I_{E>}$ lights red.
- By pressing push buttons <+> <-> the value displayed can be changed.
- The changed value is stored by pressing <ENTER> and entering the password.
- By pressing the <SELECT/RESET> push button, any further protection function which can be blocked is displayed.
- Thereafter the blocking menu is left by pressing <SELECT/RESET> again.

Function		Display	LED/Colour
IE>	Overcurrent (Low set)	NO_B	$I_{E>}$ yellow
IE>>	Overcurrent (High set)	BLOC	$I_{E>>}$ yellow
tCBFP	Circuit breaker failure protection	NO_B	

Table 6.1: Default settings of blocking functions

Assignment of the output relays:
Unit XRI1-ER has five output relays. The fifth output relay is provided as permanent alarm relay for self supervision is normally on. Output relays 1 - 4 are normally off and can be assigned as alarm or tripping re-lays to the current functions which can either be done by using the push buttons on the front plate or via serial interface RS485. The assignment of the output relays is similar to the setting of parameters, however, only in the assignment mode. The assignment mode can be reached only via the blocking mode.
By pressing push button <SELECT/RESET> in blocking mode again, the assignment mode is selected.

The relays are assigned as follows: LEDs $I_{E>}$, $t_{IE>}$, $I_{E>>}$, $t_{IE>>}$ are two-colored and light up green when the output relays are assigned as alarm relays and red as tripping relays.
In addition, the LED →← also lights up with each adjustment. Green means forward and red backward direction.

Definition:
Alarm relays are activated at pickup.
Tripping relays are only activated after elapse of the tripping delay.

After the assignment mode has been activated, first LED IE> lights up green. Now one or several of the four output relays can be assigned to current element I> as alarm relays. At the same time the selected alarm relays for frequency element 1 are indicated on the display. Indication "1_ _ _" means that output relay 1 is assigned to this current element. When the display shows "_ _ _ _", no alarm relay is assigned to this cur-rent element. The assignment of output relays 1 - 4 to the current elements can be changed by pressing <+> and <-> push buttons. The selected assignment can be stored by pressing push button <ENTER> and subsequent input of the password. By pressing push button <SELECT/RESET>, LED $t_{IE>}$ lights up red. The output re-lays can now be assigned to this current element as tripping relays.
Relays 1 - 4 are selected in the same way as described before. By repeatedly pressing of the <SELECT/RESET> push button and assignment of the relays all elements can be assigned separately to the relays. The assignment mode can be terminated at any time by pressing the <SELECT/RESET> push button for some time (abt. 3 s).

Note:

- A form is attached to this description where the set-ting requested by the customer can be filled-in. This form is prepared for fax transmission and can be used for your own reference as well as for telephone queries.

Relay function		Output relays				Display-indication	Lighted LED
		1	**2**	**3**	**4**		
$I_{E>}$ (V)	alarm				X	_ _ _ 4	I>; →← green
$t_{IE>}$ (V)	tripping	X				1 _ _ _	$t_{I>}$; →← green
$I_{E>}$ (R)	alarm				X	_ _ _ 4	I>>; →← red
$t_{IE>}$ (R)	tripping	X				1 _ _ _	$t_{I>>}$; →← red
$I_{E>>}$ (V) $I_{E>}$	alarm				X	_ _ _ 4	$I_{IE>}$; →← green
$t_{IE>>}$ (V)	tripping	X				1 _ _ _	$t_{IE>>}$; →← green
$I_{E>>}$ (R) $I_{E>>}$	alarm				X	_ _ _ 4	$I_{E>>}$; →← red
$t_{IE>>}$ (R)	tripping	X				1 _ _ _	$t_{I>>}$; →← red
t_{CBFP}	tripping					_ _ _ _	

Table 6.2: Example of assignment matrix of the output relay (default settings).

(V) = forward direction;
(R) = backward direction

This way, a tripping relay can be set for each activation and tripping direction.

