Reyrolle
Protection
Devices

7SR45 Argus User Manual

Self Powered Overcurrent and Earth Fault Relay

Energy Management

SIEMENS

Contents

Technical Manual Chapters

1. Description of Operation

2. Settings, Configuration & Instruments

3. Performance Specifications

4. Installation

5. Commissioning and Maintenance

6. Applications Guide

7SR45

Description of Operation

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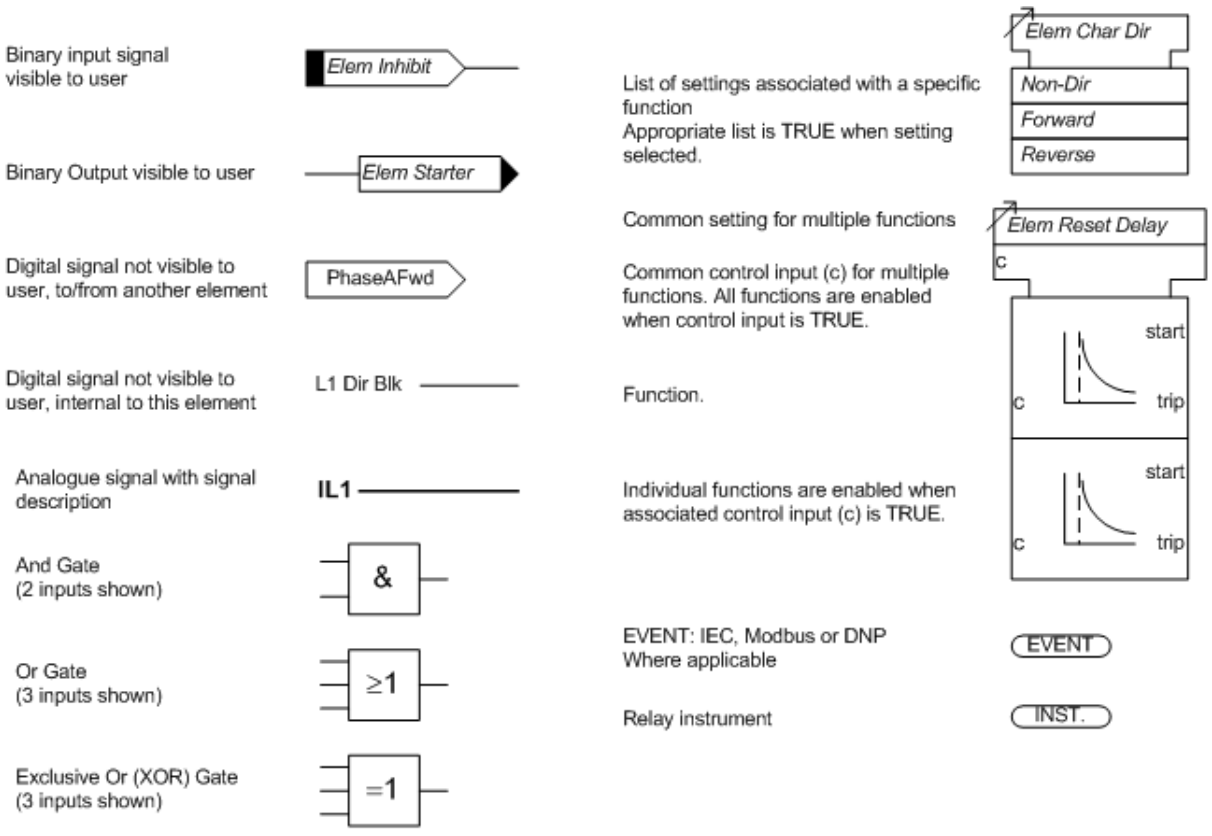
Symbols and Nomenclature

The following notational and formatting conventions are used within the remainder of this document:

- **Setting Menu Location** **MAIN MENU>SUB-MENU**
- **Setting:** ***Elem name -Setting***
- **Setting value:** **value**
- **Alternatives:** **[1st] [2nd] [3rd]**


Binary input signal visible to user
Elem Inhibit
Binary Output visible to user
Elem Starter
Digital signal not visible to user, to/from another element
PhaseAFwd
Digital signal not visible to user, internal to this element
L1 Dir Blk
Analogue signal with signal description
IL1
And Gate (2 inputs shown)
&
Or Gate (3 inputs shown)
≥1
Exclusive Or (XOR) Gate (3 inputs shown)
=1
List of settings associated with a specific function
Appropriate list is TRUE when setting selected.
Elem Char Dir
Non-Dir
Forward
Reverse
Common setting for multiple functions
Common control input (c) for multiple functions. All functions are enabled when control input is TRUE.
Function.
Individual functions are enabled when associated control input (c) is TRUE.
Elem Reset Delay
c
start
trip
EVENT: IEC, Modbus or DNP Where applicable
EVENT
Relay instrument
INST.

DANGER

Danger of explosion of the battery.

Noncompliance with the safety instructions means that death, severe injuries, or considerable material damages can occur.

Do not throw the lithium batteries into a fire.

WARNING

Warning about battery disposal.

Noncompliance with the safety instructions means that severe injuries or considerable material damages can occur.

When discharged, or when properly secured against short-circuit, lithium batteries can be disposed of through retailers or at depots run by competent organizations.

NOTE

The lithium batteries in the equipment are subject to special provision (188/A45) of the dangerous goods regulations of the different transport modes (as in edition 2003, lithium content and tests of UN Manual of Tests and Criteria).

This is only valid for the original battery or original spare batteries. For general transport security by shipment as freight: Electric equipment is only to be sent as freight if shut off.

Section 1: Introduction

This manual is applicable to the following relay:

- 7SR45 Self Powered Overcurrent and Earth Fault Relay

General Safety Precautions

1.1 Current Transformer Circuits

The secondary circuit of a live CT must not be open circuited. Non-observance of this precaution can result in injury to personnel or damage to equipment.

1.2 External Resistors

Where external resistors are connected to the relay circuitry, these may present a danger of electric shock or burns, if touched.

1.3 Description

7SR45 self powered overcurrent and earth fault relay is developed using the latest generation of hardware technology and is available in two variants depending on the CT ratings (1 A/5 A). 7SR45 is a member of Siemens Reyrolle® protection devices Argus product family.

7SR45 self powered overcurrent and earth fault relay is housed in a 4U high, size 4 non draw-out case and provides protection, monitoring, and instrumentation functions with integrated input and output logic, events (Event Log), and fault records (Trip Log).

The relay functionality can be configured via a front USB port. By using the Reydisp evolution software, the user can update the settings and view the fault records (Trip Log) and events (Event Log).

1.4 Ordering Options

Reyrolle - 7SR45 Argus

Product description	Variants	Order No.
		1 2 3 4 5 6 7 - 8 9 10 11 12 - 13 14 15 16
7SR45 Argus		**7 S R 4 5 0** □ **-** □ □ **A** □ □ **- 1 A A 0**
Non directional O/C Relay		
	Relay Type Size 4 Moulded Case (Non-Drawout Design), 4 CT[1], 2 BI/2 BO, Impulse Output, 9 LEDs	**1**
	Measuring Input 1 A, 50/60 Hz 5 A, 50/60Hz	**1** **2**
	Auxiliary Voltage Self Powered (CT Powered Only)	**G**
	Spare	**A**
	Communication Options Front Communication port : USB	**1**
	Protocol No Protocol (No rear port communication)	**0**
	Front Fascia Standard Version	**1**
	Protection Function Packages - Standard version 50 Instantaneous phase fault overcurrent 50G/50N Instantaneous earth fault 51 Time delayed phase fault overcurrent 51G/51N Time delayed earth fault 50LC/SOTF Switch-On-To-Fault	**A**
	Additional functionality No additional functionality	**A**
	Spare Spare	**0**

[1] 4 CT is configured as 3PF + EF

Use the following ordering information to order 7SR45 self powered overcurrent and earth fault relay battery spares.

Table 1-1 Battery Spares Ordering Options

Variants	Description
7XG1900-1AA00-1000	Main Battery CR123A
7XG1900-2AA00-1000	RTC Battery CR1632
7XG1900-3AA00-1000	Main Battery CR123A + RTC Battery CR1632

NOTE:

If possible, it is recommended to procure the battery from the local supplier/market.

1.5 Functional Diagram

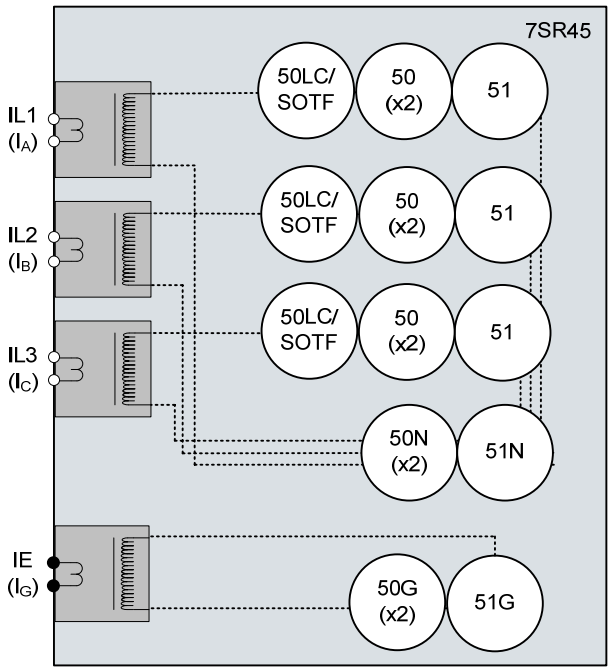


Figure 1-1 Functional Diagram of 7SR45 self powered overcurrent and earth fault relay

1.6 Terminal Diagram

The relay is housed in a non draw-out case 4U high size 4 case. The rear connection comprises of user-friendly pluggable type terminals for Binary Input (BI), Binary Output (BO), Pulse Output (PO), and Current Transformer (CT) wire connections.

The CT terminals are suitable for ring type lug connection and to provide a secure and reliable termination.

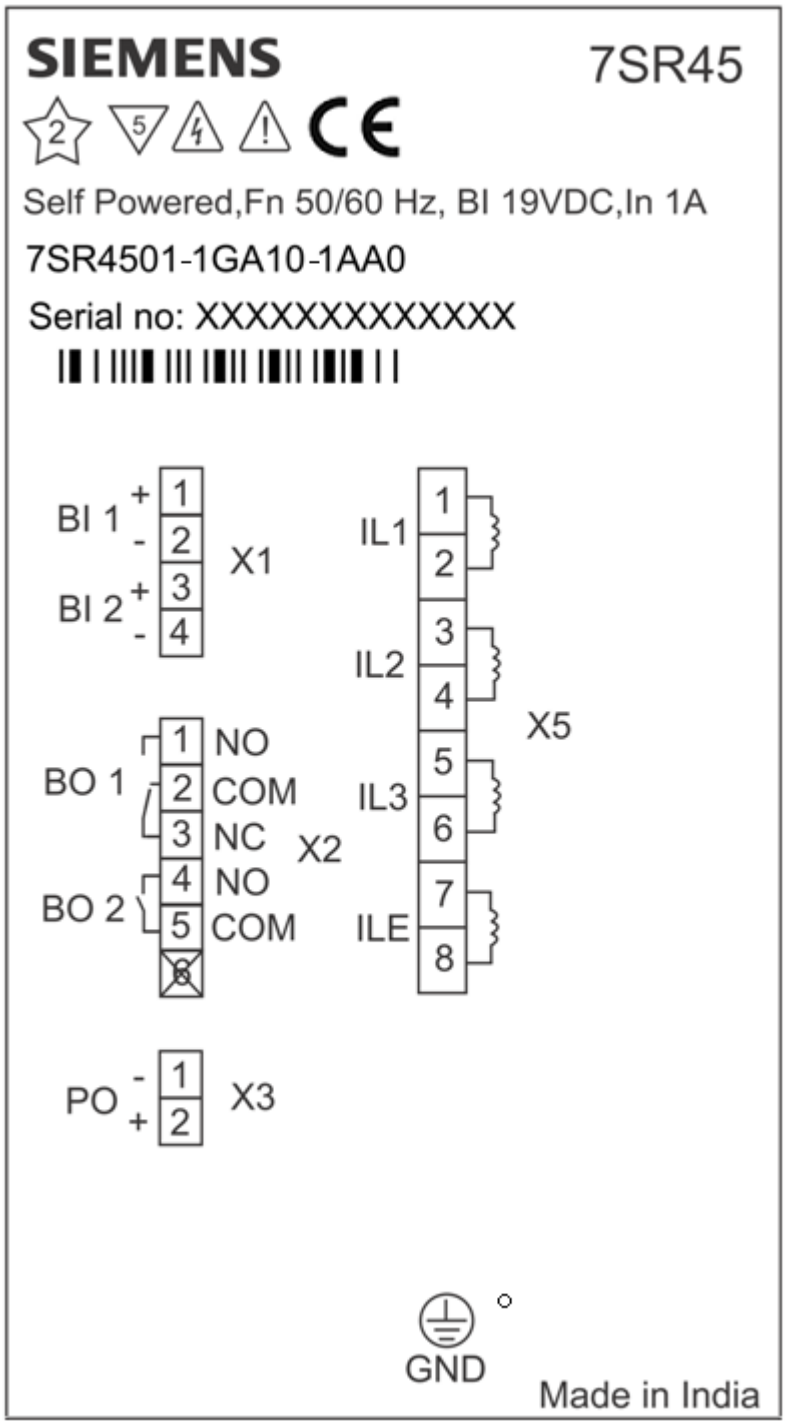


Figure 1-2 Terminal Diagram of 7SR45 self powered overcurrent and earth fault relay

Section 2: Hardware Description

2.1 Operator Interface

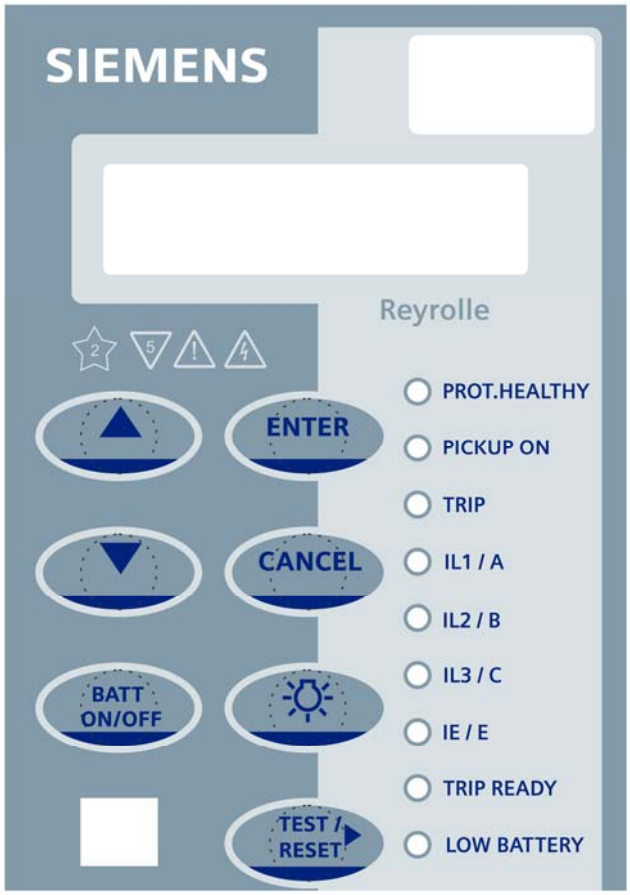


Figure 2-1 LED Indication Label

The rating label is located on the housing and provides more technical information about the 7SR45 self powered overcurrent and earth fault relay.

Relay Information

The rating label contains the following product Information:

- Product name
- MLFB ordering code, with hardware version suffix
- Nominal current rating
- Rated frequency
- Binary input supply rating
- Serial number

For safety reasons, the following symbols are displayed on the label.

