FANOX
Safely protected

SIL-G

Feeder & Generator Protection Relay

USER'S MANUAL

1 RECEPTION, HANDLING, INSTALLATION

1.1 Unpackaging

Relays must only be handled by qualified personnel and special care must be taken to protect all their parts from any damage while they are being unpacked and installed.

The use of good illumination is recommended to facilitate the relay visual inspection.

The facility must be clean and dry, and relays should not be stored in places that are exposed to dust or humidity. Special care must be taken if construction work is taking place.

1.2 Reception of relays

It is necessary to inspect the relay at the time it is delivered to ensure that the relays have not been damaged during transport.

If any defect is found, the transport company and FANOX should be informed immediately.

If the relays are not for immediate use, they should be returned to their original packaging.

1.3 Handling electronic relay

Relays contain an electronic component that is sensitive to electrostatic discharges.

Just by moving, a person can build up an electrostatic potential of several thousand volts.

Discharging this energy into electronic components can cause serious damage to electronic circuits. It is possible that this damage may not be detected straight away, but the electronic circuit reliability and life will be reduced. This electronic component in the relay is well protected by the metal housing, which should not be removed as the relay cannot be adjusted internally.

If it is necessary to disassemble the electronic component, this must be carried out with care and contact with electronic components, printed circuits and connections must be avoided to prevent an electrostatic discharge that could damage one of the components. If the electronic components are stored outside the metal housing, they must be placed in an antistatic conductive bag.

If it is necessary to open a module, care must be taken to preserve the relay reliability and the duration of the life cycle as designed by the manufacturer, taking the following actions:

- Touch the housing to ensure that you have the same potential
- Avoid touching the electronic components and handle the module by its edges.
- Remember that everyone who handles the module must have the same potential.
- Use a conductive bag to transport the module.

For more information about how to handle electronic circuits, consult official documents such as the IEC 147-OF.

1.4 Installation, commissioning and service

The personnel in charge of installing, commissioning, and maintaining this relay must be qualified and must be aware of the procedures for handling it. The product documentation should be read before installing, commissioning, or carrying out maintenance work on the relay.

Personnel should take specific protection measures to avoid the risk of electronic discharge when access is unlocked on the rear part of the relay.

To guarantee safety, the crimp terminal and a suitable tool must be used to meet isolation requirements on the terminal strip. Crimped terminations must be used for the voltage and current connections.

It is necessary to connect the relay to earth through the corresponding terminal, using the shortest possible cable. As well as guaranteeing safety for the personnel, this connection allows high frequency noise to be evacuated directly to earth.

The following checks must be performed before the relay is supplied:

- The rated voltage and polarity.
- The power rating of the CT circuit and the integrity of the connections.
- The integrity of the earth connection.

The relay must be used within the stipulated electrical and environmental limits.

NOTE: current transformer circuits: Do not open a live CT secondary circuit. The resulting high voltage could damage the isolation and threaten lives.

1.5 Storage

If the relays are not going to be installed immediately, they must be stored in a dust- and humidity free environment after the visual inspection has been performed.

1.6 Recycling

Before recycling the relay, the capacitors should be discharged through the external terminals. All electrical power sources should be removed before performing this operation to avoid the risk of electrical discharge.

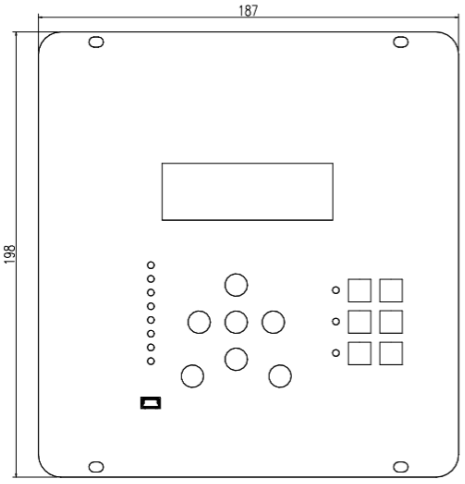
This product must be disposed of in a safe way. It should not be incinerated or brought into contact with water sources like rivers, lakes, etc.

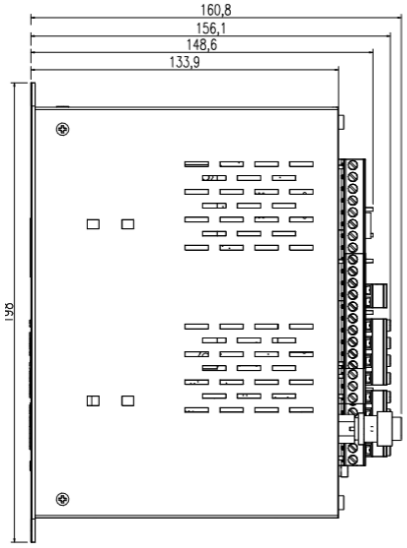
Fanox Electronic, S.L. adheres itself to the 1st additional disposal of the Spanish 11/97 Standard in which it is said that the final user of the containers should give them, properly segregated by materials, to an authorized recovery, recycler, or valuer company.

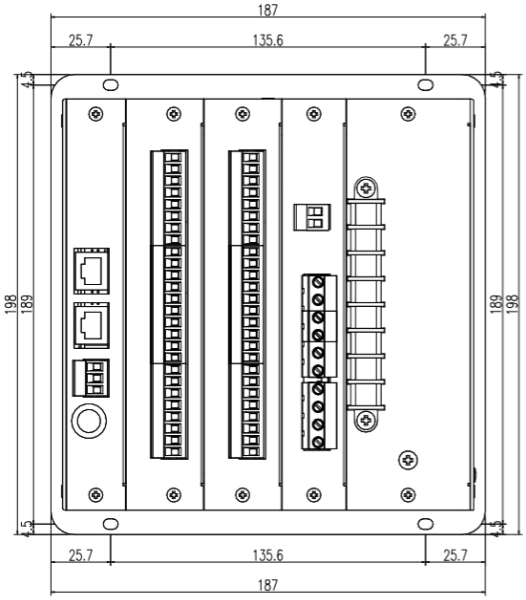
2 DIMENSIONS AND CONNECTION DIAGRAMS

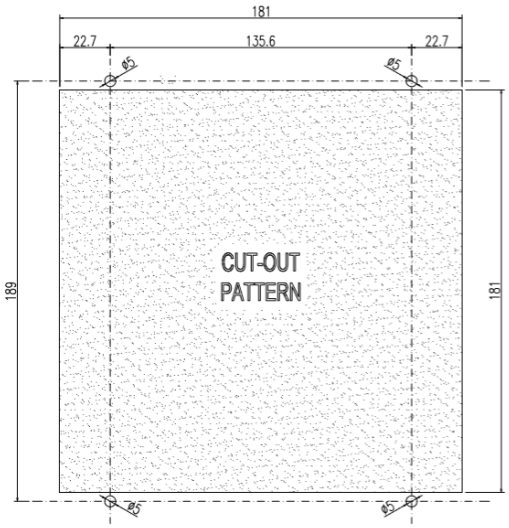
2.1 Relay front view

2.2 Relay dimensions



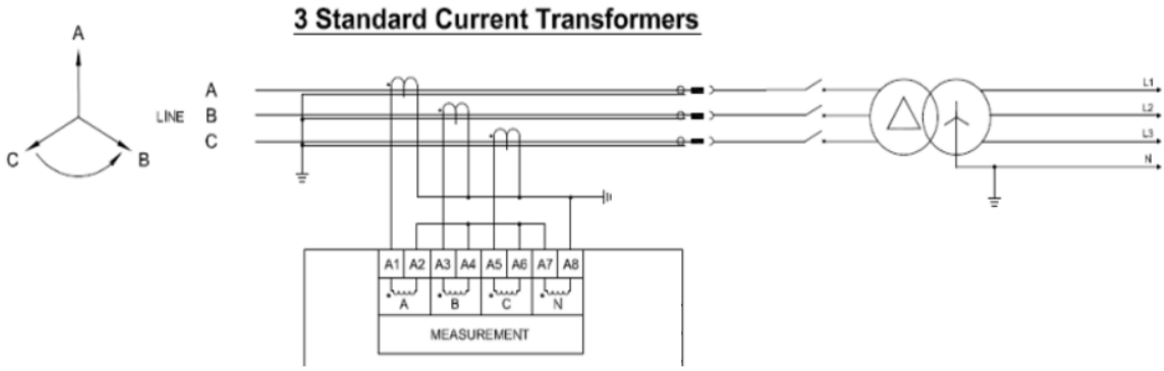


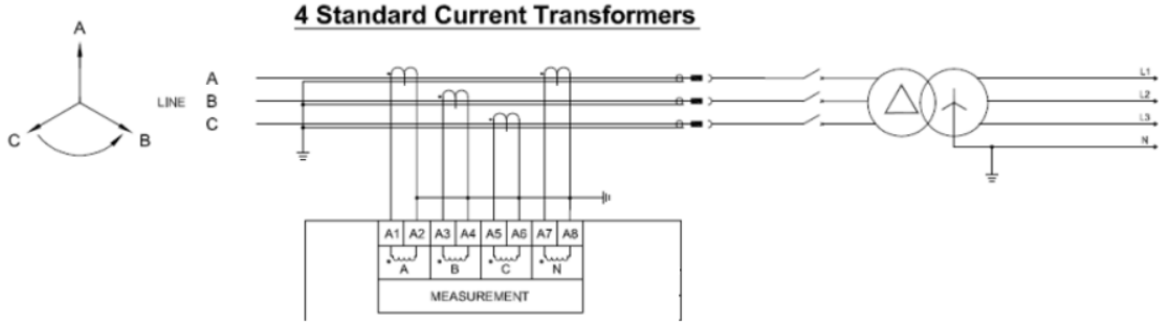




2.3 Connection diagrams

2.3.1 Analog current connections





2.3.2 Analog voltage connections

In SIL-G relay it is important to consider the connection type is configurable by the user. Depending on model the following options are available:

SIL-Gxxxx0xxxxx (without ANSI 25): (Un = 100-130 V)

3 VT Phase-Neutral configuration

3 VT Phase-Neutral configuration + residual voltage

3VT Phase-Phase configuration

3VT Phase-Phase configuration + residual voltage

2VT Phase-Phase configuration + residual voltage

Connecting the relay directly to Low Voltage line (Un = 200-480 V)

Phase to neutral configuration

Phase to phase configuration

SIL-Gxxxx1xxxxx (with ANSI 25): (Un = 100-130 V)

3 VT Phase-Neutral configuration + Phase B line voltage

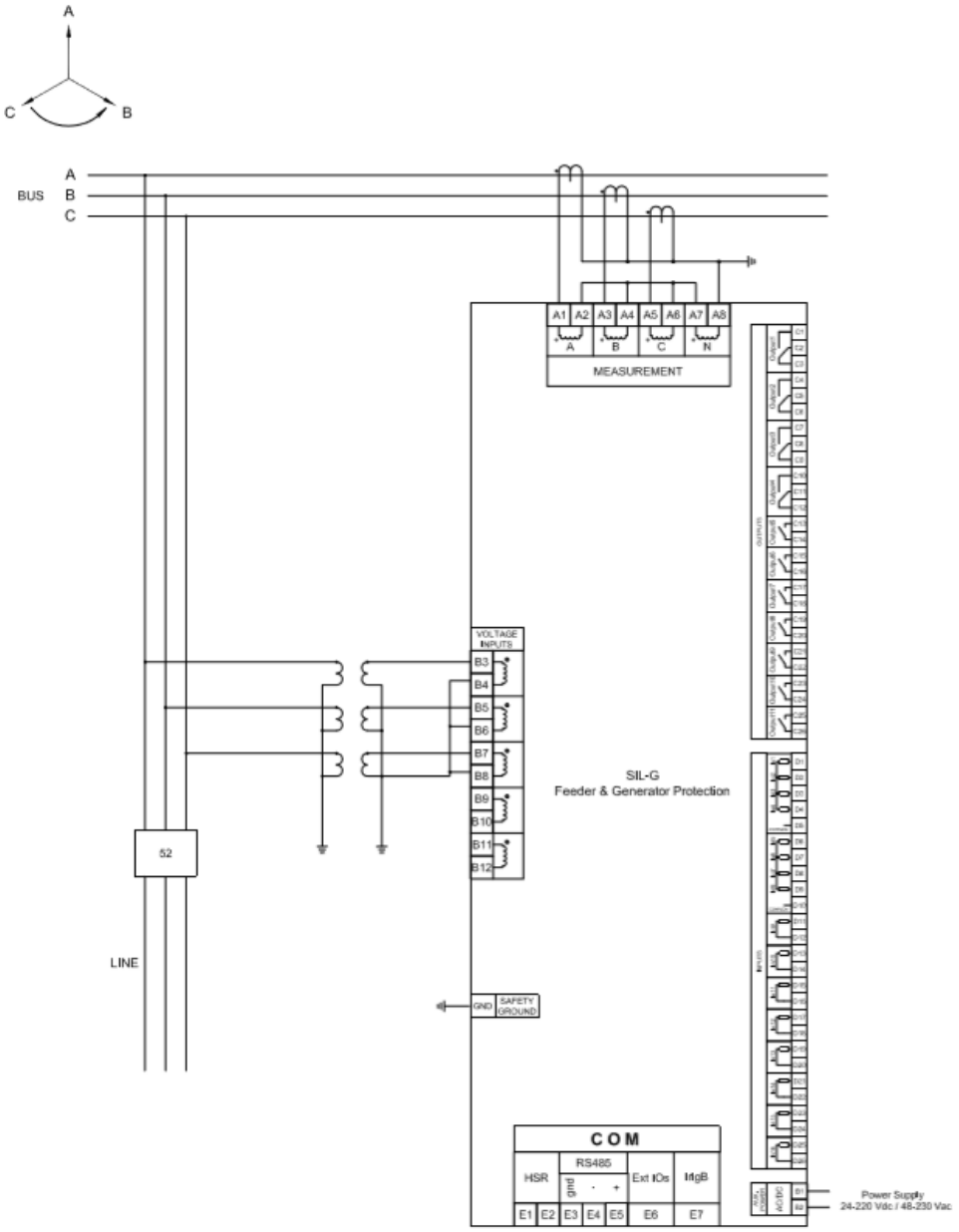
3 VT Phase-Neutral configuration + residual voltage + Phase B line voltage

3VT Phase-Phase configuration + Phase B line voltage

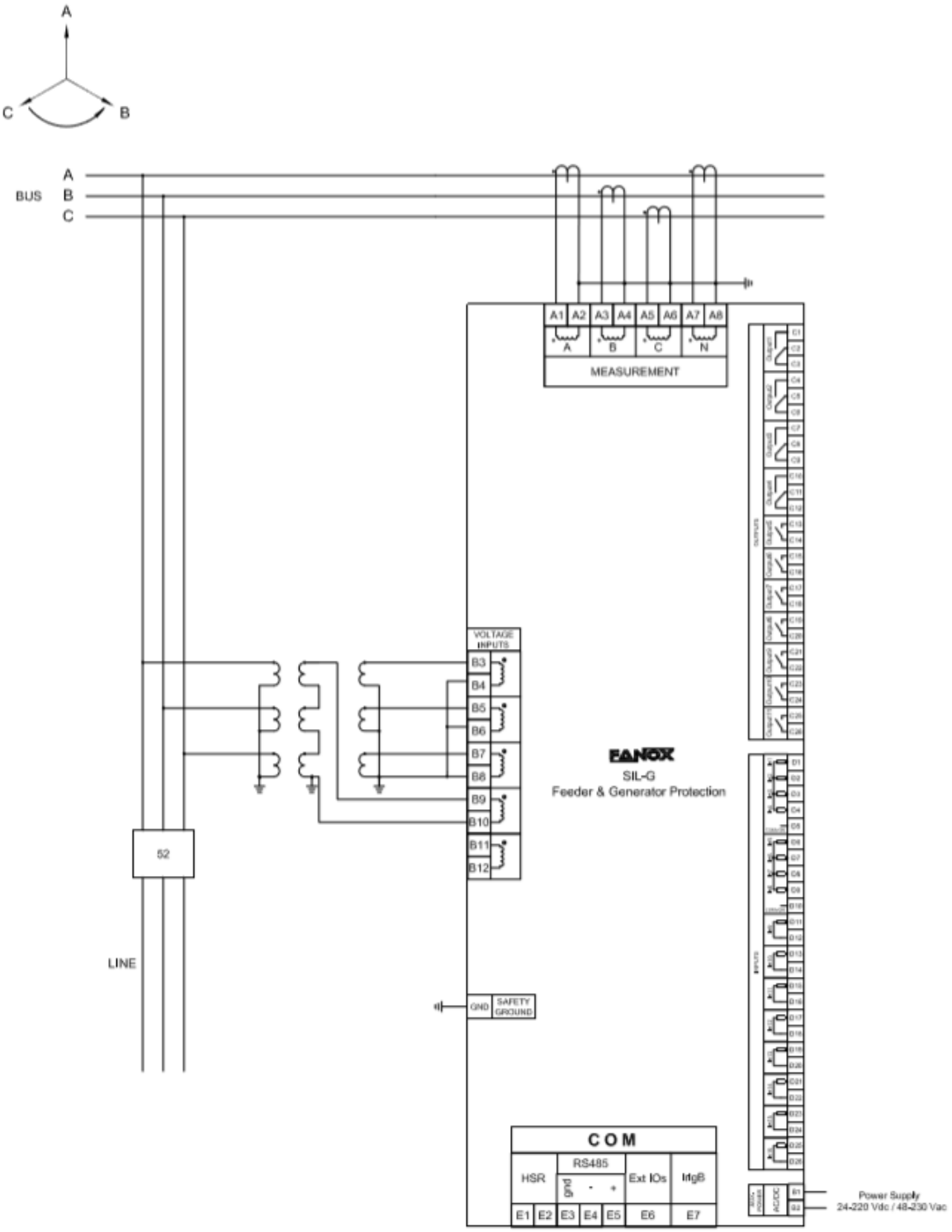
3VT Phase-Phase configuration + residual voltage + Phase B line voltage

2VT Phase-Phase configuration + residual voltage + Phase B line voltage

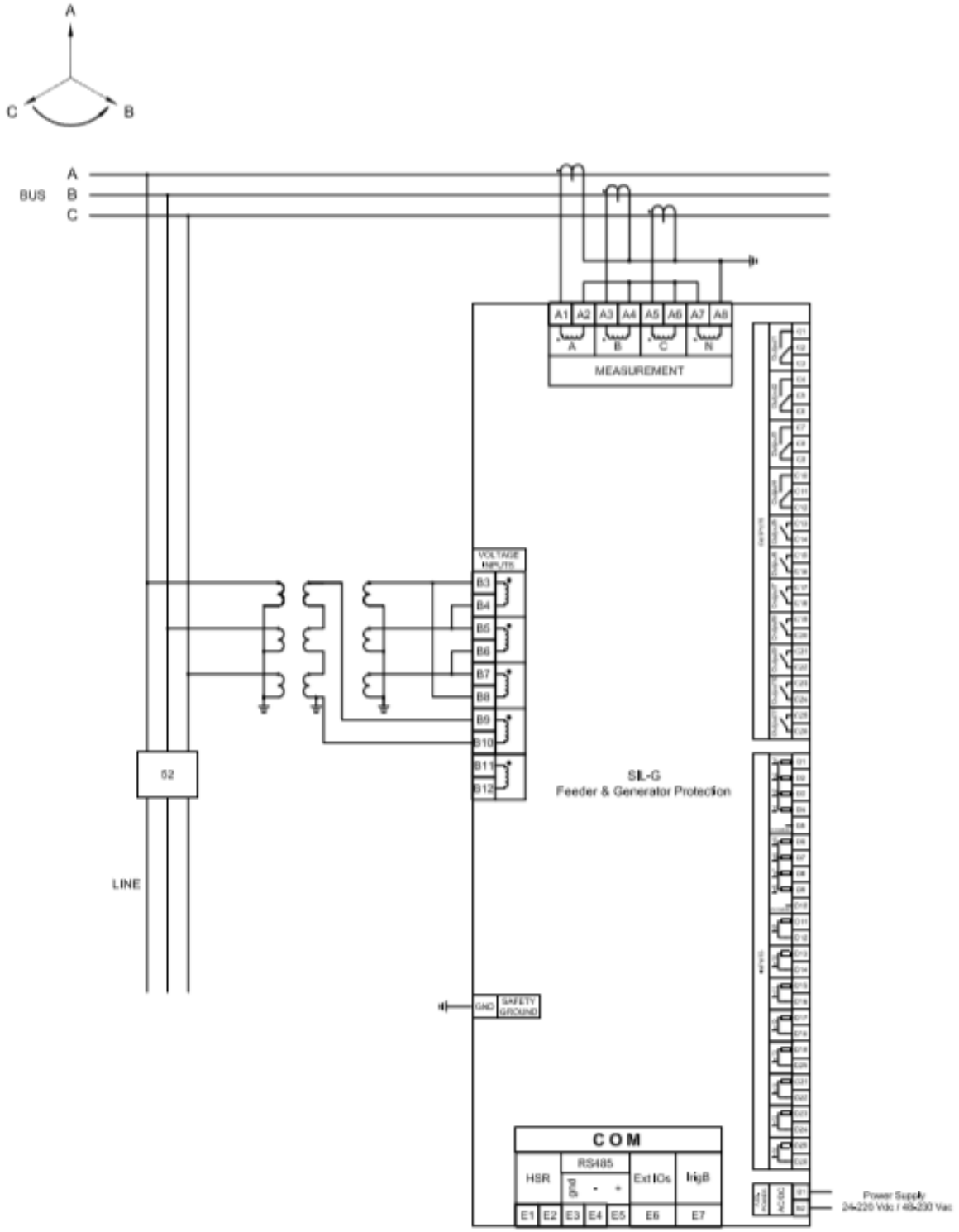
3 VT configuration (phase-neutral)



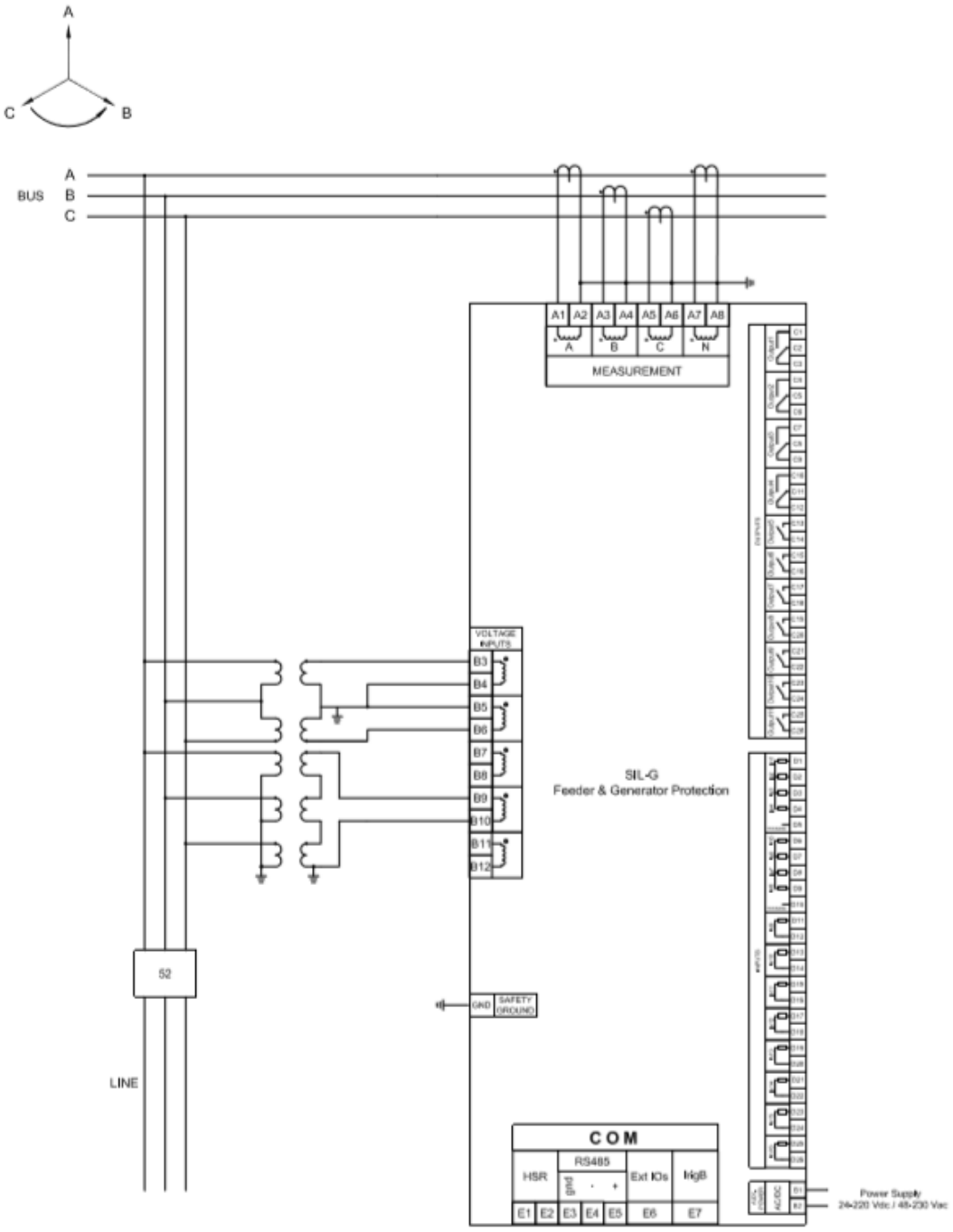
3 VT configuration (phase-neutral) + residual voltage



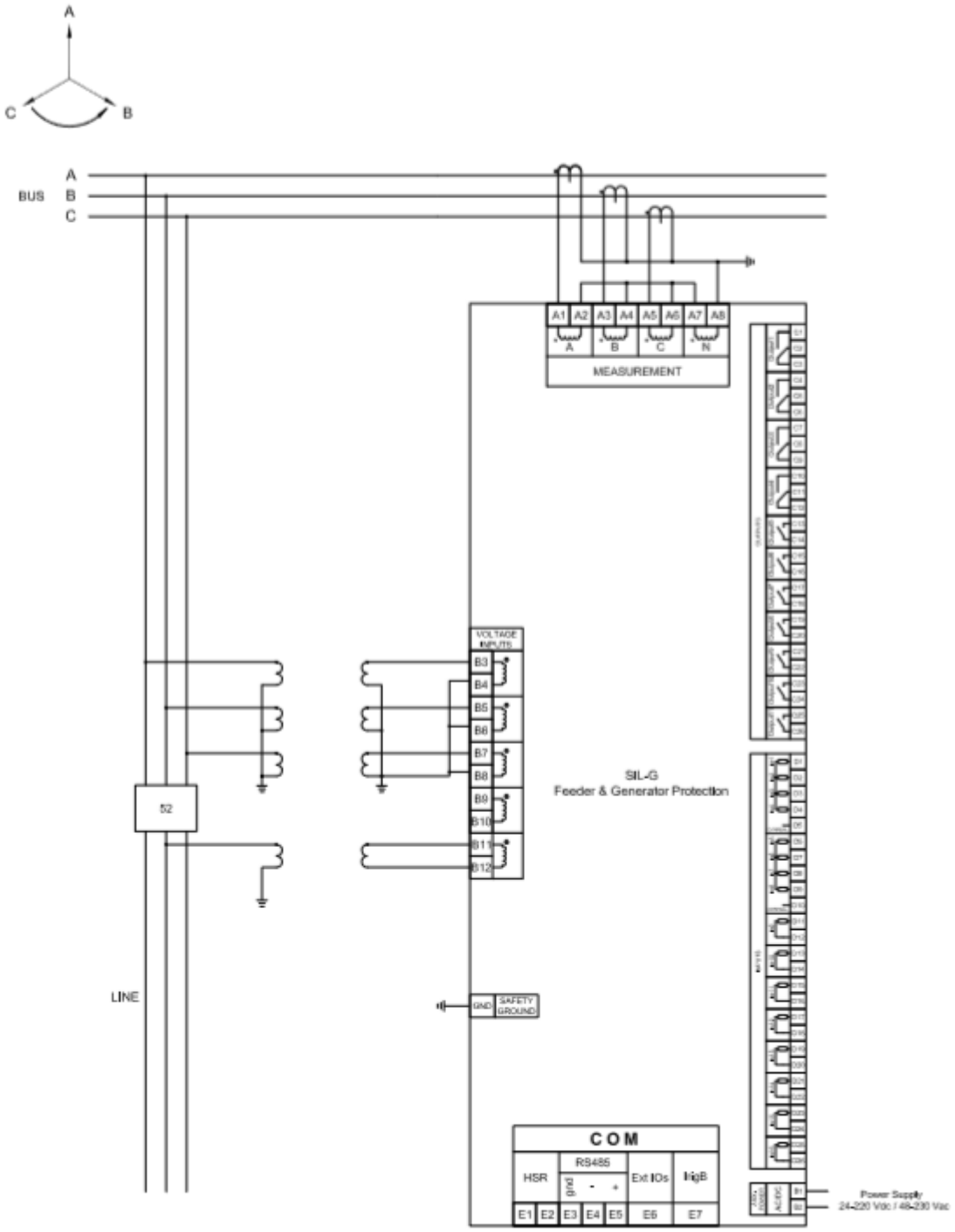
3VT configuration (phase-phase) + residual voltage



2VT configuration (phase-phase) + residual voltage

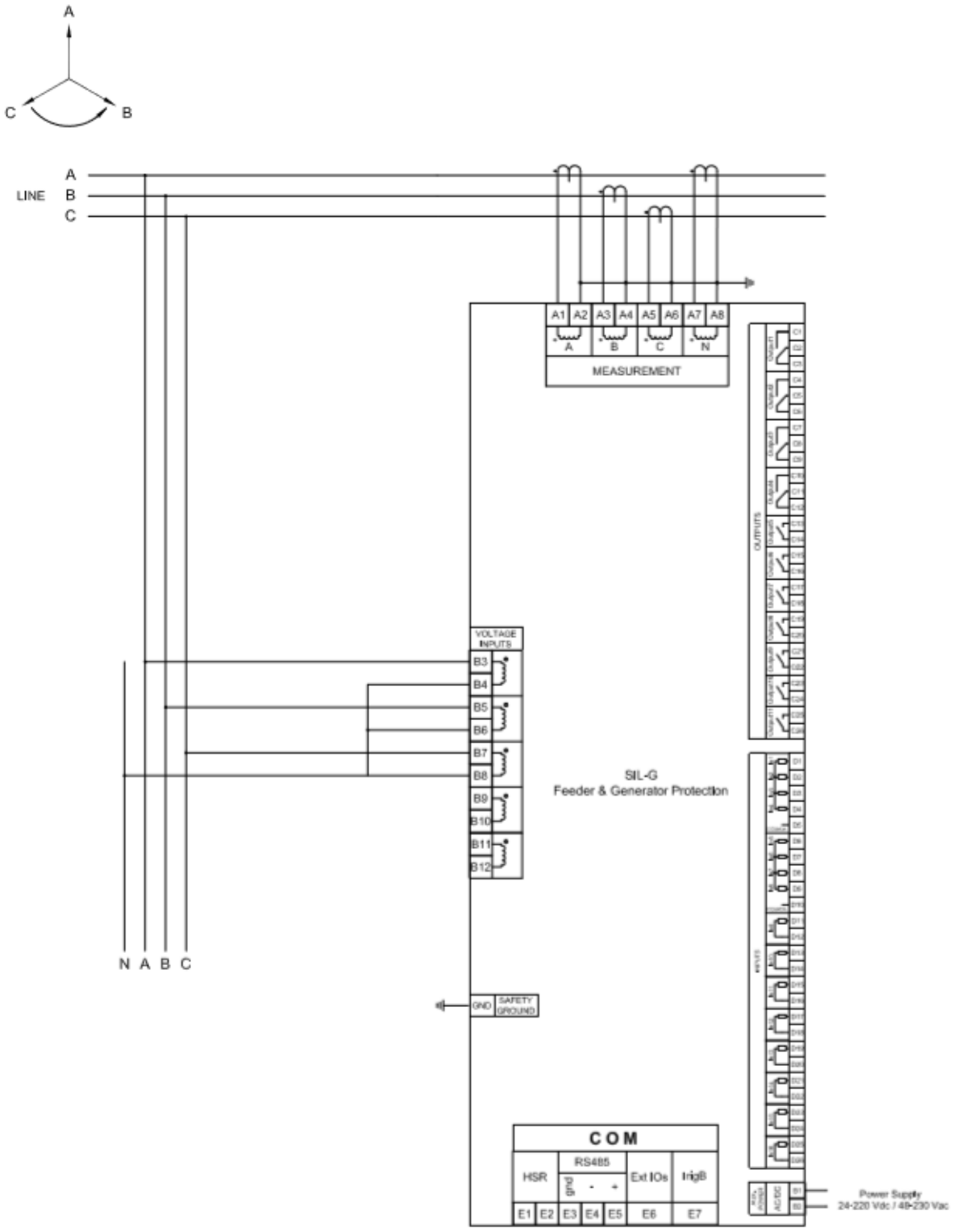


3 VT configuration (phase-neutral) + phase B line voltage

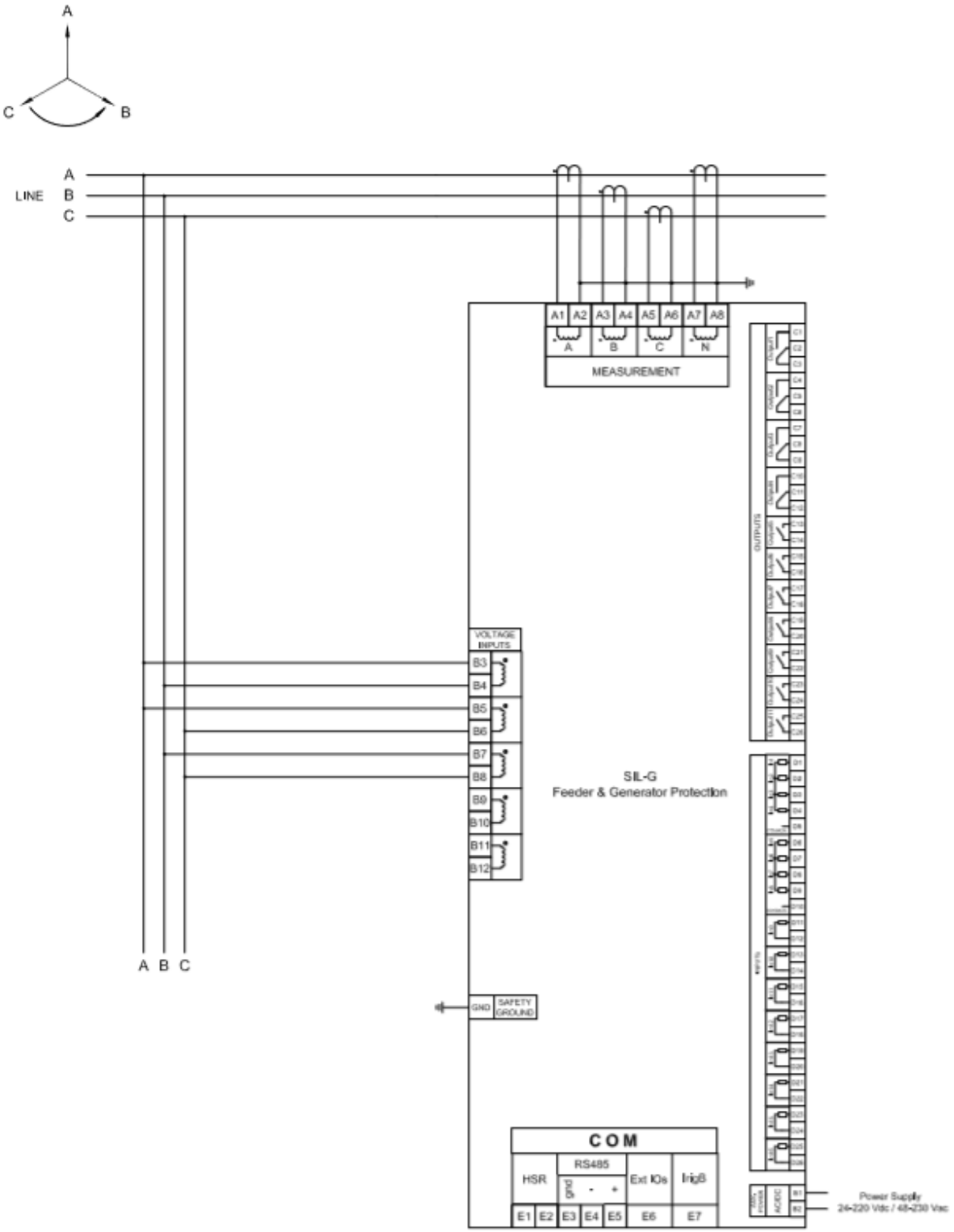


Connecting the relay directly to Low Voltage line (Un = 260-480 V)

Phase-neutral connection



Phase-phase connection



NOTE. Voltage Neutral protections (50N, 67N and 59N), voltage ground protections (50G, 67G and 59G) and voltage sequence protection (47) are not available with this configuration.

2.4 Terminals

All the models have the same terminals for current and voltage connections:

A1	Phase A current input
A2	Phase A current output
A3	Phase B current input
A4	Phase B current output
A5	Phase C current input
A6	Phase C current output
A7	Neutral current input
A8	Neutral current output

B1-B2	Auxiliary voltage
B3	Phase A voltage +
B4	Phase A voltage -
B5	Phase B voltage +
B6	Phase B voltage +
B7	Phase C voltage +
B8	Phase C voltage -
B9	Neutral voltage +
B10	Neutral voltage -
B11	Line Phase B voltage +
B12	Line Phase B voltage -

Depending on number of Inputs/Outputs chosen by model, following configurations are available:

2.4.1 SILGxxxxxx0xxx

SLOT 3 (In/Out/COM)	
C1	Digital input 1
C2	Digital input 2
C3	Digital input 3
C4	Digital input 4
C5	Common of digital inputs 1, 2, 3 and 4
C6	Digital input 5
C7	Digital input 6
C8	Digital input 7
C9	Digital input 8
C10	Common of digital inputs 5, 6, 7 and 8
C11-C12	Digital output 1 NC
C13-C14	Digital output 2 NO
C15-C16	Digital output 3 NO
C17-C18	Digital output 4 NO
C19-C20	Digital output 5 NO
C21-C22	Digital output 6 NO
C23-C24	Digital output 7 NO
C25-C26	RS-485 connections

SLOT 4	
-	EMPTY

2.4.2 SILGxxxxxx5xxx

SLOT 3 (Inputs)	
D1	Digital input 1
D2	Digital input 2
D3	Digital input 3
D4	Digital input 4
D5	Common of digital inputs 1, 2, 3 and 4
D6	Digital input 5
D7	Digital input 6
D8	Digital input 7
D9	Digital input 8
D10	Common of digital inputs 5, 6, 7 and 8
D11-D12	Digital input 9 – Common of digital input 9
D13-D14	Digital input 10 – Common of digital input 10
D15-D16	Digital input 11 – Common of digital input 11
D17-D18	Digital input 12 – Common of digital input 12
D19-D20	Digital input 13 – Common of digital input 13
D21-D22	Digital input 14 – Common of digital input 14
D23-D24	Digital input 15 – Common of digital input 15
D25-D26	Digital input 16 – Common of digital input 16

SLOT 4 (In/Out/COM)	
C1	Digital input 17
C2	Digital input 18
C3	Digital input 19
C4	Digital input 20
C5	Common of digital inputs 17, 18, 19 and 20
C6	Digital input 21
C7	Digital input 22
C8	Digital input 23
C9	Digital input 24
C10	Common of digital inputs 21, 22, 23 and 24
C11-C12	Digital output 1 NO
C13-C14	Digital output 2 NO
C15-C16	Digital output 3 NO
C17-C18	Digital output 4 NO
C19-C20	Digital output 5 NO
C21-C22	Digital output 6 NO
C23-C24	Digital output 7 NO
C25-C26	-

2.4.3 SILGxxxxxx6xxx

SLOT 3 (In/Out/COM)	
C1	Digital input 1
C2	Digital input 2
C3	Digital input 3
C4	Digital input 4
C5	Common of digital inputs 1, 2, 3 and 4
C6	Digital input 5
C7	Digital input 6
C8	Digital input 7
C9	Digital input 8
C10	Common of digital inputs 5, 6, 7 and 8
C11-C12	Digital output 1 NC
C13-C14	Digital output 2 NO
C15-C16	Digital output 3 NO
C17-C18	Digital output 4 NO
C19-C20	Digital output 5 NO
C21-C22	Digital output 6 NO
C23-C24	Digital output 7 NO
C25-C26	RS-485 connections

SLOT 4 (Outputs)	
E1	NO contact output 8
E2	NC contact output 8
E3	Common point output 8
E4	NO contact output 9
E5	NC contact output 9
E6	Common point output 9
E7	NO contact output 10
E8	NC contact output 10
E9	Common point output 10
E10	NO contact output 11
E11	NC contact output 11
E12	Common point output 11
E13-E14	Digital output 12 NO
E15-E16	Digital output 13 NO
E17-E18	Digital output 14 NO
E19-E20	Digital output 15 NO
E21-E22	Digital output 16 NO
E23-E24	Digital output 17 NO
E25-E26	Digital output 18 NO

2.4.4 SILGxxxxxx7xxx

SLOT 3 (Inputs)	
D1	Digital input 1
D2	Digital input 2
D3	Digital input 3
D4	Digital input 4
D5	Common of digital inputs 1, 2, 3 and 4
D6	Digital input 5
D7	Digital input 6
D8	Digital input 7
D9	Digital input 8
D10	Common of digital inputs 5, 6, 7 and 8
D11-D12	Digital input 9 – Common of digital input 9
D13-D14	Digital input 10 – Common of digital input 10
D15-D16	Digital input 11 – Common of digital input 11
D17-D18	Digital input 12 – Common of digital input 12
D19-D20	Digital input 13 – Common of digital input 13
D21-D22	Digital input 14 – Common of digital input 14
D23-D24	Digital input 15 – Common of digital input 15
D25-D26	Digital input 16 – Common of digital input 16

SLOT 4 (Outputs)	
E1	NO contact output 1
E2	NC contact output 1
E3	Common point output 1
E4	NO contact output 2
E5	NC contact output 2
E6	Common point output 2
E7	NO contact output 3
E8	NC contact output 3
E9	Common point output 3
E10	NO contact output 4
E11	NC contact output 4
E12	Common point output 4
E13-E14	Digital output 5 NO
E15-E16	Digital output 6 NO
E17-E18	Digital output 7 NO
E19-E20	Digital output 8 NO
E21-E22	Digital output 9 NO
E23-E24	Digital output 10 NO
E25-E26	Digital output 11 NO

2.4.5 SILGxxxxxxAxxx

SLOT 3 (In/Out/COM)	
C1	Digital input 1
C2	Digital input 2
C3	Digital input 3
C4	Digital input 4
C5	Common of digital inputs 1, 2, 3 and 4
C6	Digital input 5
C7	Digital input 6
C8	Digital input 7
C9	Digital input 8
C10	Common of digital inputs 5, 6, 7 and 8
C11-C12	Digital output 1 NC
C13-C14	Digital output 2 NO
C15-C16	Digital output 3 NO
C17-C18	Digital output 4 NO
C19-C20	Digital output 5 NO
C21-C22	Digital output 6 NO
C23-C24	Digital output 7 NO
C25-C26	RS-485 connections

SLOT 4 (AFD)	
F1 – F2	High-speed output 1 NO
F3 – F4	High-speed output 2 NO
F5 – F6	High-speed output 3 NO
F7 – F8	High-speed output 4 NO
AFD1	Arc Flash Detector input 1
AFD2	Arc Flash Detector input 2
AFD3	Arc Flash Detector input 3
AFD4	Arc Flash Detector input 4

3 DESCRIPTION

3.1 Introduction

The energy sector is currently immersed in a deep change worldwide. As a result of high levels of energy demand more distribution lines and advanced supervision systems are required. Given the need for creating intelligent infrastructures, FANOX has developed the SIL family to carry out this function.

The SIL-G relay is designed to protect a feeder system using current and voltage functions. It is designed to use a circuit breaker as a cut-off component.

The protection functions may be activated selectively either by using the front-mounted panel, or through the communications link to the SICom program, which facilitates accurate coordination with other relay.

As an additional advantage all the models have been designed so that they can be powered by an external battery. This facilitates putting centers into operation, event management and specific work under adverse conditions.