6.2 Indication of measuring and fault values

6.2.1 Measuring values

The following measuring quantities can be indicated on the display during normal service:

- Apparent earth current (LED E green)
- Active earth current (LED E and IP green)
- Reactive earth current (LED E and IQ green)
- Residual voltage UR (LED UE)
- Angle between IE and UE

7. Relay testing and commissioning

The test instructions following below help to verify the protection relay performance before or during commissioning of the protection system. To avoid a relay damage and to ensure a correct relay operation, be sure that:

- the auxiliary power supply rating corresponds to the auxiliary voltage on site.
- the rated current and rated voltage of the relay correspond to the plant data on site.
- the current transformer circuits and voltage transformer circuits are connected to the relay correctly.
- all signal circuits and output relay circuits are connected correctly.

7.1 Power-On

NOTE!
Prior to switch on the auxiliary power supply, be sure that the auxiliary supply voltage corresponds to the rated data on the type plate.

Switch on the auxiliary power supply to the relay and check that the message "ISEG" appears on the display and the self supervision alarm relay (watchdog) is energized (Contact terminals 71 and 74 closed).

7.2 Testing the output relays and LEDs

NOTE!
Prior to commencing this test, interrupt the trip circuit to the circuit breaker if tripping is not desired. By pressing the push button <TRIP> once, the display shows the first part of the software version of the relay (e.g. „D08-“). By pressing the push button <TRIP> twice, the display shows the second part of the software version of the relay (e.g. „4.01“). The software version should be quoted in all correspondence. Pressing the <TRIP> button once more, the display shows "PSW?". Please enter the correct password to proceed with the test. The message "TRI?" will follow. Confirm this message by pressing the push button <TRIP> again. All output relays should then be activated and the self supervision alarm relay (watchdog) be deactivated one after another with a time interval of 3 seconds and all LEDs with a delay of 0.5 seconds, with the self-supervision relay dropping. Thereafter, reset all output relays back to their normal positions by pressing the push button <SELECT/RESET> (about 3 s).

7.3 Checking the set values

By repeatedly pressing the push button <SELECT>, all relay set values may be checked. Set value modification can be done with the push buttons <+><-> and <ENTER>. For detailed information about that, please refer to chapter 6.
For a correct relay operation, be sure that the frequency set value (f=50/60) has been selected according to your system frequency (50 or 60 Hz).

7.4 Secondary injection test

7.4.1 Test equipment

- Voltmeter, Ammeter with class 1 or better
- Auxiliary power supply with the voltage corresponding to the rated data on the type plate
- Single-phase current supply unit (adjustable from 0 to ≥ 0,5 x In)
- Single-phase voltage supply unit (adjustable from 0 to ≥ 1.2 x Un)
- Timer to measure the operating time (Accuracy class ≤±10 ms)
- Switching device
- Test leads and tools