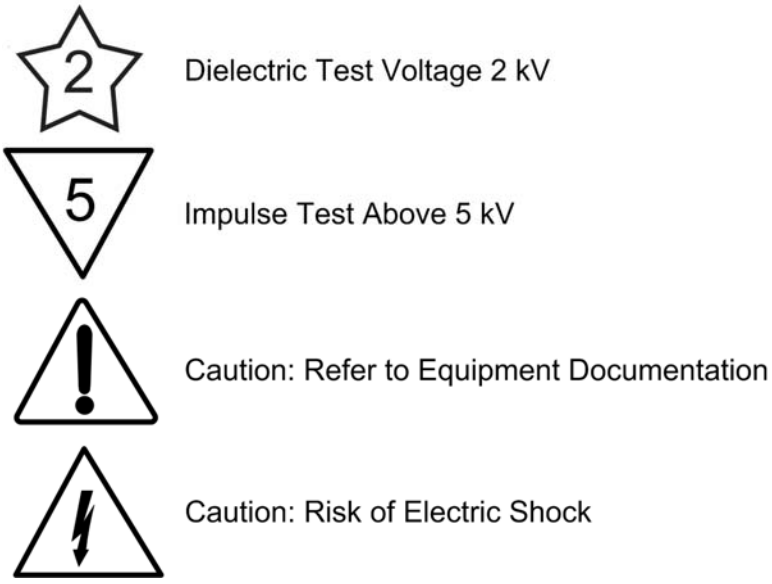


Figure 2-2 Safety Symbols

7SR45 self powered overcurrent and earth fault relay consist of the following human machine interface:

1. LCD
2. Keypads
3. LED

2.1.1 Liquid Crystal Display (LCD)

7SR45 self powered overcurrent and earth fault relay consists of 16x2 LCD that indicates the settings, instrumentation, and fault data.

By using the LCD, the user can view or edit a configuration parameter. LCD allows the user to view the real time status of relay such as BI, BO, primary, and secondary current values of each phase and earth.

LCD displays the stored fault information to the user. When any fault condition occurs, the relay displays the latest fault information in LCD.

The backlight TURNS ON automatically if the 7SR45 self powered overcurrent and earth fault relay is powered on with CT power and the current is more than 0.4In (single phase) or 0.14In (three phase). If the 7SR45 self powered overcurrent and earth fault relay is energized with current less than the defined limits, the backlight does not TURN ON.

If the 7SR45 self powered overcurrent and earth fault relay is powered ON by inserting a USB cable or by inserting a battery, the backlight TURNS ON automatically.

The backlight can be turned off manually by pressing the backlight key. If no activity is performed in the HMI for more than 30 s, the backlight turns off automatically to save energy.

In the CT power mode, 7SR45 self powered overcurrent and earth fault relay periodically monitors that sufficient current is available to TURN ON the back light.

In the USB or battery power mode, if the back light is already turned on and if the CT power source is provided, the back light TURNS OFF due to the switching of power mode from USB or Battery to CT power. The back light can be TURNED ON again if sufficient current is available.

For more information about power source, refer to Modes of Operation.

Figure 2-3 Relay LCD

2.1.2 Keypad

7SR45 self powered overcurrent and earth fault relay keypad consists of 5 standard keys for navigation and editing the values. The standard keys are used to navigate the menu structure and control the relay functions. 2 additional keys are available for LCD backlight and battery mode.

The keys are used for the following functions:

- To display and edit the relay settings
- To display the relay instrumentation and fault data
- To reset the output relays and LEDs

Used for navigating to sub menu or to increase the parameter value in the edit mode.

Used for navigating to sub menu or to decrease the parameter value in the edit mode.

Used for clearing the fault flags. By using this key, the user can acknowledge the LEDs and binary output status. This key is also used for selecting the sub menu or selecting parameter values in the edit mode.

Used for selecting parameter or confirming the values.
ENTER key is used to initiate and accept the setting changes.

Press **ENTER** to edit the parameter setting. The setting value flashes and can be changed by using the▲ or ▼ keys.

Used for navigating to previous menu or to discard the value.
CANCEL key is used to return the relay to its initial status or one level above in the menu structure.

Press **CANCEL** key repeatedly to return to the Relay Identifier screen.

Used to switch-on and switch-off the relay with battery power when USB and CT power are not available.

Used to switch-on and switch-off the backlight.

2.1.3 Light Emitting Diode (LED)

2.1.3.1 Indication

7SR45 self powered overcurrent and earth fault relay consists of 9 fixed function LEDs. LED indicates the parameter status of the relay such as TRIP READY and PICKUP. The pre-defined LED functions are:

LEDs	LED Functions	Color
LED 1	PROT. HEALTHY	GREEN
LED 2	PICKUP ON	AMBER
LED 3	TRIP	RED
LED 4	IL1 / A	RED
LED 5	IL2 / B	RED
LED 6	IL3 / C	RED

LED 7	IE / E	RED
LED 8	TRIP READY	GREEN
LED 9	LOW BATTERY	AMBER

2.1.3.2 Protection Healthy LED

The steady illumination of green LED indicates that required CT current (0.20xIn of nominal current in single phase or 0.13xIn of nominal current in three phases) is applied to the relay and the relay is functioning healthily.

2.1.3.3 Trip Ready LED

The steady illumination of green LED indicates that required CT current (0.20xIn of nominal current in single phase or 0.13xIn of nominal current in three phases) is applied to the relay and the relay is having sufficient energy to trip either through the low impulse output or binary output.

2.2 Home Screen

After the relay is powered on, the user can access or navigate to other menus from the Home Screen.

The following operations can be performed from the Home Screen:

ENTER	Press **ENTER** key to navigate to SETTING MODE
READ UP	Press **READ UP** key to navigate to MAINTENANCE MODE
READ DOWN	Press **READ DOWN** key to navigate to SETTING MODE
TEST/RESET►	Press **TEST/RESET►** key to reset flag and LED
CANCEL+TEST/RESET►	Press **CANCEL+TEST/RESET►** key to navigate to SOFTWARE VERSION

2.3 Password Protection

7SR45 self powered overcurrent and earth fault relay allow the user to set the password via SETTING MODE > SYSTEM CONFIG > PASSWORD. The length of the password should be 4 characters. Alphanumeric and 3 special characters such as "**+**", "–", and "*/*" are allowed.

User password can be disabled by configuring as NONE.

From the parameter view screen, the user enters the password and presses ENTER for validation. If the entered password is valid, the next screen appears. If the password is invalid, LCD displays the password retry screen again.

After successful login and editing of parameter, password prompt screen does not appear till the login expires.

If the user does not perform any operation for more than 1 minute, the login expires and unsaved settings will be discarded.

2.4 Software Version Menu

Software version menu can be viewed by holding the CANCEL key and followed by pressing of TEST/RESET► key. The user can view the software information by pressing ▲ or ▼key.

The software version menu contains the following information:

Firmware Art No.	The firmware article number installed in the relay
Build Date	The date of software version build
Build Time	The time of software version build
Serial No	The serial number of the relay
MLFB	MLFB number of the relay
Product Art No	Unique number of the product assigned by SIEMENS
Product Name	Product name for display

2.5 Alert Screen

2.5.1 Fault Alert

When any fault is detected by the relay, LCD pops-up the fault alert. Any previous alert pop-up messages are updated or replaced by the latest message.

2.5.2 Alarm Alert

Alarm alert appears when any binary input is configured for general alarm and it is triggered.

2.5.3 Info Alert

Info alert displays the required information to the user. Info alert displays for 2 s and the alert clears automatically.

Table 1-2 shows the info. alert and the required description.

Table 1-2 Info Alert

* TIME OUT *	This alert appears during the edit mode and after 15 s of inactivity time; the edited value of the parameter will be discarded.
* LED TEST * * FLAGS RESET *	This alert appears when the fault flags are reset and LED test is performed.
* FLAGS RESET *	This alert appears when the fault flags are reset.
* FAULT * * PERSISTS *	This alert appears when reset of the fault flag is failed due to the presence of fault current and the fault persists.
* USB * * DETECTED *	This alert appears when the user connects to the USB host.
* PASSWORD * * NOT MATCH *	Enter the password twice for confirmation or changing a password. This alert message appears when the password does not match with the previously typed password.
* INVALID * * CHARACTER *	This alert appears when the password entered by the user contains "_" or any special characters when changing the password.
* RECORD * * CLEARED *	This alert appears when the user selects to clear the fault or event records and the operation is successful.
* BATTERY ON *	This alert appears when the relay is powered-on in the battery mode.
* HIBERTNATE *	This alert appears when the relay goes to sleep mode.
* INSUFFICIENT * * ENERGY *	This alert appears when there is insufficient energy to perform the following actions: • Turn on backlight • To operate or reset the binary outputs
* FAULT IS NOT * * ACKNOWLEDGED *	This alert appears when the user clears the fault records, but the latest fault is not acknowledged by resetting the flag.
* CT Power *	This alert appears when the relay is powered by CT.

2.6 Parameter Edit Screen

7SR45 self powered overcurrent and earth fault relay allows the user to edit the parameter value in the LCD.

To edit the parameter, follow the procedure given below:

1. From the **Relay Identifier** screen, navigate to the **Parameter** screen.
2. In the **Parameter** screen, press **ENTER** key to display the edit screen.
3. In the Edit Screen, the user can edit the parameter value in the editable field.
4. Press ▲ key and ▼key to select the valid value.
5. Press **ENTER** to save the parameter value.
   To discard the parameter value, press the **CANCEL** key.
6. Press **CANCEL** till the user return to the Relay Identifier screen.
7. Press **ENTER** to save the configuration in memory.

Section 3: Protection Functions (50, 51, 50N, 51N, 50G, 51G, 50LC)

3.1 Instantaneous Overcurrent Protection (50)

Two Instantaneous overcurrent elements are provided in the 7SR45 self powered overcurrent and earth fault relay.

50-1, 50-2

Each instantaneous element (50-n) has independent settings. ***50-n Setting*** for pick-up current and **50-n *Delay*** definite time delay.

Operation of the instantaneous overcurrent elements can be inhibited from:

Inhibit 50-n A binary input.

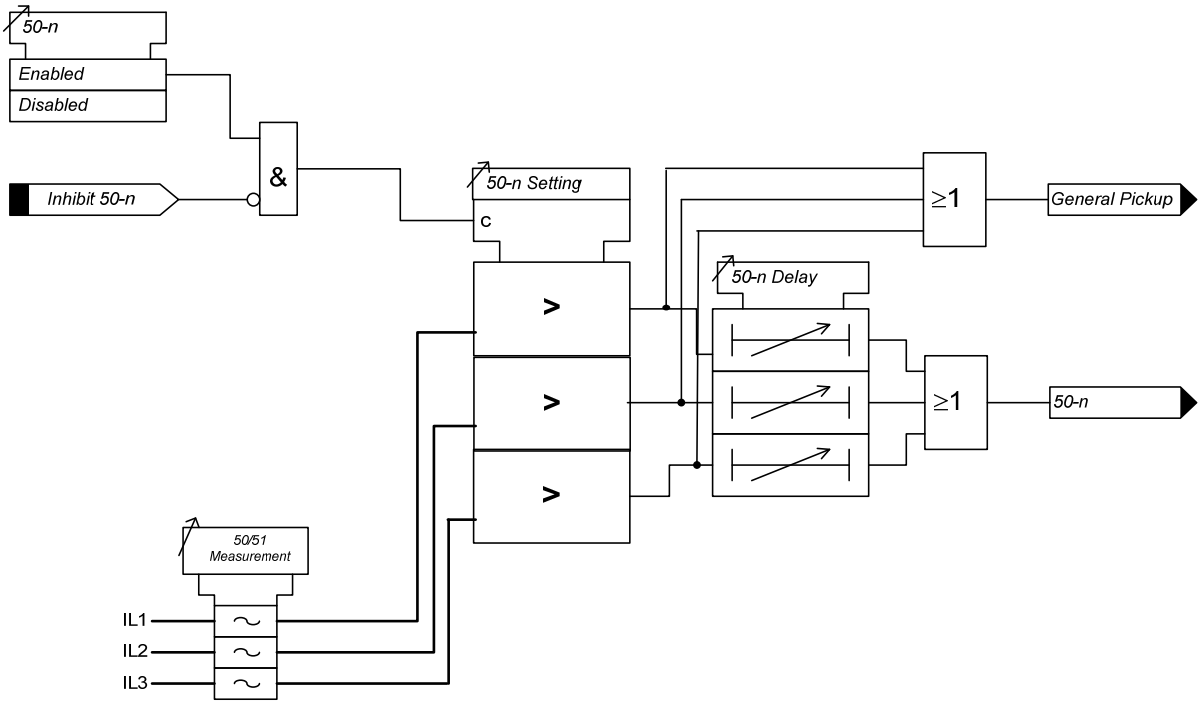


Figure 3-1 Logic Diagram: Instantaneous Overcurrent Element

Table 3-1 Instantaneous Overcurrent Protection (50-n)

Parameters	Description	Default Value	Min	Max	Step Change
50-n Element	50-n Block	Disabled	-	-	-
50-n Setting	Current Set point	1	1xIn	20xIn	1
50-n Delay	Delay time	0	0	600 s	0.01

3.2 Time Delayed Overcurrent Protection (51)

One time delayed overcurrent element is provided in the 7SR45 self powered overcurrent and earth fault relay.

51-1

51-n Setting sets the pick-up current level.

A number of shaped characteristics are provided. An inverse definite minimum time (IDMT) characteristic is selected from IEC, ANSI using ***51-n Char***. A time multiplier is applied to the characteristic curves using the ***51-n Time Mult*** setting. Alternatively, a definite time lag delay (DTL) can be chosen using ***51-n Char***. When Definite Time Lag (DTL) is selected the time multiplier is not applied and the ***51-n Delay (DTL)*** setting is used instead.

The ***51-n Reset*** setting can apply a **definite time delayed reset**, or when the operation is configured as an IEC or ANSI and if the reset is selected as **(IEC/ANSI) DECAY** reset, the associated reset curve will be used.

A minimum operate time for the characteristic can be set using ***51-n MinOperate*** setting.

A fixed additional operate time can be added to the characteristic using ***51-n Follower*** setting.

Operation of the time delayed overcurrent elements can be inhibited by assigning binary inputs.

Inhibit 51-n A binary input.

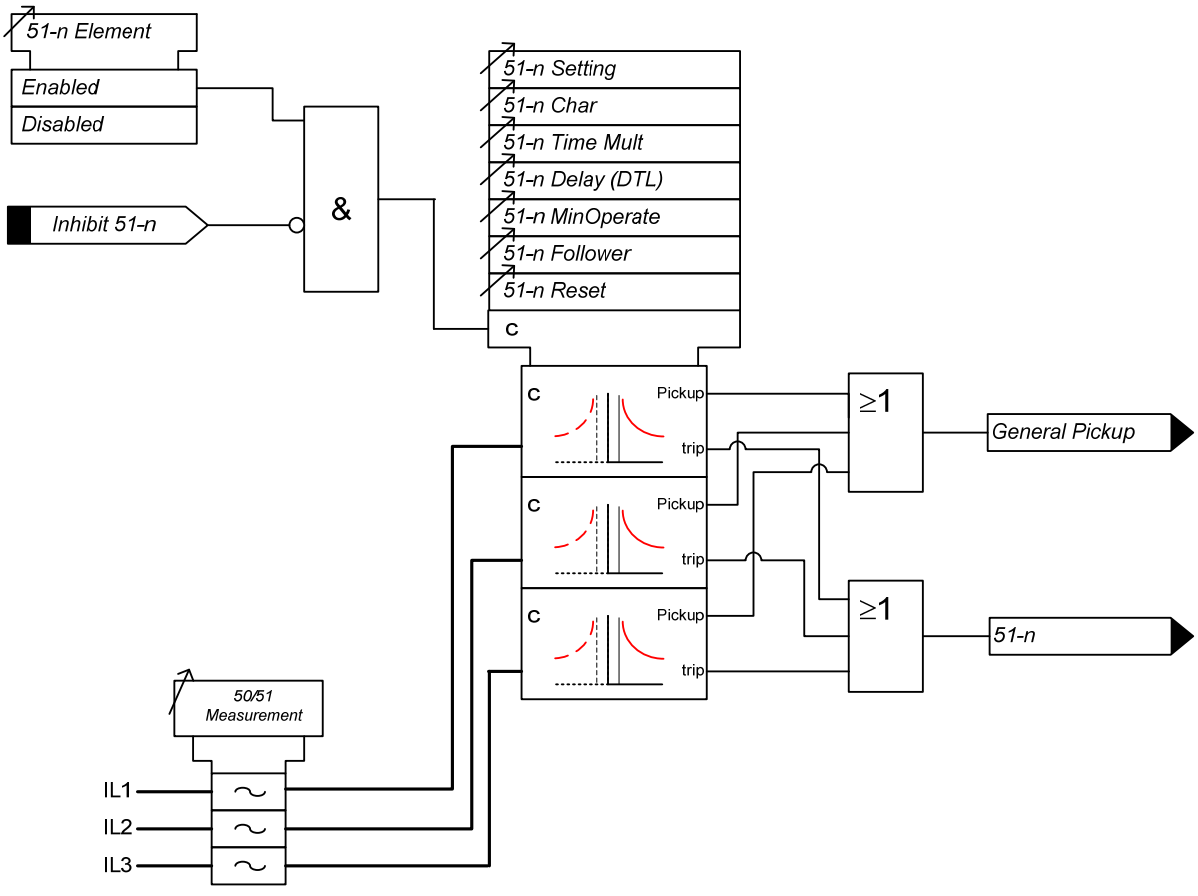


Figure 3-2 Logic Diagram: Time Delayed Overcurrent Element

The following are the 51-n supported Curve Characteristic:

- **DTL, IEC-NI, IEC-VI, IEC-EI, IEC-LTI, ANSI-MI, ANSI-VI, ANSI-EI**

Table 3-2 Time Delayed Overcurrent Protection (51-n)

Parameters	Description	Default Value	Min	Max	Step Change
51-n Element	51-1 Block	Disabled	-	-	-
51-n Setting	Current Set point	1xIn	0.2xIn	2.0xIn	0.01
51-n Char	Characteristics	DTL	-	-	-
51-n Time Mult	Time Multiplier (other than DTL)	1	0.01 s	10	0.01
51-n Delay	Delay (Applicable only for DTL)	5 s	0 s	15 s	0.01
51-n Min Operate	Minimum Operate Time	0 s	0 s	20 s	0.01
51-n Follower	Follower DTL	0 s	0 s	20 s	0.01
51-n Reset	Reset	0 s	0 s	60, IEC/ ANSI DECAY	1

3.3 Instantaneous Derived Earth Fault Protection (50N)

Earth current is derived by calculating the sum of the measured line currents.

