SIL B

Feeder Relay

USER'S MANUAL

SIL_MANU_SILB_ING_R010_Beta

1. RECEPTION, HANDLING, INSTALLATION

1.1. Unpackaging

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

The use of good illumination is recommended to facilitate the equipment 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 equipment 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 equipment

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 equipment is well protected by the metal housing, which should not be removed as the equipment 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 equipment reliability and the duration of the life cycle as designed by the manufacturer by 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, commisioning and service

The personnel in charge of installing, commissioning and maintaining this equipment 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 equipment.

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

In order 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 equipment 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 equipment 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 equipment must be used within the stipulated electrical and environmental limits.

NOTE: current transformer circuits: Do not open a live CT secondary circuit. The high voltage produced as a result 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 equipment, 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.

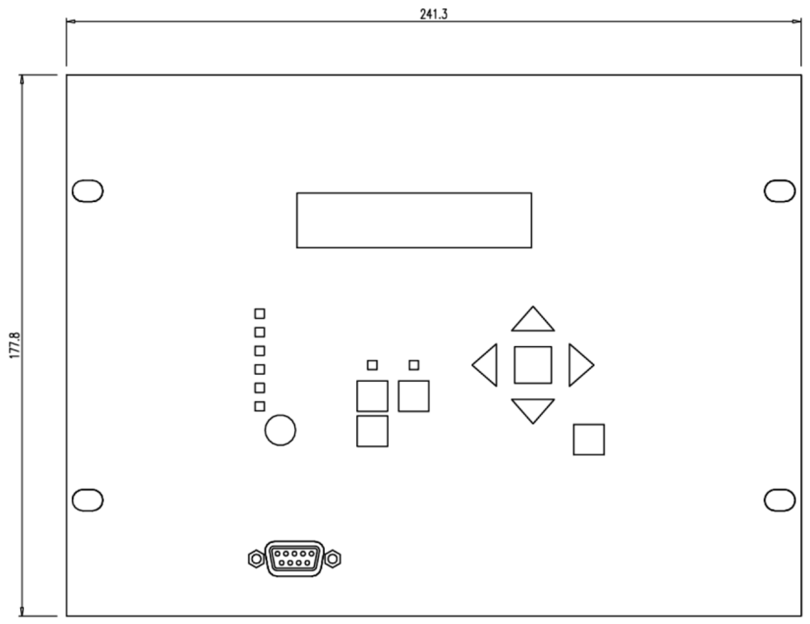
2. DIMENSIONS AND CONNECTION DIAGRAMS

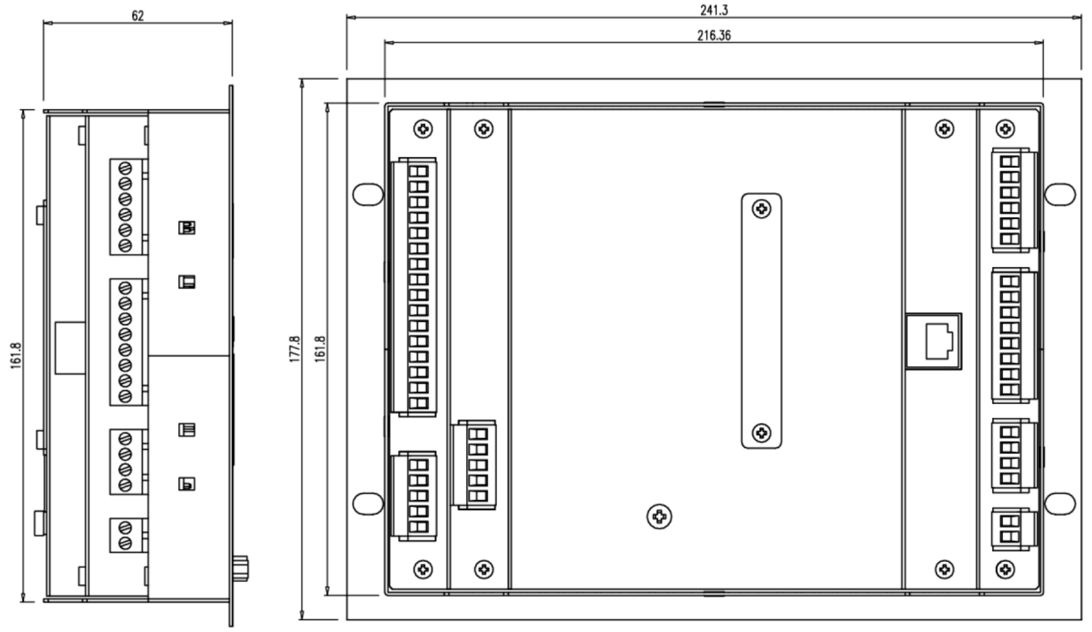
2.1. Non compact SILB (with external magnetic module)

2.1.1. Equipment front view

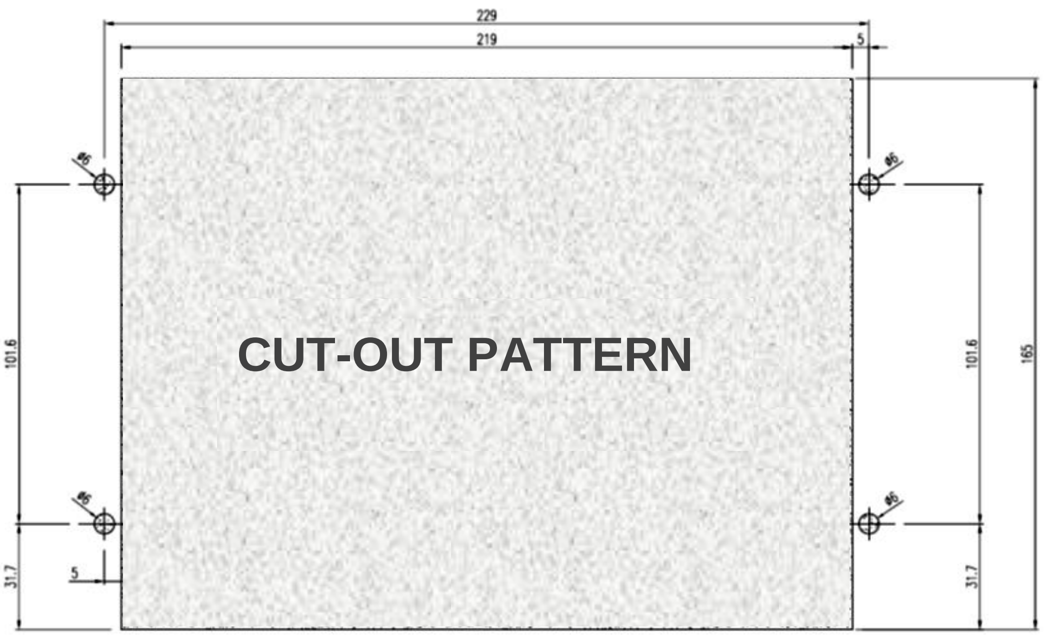
2.1.2. Equipment dimensions

Dimensions are in mm.

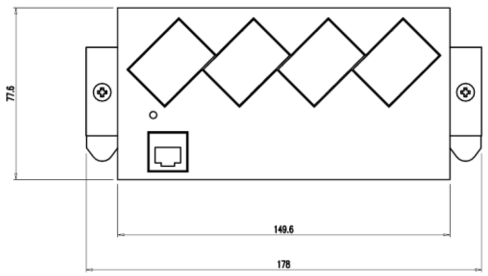


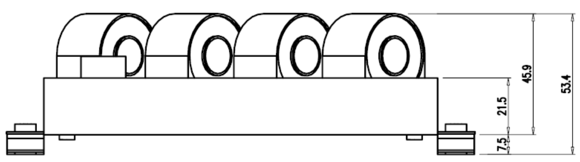


2.1.3. Cut-out pattern



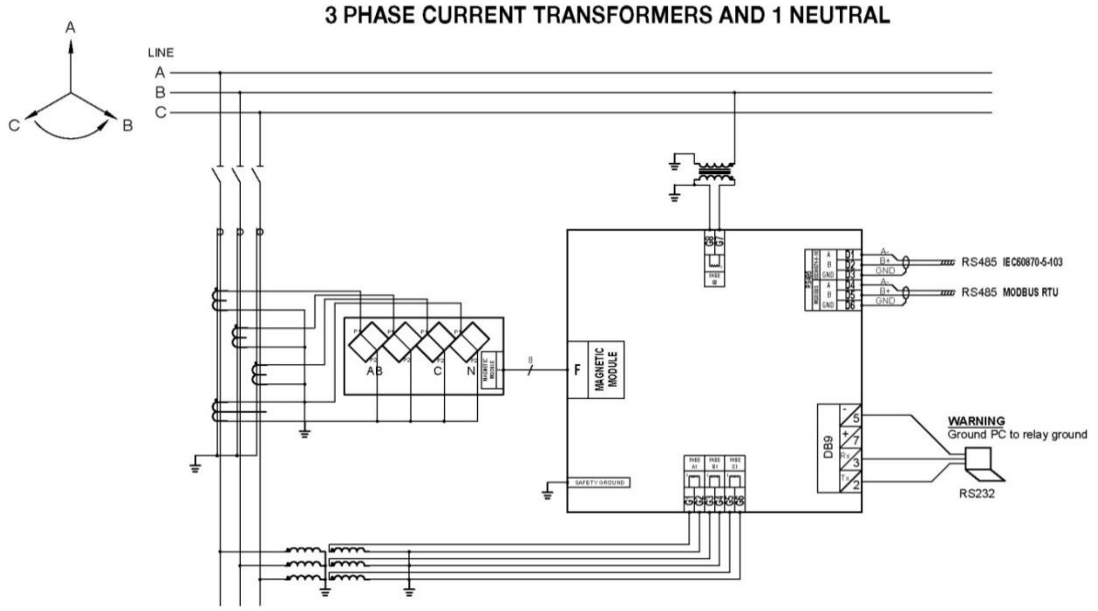
2.1.4. Magnetic module dimensions

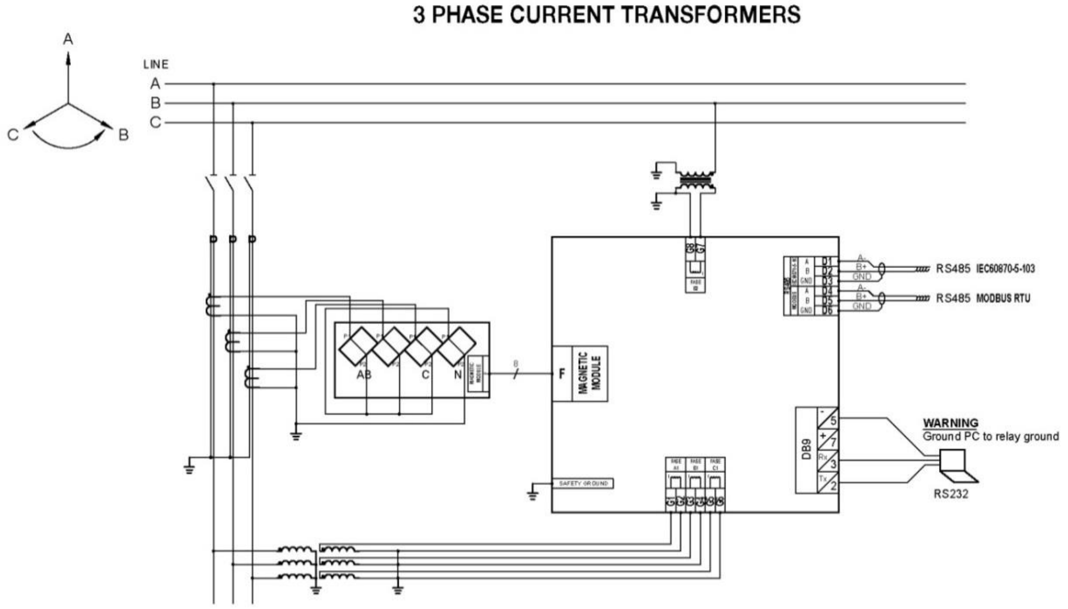




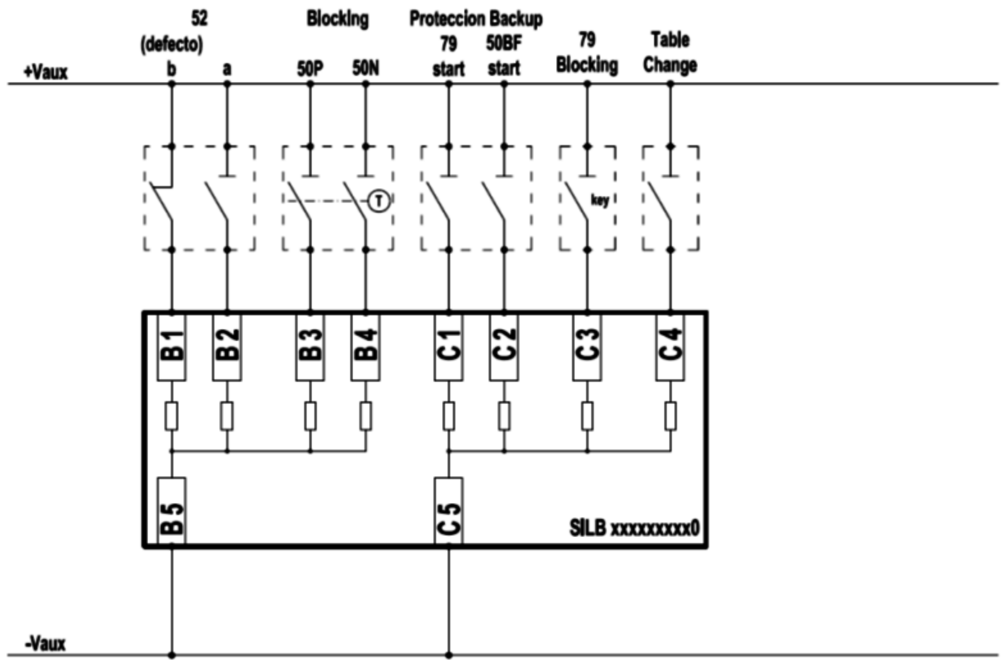
2.1.5. Connection diagrams

Analogical connections and communications

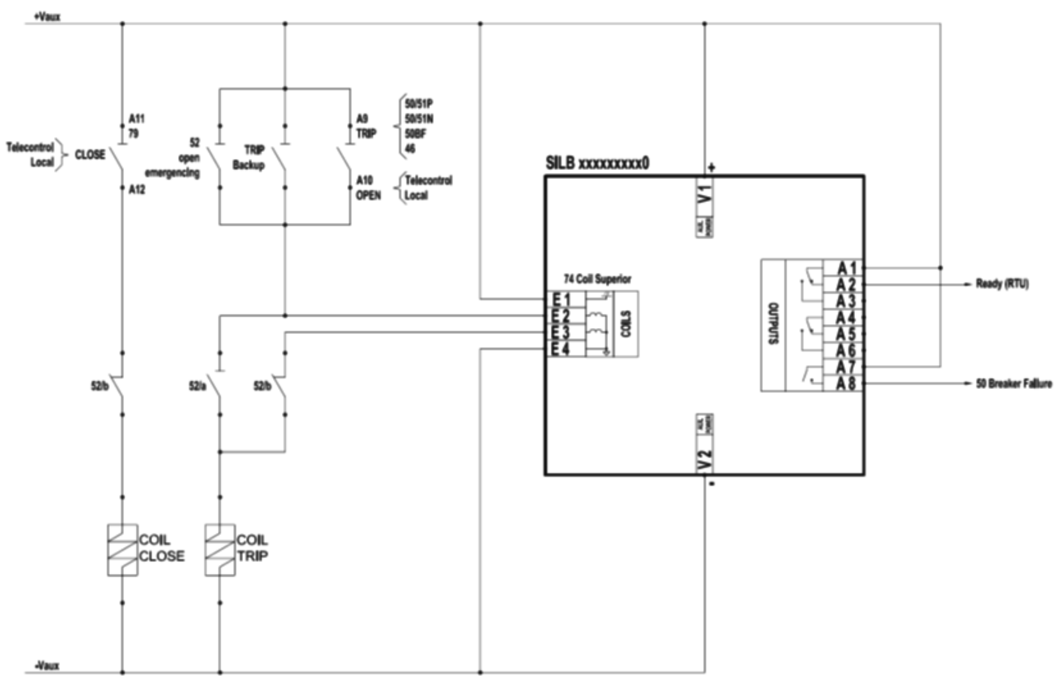




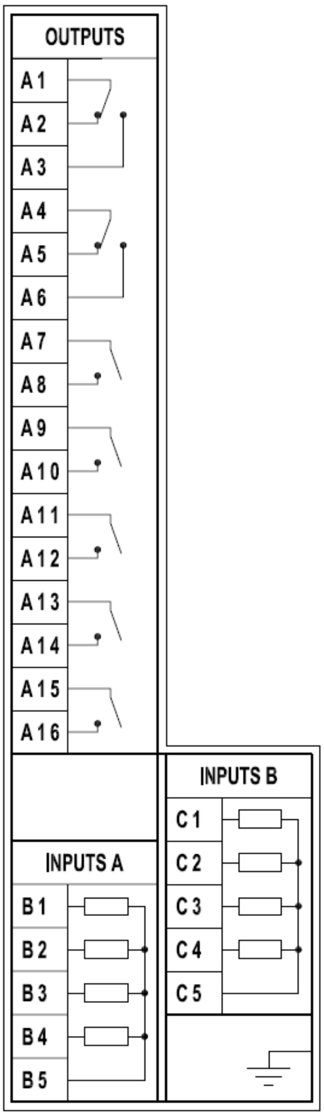
Digital connections

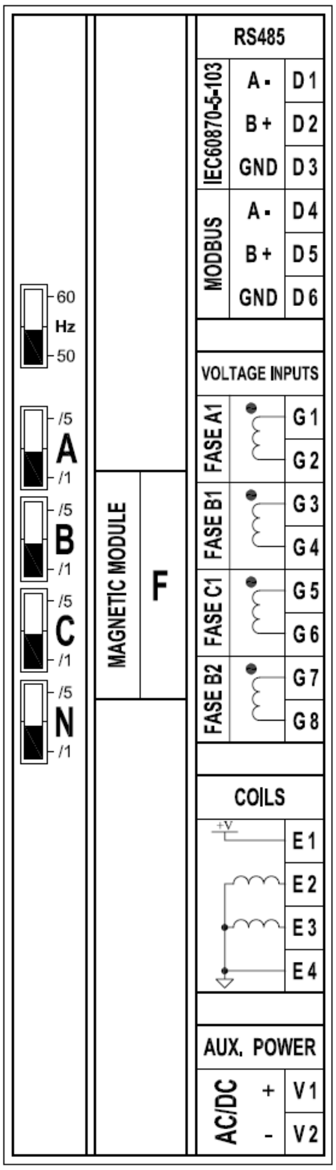


Outputs and Trip circuit supervision



2.1.6. Terminals

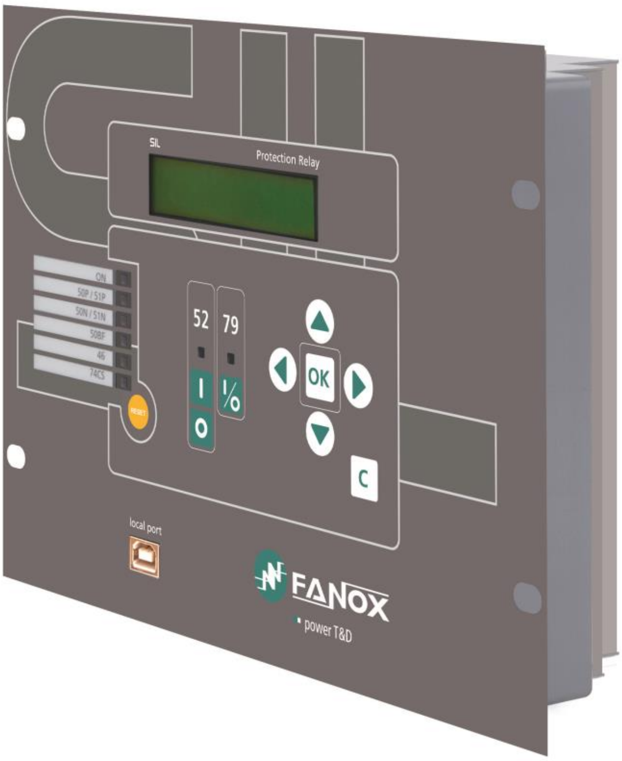




A1	Digital output common 1
A2	Digital output 1 NC
A3	Digital output 1 NO
A4	Digital output common 2
A5	Digital output 2 NC
A6	Digital output 2 NO
A7-A8	Digital output 3 NO
A9-A10	Digital output 4 NO
A11-A12	Digital output 5 NO
A13-A14	Digital output 6 NO
A15-A16	Digital output 7 NO
B1	Digital input 1
B2	Digital input 2
B3	Digital input 3
B4	Digital input 4
B5	Common of digital inputs 1, 2, 3 and 4
C1	Digital input 5
C2	Digital input 6
C3	Digital input 7
C4	Digital input 8
C5	Common of digital inputs 5, 6, 7 and 8