7.4.2 Test circuit of XRI1-ER

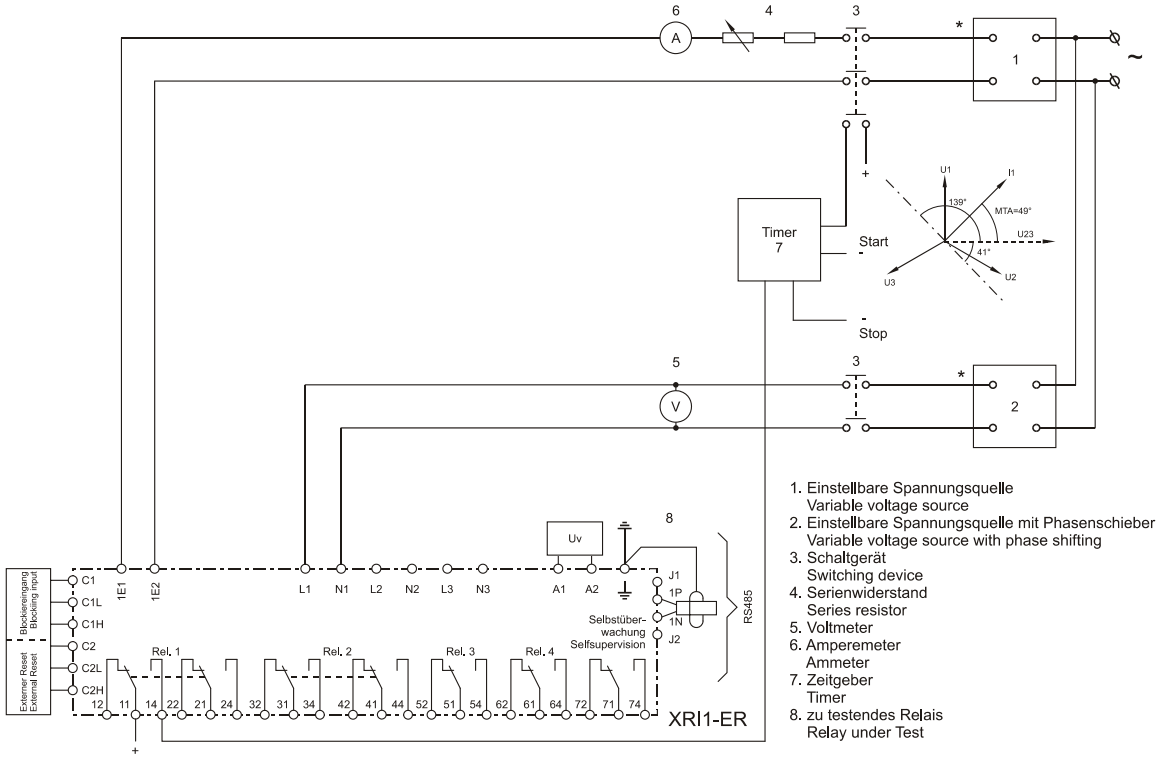


Figure 7.1: Test circuit

For testing relays with directional feature, current and voltage input signals with adjustable phase shifting are required. Figure 7.1 shows an example of a single phase test circuit with adjustable voltage and current energizing the XRI1-ER relay under test.
For testing a relay with directional feature, one of the input energizing quantity (voltage) shall be applied to the relay with a constant value within its effective range. The other input energizing quantity (current) and phase angle shall be appropriately varied.
XRI1-ER is a three phase directional time overcurrent relay with relay connection angle of -0°. The relay input currents and their corresponding reference voltages are shown in table 7.1 (refer to Fig. 4.2):

If the single phase test circuit is applied to test the directional feature of the relay and the current source is connected to phase E current input (1E1/1E2), then the voltage source should be connected to relay terminals L1/N1.

In order to test the directional feature, parameters have to be set in compliance with table 7.2. Then a test voltage equivalent to the rated voltage is connected to terminals L1/N1 and a current of 0.4 x In is impressed upon the current inputs 1E1/1E2.
It is now possible to read and check all measured values in accordance with Table 7.1. If the phase position is changed, the values I_Q and I_P change. If the angle is changed by 90°, for example, the measured value for current input E must be ±0 for I_P and +0.4 for I_Q.

Determining the change in direction

The tripping direction is determined by the sin- or cos-method. When testing the sin-method, the current must be adjusted 90° lagging in relation to the voltage and a definite direction in the forward range must be recognizable.

Current input	Terminals	Reference-voltage	Terminals	Display			
				E	I_P	I_Q	U
E (ER-type)	1E1/1E2	100 V	L1/N1	0.40 ±0.3%	±0.4 ±0.3%	±0.0 ±3%	100V ±1%
E (XR-type)	1E1/1E2	100 V	L1/N1	4.0 ±0.03%	±4.0 ±0.03%	±0.0 ±0.03%	100V ±1%

Table 7.1: Connection of test currents and voltages and corresponding display values

For relay assignment:

Parameter	Relays
IE> Alarm (V)	_2__
IE> Alarm (R)	__3_

Parameter	Setting
IE>	0.2 x In
tIE> (V)	EXIT
tIE> (R)	EXIT
sin/cos	sin

Table 7.2: Necessary parameter setting and relay assignment

A test current of 0.4 x In is impressed upon the current input. The voltage source is to be connected as pro-vided for in Table 7.1. With an angle setting of 90o leading, relay 2 must respond and LED →← lights up green. If the angle is now changed beyond the marginal regions, the LED →← changes from green to red. Relay 2 drops and relay 3 responds.