3.2 Description

SIL-G can be powered with an auxiliary voltage, equal to, depending on model:

24-48 Vdc

48-230 Vac/dc

24-230 Vac/dc

The following protection functions are available on the SIL-G:

- Phase and neutral/ground definite-time and inverse-time (IEC and IEEE curves) overcurrent protections, with directional discrimination.
- Negative sequence overcurrent protection. Also broken conductor is detected
- Undercurrent protection (it depends on model)
- Phase and neutral/ground overvoltage protection (for bar phases and for phase B of the line).
- Phase undervoltage protection (for bar phases and for phase B of the line).
- Directional overpower protection
- Phase reversal protection
- Thermal image protection
- Overfrequency and underfrequency protection (it depends on the model)
- Rate of change of frequency
- Vector shift (Out of Step)
- Cold Load Pickup
- Second harmonic blocking

It is also fitted with a recloser (79). This automated device allows the line to be closed, up to five times. Each reclosure time can be programmed. The relay can be locked in different ways: from the keypad (for which there is a separate key), from remote communications stations and through an input.

Besides, control functions are included as VT supervision, CT Supervision, Trip circuit monitoring or breaker failure monitoring.

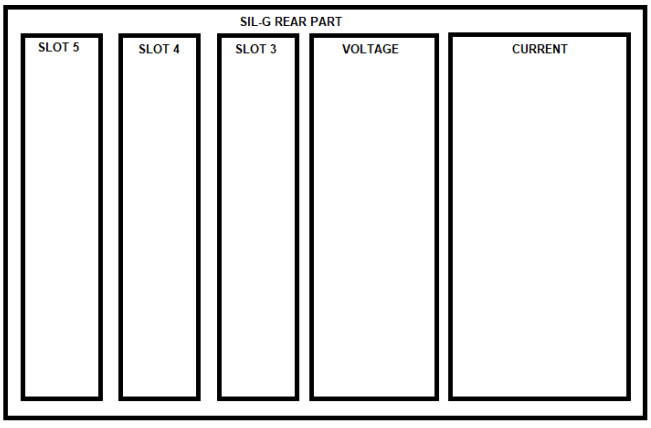
All models include a circuit breaker management block, which:

- Monitors the condition of the circuit breaker, the number of openings and accumulated amperes. It generates an indication when there is an excessive number of openings and accumulated amperes.
- Determines if an opening fault has occurred
- Allows circuit breaker opening and closing commands to be given from the HMI (using different keys) and through local and remote communications

The following measurements are provided by the SIL-G relay:

- Phase currents, neutral (measured and calculated), maximum current, positive sequence current and negative sequence current.
- Second harmonic current per phase
- Simple voltages, phase to phase voltages, neutral voltage (calculated and measured), maximum voltage, line voltage, positive sequence voltage and negative sequence voltage.
- Current angle for each phase and neutral (referred to VA)
- Voltage angle per each phase and neutral (referred to VA)
- Phase B Line voltage angle
- Active, reactive and apparent powers (3- phase and per phase)
- Thermal image
- Line frequency and busbar frequency
- Rate of change of frequency
- V/Hz related to nominal Vn/fn

Depending on model, the relay can include different slots regarding inputs and outputs:



The slots 3 and 4 include the inputs and outputs that depending on model offered:

- SILGxxxxxx0xxx: 7 outputs and 8 inputs. All the outputs and inputs are included in **SLOT 3**, being **SLOT 4** empty.
- SILGxxxxxx7xxx: 11 outputs and 16 inputs. The 16 inputs are included in the **SLOT 3** and the 11 outputs in the **SLOT 4.**
- SILGxxxxxx5xxx: 7 outputs and 24 inputs. The 16 inputs are included in the **SLOT 3** and in the SLOT4 the other 8 inputs and 7 outputs.
- SILGxxxxxx6xxx: 18 outputs and 8 inputs. 8 inputs and 7 outputs are included in the **SLOT 3** and the 11 outputs in **SLOT 4**.
- SILGxxxxxx7xxx: 11 outputs and 16 inputs. The 16 inputs are included in the **SLOT 3** and the 11 outputs in the **SLOT 4**.
- SILGxxxxxxAxxx: 7 outputs, 8 inputs, 4 AFD inputs and 4 high-speed outputs. The 7 inputs and 8 outputs are included in **SLOT 3**, and the 4 AFD inputs and 4 high-speed outputs included in **SLOT 4**.

Both, the inputs and outputs can be configured by the user.

Depending on the configuration:

The outputs located in slot 3:

250 Vac – 8 A

30 Vdc – 8A

The outputs located in slot 4:

Terminals E1-E22:

250 Vac – 8 A

30 Vdc – 8A

Terminals E23-E26:

250 Vac – 16 A

30 Vdc – 16 A

The SIL-G relay is housed in a metal case with all measurement and digital inputs and outputs with galvanic isolation (except for local communications and battery power, as these are sporadic connections). This gives the relay the highest degree of electromagnetic compatibility, both in terms of radiated and conduced EMI and emissivity and immunity. Said levels are those established for primary substations.

It has an LCD with four rows and twenty columns, and a 6 key membrane keypad. These allow the state of the relay, measurements, adjustments to protection criteria and the events or events associated with the relay to be displayed. In addition to the keys used to navigate through the menus, there are some special keys:

- Reset. Used to reset signals and events.
- I/O of the circuit breaker. Used to close and open the circuit breaker.
- Bock/Unblock 79. Used to block and unblock the recloser.
- Local/Remote Control. Used to forbid/allow remote communications.

The SIL-G has 11 front-mounted LEDs, 3 with fixed functions and 8 can be configured. The LEDs with fixed functions are:

- Status of the circuit breaker.
- Status of the recloser.
- Status of the communication (Local control or Remote control)

The remaining 8 LEDs can be configured to show alarms and states.

The relay has a non-volatile RAM memory for up to 3072 events, allowing any recorded events to be analyzed.

There may be a very extensive number of fault events, resulting from the use of inverse criteria and the recloser. As each oscillography is time limited (1300-1500 cycles depending on the number of records). Similarly, the events log contains generic information, and it can lose information pertaining to a specific event after a time. Therefore, a log of fault reports has been included. The log stores the reports associated with the last 100 faults that are detected depending on the cycles.

The number of cycles per each fault report/oscillography is configurable being the first 8 cycles the pre-fault, so:

- 260 cycles→it is recorded 5 oscillography records (length 260x5)
- 60 cycles→it is recorded 25 oscillography records (length 60x25)
- 30 cycles→it is recorded 50 oscillography records (length 30x50)
- 15 cycles→it is recorded 100 oscillography records (length 15x100)

Each oscillographic record contains 10 analogue channels and up to 96 digital channels, which include start-ups and trips of the protection functions, inputs, outputs, etc. The format used is COMTRADE (IEEE C37.111-1991). Current measurements are made using DFT values with a precision of 2% in the 20% band around rated current. The suitable current transformers are standard 5A and 1A CTs.

There are many possibilities regarding to the communications:

LOCAL COMMUNICATION: One USB front port (in all the models).

REMOTE COMMUNICATION: The rear port (s) will depend on the model:

- 1 RS485 port: Modbus RTU, IEC60870-5-103 or DNP 3.0 Serial (selectable by general settings)
- 2 rear ports: 1 RS485 port: Modbus RTU or IEC60870-5-103 (selectable by general settings) + 1 Ethernet port (RJ45): Modbus TCP and DNP 3.0 TCP (selectable by general settings) + IRIG-B
- 2 Ethernet ports (RJ45): 1 RJ45 port for IEC 61850 + 1 RJ45 port: Modbus TCP or DNP 3.0 TCP + IRIG-B
- 2 Ethernet ports: 1 FO-LC port for IEC 61850 + 1 RJ45 port: Modbus TCP or DNP 3.0 TCP + IRIG-B
- 3 rear ports: 2 Fiber Optic port: HSR – IEC61850 + 1 Ethernet port (RJ45): Modbus TCP or DNP 3.0 TCP (selectable by general settings) + IRIG-B
- 3 rear ports: 2 Fiber Optic port: PRP – IEC61850 + 1 Ethernet port (RJ45): Modbus TCP or DNP 3.0 TCP (selectable by general settings) + IRIG-B
- WiFi + 1 RS485 port: Modbus RTU, IEC60870-5-103 or DNP 3.0 Serial (selectable by general settings)

- WiFi + 2 rear ports: 1 RS485 port: Modbus RTU or IEC60870-5-103 (selectable by general settings) +1 Ethernet port (RJ45): Modbus TCP and DNP 3.0 TCP (selectable by general settings) + IRIG-B
- WiFi + 2 Ethernet ports (RJ45): 1 RJ45 port for IEC 61850 + 1 RJ45 port: Modbus TCP and DNP 3.0 TCP (selectable by general settings) + IRIG-B
- WiFi + 2 Ethernet ports: 1 FO-LC port for IEC 61850 + 1 RJ45 port: Modbus TCP and DNP 3.0 TCP (selectable by general settings) + IRIG-B
- WiFi + 2 rear ports: 1 Fiber Optic port: HSR – IEC61850 + 1 Ethernet port (RJ45): Modbus TCP and DNP 3.0 TCP (selectable by general settings) + IRIG-B
- WiFi + 2 rear ports: 1 Fiber Optic port: PRP – IEC61850 + 1 Ethernet port (RJ45): Modbus TCP and DNP 3.0 TCP (selectable by general settings) + IRIG-B

Logging-in allows four levels of access with passcodes that can be configured by the user.

Thanks to the protection functions that are available, its user-friendly interface, its reduced maintenance requirements and simple integration, the SIL-G is an accurate and practical solution for protecting a feeder system. SIL-G offers protection against earth faults that is sufficiently sensitive for use with electrical systems with a low earth failure current (it can be adjusted to 0.01 times the rated current so low rated levels can be selected).

The main features of the relay are listed below. These will be described in greater detail in this manual:

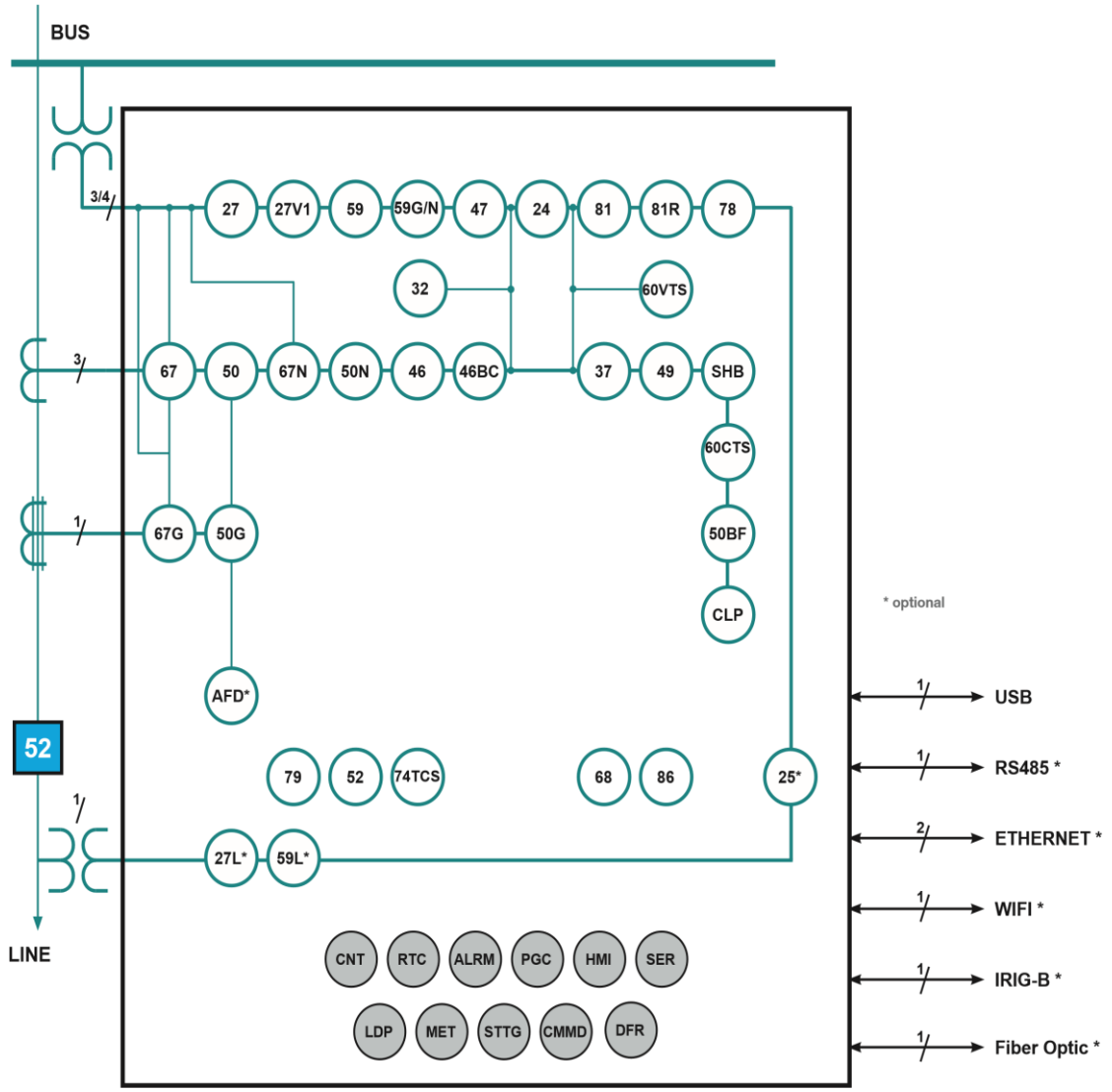
Function	Description	SIL-G
Protection		
50	Phase instantaneous overcurrent	2
SOTF	Switch On To Fault	1
50G	Ground instantaneous overcurrent	1
50N	Neutral instantaneous overcurrent (calculated)	1
67	Phase Inverse time directional overcurrent	4
67G	Ground Inverse time directional overcurrent	2
67N	Neutral Inverse time directional overcurrent (calculated)	2
46	Negative sequence over current / Phase balance current	1
46BC	Broken conductor detection	1
49	Thermal image	1
37	Phase instantaneous undercurrent	1
AFD	Arc Flash detection	1 (4 AFD inputs + 4 high-speed outputs)
27	Phase Instantaneous undervoltage	2
27V1	Positive sequence undervoltage	1
27L	Line Instantaneous undervoltage	1 (Optional)
59	Phase Instantaneous overvoltage	2
59N/G	Neutral Instantaneous overvoltage (measured/calculated)	2
47	Negative sequence overvoltage / Phase balance voltage	1
59L	Line Instantaneous overvoltage	1 (Optional)
32	Directional Power	4
81U/O	Under/Over frequency	4
81R	Rate of change of frequency (ROCOF)	4
78	Vector shift (Out of step)	1
24	Overfluxing	2
79	Recloser	✓ Up to 4 attempts.
25	Synchro check	1 (Optional)
74TCS	Trip Circuit supervision	1
60CTS	Current Transformer Supervision	1

60VTS	Voltage Transformer Supervision	1
50BF	Breaker failure monitoring	1
SHB	Second harmonic blocking	1
CLP	Cold Load Pick-up	1
52	Circuit breaker monitoring	✓
86	Trip output lockout with PLC	✓
Circuit breaker		
	State and command of the circuit breaker	✓
	Counter for the number of openings	✓
	Counter for accumulated amperes	✓
	Maximum number of openings in a time window	✓
Inputs and Outputs		
	Configurable inputs	Depending on model: 8 inputs at 24-230 Vac/dc 16 inputs at 24-230 Vac/dc 24 inputs at 24-230 Vac/dc 8 inputs at 24-230 Vac/dc + 4 AFD Inputs
	Configurable outputs	Depending on model: 7 outputs: 1 NC or 1 NO (depending on model) + 6 NO 11: 4 NO/NC + 7 NO 18: 4 NO/NC + 1 NC + 13 NO 7: 1 NC + 6 NO + 4 High-Speed outputs

Communication and HMI		
	LOCAL Port: ModBus RTU	✓
	REMOTE Ports: • 1 RS485 port: Modbus RTU, IEC60870-5-103 or DNP 3.0 Serial (selectable by general settings) • 2 rear ports: 1 RS485 port: Modbus RTU, IEC60870-5-103 or DNP 3.0 Serial (selectable by general settings) + 1 Ethernet port (RJ45): Modbus TCP and DNP 3.0 TCP (selectable by general settings) + IRIG-B • 2 Ethernet ports (RJ45): 1 RJ45 port for IEC 61850 + 1 RJ45 port: Modbus TCP or DNP 3.0 TCP + IRIG-B • 2 Ethernet ports: 1 FO-LC port for IEC 61850 + 1 RJ45 port: Modbus TCP or DNP 3.0 TCP + IRIG-B • 3 rear ports: 2 Fiber Optic port: HSR – IEC61850 + 1 Ethernet port (RJ45): Modbus TCP or DNP 3.0 TCP (selectable by general settings) + IRIG-B • 3 rear ports: 2 Fiber Optic port: PRP – IEC61850 + 1 Ethernet port (RJ45): Modbus TCP or DNP 3.0 TCP (selectable by general settings) + IRIG-B • WiFi + 1 RS485 port: Modbus RTU, IEC60870-5-103 or DNP 3.0 Serial (selectable by general settings) • WiFi + 2 rear ports: 1 RS485 port: Modbus RTU, IEC60870-5-103 or DNP 3.0 Serial (selectable by general settings) +1 Ethernet port (RJ45): Modbus TCP and DNP 3.0 TCP (selectable by general settings) + IRIG-B • WiFi + 2 Ethernet ports (RJ45): 1 RJ45 port for IEC 61850 + 1 RJ45 port: Modbus TCP and DNP 3.0 TCP (selectable by general settings) + IRIG-B • WiFi + 2 rear ports: 1 Fiber Optic port: HSR – IEC61850 + 1 Ethernet port (RJ45): Modbus TCP and DNP 3.0 TCP (selectable by general settings) + IRIG-B • WiFi + 2 rear ports: 1 Fiber Optic port: PRP – IEC61850 + 1 Ethernet port (RJ45): Modbus TCP and DNP 3.0 TCP (selectable by general settings) + IRIG-B • WiFi + 2 Ethernet ports:1 FO-LC port for IEC 61850 + 1 RJ45 port: Modbus TCP and DNP 3.0 TCP (selectable by general settings) + IRIG-B	✓ (Optional)
	SICom Program for Windows 7, 8, 8.1 or 10	✓
	Session: 4 log-in levels with a configurable password	✓
	HMI: LCD, 20x4	✓
	6 keys + 1 reset button + 2 keys to open/close 52 + 2 key to block/unblock 79 + 2 keys to change local/remote control	✓
	LED indicators	11: 8 configurable + 3 non-configurable

Power Supply		
	Auxiliary voltage	Depending on model: 24-48 Vdc 48-230 Vdc/ac 24-230 Vdc/Vac
Monitoring and Recording		
	Events stored in the non-volatile RAM memory	3072
	Oscillographic logs in the non-volatile FRAM memory	1300-1500 cycles at 32 samples/cycle Number of cycles configurable: 260 cycles→it is recorded 5 oscillography records (length 260x5=1300). 60 cycles→it is recorded 25 oscillography records (length 60x25=1500). 30 cycles→it is recorded 50 oscillography records (length 30x50=1500). 15 cycles→it is recorded 100 oscillography records (length 15x100=1500).
	Load data profiling (LDP)	✓ 2160 records
	Alarms Panel	✓ 32 alarms
	Real Time Clock (RTC 1 millisecond)	✓
	IRIG-B synchronism	✓ (Optional)
	Test menu	✓
	Self-diagnostic	✓
Settings Group		
	Using keys Using configurable inputs Using communications	4 settings group
Mechanics		
	Dimensions	175x175x150

3.3 Functional diagram



ADDITIONAL FUNCTIONS	
CNT	Counters
RTC	Real Time Clock
ALRM	Alarm panel
PGC	Programmable Logic Control
HMI	Human Machine Interface
SER	Sequential Event Recording
DFR	Disturbance Fault Recording
LDP	Load Data Profiling
MET	Metering
STTG	Settings Groups
CMMD	Commands

3.4 Selection & Ordering codes

SIL-G	Feeder & Generator Protection Relay										
	0										**PHASE CURRENT MEASUREMENT** In= 1 A or 5 A
		0									**NEUTRAL CURRENT MEASUREMENT** In= 1 A or 5 A
			0								**VOLTAGE MEASUREMENT** Up to 1000 V (direct connection) or 250 V (with VTs)
				A B C							**POWER SUPPLY** 24-48 Vdc 48-230 Vac/dc 24-230 Vac/dc (Only for communication models: A, B, F and G)
					0 1						**ADDITIONAL FUNCTIONS** - +25 + 27L + 59L
						A B C D E F G H I J K L					**COMMUNICATIONS** A: USB (Modbus RTU) + RS485: (Modbus RTU, IEC60870-5-103 or DNP3.0 Serial) B: USB (Modbus RTU) + RS485 (Modbus RTU, IEC60870-5-103 or DNP3.0 Serial) + RJ45 (Modbus TCP or DNP3.0 TCP) + IRIG-B C: USB (Modbus RTU) + Ethernet - RJ45 (IEC 61850) + RJ45 (Modbus TCP or DNP3.0 TCP) + IRIG-B D: USB (Modbus RTU) + HSR – FO (IEC 61850) + RJ45 (Modbus TCP or DNP3.0 TCP) + IRIG-B E: USB (Modbus RTU) + PRP – FO (IEC 61850) + RJ45 (Modbus TCP or DNP3.0 TCP) + IRIG-B F: USB (Modbus RTU) + WiFi + RS485 (Modbus RTU, IEC60870-5-103 or DNP3.0 Serial) G: USB (Modbus RTU) + WiFi + RS485 (Modbus RTU, IEC60870-5-103 or DNP3.0 Serial) + RJ45 (Modbus TCP or DNP3.0 TCP) + IRIG-B H: USB (Modbus RTU) + WiFi + Ethernet - RJ45 (IEC 61850) + RJ45 (Modbus TCP or DNP3.0 TCP) + IRIG-B I: USB (Modbus RTU) + WiFi + HSR – FO (IEC 61850) + RJ45 (Modbus TCP or DNP3.0 TCP) + IRIG-B J: USB (Modbus RTU) + WiFi + PRP – FO (IEC61850) + RJ45 (Modbus TCP or DNP3.0 TCP) + IRIG-B K: USB (Modbus RTU) + FO-LC (IEC 61850) + RJ45 (Modbus TCP or DNP3.0 TCP) + IRIG-B L: USB (Modbus RTU) + WiFi + FO-LC (IEC 61850) + RJ45 (Modbus TCP or DNP3.0 TCP) + IRIG-B
							0 5 6 7 A				**INPUTS AND OUTPUTS** 8 Inputs + 7 Outputs 24 Inputs + 7 Outputs 8 Inputs + 18 Outputs 16 Inputs + 11 Outputs 8 Inputs + 7 Outputs + 4 AFD Inputs + 4 High-speed Outputs
								4			**MECHANICAL ASSEMBLY** Vertical Assembly
									A E		**LANGUAGE** English, Spanish, German and French English, Spanish, Turkish and Russian
										B	**ADAPTATION** Second generation. Default functions: 50(2) + SOTF + 50G + 50N + 67(4) + 67G(2) + 67N(2) + 46 + 46BC + 49 + 37 +27(2) + 27V1 + 59(2) + 59N/G(2) + 47 + 32(4) + 81U/O(4) + 81R(4) + 78 + 24(2) + 79 + 74TCS + 60CTS + 60VTS + 50BF + SHB + CLP + 52 + 86

Not all combinations are possible. Please, confirm with Fanox chosen model.

3.5 Phase CT and neutral CT selection

SIL-G measures from 0.01 times the nominal current to 30 times the nominal current.

The following table shows a summary of the phase and neutral CT combinations:

Model	In	Phase range	Neutral Range
SIL-G00	5 A	0.05-150 A	0.05-150 A
SIL-G00	1 A	0.01-30 A	0.01-30 A

4 CURRENT PROTECTION FUNCTIONS

To be able to trip with any of the protection functions, the setting Function Enable must be set to a value different to No. There are 3 different options: Alarm, Trip or SHB Trip.

In two first cases the function will trip, but only if the Function Enable is set to Trip the protection function will participate in the GENERAL TRIP.

If SHB Trip is selected, the SHB function is checked (if enable) and if a second harmonic is the responsible of the Pickup the trip is blocked.

4.1 Function 50. Instantaneous phase overcurrent

This protection function can be set by using the following parameters:

Function	Description	Minimum	Maximum	Step	Unit	Default
50-1 50-2	**Instantaneous phase overcurrent**					
	Function Enable	-	-	No/Alarm/Trip/SHB Trip	-	No
	Current Tap	0.010	30.000	0.001	xIn	5.000
	Time Delay	0.000	300.000	0.001	s	0.200

The time delay is independent from the operating current flowing through the relay, so if the phase current exceeds its predetermined value for an equal or greater amount of time than this preset value, the protection function activates (trips) and does not reset itself until the average value of the phase drops below the point of current pick-up. The function activates at 100% of the preset input and deactivates at 95%. The reset is instantaneous.

The accuracy of the Time Delay is equal to the set time ±35ms or ±0.5% (whichever is greater).

4.2 Function SOTF. Switch On To Fault

This protection function can be set by using the following parameters:

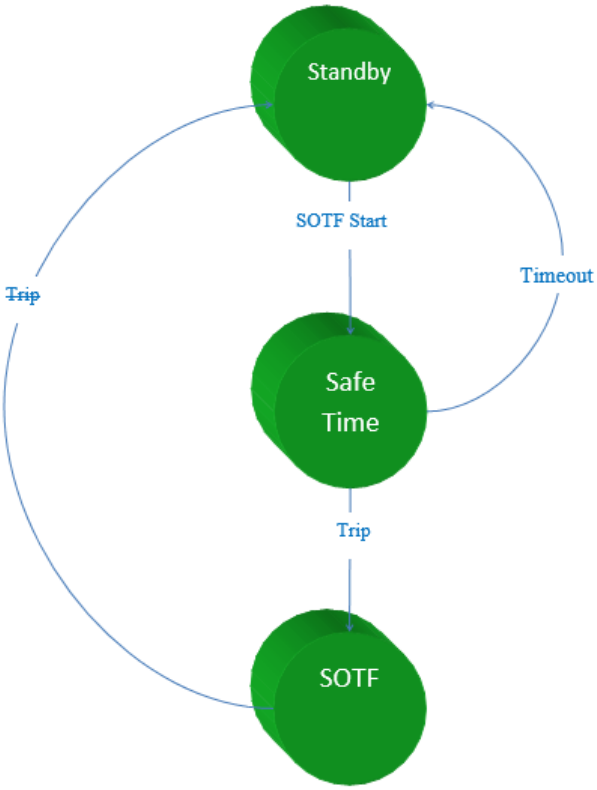
Function	Description	Minimum	Maximum	Step	Unit	Default
SOTF	**Switch On To Fault**					
	Function Enable	-	-	No/Alarm/Trip/SHB Trip	-	No
	Current Tap	0.010	30.000	0.001	xIn	5.000
	Time Delay	0.000	295.000	0.001	s	0.050
	Safe Time	0.000	300.000	0.001	s	2.000

When the logic signal '**SOFT Star**' is activated, it starts the pickup of the function. This protection is provided for high speed clearance of detected fault immediately after Manual Closure of Circuit Breaker or any other conditions selectable through this logical signal.

The function is active during the time adjusted in Safe Time and this setting must be coordinated with the Time delay in order to allow the correct behavior of the function.

The time delay is independent from the operating current flowing through the relay, so if the phase current exceeds its predetermined value for an equal or greater amount of time than this preset value, the protection function activates (trips) and does not reset itself until the average value of the phase drops below the point of current pick-up. The function activates at 100% of the preset input and deactivates at 95%. The reset is instantaneous.

The accuracy of the Time Delay is equal to the set time ±35ms or ±0.5% (whichever is greater).



4.3 Function 67. Inverse time directional phase overcurrent

This protection function can be set by using the following parameters:

Function	Description	Minimum	Maximum	Step	Unit	Default
67-1 67-2 67-3 67-4	**Inverse time directional phase overcurrent**					
	Function Enable	-	-	No/Alarm/Trip/SHB Trip	-	No
	Curve Type	-	-	(1)	-	IEC Standard Inverse
	Time Dial (TMS)	0.05	25.00	0.01	(2)	1.00
	Current Tap	0.010	20.000	0.001	xIn	5.000
	Time Delay	0.000	300.000	0.001	s	0.200
	Directionality	-	-	No/Forward/Reverse	-	No
	Polarization voltage	0.08	2.00	0.01	xUn	0.50
	Operating angle	0	359	1	degrees	90
	Halfcone angle	10	170	1	degrees	90

"Un" will be ***Nominal V. P-P*** setting (available in general settings) regardless the VT connection type, due to the polarization voltage is always considered as phase-phase voltage.

(1) Definite time and 8 curves are included to be selected by the user:

TYPE	NAME
DT	Definite Time
IEC	Standard Inverse
	Very Inverse
	Extremely Inverse
	Long Time Inverse
	Short time Inverse
IEEE	Moderately Inverse
	Very Inverse
	Extremely Inverse

(2) The range of the time Multiplier setting will depend on the curve. The range of this setting for each curve family is as follows:

TIME DIAL (TMS)						
	Description	**Minimum**	**Maximum**	**Step**	**Unit**	**Default**
IEC	Time Multiplier	0.05	1.00	0.01	-	1.00
IEEE	Time Multiplier	0.10	25.00	0.01	-	1.00

If the option 'Defined time' is selected for the curve setting, the unit behaves like an instantaneous directional overcurrent unit. In this case, the unit time delay is adjusted by using the parameter 'Time delay'.

If a curve is selected for the curve setting, the time delay depends on the curve, dial and tap settings.

If the unit operates as defined time, the function is activated at 100% of the set tap value, and it deactivates at 95%.

If the unit operates with a curve, the function is activated at 110% of the set tap value, and it deactivates at 100%.

The reset is instantaneous in both cases.

If the unit operates as defined time, the accuracy of the Time Delay is equal to the set time ±35ms or ±0.5% (whichever is greater).

If a curve is selected for the curve setting, the accuracy of the time delay is equal to the theoretical time ±30ms or ±5% (whichever is greater).

The curves used are IEC 60255-151 and IEEE, which are described in the corresponding section.

This function uses the cross-phase voltage as a polarization magnitude and the phase current as an operating magnitude. The intervention sector is defined in the following way: the operating angle is rotated anticlockwise from the polarization voltage which gives us the maximum torque direction. A cone is drawn, with the half-cone angle adjusted, over this maximum torque direction.

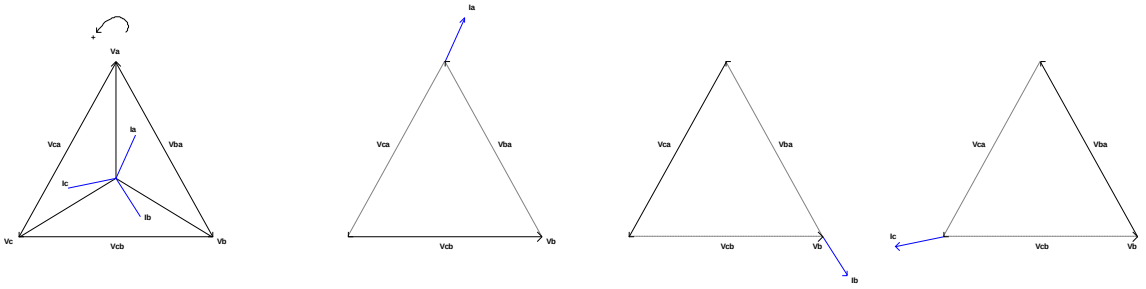
If the directionality option is not activated, the 67 function behaves like a 51/50 function.

The actuation time starts when the following conditions are met simultaneously:

- Phase current higher than adjusted.
- Polarization voltage higher than adjusted. To reset this condition a value lower than 95% of adjusted voltage is required.
- The phase shift of phase current and polarization voltage is such that the phase current is inside the intervention sector. To reset this condition a displacement higher than 3º of operating area limits is required.

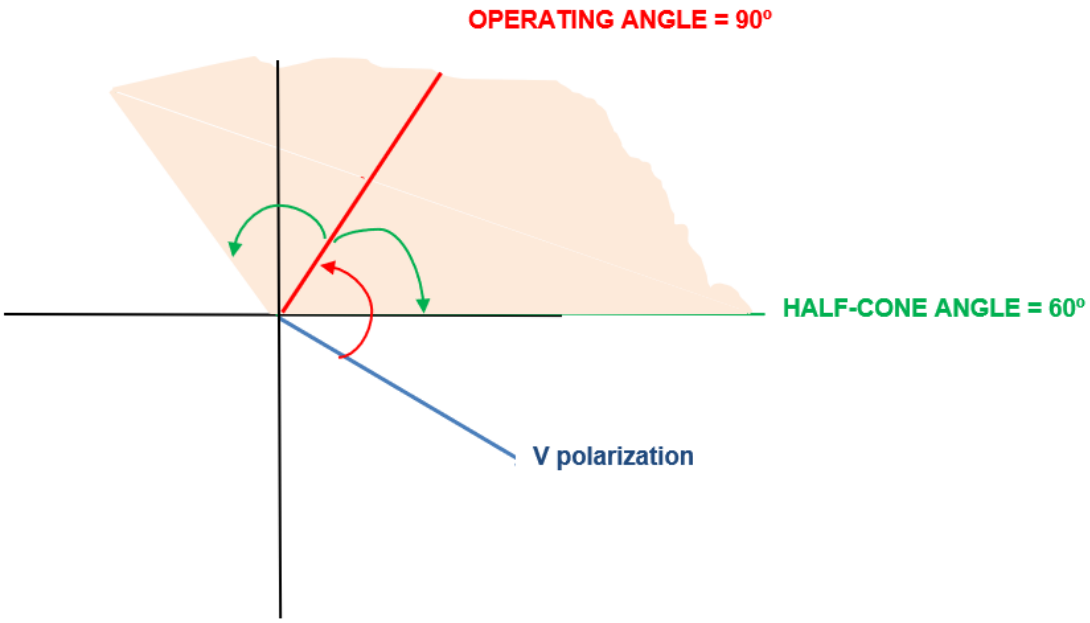
The following table shows the operating and polarization magnitudes used for each phase. Those magnitudes are displayed graphically below the table.

Phase	Operating magnitude	Polarization magnitude
Phase A	IA Current	UBC Voltage
Phase B	IB Current	UCA Voltage
Phase C	IC Current	UAB Voltage

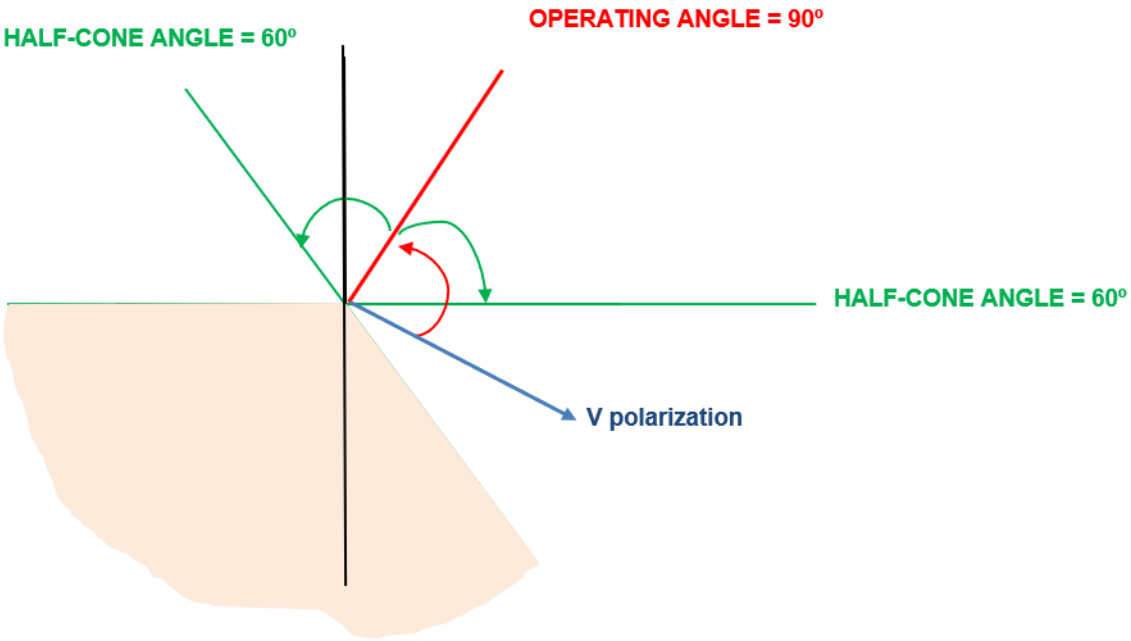


The following figure shows a graphic representation of the directional actuation zone, adjusted with an operating angle of 90° and a half-cone angle of 60°.

FORWARD



REVERSE



4.4 Function 50G. Instantaneous measured neutral overcurrent

This protection function can be set by using the following parameters:

Function	Description	Minimum	Maximum	Step	Unit	Default
50G	**Instantaneous calculated neutral overcurrent**					
	Function Enable	-	-	No/Alarm/Trip/SHB Trip	-	No
	Current Tap	0.010	30.000	0.001	xIn	5.000
	Time Delay	0.000	300.000	0.001	s	0.200

The time delay is independent from the operating current flowing through the relay, so if the phase current exceeds its predetermined value for an equal or greater amount of time than this preset value, the protection function activates (trips) and does not reset itself until the average value of the phase drops below the point of current pick-up.

The function activates at 100% of the preset input and deactivates at 95%. The reset is instantaneous.

The accuracy of the Time Delay is equal to the set time ±35ms or ±0.5% (whichever is greater).

4.5 Function 50N. Instantaneous calculated neutral overcurrent

This protection function can be set by using the following parameters:

Function	Description	Minimum	Maximum	Step	Unit	Default
50N	**Instantaneous calculated overcurrent**					
	Function Enable	-	-	No/Alarm/Trip/SHB Trip	-	No
	Current Tap	0.050	30.000	0.001	xIn	5.000
	Time Delay	0.000	300.000	0.001	s	0.200

The time delay is independent from the operating current flowing through the relay, so if the phase current exceeds its predetermined value for an equal or greater amount of time than this preset value, the protection function activates (trips) and does not reset itself until the average value of the phase drops below the point of current pick-up.

The function activates at 100% of the preset input and deactivates at 95%. The reset is instantaneous.

The accuracy of the Time Delay is equal to the set time ±35ms or ±0.5% (whichever is greater).

4.6 Function 67G. Inverse time directional measured neutral overcurrent

This protection function can be set by using the following parameters:

Function	Description	Minimum	Maximum	Step	Unit	Default
67G-1 67G-2	**Inverse time directional measured neutral overcurrent**					
	Function Enable	-	-	No/Alarm/Trip/SHB Trip	-	No
	Curve Type	-	-	(1)	-	IEC Standard Inverse
	Time Dial (TMS)	0.05	25	0.01	(2)	1.00
	Current Tap	0.010	20.000	0.001	xIn	5.000
	Time Delay	0.000	300.00	0.001	s	0.200
	Directionality	-	-	No/Forward/Reverse	-	No
	Polarization voltage	0.08	2.00	0.01	xUn	0.5
	Operating angle	0	359	1	degrees	90
	Half-cone angle	10	170	1	degrees	90

"Un" will be ***Nominal V. P-P setting/*** $\sqrt{3}$ (available in general settings) regardless the VT connection type.

(1) Definite time and 8 curves are included to be selected by the user:

TYPE	NAME
DT	Definite Time
IEC	Standard Inverse
	Very Inverse
	Extremely Inverse
	Long Time Inverse
	Short time Inverse
IEEE	Moderately Inverse
	Very Inverse
	Extremely Inverse

(2) The range of the time Multiplier setting will depend on the curve. The range of this setting for each curve family is as follows:

TIME DIAL (TMS)						
	Description	**Minimum**	**Maximum**	**Step**	**Unit**	**Default**
IEC	Time Multiplier	0.05	1.00	0.01	-	1.00
IEEE	Time Multiplier	0.10	25.00	0.01	-	1.00

If the option 'Defined time' is selected for the curve setting, the unit behaves like an instantaneous directional overcurrent unit. In this case, the unit time delay is adjusted by using the parameter 'Time delay'.

If a curve is selected for the curve setting, the time delay depends on the curve, dial and tap settings.

If the unit operates as defined time, the function is activated at 100% of the set tap value, and it deactivates at 95%.

If the unit operates with a curve, the function is activated at 110% of the set tap value, and it deactivates at 100%.

The reset is instantaneous in both cases.

If the unit operates as defined time, the accuracy of the Time Delay is equal to the set time ±35ms or ±0.5% (whichever is greater).

If a curve is selected for the curve setting, the accuracy of the time delay is equal to the theoretical time ±30ms or ±5% (whichever is greater).

The curves used are IEC 60255-151 and IEEE, which are described in the corresponding section.

This function uses the neutral voltage as a polarization magnitude and the neutral current as an operating magnitude. The intervention sector is defined in the following way: the operating angle is rotated anticlockwise from the polarization voltage which gives us the maximum torque direction. A cone is drawn, with the half-cone angle adjusted, over this maximum torque direction.

If the directionality option is not activated, the 67G function behaves like a 51G/50G function.

The actuation time starts when the following conditions are met simultaneously:

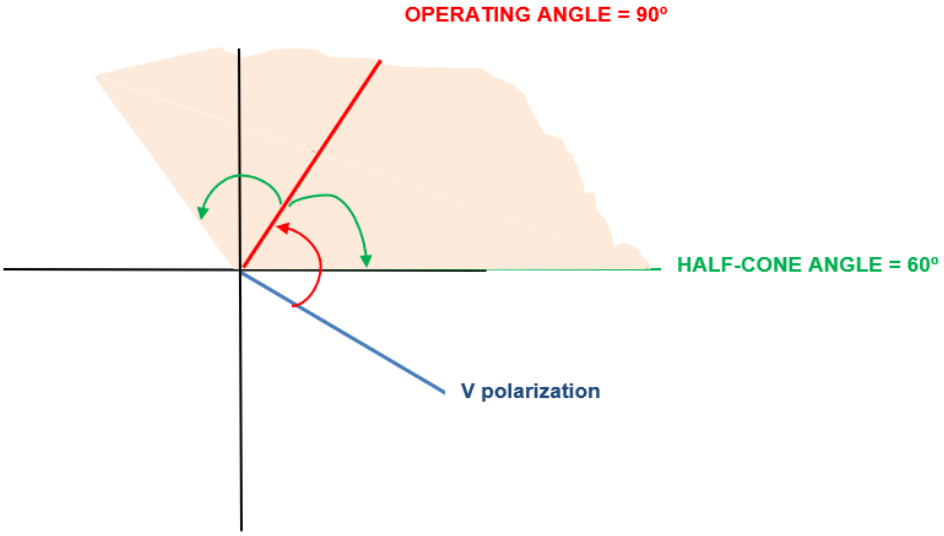
- Neutral current higher than adjusted.
- Polarization voltage higher than adjusted. To reset this condition a value lower than 95% of adjusted voltage is required.
- The phase shift of phase current and polarization voltage is such that the neutral current is inside the intervention sector. To reset this condition a displacement higher than 3º of operating area limits is required.

The following table shows the operating and polarization magnitudes used for this function. Those magnitudes are displayed graphically below the table.

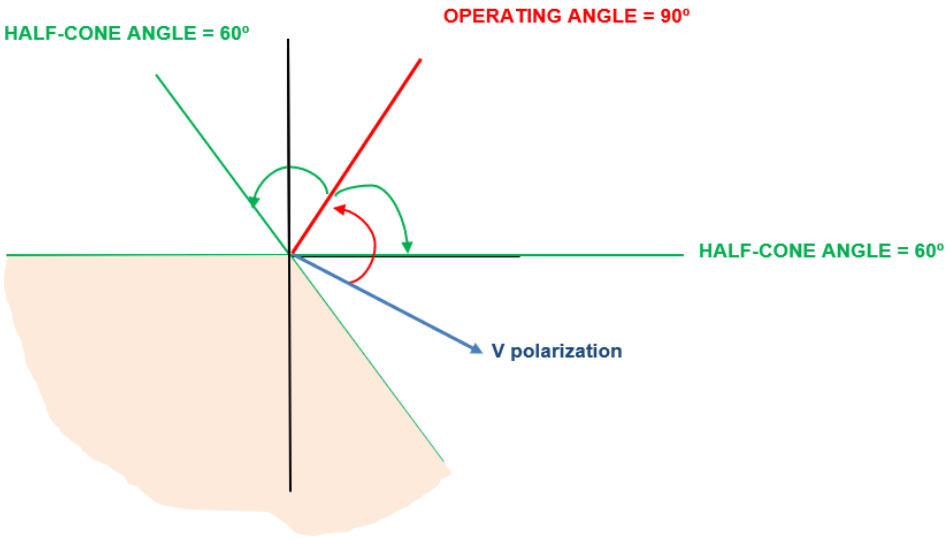
Neutral	Operating magnitude	Polarization magnitude
Neutral	IN Current	Vr if available or 3V0 Voltage

For this function, depending on the VT connection, the polarization voltage will be the Residual Voltage (Vr) when available or the calculated 3V0 when there is no direct measurement of the neutral voltage.