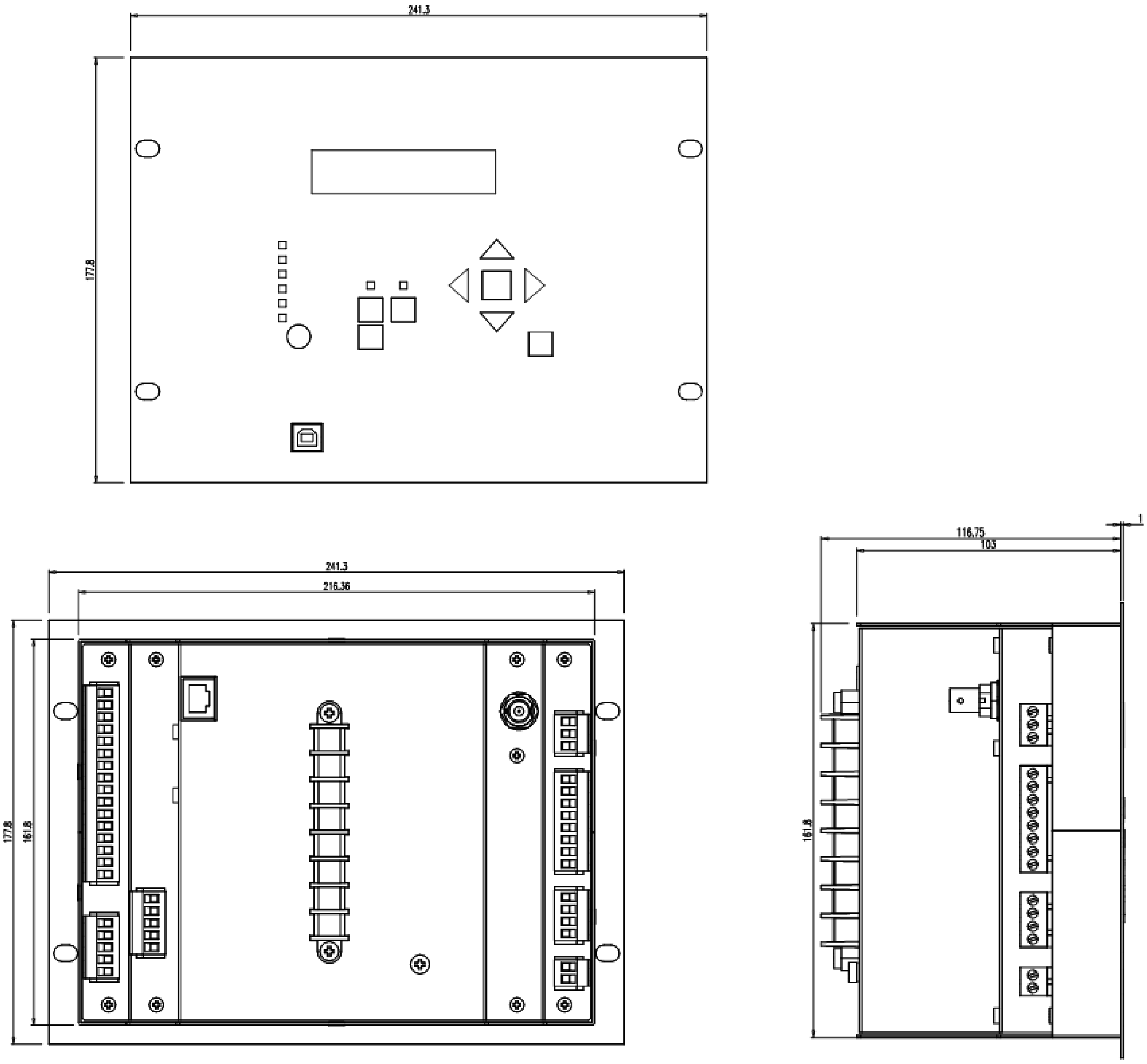
D1	A – RS485 IEC 60870-5-103
D2	B + RS485 IEC60870-5-103
D3	Gnd RS485 IEC60870-5-103
D4	A – RS485 Modbus RTU
D5	B + RS485 Modbus RTU
D6	Gnd RS485 Modbus RTU
F	RJ45 connector for the external magnetic module
G1	Phase A voltage +
G2	Phase A voltage -
G3	Phase B voltage +
G4	Phase B voltage -
G5	Phase C voltage +
G6	Phase C voltage -
G7	Busbar Voltage +
G8	Busbar Voltage -
E1	74TCS voltage presence
E2	74TCS coil 1
E3	74TCS coil 2
E4	74TCS common
V1	Auxiliary voltage +
V2	Auxiliary voltage -

2.2. Compact SILB (without external magnetic module)

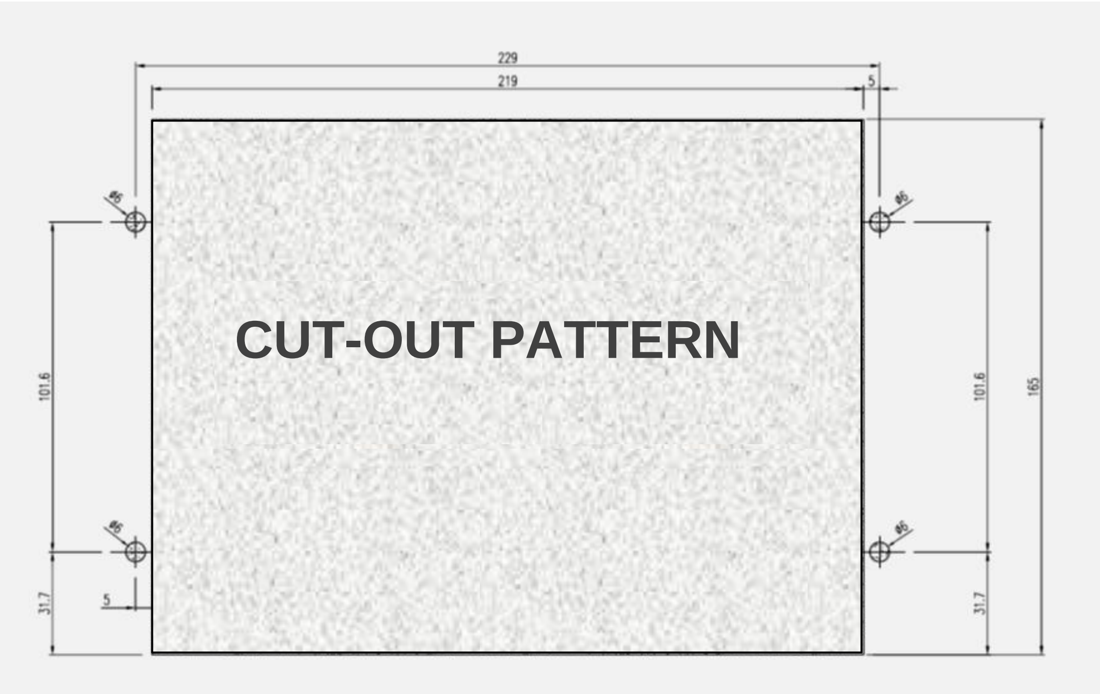


2.2.1. Equipment front view

2.2.2. Equipment dimensions



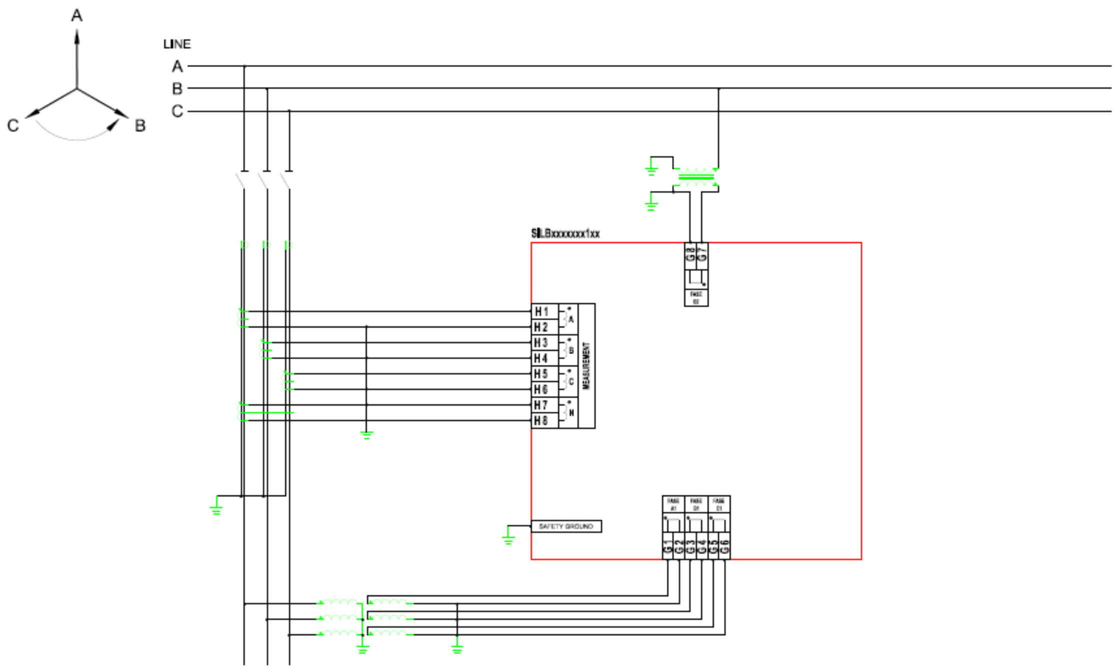
2.2.3. Cut-out pattern



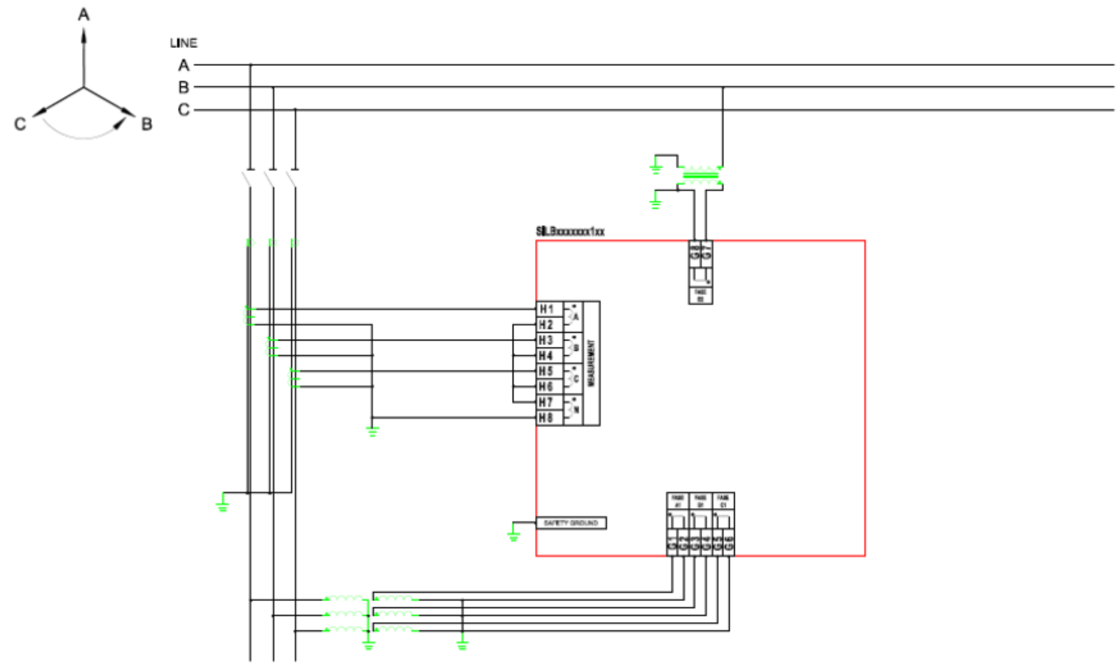
2.2.4. Connection diagrams

Analog connections and communications

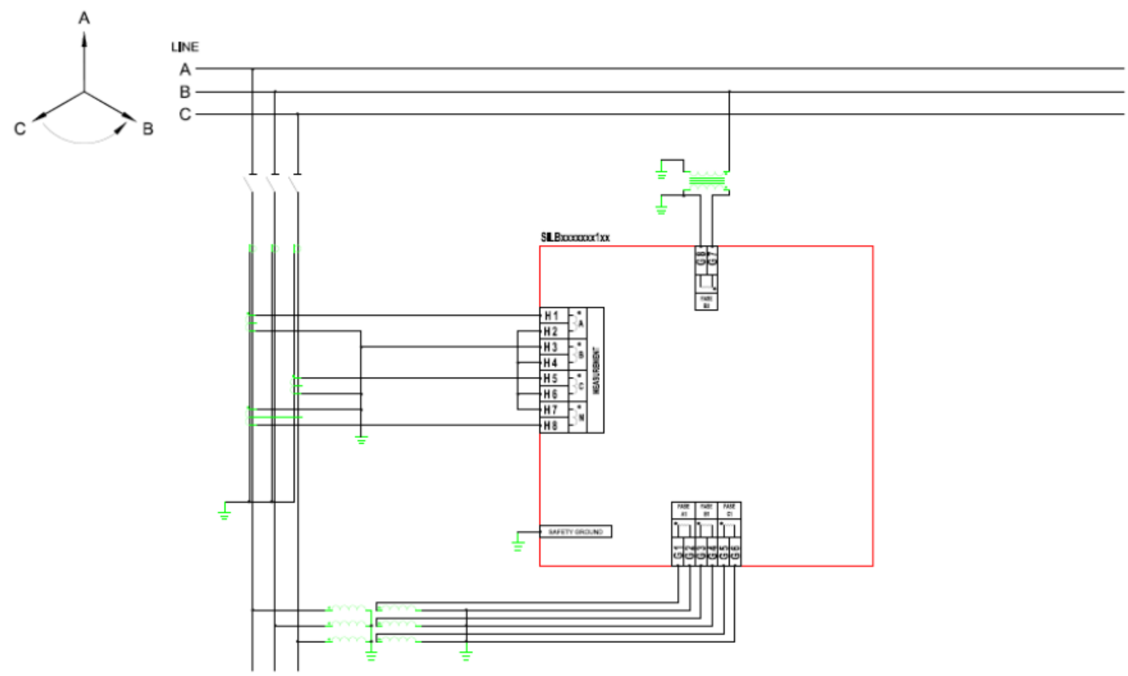
3 PHASES CT AND 1 NEUTRAL CT.



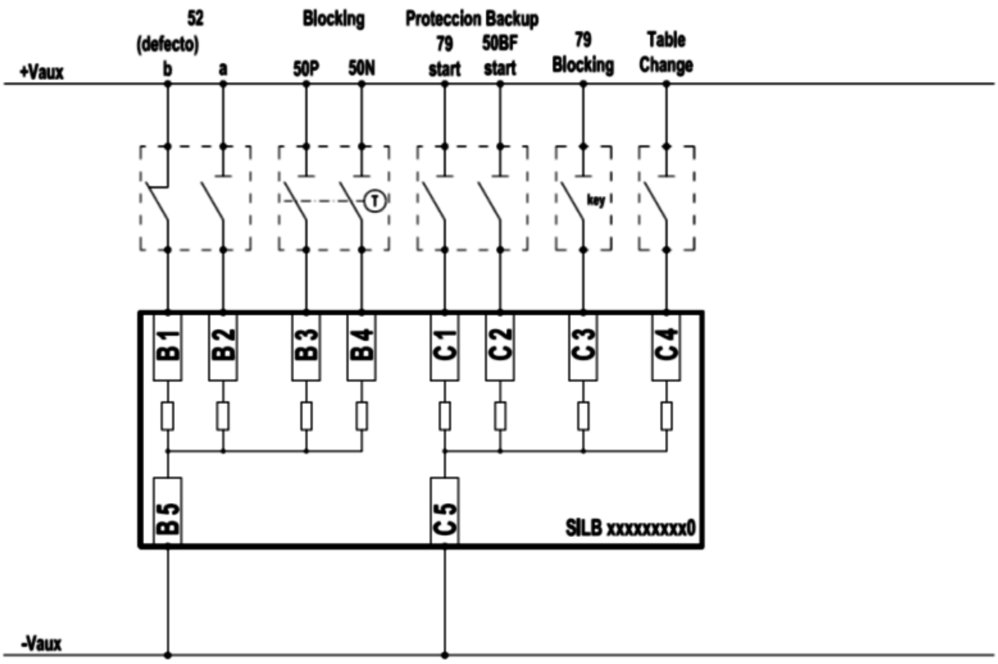
3 PHASES CT.



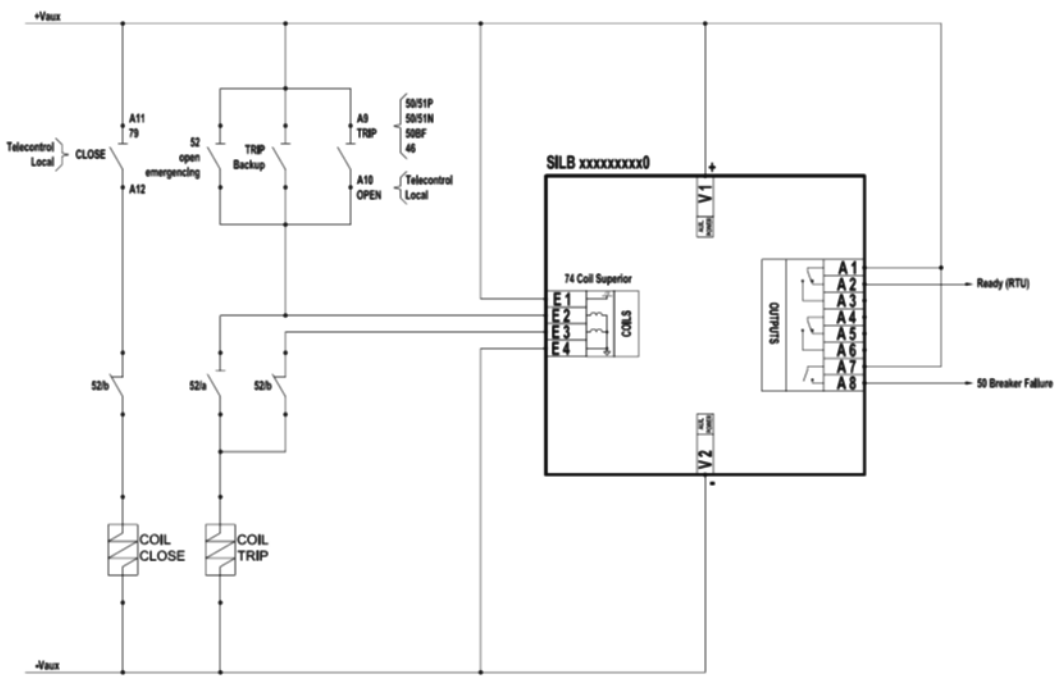
2 PHASES CT AND 1 NEUTRAL CT.