Two instantaneous derived earth fault elements are provided in the 7SR45 self powered overcurrent and earth fault relay.

50N-1, 50N-2

Each instantaneous element has independent settings for pick-up current ***50N-n Setting*** and a definite time delay ***50N-n Delay***.

Operation of the instantaneous earth fault elements can be inhibited from:

Inhibit 50N-n A binary input.

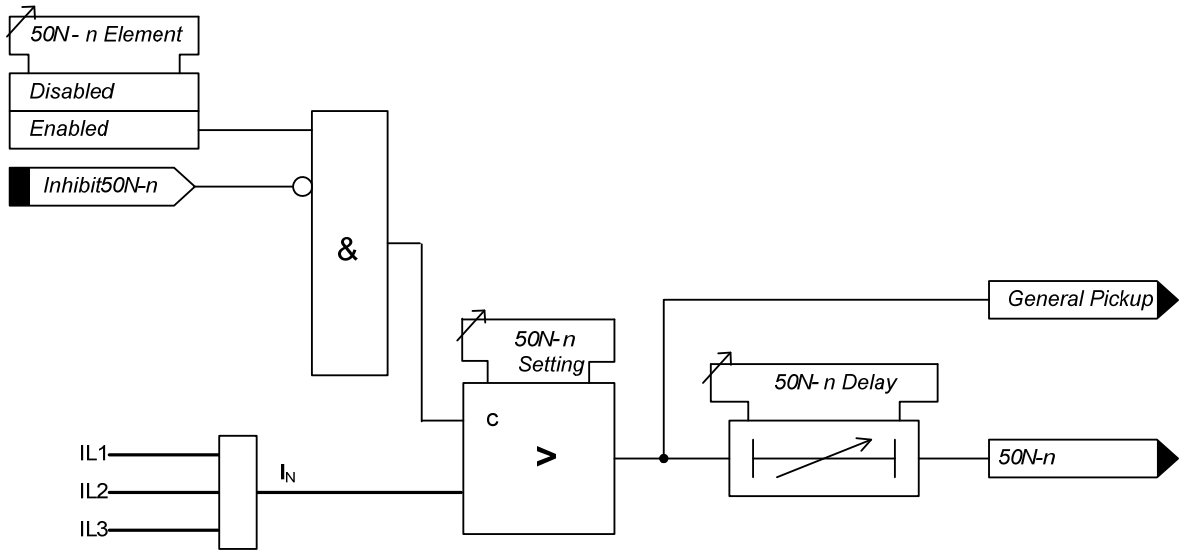


Figure 3-3 Logic Diagram: Derived Instantaneous Earth Fault Element

Table 3-3 Instantaneous Derived Earth Fault Protection (50N-n)

Parameters	Description	Default Value	Min	Max	Step Change
50N-n Element	50N-n Block	Disabled	-	-	-
50N-n Setting	Current Set point	1xIn	1xIn	20xIn	1
50N-n Delay	Delay time	0	0 s	600 s	0.01

3.4 Time Delayed Derived Earth Fault Protection (51N)

One time delayed derived earth fault element is provided in the 7SR45 self powered overcurrent and earth fault relay.

51N-1

51N-n Setting sets the pick-up current level.

A number of shaped characteristics are provided. An inverse definite minimum time (IDMT) characteristic is selected from IEC and ANSI using ***51N-n Char***. A time multiplier is applied to the characteristic curves using the ***51N-n Time Mult*** setting. Alternatively, a definite time lag delay (DTL) can be chosen using ***51N-n Char.*** When definite time lag (DTL) is selected the time multiplier is not applied and the ***51N-n Delay (DTL)*** setting is used instead.

The ***51N-n Reset*** setting can apply a **definite time delayed reset**, or when the operation is configured as an IEC or ANSI if the reset is selected as **IEC/ANSI (DECAY)** reset, the associated reset curve will be used.

A minimum operate time for the characteristic can be set using the ***51N-n MinOperate*** setting.

A fixed additional operate time can be added to the characteristic using the ***51N-n Follower*** setting.

Operation of the time delayed earth fault elements can be inhibited by assigning binary inputs.

Inhibit 51N-n A binary input.

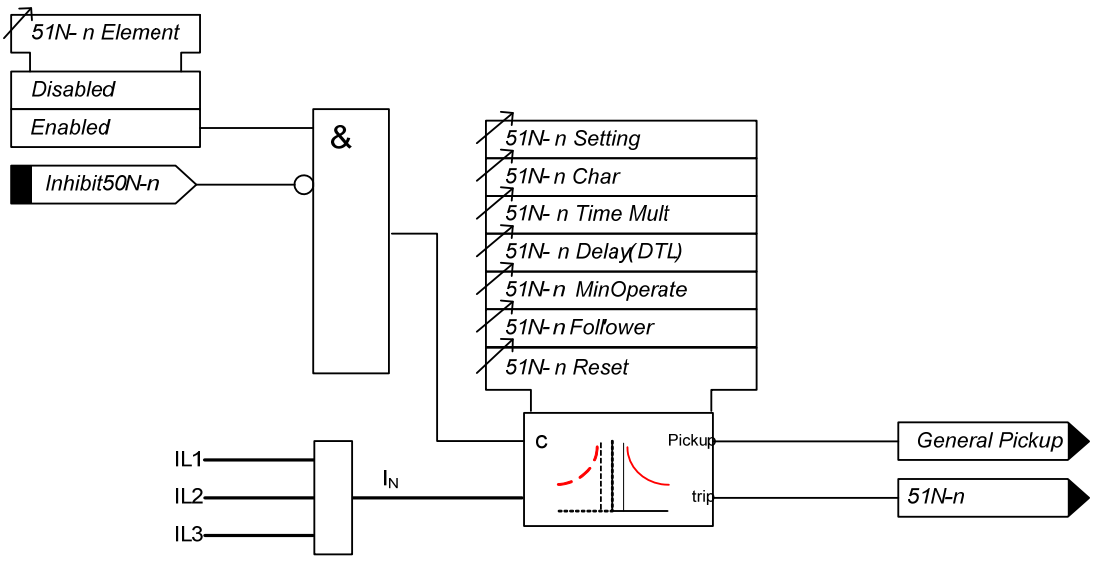


Figure 3-4 Logic Diagram: Derived Time Delayed Earth Fault Protection

The following are the 51N-n supported curve characteristic:

- **DTL, IEC-NI, IEC-VI, IEC-EI, IEC-LTI, ANSI-MI, ANSI-VI, ANSI-EI**

Table 3-4 Time Delayed Derived Earth Fault Protection (51N-n)

Parameters	Description	Default Value	Min	Max	Step Change
51N-n Element	51-1 Block	Disabled	-	-	-
51N-n Setting	Current Set point	0.5XIn	0.1xIn	0.8xIn	0.01
51N-n Char	Characteristics	DTL	-	-	-
51N-n Time Mult	Time Multiplier (other than DTL)	1	0.01	10	0.01
51N-n Delay	Delay (Applicable only for DTL)	5 s	0 s	15 s	0.01
51N-n Min Operate	Minimum Operate Time	0 s	0 s	20 s	0.01
51N-n Follower DTL	Follower DTL	0 s	0 s	20 s	0.01
51N-n Reset	Reset	0 s	0 s	60, IEC/ ANSI DECAY	1

3.5 Instantaneous Measured Earth Fault Protection (50G)

The earth current is measured directly via a dedicated current analogue input, I_N.

Two instantaneous measured earth fault elements are provided in the 7SR45 self powered overcurrent and earth fault relay.

50G-1, 50G-2

Each instantaneous element has independent settings for pick-up current ***50G-n Setting*** and a definite time delay ***50G-n Delay***.

Operation of the instantaneous measured earth fault elements can be inhibited from:

Inhibit 50G-n A binary input

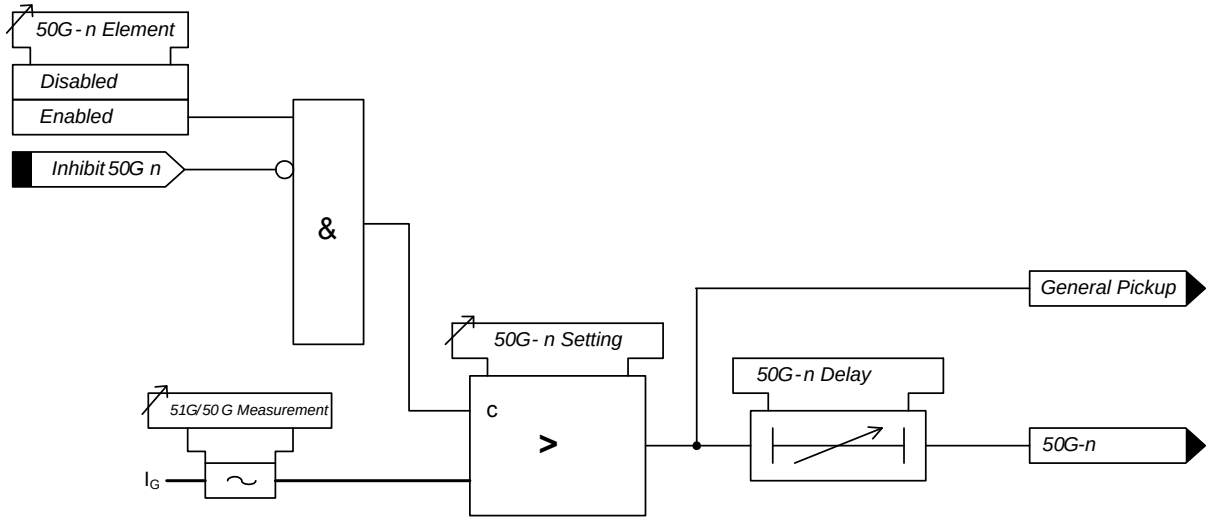


Figure 3-5 Logic Diagram: Instantaneous Measured Earth-fault Element

Table 3-5 Instantaneous Measured Earth Fault Protection (50G-n)

Parameters	Description	Default Value	Min	Max	Step Change
50G-n Element	50G-n Block	Disabled	-	-	-
50G-n Setting	Current Set point	1xIn	1xIn	20xIn	1
50G-n Delay	Delay time	0	0 s	600 s	0.01

3.6 Time Delayed Measured Earth Fault Protection (51G)

One instantaneous time delayed measured earth fault element is provided in the 7SR45 self powered overcurrent and earth fault relay.

51G-1

51G-n Setting sets the pick-up current level.

A number of shaped characteristics are provided. An inverse definite minimum time (IDMT) characteristic is selected from IEC and ANSI using ***51G-n Char***. A time multiplier is applied to the characteristic curves using the ***51G-n Time Mult setting***. Alternatively, a definite time lag (DTL) can be chosen using ***51G-n Char***.

When DTL is selected the time multiplier is not applied and the ***51G-n Delay (DTL)*** setting is used instead.

The ***51G-n Reset*** setting can apply a **definite time delayed** reset, or when the operation is configured as an IEC or ANSI if the reset is selected as **IEC/ANSI (DECAY),** reset the associated reset curve will be used. The reset mode is significant where the characteristic has reset before issuing a trip output.

A minimum operate time for the characteristic can be set using ***51G-n MinOperate*** setting.

A fixed additional operate time can be added to the characteristic using ***51G-n Follower*** setting.

Operation of the time delayed measured earth fault elements can be inhibited by assigning binary inputs.

Inhibit 51G-n A binary input.

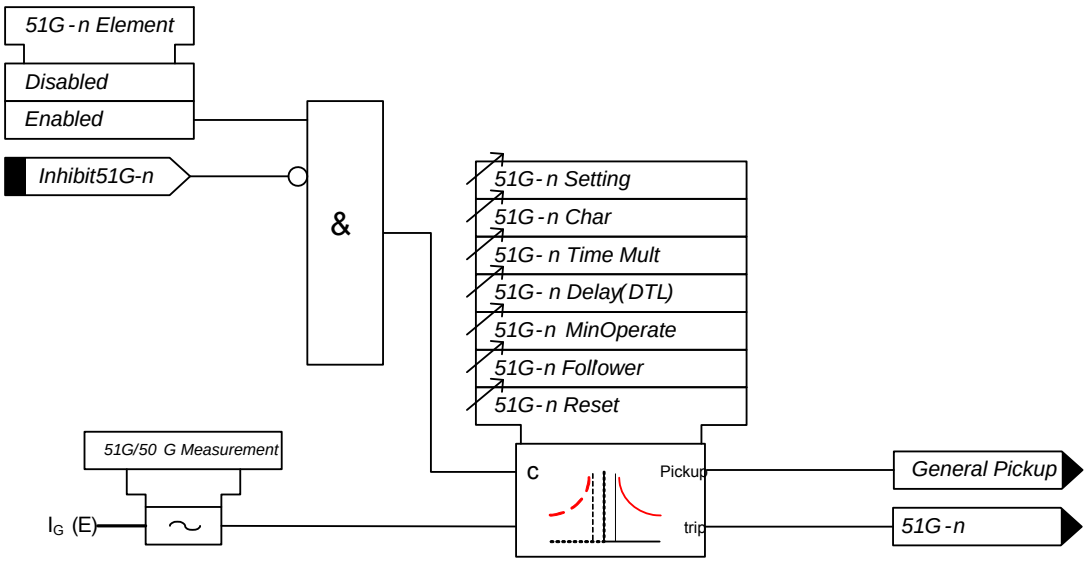


Figure 3-6 Logic Diagram: Measured Time Delayed Earth Fault Element

The following are the 51G-n supported Curve Characteristic:

- **DTL, IEC-NI, IEC-VI, IEC-EI, IEC-LTI, ANSI-MI, ANSI-VI, ANSI-EI**

Table 3-6 Instantaneous Measured Earth Fault Protection (51G-n)

Parameters	Description	Default Value	Min	Max	Step Change
51G-n Element	51G-1 Block	Disabled	-	-	-
51G-n Setting	Current Set point	0.5xIn	0.1xIn	0.80xIn	0.01
51G-n Char	Characteristics	DTL	-	-	-
51G-n Time Mult	Time Multiplier (other than DTL)	1	0.01	10	0.01
51G-n Delay	Delay (Applicable only for DTL)	5 s	0 s	15 s	0.01
51G-n Min Operate	Minimum Operate Time	0 s	0 s	20 s	0.01
51G-n Follower DTL	Follower DTL	0 s	0 s	20 s	0.01
51G-n Reset	Reset	0 s	0 s	60, IEC/ ANSI DECAY	0.01

3.7 Switch-On-To-Fault (50LC/SOTF)

SOTF provides high-speed tripping when the relay is energized with short-circuit current or fault current.

SOTF function monitors the 3-phase current for 10 AC cycles from the start-up of relay with CT power and trips when any fault is detected as per the user settings. After 10 AC cycle, SOTF will not monitor current and does not operate.

SOTF can be inhibited by assigning binary input.

Operation of the Switch-On-To-Fault elements can be inhibited from:

Inhibit 50LC A binary input.