FORWARD



REVERSE



4.7 Function 67N. Inverse time directional calculated overcurrent

This protection function can be set by using the following parameters:

Function	Description	Minimum	Maximum	Step	Unit	Default
67N-1 67N-2	**Inverse time directional calculated overcurrent**					
	Function Enable	-	-	No/Alarm/Trip/SHB Trip	-	No
	Curve Type	-	-	(1)	-	IEC Standard Inverse
	Time Dial (TMS)	0.05	25.00	0.01	(2)	1.00
	Current Tap	0.050	20.000	0.001	xIn	5.000
	Time Delay	0.000	300.000	0.001	s	0.200
	Directionality	-	-	No/Forward/Reverse	-	No
	Polarization voltage	0.08	2.00	0.01	xUn	0.50
	Operating angle	0	359	1	degrees	90
	Half-cone angle	10	170	1	degrees	90

"Un" will be ***Nominal V. P-P setting/*** $\sqrt{3}$ (available in general settings) regardless the VT connection type.

(1) Definite time and 8 curves are included to be selected by the user:

TYPE	NAME
DT	Definite Time
IEC	Standard Inverse
	Very Inverse
	Extremely Inverse
	Long Time Inverse
	Short time Inverse
IEEE	Moderately Inverse
	Very Inverse
	Extremely Inverse

(2) The range of the time Multiplier setting will depend on the curve. The range of this setting for each curve family is as follows:

TIME DIAL (TMS)						
	Description	**Minimum**	**Maximum**	**Step**	**Unit**	**Default**
IEC	Time Multiplier	0.05	1.00	0.01	-	1.00
IEEE	Time Multiplier	0.10	25.00	0.01	-	1.00

If the option 'Defined time' is selected for the curve setting, the unit behaves like an instantaneous directional overcurrent unit. In this case, the unit time delay is adjusted by using the parameter 'Time delay'.

If a curve is selected for the curve setting, the time delay depends on the curve, dial and tap settings.

If the unit operates as defined time, the function is activated at 100% of the set tap value, and it deactivates at 95%.

If the unit operates with a curve, the function is activated at 110% of the set tap value, and it deactivates at 100%.

The reset is instantaneous in both cases.

If the unit operates as defined time, the accuracy of the Time Delay is equal to the set time ±35ms or ±0.5% (whichever is greater).

If a curve is selected for the curve setting, the accuracy of the time delay is equal to the theoretical time ±30ms or ±5% (whichever is greater).

The curves used are IEC 60255-151 and IEEE, which are described in the corresponding section.

This function uses the calculated neutral voltage as a polarization magnitude and the neutral current as an operating magnitude. The intervention sector is defined in the following way: the operating angle is rotated anticlockwise from the polarization voltage which gives us the maximum torque direction. A cone is drawn, with the half-cone angle adjusted, over this maximum torque direction.

If the directionality option is not activated, the 67N function behaves like a 51N/50N function.

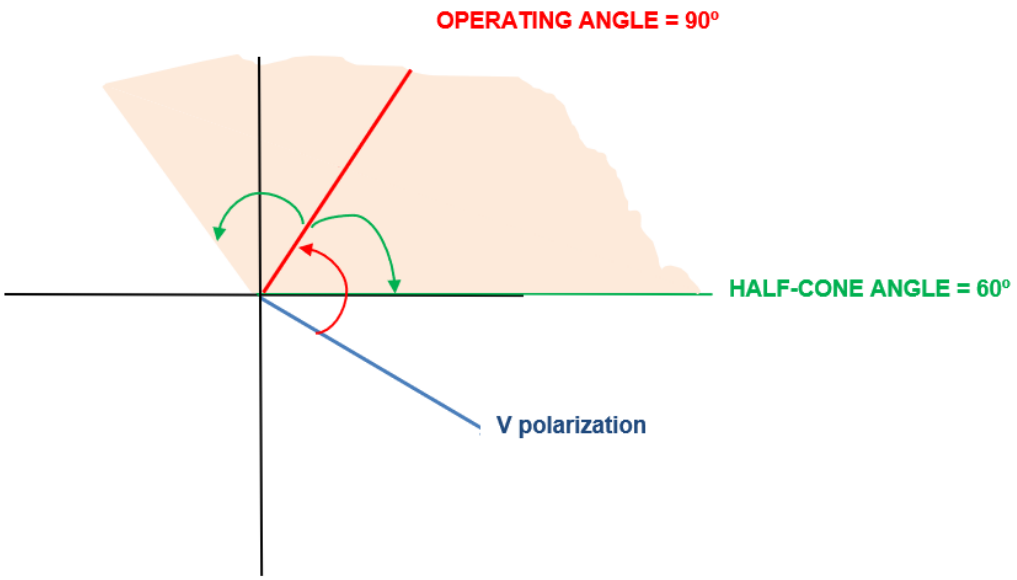
The actuation time starts when the following conditions are met simultaneously:

- Phase current higher than adjusted.
- Polarization voltage higher than adjusted. To reset this condition a value lower than 95% of adjusted voltage is required.
- The phase shift of phase current and polarization voltage is such that the phase current is inside the intervention sector. To reset this condition a displacement higher than 3º of operating area limits is required.

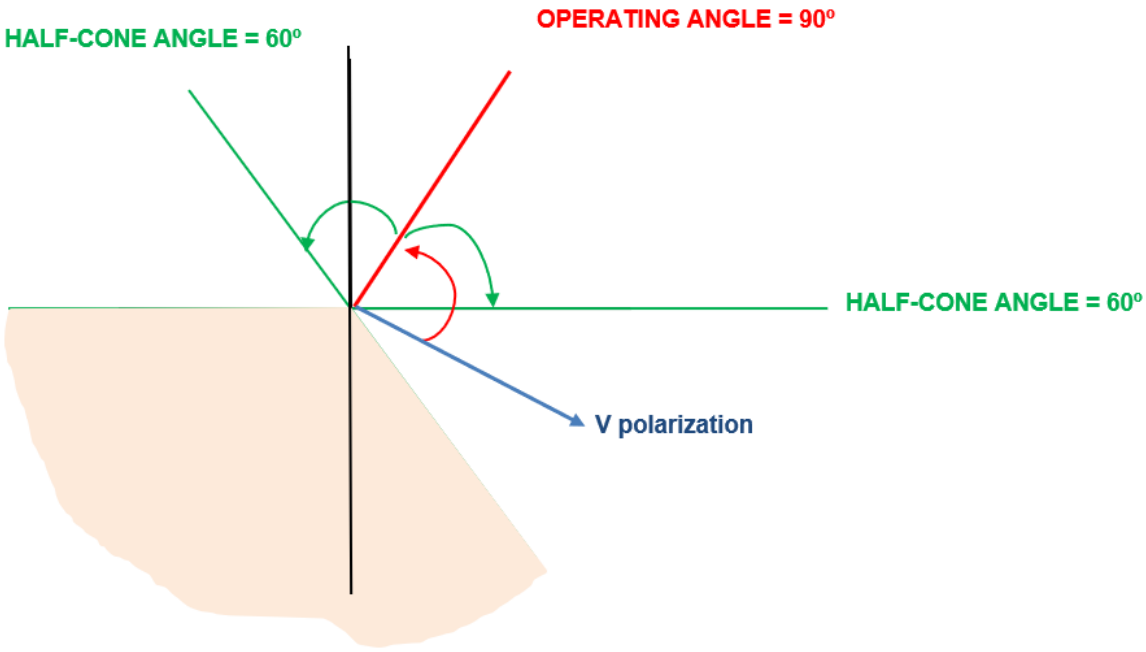
The following table shows the operating and polarization magnitudes used for this function. Those magnitudes are displayed graphically below the table.

Neutral	Operating magnitude	Polarization magnitude
Neutral	IN Current	3V0 Voltage

FORWARD



REVERSE



4.8 Function 46. Phase balance current protection

This protection function can be set by using the following parameters:

Function	Description	Minimum	Maximum	Step	Unit	Default
46	**Phase balance current protection**					
	Function Enable	-	-	No/Alarm/Trip/SHB Trip	-	No
	Curve Type	-	-	(1)	-	IEC Standard Inverse
	Time Dial (TMS)	0.05	25.00	0.01	(2)	1.00
	Current Tap	0.050	20.000	0.001	xIn	5.000
	Time delay	0.000	300.000	0.001	s	0.200

(1) Definite time and 8 curves are included to be selected by the user:

TYPE	NAME
DT	Definite Time
IEC	Standard Inverse
	Very Inverse
	Extremely Inverse
	Long Time Inverse
	Short time Inverse
IEEE	Moderately Inverse
	Very Inverse
	Extremely Inverse

(2) The range of the time Multiplier setting will depend on the curve. The range of this setting for each curve family is as follows:

TIME DIAL (TMS)						
	Description	**Minimum**	**Maximum**	**Step**	**Unit**	**Default**
IEC	Time Multiplier	0.05	1.00	0.01	-	1.00
IEEE	Time Multiplier	0.10	25.00	0.01	-	1.00

If the option ‘Defined time’ is selected for the curve setting, the unit behaves like an instantaneous directional overcurrent unit. In this case, the unit time delay is adjusted by using the parameter ‘Time delay’.

If a curve is selected for the curve setting, the time delay depends on the curve, dial and tap settings.

If the unit operates as defined time, the function is activated at 100% of the set tap value, and it deactivates at 95%.

If the unit operates with a curve, the function is activated at 110% of the set tap value, and it deactivates at 100%.

The reset is instantaneous in both cases.

If the unit operates as defined time, the accuracy of the Time Delay is equal to the set time ±35ms or ±0.5% (whichever is greater).

If a curve is selected for the curve setting, the accuracy of the time delay is equal to the theoretical time ±30ms or ±5% (whichever is greater).

The curves used are IEC 60255-151 and IEEE, which are described in the corresponding section.

4.9 Function 46BC. Broken conductor detection

This protection function can be set by using the following parameters:

Function	Description	Minimum	Maximum	Step	Unit	Default
46BC	**Broken conductor protection**					
	Function Enable	-	-	No/Alarm/Trip	-	No
	Tap	15	100	1	%	50
	Operating time	0.030	300.000	0.001	s	0.200

This protection detects the percentage phase unbalance due to an open phase condition. It considers the measurement I2/I1 in percentage.

If the measured relation between I2 and I1 is higher (in percentage) than the setting in the function during the adjusted time, the function will trip.

The function activates at 100% of the preset input and deactivates at 95%. The reset is instantaneous.

The accuracy of the time delay is equal to the set time ±30ms or ±0.5% (whichever is greater).

4.10 Function 49. Thermal Overload

This protection function can be set by using the following parameters:

Function	Description	Minimum	Maximum	Step	Unit	Default
49	**Thermal image**					
	Function Enable	-	-	No/Alarm/Trip	-	No
	Current Tap	0.100	2.400	0.001	xIn	1.200
	ζ Heating constant	3	600	1	min	3
	Cooling constant	1	6	1	x ζ Heating	1
	Alarm	20	99	1	%	80

Thermal image is a measurement of heating and cooling of an electric machine. Contrary to an overcurrent protection time is not counted when a fault is detected. It continues calculating the thermal

status of the monitored machine. Tripping time depends on adjusted thermal constants, operative current and previous thermal status of the machine.

Thermal image is calculated based on next equation:

$$\theta = 100 \times (I/It)^2 \times (1 - e^{-t/\zeta}) + \theta'0 \times e^{-t/\zeta}$$

where:

I, maximum three phase fundamental current

It, adjusted tap current

ζ, thermal constant

θ'0, initial thermal status

Tripping time is determined by next equation:

$$t = \zeta \times \ln \{ [(I/It)^2 - (\theta'0 / 100)] / [(I/It)^2 - 1] \}$$

Tripping time accuracy is the 5% over the theorical time.

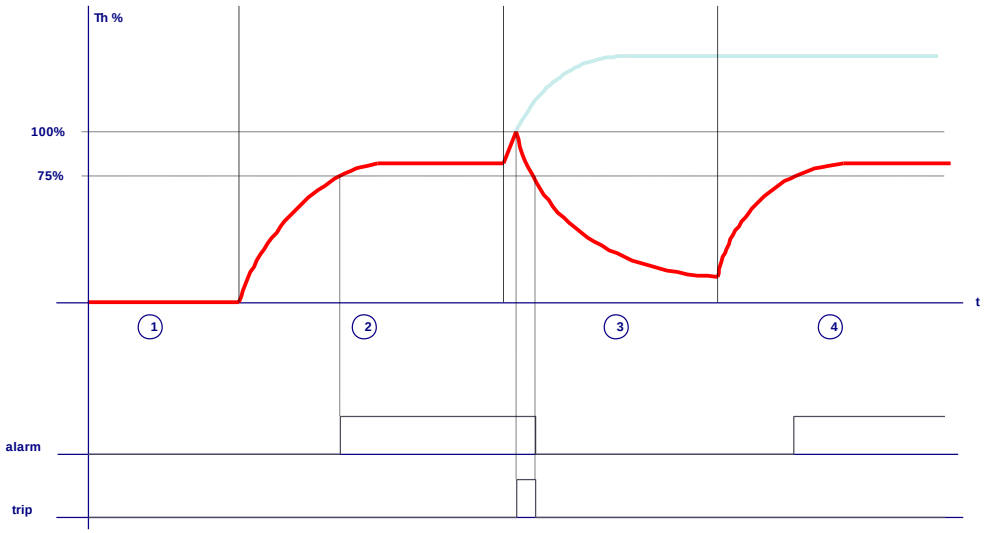
The algorithm uses the maximum current of the three phase currents. If the maximum current is higher than the adjusted tap, heating thermal constant is applied. If maximum current is lower than the adjusted tap, cooling thermal constant is applied.

Overload function trips when thermal image reaches the value of 100%. This value is got when the flow current is equal to the adjusted tap for the thermal image.

A configurable level is established in order to generate an alarm. If a trip happens, the overload function is reset when thermal image is below to the adjusted alarm level.

4.10.1 Thermal image measurement evolution graphic

On next graphic, thermal image measurement evolution can be observed depending on applied current:



With the thermal image protection adjusted with a tap of 1.1 times the nominal current and an alarm level of 75%.

Zone 1: The machine is deenergized for a long time. Thermal image is 0%.

Zone 2: We supply the machine with the nominal current. Thermal image evolutions so as to get the value of the thermal balance corresponding to one time the nominal current Th = $(I/It)^2$ = 82%. The time that it takes in getting the thermal balance depends on the adjusted heating constant.

Zone 3: Once reached the thermal image corresponding to the application of one time the nominal current, we apply 1.2 times the nominal current. Therma image will evolution so as to get the thermal balance corresponding to 1.2 times the nominal current Th = $(I/It)^2$ = 119%. This would occur if we had the permission of the thermal function disabled. If the permission is disabled, 49 protection function performs when the thermal image reaches the value of 100%. Once tripped, current stops and thermal image is getting cool based on the cooling constant.

Zone 4: Before getting totally cool, nominal current is applied again and thermal balance is reached once passed the time determined by the heating thermal constant.

Thermal image protection alarm bit is active if the thermal image measurement is over the adjusted alarm level.

Thermal image protection trip bit is active when the measurement of the thermal image is over 100% and it is reset when the measurement of the thermal image is under the adjusted alarm level.

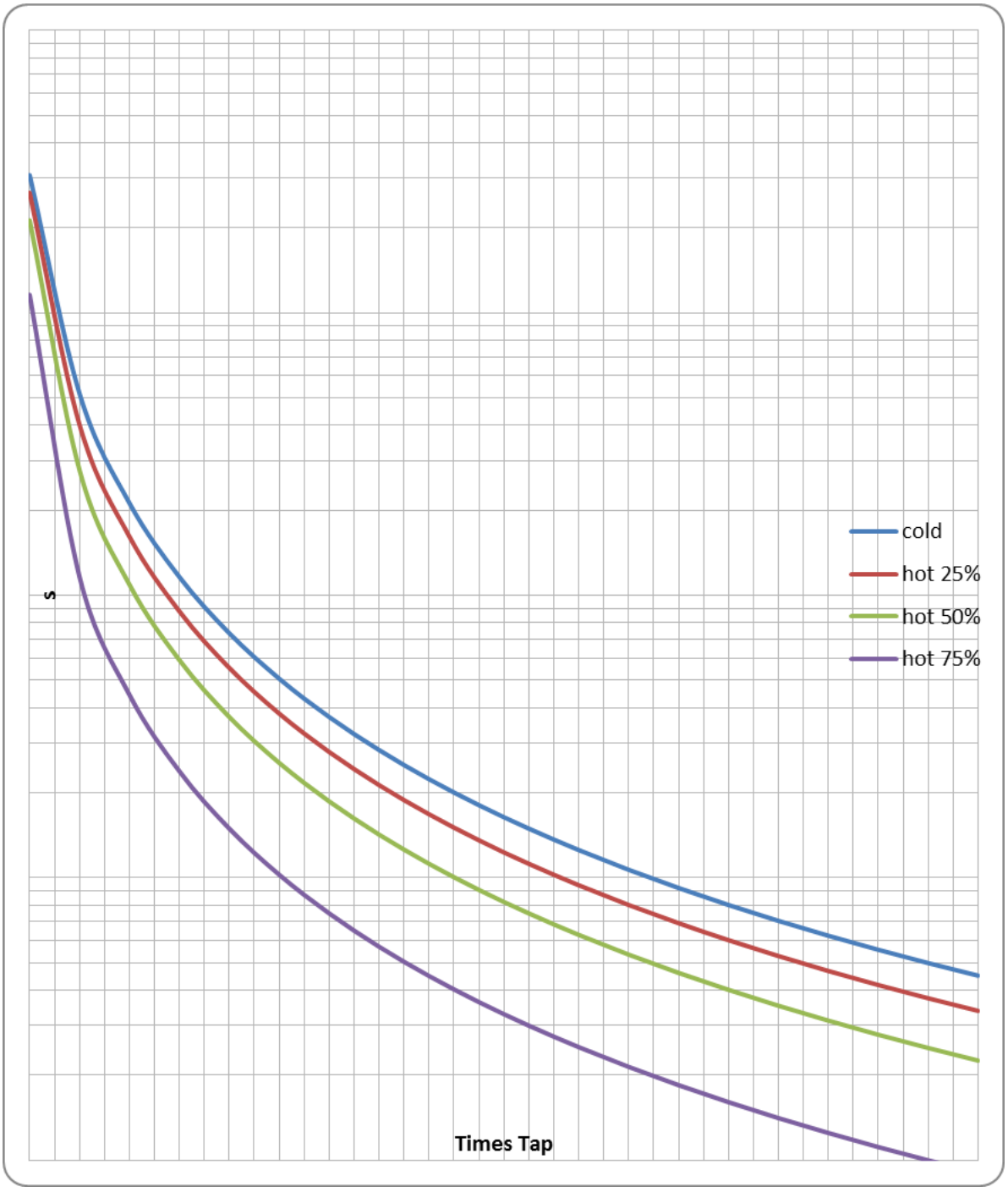
4.10.2 Thermal image with memory

Thermal image is stored in non-volatile RAM memory periodically every second. By this way, though the relay loses the power supply, it will keep the thermal status of the machine.

4.10.3 Thermal image measurement display. Reset.

Thermal image measurement is displayed on Measurement menu. Thermal image value reset is possible in Commands menu (Reset TI). This command reset the value of the thermal image to the value set in the alarm level.

4.10.4 Thermal protection curves



This is the thermal curve for ζ = 3 minutes.

4.11 Function 37. Instantaneous phase undercurrent

This protection function can be set by using the following parameters:

Function	Description	Minimum	Maximum	Step	Unit	Default
37	**Instantaneous phase undercurrent**					
	Function Enable	-	-	No/Alarm/Trip	-	No
	Current Tap	0.010	30.000	0.001	xIn	0.500
	Minimum Level	0.000	1.000	0.001	xIn	0.000
	Time delay	0.060	300.00	0.001	s	0.200

The setting “Minimum level” indicates the minimum level of current it is necessary to measure to work with the function. This is, if the measured current is lower than the “Minimum Level” setting, the function will not trip although this current is lower than the tap.

The time delay is independent from the operating current flowing through the relay, so if the phase current drops below its predetermined value for an equal or greater amount of time than this preset value, the protection function activates (trips) and does not reset itself until the average value of the phase exceeds the point of current pick-up.

The function activates at 100% of the preset input and deactivates at 105%. The reset is instantaneous.

The accuracy of the Time Delay is equal to the set time ±30ms or ±0.5% (whichever is greater).

4.12 Function AFD. Arc Flash Detection

This protection function can be set by using the following parameters:

Function	Description	Minimum	Maximum	Step	Unit	Default
AFD	**Arc Flash Detection**					
	Function Enable	-	-	No/Alarm/Trip	-	No
	Current Tap	1	20	1	xIn	2
	Time delay	1	4	1	samples	1

The setting “Time delay” indicates the number of samples of the measurement that the relay will take before the trip.

The arc flash can be detected by two different methods:

- By current: When the current of the line is higher than the one set in “current tap” the protection will trip.
- By light: When arc flash sensor connected to the relay detects the light due to the arc appeared in the circuit breaker, it will trip.

To activate the high-speed output, it is recommended to apply at least 19Vdc/ac.

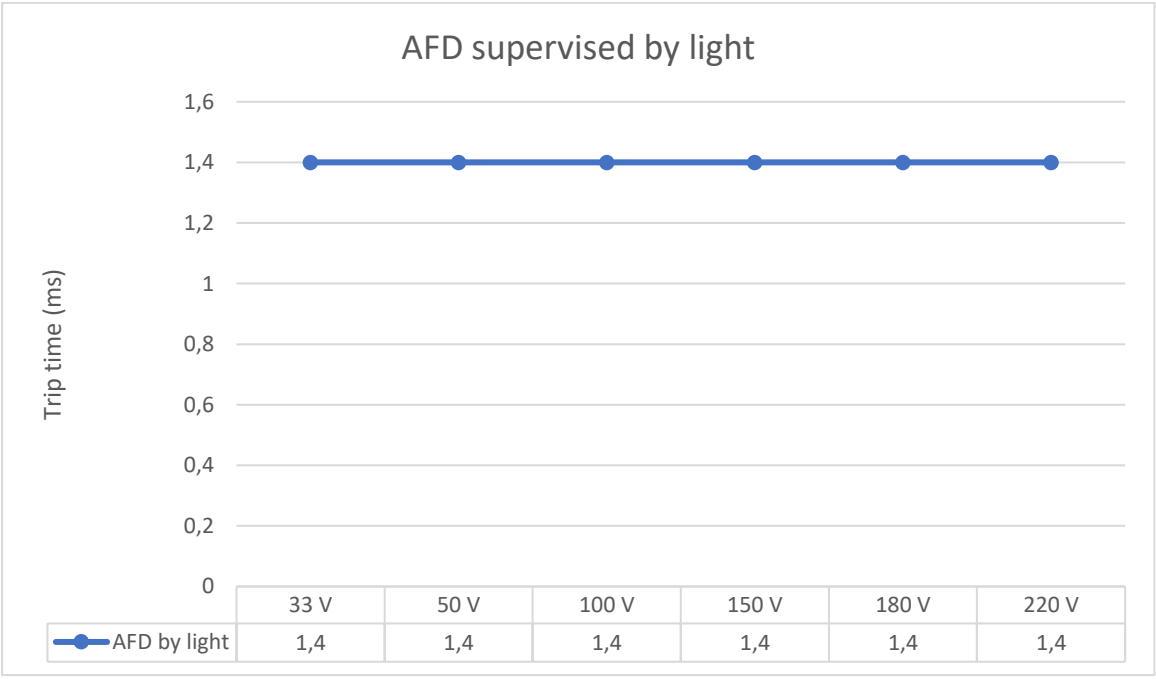
The detection method is configurable by the user in “AFD Outputs” by default, output 1 and output 2 are configured to detect the arc flash supervised by current and output 3 and output 4 supervise the arc flash supervised by light:

OUTPUTS	*LOGICAL GATE*	BINARY STATES
HSO 1	*AND_PULSE*	• AFD Input 1 • AFD TestOK 1 • AFD Overcurrent
HSO 2	*AND_PULSE*	• AFD Input 2 • AFD TestOK 2 • AFD Overcurrent
HSO 3	*AND_PULSE*	• AFD Input 3 • AFD TestOK 3
HSO 4	*AND_PULSE*	• AFD Input 4 • AFD TestOK 4

The accuracy of the trip time depends on the method used to supervise the arc flash:

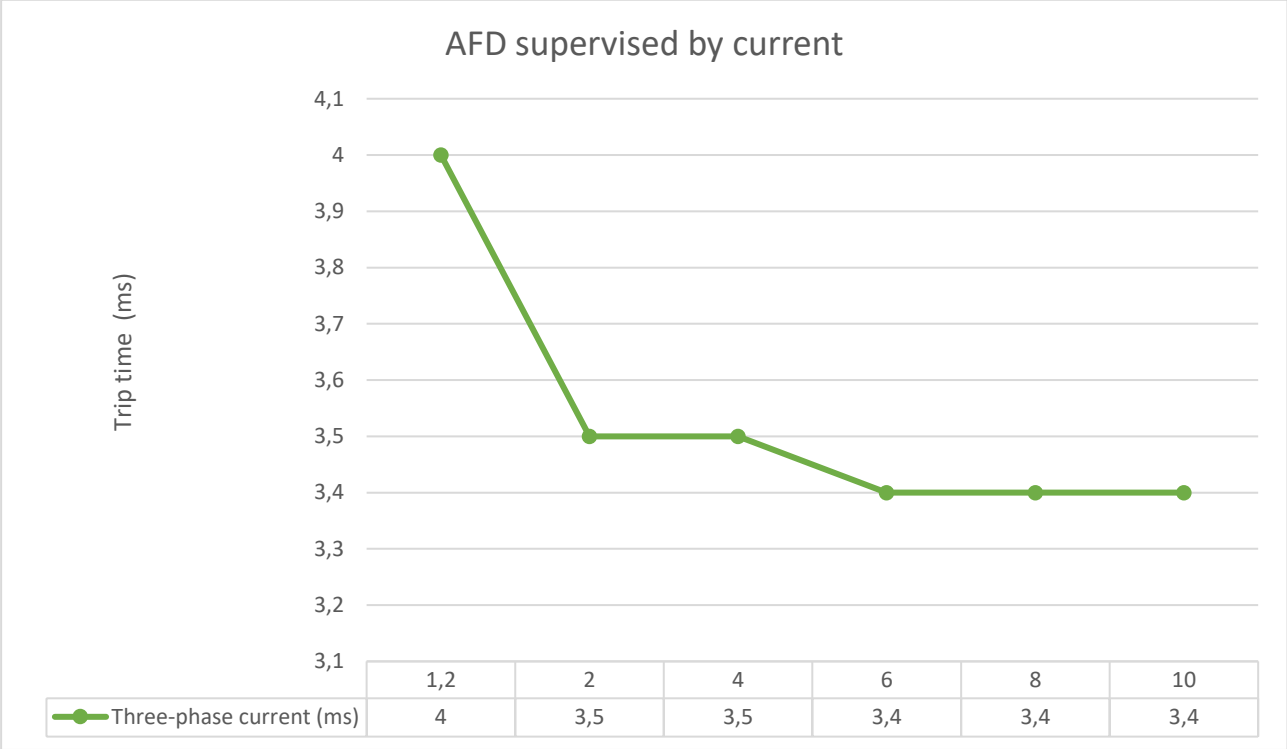
- Supervised by light: maximum trip time will be 1.4ms.
- Supervised by current: maximum trip time will be 6.5ms in a single-phase system, in three-phase system 4.1ms. The trip time will depend on the injected current value above the “current tap” and the number of samples selected in “time delay”. The following curves are made with “current tap=1” and “time delay=1”.

AFD supervised by light:

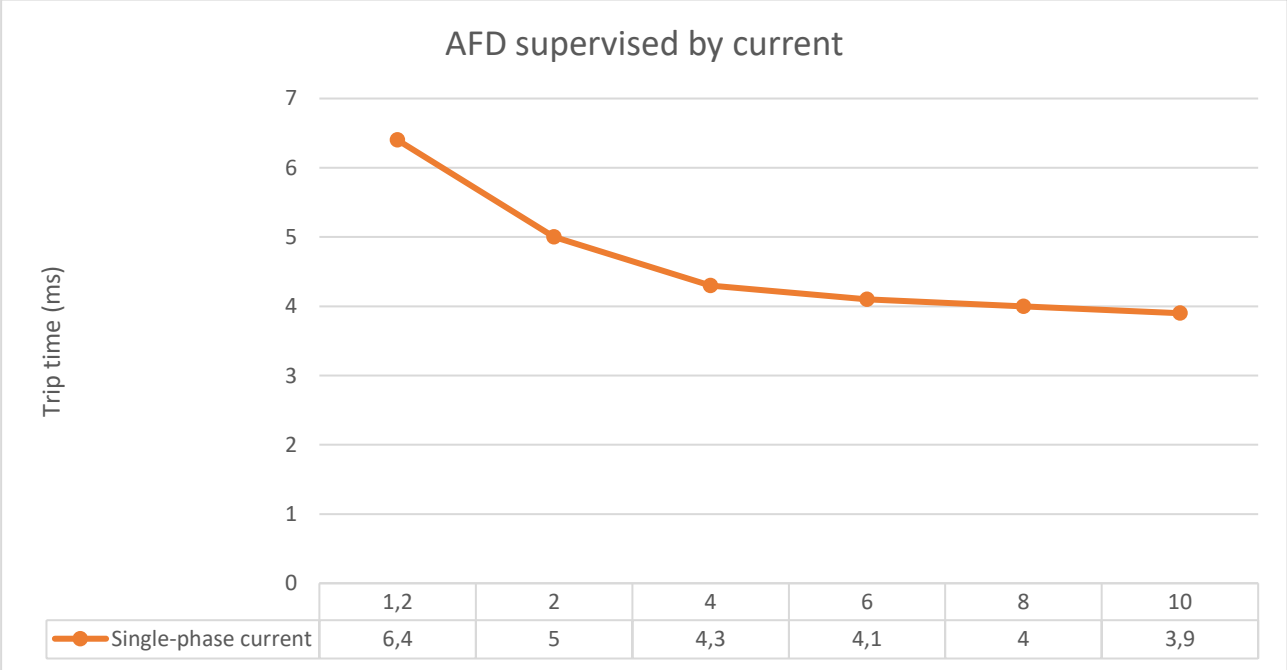


AFD supervised by current:

- Three-phase current:



- Single-phase current:



5 VOLTAGE PROTECTION FUNCTIONS

To be able to trip with any of the protection functions, the setting Function Enable must be set to a value different to No. We have 2 different options: Alarm or Trip.

In both cases the function will trip, but only if the Function Enable is set to Trip the protection function will participate in the GENERAL TRIP.

5.1 Function 27. Instantaneous phase undervoltage

This protection function can be set by using the following parameters:

Function	Description	Minimum	Maximum	Step	Unit	Default
27-1 27-2	**Instantaneous phase undervoltage**					
	Function Enable	-	-	No/Alarm/Trip	-	No
	Voltage Tap	0.08	2.00	0.01	xUn	0.5
	Minimum Level	0.00	1.00	0.01	xUn	0.00
	Time delay	0.060	300.000	0.001	s	0.200
	Reset time	0.020	300.000	0.001	s	0.200

"Un" will be ***Nominal V. P-P*** setting (available in General settings) when the connection is phase to phase or ***Nominal V. P-P/***$\sqrt{3}$ if the connection is phase-neutral.

The setting "Minimum level" indicates the minimum level of voltage it is necessary to measure to work with the function. This is, if the measured voltage is lower than the "Minimum Level" setting, the function will not trip although this voltage is lower than the tap.

The time delay is independent from the measured phase voltage through the relay, if any phase voltage is less than the adjusted value for an equal or greater amount of time than this preset value, the protection function activates (trips) and does not reset itself until the average value of the phase exceeds the 105% of voltage pick-up. The function activates at 100% of the preset input and deactivates at 105%. The reset time is configurable.

The accuracy of the Time Delay is equal to the set time ±30ms or ±0.5% (whichever is greater).

5.2 Function 27V1. Instantaneous positive sequence undervoltage

This protection function can be set by using the following parameters:

Function	Description	Minimum	Maximum	Step	Unit	Default
27V1	**Instantaneous positive sequence undervoltage**					
	Function Enable	-	-	No/Alarm/Trip	-	No
	Voltage Tap	0.15	2.00	0.01	xUn	0.50
	Minimum Level	0.00	1.00	0.01	xUn	0.000
	Time delay	0.060	300.000	0.001	s	0.200
	Reset time	0.020	300.000	0.001	s	0.20

"Un" will be always the setting ***Nominal V. P-P divided by*** $\sqrt{3}$ regardless the connection type, due to the positive sequence voltage is always calculated in a phase-neutral system.

The setting "Minimum level" indicates the minimum level of voltage it is necessary to measure to work with the function. This is, if the measured voltage is lower than the "Minimum Level" setting, the function will not trip although this voltage is lower than the tap.

The time delay is independent from the measured phase voltage through the relay, if any phase voltage is less than the adjusted value for an equal or greater amount of time than this preset value, the protection function activates (trips) and does not reset itself until the average value of the phase exceeds the 105% of voltage pick-up.

The function activates at 100% of the preset input and deactivates at 105%. The reset time is configurable.

The accuracy of the Time Delay is equal to the set time ±30ms or ±0.5% (whichever is greater).

5.3 Function 27-L. Instantaneous line undervoltage

This protection function can be set by using the following parameters:

Function	Description	Minimum	Maximum	Step	Unit	Default
27-L (*)	**Instantaneous Line undervoltage**					
	Enable	-	-	No/Alarm/Trip	-	No
	Voltage Tap	0.08	2.00	0.01	xUn	0.50
	Minimum Level	0.00	1.00	0.01	xUn	0.00
	Time delay	0.060	300.000	0.001	s	0.200
	Reset time	0.020	300.000	0.001	s	0.200

(*) Optional depending on model

"Un" will be ***Nominal V. P-P*** setting (available in general settings) when the connection is phase to phase or ***Nominal V. P-P/***$\sqrt{3}$ if the connection is phase-neutral.

This function is only available for models provided with synchronism function. Its working principle is the same as ANSI 27, but it considers the voltage measured in the line instead of the busbar.

The setting “Minimum level” indicates the minimum level of voltage it is necessary to measure to work with the function. This is, if the measured voltage is lower than the “Minimum Level” setting, the function will not trip although this voltage is lower than the tap.

The time delay is independent from the measured phase voltage through the relay, if any phase voltage is less than the adjusted value for an equal or greater amount of time than this preset value, the protection function activates (trips) and does not reset itself until the average value of the phase exceeds the 105% of voltage pick-up.

The function activates at 100% of the preset input and deactivates at 105%. The reset time is configurable.

The accuracy of the Time Delay is equal to the set time ±30ms or ±0.5% (whichever is greater).

✋**NOTE**: The connected line voltage (phase-neutral or phases-phase depending on the adjusted system) must coincide with the busbar voltage phase-neutral or phases-phase depending on the adjusted system) connected to the terminals B5-B6 (due to these voltages will be compared to determine if the synchronism exists).

5.4 Function 59. Instantaneous phase overvoltage

This protection function can be set by using the following parameters:

Function	Description	Minimum	Maximum	Step	Unit	Default
59-1	**Instantaneous phase overvoltage**					
59-2	Function Enable	-	-	No/Alarm/Trip	-	No
	Voltage Tap	0.08	2.00	0.01	xUn	1.20
	Time delay	0.045	300.000	0.001	s	0.200
	Reset Time	0.020	300.000	0.001	s	0.200

“Un” will be ***Nominal V. P-P*** setting (available in general settings) when the connection is phase to phase or ***Nominal V. P-P/***$\sqrt{3}$ if the connection is phase-neutral.

The time delay is independent from the measured phase voltage through the relay, if any phase voltage exceeds the adjusted value for an equal or greater amount of time than this preset value, the protection function activates (trips) and does not reset itself until the measured value of the phase voltage drops below the voltage pick-up.

The function activates at 100% of the preset input and deactivates at 95%. The reset time is configurable.

The accuracy of the Time Delay is equal to the set time ±30ms or ±0.5% (whichever is greater).

5.5 Function 59N/G. Instantaneous calculated/measured neutral overvoltage

This protection function can be set by using the following parameters:

Function	Description	Minimum	Maximum	Step	Unit	Default
59N/G-1 **59N/G-2**	**Instantaneous calculated/measured neutral overvoltage**					
	Function Enable	-	-	No/Alarm/Trip	-	No
	Voltage Tap	0.08	2.00	0.01	xUn	0.10
	Time delay	0.045	300.000	0.001	s	0.200
	Reset Time	0.020	300.000	0.001	s	0.200

As this is always a voltage to neutral (measured or calculated), on the setting Voltage Tap "Un" will be ***Nominal V. P-P/*** $\sqrt{3}$.

The neutral voltage will be calculated or measured depending on the VT connection.

The time delay is independent from the measured phase voltage through the relay, if any phase voltage exceeds the adjusted value for an equal or greater amount of time than this preset value, the protection function activates (trips) and does not reset itself until the measured value of the phase voltage drops below the voltage pick-up.

The function activates at 100% of the preset input and deactivates at 95%. The reset time is configurable.

The accuracy of the Time Delay is equal to the set time ±30ms or ±0.5% (whichever is greater).

5.6 Function 59-L. Instantaneous line overvoltage

This protection function can be set by using the following parameters:

Function	Description	Minimum	Maximum	Step	Unit	Default
59-L (*)	**Instantaneous line overvoltage**					
	Function Enable	-	-	No/Alarm/Trip	-	No
	Voltage Tap	0.08	2.00	0.01	xUn	1.20
	Time delay	0.020	300.000	0.001	s	0.200
	Reset Time	0.020	300.000	0.001	s	0.200

(*) Optional depending on model

"Un" will be ***Nominal V. P-P*** setting (available in general settings) when the connection is phase to phase or ***Nominal V. P-P/*** $\sqrt{3}$ if the connection is phase-neutral.

This function is only available for models provided with synchronism function. Its working principle is the same as ANSI 59, but it considers the voltage measured in the line instead of the busbar.

The time delay is independent from the measured phase voltage through the relay, if any phase voltage exceeds the adjusted value for an equal or greater amount of time than this preset value, the protection function activates (trips) and does not reset itself until the measured value of the phase voltage drops below the voltage pick-up.

The function activates at 100% of the preset input and deactivates at 95%. The reset time is configurable.

The accuracy of the Time Delay is equal to the set time ±30ms or ±0.5% (whichever is greater

NOTE: The connected line voltage (phase-neutral or phases-phase depending on the adjusted system) must coincide with the busbar voltage phase-neutral or phases-phase depending on the adjusted system) connected to the terminals B5-B6 (due to these voltages will be compared to determine if the synchronism exists).

5.7 Function 47. Phase balance voltage protection

This protection function can be set by using the following parameters:

Function	Description	Minimum	Maximum	Step	Unit	Default
47	**Phase balance voltage protection**					
	Function Enable	-	-	No/Alarm/Trip	-	No
	Voltage Tap	0.08	2.00	0.01	xUn	0.20
	Time delay	0.020	300.000	0.001	s	0.200
	Reset Time	0.020	300.000	0.001	s	0.200

"Un" will be always the setting ***Nominal V. P-P divided by*** $\sqrt{3}$ regardless the connection type, due to the negative sequence voltage is always calculated in a phase-neutral system.

The time delay is independent from the negative sequence voltage, if the negative sequence voltage exceeds the adjusted value for an equal or greater amount of time than this preset value, the protection function activates (trips) and does not reset itself until the negative sequence voltage drops below the 95% of the voltage pick-up.

The function activates at 100% of the preset input and deactivates at 95%. The reset time is configurable.

The accuracy of the Time Delay is equal to the set time ±30ms or ±0.5% (whichever is greater).

6 POWER PROTECTION FUNCTIONS

To be able to trip with any of the protection functions, the setting Function Enable must be set to a value different to No. We have 2 different options: Alarm or Trip.

In both cases the function will trip, but only if the Function Enable is set to Trip the protection function will participate in the GENERAL TRIP.

6.1 Function 32. Directional overpower

This protection function can be set by using the following parameters:

Function	Description	Minimum	Maximum	Step	Unit	Default
32-1	**Directional overpower**					
32-2	Function Enable	-	-	No/Alarm/Trip	-	No
32-3	Activation Level	0.02	2.00	0.01	xSn	1.20
32-4	Operating Angle	0	359	1	degrees	30/60/90/120
	Time Delay	0.020	300.000	0.001	s	0.200

The Time Delay is independent of the apparent power measured in any of the phases of the relay. If any phase apparent power exceeds the adjusted value for an equal or higher time than the preset value, the protection function activates (trips). The function will not reset until the measured value of the phase apparent power drops below the activation level pick-up.

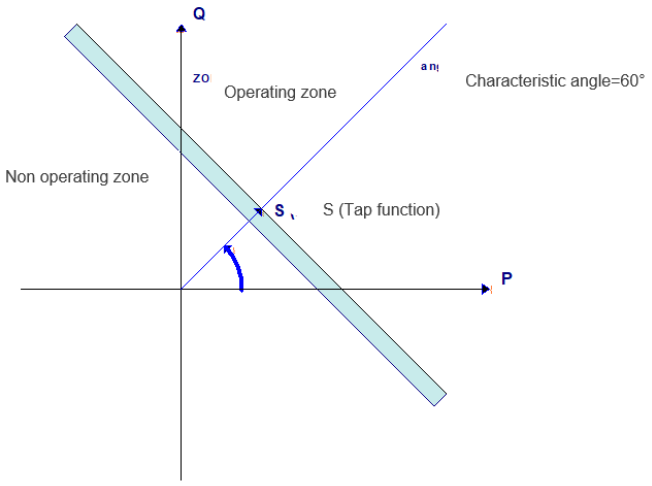
The function activates at 100% of the preset input and deactivates at 95%. However, this protection function has a hysteresis for its activation: it takes a minimum of 6.5 volts to be operational. If the measured voltage is less than 6.5 volts, the protection function will not act.

The accuracy of the Time Delay is equal to the set time ±30ms or ±0.5% (whichever is greater).

Apparent power is defined as S=V*Iconjugated.

The intervention sector is defined in the following way: the characteristic angle is rotated anticlockwise along the active power axis, which gives us the maximum torque direction. A straight line is drawn perpendicular to this maximum torque direction at the adjusted pickup point, to establish two half-planes to define the operating and non-operating zones.

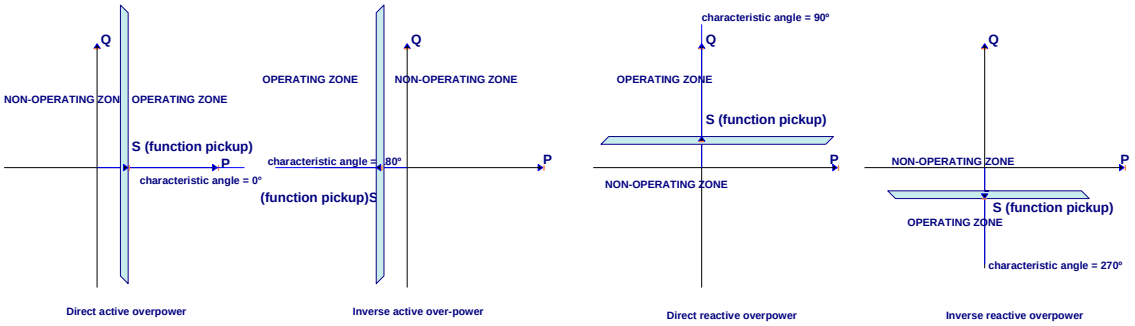
The directional power protection function operates in accordance with the following characteristic:



An operating zone is established based on the tap setting of the function and the setting of the characteristic angle. The function trips if the measured power is maintained in the operating zone for the time established using the corresponding time setting.

As the characteristic angle can be adjusted from 0° to 359°, we can adjust the function to obtain direct active overpower, reverse active overpower, direct reactive overpower and reverse reactive overpower.

Characteristic angle	Description	Direction
0º	Active overpower	Direct
180º	Active overpower	Inverse
90º	Reactive overpower	Direct
270º	Reactive overpower	Inverse



Note:

- Q- y P+ → P and Q are consumed
- Q+ y P+ → P is consumed, and Q is generated
- Q- y P- → P is generated, and Q is consumed
- Q+ y P- → P and Q are generated

7 FREQUENCY PROTECTION FUNCTIONS

To be able to trip with any of the protection functions, the setting Function Enable must be set to a value different to No. We have 2 different options: Alarm or Trip.