Digital connections

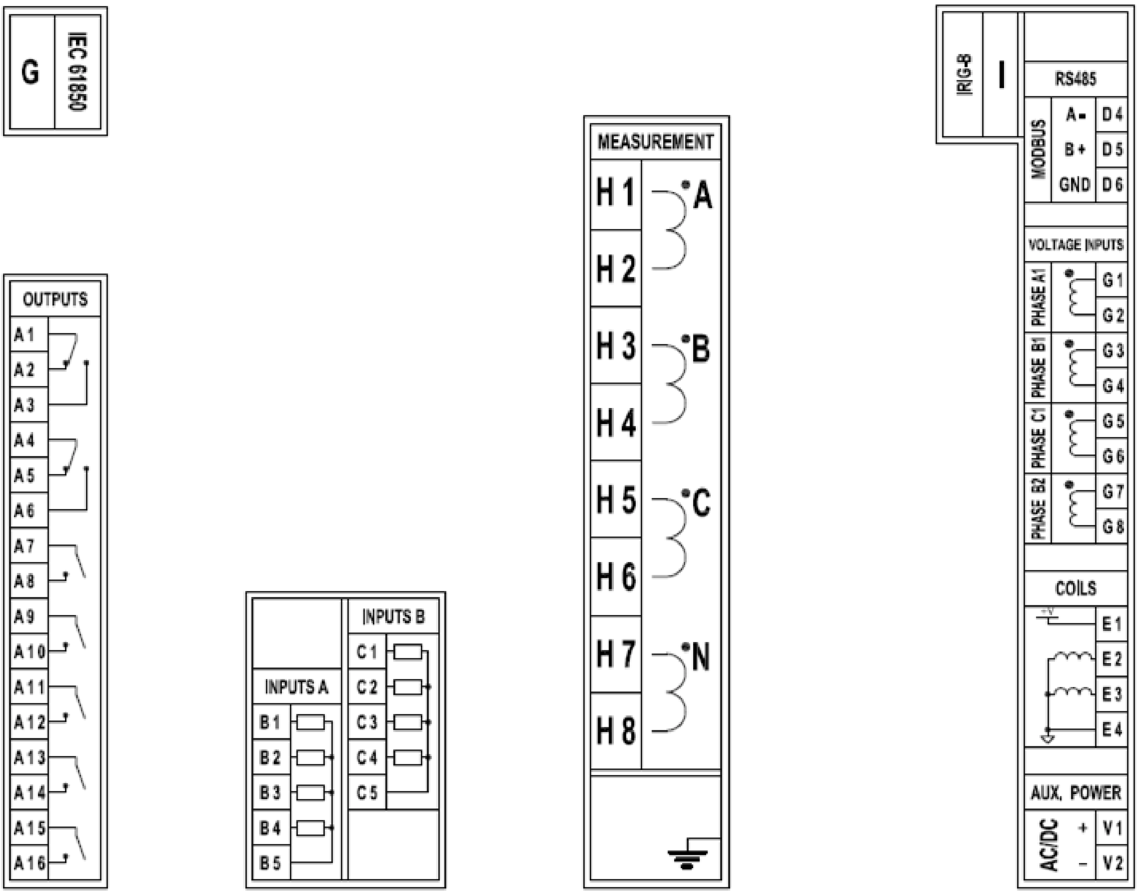


Outputs and Trip circuit supervision



2.2.5. Terminals

Compact SILB with IEC 61850



A1	Digital output common 1
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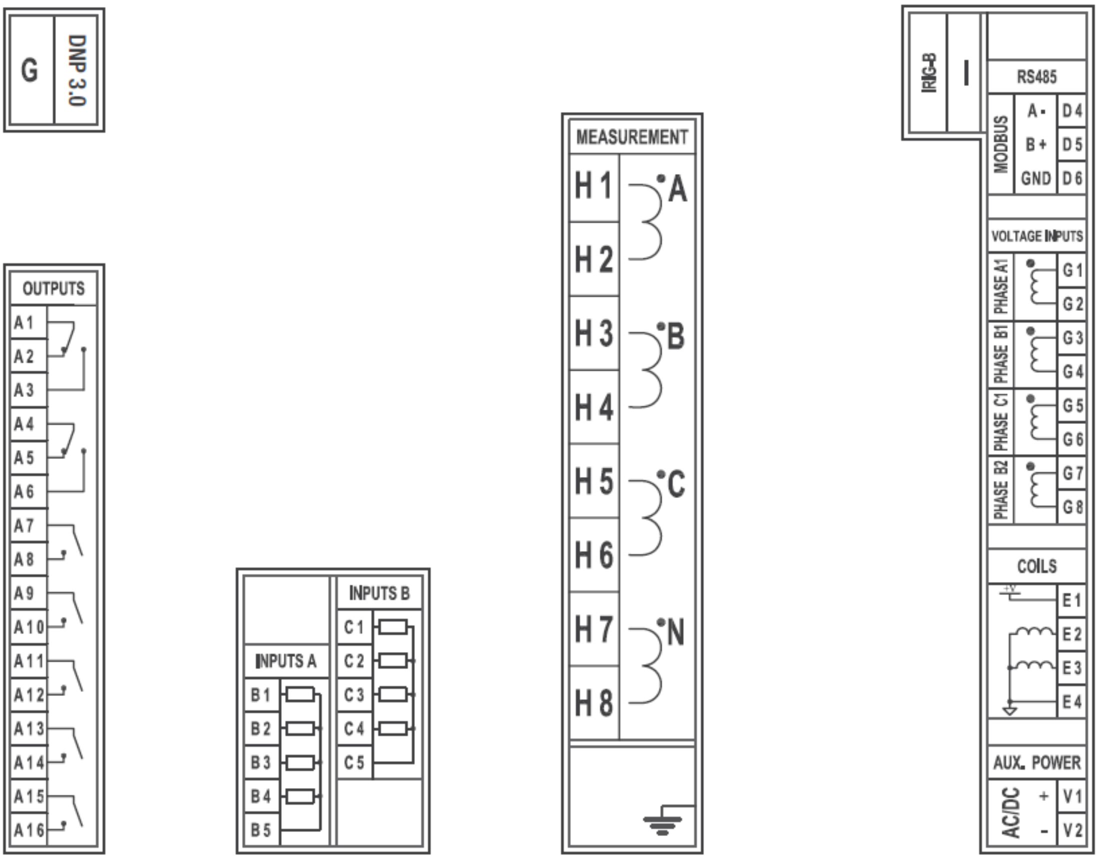
A4	Digital output common 2
A5	Digital output 2 NC
A6	Digital output 2 NO
A7-A8	Digital output 3 NO
A9-A10	Digital output 4 NO
A11-A12	Digital output 5 NO
A13-A14	Digital output 6 NO
A15-A16	Digital output 7 NO
B1	Digital input 1
B2	Digital input 2
B3	Digital input 3
B4	Digital input 4
B5	Common of digital inputs 1, 2, 3 and 4
C1	Digital input 5
C2	Digital input 6
C3	Digital input 7
C4	Digital input 8
C5	Common of digital inputs 5, 6, 7 and 8

D4	A – RS485 Modbus RTU
D5	B + RS485 Modbus RTU
D6	Gnd RS485 Modbus RTU
G	RJ45 connector for IEC 61850 protocol
G1	Phase A voltage +
G2	Phase A voltage -
G3	Phase B voltage +
G4	Phase B voltage -
G5	Phase C voltage +
G6	Phase C voltage -
G7	Busbar Voltage +
G8	Busbar Voltage -
E1	74TCS voltage presence
E2	74TCS coil 1
E3	74TCS coil 2
E4	74TCS common
V1	Auxiliary voltage +
V2	Auxiliary voltage -
I	IRIG B connector (depending on model)

Compact SILB with DNP 3.0 TCP/IP



A1	Digital output common 1
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A4	Digital output common 2
A5	Digital output 2 NC
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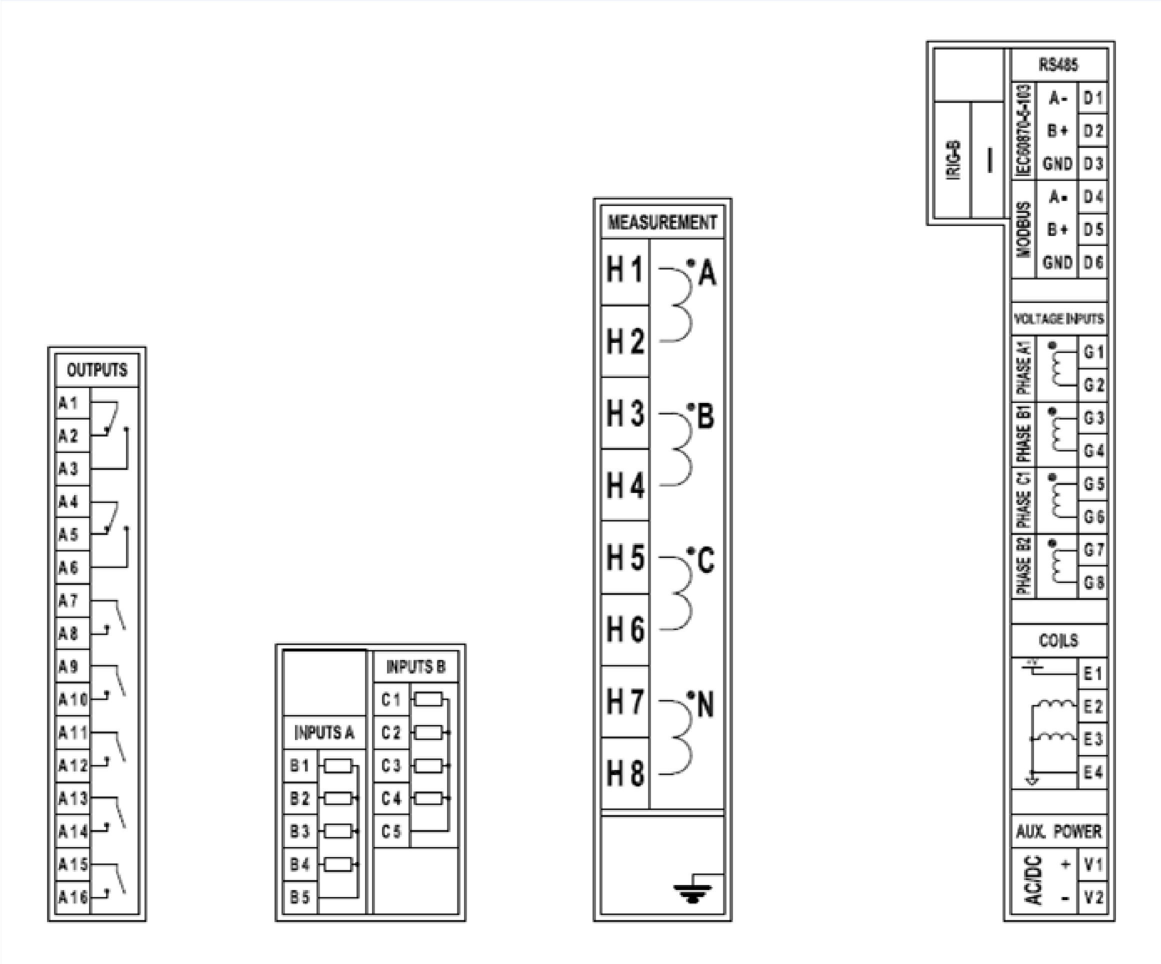
A15-A16	Digital output 7 NO
B1	Digital input 1
B2	Digital input 2
B3	Digital input 3
B4	Digital input 4
B5	Common of digital inputs 1, 2, 3 and 4
C1	Digital input 5
C2	Digital input 6
C3	Digital input 7
C4	Digital input 8
C5	Common of digital inputs 5, 6, 7 and 8

D4	A – RS485 Modbus RTU
D5	B + RS485 Modbus RTU
D6	Gnd RS485 Modbus RTU
G	RJ45 connector for DNP 3.0 TCP/IP protocol
G1	Phase A voltage +
G2	Phase A voltage -
G3	Phase B voltage +
G4	Phase B voltage -
G5	Phase C voltage +
G6	Phase C voltage -
G7	Busbar Voltage +
G8	Busbar Voltage -
E1	74TCS voltage presence
E2	74TCS coil 1
E3	74TCS coil 2
E4	74TCS common
V1	Auxiliary voltage +
V2	Auxiliary voltage -
I	IRIG B connector (depending on model)

Compact SILB with IEC 60870-5-103 protocol



A1	Digital output common 1
A2	Digital output 1 NC
A3	Digital output 1 NO
A4	Digital output common 2
A5	Digital output 2 NC
A6	Digital output 2 NO
A7-A8	Digital output 3 NO
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A11-A12	Digital output 5 NO
A13-A14	Digital output 6 NO
A15-A16	Digital output 7 NO
B1	Digital input 1
B2	Digital input 2
B3	Digital input 3
B4	Digital input 4
B5	Common of digital inputs 1, 2, 3 and 4
C1	Digital input 5
C2	Digital input 6
C3	Digital input 7
C4	Digital input 8
C5	Common of digital inputs 5, 6, 7 and 8

D1	A – RS485 IEC 60870-5-103
D2	B + RS485 IEC60870-5-103
D3	Gnd RS485 IEC60870-5-103
D4	A – RS485 Modbus RTU
D5	B + RS485 Modbus RTU
D6	Gnd RS485 Modbus RTU
I	IRIG-B (depending on model)
G1	Phase A voltage +
G2	Phase A voltage -
G3	Phase B voltage +
G4	Phase B voltage -
G5	Phase C voltage +
G6	Phase C voltage -
G7	Busbar Voltage +
G8	Busbar Voltage -
E1	74TCS voltage presence
E2	74TCS coil 1
E3	74TCS coil 2
E4	74TCS common
V1	Auxiliary voltage +
V2	Auxiliary voltage -

3. DESCRIPTION

3.1. Introduction

The worldwide energy industry is going through a profound transformation. Due to huge energy demands, more distribution lines with advanced monitoring systems are needed. Assuming the need for creating intelligent infrastructure, FANOX has developed the SIL range of products to carry out this function.

The SIL-B 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 equipment.

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

The power supply voltage for the SIL-B can be selected by model. We cover a wide range of power supply voltages with two models:

- 24Vdc – 48Vdc
- 90Vdc – 300Vdc / 110Vac – 230 Vac

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

- Phase and neutral, definite-time and inverse-time (IEC and ANSI curves) overcurrent protections, with directional discrimination.
- Negative sequence overcurrent protection.
- Undercurrent protection (it depends on model)
- Phase and neutral overvoltage protection
- Phase undervoltage protection
- Directional overpower protection
- Thermal image protection
- Overfrequency and underfrequency protection (it depends on the model)

This manual provides full details of the number of available protection units, along with their parameters and operating characteristics.

As this is a line protection device, 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 equipment can be locked in different ways: from the keypad (for which there is a separate key), from remote communications stations and through an input.

Depending on model, the device is fitted with synchronism protection function that is designed to verify the conditions that the voltage of both ends of the switchgear must have to carry out to allow the closure of the switchgear.

A series of other complementary line protection functions have been included, such as cold load pickup and closure circuit 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-B equipment:

- Phase currents, neutral, positive sequence and negative sequence
- Phase voltages, voltages between phases, residual neutral voltage and busbar voltage
- Angle between voltage and current of each phase
- Cos φ (3-phase and per phase)
- Active, reactive and apparent powers (3- phase and per phase)
- Thermal image
- Line frequency and busbar frequency
- Phase difference between phase B line voltage and busbar voltage

The SIL-B equipment has eight inputs and seven outputs. Both the inputs and outputs can be configured by the user.

The SIL-B equipment is housed in a metal case with all measurement and digital inputs and outputs with galvanic isolation (with the exception of local communications and battery power, as these are sporadic connections). This gives the equipment 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 two rows and twenty columns, and a 6 key membrane keypad. These allow the state of the equipment, measurements, adjustments to protection criteria and the events or events associated with the equipment 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.
- Locking 79. Used to lock and unlock the recloser.
- I/O of the circuit breaker. Used to control the circuit breaker

The SIL-B has 8 front-mounted LEDs, of which 2 have fixed functions and 6 can be configured. The LEDs with fixed functions are:

- Status of the circuit breaker.
- Status of the recloser.

The remaining 6 LEDs are designed to indicate events and can be configured to show alarms and states.

The equipment has a memory for up to 1000 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 the oscillography is time limited (50 cycles), it may not have the capability to record the entire fault. Similarly, the events log contains generic information, and it can lose information pertaining to a specific event after a time. This is why a log of fault reports has been included. Each fault report contains up to 80 events associated with the time of failure. The log stores the reports associated with the last 20 faults that are detected.

As mentioned in the previous paragraph, 2 oscillographic logs are available, each with a size of 138 cycles (2.7 seconds at 50Hz, 2.3 seconds at 60Hz): 10 pre-fault cycles and 128 post-fault cycles. The oscillography start can be configured by the user. Each oscillographic record contains the phase and neutral currents, the phase and neutral voltages and up to 128 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 r.m.s. values with a precision of 2% in the 20% band around rated current. The current transformers used at standard 5A and 1A CTs.

It has three communications ports: one front port (RS232) and two rear ports. Optionally RS485, plastic optical fiber or Ethernet can be chosen for the physical medium of the ports. The RS232 port allows a PC to be connected and the equipment to be monitored using the SICom program in WINDOWS XP or WINDOWS 7 (supplied by FANOX).

The rear communications ports are designed for different functions. One is designed for control, mainly including the alarm and command functions, and the other is designed for specific queries by protection staff, who may query or change settings or download events and oscillographs without interfering with the operation of the command side. Non compact SILB has two RS485 communication ports, one for MODBUS RTU protocol and the other one for IEC 60870-5-103 protocol. In compact SILB there are two options: On of those option is the possibility of having two RS485 communication ports, one for MODBUS RTU protocol and the other one for IEC 60870-5-103 protocol.The other possibility is having two rear ports, one RS485 for MODBUS RTU protocol and the other one RJ45 (Ethernet) for IEC 61850 or DNP 3.0.

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-B is an accurate and practical solution for protecting a feeder system. SIL-B 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 0.1 times the rated current and really low rated levels can be selected.