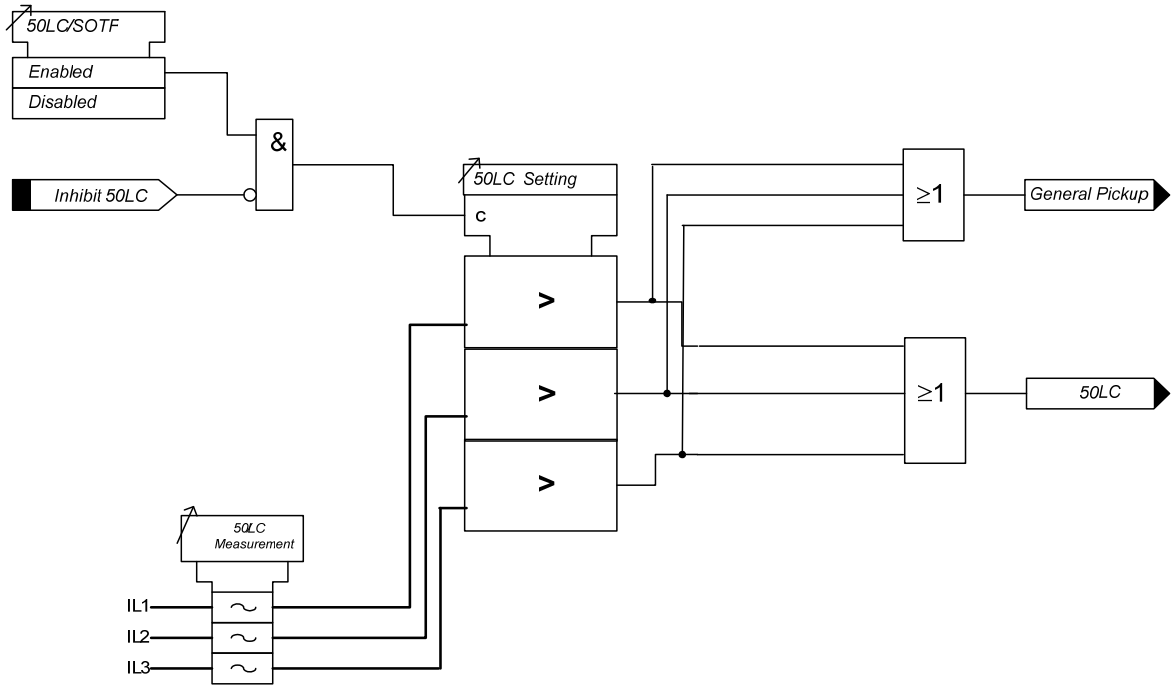


Figure 3-7 Logic Diagram: 50LC Overcurrent Element

Table 3-7 50LC/SOTF

Parameters	Description	Default Value	Min	Max	Step Change
50LC Setting	Current Set point	2	1xIn	20xIn	1

The following graphs show the SOTF operating time.

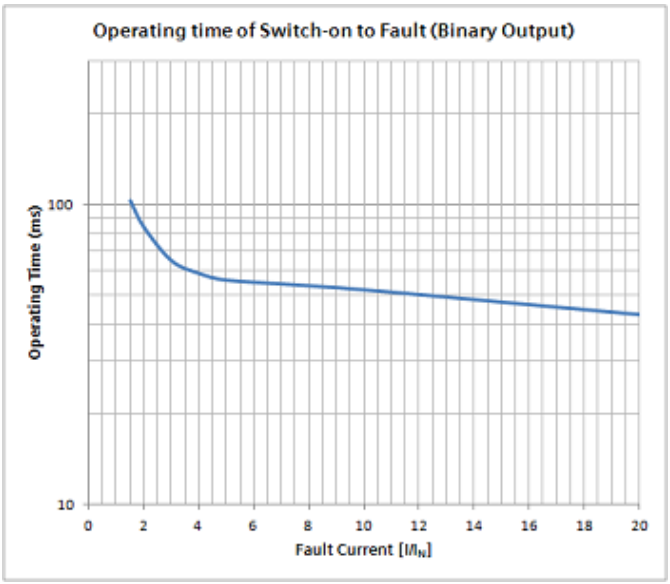


Figure 3-8 Operating Time for Single Phase Fault with Binary Output

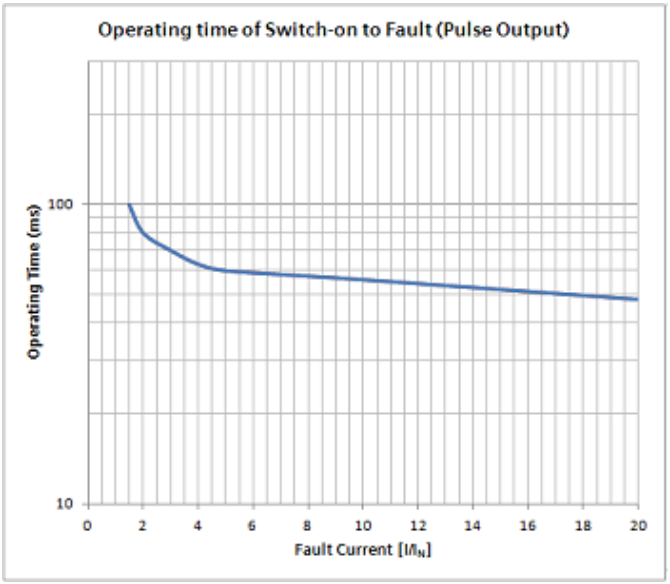


Figure 3-9 Operating Time for Single Phase Fault with pulse output

NOTE:

Multi-phase faults results to a shorter operating time.

3.8 General Alarm

General Alarms are user defined text messages displayed on the LCD when binary inputs are mapped and triggered.

Up to 2 general alarms of 16 characters can be configured, each triggered from one or more input. Each general alarm generates an event.

If multiple alarms are activated simultaneously, the last alarm messages will be displayed on the LCD.

All the fault trigger generated by general alarms are logged into the fault data record.

Table 3-8 General Alarm

Parameters	Description	Range	Default Value	Min	Max	Step Change
General Alarm-1	General Alarm-1	16 char (0-9, A-Z, +, -, /, SPACE)	Alarm1	-	-	-
General Alarm-n	General Alarm-n	16 char (0-9, A-Z, +, -, /, SPACE)	Alarm-n	-	-	-

3.9 Reset LEDs Outputs

Depending upon any binary output configuration set by the user to operate the protection function, if the protection functions detect any fault, binary output and LEDs operates and latched.

7SR45 self powered overcurrent and earth fault relay allows the user to reset binary outputs, LEDs, timers, and protection functions by using the RESET flag functionality.

The user can reset binary output/LEDs in anyone of the following methods:

- **TEST/RESET►** key
- **Binary Input**
- **Reydisp Software**

After successful reset of binary output and LEDs, the "FLAGS RESET" message appears on LCD and all LEDs glow and reset.

In CT power mode, LEDs test can be performed if the current is more than 0.4In (single phase) or 0.14In (three phase).

If the fault current persists, pop-up message appears on LCD “FAULT PERSISTS”.

3.9.1 Binary Input

In the INPUT MATRIX configuration, LEDs and outputs can be reset by configuring the binary input. The configuration can be executed with ReyDisp Evolution or Human Machine Interface (HMI).

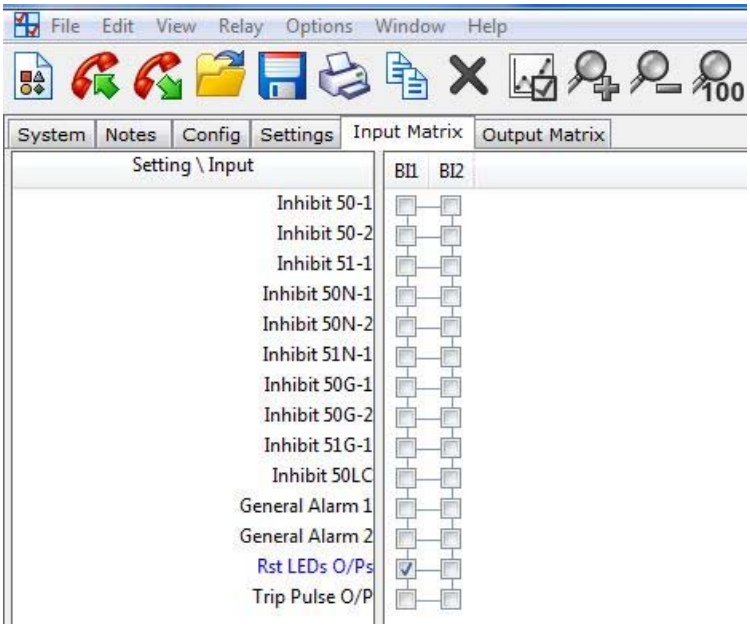


Figure 3-10 Reset LEDs Outputs: Reydisp Software Input Matrix

3.9.2 Reydisp Software

When the relay is latched, LEDs can be reset by sending an appropriate command over the data communications channels using Reydisp software.

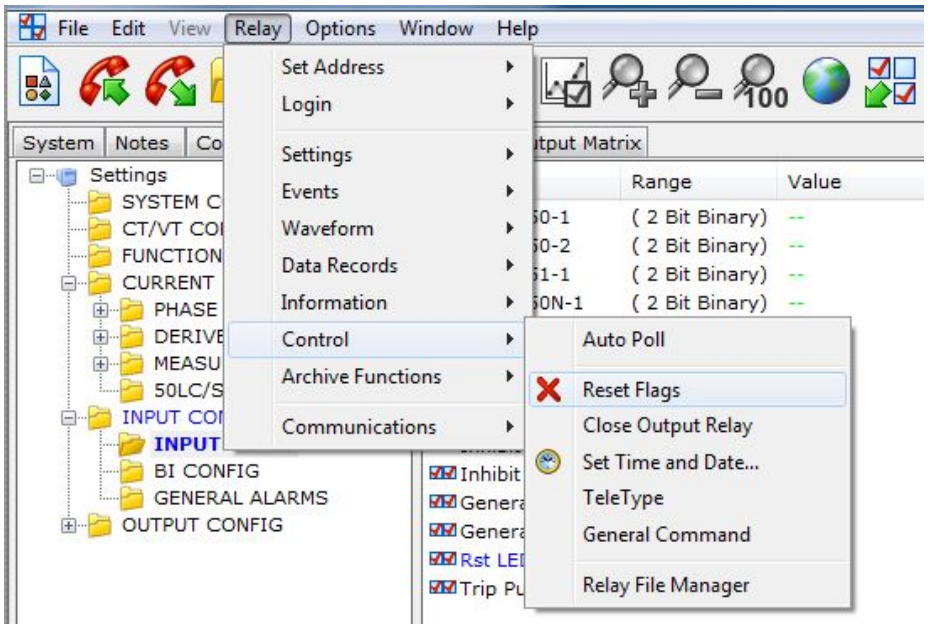


Figure 3-11 Reset Flags

In the Reydisp Evolution screen, navigate to **Relay > Control** and click **Reset Flags**.

3.9.3 TEST/RESET► Key

From the Relay Identifier Screen, reset the LEDs and outputs by pressing the TEST/RESET► key.

3.10 Current Inputs

4 current inputs are provided on the 7SR45 self powered overcurrent and earth fault relay. 3 current inputs are provided for measuring the phase currents and 1 current input is provided for measuring the ground current.

Based on the ordering option, current inputs are available for 1 A and 5 A variants.

7SR45 self powered overcurrent and earth fault relay consists of 1 built-in Power Current Transformer (PCT) and 1 built-in Measuring Current Transformer (MCT) for each phase current input. 1 MCT is provided on the ground current input.

Current is sampled at 800 Hz for both 50 Hz and 60 Hz system frequency. Protection and monitoring functions of the relay use the fundamental frequency component to calculate the RMS value of current.

The primary CT ratio used for the relay instruments can be set in the CT/VT configuration menu.

3.11 Binary Inputs

The binary inputs (BI) are opto-couplers operated from a suitably rated DC power supply.

Each BI can be configured to perform one or more of the relay functions.

The status of BI can be viewed via LCD or Reydisp Evolution software.

Binary input can be configured to operate the binary output or pulse output.

Relays are fitted with 2 binary inputs. The user can assign any binary input to any of the available functions such as inhibits, binary outputs, reset flags, and general alarms (INPUT CONFIG > INPUT MATRIX). Binary input can also be mapped to operate the pulse output in the presence of CT power.

Pick-up (PU) and drop-off (DO) time delays are associated with each binary input. Where no pick-up time delay has been applied the input may pick up due to induced AC voltage on the wiring connections (e.g. cross site wiring). The default pick-up time of 20 ms provides AC immunity. Each input can be configured independently.

Each input may be logically inverted to facilitate integration of the relay within the user scheme. When inverted the relay indicates that the BI is triggered when no voltage is applied. Inversion occurs before the PU & DO time delay.

Binary inputs can be configured for instantaneous operation from 19 V DC power supply by setting of 0 ms PU and 25 ms DO timers.

Each binary input can be assigned to any binary output. This allows the relay to provide panel indications and alarms.

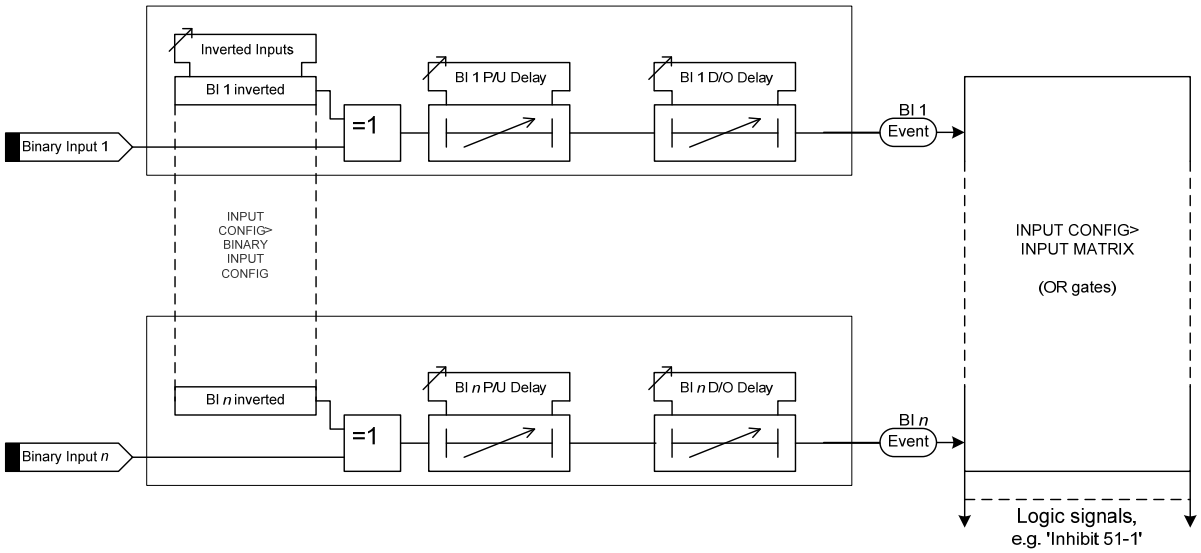


Figure 3-12 Binary Input Logic

Table 3-9 Binary Input

Parameters	Description	Default Value	Min	Max	Step Change
Inhibit 50-1	50-1 element block	-	-	1	-
Inhibit 50-2	50-2 element block	-	-	1	-
Inhibit 51-1	51-1 element block	-	-	1	-
Inhibit 50N-1	50N-1 element block	-	-	1	-
Inhibit 50N-2	50N-2 element block	-	-	1	-
Inhibit 51N-1	51N-1 element block	-	-	1	-
Inhibit 50G-1	50G-1 element block	-	-	1	-
Inhibit 50G-2	50G-2 element block	-	-	1	-
Inhibit 51G-1	51G-1 element block	-	-	1	-

Inhibit 50LC	50LC/SOTF element block	-	-	1	-
General Alarm-1	Display General alarm-1 text	-	-	1	-
General Alarm-2	Display General alarm-2 text	-	-	1	-
Rst LEDs O/Ps	Reset LED's and BO's	-	-	1	-
Trip Pulse O/P	Pulse output	-	-	1	-

Table 3-10 Binary Configuration

Inverted Inputs	Input Inversion	-	-	1	-
BI-1 Pickup dly	Pickup delay	0.020	0	600 s	0.01
BI-1 dropoff dly	Dropoff delay	0.000	0	600 s	0.01

3.12 Binary Outputs

7SR45 self powered overcurrent and earth fault relay consists of 2 binary output which can be configured to send commands to the switchgear units and annunciations for remote signalling of the important events and status.