To check the trip delays for forward and backward direction they have to be set differently, because there's only one trip relay for both directions.
Great care must be taken to connect the test current and test voltage to the relay in correct phase angle and polarity. In Figure 7.1 the relay and test source polarity are indicated by a * mark near the terminals. The markings indicate that the relay will trip in its maximum sensitive angle when the voltage drop from the marked end to the non-marked end in the voltage input circuit has 49° phase angle lagging the current flowing from the marked end to the non-marked in the current input circuit. Of course, regardless of polarity, the current level must be above the pickup value.

7.4.3 Checking the input circuits and measured values

Inject a current in phase E (terminals 1E1/1E2), which is less than the relay pickup current set values, and check the measured current on the display by pressing the push button <SELECT>. For a relay with rated cur-rent In = 5 A, for example, a secondary current injection of 1 A should be indicated on the display with about 0.2 (0.2 x In). Compare the displayed current value with the reading of the ammeter. The deviation must not exceed 0.3% or 0.03% In. By using an RMS-metering instrument, a greater deviation may be ob-served if the test current contains harmonics. Because the XRI1-ER relay measures only the fundamental component of the input signals, the harmonics will be rejected by the internal DFFT-digital filter. Whereas the RMS-metering instrument measures the RMS-value of the input signals.

7.4.4 Checking the operating and resetting values of the relay

Inject a current which is less than the relay set values in phase 1 of the relay and gradually increase the current until the relay starts, i.e. at the moment when the LED IE> and E light up or the alarm output relay IE> is activated. Read the operating current indicated by the ammeter. The deviation must not exceed 3% of the set operating value or ±0.3% In.
Furthermore, gradually decrease the current until the re-lay resets, i.e. the alarm output relay I> is de-energized. Check that the resetting current is smaller than 0.97 times the operating current.
This procedure has also to be used for the other phases.

7.4.5 Checking the relay operating time

To check the relay operating time, a timer must be connected to the trip output relay contact. The timer should be started simultaneously with the current injection in the current input circuit and stopped by the trip relay contact. Set the current to a value corresponding to twice the operating value and inject the current instantaneously. The operating time measured by the timer should have a deviation of less than 3% of the set value or ±10 ms. than 1%. Otherwise the test results may be wrong.

7.4.6 Checking the high set element of the relay

Set a current above the set operating value of $I_{E>>}$. Inject the current instantaneously and check that the alarm output relay $I_{E>>}$ operates. Check the tripping time of the high set element according chapter 7.4.5.
Check the accuracy of the operating current setting by gradually increasing the injected current until the $I_{E>>}$ element picks up. Read the current value form the am-meter and compare with the desired setting.

Note !
Where test currents >4 x I_N are used, the thermal with-stand capability of the current paths has to be considered (see technical data, chapter 8.1).

7.4.7 Checking the external blocking and reset functions

The external blocking input inhibits e. g. the function of the high set element of the phase current. To test the blocking function apply auxiliary supply voltage to the external blocking input of the relay (terminals C1/C1L or C1/C1H). The time delay tI> should be set to EXIT for this test. Inject a test current which could cause a high set (I>>) tripping. Observe that there is no trip and alarm for the high set element.

Remove the auxiliary supply voltage from the blocking input. Inject a test current to trip the relay (message „TRIP“ on the display). Interrupt the test current and apply auxiliary supply voltage to the external reset input of the relay (terminals C2/C2L or C2/C2H). The display and LED indications should be reset immediately.

7.4.8 Test of the CB failure protection

For testing the tripping time a test current of about 1 times the rated current has to be injected. The timer is started upon tripping of the relay of a protection function (IE>, IE>>) and stopped as soon as the relay for the CB failure protection has picked up. Message "CBFP" is displayed. The tripping time ascertained by the timer should not deviate more than 1% or, at short trip delay, less than 10 ms from the set tripping time.
Alternatively, the timer can be started when the aux. voltage and the test current are injected simultaneously. The timer stops when the corresponding output relay for circuit breaker failure protection trips.
In this case the previously measured tripping delay (see section 6.4.5) has to be subtracted from the total tripping time measured.