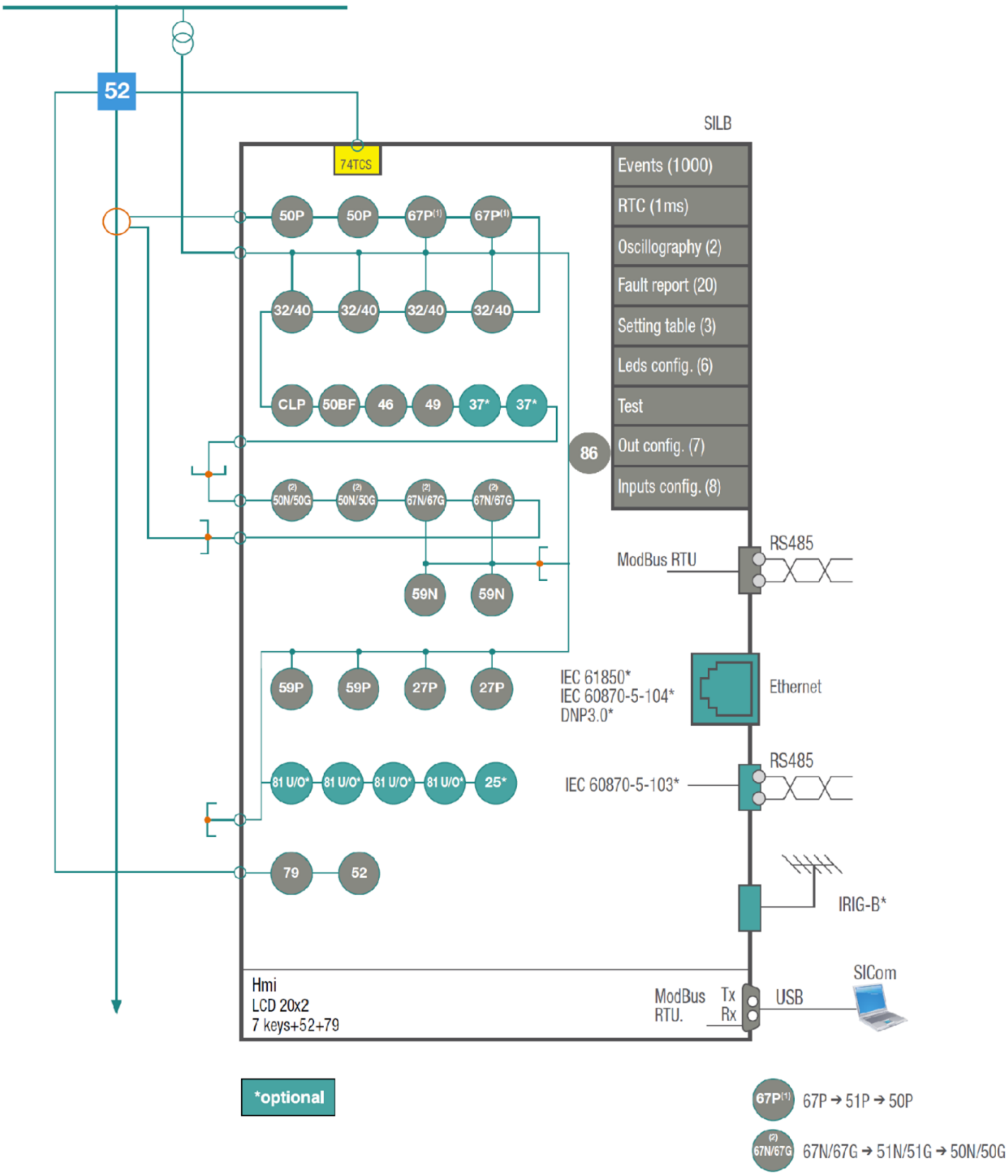
The main features of the equipment are listed below. These will be described in greater detail in this manual:

Function	Description	SIL-B
Protection		
50P	Definite-time overcurrent protection function (phase)	2
50N	Definite-time overcurrent protection function (neutral)	2
67/51/50P	Inverse-time overcurrent protection function (phase)	2
67/51/50N	Inverse-time directional overcurrent protection function (neutral)	2
46	Inverse-time overcurrent protection function (negative sequence)	1
49	Thermal image protection function	1
37	Undercurrent protection function	2(depending on model)
59P	Definite-time overvoltage protection function (phase)	2
59N	Definite-time overvoltage protection function (neutral)	2
27P	Definite-time undervoltage protection function (phase)	2
32/40	Definite-time directional overpower function	4
79	Recloser	Up to 5 attempts
25	Synchronism protection function	1(depending on model)
50BF	Opening failure	1
74TCS	Monitoring of the circuit breaker’s coils	1
81O/U	Overfrequency and underfrequency protection function	4(depending on model)
86	Trip Output Lockout	✓
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	✓

Measurements		
	Phase and neutral rms currents with a precision of 2% in a band of ±20% when compared to the rated current, and 4% in the rest of the range.	✓
	Negative and positive sequence currents	✓
	Phase rms voltages, voltages between phases, residual neutral voltage and busbar voltage with a precision of 2% in a band of ±20% when compared to the rated voltage, and 4% in the rest of the range.	✓
	Apparent power S (total and per phase) Active power P (total and per phase) Reactive power Q (total and per phase)	✓
	Power factor: cos φ (total and per phase)	✓
	Active and reactive energy	✓
	Thermal image	✓
	Line frequency and bar frequency	Depending on model
Inputs and Outputs		
	Configurable inputs	8 to Vaux
	Configurable outputs	2 (no-nc) + 5 (no)
Communication and HMI		
	LOCAL Port: ModBus RTU	✓
	REMOTE Port: ModBus RTU	✓
	REMOTE Port: IEC 60870-5-103	Depending on model
	REMOTE Port: IEC 61850	Depending on model
	REMOTE Port: DNP 3.0	Depending on model
	SICom Program for Windows XP/7	✓
	Session: 4 log-in levels with a configurable password	✓
Control and signaling		
	HMI: LCD, 20x2	✓
	6 keys + 1 reset button + 2 command keys for 52 + 1 separate key for locking 79	✓
	LED indicators	8
Power Supply		
	Auxiliary voltage	24VDC-48 VDC 90VDC–300VDC/110VAC–230VAC

Monitoring and Recording		
	Events stored in the non-volatile FRAM* memory	1000
	Oscillographic logs in the non-volatile FRAM memory	2 Logs of 2.76 s = 10+128 cycles 20 fault reports
	Real Time Clock (RTC 1 millisecond)	✓
	IRIG-B synchronism	Depending on model
	Test menu	✓
	Auto-diagnostic	✓
Table of settings		
	Using keys Using inputs Using communications	3 tables of settings
Cold Load Pickup		
	Activated by current Multiplying the pickups	✓
Mechanics		
	Dimensions	4U x ½ rack

3.3. Functional diagram



3.4. Model list SIL-B

	TYPE	PHASE MEASUREMENT	NEUTRAL MEASUREMENT	NET FREQUENCY	POWER SUPPLY	ADDITIONAL FUNCTIONS	COMMUNICATIONS	INPUTS - OUTPUTS	MECHANICS	LANGUAGE	ADAPTATION	
SIL	B											50P(2) + 67P(2) + 50N(2) + 67N(2) + 46 + 59P(2) + 59N(2) + 27P(2) + 32(4) + 52 + 50BF + 79 + 74TCS + Cold Load Pickup + 49+86
		1 5										1 A 5 A
			1 5									1 A 5 A
				5 6								50 Hz 60 Hz
					A B							24 - 48Vcc 90 – 300,00Vcc / 110 – 230Vca
						0 1 2						- + 81U/O(4) + 25 + 37(2) + 81U/O(4) + 25 + 37(2) + IRIG-B
						0 1 2 3 4 5						RS485: ModBus + IEC 60870-5-103 FOP: ModBus + IEC 60870-5-103 FOC-ST: ModBus + IEC 60870-5-103 ----------Compact version-------------- IEC61850 + ModBus (RS485) DNP 3.0 + ModBus (RS485) IEC 60870-5-104 + ModBus (RS485)
								0				7 outputs + 8 inputs
									0 1			With external MMS module:4U x ½ rack Compact: 4U x ½ rack
										A B D		English, Spanish , French and German English, Spanish, French and Turkish English, Spanish , French and Russian
											A	-

3.5. Phase CT and neutral CT selection

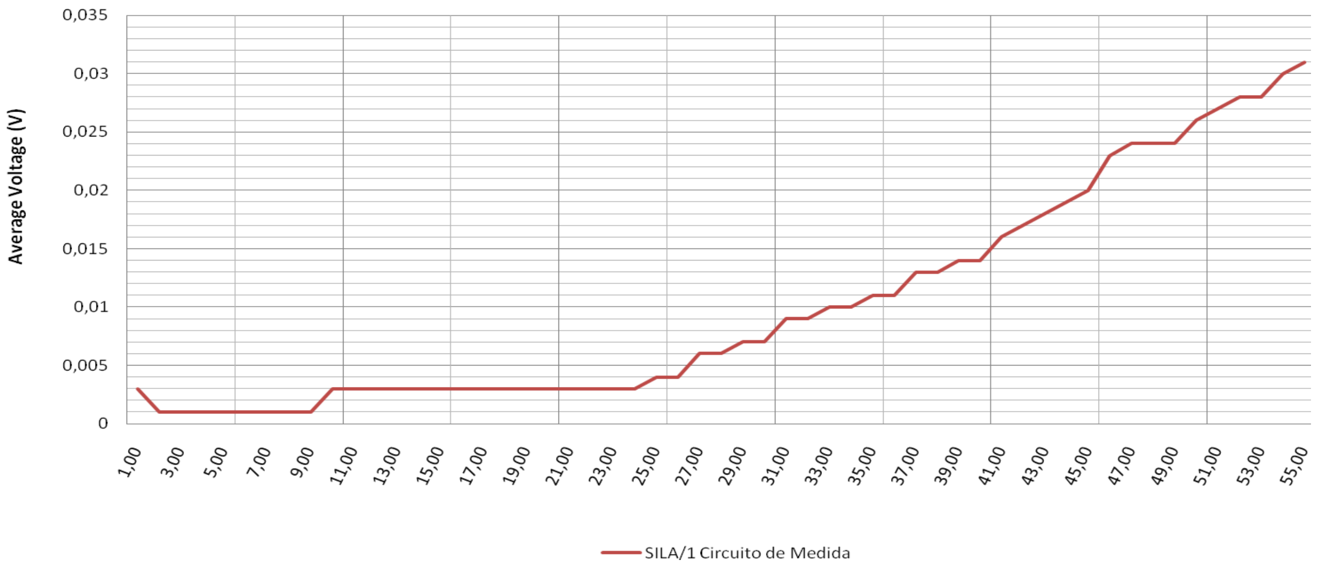
The following table shows a summary of the phase and neutral CT combinations:

Model	Phase	Neutral	Phase range	Neutral range
SIL-B55	CT 5 A	Residual phase connection	1-150 A	1-150 A
SIL-B11	CT 1 A	Residual phase connection	0.2-30 A	0.2-30 A
SIL-B51	CT 5 A	CT 1 A	1-150 A	0.2-30 A

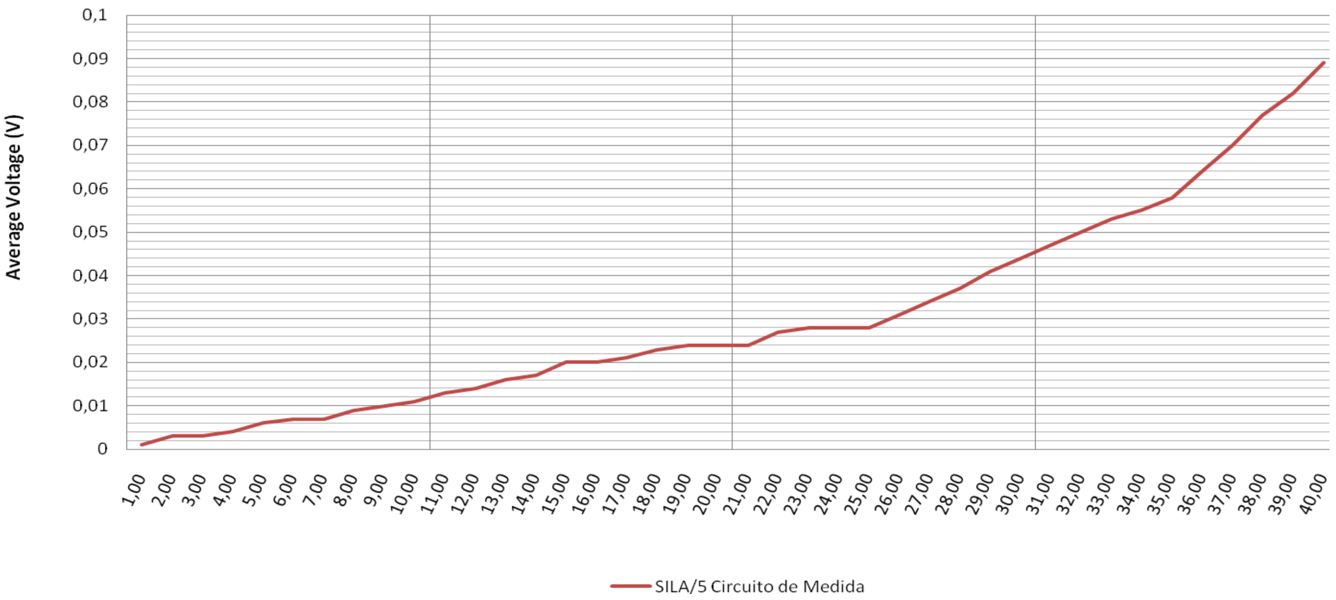
To ensure the relay functions correctly, a suitable current transformer must be used. The load of the relay's own measurement circuits and the load on the cables that connect the CTs and the relay must be taken into account.

PRECISION	BURDEN	RELAYS
5P10	0,5 VA	SIL-B/1
5P20	0,5 VA	SIL-B/1
5P30	0,5 VA	SIL-B/1
5P10	1 VA	SIL-B/5
5P20	1 VA	SIL-B/5
5P30	1 VA	SIL-B/5

3.5.1. SIL-B/1 CHARGE CURVE



3.5.2. SIL-B/5 CHARGE CURVE



4. PROTECTION FUNCTIONS

4.1. Functions 50P_1 and 50P_2. Instantaneous phase overcurrent

This protection function can be set by using three parameters:

Function	Description	Minimum	Maximum	Step	Unit	Default
50P_1 50P_2	**Instantaneous phase overcurrent**					
	Permission	-	-	Yes/No	-	No
	Tap	0.10	30.00	0.01	Inominal	5.00
	Operating time	0.02	300.00	0.01	s	0.02

The operating time is independent from the operating current flowing through the equipment, 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 operating time is equal to the preset time plus a maximum of 30 ms.

4.2. Function 67/51/50P1 & 67/51/50P2. Inverse-time phase directional overcurrent

Two phase directional units are available: 67P1 y 67P2.

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 67P function behaves like a 51/50P function.

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

- Polarization voltage higher than adjusted
- Phase current higher than adjusted
- The phase shift of phase current and polarization voltage is such that the phase current is inside the intervention sector.

The function settings are as follows:

Function	Description	Minimum	Maximum	Step	Unit	Default
67P_1 **67P_2**	**Inverse-time phase directional overcurrent**					
	Permission	-	-	Yes/No	-	No
	Curve	-	-	(1*)	-	IEC Extremely inverse
	Dial	0.05	2.20	0.01	-	1.00
	Pickup	0.10	30.00	0.01	I rated	5.00
	Operating time	0.02	300.00	0.01	s	0.02
	Directionality	-	-	Yes/No	-	No
	Polarization voltage	4.00	110	1	V	5
	Operating angle	0	359	1	º	90
	Half-cone angle	0	170	1	º	90

(1*) IEC Inverse, IEC Very inverse, IEC Extremely Inverse, ANSI inverse, ANSI very inverse, ANSI extremely inverse, definite-time

If the "definite-time" option is selected for the curve setting, the unit behaves as an instantaneous directional overcurrent unit. In this case, the unit's operating time is adjusted using the "Operating time" parameter.

If an inverse, very inverse or extremely inverse curve is selected in the curve setting, the operating time is a function of curve, dial and pickup adjustments.

If the unit operates with definite-time, the function starts up at 100% of the adjusted pickup and resets at 95%.

If the unit operates with a curve, the function starts up at 110% of the adjusted pickup and resets at 100%. Resets are instantaneous in both cases.

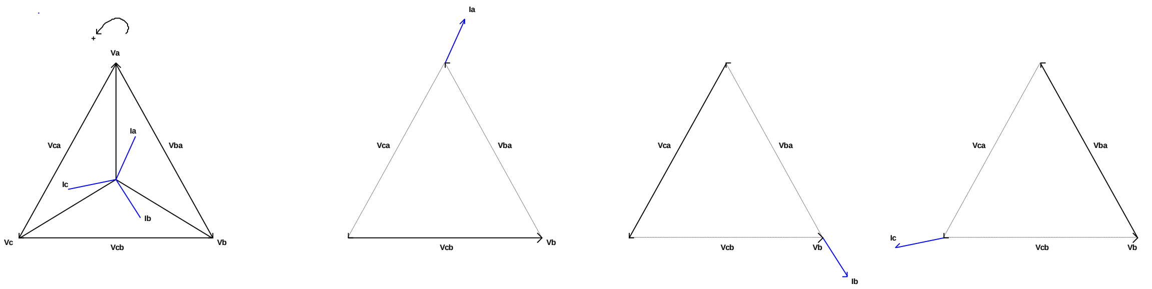
The actuation time is accurate to ±5%, o ±30ms, whichever is higher, of the theoretical actuation time.

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

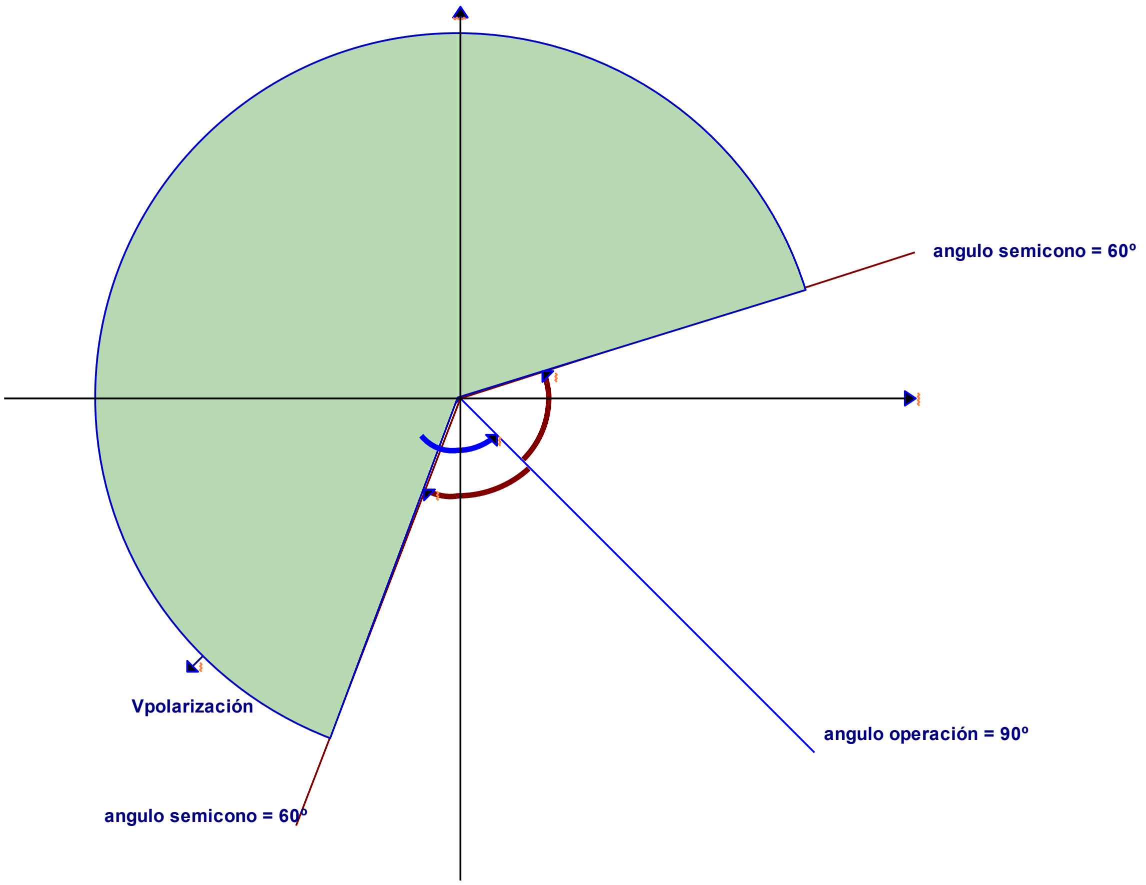
The activation level for the polarization voltage is 100%, and the reset level is 95%. Resets are instantaneous.

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

Phase	Operating magnitude	Polarization magnitude
Phase A	IA Current	VCB Voltage
Phase B	IB Current	VAC Voltage
Phase C	IC Current	VBA 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°.



4.3. Functions 50N_1 and 50N_2. Instantaneous neutral overcurrent

This protection function can be set by using three parameters:

Function	Description	Minimum	Maximum	Step	Unit	Default
50N_1 50N_2	**Neutral instantaneous overcurrent**					
	Permission	-	-	Yes/No	-	No
	Tap	0.10	30.00	0.01	I nominal	1.00
	Operating time	0.02	300..00	0.01	s	0.02

The operating time is completely independent from the operating current that flows through the equipment, so if the neutral 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 tap.

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

The accuracy of the operation time is equal to the preset time plus a maximum of 30 ms.

4.4. Function 67/51/50N1 & 67/51/50N2. Inverse-time neutral directional overcurrent

Two neutral directional units are available: 67N1 y 67N2.

This function uses the residual voltage as a polarization magnitude and the residual current as an operating magnitude. The intervention sector is defined in the following way: the operating angle is rotated anticlockwise from the residual 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 51/50N function.

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

- Residual voltage higher than adjusted
- Residual current higher than adjusted
- The phase shift of residual current and residual voltage is such that the residual current is inside the intervention sector.

The function settings are as follows:

Function	Description	Minimum	Maximum	Step	Unit	Default
67N_1 **67N_2**	**Inverse-time neutral directional overcurrent**					
	Permission	-	-	Yes/No	-	No
	Curve	-	-	(1*)	-	IEC Extremely inverse
	Dial	0.05	2.20	0.01	-	1.00
	Pickup	0.10	7.00	0.01	I rated	1.00
	Operating time	0.02	300.00	0.01	S	0.02
	Directionality	-	-	Yes/No	-	No
	Polarization voltage	4,00	110	1	G	5
	Operating angle	0	359	1	º	90
	Half-cone angle	0	170	1	º	90

(1*) IEC Inverse, IEC Very inverse, IEC Extremely Inverse, ANSI inverse, ANSI very inverse, ANSI extremely inverse, definite-time

If the "definite-time" option is selected for the curve setting, the unit behaves as an instantaneous directional overcurrent unit. In this case, the unit's operating time is adjusted using the "Operating time" parameter.