3.12.1 Binary Output Matrix

Binary output can be assigned to any available functions under OUTPUT CONFIG > OUTPUT MATRIX menu.

3.12.2 Binary Output Configuration

If the binary output is configured for protection trip or binary input operations it will act as “hand reset”.

If the binary output is configured for other functions such as general pickup, protection healthy, and low battery, it will act as a self reset.

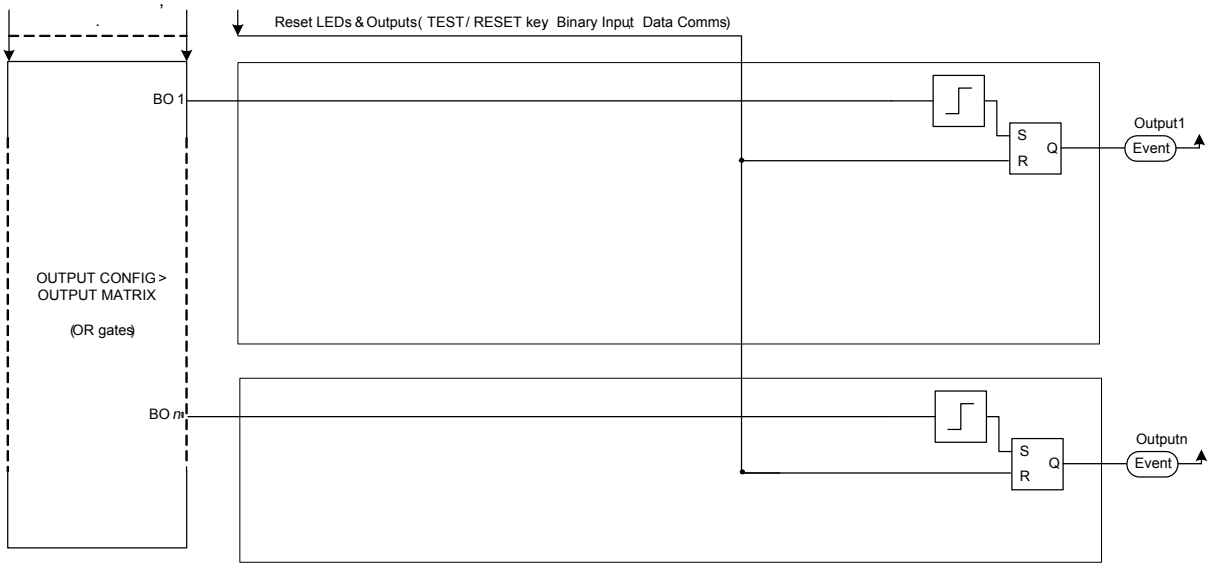


Figure 3-13 Binary Output Logic

Table 3-11 Binary Output

Parameters	Description	Default Value	Min	Max	Step Change
50-1	50-1 element operate	-	-	1	-
50-2	50-2 element operate	-	-	1	-
51-1	51-1 element operate	-	-	1	-
50N-1	50N-1 element operate	-	-	1	-
50N-2	50N-2 element operate	-	-	1	-
51N-1	51N-1 element operate	-	-	1	-
50G-1	50G-1 element operate	-	-	1	-
50G-2	50G-2 element operate	-	-	1	-
51G-1	51G-1 element operate	-	-	1	-
50LC	50LC/SOTF element operate	-	-	1	-
General Pickup	Pickup detected	-	-	1	-
Prot'n Healthy	Protection Healthy	-	-	1	-
Low Battery	Battery Volts low indication	-	-	1	-
BI1 Operated	BI-1 operated	-	-	1	-
BI2 Operated	BI-2 operated	-	-	1	-

3.13 Binary Output Operation

Relay reset can be performed from the **Relay Identifier Screen > TEST/RESET►** key.

If the fault current persists and if the user presses **TEST/RESET►** key, the pop-up message appears, *"**Fault persists**"*

Based on the availability of power source, the flag can be reset by using any one of the following conditions:

3.13.1 BO Trip/Reset on Battery Power and USB Power

In this mode, the relay uses the power from battery to operate/reset the binary output and takes approximately 4 s to perform the action.

The relay does not perform any actions. If consecutive commands are provided within 4 s and displays a pop-up message on HMI as:

"***Insufficient Energy***".

3.13.2 BO Trip/Reset on CT Power

In this mode, the relay uses the power from CT to operate/reset the binary output instantaneously.

If the relay is operating on CT power and if the current threshold set by the user is less than the current setting value of any protection functions, the binary outputs reset instantly.

3.14 Pulse Output

The pulse output is used to interface directly with the low energy circuit breaker tripping coil directly. The pulse output provides 24 V, 0.1 Ws pulses of 50 ms ON and 500 ms OFF. The OFF duration can vary based on the magnitude of the fault current.

The pulse output operates when any protection function trips. The trip energy for the trip coil is stored by a capacitor built into the protection relay. The capacitors are charged by the current input. The pulses are repeated till the threshold exceeded. Pulse output does not require any mapping with protection functions.

In the presence of CT power, pulse output can be operated by mapping to a binary input. The pulse output operates and **Trip LED** glows when the assigned binary input is triggered. Pulse output is provided till the current is available. The pulse output can be reset by performing reset flags.

3.15 Modes of Operation

7SR45 self powered overcurrent and earth fault relay operates in the following priority and modes:

- CT Power
- USB Power
- Battery Power

7SR45 self powered overcurrent and earth fault relay is powered primarily from CT power even though all the power sources such as USB, battery power are available. When CT power is not available (<0.2xIn) and if both the USB and battery power are available, the relay uses the power from USB.

If both the USB and CT power are not available, the relay uses power from the battery.

3.15.1 CT Power

All the protection and measurement algorithms are active only when the 7SR45 self powered overcurrent and earth fault relay is powered by CT. The binary outputs and pulse output can be operated with CT power.

3.15.1.1 Sensitivity

Sensitivity of the relay is the minimum phase current required for the relay to energize, detect a fault and trip as per the configuration.

The sensitivity of 7SR45 Self Powered Overcurrent and Earth Fault Relay is 0.20xIn nominal current in single phase and 0.13xIn nominal current in three phases.

This minimal current limit is necessary for healthy functioning of the relay. The PROTECTION HEALTHY and TRIP READY LEDs must be ON.

The following graphs show the sensitivity of the relay and corresponding operating time for different start up currents.

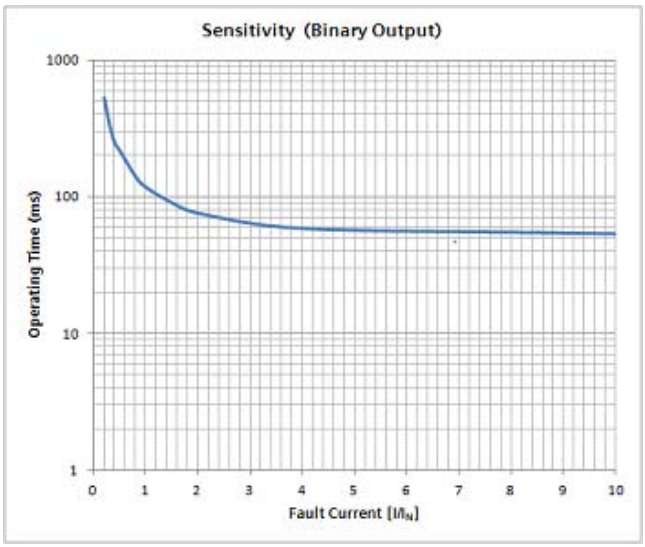


Figure 3-14 Sensitivity for Single Phase Fault with Binary Output

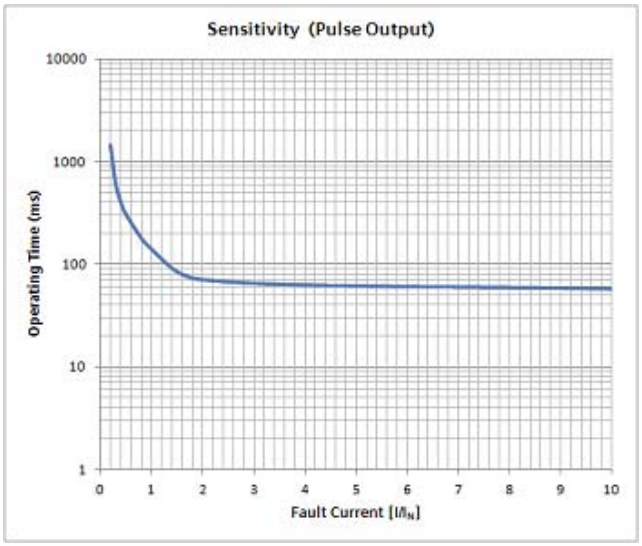


Figure 3-15 Sensitivity for Single Phase Fault with Pulse Output

NOTE:

Multi-phase current will improve the sensitivity.

3.15.2 USB Power

In the USB mode, even though protection functions are inactive, all the settings can be edited. Both the binary input and binary output are operational in the USB power mode. The pulse output cannot be operated with USB power.

3.15.3 Battery Power

In the battery mode, even though protection functions are inactive, all the settings can be edited. Both the binary input and binary output is operational in the battery power mode. The pulse output cannot be operated with battery power.

The battery power is used to operate 7SR45 self powered overcurrent and earth fault relay only when both CT power and USB power are not available.

In the battery mode, the relay is energized by pressing the **BAT ON/OFF** key or if any binary input status is changed.

In the battery power mode, if no keys are pressed for 60 s, the relay goes to sleep mode automatically.

By default, in the battery mode, the backlight is OFF.

3.15.4 Sleep Mode

Sleep Mode is active when the CT power and USB power are not available. When the relay is in sleep mode, the user can access the LCD by pressing the battery key.

When the relay is powered by CT and any fault condition occurs, the relay goes to sleep mode after 60 s if the current supply is disconnected due to trip.

When the relay is powered by USB, the relay goes to sleep mode immediately if the USB cable is removed.

When the relay is powered by battery, the relay goes to sleep mode if the **BAT ON/OFF** key is pressed or if the inactive time of 60 s is elapsed.

3.15.5 Low Battery Indication

Low battery LED indication is displayed when the battery voltage falls below 2.0 V. In the low battery condition, if the relay starts, the LCD displays as "**INSUFFICIENT ENERGY**" and goes back to sleep mode.

In the low battery mode, the backlight will not TURN ON.

Low battery can be mapped to a binary output and can be used for remote signalling.

3.16 Maintenance Mode

3.16.1 Output Test

The output test allows the user to operate the output relays.

Any functions assigned in binary output matrix (except protection healthy) will appear in the output test.

The output tests will operate only for the binary outputs which are assigned to that function.

3.17 Self Monitoring

The relay incorporates a number of self-monitoring features.

Supervision includes monitoring of power supply signals, code execution watchdog, memory checks by checksum, RTC check and battery health checks. The '**Protection Healthy**' LED is illuminated when the internal power supply signals are healthy.

Self monitoring is performed when the relay boots and runs periodically for every 5 minutes.

3.18 Data Storage

The relay stores two types of data: **Fault Records**, **Event records**.

Data records are stored in the non-volatile memory. The data storage menu contains the settings for clearing events and faults.

3.18.1 Fault Records (Trip Log)

Fault records are triggered when the protection function detects a fault condition and the trip alert message appears on LCD to indicate a new fault has occurred. Up to 10 fault records can be stored and displayed on the fascia LCD.

Fault records provide a summary of relay status when the trip occurs, i.e. element issued the trip, any phase/earth picked up, fault magnitude, LED indications, general alarm, and date and time.

Trip alert message is displayed until the fault is acknowledged by the user.

When analyzed the event records and the fault records provide the full sequence of events that resulted to a trip.

Fault records are stored in a rolling buffer with the oldest faults overwritten. The fault storage can be cleared with the DATA STORAGE/Fault Storage > "Clear Faults" setting in HMI.

3.18.2 Event Records (Event Log)

The event recorder feature allows the time tagging of any change of state (Event) in the relay. When an event occurs, the actual event condition is logged as a record with a date and time stamp to a resolution of 1 ms. The relay can store maximum of 100 event records. When the event buffer is full and any new record will overwrite the old records.

Stored events can be erased by using the DATA STORAGE > ***Clear Events*** setting in HMI or from Reydisp.

The following events are logged:

- Change of state of binary outputs
- Change of state of binary inputs
- Change of settings
- Device start up and shut down
- Protection element operation
- Low battery
- General alarm

All events can be uploaded over the data communications channel(s) and displayed in the 'Reydisp' package in chronological order and viewed in the sequence of events.

3.19 Real Time Clock

Time and date can be set either via the relay fascia using appropriate commands in the System Config menu or using Reydisp software. When the relay is de-energized, time and date are maintained by CR1632, 3 V 140 mAh Li/MnO2 coin cell battery.

The relay can be synchronized to the nearest second or minute using the Reydisp software. The device can have a drift of ±5 s/day.

The default date is set as 01/01/2014 to indicate that the date is not set. In the relay, only the hours and minutes can be edited. When the user presses ENTER after editing the seconds, seconds is set to zero and the clock starts.

3.20 Battery

7SR45 self powered overcurrent and earth fault relay consists of CR123A, 3 V 1400 mAh Li-Mn non rechargeable battery. The battery is used to energize the device when CT power/USB power is not available. The user can perform actions such as viewing the fault records, setting change, and resetting the flags with battery power.

3.21 Firmware Update

In 7SR45 self powered overcurrent and earth fault relay, firmware can be updated by performing the following procedure:

1. Connect the relay to a local PC using a USB cable.
2. Run the valid **executable** file from the local PC.
   The application detects the connected relay and updates the firmware.
   If any failure occurs, a message appears automatically in the PC application.
3. After successful update, the relay restarts.

Do not disconnect the USB when the firmware update is in progress. If the firmware update is terminated intermittently, it may corrupt the existing firmware in the relay and the relay may stop from working

7SR45

Settings & Instruments

Document Release History

This document is issue 2015/08. The list of revisions up to and including this issue is:

2015/08	First Issue

Software Revision History

2015/08	2438H80001R1a-1a	First Release

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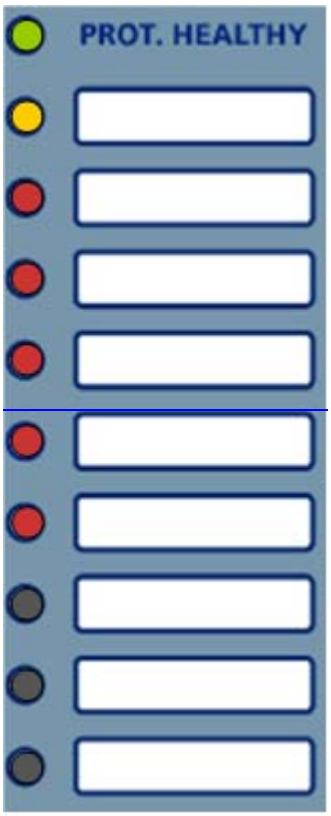

1.1 Relay Menus

1. **Setting Mode** – This mode allows the user to view and change settings in the relay.
2. **Instrument Mode** – This mode allows the user to view the conditions of the relay i.e. Current and IO status.
3. **Fault Data Mode** – This mode allows the user to view fault records.

   If the password is configured, the user can only view all the menus without entering a password. Further actions are permitted if the correct password is entered.

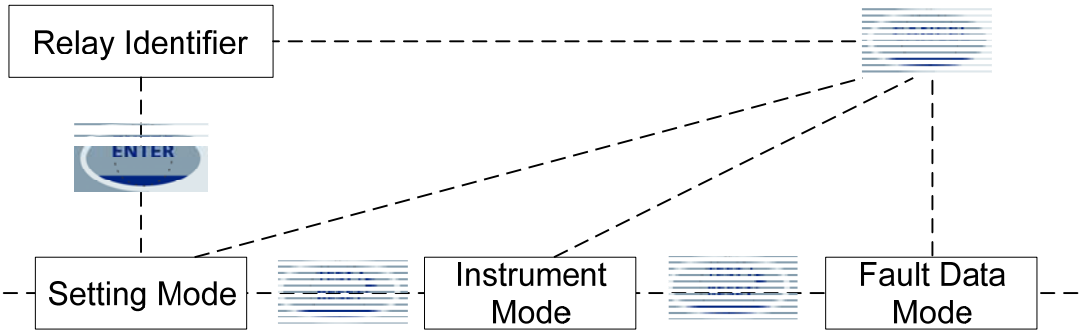

Figure 1-1 Menus

1.2 Operation Guide

1.2.1 User Interface Operation

Figures 1.3 show the basic menu structure diagram and display the main modes:

- SETTING MODE
- INSTRUMENT MODE
- FAULT DATA MODE

When the relay is shipped from the factory all stored data is cleared and the password is set to NONE.