7.5 Primary injection test

Generally, a primary injection test could be carried out in the similar manner as the secondary injection test described above. With the difference that the protected power system should be, in this case, connected to the installed relays under test „on line“, and the test currents and voltages should be injected to the relay through the current and voltage transformers with the primary side energized. Since the cost and potential hazards are very high for such a test, primary injection tests are usually limited to very important protective relays in the power system.

Because of its powerful combined indicating and measuring functions, the XRI1-ER relay may be tested in the manner of a primary injection test without extra expenditure and time consumption. In actual service, for example, the measured current values on the XRI1-ER relay display may be compared phase by phase with the current indications of the ammeter of the switchboard to verify that the relay works and measures correctly. In case of a XRI1-ER re-lay with directional feature, the active and reactive parts of the measured currents may be checked and the actual power factor may be calculated and compared it with the cosφ -meter indication on the switchboard to verify that the relay is connected to the power system with the correct polarity.

7.6 Maintenance

Maintenance testing is generally done on site at regular intervals. These intervals vary among users depending on many factors: e.g. the type of protective relays employed; the importance of the primary equipment being protected; the user's past experience with the relay, etc.

For electromechanical or static relays, maintenance testing will be performed at least once a year according to the experiences. For digital relays like XRI1-ER, this interval can be substantially longer. This is because:

- the XRI1-ER relays are equipped with very wide self-supervision functions, so that many faults in the relay can be detected and signalized during service. Important: The self-supervision output relay must be connected to a central alarm panel!
- the combined measuring functions of XRI1-ER relays enable supervision of the relay functions during ser-vice.
- the combined TRIP test function of the XRI1-ER relay allows to test the relay output circuits.

A testing interval of two years for maintenance will, therefore, be recommended.
During a maintenance test, the relay functions including the operating values and relay tripping characteristics as well as the operating times should be tested.

8. Technical data

8.1 Measuring input circuits

Rated data:	Nominal current I_N	1A or 5A
	Nominal voltage U_N	100 V, 230 V, 400 V
	Nominal frequency f_N	50 Hz; 60 Hz adjustable
Power consumption in current circuit:	at I_N = 1 A	0.2 VA
	at I_N = 5 A	0.1 VA
Power consumption in voltage circuit:	< 1 VA	
Thermal withstand capability in current circuit:	dynamic current withstand	
	(half-wave)	250 x I_N
	for 1 s	100 x I_N
	for 10 s	30 x I_N
	continuously	4 x I_N
Thermal withstand in voltage circuit:	continuously	1.5 x U_N

8.2 Common data

Dropout to pickup ratio:	>97%
Returning time:	30 ms
Time lag error class index E:	±10 ms
Minimum operating time:	30 ms
Influences on the current measurement	
Auxiliary voltage:	in the range of 0.8 <U_H/U_{HN} <1.2 no additional influences can be measured
Frequency:	in the range of 0.9 < f/f_N < 1.1; <0.2%/Hz
Harmonics:	up to 20% of the third harmonic; <0.08% per percent of the third harmonic up to 20% of the fifth harmonic; <0.07% per percent of the fifth harmonic
Influences on delay times:	no additional influences can be measured

8.3 Setting ranges and steps

8.3.1 Earth fault protection

	Setting range	Step	Tolerance
I_E>	0.01...0.45 x I_N (EXIT) (ER)	0.001; 0.002; 0.005; 0.01 x I_N 0.01%; 0.02%; 0.05%; 0.1% x I_N	±5 % from set value or ±0.3 % I_N (ER); ±0.03 % I_N (XR) ±3 % or ±15 ms
t_{IE}>	0.1...4.5% I_N (EXIT) (XR) 0.05 - 260 s (definite time)	0.01; 0.02; 0.05; 0.1; 0.2; 0.5; 1.0; 2.0; 5.0; 10; 20 s	
I_E>>	0.01...0.45 x I_N (EXIT) (ER)	0.001; 0.002; 0.005; 0.01x I_N 0.01%; 0.02%; 0.05%; 0.1% x I_N	±5 % from set value or ±0.3 % I_N (ER); ±0.03 % I_N (XR)
t_{IE}>>	0.1...4.5% I_N (EXIT) (XR) 0.05...2.0 s	0.01 s; 0.02 s; 0.05 s	± 3 % or ±15 ms
$U_{E>}$	U_N = 100 V: 3 PHA/e-n: 1 - 70 V 1:1: 1- 120 V	 1 V 1 V	±5 % from set value or < 0.5 % U_N
	U_N = 230 V: 3 PHA/e-n: 2 - 160 V 1:1: 2 - 300 V	 2 V 2 V	
	U_N = 400 V: 3 PHA/e-n: 5 - 300 V 1:1: 5 - 500 V	 5 V 5 V	