If an inverse, very inverse or extremely inverse curve is selected in the curve setting, the operating time is a function of curve, dial and pickup adjustments.

If the unit operates with definite-time, the function starts up at 100% of the adjusted pickup and resets at 95%.

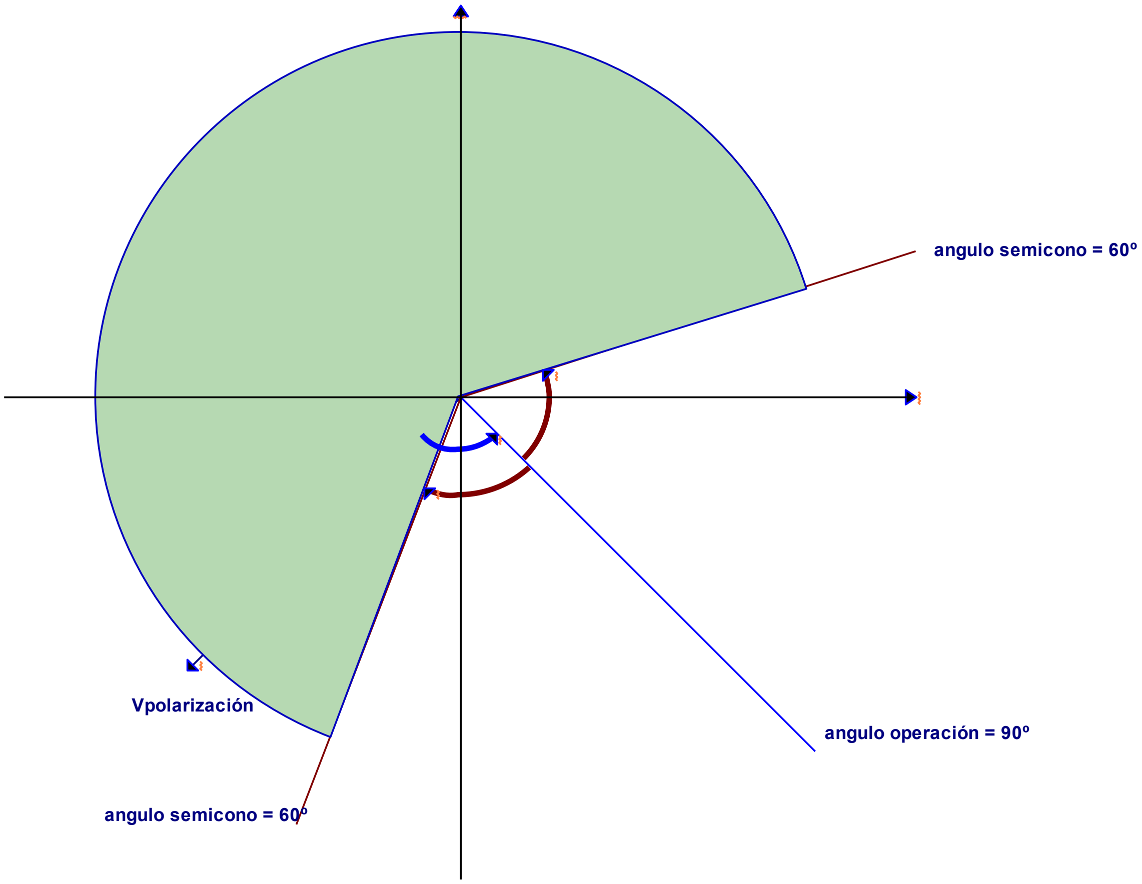
If the unit operates with a curve, the function starts up at 110% of the adjusted pickup and resets at 100%. Resets are instantaneous in both cases.

The actuation time is accurate to ±5%, o ±30ms, whichever is higher, of the theoretical actuation time.

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

The activation level for the residual voltage is 100%, and the reset level is 95%. Resets are instantaneous.

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°.



4.5. Function 46. Negative sequence inverse-time overcurrent

This protection function can be set by using three parameters:

Function	Description	Minimum	Maximum	Step	Unit	Default
46	**Negative sequence inverse-time overcurrent**					
	Permission	-	-	Yes/No	-	No
	Curve	-	-	(1*)	-	IEC Extremely Inverse
	Dial	0.05	2.20	0.01	-	1.00
	Tap	0.10	1.00	0.01	I nominal	0.2
	Operating time	0.02	300,0	0.01	s	0.02

(1*) IEC Inverse, IEC Very inverse, IEC Extremely Inverse, ANSI inverse, ANSI very inverse, ANSI extremely inverse, definite-time

If Definite Time is selected on curve settings, the unit behaves as an instantaneous overcurrent unit. For this case, unit's operating time is the one adjusted on the parameter "Operating time".

If for the curve setting it is selected a curve (inverse, very inverse or extremely inverse), operating time is function of curve settings, dial and tap.

If the unit operates as a definite time, the starting up of the function occurs with 100% of adjusted tap, and it resets with the 95%.

If the unit operates with curve, the starting up of the function occurs with the 110% of the adjusted tap and it resets with the 100%. Reset is instantaneous in both cases.

Action time accuracy is ±5% or ±30ms highest of both, over theorical time of action.

Used curves are IEC 60255-151 and ANSI IEEE, which are described on corresponding section of this manual.

4.6. Function 49. Thermal image protection

Thermal image is a measure of heating and cooling of an electric machine. Unlike overcurrent protection, do not start counting the time when it detects a fault, but is continuously determining the thermal state of the machine that monitors. The trip time depends on the thermal constants adjusted, the current flowing and the prior thermal state of the machine.

The thermal image is calculated based on the following equation:

$$\theta = 100 \times (I/I_t)^2 \times (1 - e^{-t/\zeta}) + \theta'_0 \times e^{-t/\zeta}$$

where :

- I, máximum r.m.s. current of three phases
- $I_{t,}$ adjusted tap current
- ζ, termal constant
- θ'_0, initial termal state

The trip time is given by the equation:

$$t = \zeta \times \ln \{ [(I/I_t)^2 - (\theta'_0 / 100)] / [(I/I_t)^2 - 1] \}$$

The algorithm uses the maximum of the three phase currents. If the maximum is greater than 15% of the adjusted tap, heating thermal constant is applied. If the maximum is less than 15% of the adjusted tap cooling thermal constant is taken into account.

The overload function trips when the thermal image reaches the value of 100%. This value is reached in time when the current flowing is equal to the function adjusted in thermal function.

It provides an adjustable level of thermal imaging to generate an alarm. If the trip occurs, the function of overload is reset when the thermal image falls below the set alarm level.

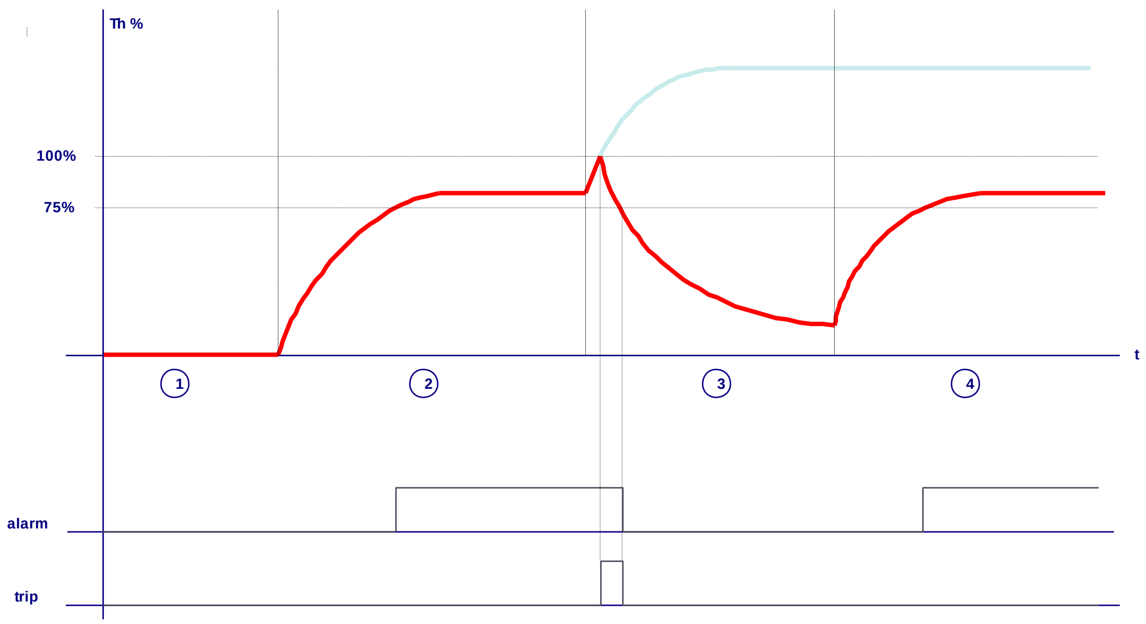
As the current measurement algorithm used is r.m.s., in the thermal model is taken into account the heat produced by the harmonics.

This protection function is adjusted by setting five different parameters:

Function	Description	Minimum	Maximum	Step	Unit	Default
49	**Thermal image protection function**					
	Permission	-	-	Yes/No	-	No
	Tap	0.10	2.40	0.01	I nom	1.2
	ζ heating	3	600	1	min	3
	ζ cooling	1	6	1	ζ heating	1
	Alarm	20	99	1	%	80

4.6.1. Thermal image measurement evolution graphic

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



We suppose that thermal image protection has and adjusted tap of 1,1 times the nominal current and an alarm level of 75%.

Zone 1: The machine is deenergized for a long time. Therma 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 evolutione 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 reachs the value of 100%. Once tripped, current is cutted and thermal image is getting cool based on the cooling constant.

Zone 4: Before getting totally cool, nominal current is applied again and thermal balnace 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.

4.6.2. 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.

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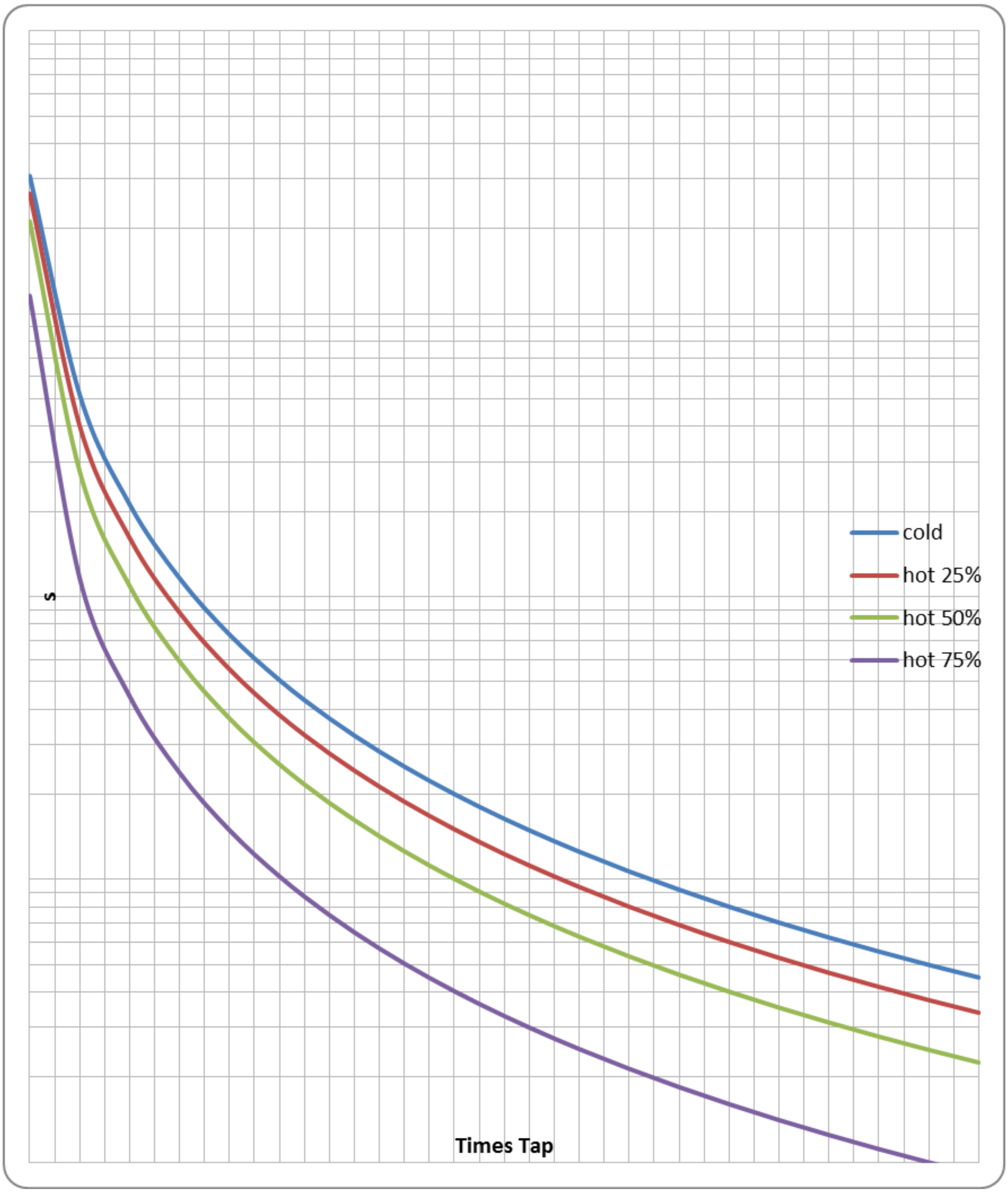
4.6.3. Thermal image measurement display. Reset.

Thermal image measuremet can be displayed on Measurement menu and Counters menu.

Display is possible in Measurement menu. Display and thermal image value reset is possible in Counters menu.

4.6.4. Thermal protection curves



This is the thermal curve for ζ = 3 minutes.

4.7. Function 37P. Definite-time phase undercurrent

This protection function is adjusted by setting three different parameters:

Function	Description	Minimum	Maximum	Step	Unit	Default
37P_1 37P_2	**Definite-time phase undercurrent**					
	Permission	-	-	Yes/No	-	No
	Tap	0.10	30	0.01	xI_B	0.50
	Operating time	0.02	300.00	0.01	s	0.02

The operating time is completely independent of the operating current through the equipment, such that should the phase current gone down the set value during the same amount of time or more than the set one, the protection function acts (trips) and there it is not restored until the measured value of the phase exceeds the current set point.

The function pick up occurs at 100% of the adjusted input and the dropout at 105%. The reset type is instantaneous.

The accuracy of the "Operating time" is the set time plus a maximum of 30 ms.

4.8. Function 59P_1 and 59P_2. Definite-time phase overvoltage

This protection function is adjusted using three parameters:

Function	Description	Minimum	Maximum	Step	Unit	Default
59P_1 59P_2	**Definite-time phase overvoltage**					
	Permission	-	-	Yes/No	-	No
	Tap	4	110	1	V	75
	Operating time	0.02	300.00	0.01	s	100
	Reset time	0.2	1200.0	0.1	s	0.2

The operating time is completely independent from the measured phase voltage, such that if the phase voltage exceeds the adjusted value for a period of time equal to or higher than the pre-established value, the protection function actuates (trips) and does not reset itself until the measured phase voltage value drops below the pre-established voltage point during adjusting reset time.

The function activates at 100% of the adjusted input and deactivates at 95%. Reset is temporized and reset time is adjusted with reset time parameter.

The accuracy of the operating time is the adjusted time ±30ms.

4.9. Function 59N_1 and 59N_2. Definite-time neutral overvoltage

This protection function is adjusted using three parameters:

Function	Description	Minimum	Maximum	Step	Unit	Default
59N_1 59N_2	**Definite-time neutral overvoltage**					
	Permission	-	-	Yes/No	-	No
	Pickup	4	110	1	V	10
	Operating time	0.02	300.00	0.01	s	100
	Reset time	0.2	1200.0	0.1	s	0.2

The operating time is completely independent of the measured neutral voltage, such that should the neutral voltage exceed the set value during the same amount of time or more than the set one during operation time, the protection function acts (trips) and there it is not restored until the measured value of the neutral voltage drops below the voltage set point during adjusting reset time.

The function pick up occurs at 100% of the adjusted input and the dropout at 95%. The reset type is temporized and reset time is adjusted with reset time parameter.

The accuracy of the operating time is the adjusted time ±30ms.

NB: The neutral voltage is obtained internally in the equipment, using the sum of the 3-phase voltages.

4.10. Function 27P_1 and 27P_2. Definite-time phase undervoltage

This protection function is adjusted using three parameters:

Function	Description	Minimum	Maximum	Step	Unit	Default
27P_1 27P_2	**Definite-time phase undervoltage**					
	Permission	-	-	Yes/No	-	No
	Pickup	4	110	1	V	50
	Operating time	0.02	300	0.01	s	100
	Reset time	0.2	1200.0	0.1	s	0.2

The operating time is completely independent of the measured phase voltage, such that should the phase voltage goes down the set value during the same amount of time or more than the set one, the protection function acts (trips) and there it is not restored until the measured value of the phase voltage exceeds the voltage set point during adjusting reset time.

The function pick up occurs at 100% of the adjusted input and the dropout at 105%. The reset type is instantaneous temporized and reset time is adjusted with reset time parameter.

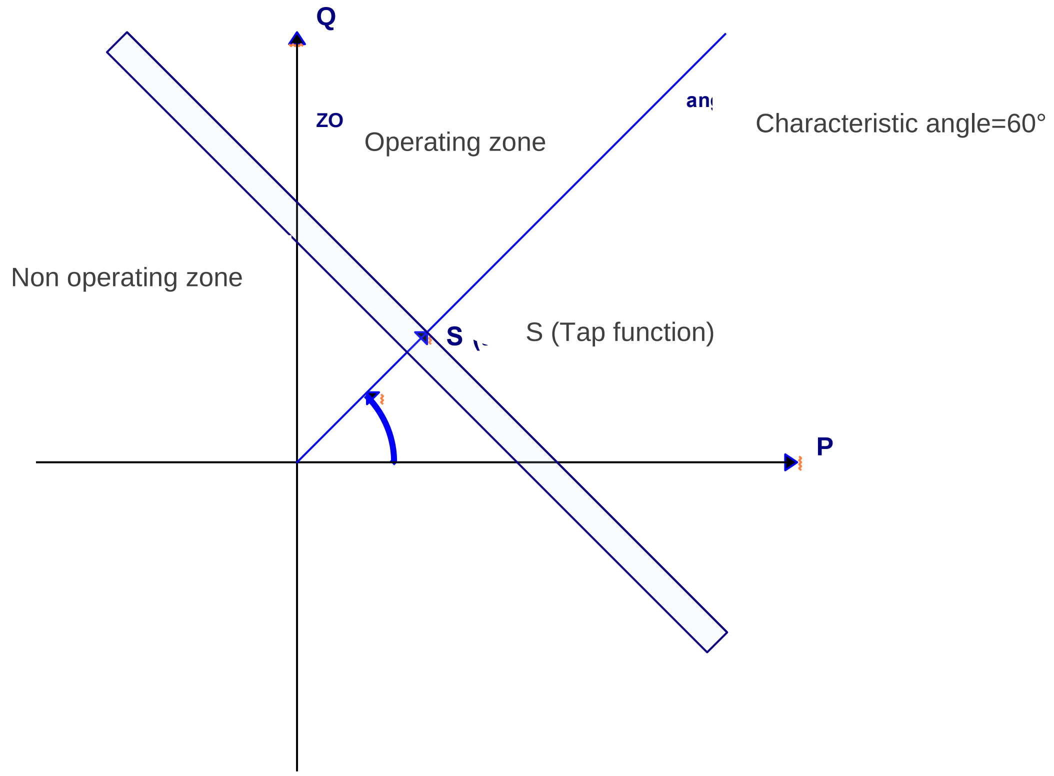
The accuracy of the operating time is the adjusted time ±30ms.

4.11. Function 32/40. Definite-time directional overpower

Four definite-time directional overpower units are available.

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.