When the relay is energized for the first time, the following message is displayed:

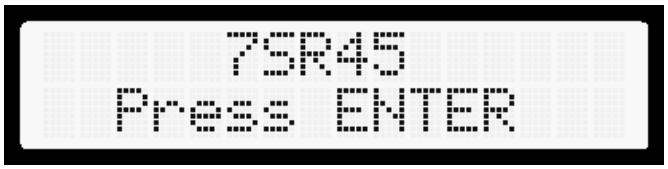

Figure 1-2 Relay Identifier Screen

1.3 Setting Mode

The Setting Mode is reached by pressing the READ DOWN▼ or by pressing ENTER key from the Relay Identifier Screen.

Once the Setting Mode is reached, the user can navigate into the settings mode sub-menus.

Each sub-menu contains the configurable settings of the relay in separate groups. The sub menus are accessed by pressing the TEST/RESET► key. Press ▲ or ▼ keys to scroll through the first and last settings. If the keys are pressed further from the first and last settings sub menu, it exits from the sub menu and returns to the previous menu.

Press ENTER key to edit the setting value. If the relay setting is password protected, the user is prompted to enter the password. After entering the correct password, the user is allowed to configure the settings. If an incorrect password is entered, editing is not permitted. The user can view and navigate to all screens without knowing password.

When a setting is edited, flashing characters indicate the edit field. Press the ▲ or ▼ key to scroll through the valid field values. Hold the ▲ or ▼ keys to increase the rate of scrolling. To navigate between the digits of the setting values, press TEST/RESET► key.

Once the setting is updated by the user, press the CANCEL key to return to the Relay Identifier screen. The LCD displays the "**Save & Restart"** prompt message. Press ENTER to store the setting in non-volatile memory and the relay will restart. Press CANCEL key to discard the changed settings.

1.4 Instrument Mode

The Instrument Mode sub-menu displays the current values, status of binary inputs and binary outputs. The following meters are available and are navigated by using the ▲, ▼, and **TEST/RESET►** keys.

INSTRUMENT	**DESCRIPTION**
CURRENT METERS →to view	This sub-group includes all the meters that are associated with current. TEST/RESET► key allows access to sub-group. The values of current automatically refreshes at every 1 s interval.
Primary Current Ia 0.00A Ib 0.00A Ic 0.00A Ig 0.00A In 0.00A	Displays the primary RMS values of 3 phase currents, measured and derived earth currents.
Secondary Current Ia 0.00A Ib 0.00A Ic 0.00A Ig 0.00A In 0.00A	Displays the secondary RMS values of 3 phase currents, measured and derived earth currents.
BINARY I/p METERS →to view	Binary Input Meter displays the status of the binary input signals. TEST/RESET► key allows access to sub-group. The values of binary input status refreshes at every 1 s interval.

BI 1-2 _ _	Displays the state of DC binary input 1 and binary input 2. If status is "_" the value is zero. If status is "1" the value is one.
BINARY O/p METERS →to view	Binary Output Meter displays the status of the binary output signals. TEST/RESET► key allows access to sub-group. The values of BO status refreshes at every 1 s interval.
BO 1-2 _ _	Displays the state of binary output 1 and binary output 2. If status is "_" the value is zero. If status is "1" the value is one.

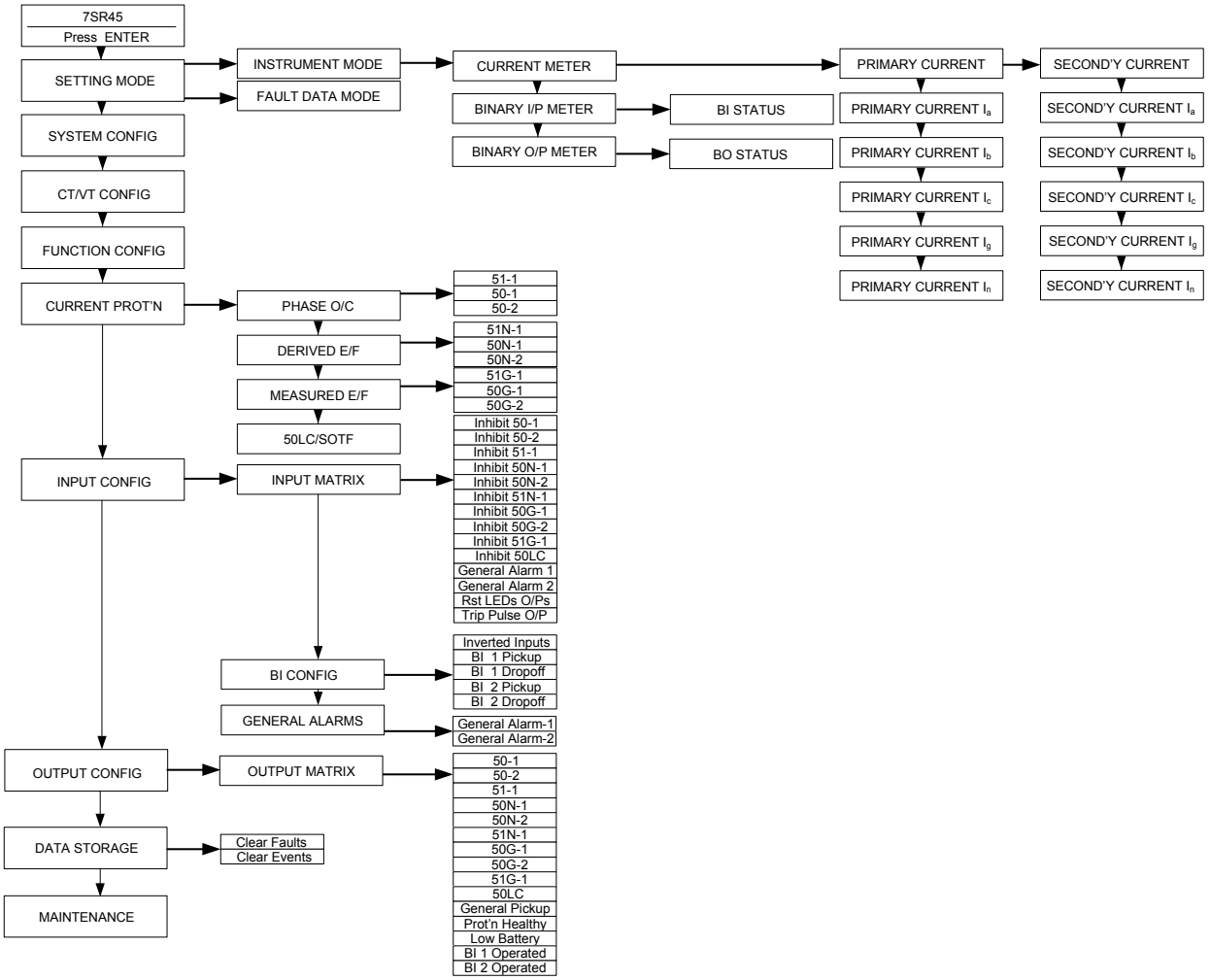

Figure 1-3 Menu Structure

1.5 Fault Data Mode

7SR45 self powered overcurrent and earth fault relay stores maximum of 10 fault records. Each stored fault data can be viewed by pressing the TEST/RESET► key. Each record contains data of the operated elements, analogue values, and LED status at the time of the fault. The data is viewed by scrolling down using the▼ key.

7SR45

Performance Specification

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Section 1: Performance Specification

1.1 Indication of Conformity

Low Voltage Directive:

2006/95/EC Directive of the European Parliament and of the Council of 12 December 2006 on the harmonisation of the laws of Member States relating to electrical equipment designed for use within certain voltage limits (***until 19.04.2016***)

2014/35/EU Directive of the European Parliament and of the Council of 26 February 2014 on the harmonisation of the laws of the Member States relating to the making available on the market of electrical equipment designed for use within certain voltage limits; Official Journal of the EU L96, 29/03/2014, p. 357–374 (***from 20.04.2016***)

CE

EMC Directive:

2004/108/EC Directive of the European Parliament and of the Council of 15 December 2004 on the approximation of the laws of the Member States relating to electromagnetic compatibility (***until 19.04.2016***)

2014/30/EU Directive of the European Parliament and of the Council of 26 February 2014 on the harmonisation of the laws of the Member States relating to electromagnetic compatibility; Official Journal of the EU L96, 29/03/2014, p. 79–106 (***from 20.04.2016***)

1.2 Technical Specifications

This section provides the technical information of 7SR45 Self Powered Overcurrent and Earth Fault Relay.

Table 1-1 Technical Data Overview

` Product Family (Self powered)	Non Directional Self Powered Overcurrent and Earth Fault Relay
Case and LEDs	Non draw-out polycarbonate case (Size 4 standard, Non draw-out design), 9 fixed function LEDs
Measuring Inputs (Current)	1 A or 5 A (ordering option), 50 Hz/60 Hz
Communication	Front communication port (works with Reydisp Evolution)
Protection Functions	50, 50G/N, 51, 51G/N, 50LC/SOTF
Binary Input and Binary Output	2 BI and 2 BO
Pulse output	24 V, 0.1 Ws pulse output
Overvoltage	Category III
Pollution Degree	2

Table 1-2 Sensitivity

Minimum current for relay operation	0.20xIn of nominal current in single phase 0.13xIn of nominal current in three phases

Table 1-3 Mechanical Specifications

Design	Panel mounting, Non draw-out polycarbonate moulded case
Enclosure	IP 52 (front panel) IP 40 (enclosure sides) IP 20 (rear side) Depth is 203 mm
Weight	1.8 kgs (appx)

Table 1-4 Terminal Blocks

Current Inputs	8 position (Terminal X5), M4 Screw-type Barrier Terminal block suitable for 2.5 mm^2/4 mm^2 cable
Binary Input	4 position (Terminal X1), M3 screw-type plug-in terminals suitable for 2.5 mm^2 cable
Binary Output	6 position (Terminal X2), M3 screw-type plug-in terminals suitable for 2.5 mm^2 cable
Pulse Output	2 position (Terminal X2), M3 screw-type plug-in terminals suitable for 2.5 mm^2 cable
Front Port	USB, Type B
Ground Terminal	M3 ring type terminals suitable for 2.5 mm^2/4 mm^2 cable

Table 1-5 Current Inputs

Quantity	3 x Phase and 1 x Earth
Rated Current In	1 A or 5 A (ordering option)
Measuring Range	0.2xIn to 20xIn
Instrumentation	> 0.13xIn to 2xIn ± 5 % (Typical) > 2xIn to 20xIn ± 3%
Frequency	50 Hz (Range: 45 Hz to 55 Hz) 60 Hz (Range: 54 Hz to 66 Hz)
Thermal Withstand: Continuous 1 second	 2xIn 50 A (1 A) 150 A (5 A)
Burden @ In	≤ 3.0 VA per phase and ≤ 0.2 VA earth for 1 A ≤ 3.5 VA per phase and ≤ 0.2 VA earth for 5 A

Table 1-6 Binary Inputs

Number	2	
	19 V DC	19 V - 110 V DC
Maximum DC current for operation 19 V - 110 V DC	3.0 mA	
Pick Up Delay	User selectable 0 to 600 s (up to 10 minutes)	
Drop Off Delay	User selectable 0 to 600 s (up to 10 minutes)	

Table 1-7 Binary Outputs

Number	2 (1 NO contact and 1 C/O contact)
Operating Voltage	Voltage Free
Operating Mode	Latched
Operating Time from energizing Binary Input	< 20 ms
Making Capacity: Carry continuously Make and carry (L/R ≤ 40 ms and V ≤ 300 V)	 5 A AC or DC 20 A AC or DC for 0.5 s 30 A AC or DC for 0.2 s
Breaking Capacity (≤ 5 A and ≤ 125 V DC, 250 V AC): AC Resistive AC Inductive DC Resistive DC Inductive	 1250 VA 250 VA at p.f. ≤ 0.4 75 W 30 W at L/R ≤ 40 ms 50 W at L/R ≤ 10 ms

Table 1-8 Front Communication Port

Quantity	1
Electrical connection	USB, Type B

Table 1-9 Data Storage

Fault Record	10 records
Events	100 events (1 ms resolution)

Table 1-10 Environment

Altitude above sea level	Maximum upto 2000 m

1.3 Environmental Performance

This section describes about the environmental tests performed with 7SR45 Self Powered relay under different conditions.

Table 1-11 Mechanical Tests

Type Test	**Reference**	**Requirement**
Vibration	IEC60255-21-1	Class 1 (Endurance 1G, Response 0.5G)
Shock and Bump	IEC 60255-21-2	Shock response, Class I Shock withstand, Class I Bump, Class I
Degree of Protection	IEC 60529	IP52 front IP20 back
Seismic	IEC 60255-21-3, Class I	In single axis sine sweep in X-axis Sweep (@a sweep rate of 1 octave/min) vibration in the frequency range (1 Hz - 35 Hz) at amplitude of 3.5 mm or 1.0 gn (whichever is less)

Type Test	Reference	Requirement
		In single axis sine sweep in Y-axis: sweep (@a sweep rate of 1 octave/min) vibration in the frequency range (1 Hz - 35 Hz) at amplitude of 1.5 mm or 0.5 gn (whichever is less)
Contact	IEC 60255-1 (Ref: Std IEC 61810-1)	Making capacity, Make and carry capacity, Breaking capacity
Electrical Endurance Test	IEC 60255-1 (Ref: Std IEC 61810-1)	10000 operations at 250 V, 5 A

Table 1-12 Electrical Tests

Type Test	Reference	Requirement
Insulation Resistance	IEC 60255-27#	Insulation resistance >100 M Ohms at 500 V DC Test Duration: > 5 s
Impulse Voltage Withstand	IEC 60255-27#	5 kV, 1.2/50 µs, 0.5 J 5 +ve, -ve pulses Between all terminals and case earth and any two independent circuits.
Hi Voltage (Dielectric) Voltage	IEC 60255-27#	• All case terminals connected together 2.0 kV AC RMS, 50 Hz, 1 min between terminals of independent circuits • 1.0 kV AC RMS, 1 min across normally open contacts
High Frequency Disturbance	IEC 60255-26	• Common-mode test voltage: 2.5 kV • Differential test voltage: 1.0 kV • Test duration: 2 s • Source impedance: 200 Ω
Electrostatic Discharge	IEC 60255-26	• 8 kV air discharge • 6 kV contact discharge
Electrical Fast Transient or Burst	IEC 60255-26, Zone B	Test severity Amplitude: 2 kV, 5 kHz
Surge Immunity	IEC 60255-26, Zone B	Time to half-value: 1.2/50 µs • Amplitude: 4 kV between all groups and case earth (CM) • Amplitude: 2 kV between terminals of each group (DM)
Radiated Immunity	IEC 60255-26	Test field strength, frequency band 80 MHz to 1.0 GHz and 1.4 GHz to 2.7 GHz: 10 V/m, Test using AM: 1 kHz/80 %
Conducted Radio Frequency Interference	IEC 60255-26	150 kHz to 80 MHz 10 V
Power Frequency Magnetic Field	IEC 60255-26	30 A/m applied continuously, 300 A/m applied for 3 s
Radiated Emissions	IEC 60255-26 CISPR 11, Class A	30 MHz - 230 MHz, 40 dB µ V/m at 10 m measurement distance 230 MHz - 1 GHz, 47 dB µ V/m at 10 m measurement distance

Type Test	Reference	Requirement
Thermal Withstand Continuous	IEC 60255-27 IEC 60255-1	**1s:** 2 x In 50 A (1 A) 150 A (5 A) **Burden:** ≤ 3.0 VA per phase and ≤ 0.2 VA earth for 1 A ≤ 3.5 VA per phase and ≤ 0.2 VA earth for 5 A
Functional	IEC 60255-3	for both 1 A and 5 A CTs
Maximum Allowable Temperature	IEC 60255-6	Max. temperature limit +100° C

NOTE: All aspect of IEC 60255-5 have been covered under IEC 60255-27

Table 1-13 Climatic/Environmental Tests

Type Test	Reference	Requirement
Ambient Operating Temperature	IEC 60068-2-1, IEC 60068-2-2	-10°C to + 60°C
Permissible Temporary Operating Temperature, (Tested for 16 h)	IEC 60068-2-1, IEC 60068-2-2	-40°C to + 70°C
Permissible Temporary Operating Temperature, (Tested for 96 h)	IEC 60068-2-1, IEC 60068-2-2	-20°C to + 70°C
Cold test - Operational test Cold test - Non-operational storage test	IEC 60068-2-1	-10°C, 96 h -25°C, 16 h
Dry heat test Operational Dry heat test Non-Operational, Storage	IEC 60068-2-2	+60°C, 96 h +70°C, 16 h
Damp heat test, Steady State	IEC 60068-2-78	4 days at 95% RH, +40°C
Damp heat test, cyclic	IEC 60068-2-30	(+25…55°C, R.H. > 93%) 6 cycles

NOTE:

Cold test at -40°C:

The device was kept in non-energized condition at -40° C for 16 hours. Energized at the end of 16 hours (@ -40°C) and accuracy test was performed and found to be within limits. The LCD was blank at -40°C.