8.3.2 Switch failure protection

t_{CBFP}	t_{CBFP}	0.1...2.0 s; EXIT	0.01; 0.02; 0.05; 0.1 s	±1% resp. ±10 ms

8.3.3 Interface parameter

Function	Parameter	RS485 Open Data Protocol
RS	Slave-Address	1 - 32
RS	Baud Rate*	1200, 2400, 4800, 9600
RS	Parity*	even, odd, no

* only Modbus Protocol

8.4 Output relays

Contacts: 2 relays with 2 changeover contacts;
3 relays with 1 changeover contact

The output relays have with the following characteristics:

maximum breaking capacity 250 V AC / 1500 VA / continuous current 6 A

for DC voltage:

	ohmic	L/R = 40 ms	L/R = 70 ms
300 V DC	0.3 A/90 W	0.2 A/63 W	0.18 A/54 W
250 V DC	0.4 A/100 W	0.3 A/70 W	0.15 A/40 W
110 V DC	0.5 A/55 W	0.4 A/40 W	0.2 A/22 W
60 V DC	0.7 A/42 W	0.5 A/30 W	0.3 A/17 W
24 V DC	6 A/144 W	4.2 A/100 W	2.5 A/60 W

Max. rated making current: 64 A (VDE 0435/0972 and IEC 65/VDE 0860/8.86)
Making current: max. 20 A (16 ms)
mechanical life span: 30 x 10^6 operating cycles
electrical life span: 2 x 10^5 operating cycles at 220 V AC / 6 A
Contact material: silver cadmium oxide (AgCdO)

8.5 Power supply

Auxiliary voltage 16 - 360 V DC/16 - 270 V AC
Power consumption: standby 3 W operating 5 W
The connection terminals are C9, E9.

Max. allowed interruption of the
auxiliary supply without effecting
the function of the device: 50 ms
Propper connection of the terminal ⊥ is essential for the EMC withstand of the relay.
Use wires of min. 1.5 mm^2.

8.6 Inputs, Blockage and Reset

Low-range:
For rated voltages 24 V, 48 V, 60 V $U_{ON} \geq 10$ V $U_{OFF} \geq 8$ V
Current consumption 1 mA DC at 24 V

High-range:
For rated voltages 100 V, 110 V, 125 V, 220 V, 230 V
$U_{ON} \geq 70$ V $U_{OFF} \leq 60$ V
Current consumption 1.5 mA DC at 360 V DC or 11.0 mA AC at 230 V DC

Technical data subject to change without notice!

8.7 System data and test specifications

Design standards:	
Generic standard:	EN 50082-2, EN 50081-1
Product standard:	EN 60255-6, IEC 255-4, BS142
Specified ambient service recommended temperature for operation:	-10°C to +55°C
temperature limits:	in operation -25°C to +70°C in storage -25°C to +70°C
Moisture-carrying capacity class F as per DIN 40040 and per DIN IEC 68, part 2-3:	rel. humidity <95% at 40°C for 56 days
Insulation test voltage, inputs and outputs between themselves and to the relay frame as per EN 60255-6, IEC 255-5:	2.5 kV (eff.) / 50 Hz.; 1 min.
Impulse test voltage, inputs and outputs between themselves and to the relay frame as per EN 60255-6, IEC 255-5:	5 kV; 1.2/50 µs, 0.5 J
High frequency interference test voltage, inputs and outputs between themselves and to the relay frame as per EN 60255-6, IEC 255-6:	2.5 kV/1 MHz
Electrical discharge (ESD) test as per EN 61000-4-2, IEC 255-22-1:	8 kV air discharge, 6 kV contact discharge
Electrical fast transient (Burst) test as per EN 61000-4-8, IEC 255-22-1:	4 kV/2.5 kHz, 15 ms
Power frequency magnetic field immunity test:	100 A/m continuously 1000 A/m for 3 s
Radiated electromagnetic field disturbance test as per ENV 50140, IEC 255-22-3:	electric field strength: 10 V/m
Guided radiated electromagnetic field disturbance test as per ENV 50141:	electric field strengh: 10 V
Surge immunity test as per EN 61000-4-5:EN 61000-4-5:	4 kV
Radio interference suppression test as per EN 55011:	limit value class B
Radio interference radiation test as per EN 55011:	limit value class B