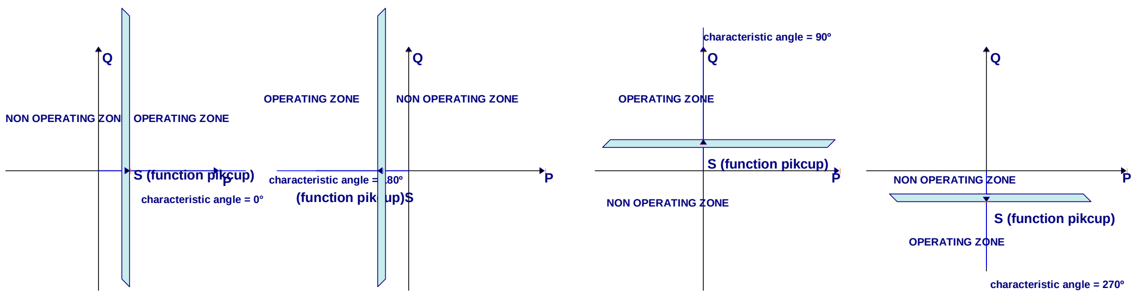
The directional power protection function operates in accordance with the following characteristic:



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	Address
0º	Active overpower	Direct
180º	Active overpower	Inverse
90º	Reactive overpower	Direct
270º	Reactive overpower	Inverse



Direct active overpower | Inverse active overpower | Direct reactive overpower | Inverse reactive overpower

The following table establishes the settings for each function and its characteristics:

Function	Description	Minimum	Maximum	Step	Unit	Default
32_1 32_2 32_3 32_4	**Definite-time directional overpower**					
	Permission	-	-	Yes/No	-	No
	Tap	0	10000	1	VA	10
	Characteristic angle	0	359	1	º	0
	Time	0.02	300.00	0.01	s	100

4.12. Function 81O/U. Overfrequency and underfrecuency protection

There are four protection units of the variation in frequency. Each one of them has an adjustment which determines whether the unit acts as overfrequency or underfrequency. The reaction time of the unit is determined by the set operating time.

In case the unit acts like overfrequency, activation of the function occurs at 100% frequency level set and is reset when the measured frequency is 50 mHz lower than set start level.

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

The reset is temporized and the reset time is determined by the reset time setting.

Accuracy of operating time and reset time is adjusted time plus a maximum of 30ms.

The frequency measurement is done from the voltage of phase B. It takes a minimum of 30 volts at this stage for 81 functions to be operational. If the measured phase voltage is less than 30 volts, it activates a state bit indicating function blocked. When the frequency measurement is again valid, function begins in the start state with all bits and counters reset.

This protection function is adjusted by setting five different parameters:

Function	Description	Minimum	Maximum	Step	Unit	Default
81_1 **81_2** **81_3** **81_4**	**Overfrequency or Underfrequency**					
	Permission	-	-	Yes/No	-	No
	Type	-	-	(1*)	-	Underfrequency
	Activation level	45.00	65.00	0.01	Hz	55
	Operating time	0.02	300.00	0.01	s	100
	Reset time	0.2	1200.0	0,1	s	0.2

(1*) Overfrequency or Underfrequency

4.13. Function 52. Circuit Breaker monitoring

This function allows the status of the circuit breaker to be monitored and preventive maintenance to be performed, for which the following parameters need to be configured:

Function	Description	Minimum	Maximum	Step	Unit	Default
52	**Circuit breaker monitoring**					
	Excess of number of openings	1	10,000	1	-	10
	Maximum accumulated amperes	1	100,000	1	M(A²)	1,000
	Opening time	0.02	300.00	0.01	s	0.10
	Closing time	0.02	300.00	0.01	s	0.10
	Excess of repetitive number of openings	1	10,000	1	-	3
	Time for excess of repetitive number of openings	1.00	300.00	0.01	min	9.00

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).

It is also necessary to assign the logical inputs 52a and/or 52b to a physical input.

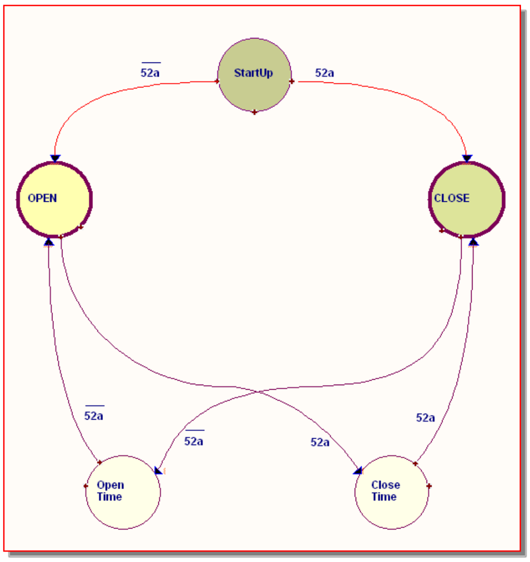
This function provides information about the circuit breaker status and if any maintenance alarm has been activated.

The following statuses are associated with this function:

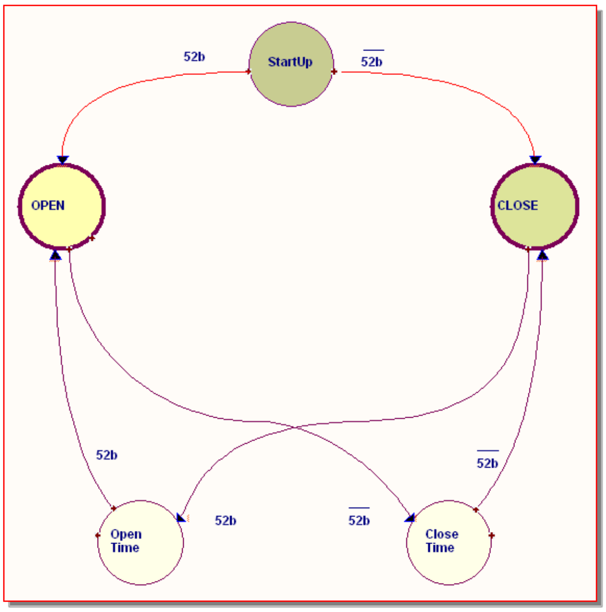
Function	Status	Description
52	**Breaker monitoring**	
	Start	Energized/Deenergized These are the different statuses of the circuit breaker automatic control
	Error	
	Open	
	Opening Time	
	Opening Failure	
	Close	
	Closing Time	
	Closing Failure	
	Configured number of openings exceeded	Activated if the counter that measures the number ofopenings exceeds the "Maximum number of openings" setting
	Configured accumulated amperes exceeded	Activated if the accumulated amps counter exceeds "Maximum accumulated amps" setting
	Repetitive trips	Activated the number of openings exceeds the setting in "Maximum repeated openings" for the time set in "Time of maximum repeated openings"

The way that the circuit breaker is monitored becomes more or less complex depending on whether it is fitted with one breaker contact (52a or 52b) or both (52a and 52b).

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:

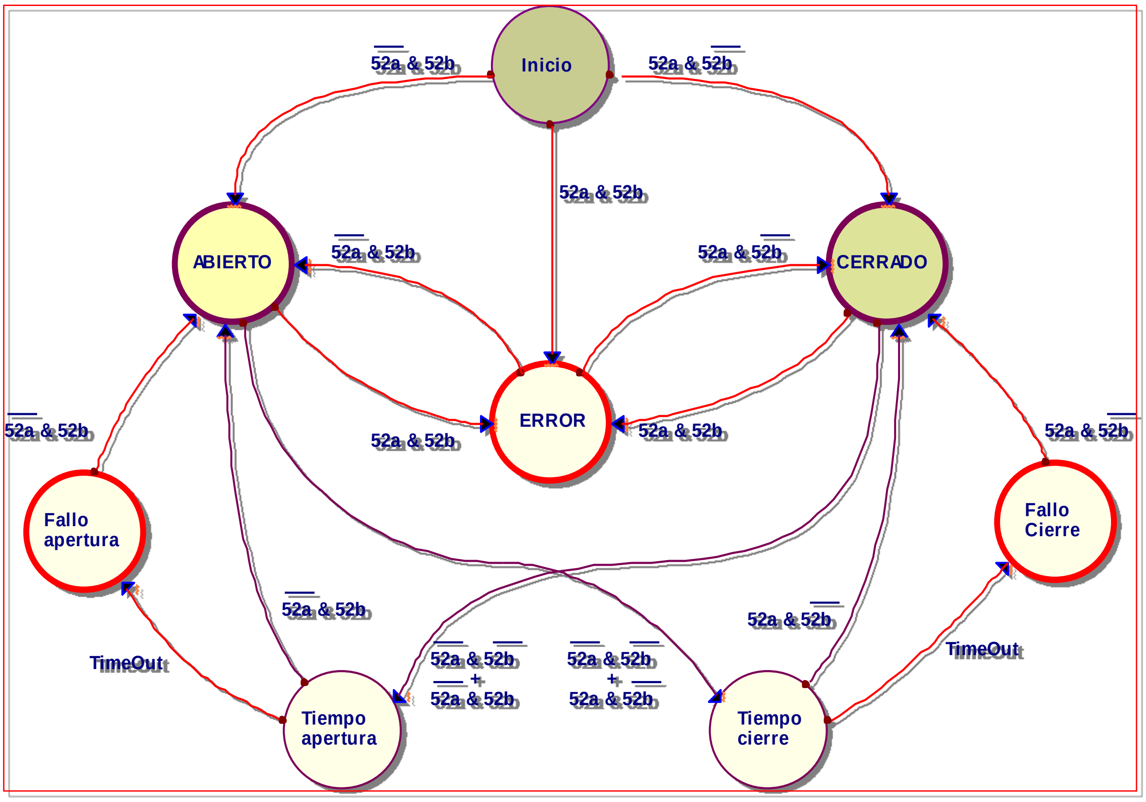


If only the circuit breaker 52b contact is available, it should be wired to the corresponding physical input. This physical input is then assigned to the "52b Input" logical input. The 52a logical input is calculated internally as the negative of 52b. The circuit breaker performance is shown in the following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



If both of the 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's automaton is considered as having eight statuses: start, open, closed, error, opening time, opening fault, closing time and closing fault.

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



4.13.1. 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. In order that the command related to the key can run, the menu must be in standby mode.

To carry out commands from the remote communications (ModBus or IEC60870-5-103 for non compact SILB and ModBus, IEC60870-5-103, IEC61850 or DNP 3.0 for compact SILB) the equipment must be in TELECONTROL mode. (see the telecontrol section).

For the commands to have an effect, they should be assigned to the corresponding outputs. The "Open circuit breaker" and "Close circuit breaker" bits are assigned to their corresponding outputs in the "CONTROL" status group in the status menu.

4.13.2. Counter to register the number of openings

The SIL-B equipment is fitted with a counter that registers the number of times the circuit breaker opens.

This counter is associated with the "Excess of number of openings" setting. When the number of openings exceeds this preset value, the "Maximum number of openings" status is activated and its corresponding event is generated.

This counter reading can be set to any value within its range from the HMI or by using communications.

4.13.3. Accumulated amps counter: I^2t

An accumulated amps counter is also fitted. This counter accumulates the amps that are cleared by the circuit breaker by opening.

When the circuit breaker opens, the maximum number of primary amps in any of the phases is detected. This reading is squared and divided by 1000 and then rescaled to KA and accumulated. If the current detected in the opening is less than the rated current, the rated current value is used for the accumulation.

It is used in conjunction with the counter of the number of openings, to measure the circuit breaker aging process.

Since primary amps are being accumulated, it is essential to correctly adjust the phase CT transformation ratio.

The "Maximum accumulated amps" setting is associated with this counter. When the number of accumulated amps exceeds this preset value, the "Maximum accumulated amps" status is activated and its corresponding event is generated.

The value of this counter can be started at any value within its range from the hmi or from communications, if this protection is fitted on a circuit breaker with a previous service life.

This alarm can be replaced by modifying the Accumulated Amps counter.

The display unit shall be KA^2 (square kilo amperes).

4.13.4. Maximum openings in a time window

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

When this number is exceeded, the " Excess of repetitive number of openings " status is activated and its corresponding event is generated.

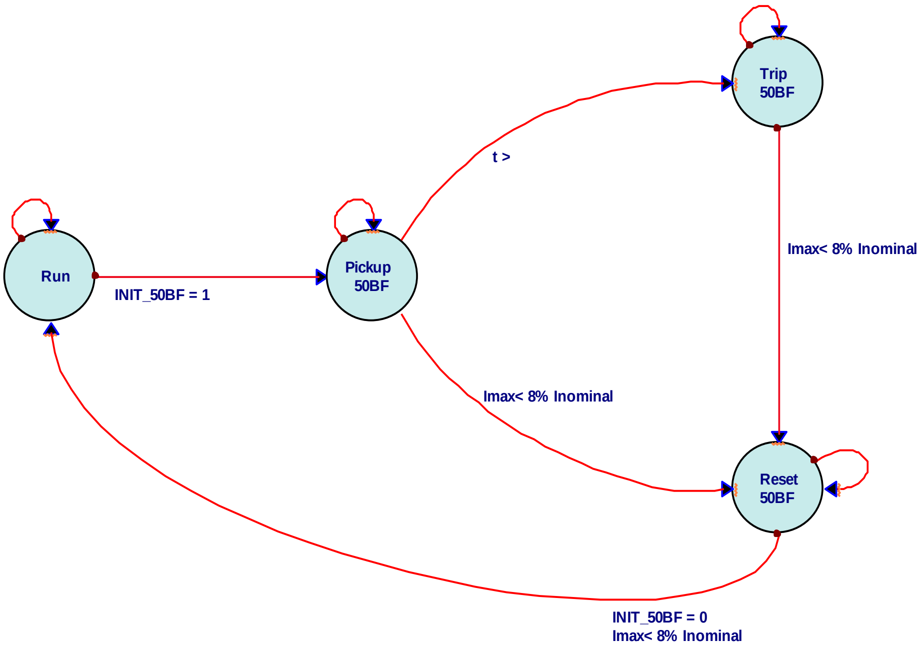
This alarm resets itself, when the corresponding time is exceeded with less trips than those indicated.

4.14. Function 50BF. Circuit Breaker opening fault

This function settings are as follows:

Function	Description	Minimum	Maximum	Step	Unit	Default
50BF	**Circuit breaker opening fault**					
	Permission	-	-	Yes/No	-	No
	Opening fault time	0.02	1.00	0.01	s	0.2

The following automaton describes the open fault function:



When the “50BF Start” status is activated, a switch is made to the "50BF" start and time is counted. If, following the adjusted open fault time, the switch is not detected to have open, the function trips. The function is reset when the circuit breaker is detected to have opened, and the “50BF Start” status has been reset.

To monitor the circuit breaker opening the current measurement via the three phases is used. When the current via the three phases is less than 8% of the rated current, the circuit breaker is considered to be open.

There is a “50BF start input” to start the open fault from an external protection.

The “50BF Start” status is an adjustable logic output. The default configuration is shown below:

- Opening fault input activation (50BF start input)
- Circuit breaker opening from an HMI/local modbus
- Circuit breaker opening from a remote modbus
- Circuit breaker opening from remote communications
- General trip

4.15. Function 74TCS. Trip circuit supervision

This function permits monitoring of the circuit breaker trip circuits. This is performed in two ways:

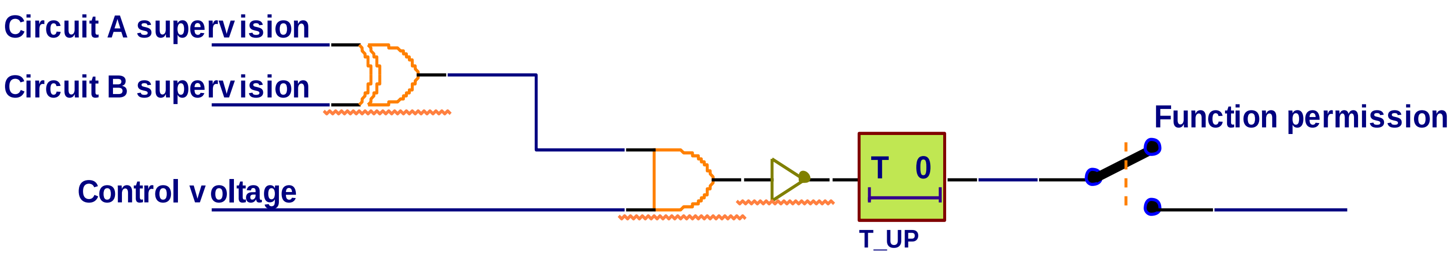
- Verifying there is a trip voltage.
- Verifying the continuity of the trip circuit, in both circuit breaker position, both open and closed.

For the first monitoring procedure, a digital input is fitted, with stricter activation than the other inputs. For the second monitoring procedure, a weak current is injected which must flow from the relay to the circuit breaker trip coil. Finally, to avoid spurious components this must be appropriately time delayed.

This function settings are as follows:

Function	Description	Minimum	Maximum	Step	Unit	Default
74TCS	**Trip circuit supervision**					
	Permission	-	-	Yes/No	-	No
	Time delay	0.02	300.00	0.01	s	2.00

The schematic for this criteria is as follows:



4.16. Function 79. Autorecloser

The reclosing function recloses the circuit breaker after a fault. It has a five reclosing capacity, following which the unit shall be Locked or in “Lockout” mode.

The reclose device can be permitted or prohibited, depending on whether or not this function is required. Prohibited must not be confused with locked. Prohibited means that the recloser shall never be in operation, regardless of the controls performed on it. A locked recloser means that the recloser is not operative, but either because it has reached the end of the reclosing cycle, or a fault has been detected, or someone has performed a control procedure on it.

There is a final permission which serves to indicate, that recloser must wait a period of time before closure. In this time, there is usually an external condition, such as closure synchronism, and this condition is defined by an external input.

Each reclosing cycle has its own specific operation time that can be set. Apart from these times, a further three times must be set:

- Hold time. This is the time the reclosing device waits for an external condition for closure.
- Reset time. This is the Hold time for the recloser for a final closure. If during this time, there is another trip, the recloser count will increase.
- Final opening time The is the time used by the recloser to declare that the circuit breaker is finally open. In this case, the recloser understands that the opening was manual or via remote control, and no reclosing is necessary. On exceeding this time, the recloser shall switch to locked mode.