In both cases the function will trip, but only if the Function Enable is set to Trip the protection function will participate in the GENERAL TRIP.

7.1 Function 81U/O. Under/Overfrecuency

This protection function can be set by using the following parameters:

Function	Description	Minimum	Maximum	Step	Unit	Default
81-1 81-2 81-3 81-4	**Under/Overfrequency**					
	Function Enable	-	-	No/Alarm/Trip	-	No
	Type	-	-	Overfrequency / Underfrequency	-	Overfrequency
	Activation level	45.000	65.000	0.001	Hz	55.000
	Time Delay	0.020	300.000	0.001	s	0.200
	Reset time	0.020	300.000	0.001	s	0.200

The four functions can be configured independently as overfrequency or underfrequency units.

If the unit is set as overfrequency, activation of the function occurs at 100% frequency level set and its reset when the measured frequency is 50mHz lower than set start level.

If the unit is set as underfrequency, activation of the function occurs at 100% frequency level set and its reset when the measured frequency is 50mHz higher than set start level.

The reset time is configurable.

The frequency measurement is done from the voltage of phase B. It has a hysteresis for its activation: it takes a minimum of 20 volts P-N (35 volts P-P) for 81 functions to be operational. If the measured phase voltage is less than 15 volts P-N (26 volts P-P), it activates a state bit (**Busbar Frequency Block**) indicating the function is blocked. When the frequency measurement is valid again, the function begins in the start state with all bits reset.

The accuracy of the Time Delay is equal to the set time ±35ms or ±0.5% (whichever is greater).

The frequency measurement is an average value of the frequency measured during 8 cycles. The accuracy of the Time Delay is the adjusted value plus the necessary time to achieve a stable measurement during 8 cycles (this time will depend on the frequency of the system).

7.2 Function 81R. Rate of change of frequency (ROCOF)

This protection function can be set by using the following parameters:

Function	Description	Minimum	Maximum	Step	Unit	Default
81-1R 81-2R 81-3R 81-4R	**Rate of Change of frequency (ROCOF)**					
	Function Enable	-	-	No/Alarm/Trip	-	No
	Type	-	-	Increase / Decrease	-	Increase
	Activation level	0.100	5.000	0.001	Hz/s	1.000
	Time Delay	0.060	40.000	0.001	s	1.000
	Reset time	0.020	300.000	0.001	s	0.200

The four functions can be configured independently as increase or decrease rate of frequency change units.

If the unit is set as increase, activation of the function occurs at 100% activation level set and its reset when the measured rate of change is 90% lower than set start level.

If the unit is set as decrease, activation of the function occurs at 100% frequency level set and its reset when the measured rate of change is 90% lower than set start level.

The reset time is configurable.

The frequency measurement is done from the voltage of phase B. It has a hysteresis for its activation: it takes a minimum of 20 volts P-N (35 volts P-P) for 81R functions to be operational. If the measured phase voltage is less than 15 volts P-N (26 volts P-P), it activates a state bit (**Busbar Frequency Block**) indicating the function is blocked. When the frequency measurement is valid again, the function begins in the start state with all bits reset.

The frequency measurement is an average value of the frequency measured during 8 cycles. The accuracy of the Time Delay is the adjusted value plus the necessary time to achieve a stable measurement during 8 cycles (this time will depend on the frequency of the system).

If the variation is close to the activation level, this time can be higher.

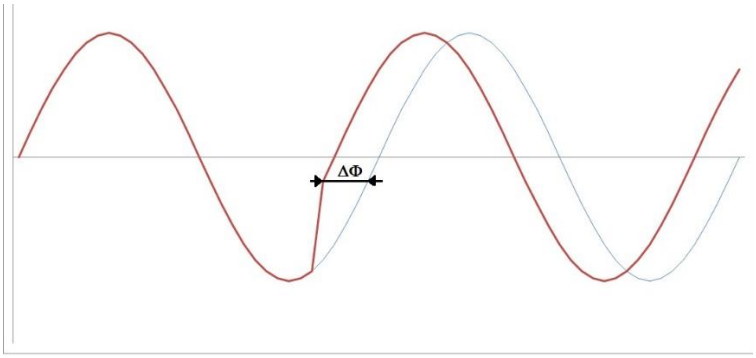
7.3 Function 78. Out of step (vector shift)

This protection function can be set by using the following parameters:

Function	Description	Minimum	Maximum	Step	Unit	Default
78	**Out of Step (vector shift)**					
	Function Enable	-	-	No/Alarm/Trip	-	No
	Activation level	1	25	1	Degrees	1
	Reset time	0.020	300.000	0.001	s	0.200

The relay has one Out-of-Step element to detect perturbations on the system and to disconnect the generators connected to it. This detection is based on phase B voltage passing by zero and it is intended to detect vector shifts from 1 to 25 degrees.

The frequency measurement is done from the voltage of phase B. It has a hysteresis for its activation: it takes a minimum of 20 volts P-N (35 volts P-P) for 81R functions to be operational. If the measured phase voltage is less than 15 volts P-N (26 volts P-P), it activates a state bit (**Busbar Frequency Block**) indicating function blocked. When the frequency measurement is valid again, function begins in the start state with all bits reset.



If Δϕ exceeds the value adjusted in “Activation Level” setting, the function activates (trips) immediately. The accuracy is ±1 degree or ±10% (whichever is greater).

The reset time is configurable.

7.4 Function 24. Overfluxing

This protection function detects overfluxing of transformer or generator magnetic circuits by calculating the ratio between the greatest phase-to-neutral or phase-to-phase voltage divided by the frequency.

This protection function can be set by using the following parameters:

Function	Description	Minimum	Maximum	Step	Unit	Default
24-1 **24-2**	**Overfluxing**					
	Enable	-	-	No/Alarm/Trip	-	No
	Curve Type	-	-	(1)	-	Definite Time
	Time Dial (TMS)	0.10	300.00	0.01	(2)	1.00
	Activation Level	0.50	2.00	0.01	Un/fn	1.00
	Time Delay	0.020	300.000	0.001	s	0.200
	Reset Time	0.020	300.000	0.001	s	0.200

(1) Definite time and 3 curves are included to be selected by the user:

TYPE
Definite Time
Inverse A
Inverse B
Inverse C

(2) The range of the Time Dial setting will depend on the curve. The range of this setting for each curve family is as follows:

TIME DIAL (TMS)					
Description	**Minimum**	**Maximum**	**Step**	**Unit**	**Default**
Curve (A, B or C)	0.1	300	0.01	-	1.00

The overfluxing protection is used as protection of the generator and connected transformer (e.g. auxiliary services transformer) against loss of insulation between the laminations of the magnetic circuit leading to overheating produced by the iron losses due to the induction increase (over-excitation).

The overfluxing condition may occur:

- With generators disconnected from the network during Start-up or standing, due to automatic control of the voltage regulator which, at Iow frequency, forces excitation increasing the flux in order to keep the voltage constant.
- For failure of the voltage regulator in automatic control or wrong operations on manual control.
- Following the over-voltage produced by the shedding of a significant load, whilst the voltage regulator is not operating sufficiently quickly to reduce the overvoltage.

The device measures the Un/fn ratio, which is proportional to the excitation level of the generator or transformer. The calculation is based on the ratio between the maximum voltage of the three phase-to-phase voltages and the frequency. The function picks up when the excitation level exceeds the activation level.

If the option ‘Defined time’ is selected for the curve setting, the unit behaves like an instantaneous overflux unit. In this case, the unit time delay is adjusted by using the parameter ‘Time delay’.

If a curve is selected for the curve setting, the time delay depends on the curve, dial and activation level settings.

If the unit operates as defined time, the function is activated at 100% of the set tap value, and it deactivates at 95%.

If the unit operates with a curve, the function is activated at 110% of the set level, and it deactivates at 100%.

The reset will depend on “Reset Time” setting in both cases.

If the unit operates as defined time, the accuracy of the Time Delay is equal to the set time ±30ms or ±0.5% (whichever is greater).

If a curve is selected for the curve setting, the accuracy of the time delay is equal to the theoretical time ±30ms or ±5% (whichever is greater).

8 CONTROL AND SUPERVISION FUNCTIONS

8.1 Function 79. AC Reclosing device

The reclosing function tries to reconnect the circuit breaker after a fault. It has four reclosing attempts capacity. After them, if the circuit breaker has not reclosed correctly, it goes to 'Lockout' state.

The reclose can be disable if it is not required, by setting the **Number of Recloses** to 0.

Disable must not be confused with blocked. Disable means that the recloser shall never be in operation, regardless of the controls performed on it. A blocked recloser means that the recloser is not operative, but either because it has reached the end of the reclosing cycle, or an irregularity has been detected, or someone has performed a control procedure on it reaching the Lockout state.

Each reclosing cycle has its own specific operation time (**Reclose Time #**) that can be set independently. Also, up to four different signals with a logic condition can be assigned to the start condition (logic signal - **79N# Start**) of each cycle. The cycles are always done sequentially, that is, if the function is going to start the first reclose cycle, but the reclose condition for the first cycle is not achieved and the condition for the second cycle is, then the function will not start.

If in **Hold Enable** Yes is selected, once the cycle is initiated, another permission (logic signal - **79Enable**) can be used to indicate that the recloser must wait another period of time **(Hold time**) before closure. During this waiting time, usually an external condition wired to an external input, such as closure synchronism, give the authorization to reconnect. If in **Hold Enable** No time is selected, there will no limitation in terms of time, the only way to reconnect is through the logic signal 79Enable.

Apart from these times, two additional times must be set on this function:

- ✓ **Reset time**: This is the waiting time for the recloser for a final closure. If during this time, there is another trip, the recloser count will increase.
- ✓ **Safe time**: Is the security time used by the recloser. When it comes from a lockout mode consequence of an unexpected condition of a reclose cycle and the circuit breaker is closed this waiting time must be observed. On exceeding this time without a circuit breaker opening, the recloser switches to Standby mode.

Function	Description	Minimum	Maximum	Step	Unit	Default
79	**AC Reclosing Device**					
	Number of Recloses	0	4	1	-	0
	Reset Time	0.020	2000.000	0.001	s	5.000
	Reclose time 1	0.020	2000.000	0.001	s	0.250
	Reclose time 2	0.020	2000.000	0.001	s	2.000
	Reclose time 3	0.020	2000.000	0.001	s	2.000
	Reclose time 4	0.020	2000.000	0.001	s	20.000
	Hold Enable	-	-	No/Yes/No time	-	Yes
	Hold time	0.000	2000.000	0.001	s	5.200
	Safe time	0.020	2000.000	0.001	s	5.000

Another time setting, configurable in function 52, is used on the state machine on the recloser.

- ✓ **Closing Time:** During this state the recloser sends a closing command and for this reason, if you wish to associate an output to that command, the output must be set to the 79 Closing Time bit.

It must be possible to block the recloser, specially is maintenance tasks are carried out on the substation. To achieve this, there is two logical signals **79Block Command** and **79Unblock Command** where up to 4 logical inputs can assigned to each one. By default, they are configured as follows:

79Block Command	
Input	**Logical Gate**
Block Command USB COM	OR
Block Command HMI	
Block Command Rear COM	

79Unblock Command	
Input	**Logical Gate**
Block Command USB COM	OR
Block Command HMI	
Block Command Rear COM	

So, it can be (un)blocked with the next options:

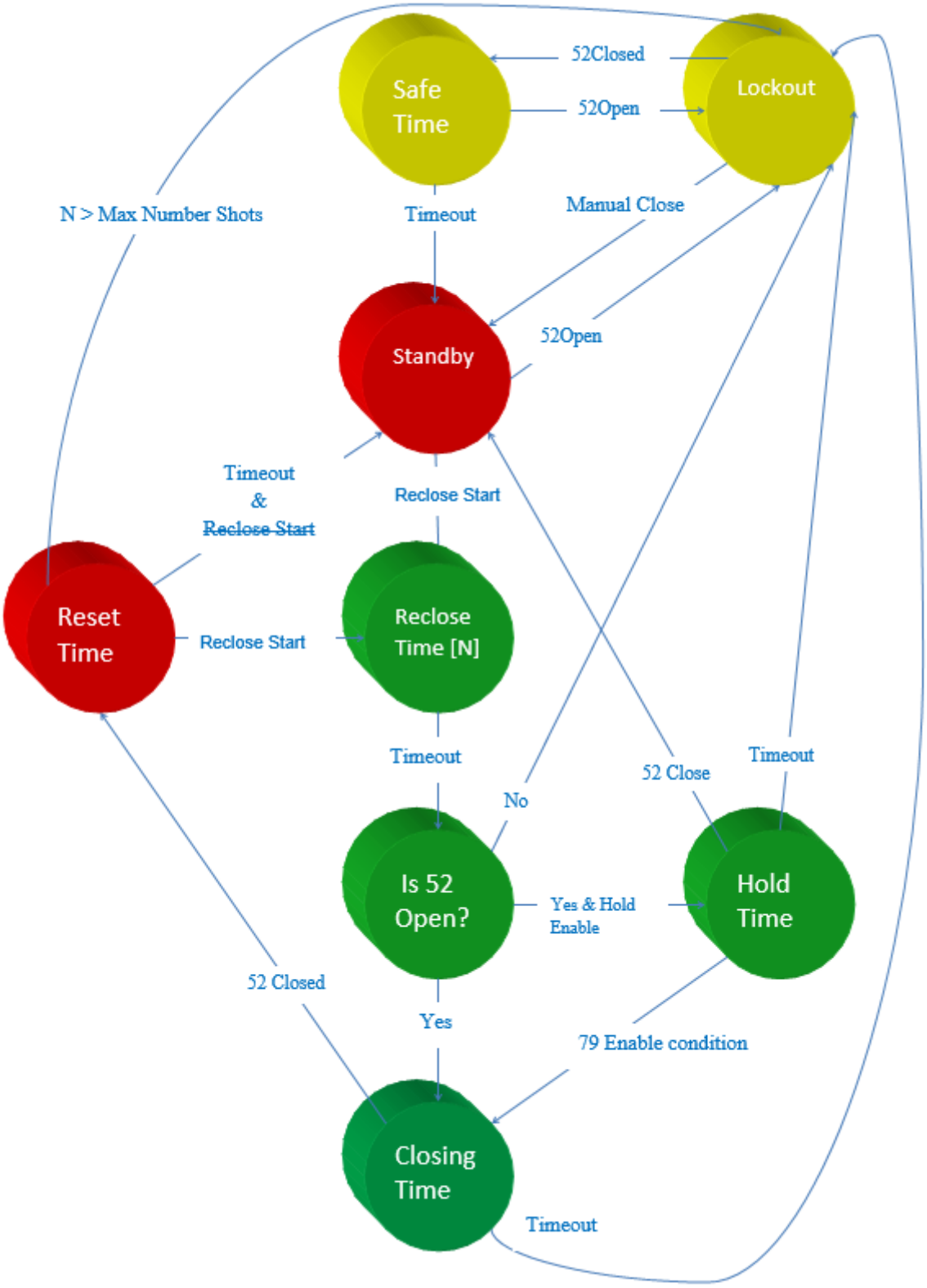
- ✓ **From the HMI.** There are two specific keys marked 79 Block and Unblock, plus a specific signal led, allowing recloser operation, blocking or unblocking it.
- ✓ **From the HMI.** This command can be executed from the command menu.
- ✓ **Via protocol.** This is performed via any means of communication. This is carried out as if it was a command, and the normal conditions of any command must be met.

In all these cases, the relay stores the block situation in the non-volatile memory, as the last command must be known for a possible re-start.

The logic signal **Hot Line Tag** also affects the behaviour of this function. When it is activated, the function is blocked, and reclosing is not permitted.

Also, this logic signal can be configured to change the Settings Groups through PGC. This can be useful to achieve a fast tripping of protection functions in Hot Line Tag Mode.

The auto-recloser´s start up is shown in the following figure:



There are two stable conditions here, Standby and Lockout, the other conditions are transient.

On Standby, the recloser can leave this mode via two conditions:

- ✓ Manual or remote control opening of the circuit breaker. In this situation it shall switch to lockout mode.
- ✓ Circuit breaker trip. This shall start the reclosing cycles. This start may arise either from the trip itself, or from an external input if external protection is fitted.

When blocked, the recloser has are two possible paths, depending on if the locked mode is the result of:

- ✓ Circuit breaker closing (from manual or remote control): it switches to Standby
- ✓ Unexpected condition from a reclose cycle: it switches to Safe time.

There are 4 logic outputs “79N# Start” in the configurable logic. Default configuration is as follow:

Reclose Condition	Default Configuration
79N1 Start	General Trip AND Standby
79N2 Start	General Trip AND 79 Reclose 1
79N3 Start	General Trip AND 79 Reclose 2
79N4 Start	General Trip AND 79 Reclose 3

8.1.1 Counter to record the number of reclosings

SILG relay has a counter that registry the reclosing actions.

8.2 Function 25. Synchronism check

This function is available depending on the selected model. The synchro-check function is designed to give a time window in which the voltage in both sides of the switch are in sync. The voltage of both ends of the switchgear must comply three conditions to ensure that there is synchronization:

- Same module
- Same phase
- Same frequency

Associated with the function, we have a line voltage and bar voltage monitoring unit, which will define the state of the line and the bar, being able to give the following combinations:

- Death Line - Dead Bar (DLDB)
- Death Line - Live Bar (DLLB)
- Live Line - Dead Bar (LLDB)
- Live Line - Live Bar (LLLB)

This control function can be set by using the following parameters:

Function	Description	Minimum	Maximum	Step	Unit	Default
25 (*)	**Synchronism check**					
	Dead Tap	0.08	2.00	0.01	xUn	0.50
	Live Tap	0.08	2.00	0.01	xUn	0.70
	Voltage Supervision Time	0.060	300.000	0.001	s	3.000
	Voltage Difference	0.05	2.00	0.01	xUn	0.10
	Phase Difference	2	90	1	Degrees	2
	Frequency Difference	0.060	10.000	0.001	Hz	0.500
	Synchrocheck Time	0.020	300.000	0.001	s	1.000

(*) Optional depending on model.

In case the line or bar or both are dead (LLDB, DLLB, DLDB situations) it is not necessary the synchronism to close the switchgear.

Transitions from dead to live and vice versa are timed with a user adjustable time (**Voltage Supervision Time**).

When the line and the bar are alive is the time to check the conditions of voltage magnitude, phase and frequency differences between line voltage and bar voltage to allow the closing. Also, it is verified that these conditions of voltage magnitude, phase difference and frequency differences are maintained over a set time (**Synchrocheck time**) to confirm that it is not a temporary situation.

Please, consider that the synchronism depends on three measurements: voltage measurement and phase measurement are achieved in 1 cycle, but frequency measurement may need 8 cycles to achieve a stable measure, so the synchrocheck time should be set according to this limitation.

If those conditions of synchronism are maintained during synchrocheck time, close permission will be allowed (state **Synchocheck**).

8.2.1 Synchronism (25) and AC Reclosing Device (79)

To close the circuit breaker when the reclosing device (79) is permitted, when both line & bar are alive it is necessary to achieve sync conditions. Only when these sync conditions are achieved, the recloser has the permission to close the circuit breaker.

To supervise the reclosing, it is necessary to set the **Syncrocheck** state of 25 function to the logical signal **79Enable**. Also, the states **DLDB**, **DLLB** and **LLDB** should be added to this logic signal (OR gate) as in those cases there is nothing to synchronize.

If the parameter **Hold Enable** of 79 function is set to No, any external condition won't be considered, and 79 function will work normally.

If **Hold Enable** of 79 function is set to Yes or No Time and the states DLDB, DLLB, LLDB and Synchrocheck of 25 function are associated to the logic signal 79 Enable, following cases can occur:

1. If line, bar or both are dead, the circuit breaker will always reclose because synchronism is not necessary.

2. If both, line and bar, are alive it will reclose only when the conditions of synchronism are achieved. If Hold Time is set to No time it will wait until those conditions are accomplished. If **Hold Time** is set to Yes, if those conditions are not fulfilled in the time set in **Hold Time** it will go to **Lockout**.

8.2.2 Synchronism (25) and Closing Breaker Command

If necessary, the same strategy can be used to supervise a manual closure. Using the logical gates available on SILG, a coordination of states can be set to supervise the closing command.

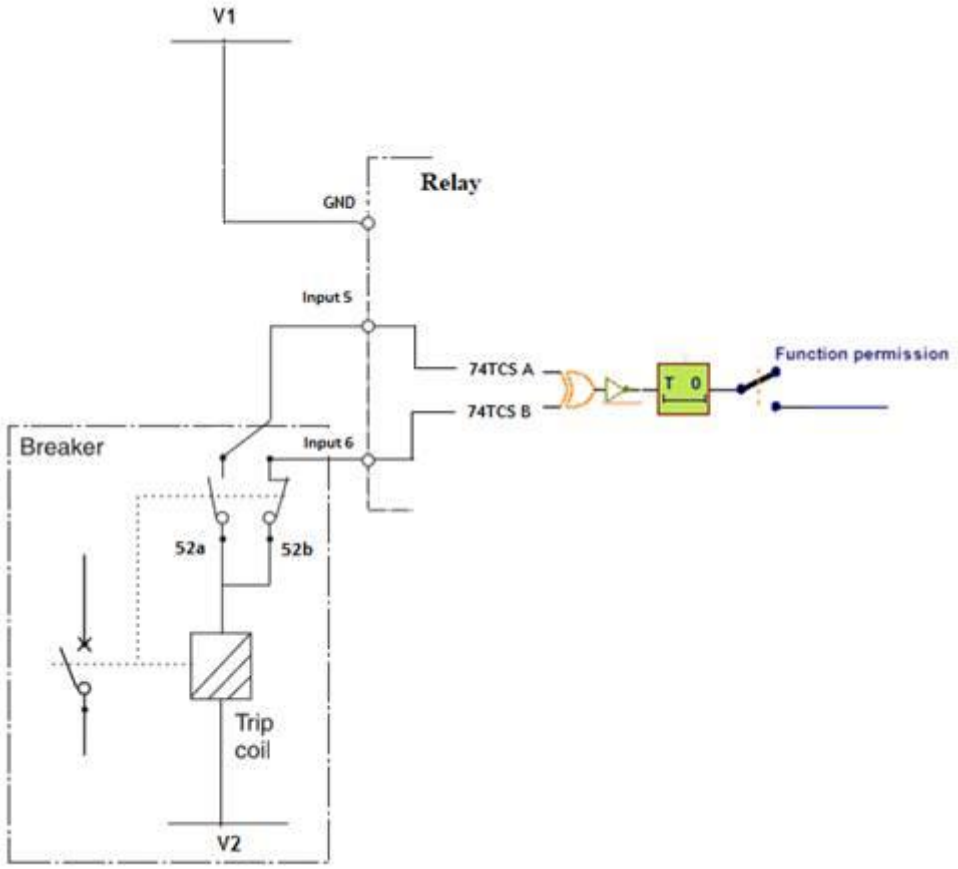
8.3 Function 74TCS. Trip circuit supervision

This control function can be set by using the following parameters:

Function	Description	Minimum	Maximum	Step	Unit	Default
74TCS	**Trip circuit supervision**					
	Function Enable	-	-	Yes/No	-	No
	Time Delay	0.020	300.000	0.001	s	0.200

This function allows to monitor the circuit breaker trip circuits. This is performed verifying the continuity of the trip circuit, in both circuit breaker positions, open and closed. To avoid spurious results, it must be appropriately time delayed.

The schematic for this function is as follows:



The accuracy is equal to the set time ±30ms or ±0.5% (whichever is greater).

Note: On the schematic Input5 and Input6 are shown for illustrative purposes. Any other input can be chosen and associated to suitable logic PGC signals '**74TCS Coil A**' and '**74TCS Coil B**'.

8.4 Function 60CTS. Phase CT Supervision

This protection function can be set by using the following parameters:

Function	Description	Minimum	Maximum	Step	Unit	Default
60CTS	**Phase CT Supervision**					
	Function Enable	-	-	Yes/No	-	No
	Time Delay	0.020	300.000	0.001	s	5

Current transformer supervision is provided to detect the loss of **one** of the phases.

If a current lower than 0.8% of the nominal current is detected in one phase during more than 40ms, the adjusted time starts to count, and the trip occurs after the set Time Delay.

The reset is instantaneous when a current higher than 8% of nominal current is detected. The accuracy of the time delay is equal to the initial 40ms plus the preset time ±30ms or ±0.5% (whichever is greater).

8.5 Function 60VTS. Phase VT supervision

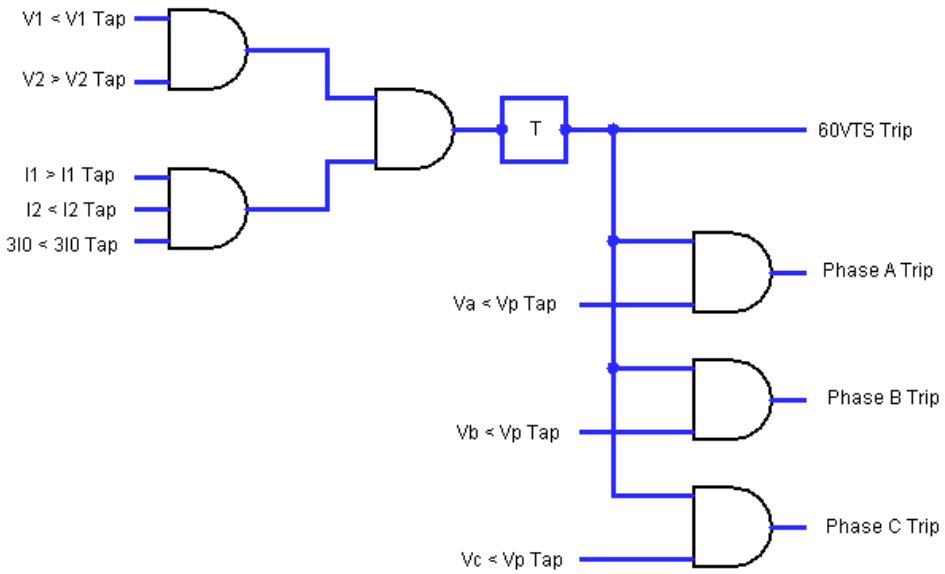
This protection function can be set by using the following parameters:

Function	Description	Minimum	Maximum	Step	Unit	Default
60VTS	Phase VT Supervision					
	Function Enable	-	-	Yes/No	-	No
	Time Delay	0.020	300.000	0.001	s	5.000
	V1 Tap	0.08	2.00	0.01	xUn	0.75
	V2 Tap	0.08	2.00	0.01	xUn	0.30
	VP Tap	0.08	2.00	0.01	xUn	0.60
	I1 Tap	0.010	20.000	0.001	xIn	0.750
	I2 Tap	0.010	20.000	0.001	xIn	0.100
	3I0 Tap	0.010	20.000	0.001	xIn	0.100

When a situation of loss of one or more of the VT signals occurs, the following conditions develop:

- There will be a drop in the positive sequence voltage accompanied by an increase in the negative sequence voltage magnitude. The magnitude of this drop depends on the number of phases impacted by a fuse failure.
- In case of a loss of VT signal and contrary to a fault condition, there should not be any change in the current's magnitudes and phases. Therefore, the negative and zero sequence currents should remain below a small tolerance value. A fault condition be distinguished from a loss of VT signal by monitoring the changes in the positive and negative current levels. In case of a loss of VT signals, these changes should remain below a small tolerance level.

All the above conditions can incorporate into a complex logic scheme to determine if indeed there has been a condition of loss of VT signal or a fault.



To obtain a stable measurement of currents and voltages a 40ms time delay is applied to the function.

The accuracy of the time delay is equal to these initial 40ms plus the preset time ±30ms or ±0.5% (whichever is greater).

8.6 Function 50BF. Circuit Breaker opening failure

This control function can be set by using the following parameters:

Group	Description	Minimum	Maximum	Step	Unit	Default
50BF	**Circuit Breaker opening Failure**					
	Function Enable	-	-	Yes/No	-	No
	Time Delay	0.020	1.000	0.001	s	0.2

When the logic signal '**50BF Start**' is activated, it starts the pickup of the function. To monitor the circuit breaker opening the current measurement via the three phases is used. When the current in the three phases is less than 8% of the rated current, the circuit breaker is considered open and the function resets itself.

If the phase current exceeds its predetermined value (0.8%In) for an equal or greater amount of time than this preset value, the protection function activates (trips) and does not reset itself until the value of the phase drops below the point of current pickup (0.8%In).

The '**50BF Start**' status is an adjustable logic PGC. By default, it is activated when a General Trip is generated:

- General trip

8.7 Function SHB. Second harmonic blocking

This protection function can be set by using the following parameters:

Group	Description	Minimum	Maximum	Step	Unit	Default
SHB	**Second harmonic blocking**					
	Function Enable	-	-	Yes/No	-	No
	Current tap	5	50	1	%	20
	Reset Time	0.000	300.000	0.001	s	0.200
	Block Threshold	0.010	30.000	0.001	xIn	7.000

The second harmonic blocking is used to avoid an undesirable behaviour due to inrush current when energizing a machine like a transformer or a generator.

In order to avoid these undesirable trips, if the second harmonic percentage is higher than the pre-set value once it is below the current tap, the trip will be kept blocked during the time set in reset time parameter.

The function picks-up at 100% of the adjusted input and the dropout is at 95%. The reset time will depend on the adjusted reset time setting.

There is also a 2nd harmonic blocking threshold. This setting allows to block this function if the fundamental current exceeds the value specified in the setting.

The SHB will only be applied in functions that have this feature. When the Function Enable of these protection functions is set to 'SHB Trip', the second harmonic blocking will supervise the protection function. As a result, tolerances for tripping times could be higher than indicated on the functions.

If the time is set from 0.00 to 0.02 seconds the it should apply +/50 ms respect to the setting. If the time delay setting is higher than 0.02 seconds, the time declared in the manual will apply with or without SHB permission (+/-35 ms).

8.8 Function CLP. Cold Load Pickup

This protection function can be set by using the following parameters:

Function	Description	Minimum	Maximum	Step	Unit	Default
CLP	**Cold Load Pickup**					
	Function Enable	-	-	Yes/No	-	No
	Settings group	1	4	1	-	4
	No Load time	0.020	300.000	0.001	s	15
	Cold Load Time	0.020	300.000	0.001	s	15

This unit is used to prevent undesired operations of the overcurrent functions in the cases where the line is de-energized, and all the loads enter at the same time.

These two parameters have the following meaning:

- **No Load Time**: If the circuit has been open for less time than the setting, the Cold Load Pickup function is not in working conditions.

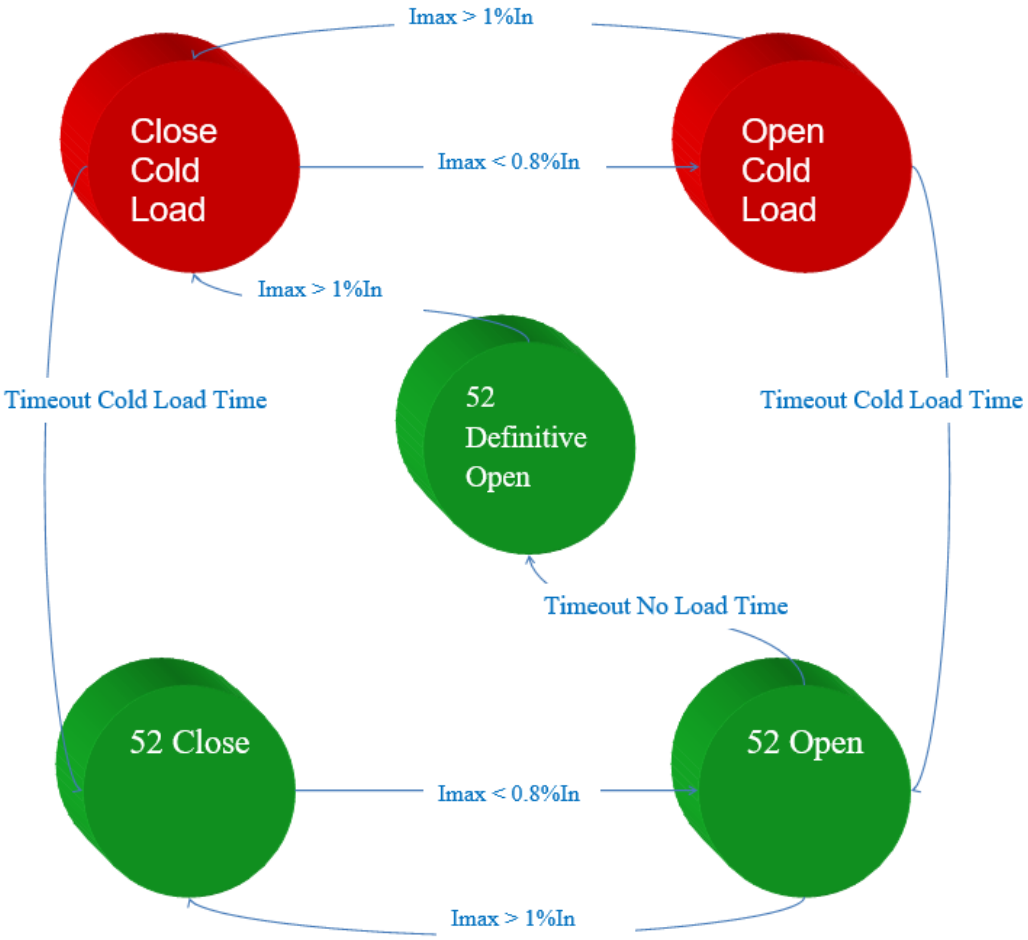
- **Cold Load Time**: If the Cold Load Pickup function is in working conditions (after the circuit has been closed), the new setting group is applied. After being in Close Cold Load or Open Cold Load (the red states of the automaton shown below) for the time defined in this parameter, the relay returns to the adjusted setting group. Changing the state of the circuit breaker (open or closed) restarts the timer as the states of the automaton change.

The controller has five states. In three of the states, the green ones on the diagram, the relay works with the usual setting group (the group adjusted in the general settings), and in the other two, the red ones, with the new setting group.

The relay uses the current level to determine the circuit breaker state (open or closed). When the current is less than 0.8% of the rated level, the line is considered open.

The relay usually operates with the settings in their active group. When the circuit breaker opens, a timer 'No Load Time' starts. After this time, the relay considers that the circuit breaker is open, so the CLP function is in working conditions.

Once the circuit breaker is closed, CLP function picks-up and 'Cold Load Time' starts to count. During this time, the relay will work with the new setting group. However, the Cold Load Time will restart anytime the state of the circuit breaker is changed. This is, the new setting group will be active until the circuit breaker is maintained closed or open, without changing the state, for the time defined in Cold Load Time.



8.9 Function 52. Breaker Wear Monitoring

This control function can be set by using the following parameters:

Function	Description	Minimum	Maximum	Step	Unit	Default
52	**Breaker Wear Monitoring**					
	Maximum number of openings	1	100000	1	-	1000
	Maximum accumulated amperes	1	100000	1	M(A²)	100
	Repetitive number of openings	1	100000	1	-	3
	Time for repetitive number of openings	1	300	1	min	3
	Maximum opening time	0.020	300.000	0.001	s	0.10
	Maximum closing time	0.020	300.00	0.001	s	0.10

NOTE: The “Maximum accumulated amperes” adjustment units are M(A²) (square mega amperes) whilst the “Accumulated amperes counter” units are K(A²) (square kilo amperes).

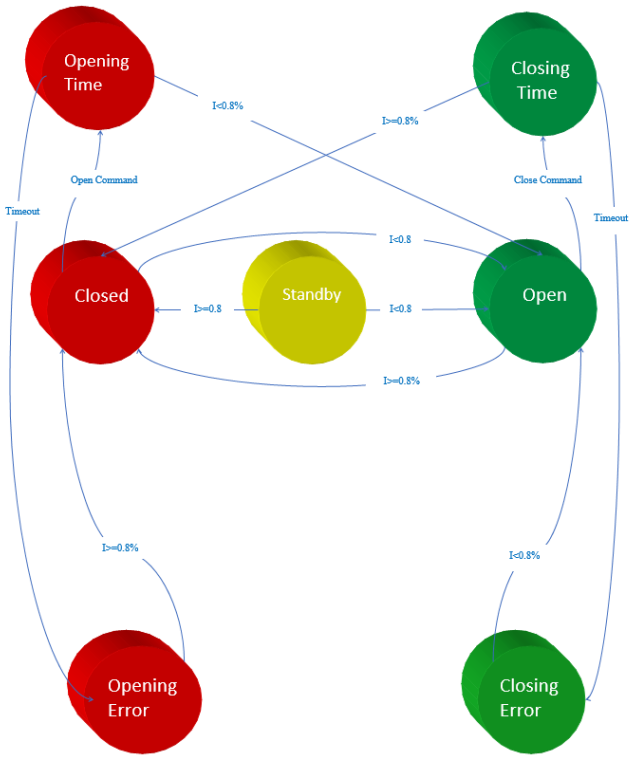
This function allows to monitor the status of the circuit breaker and to perform preventive maintenance.

The following statuses are associated with this function:

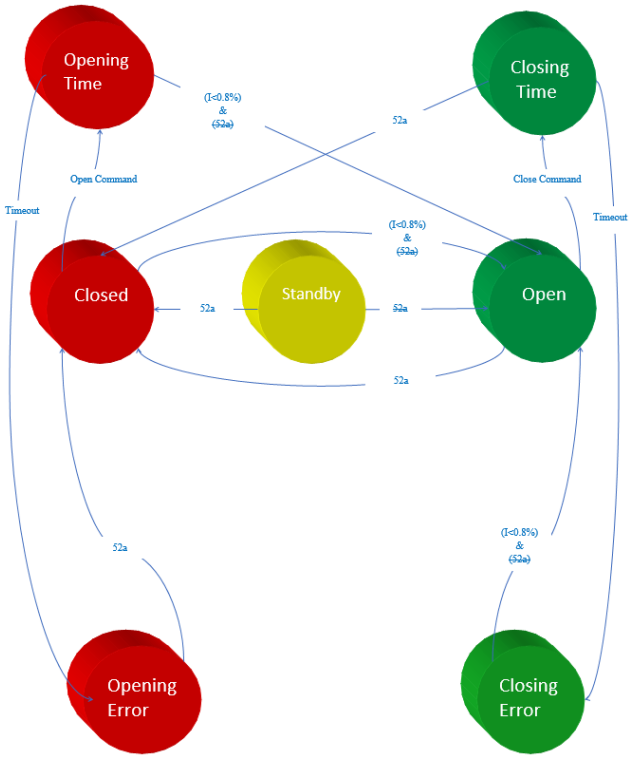
Function	Status	Description
52	Startup	These are the different statuses of the circuit breaker automatic control. The function only is initialized on Start when the relay is switched on. If the relay doesn’t lose power supply, the last state is maintained.
	Error	
	Open	
	Opening time	
	Opening error	
	Closed	
	Closing time	
	Closing error	
	Configured number of openings alarm	Activated if the counter that measures the number of openings exceeds the ‘Maximum number of openings’ setting
	Configured accumulated amperes (I^2t) alarm	Activated if the accumulated amps counter exceeds ‘Maximum Accumulated Amperes’ setting
	Configured number of openings in a time frame alarm	Activated if the number of openings exceeds the setting in ‘Maximum Number of Repetitive Openings’ during the time set in ‘Time of Repetitive Openings‘. It works like a time accumulator, to be active it needs to detect openings within the range defined by these two settings.

Monitoring function of circuit breaker will be more difficult depending on the available circuit breaker contacts, zero, only one (52a or 52b) or both (52a and 52b).

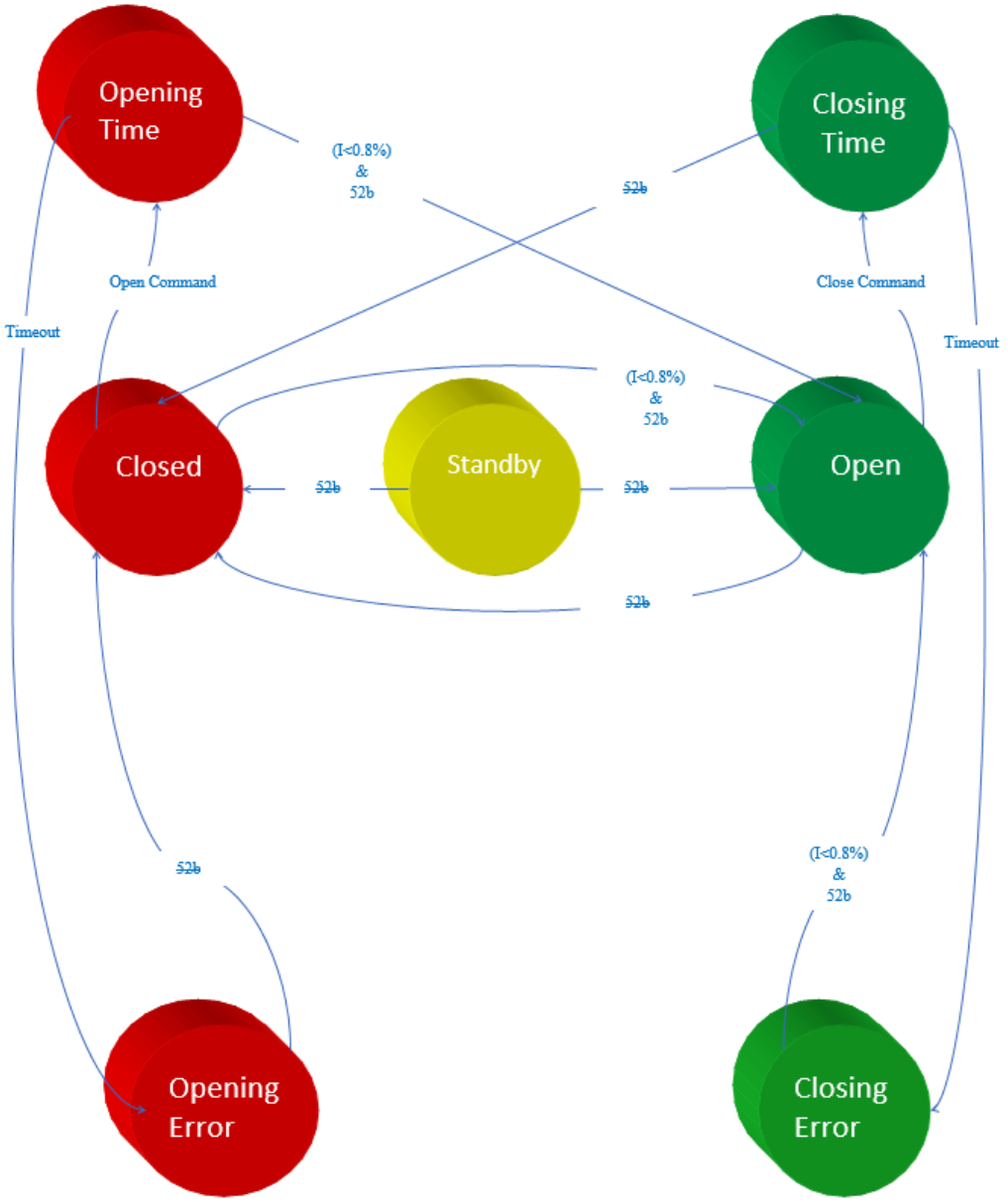
If **no breaker contacts** are used, the monitoring of the circuit breaker is made through the current measurement. This is, if less than 0.8% of rated current is detected it is considered the breaker is open and if more than 0.8% of rated current is available, it is considered the breaker is closed.