Mechanical test:

Shock:	Class 1 as per DIN IEC 255 T 21-2
Vibration:	Class 1 as per DIN IEC 255 T 21-1
Degree of protection:	IP40
Overvoltage class:	III
Weight:	1.6 kg
Relay case material:	self-extinguishing

Technical data subject to change without notice!

8.8 Relay case

Relay XRI1-ER 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).

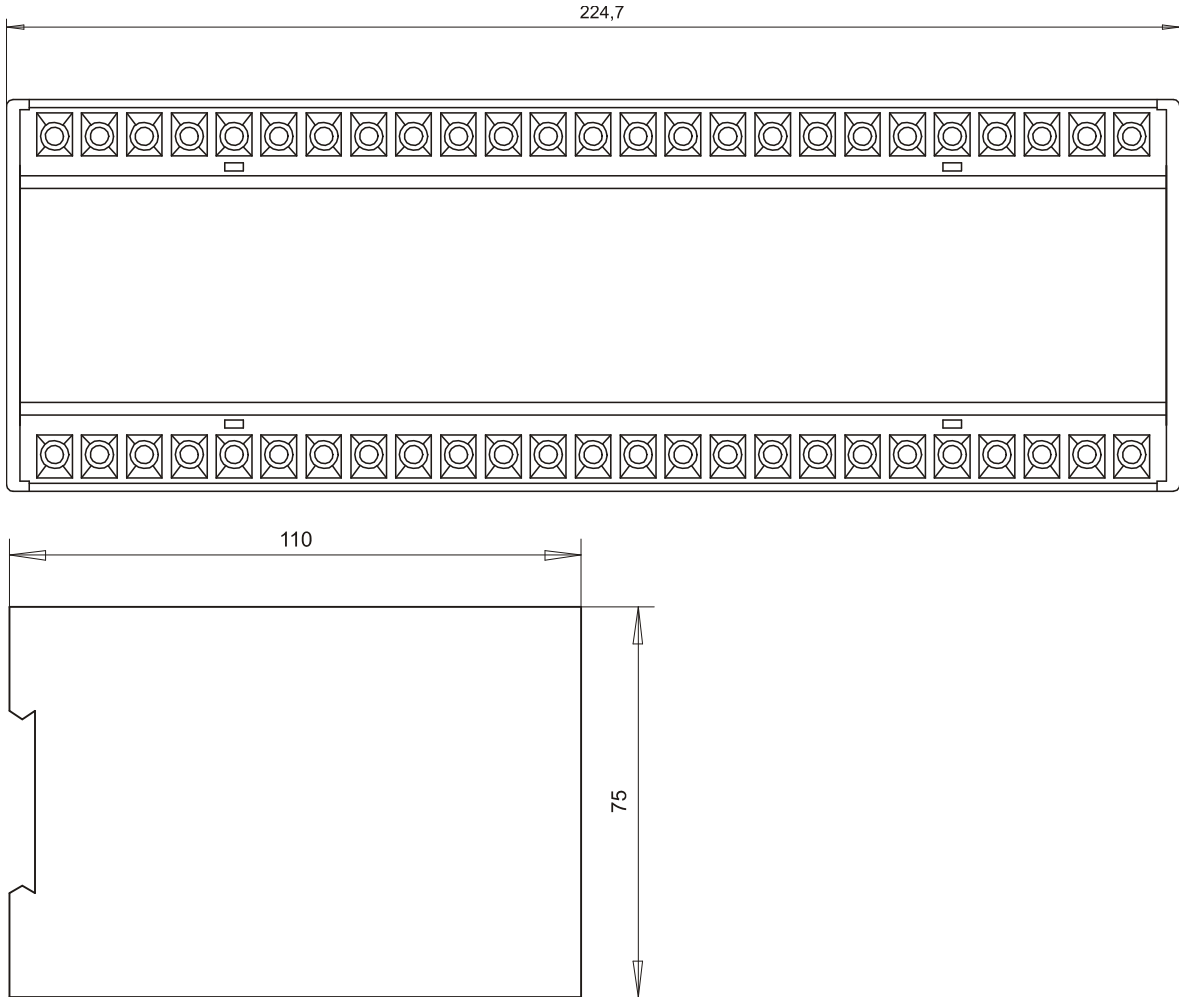


Figure 8.1: Dimensional drawing; dimensions in mm

Connection terminals
The connection of up to a maximum 2 x 2.5 mm^2 cross-section conductors is possible. For this the transparent cover of the unit has to be removed (see para. 5).

9. Order form

Earth fault current relay (with display and serial interface)	***XRI1***			**R**	**1**	
Earth current measuring for isolated/compensated systems very sensitive for isolated/compensated systems		**E** **X**				
Rated current in earth circuits 1 A 5 A			**1** **5**			
Directional feature in earth path						
Rated voltage in earth circuits 100 V						
Communication Protocol RS485 Pro Open Data MODBUS RTU						***** **M**

Setting list XRI1-ER

Note !
All settings must be checked at site and should the occasion arise, adjusted to the object/item to be protected.

Project: _____ SEG job.-no.: _____

Function group: = _____ Location: + _____ Relay code: - _____

Relay functions: _____ Password: _____

Date: _____

Setting of parameters

Function		Unit	Default settings	Actual settings
$U_{E>}$	Voltage transformer connection for residual voltage measuring		3pha	
$U_{E>}$	Pickup value for residual voltage		1V/2V/5V*	
$I_{E>}$	Pickup current for earth fault element	x I_N %	0.01 x I_N (ER) 0.1 % (XR)	
$I_{E>}$	Warn/Trip - changeover		trip	