After accuracy test at -40° C, temperature was ramped up to room temperature and accuracy test was found within limits.

Table 1-14 Product Safety Test

Type Test	Reference	Parameters	Values
Clearances and Creepage Distances	IEC/EN 60255-27: Edition 2: 2013-10	Clearances and creepage distances between external circuits mutual and to the enclosure	≥ 4 mm
IP Rating	IEC/EN 60255-27: Edition 2: 2013-10	For Unit Front side	IP52
		For Unit Rear side	IP20
Impulse Voltage	IEC/EN 60255-27: Edition 2: 2013-10	5 kV, 5 +ve, -ve pulses	
AC Dielectric Voltage	IEC/EN 60255-27: Edition 2: 2013-10	Test voltage (AC): 2 kV	After test, the relay should be operative (Reinforced Insulation with communication circuit)
		Test frequency: 50 Hz	
		Test duration: 1 min	
Insulation Resistance	IEC/EN 60255-27: Edition 2: 2013-10	Test voltage: 500 V DC	> 100 M ohm
		Test duration: > 5 s	
Protective Bonding Resistance	IEC/EN 60255-27: Edition 2: 2013-10	Test voltage: < 12V AC/DC	
		Test duration: 1 min	
		Bonding resistance	< 0.1 Ohm
Protective Bonding Continuity	IEC/EN 60255-27: Edition 2: 2013-10	Accessible conductive parts should be bonded with the protective conductor terminal	Low current continuity test
Flammability of Insulating Materials, Components and Fire enclosures	IEC/EN 60255-27: Edition 2: 2013-10	Structure Part	Standard for insulating material of flammability class
		Terminals	Class UL 94 V-0
		Terminal Mounting	Class UL 94 V-0
		Wiring (CT)	(N)2GFAF (VDE)
		Components mounting	Class UL 94 V-0
		Enclosure	Class UL 94 V-0
		PCB	Class UL 94 V-0
		LCD	Class UL 94 V-0

Type Test	Reference	Parameters	Values
Single Fault Condition	IEC/EN 60255-27: Edition 2: 2013-10	Assessment of: • Insulation between circuits and parts • Compliance with requirements for protection against the spread of fire • Overloads • Intermittently rated resistors • Compliance with requirements for mechanical protection	The equipment shall not present a risk of electric shock or fire after a single-fault test.

Table 1-15 Real Time Digital Simulation Test (RTDS)

Trip Response at different fault currents	Fault Current: 1.1, 2, 3, 5, 10 times of set value
Influence on Accuracy	**Influence of DC components** DC content at first peak : 100% Decay time: 25 ms, 50 ms, 100 ms
	Immunity to inrush current 2nd harmonic content : up to 28%
	Relay behaviour at primary CT saturation Fault currents: 10 A, 20 A, 40 A
Trip response at recurring faults	Fault Current: 2 times and 5 times of set value. Delay between recurring faults: 300 ms, 1 s, 2 s

Table 1-16 Inrush Response Test

Test Conditions	Simulated Inrush current with 15 % 2nd harmonic content
Test Result	The relay does not operate until fault current peak reaches 3 times the setting value

1.4 Performance Specification

This section describes about the settings available for different protection functions and its tolerance limits.

Table 1-17 50 Instantaneous & DTL OC & EF

Operation	Non directional
Elements	Phase, Derived Earth, Measured Earth
Setting Range Is (50/50N/50G)	1,2,...20xIn
Time Delay	0,0.01,....600 s
Operate Level I_{op}	100% Is, ±5%
Reset level	≥ 94 % I_{op}
Basic Operate time (with load current) 50, 50G 50N	 2xI_S 25 ms, ±15 ms, 5xI_S 20 ms, ±15 ms

Operate time delay	Tbasic+Td, ± 1% or ± 30 ms
Inhibited by	Binary Input

Table 1-18 51 Time Delayed OC & EF

Operation	Non directional
Elements	Phase, Derived Earth, Measured Earth
Setting Range Is (51)	0.2, 0.21… 2.0xIn
Setting Range Is (51G, 51N)	0.1,0.11… 0.8xIn
Time Multiplier	0.01 to 10
Time Delay (DTL)	0 s - 15 s
Operate Level	110% Is, ±5% or ±2%x In
Reset level	≥90 % Iop
Minimum Operate time ((with load current) IEC ANSI	$t_{op} = \frac{K}{\left[\frac{I}{Is}\right]^{\alpha} - 1} \times Tm$ $t_{op} = \left[\frac{A}{\left[\frac{I}{Is}\right]^{p} - 1} + B\right] \times Tm$ ± 5% or ± 50 ms
Follower Delay	0 s - 20 s
Reset	IEC/ANSI decaying, 0 s- 60 s
Inhibited by	Binary Input

Table 1-19 50LC/SOTF

Operate level	100% Is, ±5%
Setting range	1,2,....20xIn

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Installation Guide

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Section 1: Installation Guide

1.1 Installation

Execute the following procedure to install the 7SR45 Self Powered Overcurrent and Earth Fault Relay:

1. Create a slot of dimensions as shown in Figure 1-2 to house the relay in the protection panel.
2. Flush the rear-side of relay into the protection panel cut-out.
3. Fasten the relay using the four M4x20 Pan Phillips SS screws with nut provided in the 7SR45 packing box to the protection panel/cubicle.
4. Carry-out all other installation steps/wiring internally from the protection panel.
5. In the rear terminal of the relay, execute the wiring process as mentioned in scheme requirements. Refer figure for more details about the terminal connector diagram. Refer the Table 1-1 for the recommended terminal lugs to be used.
6. The earthing cable should be wired using a non-stranded cable of 2.5 mm^2/4 mm^2 and this should be terminated in the shortest possible path to the earth terminal/bus bar in panel or cubicle.
7. Maintain a minimum clearance from the relay as given in Figure 1-1 to ensure safety and accidental touch of terminals. In case of work area is restricted in a cubicle, then suitable protective terminals to be provided in the cubicle.

NOTE:

The earthing point (E) of auxiliary supply is connected to the ground (GND) point of the relay. The earth connection of relay casing should be solidly connected to the panel earth.

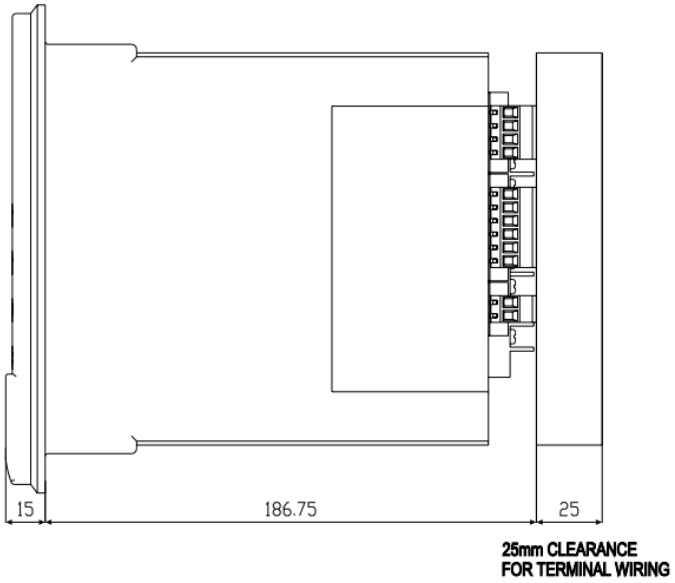

Figure 1-1 7SR45 Clearance for Terminal Wiring

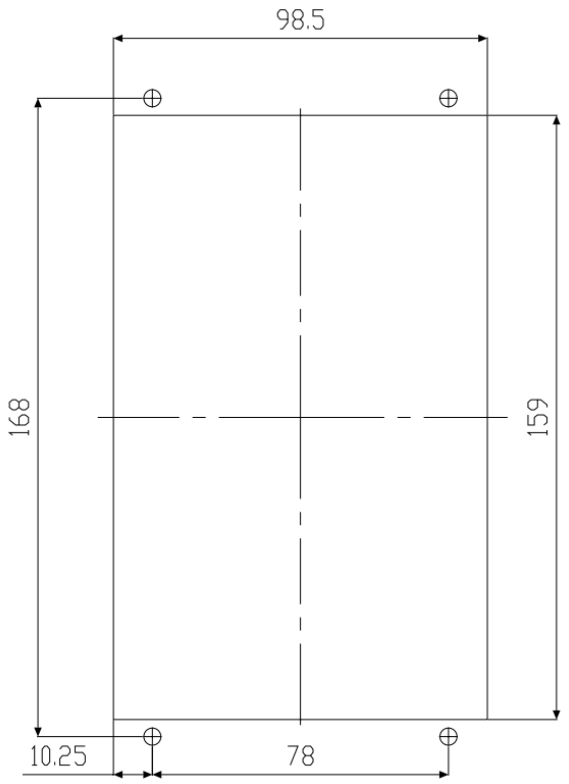

Figure 1-2 Panel cut-out

Table 1-2 Recommended Terminal Lugs Specifications

Terminal Blocks	Type/Cable Specifications	Manufacturer/Part number
Current Inputs (Terminal X5)	8 position, M4 Screw-type Barrier Terminal block suitable for 2.5 mm^2/ 4 mm^2 cable	Dowell's/RS009 or equivalent
Front Communication Port	USB, Type B	Tyco/974329-1 or equivalent
Binary Input (Terminal X1)	4 position, M3 screw-type plug-in terminals suitable for 2.5 mm^2/ 4 mm^2 cable	Dowell's/CP9/CP1 or equivalent
Binary Output (Terminal X2)	6 position, M3 screw-type plug-in terminals suitable for 2.5 mm^2/ 4 mm^2 cable	Dowell's/CP9/CP1 or equivalent
Pulse Output (Terminal X3)	2 position, M3 screw-type plug-in terminals suitable for 2.5 mm^2/ 4 mm^2 cable	Dowell's/CP9/CP1 or equivalent
Ground Terminal	M3 ring type terminals suitable for 2.5 mm^2 /4 mm^2 cable	Dowell's/RS 613-9334

1.2 Replacing the Battery

You can replace the 7SR45 self powered overcurrent and earth fault relay battery when it is damaged or exhausted. To replace the battery, follow the procedure:

1. Remove the 7SR45 self powered overcurrent and earth fault relay battery cover.
2. Remove the damaged or exhausted battery from the battery clip.
3. Insert the new battery in the battery clip with the correct polarity as indicated.
4. Fit the front cover again and screw it to the housing.

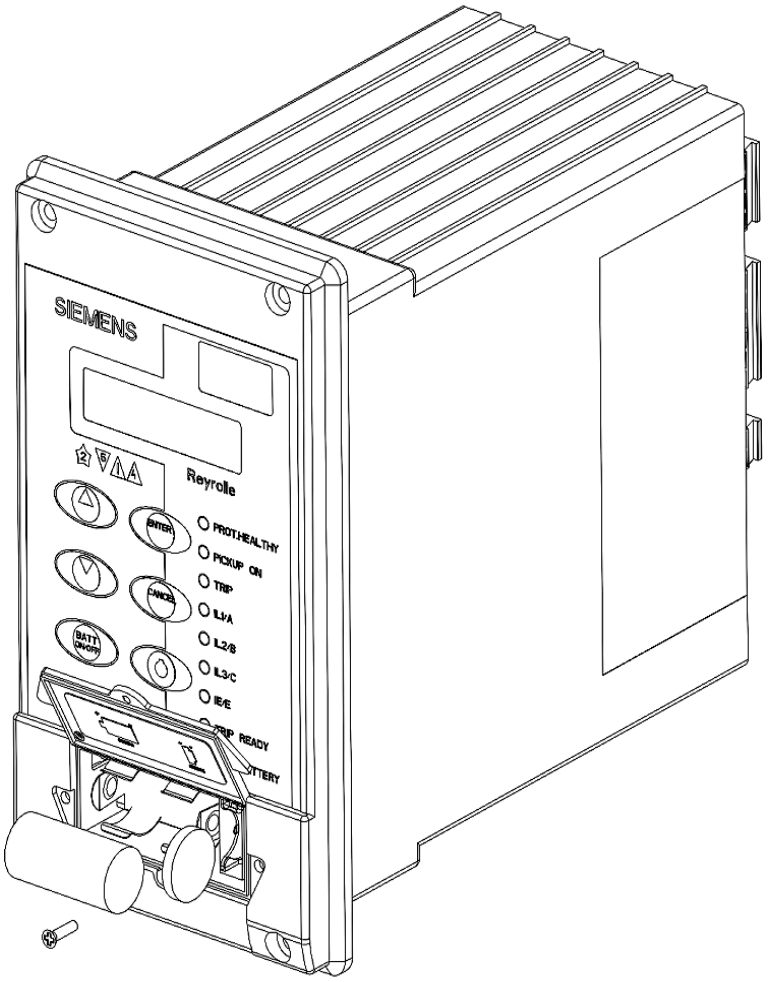

Figure 1-3 Battery Replacement

1.3 Post-Installation and Commissioning

Execute the following procedure after installation and commissioning of the 7SR45 self powered overcurrent and earth fault relay.

1. Open the 7SR45 self powered overcurrent and earth fault relay battery cover.
2. To start the 7SR45 self powered overcurrent and earth fault relay, remove the paper strip between the battery clip and battery.

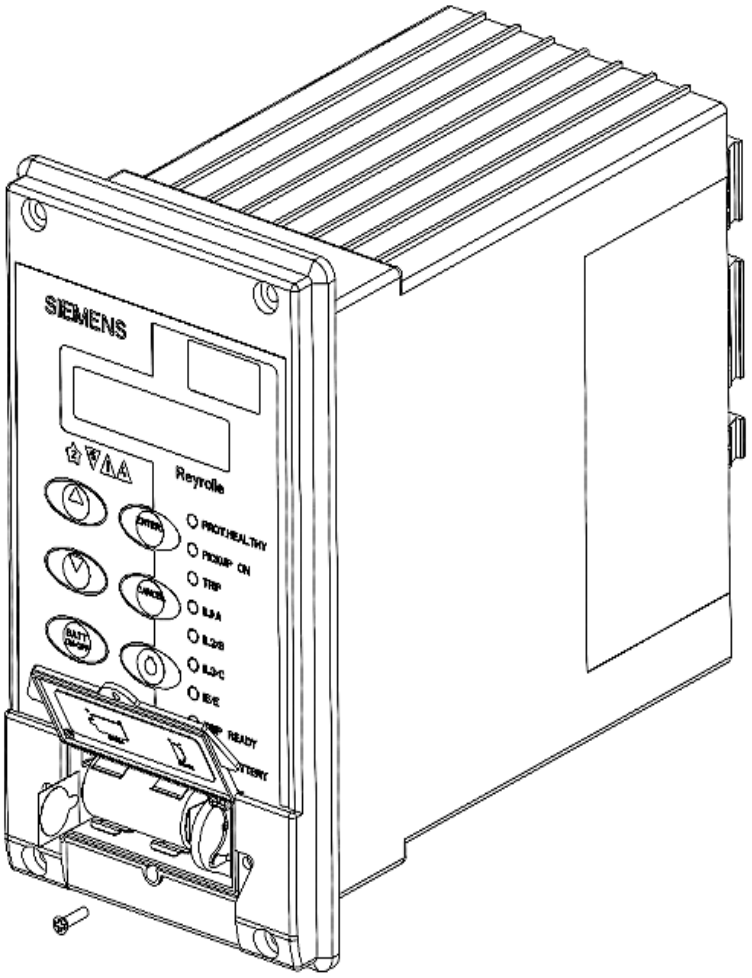

Figure 1-4 Removal of Paper Strip

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Commissioning and Maintenance Guide

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Section 1: Commissioning and Maintenance Guide

1.1 Troubleshooting

This section provides the common problems and the recommended solution to resolve the problem.