If only the circuit breaker **52a contact** is available, it should be wired to the corresponding physical input. This physical input is then assigned to the "52a Input" logical input. The 52b logical input is calculated internally as the negative of 52a. The circuit breaker performance is shown in the following finite state machine:

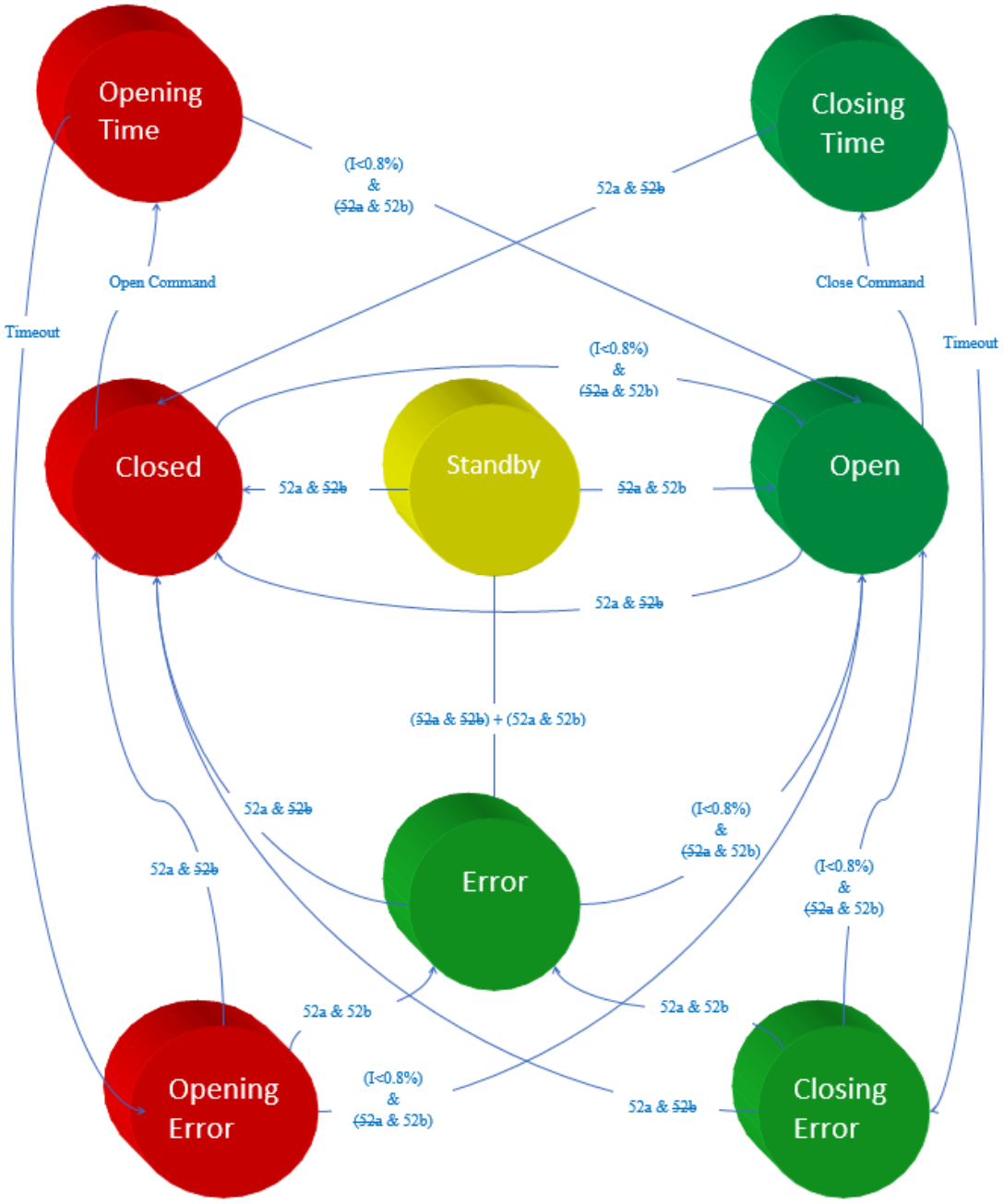


If only the circuit breaker **52b contact** is available, it should be wired to the corresponding physical input. This physical input is then assigned to the "52b Input" logical input. The 52a logical input is calculated internally as the negative of 52b. The circuit breaker performance is shown in the following finite state machine:



If **both circuit breaker contacts 52a and 52b** are available, they should be wired to the two physical inputs. These physical inputs are then assigned to the corresponding logical inputs: the circuit breaker 52a contact to the "52a Input" logical input, and the circuit breaker 52b contact to the "52b Input" logical input. The circuit breaker automaton is considered as having eight statuses: Startup, open, closed, error, opening time, opening error, closing time, and closing error.

The circuit breaker performance is shown in the following finite state machine:



8.9.1 Circuit Breaker opening and closing commands

The circuit breaker opening and closing commands are implemented. These commands can be executed from the HMI commands menu or using the HMI's specific keypad or from local or remote communications.

To execute the commands from remote communications it is necessary to execute the Remote Command, with this action, the Local Control bit is deactivated, and the remote actions are allowed.

Please, note that commands executed from HMI commands menu, HMI specific keys or Local Communication will be always executed, regardless the status of the bit 'Local Control'.

For the commands to have an effect, they should be assigned to the corresponding outputs. By default, the "Open circuit breaker" and "Close circuit breaker" bits are assigned to their corresponding outputs in the "PGC" states group in the 'STATES' menu.

8.9.2 'Openings Number' counter.

SILG relay has a counter which records the number of openings of circuit breaker.

This counter has associated the setting 'Maximum number of openings'. When number of openings is higher than adjusted value the state "Number of openings" is activated and associated event is created.

The value of this counter can be initialized to any value inside the range, by HMI or by communications, in case of installing this protection with a circuit breaker which was already working.

8.9.3 'Accumulated amperes: I^2t' counter

There is also an 'Accumulated amperes' counter. This counter accumulates broken amperes by circuit breaker with its openings.

When a circuit breaker opening happens the maximum of primary amperes are detected in any phase. If detected current is lower than nominal current, nominal current is used to calculate the accumulation.

It is used with "Openings Number" counter, as an estimation of aging of circuit breaker.

As primary amperes are accumulated, is indispensable to set correctly the CT's ratio of the phases.

Associated with this counter, there is a setting called 'Maximum accumulated amperes'. When accumulated amperes are higher than adjusted value, state 'Accumulated amperes' is activated and associated event is created.

The value of this counter can be initialized to any value inside the range, by HMI or by communications, in case of installing this protection with a circuit breaker which was already working.

8.9.4 Maximum openings in a time frame

As well as counting the number of times the circuit breaker opens, the SIL-G relay sets up a time frame and the maximum number of openings allowed during this time. Both parameters can be adjusted.

It works like a time accumulator, to be active it needs to detect openings within the range defined by these two settings.

When this number is exceeded, the 'Openings/Time Alarm' status is activated, and its corresponding event is generated.

This alarm resets itself when the corresponding time is exceeded with less trips than those indicated.

9 GENERAL SETTINGS

General settings establish some parameters that are necessary for the relay to operate. These settings are defined as general because they affect the entire relay, and as a result they are not subject to a change of table.

Any change to settings involves resetting the functions, regardless if they are active or not.

9.1 Measurements

Function	Description	Minimum	Maximum	Step	Unit	Default
	Measurements					
	Frequency	50	60	50/60	Hz	50
	Phase Nominal Current	1	5	1/5	A	1
	Neutral Nominal Current	1	5	1/5	A	1
	CT Phase Ratio	1.0	3000.0	0.1	-	1000.0
	CT Neutral Ratio	1.0	3000.0	0.1	-	1000.0
	VT Connection			(1)	-	3 VT P-N + Vr
	Phase-Phase Nominal Voltage	100	480	1	V	110
	VT Phase Ratio	1.0	3000.0	0.1	-	100.0
	VT Neutral Ratio	1.0	3000.0	0.1	-	100.0
	IA Deadband	0.03	0.50	0.01	xIn	0.1
	IB Deadband	0.03	0.50	0.01	xIn	0.1
	IC Deadband	0.03	0.50	0.01	xIn	0.1
	IN Deadband	0.03	0.50	0.01	xIn	0.1
	VA Deadband	0.03	0.50	0.01	xUn	0.1
	VB Deadband	0.03	0.50	0.01	xUn	0.1
	VC Deadband	0.03	0.50	0.01	xUn	0.1
	VN Deadband	0.03	0.50	0.01	xUn	0.1

(1) 3VTs P-N, 3VTs P-N + Vr, 3VT P-P + Vr, 2VTs P-P +Vr, 3VT P-P.

Frequency: Displays the device's frequency. It is possible to change the rated frequency (50/60Hz).

The phase and neutral CT nominal current setting allows to choose between 1A or 5A.

The phase and neutral CT transformation ratio setting allows the measurements of the primary values from the protection transformer to be showed.

VT Connection. Please see point 2.4.2 for available configurations.

Phase-Phase nominal voltage. It is possible to set the nominal voltage between phases with this parameter.

The phase and neutral VT transformation ratio setting allows the measurements of the primary values from the protection transformer to be showed.

9.2 DFR

Function	Description	Minimum	Maximum	Step	Unit	Default
	DFR					
	Number of records	-	-	5*260 cycles, 25*60 cycles. 50*30 cycles, 100*15 cycles	-	25*60 cycles
	Prefault cycles	1	8	1	-	8

9.3 General

Function	Description	Minimum	Maximum	Step	Unit	Default
	General settings					
	Identification	-	-	-	-	my IED
	Serial Number	-	-	-	-	*(*)*
	Language	-	-	-	-	English
	Settings Group	1	4	1	-	1

(*) Serial number is a read-only setting.

Identification: It is an ASCII text used to identify the relay. Protection devices are normally associated with a specific line or position, and this setting is used for said identification. It is important to fill this field in correctly, as the events and oscillography data is accompanied by this information. This setting can only be adjusted through communications.

Language. The SIL device has the capacity to display messages in four languages, one of which is English in all of them. Please see the list of models to find out about available languages.

Active Settings Group. The Settings groups used by default can be selected with this parameter.

9.4 USB communication

Function	Description	Minimum	Maximum	Step	Unit	Default
	USB Communications					
	Slave Address	1	247	1	-	1

9.5 Wi-Fi communication

Function	Description	Minimum	Maximum	Step	Unit	Default
	Communications					
	Slave Address	1	247	1	-	1
	Channel Number	1	13	1	-	3
	Port (*)	*1*	*65535*	*1*	*-*	*502*
	IP Address	1.0.0.1	223.255.255.254	-	-	192.168.1.100
	Subnet	255.0.0.0	255.255.255.252	-	-	255.255.255.0

(*) Modbus Port is read-only setting.

***When the relay is connected through wi-fi connection and the IP address is changed, the relay must switch off and on to ensure that the relay takes the new IP address. ***

9.6 Remote communications

9.6.1 Rear Serial Communication

Function	Description	Minimum	Maximum	Step	Unit	Default
	Rear Serial Communications					
	Protocol	-	-	Modbus RTU, IEC 60870-5-103 or DNP3.0		Modbus RTU
	Baud rate	4800	115200	4800, 9600, 19200, 38400, 57600, 115200	bauds	19200
	Parity	-	-	8-N-1, 8-E-1, 8-O-1, 9-N-1, 8-N-2, 8-E-2, 8-O-2, 9-N-2		8-N-1

MODBUS RTU

Function	Description	Minimum	Maximum	Step	Unit	Default
	MODBUS RTU Communications					
	Slave address	1	247	1	-	2

DNP3.0

Function	Description	Minimum	Maximum	Step	Unit	Default
	DNP3.0 Communications					
	Slave address	1	247	1	-	3
	Master address	1	247	1	-	1

IEC60870-5-103

Function	Description	Minimum	Maximum	Step	Unit	Default
	IEC 60870-5-103 Communications					
	Slave address	1	247	1	-	3

9.6.2 Rear TCP Communication

Function	Description	Minimum	Maximum	Step	Unit	Default
	Rear Serial Communications					
	Protocol	-	-	Modbus TCP, DNP3 TCP		Modbus TCP
	IP Address	1.0.0.1	223.255.255.254	-	-	192.168.200.100
	Subnet Address	255.0.0.0	255.255.255.252	-	-	255.255.255.0
	Gateway Address	1.0.0.1	223.255.255.254	-	-	192.168.200.1
	DNS-1	1.0.0.1	223.255.255.254	-	-	0.0.0.0
	DNS-2	1.0.0.1	223.255.255.254	-	-	0.0.0.0

MODBUS TCP

Function	Description	Minimum	Maximum	Step	Unit	Default
	MODBUS TCP					
	Slave address	1	247	1	-	2
	Modbus Port	1	65535	1	-	502

DNP3.0 TCP

Function	Description	Minimum	Maximum	Step	Unit	Default
	DNP3.0 TCP					
	Slave address	1	247	1	-	3
	Master Address	1	247	1	-	1
	DNP3 Port	1	65535	1	-	20000

9.6.3 IEC 61850

The settings for this protocol are predefined as indicated in the table below.

For both RJ45 and FO connection:

Function	Description	Minimum	Maximum	Step	Unit	Default
	IEC 61850 Communications					
	IP Address	-	-	-	-	192.168.200.121
	Subnet Address	-	-	-	-	255.255.255.0
	Gateway Address	-	-	-	-	192.168.200.254
	Port	-	-	-	-	102

10 SETTINGS GROUPS

There are 4 settings group settings and one general group. The settings group which is active at a specific moment can be modified in two ways:

- Changing the active Settings group. In the general settings, inside the general menu, there is a setting which establishes which settings group is active.
- By means of two logical conditions configurable through PGC (physical or logical inputs), four possibilities are defined:

Settings Group x2	Settings Group x1	
0	0	This situation is defined by the active settings group chosen in General Settings.
0	1	Settings group 1
1	0	Settings group 2
1	1	Settings group 3

In the zero position the active item is defined by the active settings group defined in the general menu. Regarding other options, regardless of that established by the settings, the inputs prevail over the settings.

Settings group 4 can be used just from the active settings group defined in the general settings.

11 AVALIABLE CURVES

11.1 IEC 60255-151 Curves

The SIL-G relay complies with the curves shown in standard IEC60255-151:

- Inverse Curve
- Very Inverse Curve
- Extremely Inverse Curve
- Long time inverse
- Short time inverse

There is a general mathematical equation that defines the time in seconds as a function of the current:

$$t = \frac{A \times D}{V^P - Q} + B \times D + K$$

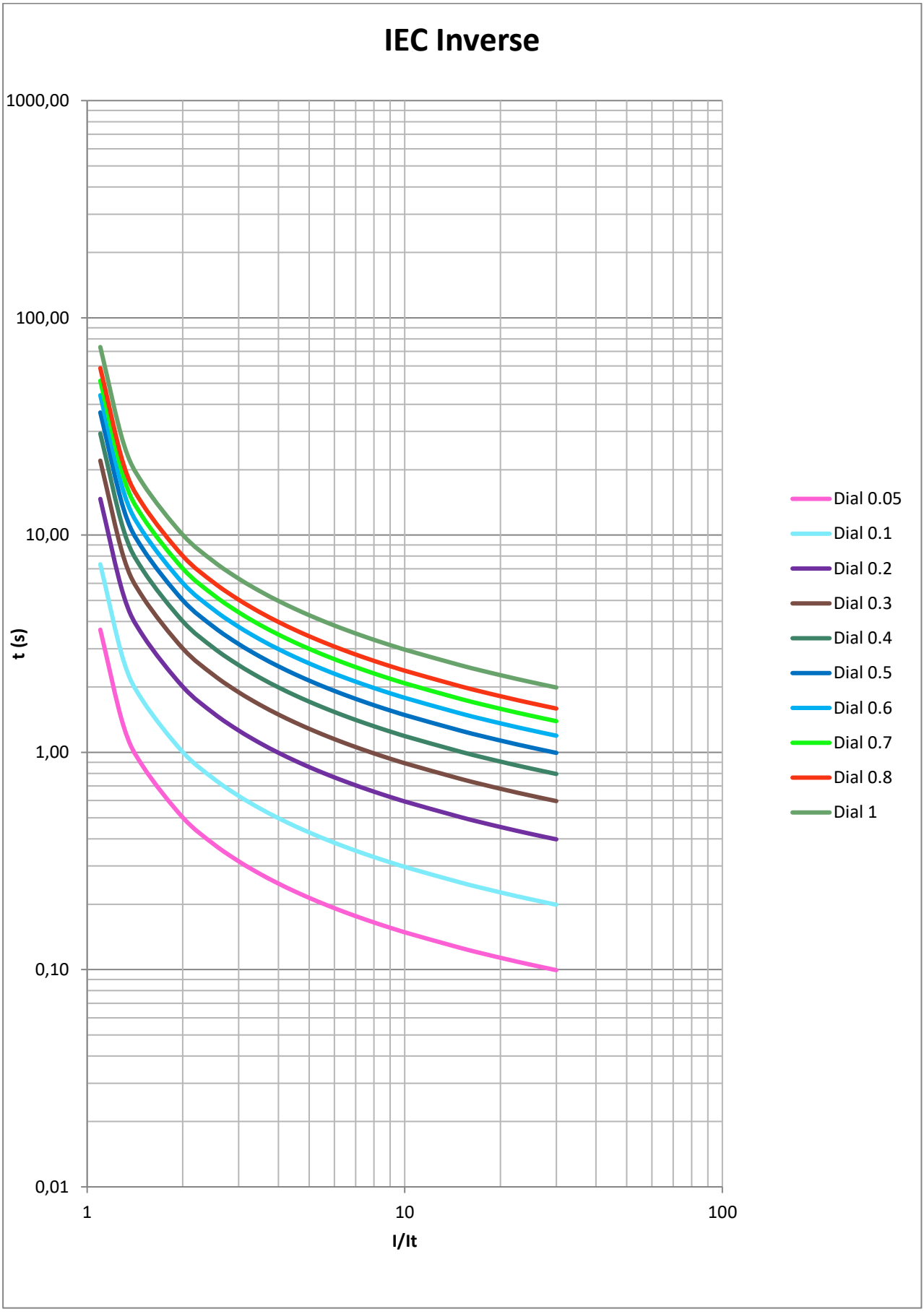
Where:

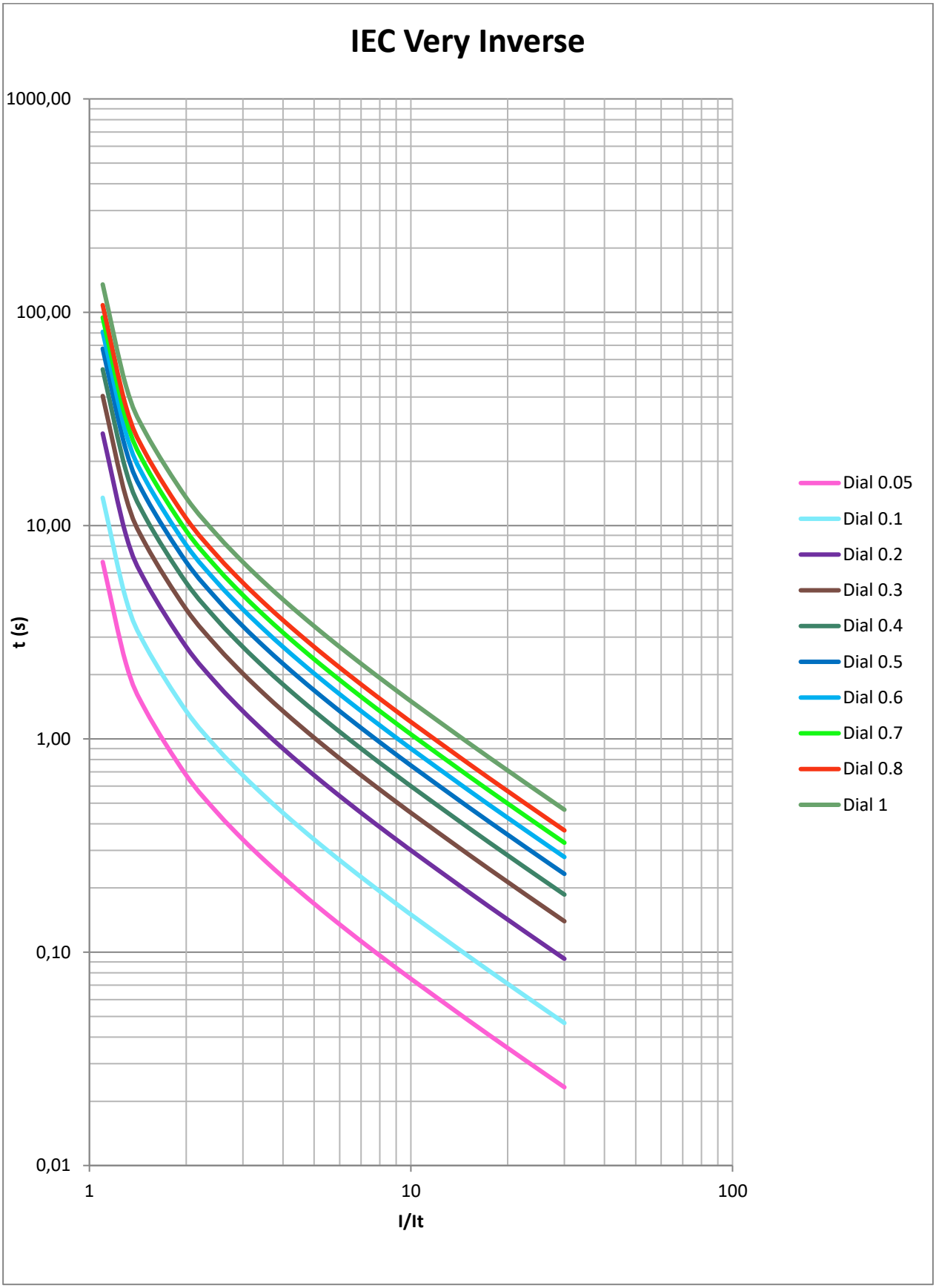
$$V = \frac{I}{I_{adjusted}}$$

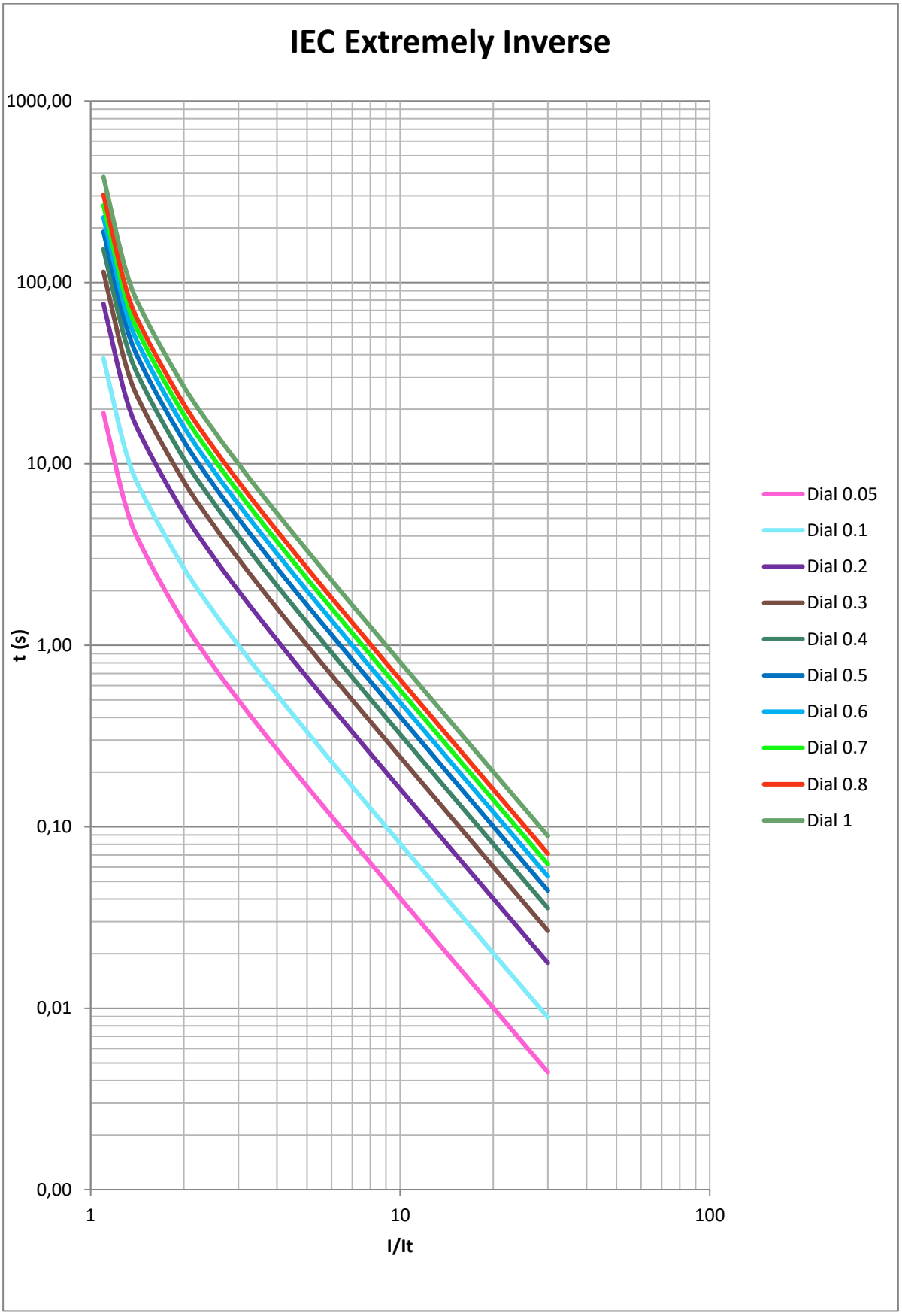
Parameters	A	P	Q	B	K
Long Time Inverse	120	1	1	0	0
Short Time Inverse	0.05	0.04	1	0	0
Ext. Inverse	80	2	1	0	0
Very Inverse	13,5	1	1	0	0
Inverse	0.14	0.02	1	0	0

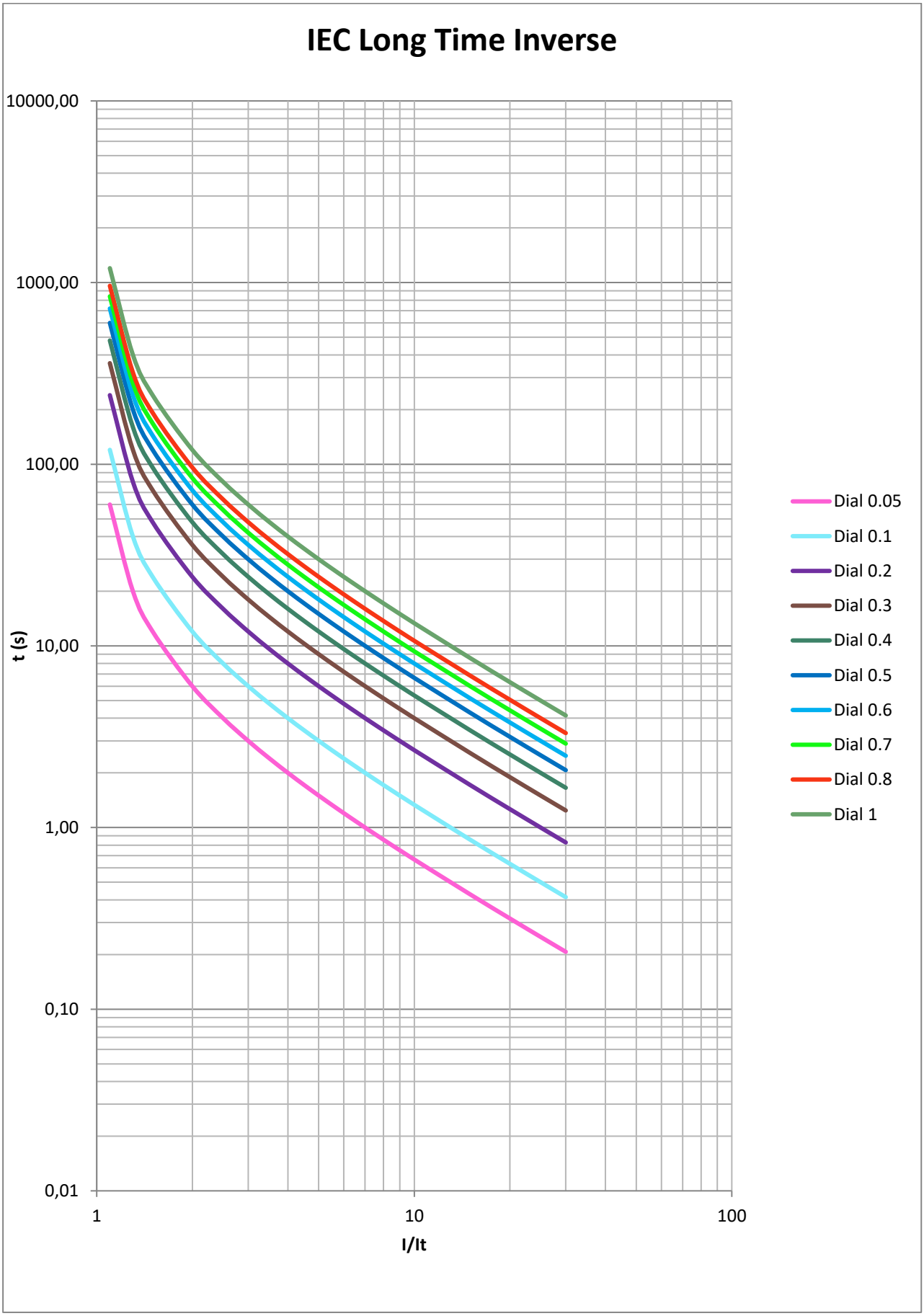
The curve can mode from its axis using the D time selection device, which the user can adjust.

$I_{adjusted}$ is the initial operating current, set by the user.


IEC Inverse
1000,00
100,00
10,00
1,00
0,10
0,01
t (s)
1
10
100
I/It
Dial 0.05
Dial 0.1
Dial 0.2
Dial 0.3
Dial 0.4
Dial 0.5
Dial 0.6
Dial 0.7
Dial 0.8
Dial 1


IEC Very Inverse
1000,00
100,00
10,00
1,00
0,10
0,01
t (s)
1
10
100
I/It
Dial 0.05
Dial 0.1
Dial 0.2
Dial 0.3
Dial 0.4
Dial 0.5
Dial 0.6
Dial 0.7
Dial 0.8
Dial 1


IEC Extremely Inverse
1000,00
100,00
10,00
1,00
0,10
0,01
0,00
t (s)
1
10
100
I/It
Dial 0.05
Dial 0.1
Dial 0.2
Dial 0.3
Dial 0.4
Dial 0.5
Dial 0.6
Dial 0.7
Dial 0.8
Dial 1


IEC Long Time Inverse
10000,00
1000,00
100,00
10,00
1,00
0,10
0,01
t (s)
1
10
100
I/It
Dial 0.05
Dial 0.1
Dial 0.2
Dial 0.3
Dial 0.4
Dial 0.5
Dial 0.6
Dial 0.7
Dial 0.8
Dial 1

11.2 IEEE Curves

The SIL-G relay complies with the curves shown in standard IEEE:

- Inverse Curve
- Very Inverse Curve
- Extremely Inverse Curve

There is a general mathematical equation that defines the time in seconds as a function of the current:

$$t = (TD) \times \left[\left(\frac{A}{V^P - 1} \right) + B \right]$$

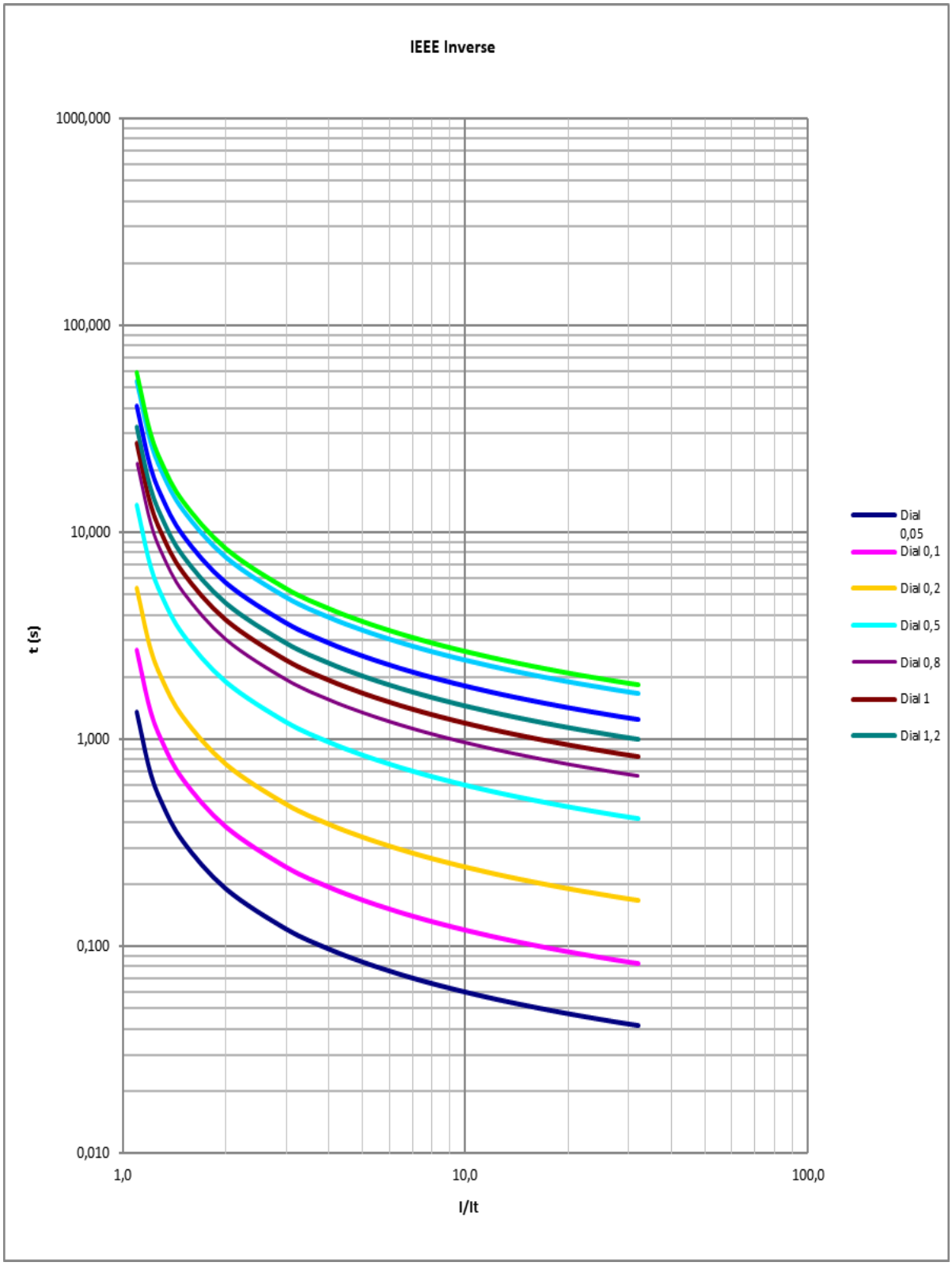
Where:

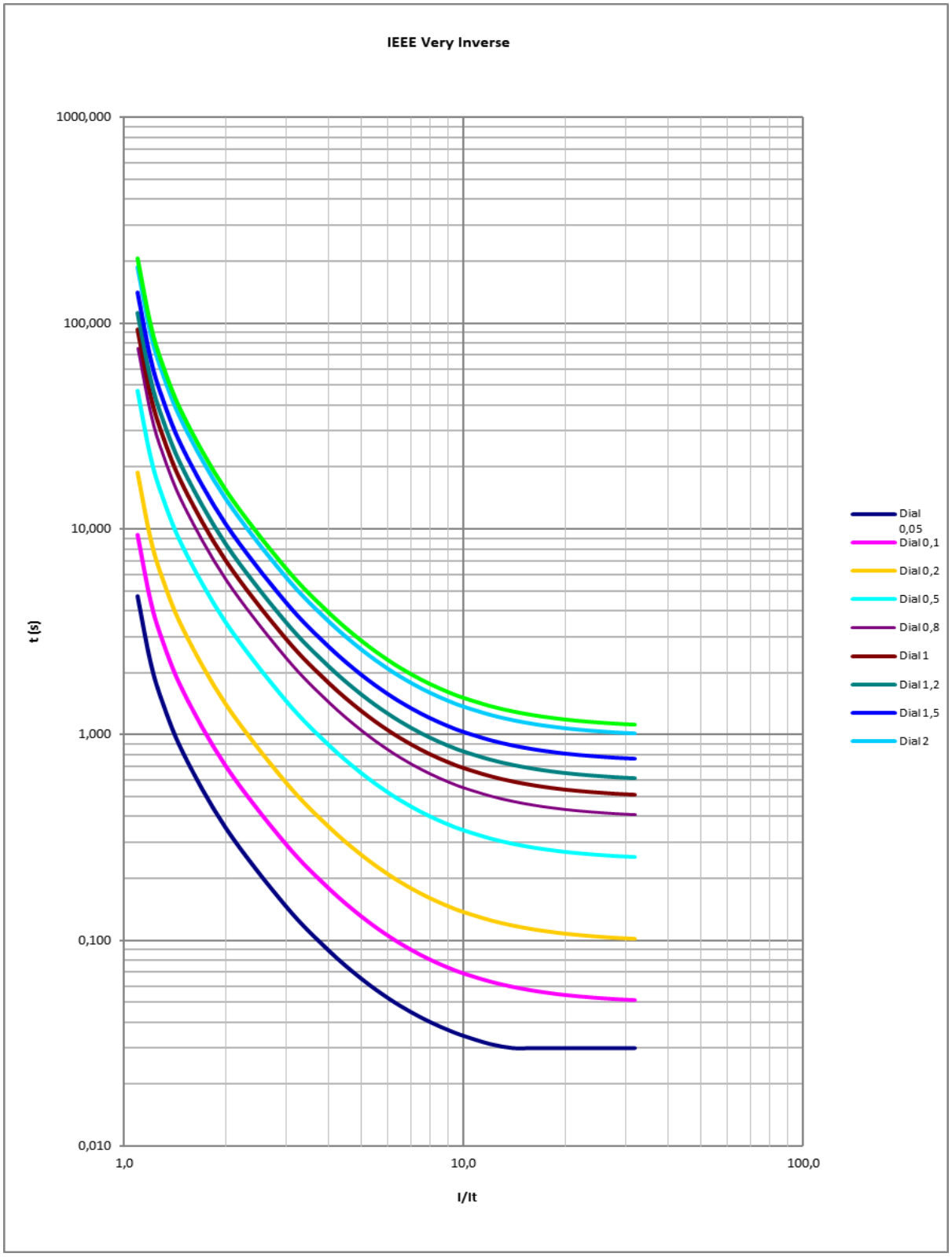
$$V = \frac{I}{I_{adjusted}}$$

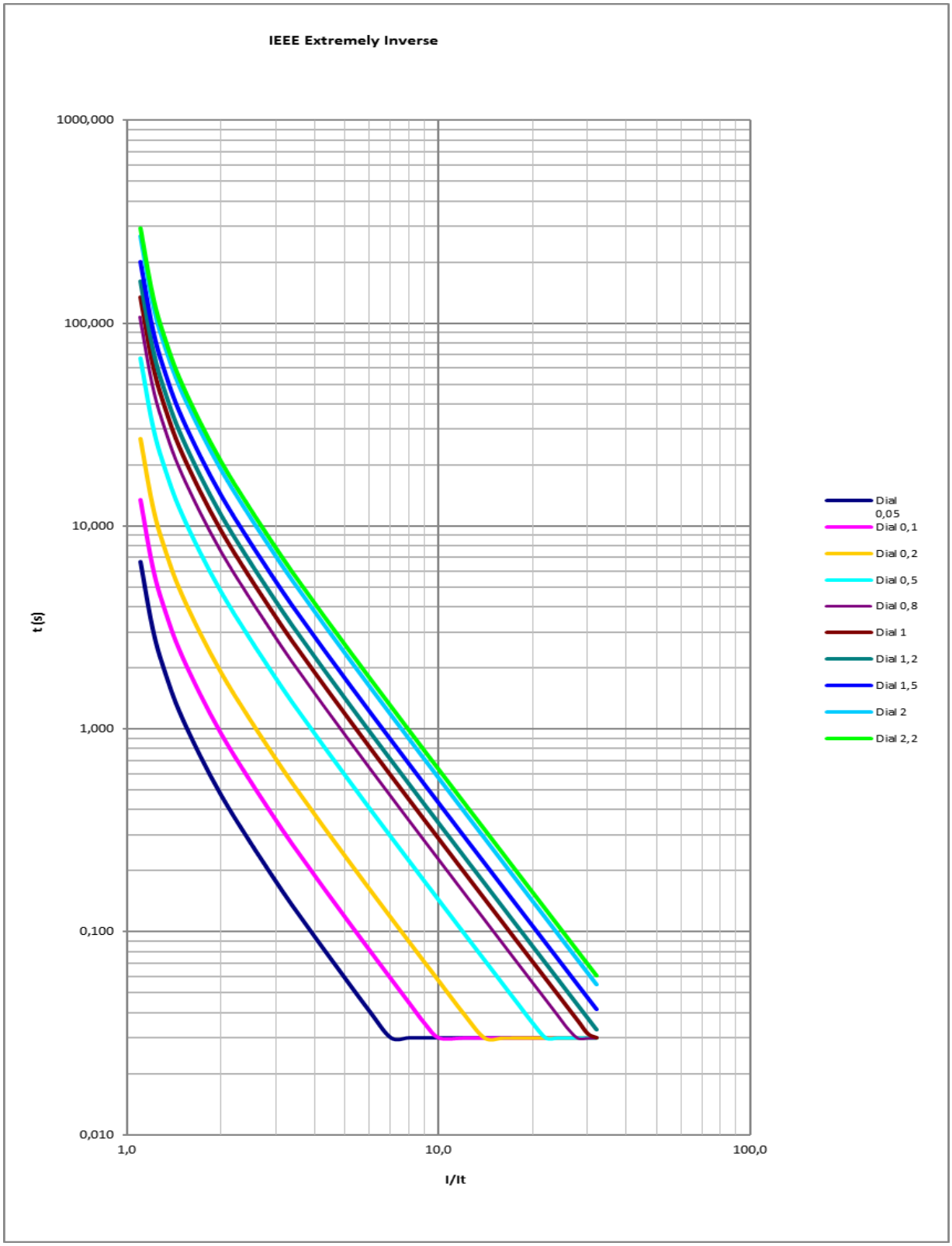
Parameters	A	P	B
Ext. Inverse	28.2	2.00	0.1217
Very Inverse	19.61	2.00	0.491
Inverse	0.0515	0.02	0.114

The curve can move from its axis using the TD time selection device, which the user can adjust.

$I_{adjusted}$ is the initial operating current, set by the user.


IEEE Inverse
1000,000
100,000
10,000
1,000
0,100
0,010
t (s)
1,0
10,0
100,0
I/It
Dial 0,05
Dial 0,1
Dial 0,2
Dial 0,5
Dial 0,8
Dial 1
Dial 1,2


IEEE Very Inverse
1000,000
100,000
10,000
1,000
0,100
0,010
t (s)
1,0
10,0
100,0
I/It
Dial 0,05
Dial 0,1
Dial 0,2
Dial 0,5
Dial 0,8
Dial 1
Dial 1,2
Dial 1,5
Dial 2


IEEE Extremely Inverse
1000,000
100,000
10,000
1,000
0,100
0,010
t (s)
1,0
10,0
100,0
I/It
Dial 0,05
Dial 0,1
Dial 0,2
Dial 0,5
Dial 0,8
Dial 1
Dial 1,2
Dial 1,5
Dial 2
Dial 2,2

12 MONITORING AND CONTROL

12.1 Measurements

The relay is provided with the following measurements. Depending on the connection type (phase to phase or phase to neutral connection), the measurements will be shown according to the selected connection type.

Current measurement:

Range: 0.01-30xIn

Accuracy: ±2% in a band of ± 20% the nominal current and ±4% or ±5 mA (greater of both) in the rest of the band.

CURRENT
Phase A Current (I-A)
Phase B Current (I-B)
Phase C Current (I-C)
Measured neutral Current (I-N)
Calculated neutral current (3I-0)
Positive Sequence Current (I-1)
Negative sequence current (I-2)
Negative sequence current/ Positive Sequence Current (I-2/I-1)
Maximum Current (I-Max)
Phase A Second harmonic current (I-A2H)
Phase B Second harmonic current (I-B2H)
Phase C Second harmonic current (I-C2H)
Phase A current angle (Ang I-A)
Phase B current angle (Ang I-B)
Phase C current angle (Ang I-C)
Measured neutral current angle (Ang I-N)
Calculated neutral current angle (Ang 3I-0)
Thermal Image (Therm. I %)

Voltage measurement:

Range:

Connection through VTs (Un setting: 100-130 V P-P): 3 to 250 V

Direct connection to low voltage line: (Un setting: 200-480 V P-P): 12 to 1000 V

Accuracy: ±1% in a band covering the ±20% of the nominal voltage and ±4% in the rest of the range.