The reclosing function settings are shown below:

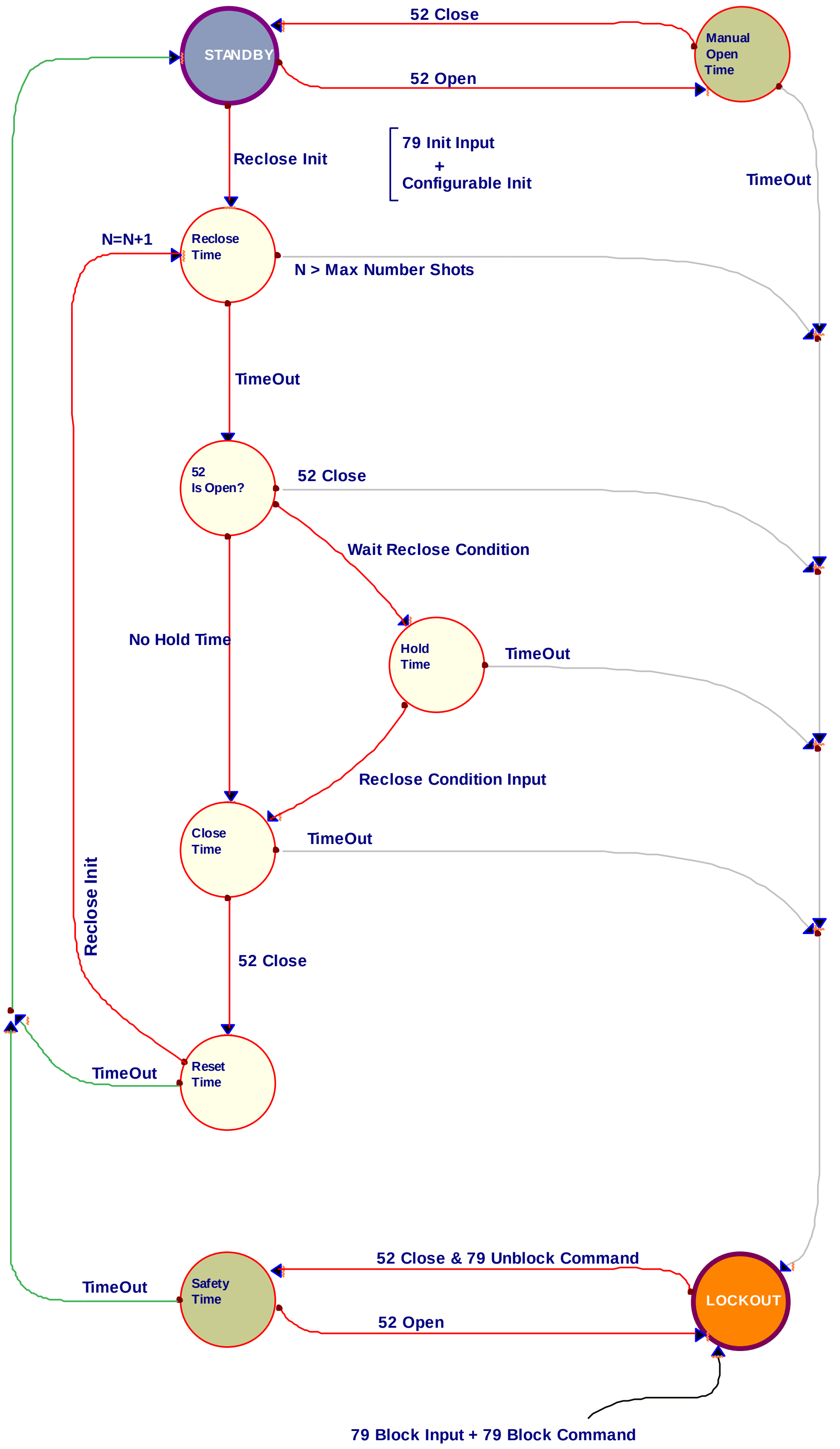
Function	Description	Minimum	Maximum	Step	Unit	Default
79	**Reclosing device**					
	Permission	-	-	Yes/No	-	No
	Hold permission	-	-	Yes/No	-	No
	Number of shots	1	5	1	-	3
	Reclose 1 time	0.02	300.00	0.01	s	0.30
	Reclose 2 time	0.02	300.00	0.01	s	3.00
	Reclose 3 time	0.02	300.00	0.01	s	180.00
	Reclose 4 time	0.02	300.00	0.01	s	180.00
	Reclose 5 time	0.02	300.00	0.01	s	180.00
	Hold time	0.02	300.00	0.01	s	10.00
	Reset time	0.02	300.00	0.01	s	10.00
	Final Opening Time	0.02	300.00	0.01	s	10.00

It must be possible to lock the recloser, particularly is maintenance tasks are carried out on the substation. To this end there are various SIL-B locking and unlocking possibilities:

- **From the HMI**. There is a specific key marked 79, plus a specific signal led, allowing recloser operation, locking or unlocking it. In order that the command related to the key can run, the menu must be in standby mode.
- **From the HMI.** This command can be executed from the control menu.
- **From two pulse inputs.** If the substation is equipped with a conventional remote control, two pulse outputs are usually assigned, where one locks the recloser and the other locks it.
- **Via protocol.** This is performed via any means of communication. This is carried out as if it were a control, and the normal conditions of any control must be met. For example, if we are operating from the HMI, it is understood that the relay is in local mode, whereby if a Lock/Unlock command is received via remote control this shall be ignored.
- **From a level input.** In this case the recloser monitors the status of the input. This may be of use if the company has a handle with a key.

In the first four cases, the equipment stores the lock situation in the non-volatile memory, as the last control must be know for a possible re-start.

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.



52 Close
STANDBY
Manual
Open
Time
52 Open
79 Init Input
+
Configurable Init
Reclose Init
TimeOut
N=N+1
Reclose
Time
N > Max Number Shots
TimeOut
52
Is Open?
52 Close
Wait Reclose Condition
No Hold Time
Hold
Time
TimeOut
Reclose Condition Input
Close
Time
TimeOut
Reclose Init
52 Close
TimeOut
Reset
Time
52 Close & 79 Unblock Command
TimeOut
Safety
Time
LOCKOUT
52 Open
79 Block Input + 79 Block Command

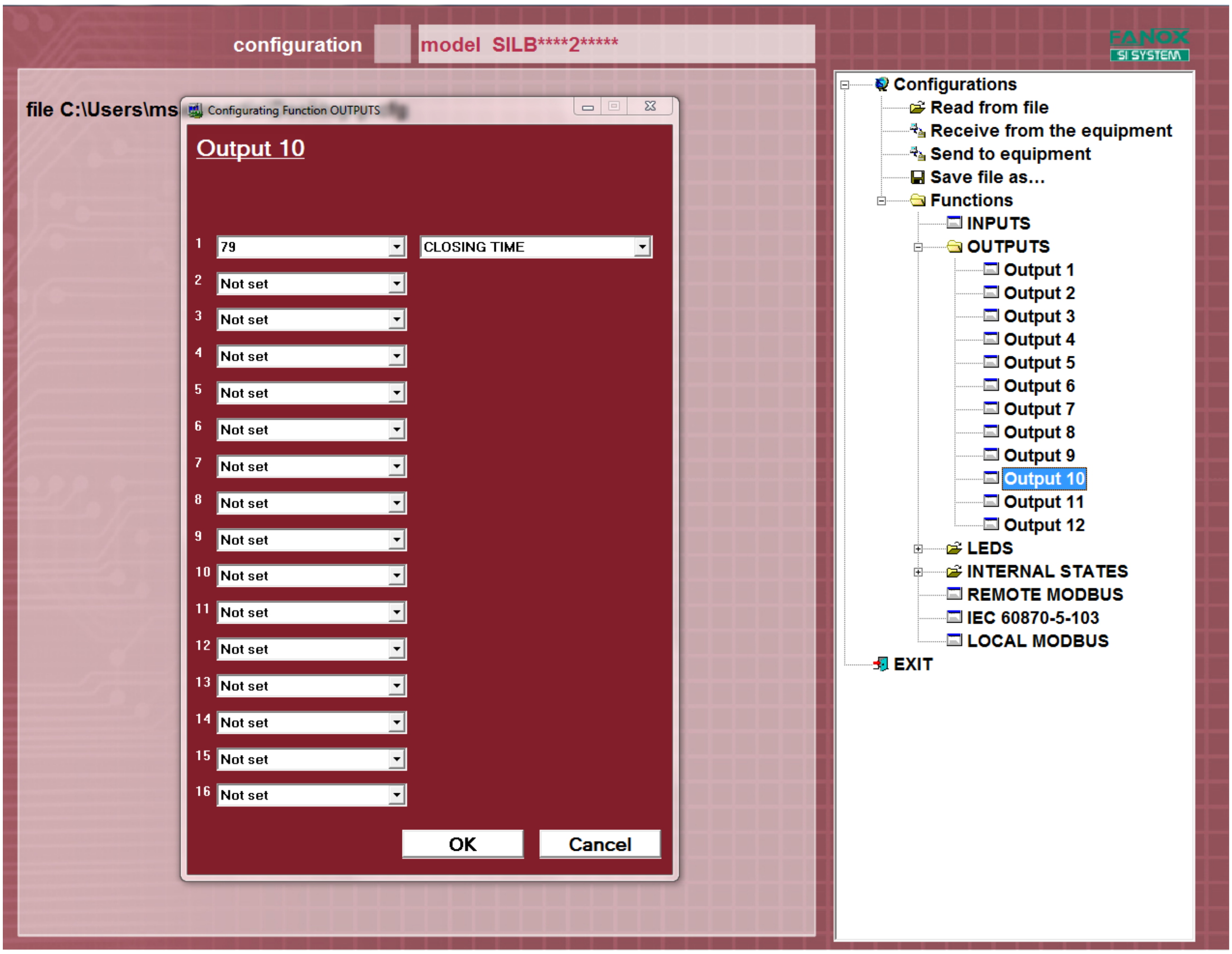
On standby. The recloser can leave this mode via three conditions:

- Recloser lock, via a command.
- Manual or remote control opening of the circuit breaker. In this situation it shall wait the final opening of the same, and then it shall switch to lock 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 locked. The recloser shall switch from this condition as a result of two different conditions:

- Manual or remote control closing of the circuit breaker. In this case it shall switch to safety time. If, during this time, there is a trip, it shall revert to Lockout.
- Unlocking of the recloser. Via a command.

Of all the remaining conditions, it is interesting to know that the recloser sends a closure command whilst it is in the Close Time condition, and for this reason if you wish to program an output on said command, the output must be set to the 79TmpCierre bit.



The “79 Start” status is an adjustable logical output. The default configuration is shown below:

- Activation of the recloser start input (“79 start input”)
- 67P_1 trip
- 67N_1 trip
- 46 trip

By default, in this configuration, the recloser is not activated by the operations of functions 50P_1, 50P_2, 50N_1, 50N_2 and 50BF.

4.16.1. Counter to record the number of reclosings

The SIL-B equipment is fitted with a counter that records the number of reclosings.

4.17. Function 25. Synchronism protection function

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 conditions that the voltage of both ends of the switchgear must have to assert that there is synchronization are:

- 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:

- LLLB (Live Line - Live Bar), live line - live bar
- LLDB (Live Line - Dead Bar), live line - dead bus
- DLLB (Death Line - Live Bar), dead line - live bar
- DLDB (Death Line - Dead Bar), dead line - dead bus

The settings associated with this unit voltage monitoring are:

Function	Description	Minimum	Maximum	Step	Unit	Default
25	**Synchronism. Line and bar voltage supervision unit**					
	Live line voltage	30	110	0,1	V	50
	Dead line voltage	4	110	0,1	V	30
	Live bar voltage	30	110	0, 1	V	50
	Dead line voltage	4	110	0, 1	V	30
	Voltage supervision time	0.02	300.00	0.01	s	0.02

A time during which it is confirmed that the end is dead or live to be sure it is not a temporary situation is specified

According to the live or dead state of the line and the bar,four permissions exist that allow or not to close the line over the bar:

Function	Description	Minimum	Maximum	Step	Unit	Default
25	**Synchronism. Operation permissions**					
	Permission LLLB	-	-	-	Yes/No	No
	Permission LLDB	-	-	-	Yes/No	No
	Permission DLLB	-	-	-	Yes/No	No
	Permission DLDB	-	-	-	Yes/No	No

In case the line or bar or both are dead (LLDB, DLLB, DLDB situations) permission to close is only determined by the setting of permission. It is not necessary the synchronism to close the switchgear.

When the line and the bar are alive is the time to check the conditions of voltage magnitude, phase difference and frequency difference between line voltage and bar voltage to allow the closure. It is verified that these conditions of voltage magnitude, phase difference and frequency difference is maintained over a set time, to verify that it is not a temporary situation.

Function	Description	Minimum	Maximum	Step	Unit	Default
25	**Synchronism. Synchronism algorithm**					
	Line-Bar voltage difference	4	110	0,1	V	15
	Line-Bar phase difference	0	359	1	°	10
	Line-Bar frequency difference	0.02	0,50	0.01	Hz	0.02
	Synchronism time	0.02	300	0.01	s	0.02

If these conditions of synchronism are mantains during synchronism time, we will have switch close permission.

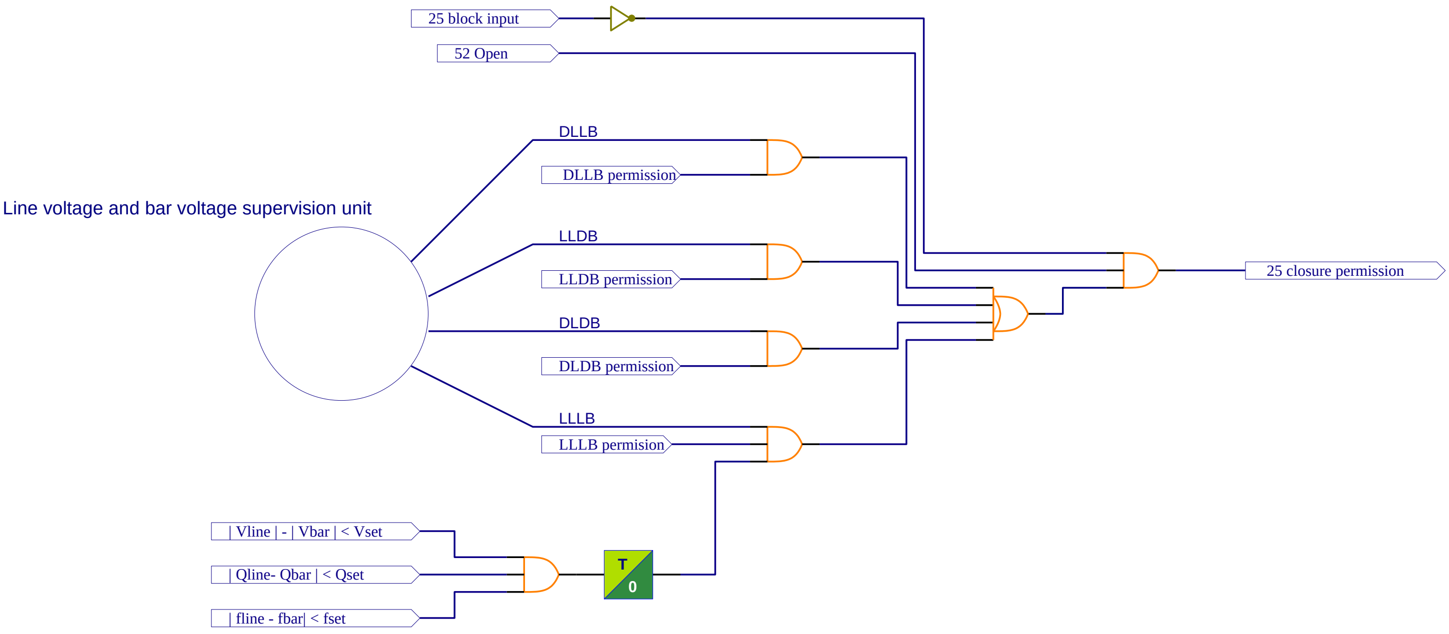
The sync function generates the following bits:

25	**Sincronismo**
	LLLB: Live line, live bar
	LLDB: Live line, dead bar
	DLLB: Dead line, live bar
	DLDB: Dead line, dead bar
	Close permission

LLLB, LLDB, DLDB and DLLB bits indicate the status of the line and the bar regardless of the operation permissions statuses.

The closing permission signal remains active while the conditions of synchronism are accomplished. In any case, once the signal is activated, it remains a minimum of 150 ms, in case synchronism conditions disappear.

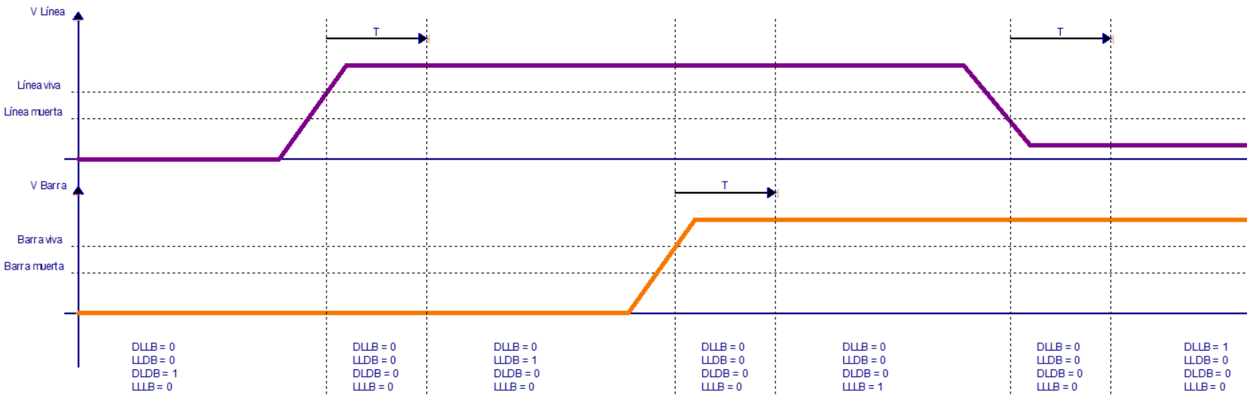
The following schema describes a logical diagram of the algorithm:



The line and bar voltage monitoring unit sets the dead or alive state of the line and bar. Transitions from dead to live and vice versa are timed with a user adjustable time. During the transition the line or bar is in undefined state. At such moments, as seen in the logical diagram of the algorithm, the closing permission is not activated.

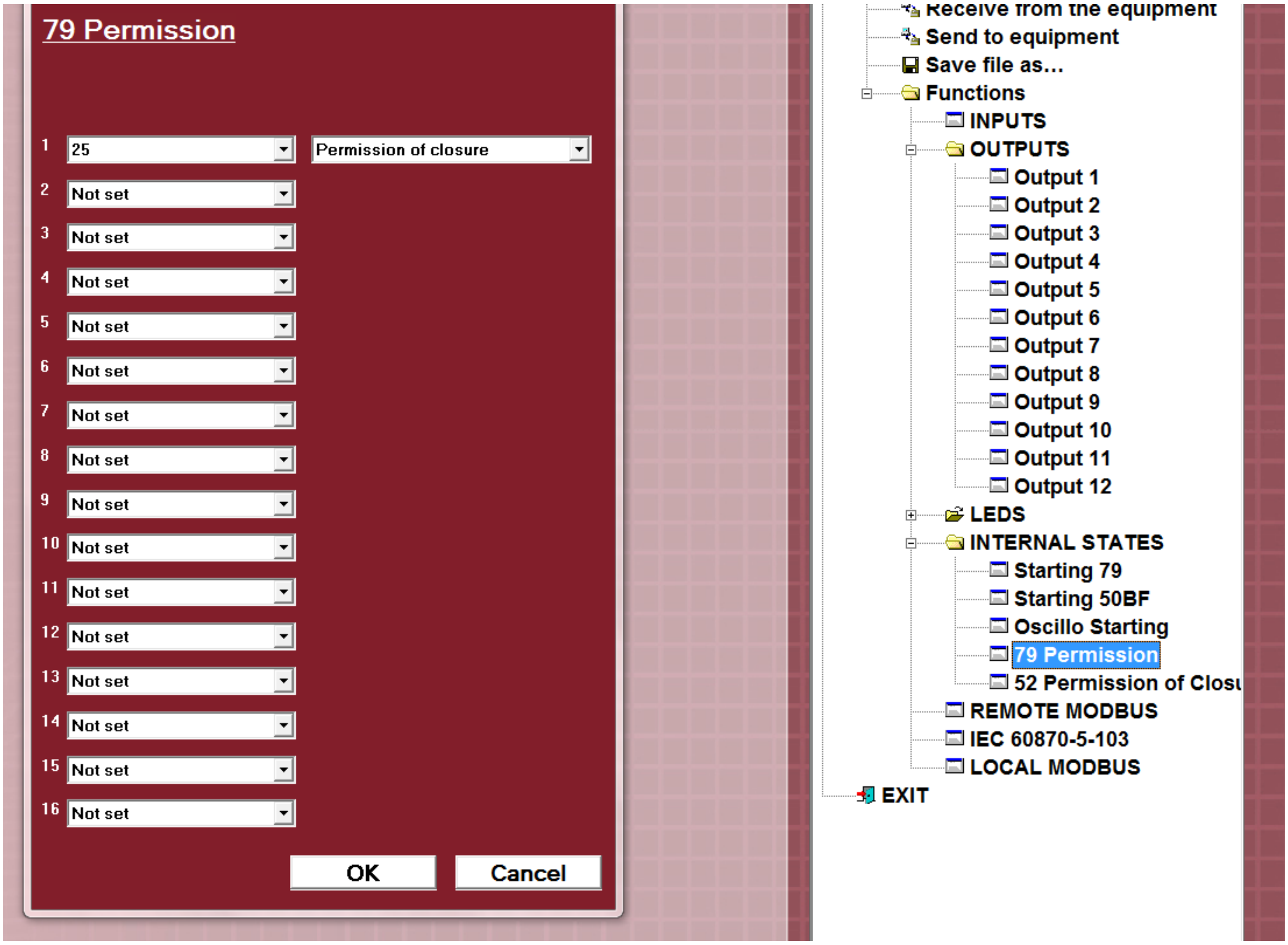
Once the voltage exceeds the live state level, a timer is started during which we turn to undefined state until the timer ends. At this moment, indicates the live status of the bar or line.

When the voltage falls below the level of dead state, a timer is started during which we turn to undefined state until the timer ends. At this moment, indicates the dead status of the bar or line.



4.17.1. Synchronism (25) and recloser (79)

For the circuit breaker is closed when recloser command (79) is permited, it is necessary to achieve sync conditions. Only when these sync conditions are achieve, the recloser has the permission to do the closure of circuit breaker. This is, for the recloser close is supervised by the closing permission given by sync function, it is necessary to set the "Permission of closure" state of sync function to the logical input "79 permission input".



Synchronism function (25) associated to recloser function (79)

If the parameter “Hold permission” of 79 function is prohibited any external condition will be considered and 79 function will work normally without considering synchronism.