$t_{IE>}$ (V) $t_{IE>}$ (R)	Trip delay time for earth fault element	s	0.05	
$I_{E>>}$	Pickup value for high set element	x I_N %	0.01 x I_N (ER) 0.1 % (XR)	
$t_{IE>>}$ (V) $t_{IE>>}$ (R)	Trip delay for high set element	s	0.05	
	SIN/COS changeover		sin	
t_{CBFP}	Trip delay for circuit breaker failure protection	s	EXIT	
f_N	Rated frequency	Hz	50	
	Pickup indication		FLSH	
RS	Slave address of the serial interface		1	
RS	Baud rate of the serial interface		9600	
RS	Parity of the serial interface		even	

* Setting depends on nominal voltage 100 V/230 V/400 V
** only Modbus Protocol

All settings must be checked at site and should the occarision arise, adjusted to the object/item to be protected.

Setting of code jumpers

Code jumper	J1		J2		J3	
	Default setting	Actual setting	Default setting	Actual setting	Default setting	Actual setting
Plugged						
Not plugged	X				X	

Assignment of the output relays:

Function	Relay 1		Relay 2		Relay 3		Relay 4	
	Default setting	Actual setting	Default setting	Actual setting	Default setting	Actual setting	Default setting	Actual setting
$I_{E>}$ alarm (V)							X	
$t_{IE>}$ tripping (V)	X							
$I_{E>}$ alarm (R)							X	
$t_{IE>}$ tripping (R)	X							
$I_{E>>}$ alarm (V)							X	
$t_{IE>>}$ tripping (V)	X							
$I_{E>>}$ alarm (R)							X	
$t_{IE>>}$ tripping (R)	X							
t_{CBFP} tripping								

Assignment of the blocking function:

	Default settings		Actual settings	
Function	blocking	No blocking	blocking	No blocking
IE>	X			
IE>>	X			
tCBFP	X			

This technical manual is valid for
software version: D01-8.20 (XRI1-ER)
D20-2.10 (XRI1-XR)
D51-1.00 (XRI1-ER-M)
D70-1.00 (XRI1-XR-M)

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