VOLTAGE MEASUREMENT
Phase A Voltage (V-A)
Phase B Voltage (V-B)
Phase C Voltage (V-C)
Measured neutral voltage (V-R)
Line voltage (V-L)
AB Voltage (U-AB)
BC Voltage (U-BC)
CA Voltage (U-CA)
Calculated neutral Voltage (3V-0)
Positive Sequence Voltage (V-1)
Negative sequence Voltage (V-2)
Maximum Voltage (V-Max)
Phase A voltage angle (Ang V-A)
Phase B voltage angle (Ang V-B)
Phase C voltage angle (Ang V-C)
Measured neutral voltage angle (Ang V-R)
Line voltage angle (Ang V-L)
Calculated neutral voltage angle (Ang 3V0)
AB voltage angle (Ang UAB)
BC voltage angle (Ang UBC)
CA voltage angle (Ang UCA)

Power measurement:

POWER
Total Active Power (P-3P)
Total Reactive Power (Q-3P)
Total Apparent Power (S-3P)
Phase A Active power (P-A)
Phase A Reactive power (Q-A)
Phase A Apparent power (S-A)
Phase B Active power (P-B)
Phase B Reactive power (Q-B)
Phase B Apparent power (S-B)
Phase C Active power (P-C)
Phase C Reactive power (Q-C)
Phase C Apparent power (S-C)

Frequency measurement:

Range: 45-65 Hz (minimum required voltage in phase B: 20 V)

Accuracy: ±0.001 Hz

FREQUENCY MEASUREMENT
Bar frequency (f bar)
Line frequency (f line)
Rate of change of frequency (df/dt)
Voltage/frequency (V/Hz)

Angle measurement:

Range: 0-359 degrees (minimum required voltage in phase B: 20 V)

Accuracy: ± 2 degrees

12.2 Alarms Panel

Once the alarms are activated according to their configurations, they can be recognized one at a time by holding RESET key on the selected alarm at the panel.

Depending on the configuration, after the recognition action, the alarms can still be activated or they can be deactivated. In alarm panel menu, these features will be shown considering this behaviour, the possibilities for the alarms are:

ALARM STATE	
ACTIVATED	Recognized
	Not recognized
DEACTIVATED	Recognized (Not shown)
	Not Recognized

12.3 States and Sequential Events Recording (SER)

The state is given by real-time information generated by the relay. Some states have an event associate with them, which is a register of a change made to the state. There are states that have an activation event associated with them, and other states have two associated events: activation and deactivation. On the HMI, activation is shown with ┘symbol and deactivation with ┐symbol. These events are registered in a circular memory (buffer) with a capacity for up to 3072 events. The memory timestamp is accurate to 1 millisecond.

The events will be registered in non-volatile FRAM memory, and the events are conserved even if the relay is not powered. The relay keeps and processes the correct date and time, even without electrical power while the internal commissioning battery works (the lifetime of this battery is 20 years).

The events can be browsed from the HMI or by using communications. Reading the events does not mean that they get deleted; they remain stored on the relay. To delete the events using the HMI requires to go to the events menu and hold the 'RESET' key until the number of events reads 1, corresponding this event to 'Events deleted'. To delete the events using communications, use the corresponding 'Delete Events' option. To delete the events, it is necessary to enter a password.

Events have the following structure:

Identifier	Unique event identifier: e.g.: Number of event, function and event description
State	Activated / Deactivated: an event is generated for Activation and Deactivation
Associated Meassurement	Depending of the event
Date	Year, month, day, hour, minutes, seconds, milliseconds

The following list shows all the states of the relay and their associated events:

NOTE: The cause of events shown in the table represents the default configured events in the relay. However, the user can mask and unmask the events distinguishing if the action applies to the activation or deactivation reasons.

Group	Status	Event	Cause	Measurement
Measurements				
	Measurement Error	Measurement Error	Activation/Deactivation	-
	Net Frequency 50 Hz	Net Frequency 50 Hz	Activation/Deactivation	-
	Line Frequency blocked	Line Frequency blocked	Activation/Deactivation	Line voltage (V-L)
	Bar Frequency Blocked	Bar Frequency Blocked	Activation/Deactivation	Phase B Voltage (V-B)
Self-Diagnosis				
	Model Error	Model Error	Activation/Deactivation	-
	Hardware Error	Hardware Error	Activation/Deactivation	-
	Slot 3 Empty	-	-	-
	Slot 4 Empty	-	-	-
	Slot 5 Empty	-	-	-
	Communication Error	COM Error	-	-
	Test State	Test State	Activation/Deactivation	-
	Default Settings	Default Settings	Activation/Deactivation	-
	Error: Settings	Error: Settings	Activation/Deactivation	-
	Default Configuration	Default Configuration	Activation/Deactivation	-
	Error: Configuration	Error: Configuration	Activation/Deactivation	-

A brief description of the general states:

- **Trip**: The relay has tripped.
- **External Trip**: A trip has been caused by the activation of the excess temperature input (external trip).
- **50 Hz**: If activated, the relay works at 50 Hz, if deactivated it works at 60Hz.
- **Trip Block Enable**: If the Trip Block functions is available in the model, it has been enabled.
- **Measurement error**: The self-diagnosis algorithms have detected a problem in the measurement block.
- **Ready**: No errors
- **Setting change**: Activated when the settings are changed.
- **Set date/time**: Activated when the date-time are synchronized.
- **Local**: Activated when the device is in Local Control mode.
- **Factory settings**: the relay is set to default settings.
- **Eeprom error**: The self-diagnosis algorithms have detected a problem in the Eeprom memory, which contains the settings.
- **Eeprom change**: Activated when the configuration or user passwords are changed.
- **Events error**: since the events buffer is circular, new events overwrite the older events once the buffer is full, and the older events are lost. To show this situation, the 'Events error' bit is activated. This bit is reset by deleting the events (from the HMI or by using communications).

Group	Status	Event	Cause	Measurement
General				
	Trip	Trip	Activation/Deactivation	Maximum Current
	Ready	Ready	Activation/Deactivation	-
	Wrong Password	Wrong Password	Activation	-
	Set date/time	Set date/time	Activation	-
	Local Control	Local Control	Activation/Deactivation	-
	Error: SER	Error: SER	Activation/Deactivation	-
	SER deleted	SER deleted	Activation	-
	Wrong Access	Wrong Access	Activation	-
	Settings Change	Settings Change	Activation	-
	Configuration Change	Configuration Change	Activation	-
	LDP Deleted	LDP Deleted	Activation	-
	New DFR	New DFR	Activation/Deactivation	-
	Phase Trip	Phase Trip	-	-
	Trip Block	Trip Block	Activation/Deactivation	Maximum Current
	Pickup	Phase Pickup	Activation/Deactivation	Maximum Current
	Phase A Pickup	Phase A Pickup	Activation/Deactivation	Phase A Current (A)
	Phase B Pickup	Phase B Pickup	Activation/Deactivation	Phase B Current (A)
	Phase C Pickup	Phase C Pickup	Activation/Deactivation	Phase C Current (A)
	Neutral Pickup	Neutral Pickup	Activation/Deactivation	Neutral Current (A)
	Phase A Trip	Phase A Trip	Activation/Deactivation	Phase A Current (A)
	Phase B Trip	Phase B Trip	Activation/Deactivation	Phase B Current (A)
	Phase C Trip	Phase C Trip	Activation/Deactivation	Phase C Current (A)
	Neutral Trip	Neutral Trip	Activation/Deactivation	Neutral Current (A)
	Settings Group 1	Settings Group 1	Activation	-
	Settings Group 2	Settings Group 2	Activation	-
	Settings Group 3	Settings Group 3	Activation	-
	Settings Group 4	Settings Group 4	Activation	-
	Set to FALSE	-	-	-
	Set to TRUE	-	-	-

Group	Status	Event	Cause	Measurement
Disturbance fault recording				
DFR	-	Phase A Current	Activation	IA
	-	Phase B Current	Activation	IB
	-	Phase C Current	Activation	IC
	-	Neutral Current	Activation	IN
	-	Phase A Voltage	Activation	VA
	-	Phase B Voltage	Activation	VB
	-	Phase C Voltage	Activation	VC
	-	Neutral Voltage	Activation	VN
	-	Phase B Line Voltage	Activation	VL
	-	Bar frequency	Activation	
Circuit Breaker monitoring				
52	52 Startup	52 Startup	Activation	-
	52 Error	52 Error	Activation	-
	52 Open	52 Open	Activation	-
	52 Opening Time	52 Opening time	Activation	-
	52 Opening Error	52 Opening error	Activation	-
	52 Closed	52 Closed	Activation	-
	52 Closing Time	52 Closing time	Activation	-
	52 Closing Error	52 Closing error	Activation	-
	52 Maximum number of openings alarm	52 Maximum number of openings alarm	Activation/Deactivation	-
	52 Maximum accumulated amperes alarm	52 Maximum accumulated amperes alarm	Activation/Deactivation	-
	52 Excessive openings in a time window	52 Excessive openings in a time window	Activation/Deactivation	-
Inputs (Models SILGxxxxxx0xxx, SILGxxxxxx6xxx & SILGxxxxxxAxxx)				
	Input 1	Input 1	Activation/Deactivation	-
	Input 2	Input 2	Activation/Deactivation	-
	Input 3	Input 3	Activation/Deactivation	-
	Input 4	Input 4	Activation/Deactivation	-
	Input 5	Input 5	Activation/Deactivation	-
	Input 6	Input 6	Activation/Deactivation	-
	Input 7	Input 7	Activation/Deactivation	-
	Input 8	Input 8	Activation/Deactivation	-

Group	Status	Event	Cause	Measurement
Inputs (Model SILGxxxxxx7xxx)				
	Input 1	Input 1	Activation/Deactivation	-
	Input 2	Input 2	Activation/Deactivation	-
	Input 3	Input 3	Activation/Deactivation	-
	Input 4	Input 4	Activation/Deactivation	-
	Input 5	Input 5	Activation/Deactivation	-
	Input 6	Input 6	Activation/Deactivation	-
	Input 7	Input 7	Activation/Deactivation	-
	Input 8	Input 8	Activation/Deactivation	-
	Input 9	Input 9	Activation/Deactivation	-
	Input 10	Input 10	Activation/Deactivation	-
	Input 12	Input 12	Activation/Deactivation	-
	Input 13	Input 13	Activation/Deactivation	-
	Input 14	Input 14	Activation/Deactivation	-
	Input 15	Input 15	Activation/Deactivation	-
	Input 16	Input 16	Activation/Deactivation	-
Inputs (Model SILGxxxxxx5xxx)				
	Input 1	Input 1	Activation/Deactivation	-
	Input 2	Input 2	Activation/Deactivation	-
	Input 3	Input 3	Activation/Deactivation	-
	Input 4	Input 4	Activation/Deactivation	-
	Input 5	Input 5	Activation/Deactivation	-
	Input 6	Input 6	Activation/Deactivation	-
	Input 7	Input 7	Activation/Deactivation	-
	Input 8	Input 8	Activation/Deactivation	-
	Input 9	Input 9	Activation/Deactivation	-
	Input 10	Input 10	Activation/Deactivation	-
	Input 12	Input 12	Activation/Deactivation	-
	Input 13	Input 13	Activation/Deactivation	-
	Input 14	Input 14	Activation/Deactivation	-
	Input 15	Input 15	Activation/Deactivation	-
	Input 16	Input 16	Activation/Deactivation	-
	Input 17	Input 17	Activation/Deactivation	-
	Input 18	Input 18	Activation/Deactivation	-
	Input 19	Input 19	Activation/Deactivation	-
	Input 20	Input 20	Activation/Deactivation	-
	Input 21	Input 21	Activation/Deactivation	-
	Input 22	Input 22	Activation/Deactivation	-
	Input 23	Input 23	Activation/Deactivation	-
	Input 24	Input 24	Activation/Deactivation	-

Group	Status	Event	Cause	Measurement
Outputs (Models SILGxxxxxx0xxx, SILGxxxxxx5xxx & SILGxxxxxxAxxx)				
	Output 1	Output 1	Activation/Deactivation	-
	Output 2	Output 2	Activation/Deactivation	-
	Output 3	Output 3	Activation/Deactivation	-
	Output 4	Output 4	Activation/Deactivation	-
	Output 5	Output 5	Activation/Deactivation	-
	Output 6	Output 6	Activation/Deactivation	-
	Output 7	Output 7	Activation/Deactivation	-
	Logic Signal 8	Logic Signal 8	Activation/Deactivation	-
	Logic Signal 9	Logic Signal 9	Activation/Deactivation	-
	Logic Signal 10	Logic Signal 10	Activation/Deactivation	-
	Logic Signal 11	Logic Signal 11	Activation/Deactivation	-
	Logic Signal 12	Logic Signal 12	Activation/Deactivation	-
	Logic Signal 13	Logic Signal 13	Activation/Deactivation	-
	Logic Signal 14	Logic Signal 14	Activation/Deactivation	-
	Logic Signal 15	Logic Signal 15	Activation/Deactivation	-
	Logic Signal 16	Logic Signal 16	Activation/Deactivation	-
	Logic Signal 17	Logic Signal 17	Activation/Deactivation	-
	Logic Signal 18	Logic Signal 18	Activation/Deactivation	-
	Logic Signal 19	Logic Signal 19	Activation/Deactivation	-
	Logic Signal 20	Logic Signal 20	Activation/Deactivation	-
	Logic Signal 21	Logic Signal 21	Activation/Deactivation	-
	Logic Signal 22	Logic Signal 22	Activation/Deactivation	-
	Logic Signal 23	Logic Signal 23	Activation/Deactivation	-
	Logic Signal 24	Logic Signal 24	Activation/Deactivation	-
	Logic Signal 25	Logic Signal 25	Activation/Deactivation	-
	Logic Signal 26	Logic Signal 26	Activation/Deactivation	-
	Logic Signal 27	Logic Signal 27	Activation/Deactivation	-
	Logic Signal 28	Logic Signal 28	Activation/Deactivation	-
	Logic Signal 29	Logic Signal 29	Activation/Deactivation	-
	Logic Signal 30	Logic Signal 30	Activation/Deactivation	-
	Logic Signal 31	Logic Signal 31	Activation/Deactivation	-
	Logic Signal 32	Logic Signal 32	Activation/Deactivation	-

Group	Status	Event	Cause	Measurement
Outputs (Model SILGxxxxxx6xxx)				
	Output 1	Output 1	Activation/Deactivation	-
	Output 2	Output 2	Activation/Deactivation	-
	Output 3	Output 3	Activation/Deactivation	-
	Output 4	Output 4	Activation/Deactivation	-
	Output 5	Output 5	Activation/Deactivation	-
	Output 6	Output 6	Activation/Deactivation	-
	Output 7	Output 7	Activation/Deactivation	-
	Output 8	Output 8	Activation/Deactivation	-
	Output 9	Output 9	Activation/Deactivation	-
	Output 10	Output 10	Activation/Deactivation	-
	Output 11	Output 11	Activation/Deactivation	-
	Output 12	Output 12	Activation/Deactivation	-
	Output 13	Output 13	Activation/Deactivation	-
	Output 14	Output 14	Activation/Deactivation	-
	Output 15	Output 15	Activation/Deactivation	-
	Output 16	Output 16	Activation/Deactivation	-
	Output 17	Output 17	Activation/Deactivation	-
	Output 18	Output 18	Activation/Deactivation	-
	Logic Signal 19	Logic Signal 19	Activation/Deactivation	-
	Logic Signal 20	Logic Signal 20	Activation/Deactivation	-
	Logic Signal 21	Logic Signal 21	Activation/Deactivation	-
	Logic Signal 22	Logic Signal 22	Activation/Deactivation	-
	Logic Signal 23	Logic Signal 23	Activation/Deactivation	-
	Logic Signal 24	Logic Signal 24	Activation/Deactivation	-
	Logic Signal 25	Logic Signal 25	Activation/Deactivation	-
	Logic Signal 26	Logic Signal 26	Activation/Deactivation	-
	Logic Signal 27	Logic Signal 27	Activation/Deactivation	-
	Logic Signal 28	Logic Signal 28	Activation/Deactivation	-
	Logic Signal 29	Logic Signal 29	Activation/Deactivation	-
	Logic Signal 30	Logic Signal 30	Activation/Deactivation	-
	Logic Signal 31	Logic Signal 31	Activation/Deactivation	-
	Logic Signal 32	Logic Signal 32	Activation/Deactivation	-

Group	Status	Event	Cause	Measurement
Outputs (Model SILGxxxxxx7xxx)				
	Output 1	Output 1	Activation/Deactivation	-
	Output 2	Output 2	Activation/Deactivation	-
	Output 3	Output 3	Activation/Deactivation	-
	Output 4	Output 4	Activation/Deactivation	-
	Output 5	Output 5	Activation/Deactivation	-
	Output 6	Output 6	Activation/Deactivation	-
	Output 7	Output 7	Activation/Deactivation	-
	Output 8	Output 8	Activation/Deactivation	-
	Output 9	Output 9	Activation/Deactivation	-
	Output 10	Output 10	Activation/Deactivation	-
	Output 11	Output 11	Activation/Deactivation	-
	Logic Signal 12	Logic Signal 12	Activation/Deactivation	-
	Logic Signal 13	Logic Signal 13	Activation/Deactivation	-
	Logic Signal 14	Logic Signal 14	Activation/Deactivation	-
	Logic Signal 15	Logic Signal 15	Activation/Deactivation	-
	Logic Signal 16	Logic Signal 16	Activation/Deactivation	-
	Logic Signal 17	Logic Signal 17	Activation/Deactivation	-
	Logic Signal 18	Logic Signal 18	Activation/Deactivation	-
	Logic Signal 19	Logic Signal 19	Activation/Deactivation	-
	Logic Signal 20	Logic Signal 20	Activation/Deactivation	-
	Logic Signal 21	Logic Signal 21	Activation/Deactivation	-
	Logic Signal 22	Logic Signal 22	Activation/Deactivation	-
	Logic Signal 23	Logic Signal 23	Activation/Deactivation	-
	Logic Signal 24	Logic Signal 24	Activation/Deactivation	-
	Logic Signal 25	Logic Signal 25	Activation/Deactivation	-
	Logic Signal 26	Logic Signal 26	Activation/Deactivation	-
	Logic Signal 27	Logic Signal 27	Activation/Deactivation	-
	Logic Signal 28	Logic Signal 28	Activation/Deactivation	-
	Logic Signal 29	Logic Signal 29	Activation/Deactivation	-
	Logic Signal 30	Logic Signal 30	Activation/Deactivation	-
	Logic Signal 31	Logic Signal 31	Activation/Deactivation	-
	Logic Signal 32	Logic Signal 32	Activation/Deactivation	-

Group	Status	Event	Cause	Measurement
PGC (Programmable Logic Control)				
	Open Breaker	Open Breaker Command	Activation	-
	Close Breaker	Close Breaker Command	Activation	-
	79 Block	79 Block Command	Activation	-
	79 Unblock	79 Unblock Command	Activation	-
	Local Control	Local Control Command	Activation	-
	Remote Control	Remote Control Command	Activation	-
	52a	52a	-	-
	52b	52b	-	-
	SettingsG1	SettingsG1	Activation/Deactivation	-
	SettingsG2	SettingsG2	Activation/Deactivation	-
	Hot Line Tag	Hot Line Tag	Activation/Deactivation	-
	79 Enable	79 Enable	Activation/Deactivation	-
	79N1 Start	79N1 Start	Activation	-
	79N2 Start	79N2 Start	Activation	-
	79N3 Start	79N3 Start	Activation	-
	79N4 Start	79N4 Start	Activation	-
	DFR Start	DFR Start	-	-
	50BF Start	50BF Start	Activation	-
	SOTF Start	SOTF Start	Activation	-
	Thermal I. Reset	Thermal I. Reset	Activation	-
	74TCS Coil A	74TCS Coil A	Activation/Deactivation	-
	74TCS Coil B	74TCS Coil B	Activation/Deactivation	-
	Neutral Block	Neutral Block	Activation/Deactivation	-
	Phase Block	Phase Block	Activation/Deactivation	-
	PGC 1	PGC 1	-	-
	PGC 2	PGC 2	-	-
	PGC 3	PGC 3	-	-
	PGC 4	PGC 4	-	-
	PGC 5	PGC 5	-	-
	PGC 6	PGC 6	-	-
	PGC 7	PGC 7	-	-
	PGC 8	PGC 8	-	-

Group	Status	Event	Cause	Measurement
Alarms				
	Alarm 1	-		-
	Alarm 2	-		-
	Alarm 3	-		-
	Alarm 4	-		-
	Alarm 5	-		-
	Alarm 6	-		-
	Alarm 7	-		-
	Alarm 8	-		-
	Logic Alarm 9	-		-
	Logic Alarm 10	-		-
	Logic Alarm 11	-		-
	Logic Alarm 12	-		-
	Logic Alarm 13	-		-
	Logic Alarm 14	-		-
	Logic Alarm 15	-		-
	Logic Alarm 16	-		-
	Logic Alarm 17	-		-
	Logic Alarm 18	-		-
	Logic Alarm 19	-		-
	Logic Alarm 20	-		-
	Logic Alarm 20	-		-
	Logic Alarm 21	-		-
	Logic Alarm 22	-		-
	Logic Alarm 23	-		-
	Logic Alarm 24	-		-
	Logic Alarm 25	-		-
	Logic Alarm 26	-		-
	Logic Alarm 27	-		-
	Logic Alarm 28	-		-
	Logic Alarm 29	-		-
	Logic Alarm 30	-		-
	Logic Alarm 31	-		-
	Logic Alarm 32	-		-

Group	Status	Event	Cause	Measurement
Arc Flash Detection (Model SILGxxxxxxAxxx)				
AFD	AFD Output 1	AFD Output 1	Activation/Deactivation	-
	AFD Output 2	AFD Output 2	Activation/Deactivation	-
	AFD Output 3	AFD Output 3	Activation/Deactivation	-
	AFD Output 4	AFD Output 4	Activation/Deactivation	-
	AFD Input 1	AFD Input 1	Activation/Deactivation	-
	AFD Input 2	AFD Input 2	Activation/Deactivation	-
	AFD Input 3	AFD Input 3	Activation/Deactivation	-
	AFD Input 4	AFD Input 4	Activation/Deactivation	-
	AFD Test OK 1	AFD Test OK 1	Activation/Deactivation	-
	AFD Test OK 2	AFD Test OK 2	Activation/Deactivation	-
	AFD Test OK 3	AFD Test OK 3	Activation/Deactivation	-
	AFD Test OK 4	AFD Test OK 4	Activation/Deactivation	-
	AFD Phase Overcurrent	AFD Phase Overcurrent	Activation/Deactivation	-
	AFD Neutral Overcurrent	AFD Neutral Overcurrent	Activation/Deactivation	-
	AFD Overcurrent	AFD Overcurrent	Activation/Deactivation	-
Level 1 Instantaneous phase overcurrent				
50-1	50-1 Phase A Pickup	50-1 Phase A Pickup	Activation/Deactivation	Phase A Current
	50-1 Phase B Pickup	50-1 Phase B Pickup	Activation/Deactivation	Phase B Current
	50-1 Phase C Pickup	50-1 Phase C Pickup	Activation/Deactivation	Phase C Current
	50-1 Pickup	50-1 Pickup	Activation/Deactivation	Maximum Current
	50-1 Phase A Trip	50-1 Phase A Trip	Activation/Deactivation	Phase A Current
	50-1 Phase B Trip	50-1 Phase B Trip	Activation/Deactivation	Phase B Current
	50-1 Phase C Trip	50-1 Phase C Trip	Activation/Deactivation	Phase C Current
	50-1 Trip	50-1 Trip	Activation/Deactivation	Maximum Current
Level 2 Instantaneous phase overcurrent				
50-2	50-2 Phase A Pickup	50-2 Phase A Pickup	Activation/Deactivation	Phase A current
	50-2 Phase B Pickup	50-2 Phase B Pickup	Activation/Deactivation	Phase B current
	50-2 Phase C Pickup	50-2 Phase C Pickup	Activation/Deactivation	Phase C current
	50-2 Pickup	50-2 Pickup	Activation/Deactivation	Maximum Current
	50-2 Phase A Trip	50-2 Phase A Trip	Activation/Deactivation	Phase A current
	50-2 Phase B Trip	50-2 Phase B Trip	Activation/Deactivation	Phase B current
	50-2 Phase C Trip	50-2 Phase C Trip	Activation/Deactivation	Phase C current
	50-2 Trip	50-2 Trip	Activation/Deactivation	Maximum Current

Group	Status	Event	Cause	Measurement
Switch on to **fault (SOFT)**				
SOFT	Phase A Pickup	Phase A Pickup	Activation/Deactivation	Phase A current
	Phase B Pickup	Phase B Pickup	Activation/Deactivation	Phase B current
	Phase C Pickup	Phase C Pickup	Activation/Deactivation	Phase C current
	Pickup	Pickup	Activation/Deactivation	Maximum current
	Phase A Trip	Phase A Trip	Activation/Deactivation	Phase A current
	Phase B Trip	Phase B Trip	Activation/Deactivation	Phase B current
	Phase C Trip	Phase C Trip	Activation/Deactivation	Phase C current
	Trip	Trip	Activation/Deactivation	Maximum current
	SOTF	SOTF	Activation/Deactivation	Maximum current
Level **1 inverse time phase directional overcurrent**				
67-1	67-1 Phase A Pickup	67-1 Phase A Pickup	Activation/Deactivation	Phase A current
	67-1 Phase B Pickup	67-1 Phase B Pickup	Activation/Deactivation	Phase B current
	67-1 Phase C Pickup	67-1 Phase C Pickup	Activation/Deactivation	Phase C current
	67-1 Pickup	67-1 Pickup	Activation/Deactivation	Maximum current
	67-1 Phase A Trip	67-1 Phase A Trip	Activation/Deactivation	Phase A current
	67-1 Phase B Trip	67-1 Phase B Trip	Activation/Deactivation	Phase B current
	67-1 Phase C Trip	67-1 Phase C Trip	Activation/Deactivation	Phase C current
	67-1 Trip	67-1 Trip	Activation/Deactivation	Maximum current
	67-1 Directionality A	67-1 Directionality A	Activation/Deactivation	BC voltage
	67-1 Directionality B	67-1 Directionality B	Activation/Deactivation	CA voltage
	67-1 Directionality C	67-1 Directionality C	Activation/Deactivation	AB voltage
Level 2 inverse **time phase directional overcurrent**				
67-2	67-2 Phase A Pickup	67-2 Phase A Pickup	Activation/Deactivation	Phase A current
	67-2 Phase B Pickup	67-2 Phase B Pickup	Activation/Deactivation	Phase B current
	67-2 Phase C Pickup	67-2 Phase C Pickup	Activation/Deactivation	Phase C current
	67-2 Pickup	67-2 Pickup	Activation/Deactivation	Maximum current
	67-2 Phase A Trip	67-2 Phase A Trip	Activation/Deactivation	Phase A current
	67-2 Phase B Trip	67-2 Phase B Trip	Activation/Deactivation	Phase B current
	67-2 Phase C Trip	67-2 Phase C Trip	Activation/Deactivation	Phase C current
	67-2 Trip	67-2 Trip	Activation/Deactivation	Maximum current
	67-2 Directionality A	67-2 Directionality A	Activation/Deactivation	BC voltage
	67-2 Directionality B	67-2 Directionality B	Activation/Deactivation	CA voltage
	67-2 Directionality C	67-2 Directionality C	Activation/Deactivation	AB voltage

Group	Status	Event	Cause	Measurement
Level 3 inverse time phase directional overcurrent				
67-3	67-3 Phase A Pickup	67-3 Phase A Pickup	Activation/Deactivation	Phase A current
	67-3 Phase B Pickup	67-3 Phase B Pickup	Activation/Deactivation	Phase B current
	67-3 Phase C Pickup	67-3 Phase C Pickup	Activation/Deactivation	Phase C current
	67-3 Pickup	67-3 Pickup	Activation/Deactivation	Maximum current
	67-3 Phase A Trip	67-3 Phase A Trip	Activation/Deactivation	Phase A current
	67-3 Phase B Trip	67-3 Phase B Trip	Activation/Deactivation	Phase B current
	67-3 Phase C Trip	67-3 Phase C Trip	Activation/Deactivation	Phase C current
	67-3 Trip	67-3 Trip	Activation/Deactivation	Maximum current
	67-3 Directionality A	67-3 Directionality A	Activation/Deactivation	BC voltage
	67-3 Directionality B	67-3 Directionality B	Activation/Deactivation	CA voltage
	67-3 Directionality C	67-3 Directionality C	Activation/Deactivation	AB voltage
Level 4 inverse time phase directional overcurrent				
67-4	67-4 Phase A Pickup	67-4 Phase A Pickup	Activation/Deactivation	Phase A current
	67-4 Phase B Pickup	67-4 Phase B Pickup	Activation/Deactivation	Phase B current
	67-4 Phase C Pickup	67-4 Phase C Pickup	Activation/Deactivation	Phase C current
	67-4 Pickup	67-4 Pickup	Activation/Deactivation	Maximum current
	67-4 Phase A Trip	67-4 Phase A Trip	Activation/Deactivation	Phase A current
	67-4 Phase B Trip	67-4 Phase B Trip	Activation/Deactivation	Phase B current
	67-4 Phase C Trip	67-4 Phase C Trip	Activation/Deactivation	Phase C current
	67-4 Trip	67-4 Trip	Activation/Deactivation	Maximum current
	67-4 Directionality A	67-4 Directionality A	Activation/Deactivation	BC voltage
	67-4 Directionality B	67-4 Directionality B	Activation/Deactivation	CA voltage
	67-4 Directionality C	67-4 Directionality C	Activation/Deactivation	AB voltage
Instantaneous ground overcurrent				
50G	50G Ground Pickup	50G Ground Pickup	Activation/Deactivation	Neutral Current
	50G Ground Trip	50G Ground Trip	Activation/Deactivation	Neutral Current
Instantaneous ground overcurrent				
50N	50N Neutral Pickup	50N Neutral Pickup	Activation/Deactivation	Neutral Current
	50N Neutral Trip	50N Neutral Trip	Activation/Deactivation	Neutral Current
Level 1 inverse time ground directional overcurrent				
67G-1	67G-1 Neutral Pickup	67G-1 Neutral Pickup	Activation/Deactivation	Neutral Current
	67G-1 Neutral Trip	67G-1 Neutral Trip	Activation/Deactivation	Neutral Current
	67G-1 Directionality	67G-1 Directionality	Activation/Deactivation	Neutral Voltage

Group	Status	Event	Cause	Measurement
Level 2 inverse time ground directional overcurrent				
67G-2	67G-2 Neutral Pickup	67G-2 Neutral Pickup	Activation/Deactivation	Neutral Current
	67G-2 Neutral Trip	67G-2 Neutral Trip	Activation/Deactivation	Neutral Current
	67G-2 Directionality	67G-2 Directionality	Activation/Deactivation	Neutral Voltage
Level 1 inverse time neutral directional overcurrent				
67N-1	67N-1 Neutral Pickup	67N-1 Neutral Pickup	Activation/Deactivation	Neutral Current
	67N-1 Neutral Trip	67N-1 Neutral Trip	Activation/Deactivation	Neutral Current
	67N-1 Directionality	67N-1 Directionality	Activation/Deactivation	Neutral Voltage
Level 2 inverse time neutral directional overcurrent				
67N-2	67N-1 Neutral Pickup	67N-1 Neutral Pickup	Activation/Deactivation	Neutral Current
	67N-1 Neutral Trip	67N-1 Neutral Trip	Activation/Deactivation	Neutral Current
	67N-1 Directionality	67N-1 Directionality	Activation/Deactivation	Neutral Voltage
Negative sequence inverse-time overcurrent				
46	46 Pickup	46 Pickup	Activation/Deactivation	Negative sequence current
	46 Trip	46 Trip	Activation/Deactivation	Negative sequence current
Broken conductor detection				
46BC	46BC Pickup	46BC Pickup	Activation/Deactivation	I2/I1
	46BC Trip	46BC Trip	Activation/Deactivation	I2/I1
Thermal image protection				
49	49 Alarm	49 Alarm	Activation/Deactivation	Thermal image
	49 Trip	49 Trip	Activation/Deactivation	Thermal image
Phase instantaneous undercurrent				
37	37 Phase A Pickup	37 Phase A Pickup	Activation/Deactivation	Phase A current
	37 Phase B Pickup	37 Phase B Pickup	Activation/Deactivation	Phase B current
	37 Phase C Pickup	37 Phase C Pickup	Activation/Deactivation	Phase C current
	37 Phase Pickup	37 Phase Pickup	Activation/Deactivation	Maximum current
	37 Phase A Trip	37 Phase A Trip	Activation/Deactivation	Phase A current
	37 Phase B Trip	37 Phase B Trip	Activation/Deactivation	Phase B current
	37 Phase C Trip	37 Phase C Trip	Activation/Deactivation	Phase C current
	37 Trip	37 Trip	Activation/Deactivation	Maximum current

Group	Status	Event	Cause	Measurement
Level 1 Definite-time phase undervoltage				
27-1	27-1 Phase A Pickup	27-1 Phase A Pickup	Activation/Deactivation	Phase A voltage
	27-1 Phase B Pickup	27-1 Phase B Pickup	Activation/Deactivation	Phase B voltage
	27-1 Phase C Pickup	27-1 Phase C Pickup	Activation/Deactivation	Phase C voltage
	27-1 Phase Pickup	27-1 Phase Pickup	Activation/Deactivation	Maximum voltage
	27-1 AB Pickup	27-1 AB Pickup	Activation/Deactivation	AB voltage
	27-1 BC Pickup	27-1 BC Pickup	Activation/Deactivation	BC voltage
	27-1 CA Pickup	27-1 CA Pickup	Activation/Deactivation	CA voltage
	27-1 Phase A Trip	27-1 Phase A Trip	Activation/Deactivation	Phase A voltage
	27-1 Phase B Trip	27-1 Phase B Trip	Activation/Deactivation	Phase B voltage
	27-1 Phase C Trip	27-1 Phase C Trip	Activation/Deactivation	Phase C voltage
	27-1 Phase Trip	27-1 Phase Trip	Activation/Deactivation	Maximum voltage
	27-1 AB Trip	27-1 AB Trip	Activation/Deactivation	AB voltage
	27-1 BC Trip	27-1 BC Trip	Activation/Deactivation	BC voltage
	27-1 CA Trip	27-1 CA Trip	Activation/Deactivation	CA voltage
Level 2 Definite-time phase undervoltage				
27-2	27-2 Phase A Pickup	27-2 Phase A Pickup	Activation/Deactivation	Phase A voltage
	27-2 Phase B Pickup	27-2 Phase B Pickup	Activation/Deactivation	Phase B voltage
	27-2 Phase C Pickup	27-2 Phase C Pickup	Activation/Deactivation	Phase C voltage
	27-2 Phase Pickup	27-2 Phase Pickup	Activation/Deactivation	Maximum voltage
	27-2 AB Pickup	27-2 AB Pickup	Activation/Deactivation	AB voltage
	27-2 BC Pickup	27-2 BC Pickup	Activation/Deactivation	BC voltage
	27-2 CA Pickup	27-2 CA Pickup	Activation/Deactivation	CA voltage
	27-2 Phase A Trip	27-2 Phase A Trip	Activation/Deactivation	Phase A voltage
	27-2 Phase B Trip	27-2 Phase B Trip	Activation/Deactivation	Phase B voltage
	27-2 Phase C Trip	27-2 Phase C Trip	Activation/Deactivation	Phase C voltage
	27-2 Phase Trip	27-2 Phase Trip	Activation/Deactivation	Maximum voltage
	27-2 AB Trip	27-2 AB Trip	Activation/Deactivation	AB voltage
	27-2 BC Trip	27-2 BC Trip	Activation/Deactivation	BC voltage
	27-2 CA Trip	27-2 CA Trip	Activation/Deactivation	CA voltage
Definite time positive sequence undervoltage				
27V1	27V1 Pickup	27V1 Pickup	Activation/Deactivation	Positive sequence voltage
	27V1 Trip	27V1 Trip	Activation/Deactivation	Positive sequence voltage
Definite time line undervoltage (*)				
27-L (*)	27-L Pickup	27-L Pickup	Activation/Deactivation	Line voltage
	27-L Trip	27-L Trip	Activation/Deactivation	Line voltage

Group	Status	Event	Cause	Measurement
Level 1 Definite time phase overvoltage				
59-1	59-1 Phase A Pickup	59-1 Phase A Pickup	Activation/Deactivation	Phase A voltage
	59-1 Phase B Pickup	59-1 Phase B Pickup	Activation/Deactivation	Phase B voltage
	59-1 Phase C Pickup	59-1 Phase C Pickup	Activation/Deactivation	Phase C voltage
	59-1 Phase Pickup	59-1 Phase Pickup	Activation/Deactivation	Maximum voltage
	59-1 AB Pickup	59-1 AB Pickup	Activation/Deactivation	AB voltage
	59-1 BC Pickup	59-1 BC Pickup	Activation/Deactivation	BC voltage
	59-1 CA Pickup	59-1 CA Pickup	Activation/Deactivation	CA voltage
	59-1 Phase A Trip	59-1 Phase A Trip	Activation/Deactivation	Phase A voltage
	59-1 Phase B Trip	59-1 Phase B Trip	Activation/Deactivation	Phase B voltage
	59-1 Phase C Trip	59-1 Phase C Trip	Activation/Deactivation	Phase C voltage
	59-1 Phase Trip	59-1 Phase Trip	Activation/Deactivation	Maximum voltage
	59-1 AB Trip	59-1 AB Trip	Activation/Deactivation	AB voltage
	59-1 BC Trip	59-1 BC Trip	Activation/Deactivation	BC voltage
	59-1 CA Trip	59-1 CA Trip	Activation/Deactivation	CA voltage
Level 2 Definite time phase overvoltage				
59-2	59-2 Phase A Pickup	59-2 Phase A Pickup	Activation/Deactivation	Phase A voltage
	59-2 Phase B Pickup	59-2 Phase B Pickup	Activation/Deactivation	Phase B voltage
	59-2 Phase C Pickup	59-2 Phase C Pickup	Activation/Deactivation	Phase C voltage
	59-2 Phase Pickup	59-2 Phase Pickup	Activation/Deactivation	Maximum voltage
	59-2 AB Pickup	59-2 AB Pickup	Activation/Deactivation	AB voltage
	59-2 BC Pickup	59-2 BC Pickup	Activation/Deactivation	BC voltage
	59-2 CA Pickup	59-2 CA Pickup	Activation/Deactivation	CA voltage
	59-2 Phase A Trip	59-2 Phase A Trip	Activation/Deactivation	Phase A voltage
	59-2 Phase B Trip	59-2 Phase B Trip	Activation/Deactivation	Phase B voltage
	59-2 Phase C Trip	59-2 Phase C Trip	Activation/Deactivation	Phase C voltage
	59-2 Phase Trip	59-2 Phase Trip	Activation/Deactivation	Maximum voltage
	59-2 AB Trip	59-2 AB Trip	Activation/Deactivation	AB voltage
	59-2 BC Trip	59-2 BC Trip	Activation/Deactivation	BC voltage
	59-2 CA Trip	59-2 CA Trip	Activation/Deactivation	CA voltage
Level 1 Definite time neutral overvoltage				
59N-1	59N-1 Neutral Pickup	59N-1 Neutral Pickup	Activation/Deactivation	Neutral voltage
	59N-1 Neutral Trip	59N-1 Neutral Trip	Activation/Deactivation	Neutral voltage
Level 2 Definite time neutral overvoltage				
59N-2	59N-2 Neutral Pickup	59N-2 Neutral Pickup	Activation/Deactivation	Neutral voltage
	59N-2 Neutral Trip	59N-2 Neutral Trip	Activation/Deactivation	Neutral voltage

Group	Status	Event	Cause	Measurement
Phase reversal				
47	47 Pickup	47 Pickup	Activation/Deactivation	Negative sequence voltage
	47 Trip	47 Trip	Activation/Deactivation	Negative sequence voltage
Definite time line overvoltage (*)				
59-L (*)	59-L Phase Pickup	59-L Phase Pickup	Activation/Deactivation	Line voltage
	59-L Phase Trip	59-L Phase Trip	Activation/Deactivation	Line voltage
Level 1 directional overpower or underpower				
32-1	32-1 Phase A Pickup	32-1 Phase A Pickup	Activation/Deactivation	S-A (VA)
	32-1 Phase B Pickup	32-1 Phase B Pickup	Activation/Deactivation	S-B (VA)
	32-1 Phase C Pickup	32-1 Phase C Pickup	Activation/Deactivation	S-C (VA)
	32-1 Phase Pickup	32-1 Phase Pickup	Activation/Deactivation	S-3P (VA)
	32-1 Phase A Trip	32-1 Phase A Trip	Activation/Deactivation	S-A (VA)
	32-1 Phase B Trip	32-1 Phase B Trip	Activation/Deactivation	S-B (VA)
	32-1 Phase C Trip	32-1 Phase C Trip	Activation/Deactivation	S-C (VA)
	32-1 Phase Trip	32-1 Phase Trip	Activation/Deactivation	S-3P (VA)
Level 2 directional overpower or underpower				
32-2	32-2 Phase A Pickup	32-2 Phase A Pickup	Activation/Deactivation	S-A (VA)
	32-2 Phase B Pickup	32-2 Phase B Pickup	Activation/Deactivation	S-B (VA)
	32-2 Phase C Pickup	32-2 Phase C Pickup	Activation/Deactivation	S-C (VA)
	32-2 Phase Pickup	32-2 Phase Pickup	Activation/Deactivation	S-3P (VA)
	32-2 Phase A Trip	32-2 Phase A Trip	Activation/Deactivation	S-A (VA)
	32-2 Phase B Trip	32-2 Phase B Trip	Activation/Deactivation	S-B (VA)
	32-2 Phase C Trip	32-2 Phase C Trip	Activation/Deactivation	S-C (VA)
	32-2 Phase Trip	32-2 Phase Trip	Activation/Deactivation	S-3P (VA)
Level 3 directional overpower or underpower				
32-3	32-3 Phase A Pickup	32-3 Phase A Pickup	Activation/Deactivation	S-A (VA)
	32-3 Phase B Pickup	32-3 Phase B Pickup	Activation/Deactivation	S-B (VA)
	32-3 Phase C Pickup	32-3 Phase C Pickup	Activation/Deactivation	S-C (VA)
	32-3 Phase Pickup	32-3 Phase Pickup	Activation/Deactivation	S-3P (VA)
	32-3 Phase A Trip	32-3 Phase A Trip	Activation/Deactivation	S-A (VA)
	32-3 Phase B Trip	32-3 Phase B Trip	Activation/Deactivation	S-B (VA)
	32-3 Phase C Trip	32-3 Phase C Trip	Activation/Deactivation	S-C (VA)
	32-3 Phase Trip	32-3 Phase Trip	Activation/Deactivation	S-3P (VA)

Group	Status	Event	Cause	Measurement
Level 4 directional overpower or underpower				
32-4	32-4 Phase A Pickup	32-4 Phase A Pickup	Activation/Deactivation	S-A (VA)
	32-4 Phase B Pickup	32-4 Phase B Pickup	Activation/Deactivation	S-B (VA)
	32-4 Phase C Pickup	32-4 Phase C Pickup	Activation/Deactivation	S-C (VA)
	32-4 Phase Pickup	32-4 Phase Pickup	Activation/Deactivation	S-3P (VA)
	32-4 Phase A Trip	32-4 Phase A Trip	Activation/Deactivation	S-A (VA)
	32-4 Phase B Trip	32-4 Phase B Trip	Activation/Deactivation	S-B (VA)
	32-4 Phase C Trip	32-4 Phase C Trip	Activation/Deactivation	S-C (VA)
	32-4 Phase Trip	32-4 Phase Trip	Activation/Deactivation	S-3P (VA)
Level 1: Definite time over or under frequency				
81-1	81-1 Pickup	81-1 Pickup	Activation/Deactivation	Frequency
	81-1 Trip	81-1 Trip	Activation/Deactivation	Frequency
Level 2: Definite time over or under frequency				
81-2	81-2 Pickup	81-2 Pickup	Activation/Deactivation	Frequency
	81-2 Trip	81-2 Trip	Activation/Deactivation	Frequency
Level 3: Definite time over or under frequency				
81-3	81-3 Pickup	81-3 Pickup	Activation/Deactivation	Frequency
	81-3 Trip	81-3 Trip	Activation/Deactivation	Frequency
Level 4: Definite time over or under frequency				
81-4	81-4 Pickup	81-4 Pickup	Activation/Deactivation	Frequency
	81-4 Trip	81-4 Trip	Activation/Deactivation	Frequency
Level 1: Rate of change of frequency				
81R-1	81R-1 Pickup	81R-1 Pickup	Activation/Deactivation	Frequency variation (Hz/s)
	81R-1 Trip	81R-1 Trip	Activation/Deactivation	Frequency variation (Hz/s)
Level 2: Rate of change of frequency				
81R-2	81R-2 Pickup	81R-2 Pickup	Activation/Deactivation	Frequency variation (Hz/s)
	81R-2 Trip	81R-2 Trip	Activation/Deactivation	Frequency variation (Hz/s)
Level 3: Rate of change of frequency				
81R-3	81R-3 Pickup	81R-3 Pickup	Activation/Deactivation	Frequency variation (Hz/s)
	81R-3 Trip	81R-3 Trip	Activation/Deactivation	Frequency variation (Hz/s)
Level 4: Rate of change of frequency				
81R-4	81R-4 Pickup	81R-4 Pickup	Activation/Deactivation	Frequency variation (Hz/s)
	81R-4 Trip	81R-4 Trip	Activation/Deactivation	Frequency variation (Hz/s)
Vector shift				
78	78 Trip	78 Trip	Activation/Deactivation	-
Level 1: Overflux. Volts per Hertz				
24-1	24-1 Pickup	24-1 Pickup	Activation/Deactivation	Un/Fn (V/Hz)
	24-1 Trip	24-1 Trip	Activation/Deactivation	Un/Fn (V/Hz)
Level 2: Overflux. Volts per Hertz				
24-2	24-2 Pickup	24-2 Pickup	Activation/Deactivation	Un/Fn (V/Hz)
	24-2 Trip	24-2 Trip	Activation/Deactivation	Un/Fn (V/Hz)