Observation	Action
Relay does not power up	Check the phase connections based on the terminal diagram and CT power is applied (or) Check the relay is connected with USB power (or) Check the battery is healthy
Relay won't accept the password	The password entered is wrong. Enter the correct password. If correct password has been forgotten, note down the numeric code displayed at the Change Password screen. To retrieve the password, communicate this numeric code to a Siemens Limited Customer representative.
Protection Healthy LED OFF/LCD not displaying	The relay may have insufficient current from CT.
Cannot communicate with the relay	• Check the communication cable is connected properly. • Check that the USB driver is installed correctly. • In Reydisp Evolution, verify that "**Do NOT Check Communications Connection**" is selected in the **Advanced** properties. • In Reydisp Evolution, check that the Relay Address is set as "**1**" in the Relay menu**.**
Status inputs do not work	• Check that the correct DC voltage is applied and that the polarity is correct. • Check that the status input settings such as the pick-up and drop-off timers and the status inversion function are correctly set.
Low Battery Indication	• Check the battery is connected with the proper polarity. • Check the battery is healthy.
Protection Healthy LED is not glowing	The relay may not have CT current inputs.

If the above troubleshooting checklist does not help in correcting the problem please contact the local Siemens office or contact customer support, Phone: +49 180/524 8437 (24hrs), Fax: +49 180/524 2471.
E-mail: support.energy@siemens.com

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Section 1: Current Transformer Requirements

7SR45 self powered overcurrent and earth fault relay uses the current inputs to energize the relay.

Higher ohmic burdens in the current transformer (CT) secondary circuit results in greater saturation of the core and introduces larger errors in the secondary current waveform. For a given secondary current, it requires more voltage from the CT for a higher burden.

The total burden on the CT is the vector sum of the CT winding resistance, the connecting lead resistance, the impedance of any auxiliary CTs, and the impedance of the connected relays and meters.

After the ohmic burden is determined, the next step in predicting CT performance is to determine the required CT excitation voltage or secondary limiting voltage by multiplying the calculated total ohmic burden by the accuracy limit factor (ALF) and rated secondary current.

The secondary limiting excitation voltage (E_{ALF}) is given by the following expression:

$E_{ALF} = ALF * I_{sr} * (R_{ct} + R_{bn})$

Where,
ALF – Accuracy Limiting Factor
I_{sr} – Rated Secondary current of CT (A)
R_{ct} – CT Winding resistance (Ω)
R_{bn} – Rated Burden of CT (Ω)

If the secondary limiting excitation voltage (E_{ALF}) calculated exceeds the knee point voltage of the connected CT, the CT may get saturated.

To select a proper CT, the accuracy limit factor (ALF) at a given burden needs to be considered. The ALF needs to be checked for entire range of currents the relay is expected to operate. For proper operation of the CT, the following condition needs to be fulfilled.

$$ALF * I_{sr} * (R_{ct} + R_{bn}) \geq I_s * (R_{ct} + R_b)$$

So,

$$ALF = \frac{Is * (R_{ct} + R_b)}{Isr * (R_{ct} + R_{bn})}$$

I_s – Actual Secondary current of CT (A)

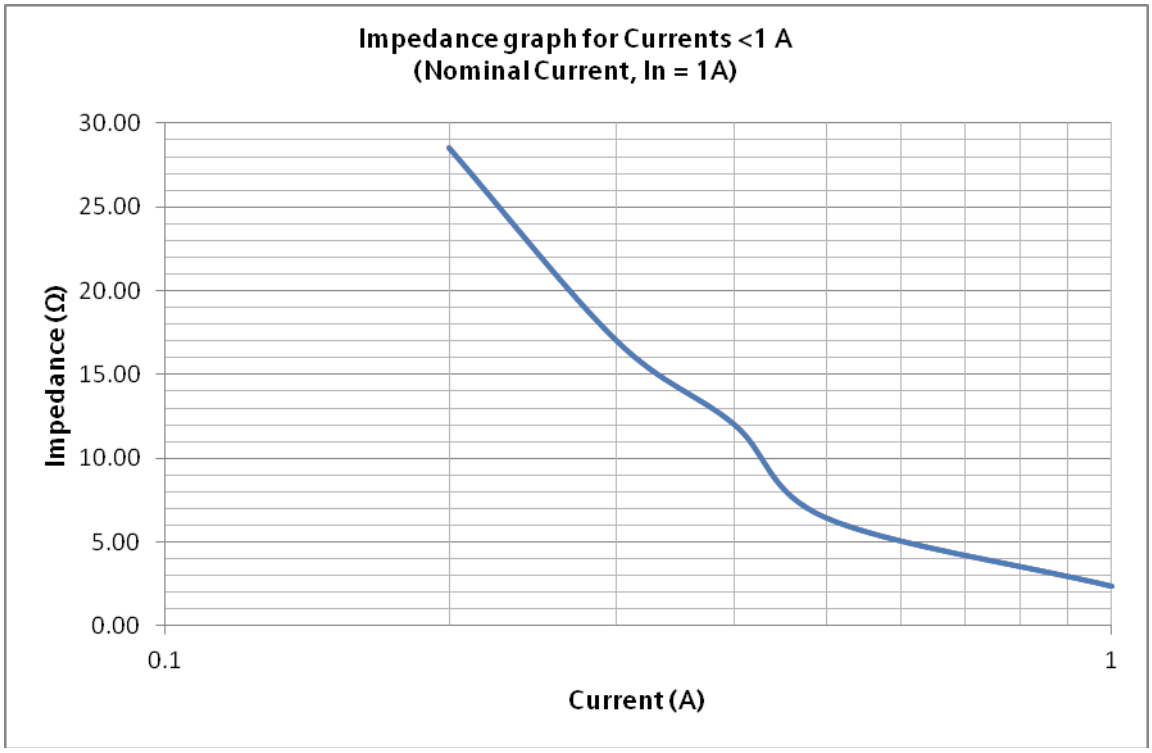
R_b – Actual secondary burden of CT (Ω) (Includes Burden of the relay (R_{rel}) and resistance (R_l) of the cable between CT and Relay.

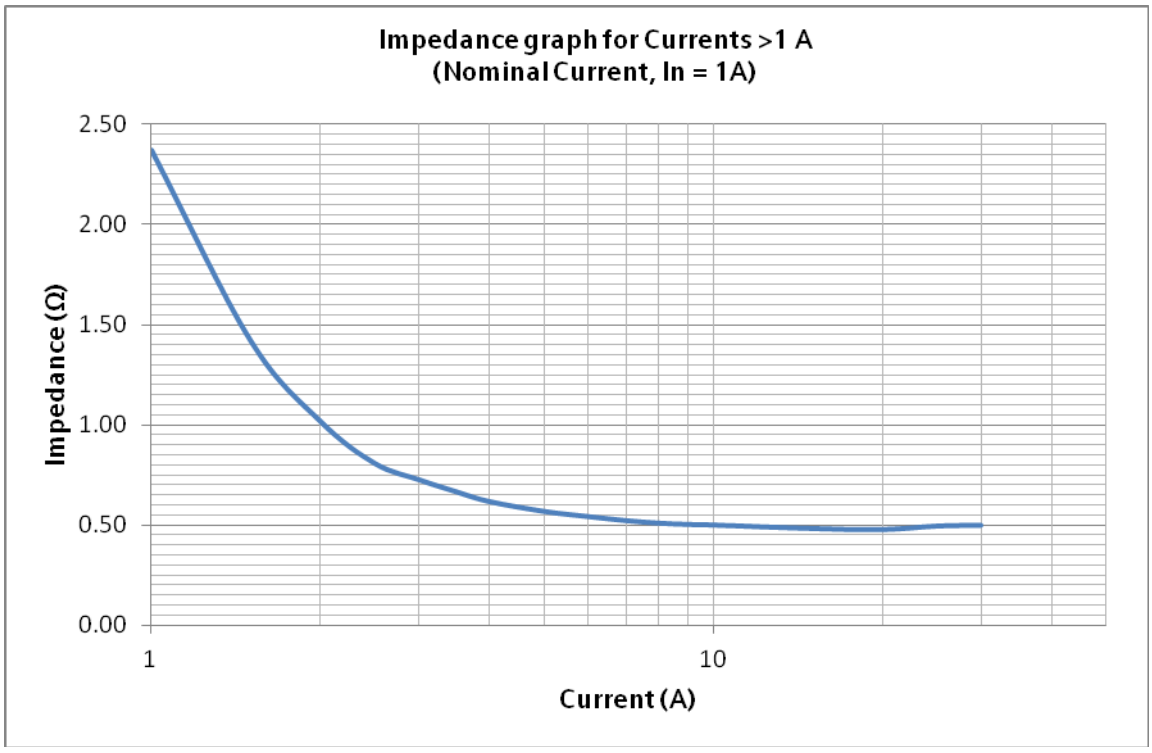
The burden of 7SR45 relay depends on the input current. The impedance of the relay is inversely proportional to the input current.

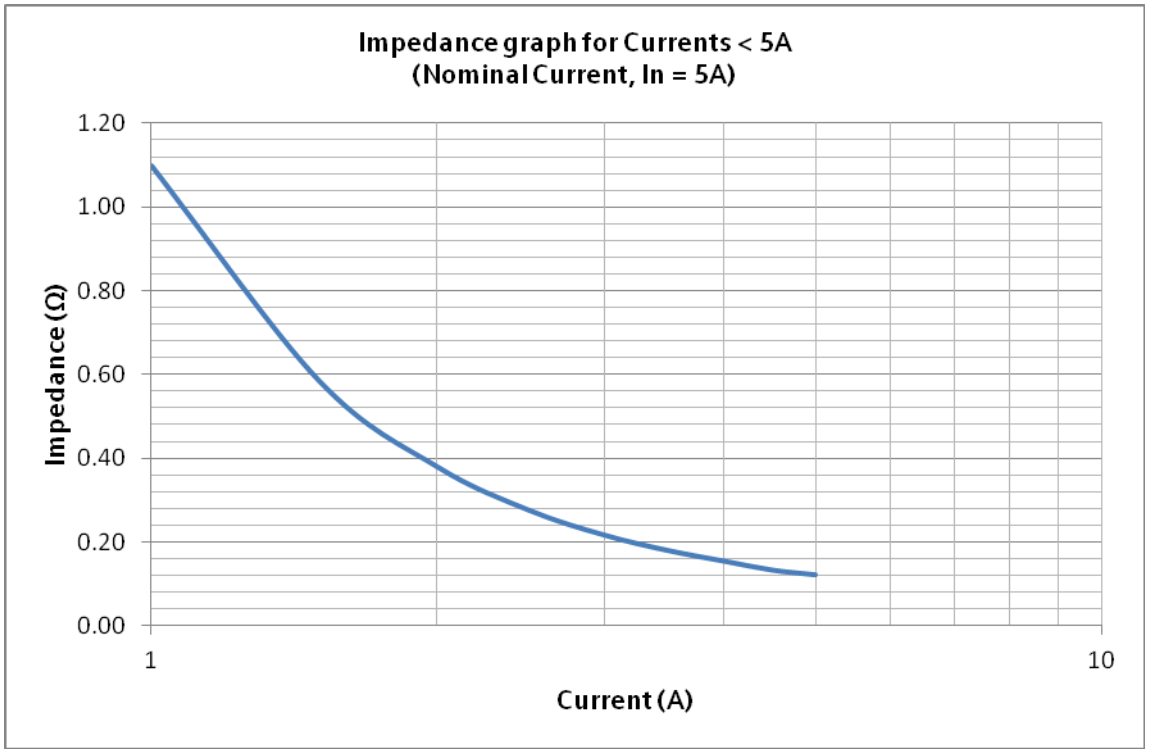
The following graphs show the impedance of the relay for different currents when the relay is powered through a single phase current input.

NOTE:

When all the three phases are available, the burden on each CT reduces.







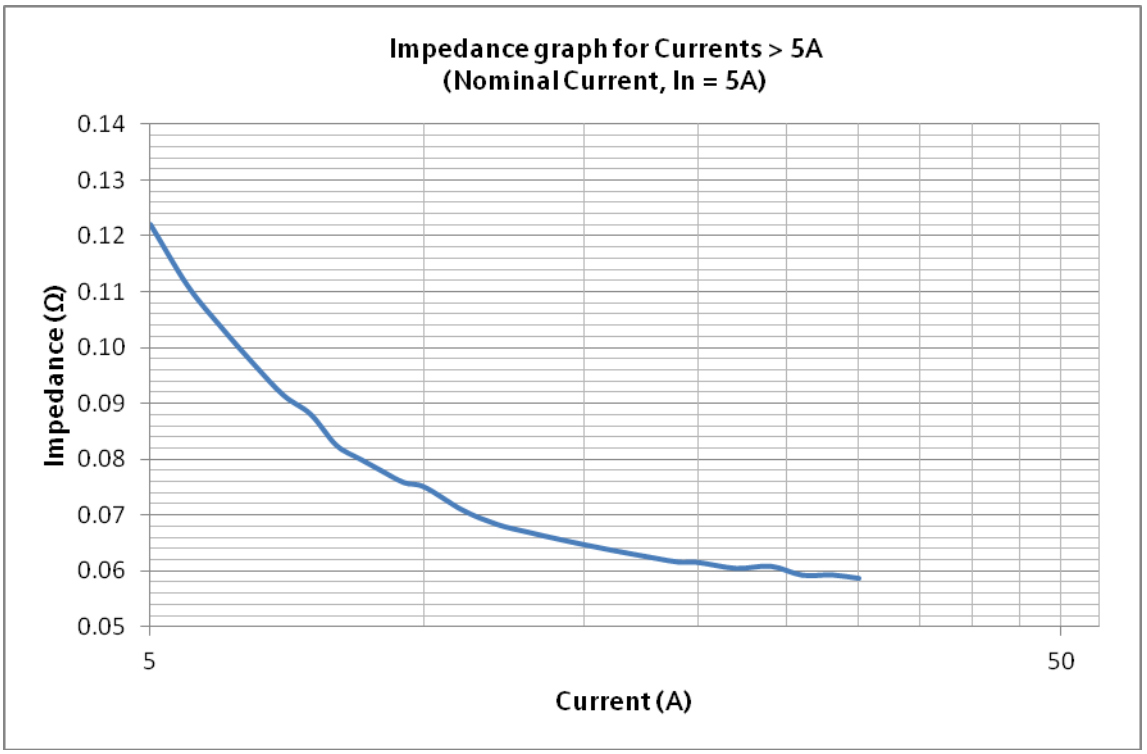


Figure 1-1 Burden of the Relay for Different Currents

Sample Calculation:

CT Ratio	:	100/1 A
Rated CT Burden (R_{bn})	:	2.5 VA (R_{bn} = 2.5 Ω for 1A secondary current)
CT winding resistance (R_{ct})	:	0.5 Ω
Rated Secondary Current (Isr)	:	1 A

Case 1:

Minimum current for relay operation in single phase = 0.2 In (I_s = 0.2A for rated current of 1 A)

$$ALF \geq \frac{0.2 * (0.5 + 28.5)}{1 * (0.5 + 2.5)}$$

R_b = 28.5 at 0.2 A (Refer graphs)

$$ALF \geq 1.933$$

Case 2:

Fault current = 20 A

$$ALF \geq \frac{20 * (0.5 + 0.49)}{1 * (0.5 + 2.5)}$$

R_b = 0.49 at 20 A (Refer graphs)

$$ALF \geq 6.6$$

The typical accuracy limit factor would be ALF = 10

The calculation shown above is an example. To select an appropriate CT, similar calculation needs to be done with the actual parameters.

Recommended CTs:

Considering the CTs are connected to 7SR45 relay only and the distance between CTs and 7SR45 relay (typically 3 m) is short, the following are the recommended CTs to be used:

- **2.5 VA, 5P10 or 5P20 for In = 1 A**
- **2.5 VA, 5P20 for In = 5 A**

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Siemens Protection Devices Limited
P.O. Box 8
North Farm Road
Hebburn
Tyne & Wear
NE31 1TZ
United Kingdom
Phone: +44 (0)191 401 7901
Fax: +44 (0)191 401 5575
www.siemens.com/energy

For more information, please contact our
Customer Support Center.
Phone: +49 180/524 8437
Fax: +49 180/524 24 71
E-mail: support.energy@siemens.com
www.siemens.com/protection

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