Group	Status	Event	Cause	Measurement
Recloser				
79	Standby	Standby	Activation	-
	Reclose Time	Reclose Time	Activation	-
	Is 52 Open?	Is 52 Open?	Activation	-
	Hold Time	Hold Time	Activation	-
	Closing Time	Closing Time	Activation	-
	Reset Time	Reset Time	Activation	-
	Lockout	Lockout	Activation	-
	Safe Time	Safe Time	Activation	-
	79 Blocked	79 Blocked	Activation/Deactivation	-
	Reclose No. 1	Reclose No. 1	-	-
	Reclose No. 2	Reclose No. 2	-	-
	Reclose No. 3	Reclose No. 3	-	-
	Reclose No. 4	Reclose No. 4	-	-
Synchrocheck (*)				
25 (*)	Synchrocheck	Synchrocheck	Activation/Deactivation	-
	Dad L & Dead B	Dad L & Dead B	-	-
	Dead L & Live B	Dead L & Live B	-	-
	Live L & Dead B	Live L & Dead B	-	-
	Live L & Live B	Live L & Live B	-	-
	Voltage Difference	Voltage Difference	Activation/Deactivation	V-B Voltage (V)
	Frequency difference	Frequency difference	Activation/Deactivation	Frequency (Hz)
	Phase difference	Phase difference	Activation/Deactivation	Ang V-B (deg)
Trip circuit supervision				
74TCS	74TCS Pickup	74TCS Pickup	Activation/Deactivation	I-Max (A)
	74TCS Trip	74TCS Trip	Activation/Deactivation	I-Max (A)
Phase CT Supervision				
60CTS	60CTS Pickup	60CTS Pickup	Activation/Deactivation	I-Max (A)
	60CTS Trip	60CTS Trip	Activation/Deactivation	I-Max (A)
Phase VT Supervision				
60VTS	60VTS Phase Pickup	60VTS Phase Pickup	Activation/Deactivation	V-2 (V)
	60VTS Phase A Trip	60VTS Phase A Trip	Activation/Deactivation	V-A (V)
	60VTS Phase B Trip	60VTS Phase B Trip	Activation/Deactivation	V-B (V)
	60VTS Phase C Trip	60VTS Phase C Trip	Activation/Deactivation	V-C (V)
	60VTS Phase Trip	60VTS Phase Trip	Activation/Deactivation	V-2 (V)
Open breaker failure				
50BF	50BF Pickup	50BF Pickup	Activation/Deactivation	I-Max (A)
	50BF Trip	50BF Trip	Activation/Deactivation	I-Max (A)
SHB. Second Harmonic Blocking				
SHB	Phase A Block	Phase A Block	Activation/Deactivation	I-A2H (A)
	Phase B Block	Phase B Block	Activation/Deactivation	I-B2H (A)
	Phase C Block	Phase C Block	Activation/Deactivation	I-C2H (A)
	Phase Block	Phase Block	Activation/Deactivation	-

Group	Status	Event	Cause	Measurement
CLP. Cold Load Pickup				
CLP	CLP Disable	CLP Disable	-	I-Max (A)
	52 Close	52 Close	-	I-Max (A)
	52 Open	52 Open	-	I-Max (A)
	52 Def. Open	52 Def. Open	-	I-Max (A)
	Close CLP	Close CLP	-	I-Max (A)
	Open CLP	Open CLP	-	I-Max (A)
	CLP	CLP	Activation/Deactivation	I-Max (A)
HMI				
HMI	Open breaker	Opening Command	-	Command identifier
	Close breaker	Closing Command	-	Command identifier
	79 Block	79Bolck Command	-	Command identifier
	79 Unblock	79Unblock Command	-	Command identifier
	Local Control	Local Command	-	Command identifier
	Remote Control	Remote Command	-	Command identifier
	Reset	Reset	-	Command identifier
	Thermal I. Reset	Thermal I. Reset	-	Command identifier
	Set Counter	Set Counter	Activation	Command identifier
	Key Reset	Key Reset	Activation	Command identifier
	HMI Activity	HMI Activity	Activation	Command identifier
	Identification	Identification	Activation	Command identifier
	Test State	Test State	Activation/Deactivation	Command identifier
USB COM				
USB COM	Open breaker	Opening Command	Activation/Deactivation	Command identifier
	Close breaker	Closing Command	Activation/Deactivation	Command identifier
	79 Block	79Block Command	Activation/Deactivation	Command identifier
	79 Unblock	79Unblock Command	Activation/Deactivation	Command identifier
	Local Control	Local Command	Activation/Deactivation	Command identifier
	Remote Control	Remote Command	Activation/Deactivation	Command identifier
	Reset	Reset	Deactivation	Command identifier
	Thermal I. Reset	Thermal I. Reset	Deactivation	Command identifier
	Set Counter	Set Counter	Activation	Command identifier
	Activity	-	-	-
	Identification	Identification	Activation/Deactivation	Command identifier
WIFI COM (*)				
WIFI COM (*)	Open breaker	Opening Command	Activation/Deactivation	Command identifier
	Close breaker	Closing Command	Activation/Deactivation	Command identifier
	79 Block	79Block Command	Activation/Deactivation	Command identifier
	79 Unblock	79Unblock Command	Activation/Deactivation	Command identifier
	Local Control	Local Command	Activation/Deactivation	Command identifier
	Remote Control	Remote Command	Activation/Deactivation	Command identifier
	Reset	Reset Command	Activation/Deactivation	Command identifier
	Thermal I. Reset	Thermal I. Reset	Activation/Deactivation	Command identifier
	WIFI ON	WIFI ON	-	Command identifier
	Set Counter	Set Counter	Activation	Command identifier
	Link	Link	-	Command identifier
	Activity	Activity	Activation/Deactivation	-
	Identification	Identification	Activation/Deactivation	Command identifier

Group	Status	Event	Cause	Measurement
MODBUS RTU (*)				
MODBUS RTU (*)	Opening Command	Opening Command	Activation/Deactivation	Command identifier
	Closing Command	Closing Command	Activation/Deactivation	Command identifier
	79Block Command	79Block Command	Activation/Deactivation	Command identifier
	79Unblock Command	79Unblock Command	Activation/Deactivation	Command identifier
	Local Command	Local Command	Activation/Deactivation	Command identifier
	Remote Command	Remote Command	Activation/Deactivation	Command identifier
	Reset	Reset	Activation/Deactivation	Command identifier
	Thermal I. Reset	Thermal I. Reset	Activation/Deactivation	Command identifier
	Set Counter	Set Counter	Activation	Command identifier
	Activity	-	-	-
	Identification	Identification	Activation/Deactivation	Command identifier
DNP3 (*)				
DNP3 (*)	Opening Command	Opening Command	Activation	Command identifier
	Closing Command	Closing Command	Activation	Command identifier
	79Block Command	79Block Command	Activation	Command identifier
	79Unblock Command	79Unblock Command	Activation	Command identifier
	Local Command	Local Command	Activation	Command identifier
	Remote Command	Remote Command	Activation	Command identifier
	Reset	Reset	Activation	Command identifier
	Thermal I. Reset	Thermal I. Reset	Activation	Command identifier
	Activity	-	-	-
IEC-103 (*)				
IEC-103 (*)	Opening Command	Opening Command	Deactivation	Command identifier
	Closing Command	Closing Command	Deactivation	Command identifier
	79Block Command	79Block Command	Deactivation	Command identifier
	79Unblock Command	79Unblock Command	Deactivation	Command identifier
	Local Command	Local Command	Deactivation	Command identifier
	Remote Command	Remote Command	Deactivation	Command identifier
	Reset	Reset	Deactivation	Command identifier
	Thermal I. Reset	Thermal I. Reset	Deactivation	Command identifier
	Activity	-	-	-
MODBUS TCP (*)				
MODBUS TCP (*)	Opening Command	Opening Command	Activation/Deactivation	Command identifier
	Closing Command	Closing Command	Activation/Deactivation	Command identifier
	79Block Command	79Block Command	Activation/Deactivation	Command identifier
	79Unblock Command	79Unblock Command	Activation/Deactivation	Command identifier
	Local Command	Local Command	Activation/Deactivation	Command identifier
	Remote Command	Remote Command	Activation/Deactivation	Command identifier
	Reset	Reset	Activation/Deactivation	Command identifier
	Thermal I. Reset	Thermal I. Reset	Activation/Deactivation	Command identifier
	Set Counter	Set Counter	Activation	Command identifier
	Activity	-	-	-
	Identification	Identification	Activation/Deactivation	Command identifier

Group	Status	Event	Cause	Measurement
DNP3 TCP (*)				
DNP3 TCP (*)	Opening Command	Opening Command	Activation/Deactivation	Command identifier
	Closing Command	Closing Command	Activation/Deactivation	Command identifier
	79Block Command	79Block Command	Activation/Deactivation	Command identifier
	79Unblock Command	79Unblock Command	Activation/Deactivation	Command identifier
	Local Command	Local Command	Activation/Deactivation	Command identifier
	Remote Command	Remote Command	Activation/Deactivation	Command identifier
	Thermal I. Reset	Thermal I. Reset	Activation/Deactivation	Command identifier
	Activity	-	-	-
WEB (*)				
WEB (*)	Opening Command	Opening Command	Activation/Deactivation	Command identifier
	Closing Command	Closing Command	Activation/Deactivation	Command identifier
	79Block Command	79Block Command	Activation/Deactivation	Command identifier
	79Unblock Command	79Unblock Command	Activation/Deactivation	Command identifier
	Local Command	Local Command	Activation/Deactivation	Command identifier
	Remote Command	Remote Command	Activation/Deactivation	Command identifier
	Reset	Reset	Activation/Deactivation	Command identifier
	Thermal I. Reset	Thermal I. Reset	Activation/Deactivation	Command identifier
	Activity	-	-	-
IEC 61850 (*)				
IEC 61850 (*)	Opening Command	Opening Command	Activation/Deactivation	Command identifier
	Closing Command	Closing Command	Activation/Deactivation	Command identifier
	79Block Command	79Block Command	Activation/Deactivation	Command identifier
	79Unblock Command	79Unblock Command	Activation/Deactivation	Command identifier
	Local Command	Local Command	Activation/Deactivation	Command identifier
	Remote Command	Remote Command	Activation/Deactivation	Command identifier
	Reset	Reset	Activation/Deactivation	Command identifier
	Thermal I. Reset	Thermal I. Reset	Activation/Deactivation	Command identifier
	Activity	-	-	-

(*) Optional depending on model

12.4 Disturbance fault recording (DFR)

The number of oscillography records can be set. Depending on the number of records chosen, the cycles for each record will vary as follows:

Num of records*cycles	Records	Cycles per record	Pre-fault cycles	Postfault cycles
5*260	5	260	1-8	252-259
25*60	25	60		52-59
50*30	50	30		22-29
100*15	100	15		7-14

The records will be register in data and COMTRADE format. The oscillography can be viewed and downloaded with the SICom, which allows to save it in COMTRADE format (IEEE C37.111-1991).

The records maintain date & time thanks to the relays internal RTC (real Time Clock).

It is possible to configure the reason of the start of the fault report through the “DFR Start” configuration in the PGC. It must be considered that if there is no trip of a protection function, the fault report will show a “0” on the trip reason and the reason of the start of the fault report it will not be shown. For this reason, Fanox recommends configuring the “DFR Start” PGC signal to “General Trip” in order to record all the information of the fault.

The following information is included in each oscillography record:

- Analog channels:

Number	Analog channels
1	Phase A current
2	Phase B current
3	Phase C current
4	Neutral current
5	Phase A voltage
6	Phase B voltage
7	Phase C voltage
8	Neutral voltage
9	Line voltage
10	Bar Frequency

- Digital channels. The digital channels are configurable. By default, the following 96 channels are displayed.

No.	Digital channels
1	50-1 Trip
2	50-2 Trip
3	SOTF
4	67-1 Trip
5	67-2 Trip
6	67-3 Trip
7	67-4 Trip
8	50G Trip
9	50N Trip
10	67G-1 Trip
11	67G-2 Trip
12	67N-1 Trip
13	67N-2 Trip
14	46 Trip
15	46BC Trip
16	49 Trip
17	37 Trip
18	27-1 Trip
19	27-2 Trip
20	27V1 Trip
21	59-1 Trip
22	59-2 Trip
23	59N/G-1 Trip
24	59N/G-2 Trip
25	47 Trip
26	32-1 Trip
27	32-2 Trip
28	32-3 Trip
29	32-4 Trip
30	81-1 Trip
31	81-2 Trip
32	81-3 Trip

No.	Digital channels
33	81-4 Trip
34	81R-1 Trip
35	81R-2 Trip
36	81R-3 Trip
37	81R-4 Trip
38	78 Trip
39	24-1 Trip
40	24-2 Trip
41	79 Closing Time
42	79 Blocked
43	79 Lockout
44	52 Closed
45	74TCS Trip
46	60CTS Trip
47	60VTS Trip
48	50BF Trip
49	SHB Block
50	CLP
51	General Trip
52	50-1 Pickup
53	50-2 Pickup
54	67-1 Pickup
55	67-2 Pickup
56	67-3 Pickup
57	67-4 Pickup
58	50G Pickup
59	50N Pickup
60	67G-1 Pickup
61	67G-2 Pickup
62	67N-1 Pickup
63	67N-2 Pickup
64	46 Pickup

No.	Digital channels
65	46BC Pickup
66	37 Pickup
67	27-1 Pickup
68	27-2 Pickup
69	27V1 Pickup
70	59-1 Pickup
71	59-2 Pickup
72	59N-1 Pickup
73	59N-2 Pickup
74	47 Pickup
75	32-1 Pickup
76	32-2 Pickup
77	32-3 Pickup
78	32-4 Pickup
79	81-1 Pickup
80	81-2 Pickup
81	81-3 Pickup
82	81-4 Pickup
83	81R-1 Pickup
84	81R-2 Pickup
85	81R-3 Pickup
86	81R-4 Pickup
87	24-1 Pickup
88	24-2 Pickup
89	General Pickup
90	Output 1
91	Output 2
92	Output 3
93	Output 4
94	Output 5
95	Output 6
96	Output 7

12.5 Load Data Profiling (LDP)

SIL-G relay provides the demand of current with the following characteristics:

- Number of records: 2160
- Recording mode circular
- Sampling rate (interval): 1 min, configurable through communications up to 60 min.
- Activation current level: 40% of In, configurable through communications from 1% to 1000% of In.
- Record format:

  Date/Time
  S (3-phase)
  P (3-phase)
  Q (3-phase)
  IMAX (during the interval)*
  IMAX (actual)*
  VMAX (actual)*

NOTE: Once the demand setting is changed, it is necessary to restart the relay to ensure that the new setting is recorded correctly.

NOTE 2: The measurements marked whit an asterisk are only visible through the SICom, not from the HMI.

12.6 Counters

The following counters are provided:

1. Number of openings of the circuit breaker
2. Recloses number
3. Amperes accumulated (I^2t) during the openings of the circuit breaker
4. Positive Active Energy (AE+)
5. Negative Active Energy (AE-)
6. Positive Reactive Energy (RE+)
7. Negative Reactive Energy (RE-)

12.7 Commands

	HMI	Local Com. ModBus RTU	Remote com: Modbus RTU Modbus TCP/IP IEC 60870-5-103 IEC61850 DNP 3.0 Serie DNP 3.0 TCP/IP
Open Breaker	✓	✓	✓
Close Breaker	✓	✓	✓
79 Block	✓	✓	✓
79 Unblock	✓	✓	✓
Local Control	✓	✓	-
Remote Control	✓	✓	-
Reset	✓	✓	✓
Reset Thermal Image	✓	✓	✓
Set Counter	(*)	✓	✓ (only Modbus)

(*) Counters have a specific menu in HMI where they can be set.

To execute commands remotely (ModBus, IEC60870-5-103, IEC 61850 or DNP 3.0) the device must be operating in REMOTE CONTROL mode.

Operations can be performed from the HMI or from local communications (ModBus), regardless of whether the relay is in remote control or not.

12.8 Real Time Clock (RTC)

The relay is provided with an internal Real Time Clock (RTC), with a precision of 1 millisecond, that allows to maintain date & time.

12.9 Configurable inputs

The SIL-G has up to 24 digital inputs that can be set by the user. Depending on the model:

Model	Configurable Inputs
SILGxxxxxx0xxx, SILGxxxxxx6xxx	8 configurable inputs
SILGxxxxxxAxxx	8 configurable inputs + 4 AFD inputs
SILGxxxxxx7xxx	16 configurable inputs
SILGxxxxxx5xxx	24 configurable inputs

The voltage to activate the inputs is the same as the power supply

The inputs can be configured from the HMI or through the SICom program. A single input can be assigned to more than one logical inputs.

12.10 Function 86. Trip output lockout

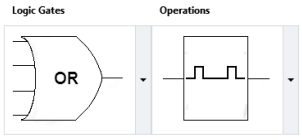
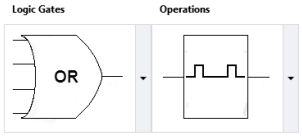
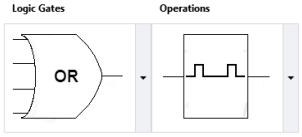
When the trip output is configured as RRSS or SSRR this output is locked thanks to programmable logic.

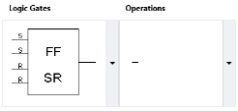
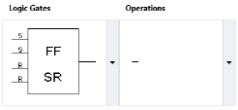
12.11 Configurable Leds

The device is equipped with 11 LEDs, 8 of which are configurable, while the other three are assigned to fixed purposes:

- Breaker status: LED on when the circuit breaker is closed.
- Recloser status: LED on when the recloser is operational.
- Local communication status: LED on when the Local communication is active.

The other LEDs can be configured by the user, with the default configuration as follows.

LED	Description	Criteria	Status	Logic Gate	Sicom Symbol
ALARM 1	Ready	General	Ready	OR BL	
ALARM 2	79 Cycle	79 79 79 79	79 Reclose Time 79 Hold Time 79 Closing Time 79 Reset Time	OR BL	
ALARM 3	Supervision	74TCS 60TCS 60VTS	74 TCS Trip 60VTS Trip 60VTS Trip	OR BL	
ALARM 4	O/C Trip	Leds Leds PGC	Logic Alarm 16 Logic Alarm 17 PGC-8	SSRR	
ALARM 5	E/F Trip	Leds Leds PGC	Logic Alarm 14 Logic Alarm 15 PGC-8	SSRR	
ALARM 6	O/V Trip	Leds Leds PGC	Logic Alarm 9 Logic Alarm 10 PGC-8	SSRR	

LED	Description	Criteria	Status	Logic Gate	Sicom Symbol
ALARM 7	Overpower Trip	Leds PGC	Logic Alarm 12 PGC-8	SSRR	
ALARM 8	Frequency Trip	Leds Leds PGC	Logic Alarm 11 Logic Alarm 13 PGC-8	SSRR	
ALARM 9	OV Trip	59-1 59-2 59N/G-1 59N/G-2	Trip Trip Trip Trip	OR	
ALARM 10	UV Trip	27-1 27-2 27V1 27-L	Trip Trip Trip Trip	OR	
ALARM 11	ROCOF Trip	81R-1 81R-2 81R-3 81R-4	Trip Trip Trip Trip	OR	
ALARM 12	Power Trip	32-1 32-2 32-3 32-4	Trip Trip Trip Trip	OR	
ALARM 13	Frequency Trip	81-1 81-2 81-3 81-4	Trip Trip Trip Trip	OR	
ALARM 14	50N/G Trip	50G 50N	Trip Trip	OR	
ALARM 15	67N/G Trip	67G-1 67G-2 67N-1 67N-2	Trip Trip Trip Trip	OR	
ALARM 16	67P Trip	67-1 67-2 67-3 67-4	Trip Trip Trip Trip	OR	

LED	Description	Criteria	Status	Logic Gate	Sicom Symbol
ALARM 17	OC Trip OR	50-1 50-2 46 SOTF	Trip Trip Trip Trip	OR	
ALARM 18	-	-	-	-	-
ALARM 19	-	-	-	-	-
ALARM 20	-	-	-	-	-
ALARM 21	-	-	-	-	-
ALARM 22	-	-	-	-	-
ALARM 23	-	-	-	-	-
ALARM 24	-	-	-	-	-
ALARM 25	-	-	-	-	-
ALARM 26	-	-	-	-	-
ALARM 27	-	-	-	-	-
ALARM 28	-	-	-	-	-
ALARM 29	-	-	-	-	-
ALARM 30	-	-	-	-	-
ALARM 31	-	-	-	-	-
ALARM 32	-	-	-	-	-

Although the READY LED is configurable, it is recommended not to modify its default configuration.

Besides, 24 logic alarms are included in LEDs menu to allow the user a complete configuration of the relay.

12.12 Programmable Logic Control (PGC)

Firstly, it is defined the concept of physical input, physical output and logical signal.

Physical inputs are the real inputs of the device. SIL-G device has 8, 16 or 24 physical inputs, depending on model. These inputs are translated to internal binary states which later, can be assigned to logical signal to get a specific operation.

SIL-G is provided with 32 outputs. Physical outputs are the real outputs of the device. SIL-G has up to 18 physical outputs, (7, 11 or 18 outputs depending on model) and the rest of them are logic outputs to configure the relay.

Besides, the relay is provided with 32 alarms. The first 8 alarms correspond to the 8 configurable front LEDs and the rest are logic alarms to configure the relay.

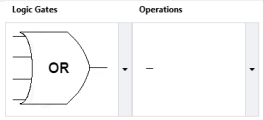
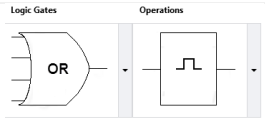
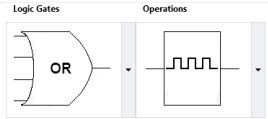
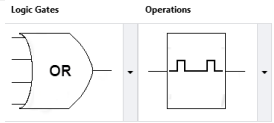
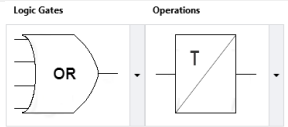
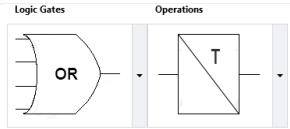
All the outputs (physical and logic alarms, physical and logic outputs) are the result of a PROGRAMMABLE LOGIC CONTROL which can be configured from HMI or from SICom software.

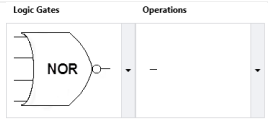
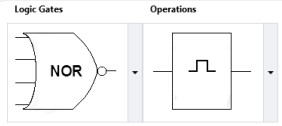
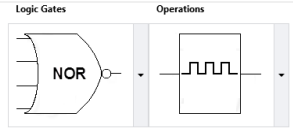
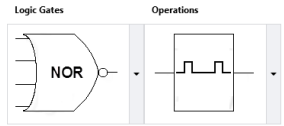
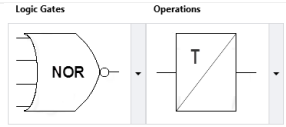
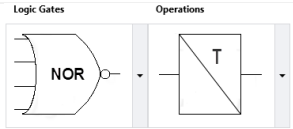
In addition, the following 24 predefined actions and 8 free PGCs are available to be configured by the user in the PGC configuration section.

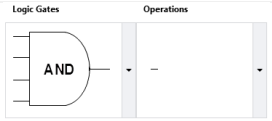
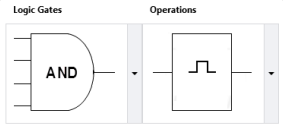
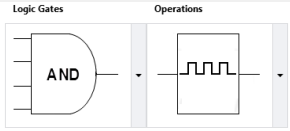
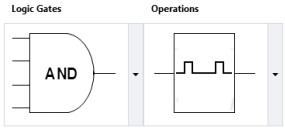
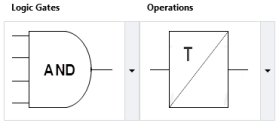
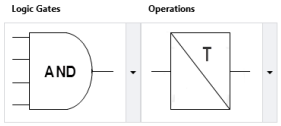
Logical inputs	Description
Open Breaker Command	Conditions to send the open breaker command
Close Breaker Command	Conditions to send the close breaker command
79 Block Command	Conditions to send the 79 Block command
79 Unblock Command	Conditions to send the 79 Unblock command
Local Control Command	Conditions to send the Local Control command
Remote Control Command	Conditions to send the Remote Control command
52a	Circuit breaker contact a
52b	Circuit breaker contact b
Settings Group 1	Active Settings Group assignment
Settings Group 2	Active Settings Group assignment
Hot Line Tag	Conditions to activate the Hot Line Tag. When it is activated, the function 79 is blocked and reclosing is not permitted.
79 Enable	Conditions to activate auto reclosing
79N1 Start	Start of first cycle of 79 protection function
79N2 Start	Start of second cycle of 79 protection function
79N3 Start	Start of third cycle of 79 protection function
79N4 Start	Start of fourth cycle of 79 protection function
DFR Start	Disturbance Fault Report Start
50BF Start	Start of circuit breaker failure protection
SOTF Start	Conditions to start the switch on to fault function
Reset Thermal Image	Conditions to reset the thermal image
74TCS Coil A Continuity	Trip circuit supervision input for coil A
74TCS Coil B Continuity	Trip circuit supervision input for coil B
Neutral Block	Conditions to block neutral trip
Phase Block	Conditions to block phase trip
PGC 1	Free PGC 1
PGC 2	Free PGC 2
PGC 3	Free PGC 3
PGC 4	Free PGC 4
PGC 5	Free PGC 5
PGC 6	Free PGC 6
PGC 7	Free PGC 7
PGC 8	Free PGC 8

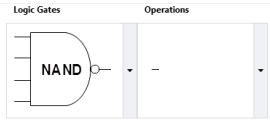
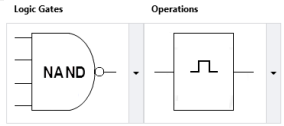
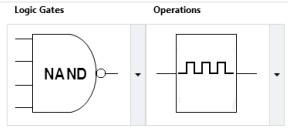
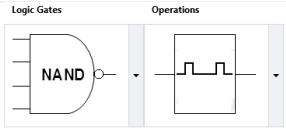
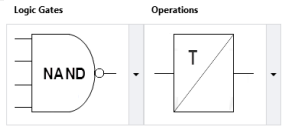
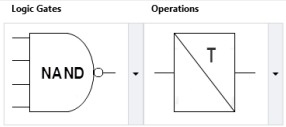
For each output there is a LOGICAL GATE that can perform a logical operation with up to 4 binary states to obtain a binary result.

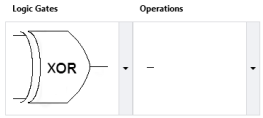
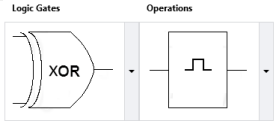
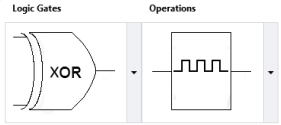
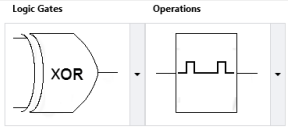
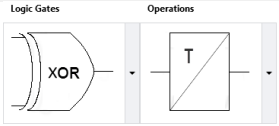
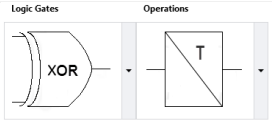
In V3 of the PGC the LOGICAL GATES that are supported by SIL-G are:

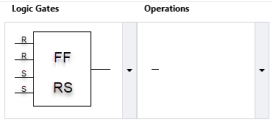
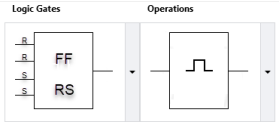
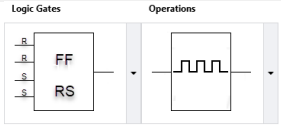
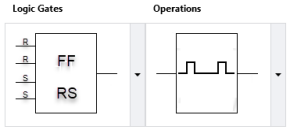
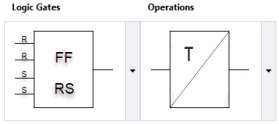
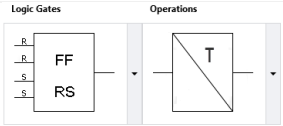
LOGIC GATE	OPERATION	SETTABLE PARAMETERS	HMI SYMBOL	SICOM SYMBOL	APPLICABLE EXTRA PARAMETERS
OR4	-	-	OR		NA
	1 PULSE	Time up: (Time during which the pulse is activated)	OR 1P		Time up The time the pulse lasts
	PULSES	Time up: Time between pulses and duration of each pulse (same for both)	OR PS		Time up The time the pulses are activated and deactivated (same time on/off)
	BLINKING	Period & Time up: Period: Repetitive time between each pulse Tme up: Time during which each pulse is activated	OR BL		Period and Time up Period: It is the period of the square wave Time up: it is the time the pulse is activated
	TIMER UP	Time up: (Delay time to activate the configured signal)	OR TU		Time up It is the delay until the configured signal is activated
	TIMER DOWN	Time up: (Delay time to deactivate the configured signal)	OR TD		Time up It is the delay until the configured signal is deactivated

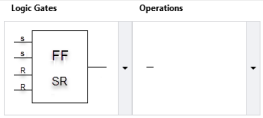
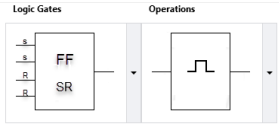
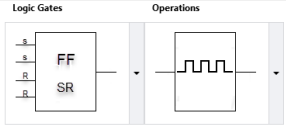
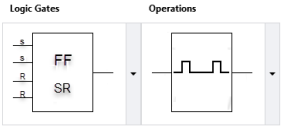
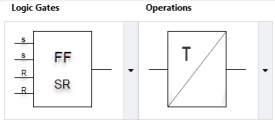
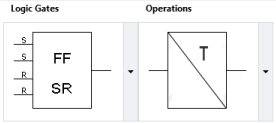
LOGIC GATE	OPERATION	SETTABLE PARAMETERS	HMI SYMBOL	SICOM SYMBOL	APPLICABLE EXTRA PARAMETERS
NOR4	-	-	NOR		NA
	1 PULSE	Time up: (Time during which the pulse is activated)	NOR 1P		Time up The time the pulse lasts
	PULSES	Time up: Time between pulses and duration of each pulse (same for both)	NOR PS		Time up The time the pulses are activated and deactivated (same time on/off)
	BLINKING	Period & time up: Period: Repetitive time between each pulse Tme up: Time during which each pulse is activated	NOR BL		Period and Time up Period: It is the period of the square wave Time up: it is the time the pulse is activated
	TIMER UP	Time up: (Delay time to activate the configured signal)	NOR TU		Time up It is the delay until the configured signal is deactivated
	TIMER DOWN	Time up: (Delay time to deactivate the configured signal)	NOR TD		Time up It is the delay until the configured signal is activated

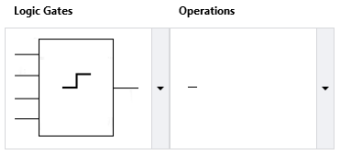
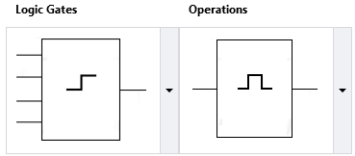
LOGIC GATE	OPERATION	SETTABLE PARAMETERS	HMI SYMBOL	SICOM SYMBOL	APPLICABLE EXTRA PARAMETERS
AND4	-	-	AND		NA
	1 PULSE	Time up: (Time during which the pulse is activated)	AND 1P		Time up The time the pulse lasts
	PULSES	Time up: Time between pulses and duration of each pulse (same for both)	AND PS		Time up The time the pulses are activated and deactivated (same time on/off)
	BLINKING	Period & time up: Period: Repetitive time between each pulse Tme up: Time during which each pulse is activated	AND BL		Period and Time up Period: It is the period of the square wave Time up: it is the time the pulse is activated
	TIMER UP	Time up: (Delay time to activate the configured signal)	AND TU		Time up It is the delay until the configured signal is activated
	TIMER DOWN	Time up: (Delay time to deactivate the configured signal)	AND TD		Time up It is the delay until the configured signal is deactivated

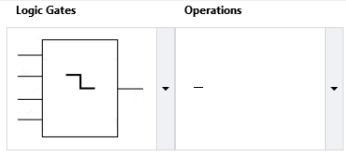
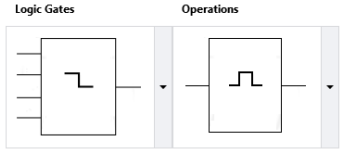
LOGIC GATE	OPERATION	SETTABLE PARAMETERS	HMI SYMBOL	SICOM SYMBOL	APPLICABLE EXTRA PARAMETERS
NAND4	-	-	NAND		NA
	1 PULSE	Time up: (Time during which the pulse is activated)	NAND 1P		Time up The time the pulse lasts
	PULSES	Time up: Time between pulses and duration of each pulse (same for both)	NAND PS		Time up The time the pulses are activated and deactivated (same time on/off)
	BLINKING	Period & time up: Period: Repetitive time between each pulse Tme up: Time during which each pulse is activated	NAND BL		Period and Time up Period: It is the period of the square wave Time up: it is the time the pulse is activated
	TIMER UP	Time up: (Delay time to activate the configured signal)	NAND TU		Time up It is the delay until the configured signal is deactivated
	TIMER DOWN	Time up: (Delay time to deactivate the configured signal)	NAND TD		Time up It is the delay until the configured signal is activated

LOGIC GATE	OPERATION	SETTABLE PARAMETERS	HMI SYMBOL	SICOM SYMBOL	APPLICABLE EXTRA PARAMETERS
XOR2	-	-	XOR		NA
	1 PULSE	Time up: (Time during which the pulse is activated)	XOR 1P		Time up The time the pulse lasts
	PULSES	Time up: Time between pulses and duration of each pulse (same for both)	XOR PS		Time up The time the pulses are activated and deactivated (same time on/off)
	BLINKING	Period & time up: Period: Repetitive time between each pulse Tme up: Time during which each pulse is activated	XOR BL		Period and Time up Period: It is the period of the square wave Time up: it is the time the pulse is activated
	TIMER UP	Time up: (Delay time to activate the configured signal)	XOR TU		Time up It is the delay until the configured signal is activated
	TIMER DOWN	Time up: (Delay time to deactivate the configured signal)	XOR TD		Time up It is the delay until the configured signal is deactivated

LOGIC GATE	OPERATION	SETTABLE PARAMETERS	HMI SYMBOL	SICOM SYMBOL	APPLICABLE EXTRA PARAMETERS
RSFF **2 for the reset + 2 for the set**	-	-	RSFF		NA
	1 PULSE	Time up: (Time during which the pulse is activated)	RSFF 1P		Time up The time the pulse lasts (in this case the FF. this configuration works as OR_PULSE)
	PULSES	Time up: Time between pulses and duration of each pulse (same for both)	RSFF PS		Time up The time the pulses are activated and deactivated (same time on/off)
	BLINKING	Period & time up: Period: Repetitive time between each pulse Tme up: Time during which each pulse is activated	RSFF BL		Period and Time up Period: It is the period of the square wave Time up: it is the time the pulse is activated
	TIMER UP	Time up: (Delay time to activate the configured signal)	RSFF TU		Time up It is the delay until the configured signal is activated
	TIMER DOWN	Time up: (Delay time to deactivate the configured signal)	RSFF TD		Time up It is the delay until the configured signal is deactivated

LOGIC GATE	OPERATION	SETTABLE PARAMETERS	HMI SYMBOL	SICOM SYMBOL	APPLICABLE EXTRA PARAMETERS
SRFF **2 for the set + 2 for the reset**	-	-	SRFF		NA
	1 PULSE	Time up: (Time during which the pulse is activated)	SRFF 1P		Time up The time the pulse lasts (in this case the FF. this configuration works as OR_PULSE)
	PULSES	Time up: Time between pulses and duration of each pulse (same for both)	SRFF PS		Time up The time the pulses are activated and deactivated (same time on/off)
	BLINKING	Period & time up: Period: Repetitive time between each pulse Tme up: Time during which each pulse is activated	SRFF BL		Period and Time up Period: It is the period of the square wave Time up: it is the time the pulse is activated
	TIMER UP	Time up: (Delay time to activate the configured signal)	SRFF TU		Time up It is the delay until the configured signal is activated
	TIMER DOWN	Time up: (Delay time to deactivate the configured signal)	SRFF TD		Time up It is the delay until the configured signal is deactivated

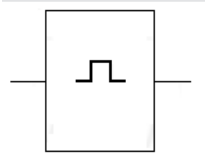
LOGIC GATE	OPERATION	SETTABLE PARAMETERS	HMI SYMBOL	SICOM SYMBOL	APPLICABLE EXTRA PARAMETERS
R_EDGE4	-	-	R EDGE		NA
	1 PULSE	Time up: (Time during which the pulse is activated)	R EDGE 1P		Time up The time the pulse lasts

LOGIC GATE	OPERATION	SETTABLE PARAMETERS	HMI SYMBOL	SICOM SYMBOL	APPLICABLE EXTRA PARAMETERS
F_EDGE4	-	-	F EDGE		NA
	1 PULSE	Time up: (Time during which the pulse is activated)	F EDGE 1P		Time up The time the pulse lasts

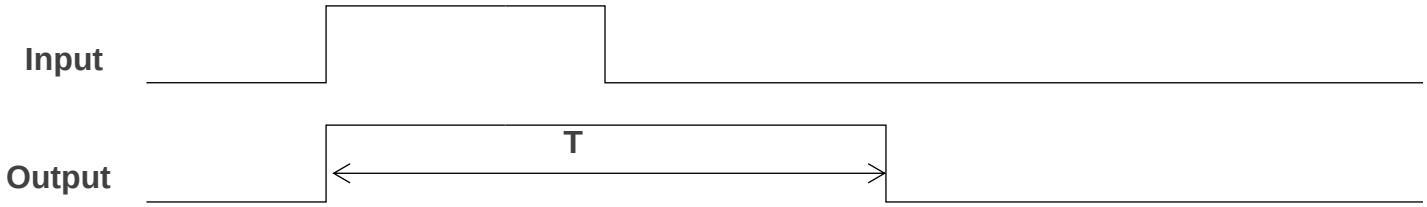
NOTE: After using RS or SR flip flops, please reset the relay before changing the configuration.

Logical gate selection guide

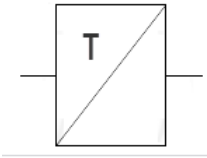
1 PULSE



The configured signal will make a pulse of the adjusted time in “time up” parameter once the input signal is activated.

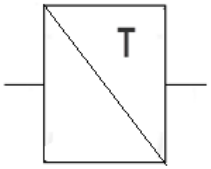


TIMER UP

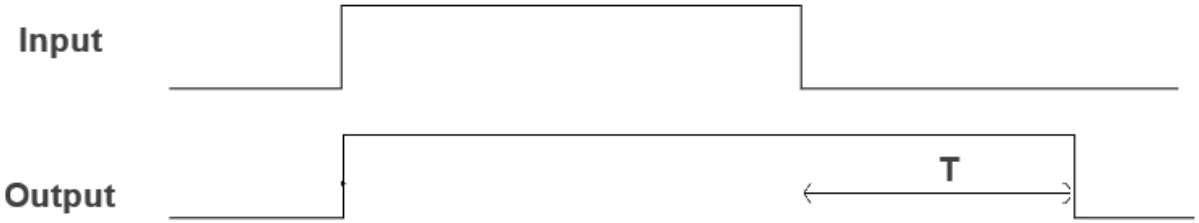


The configured signal waits the adjusted time in “time up” parameter to activate itself once the input signal is activated.

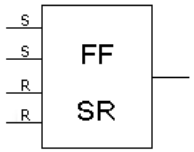
TIMER DOWN

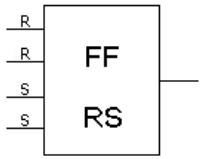


Once the configured signal is activated, it waits the adjusted time in “time up” parameter to deactivate itself.

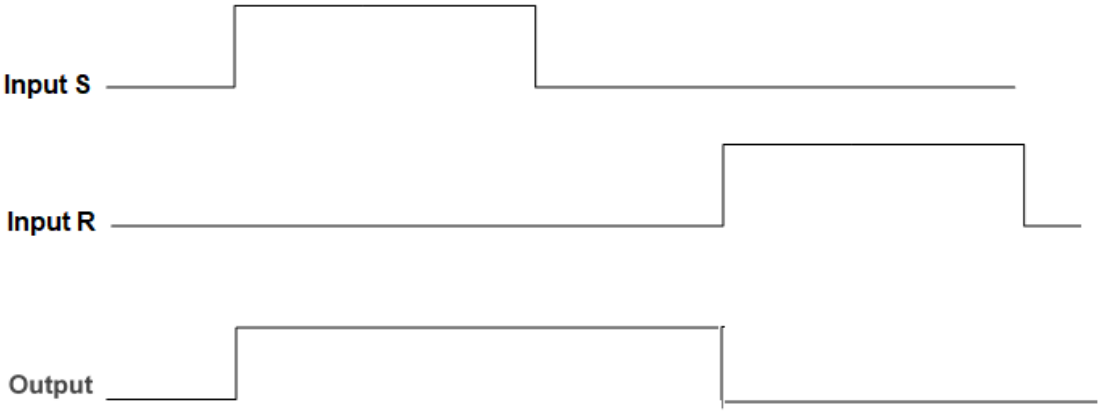


SR FLIP FLOP (priority for set signals) & RS FLIP FLOP (priority for reset signals)

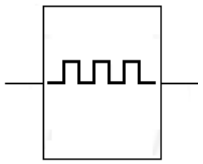




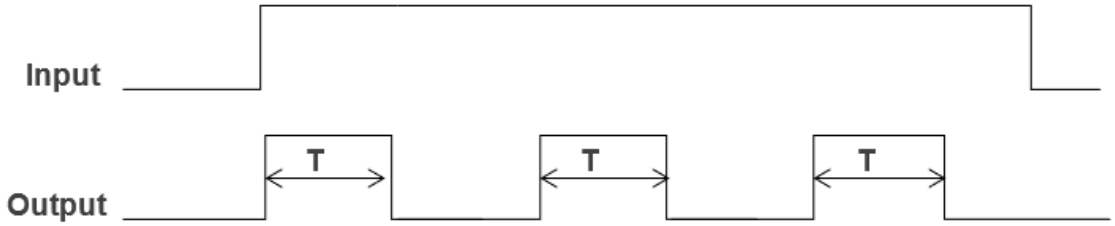
The configured signal will be activated once the bits in “s” position are activated (set position. The signal is maintained activated until the bits configured in “R” position are activated.



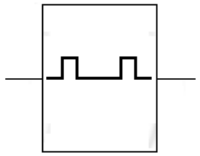
PULSES (Same time on and time off)



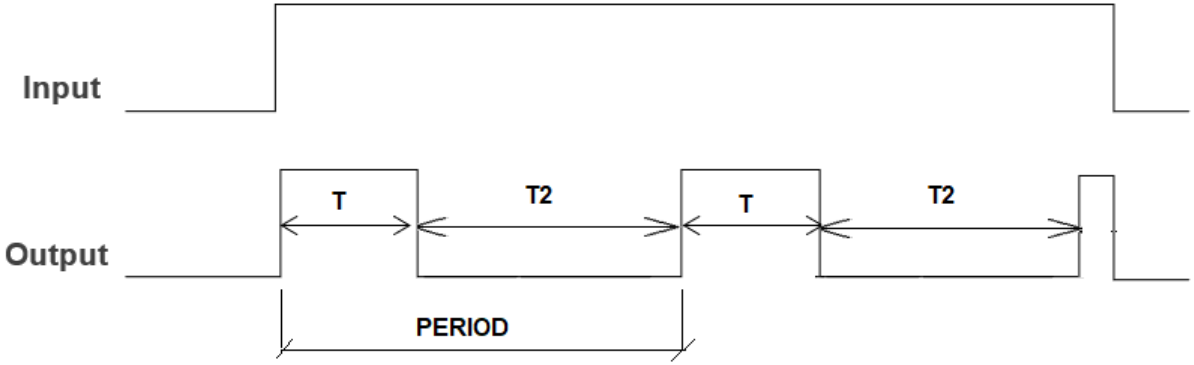
The configured signal will make pulses of the adjusted milliseconds while the input signal is activated.



BLINKING (different time on (T) and time off (T2))



The configured signal will be activated the time set in “time up” parameter and will be switched off the time set in “period” parameter less the set in “time up” parameter:



To delete the configuration, SICOM or HMI can be used. Through SICOM it is necessary to remove the configured signals and send the new configuration to the relay.

Through HMI, it is necessary to access the output, PGC or LED that is configured and press OK to visualize the configured signals. Being displaying the configured options, hold RESET key to delete them. After inserting the password, by pressing OK the action of removing the configured options is confirmed. It is necessary to press RESET key as many times as signals are configured.

Once the signal is empty, it is possible to configure it. First find the signal which will be configured to an output, LED or PGC (i.e. “General Trip”). Press “right arrow” ► an enter the password, in the first column the outputs are placed (pressing “up” ▲ or “down” ▼ keys find the output), pressing the “right” key ► LEDs (alarms) will appear, pressing the “right” key ► again Arc Flash outputs appear and finally pressing the right key ►, the PGC signals will be placed. Once the output is found, press “left” key ◄ to find the correct operation, press OK to assign the operation. Then the configuration is finished.

12.13 Self-diagnosis

Diagnostic algorithms are run on device switch on and continuously during operation of the relay. These diagnostics guarantee the correct working of the device, as a preventive process.

The following general considerations apply:

- Communications between different CPUs are confirmed with corresponding integrity checks. Continuing anomalies will lead to the restarting of the device.
- Data constituting settings are confirmed with corresponding checks. Furthermore, all tables of settings are stored in two copies. The relay can work with a corrupted table, but not if both tables are corrupted.
- A Watchdog mechanism exists, both between and within the different main CPUs. Loss of activity in any CPU will lead to the restarting of the device, which will be logged as an event.

The state flag bits associated with this process are as follows:

Model Error	It is active when the firmware version does not match the hardware model.
Hardware Error	It is active when there is a defect in the hardware.
Slot 3 Empty	It is active when the third hardware slot is detected as empty
Slot 4 Empty	It is active when the fourth hardware slot is detected as empty
Slot 5 Empty	It is active when the fifth hardware slot is detected as empty
COM Error	It is active when there is a problem with the communication between the main CPU and the communication CPU.
Test State	It is active when the user enters in the Test Menu
Settings Error	It is active when there is corrupted data on the settings page of the memory. It is performed on initialization and on each change.
Configuration Error	It is active when there is corrupted data on the configuration page of the memory. It is performed on initialization and on each change.
Measurement Error (*)	It is active when there is a problem with the communication between the main CPU and the measurement CPU.

(*) This bit is included in the Measurements State

There are also other bits on this menu that are active when a factory restoration is applied and generate an event registered on the SER.

Settings by default	Default settings are applied
Default configuration	Default configuration is applied

12.14 Date-Time synchronization.

The relay can be synchronized from the HMI or by communications, and depending on the model it is also available synchronization through modular IRIG B.

12.15 Test menu

The SIL-G device features a test menu for use to verify the LEDs and outputs. Please note that while using the test menu the protection will be disabled.

2 key sequences are available to access to this test mode:

> From the main menu enter the key sequence "◄", "▼", "►" and hold "OK" until "Test menu" is displayed, indicating that while the test menu is active, protection is deactivated.
>
> From the main menu hold "C" key until "Test menu" is displayed, indicating that while the test menu is active, protection is deactivated.

Pressing "OK" bring up the password introduction menu; if the correct password is inserted, the text menu is accessed by pressing "OK" again (by default, the password is 5555). Navigate the menu using the "up" ▲ and "down" ▼ keys. Press "OK" to toggle the state of each menu item (to activate it if it is deactivated, and to deactivate it if it is activated). Press "C" to leave the test menu.

Once the relay is in test menu all the LEDs will be activated simultaneously. In case of the outputs, they can be activated or deactivated by pressing OK key.

12.16 Power Supply

Depending on the model SIL-G is designed to be powered with an auxiliary voltage of:

- 24-48 Vdc
- 24-230 Vac/dc
- 48-230 Vac/dc

Power supply is guaranteed between -20%/+10% of auxiliary voltage. The relay may function outside of this range, but operation is not guaranteed.

Front power supply is designed for fine tuning, or situations where the auxiliary voltage is not guaranteed. In these cases, it is not guaranteed that the relay be totally operative, particularly the outputs.

The unit's power consumption is variable depending on the auxiliary voltage:

- 24-48 Vdc and 48-230 Vac/dc → less than 10VA
- 24-230 Vac/dc → less than 20VA

13 TECHNICAL SPECIFICATIONS AND STANDARDS

13.1 Technical specifications

Function 50-1 **Function 50-2**	Function enable: No/Alarm/Trip/SHB Trip
	Current tap: 0.010 to 30.000 xIn (step 0.001xIn)
	Time delay: 0.000 to 300.000 s (step 0.001 s)
	Activation level: 100%
	Deactivation level: 95%
	Instantaneous deactivation
	Timing accuracy: ±0.5% or ±35 ms (greater of both)
Function 50N-1	Function enable: No/Alarm/Trip/SHB Trip
	Current tap: 0.050 to 30.000 xIn (step 0.001xIn)
	Time delay: 0.000 to 300.000 s (step 0.001 s)
	Activation level: 100%
	Deactivation level: 95%
	Instantaneous deactivation
	Timing accuracy: ±0.5% or ±35 ms (greater of both)
Function 50G-1	Function enable: No/Alarm/Trip/SHB Trip
	Current tap: 0.010 to 30.000 xIn (step 0.001xIn)
	Time delay: 0.000 to 300.000 s (step 0.001 s)
	Activation level: 100%
	Deactivation level: 95%
	Instantaneous deactivation
	Timing accuracy: ±0.5% or ±35 ms (greater of both)
Function 67-1 **Function 67-2** **Function 67-3** **Function 67-4**	Function enable: No/Alarm/Trip/SHB Trip
	Curve Type: IEC 60255-151 and IEEE curves. IEC (Definite time, standard inverse, very inverse, extremely inverse, long time inverse, short time inverse) and IEEE (Moderately inverse, very inverse, extremely inverse). Time delay: 0.000 to 300.000 s (step 0.001 s)
	Time dial (TMS): 0.05 to 25.00 (step 0.01) If Curve type IEC: 0.05 to 1.00 (step 0.01) If Curve type IEEE: 0.10 to 25.00 (step 0.01)
	Current tap: 0.010 to 20.000 xIn (step 0.001xIn)
	Directionality: No/Forward/Reverse
	Polarization voltage: 0.08 to 2.00 xUn (step 0.01xUn)
	Operating angle: 0 to 359º (step 1º)
	Halfcone angle: 10 to 170º (step 1º)
	Curve, current activation level: 110%
	Curve, current deactivation level: 100%
	Defined time, current activation level: 100%
	Defined time, current deactivation level: 95%
	Voltage activation level: 100%
	Voltage deactivation level: 95%
	Instantaneous deactivation
	Timing accuracy for IEC and IEEE curves selection: ± 30 ms or ± 5% (greater of both) Timing accuracy for defined time curve selection: ± 35 ms or ± 0.5% (greater of both)
	Function enable: No/Alarm/Trip/SHB Trip

Function 67N-1 **Function 67N-2**	Curve Type: IEC 60255-151 and IEEE curves. IEC (Definite time, standard inverse, very inverse, extremely inverse, long time inverse, short time inverse) and IEEE (Moderately inverse, very inverse, extremely inverse). Time delay: 0.000 to 300.000 s (step 0.001 s)
	Time dial (TMS): 0.05 to 25.00 (step 0.01) If Curve type IEC: 0.05 to 1.00 (step 0.01) If Curve type IEEE: 0.10 to 25.00 (step 0.01)
	Current tap: 0.010 to 20.000 xIn (step 0.001xIn)
	Directionality: No/Forward/Reverse
	Polarization voltage: 0.08 to 2.00 xUn (step 0.01xUn)
	Operating angle: 0 to 359º (step 1º)
	Halfcone angle: 10 to 170º (step 1º)
	Curve, current activation level: 110%
	Curve, current deactivation level: 100%
	Defined time, current activation level: 100%
	Defined time, current deactivation level: 95%
	Voltage activation level: 100%
	Voltage deactivation level: 95%
	Instantaneous deactivation
	Timing accuracy for IEC and IEEE curves selection: ± 30 ms or ± 5% (greater of both) Timing accuracy for defined time curve selection: ± 35 ms or ± 0.5% (greater of both)
Function 67G-1 **Function 67G-2**	Function enable: No/Alarm/Trip/SHB Trip
	Curve Type: IEC 60255-151 and IEEE curves. IEC (Definite time, standard inverse, very inverse, extremely inverse, long time inverse, short time inverse) and IEEE (Moderately inverse, very inverse, extremely inverse). Time delay: 0.000 to 300.000 s (step 0.001 s)
	Time dial (TMS): 0.05 to 25.00 (step 0.01) If Curve type IEC: 0.05 to 1.00 (step 0.01) If Curve type IEEE: 0.10 to 25.00 (step 0.01)
	Current tap: 0.010 to 20.000 xIn (step 0.001xIn)
	Directionality: No/Forward/Reverse
	Polarization voltage: 0.08 to 2.00 xUn (step 0.01xUn)
	Operating angle: 0 to 359º (step 1º)
	Halfcone angle: 10 to 170º (step 1º)
	Curve, current activation level: 110%
	Curve, current deactivation level: 100%
	Defined time, current activation level: 100%
	Defined time, current deactivation level: 95%
	Voltage activation level: 100%
	Voltage deactivation level: 95%
	Instantaneous deactivation
	Timing accuracy for IEC and IEEE curves selection: ± 30 ms or ± 5% (greater of both) Timing accuracy for defined time curve selection: ± 35 ms or ± 0.5% (greater of both)
Function SOTF	Function enable: No/Alarm/Trip/SHB Trip
	Current tap: 0.010 to 30.000 xIn (step 0.001xIn)
	Time delay: 0.000 to 295.000 s (step 0.001 s)
	Safe Time: 0.000 to 300.000 s (step 0.001 s)
	Activation level: 100%

	Deactivation level: 95%
	Instantaneous deactivation
	Timing accuracy: ±0.5% or ±35 ms (greater of both)
Function 49	Function enable: No/Alarm/Trip
	Current tap: 0.100 to 2.400 In (step 0.001xIn)
	ζ heating: 3 to 600 min (step 1 min)
	ζ cooling: 1 to 6 xζ heating (step 1)
	Alarm: 20 to 99% (step 1%)
	Trip level: 100%
	Deactivation level: 95% of alarm level
	Timing accuracy: ± 5% respect of theorical value.
Function SHB	Function enable: No/Yes
	Current Tap: 5- 50% (step 1%)
	Reset Time: 0.000 to 300.000 (step 0.001 s)
	Block Threshold: 0.010 to 30.000xIn (step 0.001xIn)
	Activation level: 100%
	Deactivation level: 95%
	Temporized deactivation
Function CLP	Function enable: Yes/No
	Settings group: 1 to 4 (step 1)
	No load time: 0.020 to 300.000 s (step 0.001 s)
	Cold load time: 0.020 to 300.000 s (step 0.001 s)
Function 46	Function enable: No/Alarm/Trip/SHB Trip
	Curve Type: IEC 60255-151 and IEEE curves. IEC (Definite time, standard inverse, very inverse, extremely inverse, long time inverse, short time inverse) and IEEE (Moderately inverse, very inverse, extremely inverse). Time delay: 0.000 to 300.000 s (step 0.001 s)
	Time dial (TMS): 0.05 to 25.00 (step 0.01) If Curve type IEC: 0.05 to 1.00 (step 0.01) If Curve type IEEE: 0.10 to 25.00 (step 0.01)
	Current tap: 0.010 to 20.000 xIn (step 0.001xIn)
	Curve, current activation level: 110%
	Curve, current deactivation level: 100%
	Defined time, current activation level: 100%
	Defined time, current deactivation level: 95%
	Instantaneous deactivation
	Timing accuracy for IEC and IEEE curves selection: ± 30 ms or ± 5% (greater of both) Timing accuracy for defined time curve selection: ± 35 ms or ± 0.5% (greater of both)
Function 46BC	Function enable: No/Alarm/Trip/
	Tap: 15 to 100 % (step 1%)
	Time delay: 0.030 to 300.000 s (step 0.001 s)
	Activation level: 100%
	Deactivation level: 95%
	Timing accuracy: 0.5% or 30 ms (greater of both)
Function 37	Function enable: No/Alarm/Trip
	Current tap: 0.010 to 30.000 xIn (step 0.001xIn)
	Minimum level: 0.000 to 1.000 xIn (step 0.001xIn)
	Time delay: 0.060 to 300.000 s (step 0.001 s)

	Activation level: 100%
	Deactivation level: 105%
	Instantaneous reset
	Timing accuracy: 0.5% or 30 ms (greater of both)
Function 27-1 **Function 27-2**	Function enable: No/Alarm/Trip
	Voltage tap: 0.08 to 2.00 xUn (step 0.01xUn)
	Minimum level: 0.00 to 1.00 xUn (step 0.01xUn)
	Time delay: 0.060 to 300.000 s (step 0.001 s)
	Reset time: 0.020 to 300.000 s (step 0.001 s)
	Activation level: 100%
	Deactivation level: 105%
	Temporized deactivation
	Timing accuracy: ±0.5% or ±30 ms (greater of both)
Function 27V1	Function enable: No/Alarm/Trip
	Voltage tap: 0.15 to 2.00 xUn (step 0.01xUn)
	Minimum level: 0.00 to 1.00 xUn (step 0.01xUn)
	Time delay: 0.060 to 300.000 s (step 0.001 s)
	Reset time: 0.020 to 300.000 s (step 0.001 s)
	Activation level: 100%
	Deactivation level: 105%
	Temporized deactivation
	Timing accuracy: ±0.5% or ±30 ms (greater of both)
Function 27L (*)	Function enable: No/Alarm/Trip
	Voltage tap: 0.08 to 2.00 xUn (step 0.01xUn)
	Minimum level: 0.00 to 1.00 xUn (step 0.01xUn)
	Time delay: 0.060 to 300.000 s (step 0.001 s)
	Reset time: 0.020 to 300.000 s (step 0.001 s)
	Activation level: 100%
	Deactivation level: 105%
	Temporized deactivation
	Timing accuracy: ±0.5% or ±30 ms (greater of both)
Function 59-1 **Function 59-2**	Function enable: No/Alarm/Trip
	Voltage tap: 0.08 to 2.00 xUn (step 0.01xUn)
	Time delay: 0.020 to 300.000 s (step 0.001 s)
	Reset time: 0.020 to 300.000 s (step 0.001 s)
	Activation level: 100%
	Deactivation level: 95%
	Temporized deactivation
	Timing accuracy: ±0.5% or ±30 ms (greater of both)
Function 59N/G-1 **Function 59N/G-2**	Function enable: No/Alarm/Trip
	Voltage tap: 0.08 to 2.00 xUn (step 0.01xUn)
	Time delay: 0.020 to 300.000 s (step 0.001 s)
	Reset time: 0.020 to 300.000 s (step 0.001 s)
	Activation level: 100%
	Deactivation level: 95%
	Temporized deactivation
	Timing accuracy: ±0.5% or ±30 ms (greater of both)
Function 47	Function enable: No/Alarm/Trip
	Voltage tap: 0.08 to 2.00 xUn (step 0.01xUn)
	Time delay: 0.020 to 300.000 s (step 0.001 s)
	Reset time: 0.020 to 300.000 s (step 0.001 s)
	Activation level: 100%

	Deactivation level: 95%
	Temporized deactivation
	Timing accuracy: ±0.5% or ±30 ms (greater of both)
Function 59L (*)	Function enable: No/Alarm/Trip
	Voltage tap: 0.08 to 2.00 xUn (step 0.01xUn)
	Time delay: 0.020 to 300.000 s (step 0.001 s)
	Reset time: 0.020 to 300.000 s (step 0.001 s)
	Activation level: 100%
	Deactivation level: 95%
	Temporized deactivation
	Timing accuracy: ±0.5% or ±30 ms (greater of both)
Function 32-1 **Function 32-2** **Function 32-3** **Function 32-4**	Function enable: No/Alarm/Trip
	Activation level: 0.08 to 2.00 xSn (step 0.01xSn)
	Operating angle: 0 to 359º (step 1º)
	Time delay: 0.020 to 300.000 s (step 0.001 s)
	Activation level: 100%
	Deactivation level: 95%
	Instantaneous deactivation
	Timing accuracy: ±0.5% or ±30 ms (greater of both)
Function 81-1 **Function 81-2** **Function 81-3** **Function 81-4**	Function enable: No/Alarm/Trip
	Type: Underfrequency or overfrequency
	Activation level: 45.000 a 65.000 Hz (step 0.001 Hz)
	Time delay: 0.020 a 300.000 s (step 0.001 s)
	Reset time: 0.020 a 300.000 s (step 0.001 s)
	Function blocked if phase B voltage is lower than 20 volts
	Activation level: 100%
	Underfrequency reset level: activation level + 50mHz Overfrequency reset level: activation level - 50 mHz
	Temporized deactivation
	The frequency measurement is an average value of the frequency measured during 8 cycles. The accuracy of the Time Delay is the adjusted value plus the necessary time to achieve the measurement during 8 cycles.
Function 81R-1 **Function 81R-2** **Function 81R-3** **Function 81R-4**	Function enable: No/Alarm/Trip
	Type: Increase/Decrease
	Activation level: 0.100 to 5.000 Hz/s (step 0.001 Hz/s)
	Time delay: 0.060 to 40.000 s (step 0.001 s)
	Reset time: 0.020 to 300.000 s (step 0.001 s)
	Function blocked if phase B voltage is lower than 20 volts
	Activation level: 100%
	Temporized deactivation
	The frequency measurement is an average value of the frequency measured during 8 cycles. The accuracy of the Time Delay is the adjusted value plus the necessary time to achieve the measurement during 8 cycles.
Function 78	Function enable: No/Alarm/Trip
	Activation level: 1 to 25º (step 1º)
	Reset time: 0.020 to 300.000 s (step 0.001 s)
	Function blocked if phase B voltage is lower than 20 volts
	Temporized deactivation
	Measurement accuracy: ±1º or 10% (greater of both)
Function 24-1 **Function 24-2**	Function enable: No/Alarm/Trip
	Curve Type: Inverse A, Inverse B, Inverse C and Defined Time. Time delay: 0.020 to 300.000 s (step 0.001 s)
	Time dial (TMS): 0.10 to 25.00 (step 0.01)

	Activation level: 0.50 to 2.00 xUn/Fn (step 0.01 xUn/Fn)
	Time delay: 0.020 to 300.000 s (step 0.001 s)
	Reset Time: 0.020 to 300.000 s (step 0.001 s)
	Curve, activation level: 110%
	Curve, deactivation level: 100%
	Defined time, activation level: 100%
	Defined time, deactivation level: 95%
	Temporized deactivation
	Timing accuracy for curves selection: ± 30 ms or ± 5% (greater of both) Timing accuracy for defined time curve selection: ± 30 ms or ± 0.5% (greater of both)
Function 25 (*)	Dead tap: 0.08 to 2.00 xUn (step 0.01xUn)
	Live tap: 0.08 to 2.00 xUn (step 0.01xUn)
	Voltage supervision time: 0.060 to 300.000 s (step 0.001 s)
	Voltage difference: 0.05 to 2.00 xUn (step 0.01xUn)
	Phase difference: 2 to 90 º (step 1º)
	Frequency difference: 0.060 to 10.000 Hz (step 0.001 Hz)
	Synchro check time: 0.020 to 300.000 s (step 0.001 s)
Function 79	Number of recloses: 0 to 4 (step 1)
	Reclose time 1, 2, 3, 4: 0.020 to 2000.000 s (step 0.001 s)
	Hold Enable: No/Yes/No Time
	Hold time: 0.000 to 2000.000 s (step 0.001 s)
	Reset time: 0.000 to 2000.000 s (step 0.001 s)
	Safe time: 0.020 to 2000.000 s (step 0.001 s)
	Locking possibilities: pulse inputs, level inputs, commands.
Function 52	Maximum number of openings: 1 a 100,000 (step 1)
	Maximum accumulated amperes: 1 to 100,000 M(A2) (step 1)
	Repetitive number of openings: 1 to 100,000 (step 1)
	Time for repetitive number of openings: 1 to 300 min (step 1 min)
	Maximum opening time: 0.020 to 300.000 s (step 0.001 s)
	Maximum closing time: 0.020 to 300.000 s (step 0.001 s)
Function 74TCS	Function enable: No/Yes
	Time delay: 0.020 to 300.000 s (step 0.001 s)
	Continuity in circuits A and B
Function 60CTS	Function enable: No/Yes
	Time delay: 0.020 to 300.000 s (step 0.001 s)
	Timing accuracy: ± 30 ms or ± 0.5% (greater of both)
	Open breaker activation and reset threshold: 8% In
	Detection of the loss of one phase CT
Function 60VTS	Function enable: No/Yes
	Time delay: 0.020 to 300.000 s (step 0.001 s)
	V1, V2 and VP Tap: 0.08 to 2.00 xUn (step 0.001xUn)
	I1, I2 and 3I0 Tap: 0.010 to 20.000 xIn (step 0.001xIn)
	Timing accuracy: ± 30 ms or ± 0.5% (greater of both)
Function 50BF	Function enable: No/Yes
	Time delay: 0.020 to 1.000 s (step 0.001 s)
	Open breaker activation and reset threshold: 8% In
Function AFD (*)	Function enable: No/Alarm/Trip
	Current tap:1 to 20xIn (step 1xIn)

	Time delay: 1 to 4 samples (step 1 sample)
Function 86	It allows to latch (lock out) the contact trip due to programmable logic (PGC: RSFF).
Function 68	Available through configurable inputs and outputs thanks to the programmable logic (PGC).
Programmable logic control (PGC)	OR, OR_1PULSE, OR_PULSES, OR_BLINKING, OR_TIMER UP, OR_TIMER DOWN NOR, NOR_1PULSE, NOR_PULSES, NOR_BLINKING, NOR_TIMER UP, NOR_TIMER DOWN AND, AND_1PULSE, AND_PULSES, AND_BLINKING, AND_TIMER UP, AND_TIMER DOWN NAND, NAND_1PULSE, NAND_PULSES, NAND_BLINKING, NAND_TIMER UP, NAND_TIMER DOWN XOR, OR_1PULSE, XOR_PULSES, XOR_BLINKING, XOR_TIMER UP, XOR_TIMER DOWN SRFF, SRFF_1PULSE, SRFF_PULSES, SRFF_BLINKING, SRFF_TIMER UP, SRFF_TIMER DOWN RSFF, RSFF_1PULSE, RSFF_PULSES, RSFF_BLINKING, RSFF_TIMER UP, RSFF_TIMER DOWN R_EDGE, R_EDGE_1PULSE F_EDGE, F_EDGE_1PULSE
Settings tables	4 settings groups
	Selectable by input or general setting.
SER	3072 events
Disturbance fault recording (DFR)	32 samples/cycle
	Fault start configurable
	Configurable number of records depending on the size: 5 records in data and COMTRADE format (260 cycles each record): 1 to 8 pre-fault cycles + 252 to 259 postfault cycles. 25 records in data and COMTRADE format (60 cycles each record): 1 to 8 pre-fault cycles + 52 to 59 postfault cycles. 50 records in data and COMTRADE format (30 cycles each record): 1 to 8 pre-fault cycles + 22 to 29 postfault cycles. 100 records in data and COMTRADE format (15 cycles each record): 1 to 8 pre-fault cycles + 7 to 14 postfault cycles.)
	COMTRADE IEEE C37.111-1991 - 9 analog channels and 96 digital channels
Load Data Profiling (LDP)	Demand of power with the following characteristics: - Number of records: 2160 - Recording mode circular - Sampling rate (interval): configurable through communications (1-60 min)
Inputs (*)	Depending on Model: - 8 configurable inputs - 24 configurable inputs - 8 configurable inputs + 4 AFD inputs - 16 configurable inputs The voltage of the inputs is the same as the auxiliary power supply
Outputs (*)	Depending on Model: - 7 configurable outputs - 18 configurable outputs - 7 configurable outputs + 4 High-Speed Outputs - 11 configurable outputs 250 V AC – 8 A 30 V DC – 5 A
Frequency	50/60Hz
Current measurements	Phase currents (IA, IB, IC), neutral (IN, 3I0), positive sequence (I1) and negative sequence (I2) I2/I1 Maximum current (Imax), thermal Image (TI), Second harmonic (IA2H, IB2H IC2H)
	Fundamental values (DFT)
	Sampling: 32 samples/cycle
	2% precision in a band covering ±20% of nominal current and ±4% in the rest of the range

	Saturation limit: 30 times rated current
Voltage measurements	Phase voltage (VA, VB, VC), Line Voltage (VL)*, phase-phase voltage (UAB, UBC, UCA), neutral voltage (VR, 3V0), positive sequence (V1) and negative sequence (V2), Maximum voltage (VMAX) and V/f.
	Fundamental values (DFT)
	Sampling: 32 samples/cycle
	1% precision in a band covering ±20% of nominal voltage and 4% in the rest of the range
	- With VTs: 3-250 V - Direct connection: Up to 1000 V
Angle measurements	Current Angles: IA, IB, IC, IN and 3I0. Voltage Angles: VA, VB, VC, VR, VL*, 3V0, UAB, UBC and UCA.
	Accuracy: ±2º
Power measurements	Total and per phase active power
	Total and per phase reactive power
	Total and per phase apparent power
	2% accuracy in rated values with power factor between 1 and 0.7 (phase shift from 0 to ±45º).
Energy measurement	Positive and negative active energy
	Positive and negative reactive energy
Frequency measurements	Busbar Frequency, Line Frequency, df/dt
	Minimum voltage: 20V
	Accuracy: ±0.01 Hz
Communications	Local port (micro USB): Modbus RTU
	Remote port RS485: Modbus RTU, DNP3.0 and IEC60870-5-103 (*)
	Remote port RJ45: IEC 61850, DNP3.0 TCP/IP, Modbus TCP/IP (*)
	Fiber Optic: IEC 61850 with redundancy (HSR or PRP) (*)
Power supply (*)	24-48 Vdc (Tolerance: -20/+10%)
	48-230 Vac/dc (Tolerance: -20/+10%)
	24-230 Vdc / Vac (Tolerance: -20/+10%)
	48-230 Vac/dc + Self-powered through VTs (Tolerance: -20/+10%)
Environmental conditions	Operating temperature: -40 to 70ºC
	Storage temperature: -40 to 80ºC
	Relative humidity: 95%
Mechanical characteristics	Metallic box
	Panel mounted
	Height x Width: 198x 187 (mm)
	Depth: 160.8 mm
	IP-54

(*) Optional depending on model

13.2 Thermal resistance

Current:

- 4xIn continuously
- 30xIn for 20 seconds
- 100xIn for 1 second

Voltage:

- 2xUn continuously
- 2.4xUn for 10 seconds

13.3 Standards

TEST	TEST STANDARD	LEVEL
1. PRODUCT SAFETY REQUIREMENTS		
1.1. Clearance and creepage	IEC60255-27 Clause 10.6.3	see standard
1.2.1. Accessible parts test	IEC60255-27 Clause 10.6.2.5	IP2X
1.2.2. IP rating	IEC 60255-1, Clause 6.3 IEC60255-27 Clause 10.6.2.6	IP54 (front)
1.3. Impulse voltage	IEC60255-27 Clause 10.6.4.2	5 kV 1 kV
1.4. Dielectric voltage	IEC60255-27 Clause 10.6.4.3	2 kV 0,5 kV
1.5. Insulation resistance	IEC60255-27 Clause 10.6.4.4	500 VDC
1.6. Protective bonding	IEC60255-27 Clause 10.6.4.5	≤ 0,1 Ω
1.7. Flammability (visual inspection) • Housing • Cover • Terminals • Push buttons • Display • PCB boards • (Input) transformers • Opto couplers • Output relays • Wires	IEC60255-27 Clause 10.6.5.2	• 70/80 °C • 70/80 °C • V-2 • 55/70 °C • 55/70 °C • V-2 • V-1 • V-1 • V-1 • V-1
1.8. Single fault condition • **Power supply circuit**	IEC60255-27 Clause 10.6.5.5	no fire risk

1.9. Thermal short-time test ● Overvoltage VT, cont. ● Overvoltage VT, 10s. ● Overcurrent CT, cont. ● Overcurrent CT, 1s	IEC60255-27 Clause 10.6.5.3	● 2xUn ● 2,4xUn ● 4xIn ● 100xIn
2. ELECTROMAGNETIC COMPATIBILITY (EMC) tests		
2.1. EMISSION		
2.1.1. Radiated emission	IEC 60255-26 CISPR11 CISPR22 table 1 table 6 table 7	class A class A
2.1.2. Conducted emission	IEC 60255-26 CISPR22 table 2 table 2/4	class A
2.2. IMMUNITY		
2.2.1. Slow damped oscillatory wave (1 MHz)	IEC 60255-26 (IEC 61000-4-18) Clause 7.2.6	2,5 kV CM 1,0 kV DM 1 kV CM 0 kV DM
2.2.2. Electrostatic discharges	IEC 60255-26 (IEC 61000-4-2) Clause 7.2.3	6 kV cont. 8 kV air
2.2.3. Radiated radio frequency magnetic field	IEC 60255-26 (IEC 61000-4-3) Clause 7.2.4	80 - 1000 MHz 10 V/m 1,4 – 2,7 GHz 10 V/m 80, 160, 380, 450, 900, 1850, 2150 MHz 10 V/m
2.2.4. Fast transient/burst	IEC 60255-26 (IEC 61000-4-4) Clause 7.2.5	☒ Zone A 4 kV CM 2 kV CM ☐ Zone B 2 kV CM 1 kV CM
2.2.5. Surge	IEC 60255-26 (IEC 61000-4-5) Clause 7.2.7	☒ Zone A to 4 kV LE to 2 kV LL ☐ Zone B to 2 kV LE to 1 kV LL
2.2.6. Conducted disturbance induced by RF fields	IEC 60255-26 (IEC 61000-4-6) Clause 7.2.8	0,15 - 80 MHz 10 V 27, 68 MHz 10 V
2.2.7. Power frequency voltage	IEC 60255-26 (IEC 61000-4-16) Clause 7.2.9	☒ Zone A 150 V DM 300 V CM ☐ Zone B 100 V DM 300 V CM
2.2.8. Power frequency H- field	IEC 60255-26 (IEC 61000-4-8) Clause 7.2.10	30 A/m cont. 300 A/m 1-3 s

2.2.9 D.C. voltage dips	IEC 60255-26 (IEC 61000-4-29) Clause 7.2.11	100%; 10 – 1000 ms 60%; 200 ms 30%; 500 ms
2.2.10. A.C. voltage dips	IEC 60255-26 (IEC 61000-4-11) Clause 7.2.11	100%; 0,5 – 25 c. 60%; 10/12 c. 30%; 25/30 c.
2.2.11. D.C. voltage interruptions	IEC 60255-26 (IEC 61000-4-29) Clause 7.2.11	100%; 5 s
2.2.12. A.C. voltage interruptions	IEC 60255-26 (IEC 61000-4-11) Clause 7.2.11	100%; 250/300 c
2.2.13. D.C. ripple	IEC 60255-26 (IEC 61000-4-17) Clause 7.2.12	15% Ur_dc 100/120 Hz
2.2.14. D.C. gradual shut- down / start-up	IEC 60255-26 Clause 7.2.13	Shut d. ramp 60 s 5 min off St up ramp 60s
2.2.15. Damped oscillatory magnetic field (100 kHz and 1 MHz)	IEC 61000-4-10	100 A/m (peak)
2.2.16. Pulse magnetic field	IEC 61000-4-9	1000 A/m
3. CLIMATIC ENVAIRONMENTAL CONDITIONS		
3.1. Dry heat operational	IEC 60255-1 (IEC 60068-2-2, test Bd) Clause 6.12.3.1	+70°C; 72h
3.2. Cold operational	IEC 60255-1 (IEC 60068-2-1, test Ad) Clause 6.12.3.2	-40°C; 72h
3.3. Dry heat storage	IEC 60255-1 (IEC 60068-2-2, test Bb) Clause 6.12.3.3	+80°C; 72h
3.4. Cold storage	IEC 60255-1 (IEC 60068-2-1, test Ab) Clause 6.12.3.4	-40°C; 72h
3.5. Change of temperature	IEC 60255-1 (IEC 60068-2-14, test Nb) Clause 6.12.3.5	-40°C; +70°C 3 hours; 5 cycles
3.6. Damp heat, steady state	IEC 60255-1 (IEC 60068-2-78, test Cab) Clause 6.12.3.6	+40°C; 93% 10 days
3.7. Damp heat, cyclic	IEC 60255-1 (IEC 60068-2-30, test Db) Clause 6.12.3.7	+25°C; 40°C 97%; 93% 6 cycles
4. MECHANICAL ENVIRONMENTAL CONDITIONS		
4.1. Vibration response	IEC 60255-1 (IEC 60255-21-1) Clause 6.13.1	class 1
4.2. Vibration endurance	IEC 60255-1 (IEC 60255-21-1) Clause 6.13.1	class 1
4.3 Shock response	IEC 60255-1 (IEC 60255-21-2) Clause 6.13.2	class 1
4.4. Shock withstand	IEC 60255-1 (IEC 60255-21-2) Clause 6.13.2	class 1

4.5 Bump	IEC 60255-1 (IEC 60255-21-2) Clause 6.13.2	class 1
4.6 Seismic (single axis sweep)	IEC 60255-1 (IEC 60255-21-3) Clause 6.13.3	class 1

14 COMMUNICATION AND HMI

14.1 Local communication port. Micro USB

The USB communications port is installed on the front of the relay. The connector that is used is a micro USB. The used protocol is Modbus RTU (115200 – 8 bit – no parity – 1 bit stop).

The ground from the PC should be connected to the same ground as the relay to prevent communication problems.

The USB communication system is insulated from the auxiliary voltage, but not from the relay processors. For this reason, the cable connecting the PC to the relay should not be excessively long to avoid potential electromagnetic interference with the device.

14.2 Remote communications ports.

SIL-G with RS485 port for ModBus RTU, IEC60870-5-103 or DNP3.0 serial

There is one RS485 port, it is possible to select ModBus RTU protocol or IEC60870-5-103 or DNP3.0 serial protocol thanks to the general settings. The RS485 port output has two terminals (+,-), located on the rear of the relay.

This port can be used to continuously monitor the relay from a remote PC or SCADA system. Up to 32 relays can be connected to one bus; each device with a different Modbus address. The relay Modbus address can be configured using the SICom program.

To minimize communication errors as a result of noise, the use of a stranded and shielded cable is recommended for the physical connection. All of the + terminals on one side, and all of the - terminals on the other must be connected together in order to make the connection.

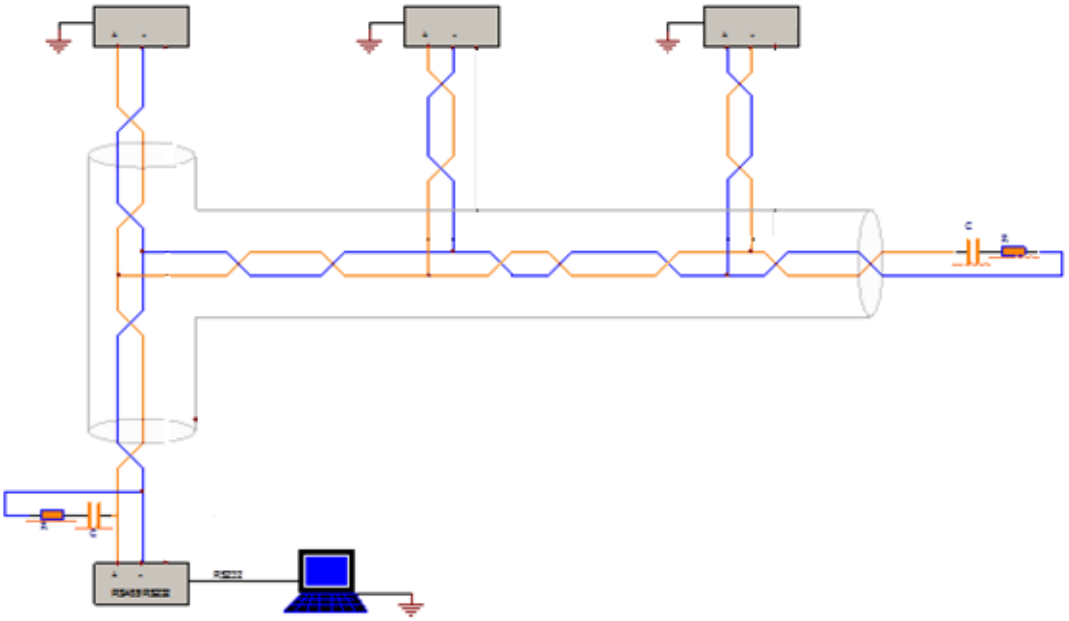
If a 3-wire cable is used, ground terminals (GND) should be connected to ground cable.

If a 2-wire cable is used, ground terminals (GND) should be connected to cable shielding. The shielding should be connected in one just point to ground to avoid circulating currents.

Resistors should be used at each end if very long cables are used. The best solution for avoiding reflection is to install resistors at both ends of the cable. The ohm value of these resistors must be equal to the cable impedance value.

The RS485 communications are fitted with auxiliary voltage insulation, but no insulation between the various RS485 communication connectors. Fiber optics can be used in very aggressive environments, and they are connected by using the corresponding converters.

Connection diagram for a RS485 bus is shown in the next image.



SIL-G with one RJ45 port for Modbus TCP/IP or DNP3.0 TCP/IP

In this case there is one RJ45 port for DNP 3.0 TCP/IP, IEC 60870-5-104 or Modbus TCP/IP protocols, where the protocol can be chosen by general settings.

SIL-G with RJ45 port for IEC61850

In this case there is one RJ45 port for IEC61850 the protocol.

SIL-G with FO port for IEC61850

In this case there is one FO port for IEC61850 the protocol.

14.3 LCD and keypad

The front of the SIL-G relay is fitted with an alphanumeric LCD screen, measuring 20x4. This screen provides the user with access to read information about the settings parameters, measurements, status and events. All of this information is arranged in a system of menus.

A keypad is fitted to the relay front panel, which can be used to access the information shown on the LCD screen and to navigate through the menu system.

This membrane keyboard has 6 keys that can be used to navigate through the different menus and to change the setting parameters. The ▲ ▼ and ◄ ► keys can be used to navigate through the different menus, the different options in each menu and the different values for the settings parameters.

The “**OK**” key is used to access the menus and the different options, as well as to approve changes to values. The “**C**” key is used to delete and to go back through the menu levels.

As well as the 6 keys, there is also a '**Reset**' key. When '**Reset**' is pressed, the LEDs indicators return to their initial position. The '**Reset**' key can also be used to delete all the events in the 'Events' menu, the Fault Reports and the LDP from each menu.

This relay is equipped with two specific keys marked with 79, which permit operation on the recloser, blocking and unblocking it.

Another two specific keys marked with 52, which permit operation on the circuit breaker, opening (O) and closing (I) it.

It is also equipped with two specific keys marked with Local, which activate or deactivate the remote communication of the relay.

14.4 SICom Communications program

The SICom program, which works with the Windows 7, Windows 8, Windows 8.1 and Windows 10 operating systems is provided, and can be used to gain access to all the relay information, to modify the settings and to save events using a graphic user interface.

The following operations can be carried out using the SICom program:

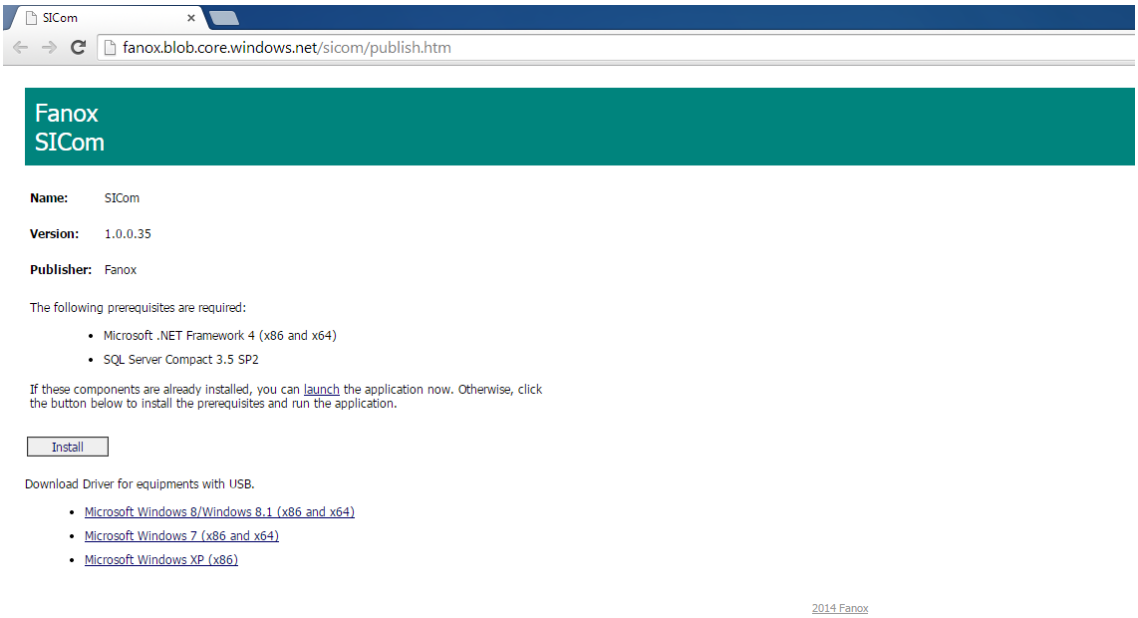
- Status reading
- Measurement reading
- Read and change settings
- Read and change configuration
- Read and delete events
- Read and delete DFR
- Configure and check the demand (LDP)
- Date-time synchronisation
- Set Counters
- Execute Commands
- Changing the user passwords
- Loading settings files
- Loading configuration files
- Checking the versions of the relay
- Configure Communication address

14.5 How to install SICOM Software

To install the SICom it is necessary the following link:

http://fanox.blob.core.windows.net/sicom/publish.htm

The link will open the next screen, where key ‘Install’ must be pressed:



The necessary drivers depending on the operative system can be downloaded from this page.

The update of the software does not require any user´s action, this is, if the computer is connected to Internet, SICom updates itself when it is started.

14.6 Setting up the session: Passwords and access levels

Users must identify themselves with a password in order to start communications and to change the relay settings or configuration using the HMI. Depending on the access level, it may or may not be possible to perform the operations shown on the table below.

HMI

ACCESS LEVEL	PASSWORD	Permission to: Change settings Set date/Time	Permission to: Execute Commands Set Counters Delete Events Delete DFR Delete LDP	Permission to: Change user´s Configuration Delete user´s configuration	Permission to: Upgrade the FW (flashing process)	Permission to: Change manufacturer´s Configuration
1	1111 2222 3333 6666 7777 8888	YES	NO	NO	NO	NO
2	4444 1010	YES	YES	NO	NO	NO
3	5555 9999	YES	YES	YES	YES	NO

SICOM

ACCESS LEVEL	PASSWORD	Read permission: Status and measurements Settings Configuration Events/DFR	Permission to: Change settings	Permission to: Execute Commands Set Counters Delete LDP Delete Events Delete DFR Set Date/Time	Permission to: Change user´s Configuration Delete user´s configuration	Permission to: Upgrade the FW (flashing process)	Permission to: Read and change access levels	Permission to: Change manufacturer´s Configuration
0	Fanox/0000	YES	NO	NO	NO	NO	NO	NO
1	Fanox/1111 Fanox/2222 Fanox/3333 Fanox/6666 Fanox/7777 Fanox/8888	YES	YES	NO	NO	NO	NO	NO
2	Fanox/4444	YES	YES	YES	NO	NO	NO	NO
3	Fanox/5555 Fanox/9999	YES	YES	YES	YES	YES	YES	NO

10 passwords and their associated levels of access can be set up using the Sicom program.

The password can make up of 10 characters as maximum for SICOM and up to 4 characters if HMI is used.

By default, the relay is programmed with the following passwords and their associated levels:

HMI PASSWORDS	SICOM PASSWORDS	ACCESS LEVEL
-	Fanox/0000	0
1111 2222 3333 6666 7777 8888	Fanox/1111 Fanox/2222 Fanox/3333 Fanox/6666 Fanox/7777 Fanox/8888	1
4444 1010	Fanox/4444	2
5555 9999	Fanox/5555 Fanox/9999	3

NOTES:

FANOX

Specialized in
Self Powered Relays

Parque tecnológico de Bizkaia • Edificio 604 • 48160 Derio • Spain
Tel. +34 944 711 409 • Fax +34 944 710 592 • fanox@fanox.com

www.fanox.com