If “Hold permission” of 79 function is enable and it is associated with “ Permission of closure” of 25 function, could be occur:

1. If permissions LLLB, DLLB, LLDB y DLDB of 25 function are all prohibited, after tripping because of a fault, circuit breaker never will be reclosed because “Permission of closure” bit of 25 function will never be activated. After time adjusted in hold time, 79 function will go to LOCKOUT status.

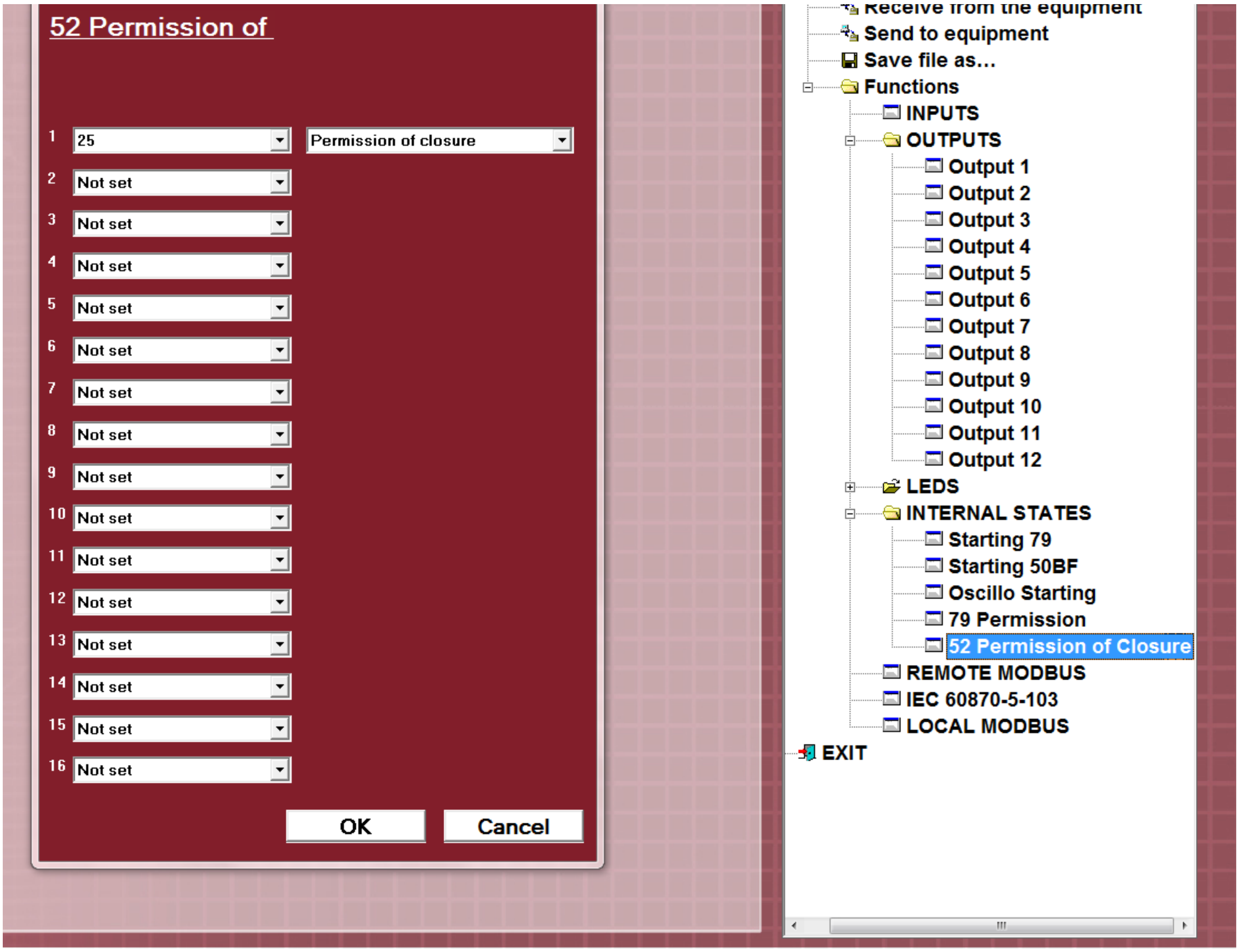
2. If permissions LLLB, DLLB, LLDB y DLDB of 25 function are all enable, it will be distinguished the following cases:

    a) If line, bar or both of them are dead, the circuit breaker will be always reclosed, because “Permission of closure” only depends on corresponding permission adjustment, and it is not necessary synchronism to get the circuit breaker reclose. .

    b) If both, line and bar, are alive it will be necessary to get the reclose of the circuit breaker, not only LLLB permission to be enable either to check synchronism. If LLLB permission is enable but synchronism conditions do not verify the reclose will not occur and vice versa.

4.17.2. Syncronism (25) and manual closure (52)

For the manual closure of 52 function is supervised by the closing permission given by sync function, it is necessary to associate the "Permission of closure " status of sync function to the logical input "52 Permission of closure "



Synchronism function (25) associated to manual closure (52)

If " 52 permission of closure" is associated with "Permission of closure" of synchronism function, could be occur:

1. If permissions LLLB, DLLB, LLDB y DLDB of 25 function are all prohibited, the closure of the circuit breaker does not occur. In spite of "close breaker" command being execute by communication or pressing the key in the relay, circuit breaker never will close

2. If LLLB, DLDB, DLLB, y LLDB permissions of 25 function are enable it can be distinguished some possibilities:.

    a) If line, bar or both of them are dead it will always produced the manual closure of the circuit breaker because "52 permission of closure" only depends on corresponding permission adjustment, and it is not necessary synchronism to get the circuit breaker closure.

    b) If both, line and bar, are alive it will be necessary to get the manual closure of the circuit breaker, not only LLLB permission to be enable either to check synchronism. If LLLB permission is enable but synchronism conditions do not verify, after pressing CLOSE BREAKER command, circuit breaker closure does not occur and vice versa.

4.18. Cold Load Pickup

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

This function settings are as follows:

Group	Description	Minimum	Maximum	Step	Unit	Default
CLP	**Cold Load Pickup**					
	Permission	-	-	Yes/No	-	No
	50P_1 Multiplier	1	5	0.01	-	1
	50P_2 Multiplier	1	5	0.01	-	1
	67P_1 Multiplier	1	5	0.01	-	1
	67P_2 Multiplier	1	5	0.01		1
	50N_1 Multiplier	1	5	0.01		1
	50N_2 Multiplier	1	5	0.01	-	1
	67N_1 Multiplier	1	5	0.01	-	1
	67N_2 Multiplier	1	5	0.01	-	1
	CLP switch time	1	18000	0.01	s	15
	CLP duration	1	18000	0.01	s	15

The two time parameters have the following meaning:

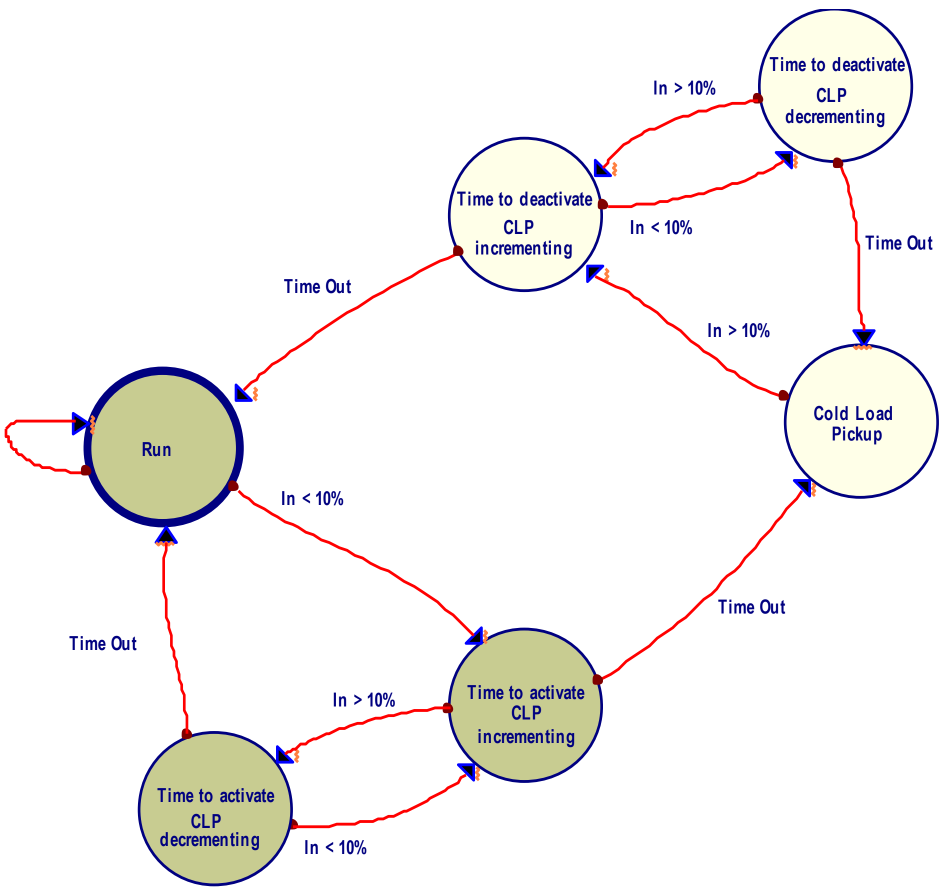
- **CLP switch time**: If the circuit has been open for less time than that set in this parameter, the Cold Load Pickup is not activated. When this time is exceeded, the overcurrent functions are multiplied by the indicated constant.
- **CLP duration**: Time from the passage of current in which time the Multiplier is applied to the overcurrent functions tap. After this time, the relay returns to the adjusted taps.

There is a conditioner in the multiplier. The maximum protection functions are located in their tap. This maximum can never be exceeded, regardless of the adjusted tap in the protection function and the Cold Load function multiplier.

The function operated according to the following automaton. The automaton consists of six statuses, three of them with normal adjustment, and the other three with the extended adjustments. During transit, the settings are maintained according to where they come from.

The current level is used to determine the change, more than the circuit breaker situation. If the current less than 10% of the rated level, it is understood that the line is open, with an extremely low usage level (operating at night, or on weekends). In one case or the other CLP must start.

The relay normally operates with the settings in their active table. When the circuit breaker opens, a timer starts. The remote control could activate circuit breaker closure, and also, if a permanent fault occurs the circuit breaker may open again. To prevent the increase counter from resetting there is a condition which reduces the activation time from where it was. If the counter exceeds its limit, a switch is made to Cold Load. On the contrary, if the counter reaches zero, a switch is made to the standby condition. This mechanism is identical in Cold Load reset.



4.19. 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.

Function	Description	Minimum	Maximum	Step	Unit	Default
	General settings					
	Equipment identifier	-	-	-	-	"www.fanox.com"
	Transformation ratio of the phase CTs	1	2000	1	-	100
	Transformation ratio of the neutral CTs	1	2000	1	-	100
	Transformation ratio of the VTs	1	2000	1	-	100
	Frequency	-	-	60/50	Hz	50
	Language	-	-	-	-	English
	Active table	1	3	1	-	1
	Communications					
	Modbus address	1	254	1	-	2
	Modbus baudrate	4800	38400	-	bauds	19200

1. Equipment identifier. It is an ASCII text used to identify the equipment. Protection equipments 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.

2. The phase and neutral CT transformation ratio setting allows the measurements of the primary values from the protection transformer to be viewed. Given that the SIL-B is a pass-through module that allows several turns to be made, the number of turns must be taken into account when the transformation ratios are adjusted.

3. Frequency. Displays the equipment's frequency.If the device is a non compact SILB the frequency is selected using an internal selector in the equipment, which can be accessed by removing the rear selector access cover. If the device is a compact SILB it is not possible to change the frequency because this parameter is imposed by the model.

4. Language. The SIL equipment 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.

5. Active Table: see Settings

6. Communication settings (address and baudrate ModBus RTU (RS485): see Communications

The rest of the settings are grouped by functions to facilitate their operation. These groups are subject to tables.

The equipment identifier setting can only be adjusted through communications.

The frequency setting is read-only. The frequency is selected using an internal selector in the equipment, which can be accessed by removing the rear selector access cover.

The rest of the settings can be modified equally from the HMI or through communications.

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

4.20. Settings Group

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

- Changing the active Table settings. In the general group there is a setting which establishes which table is active.
- By means of two inputs. To this end four possibilities are defined.

00	This situation is governed by the active table settings.
01	Table 1
10	Table 2
11	Table 3

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

If the use of both inputs is not required, then one can be used, but depending on which is used, operation can be done with table 1 or table 2.

4.21. IEC 60255-151 Curves

The IEC curves follow the following mathematical equation:

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

Where:

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

And we have the following curves:

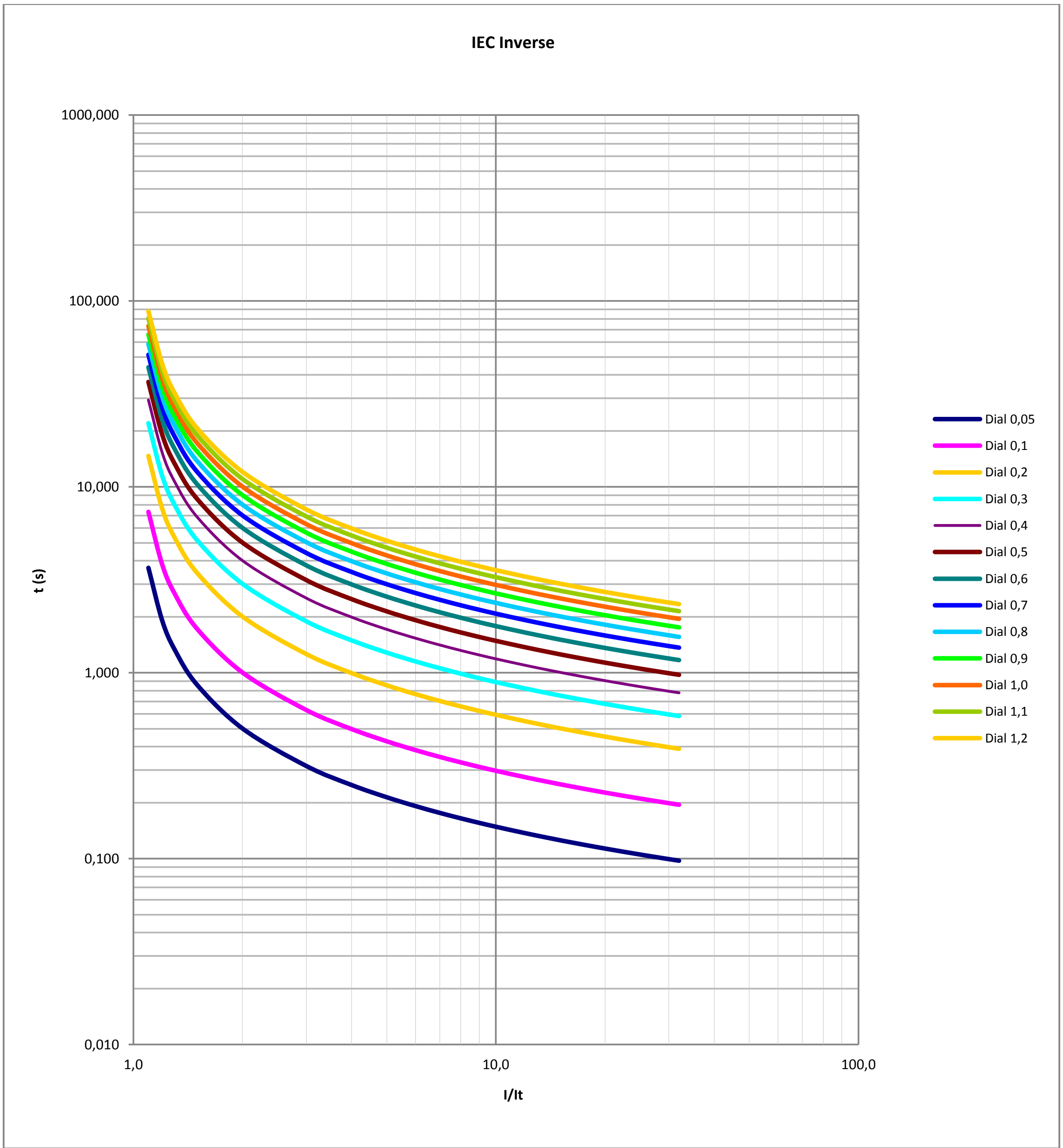
- Inverse Curve
- Very Inverse Curve
- Extremely Inverse Curve

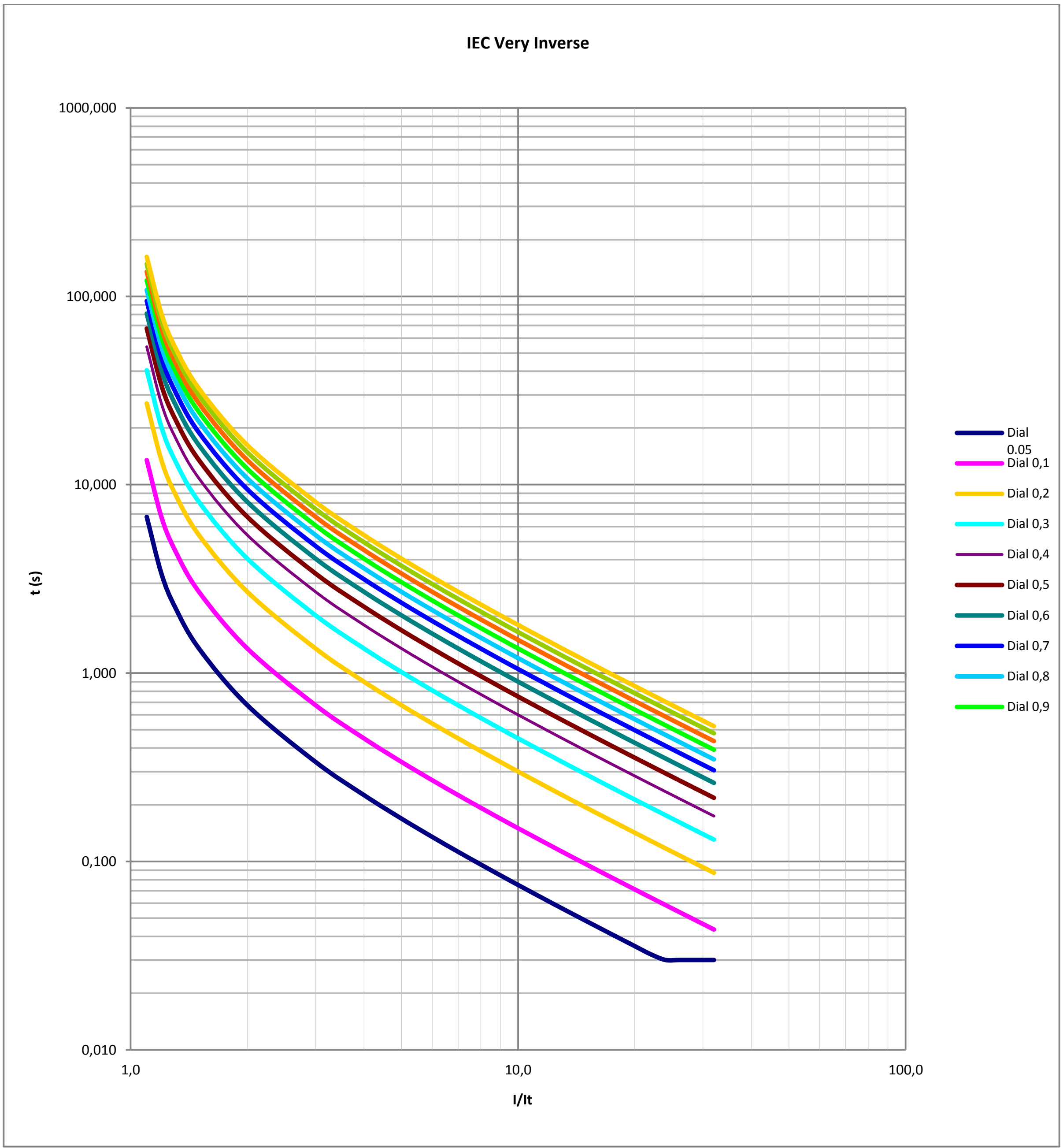
Which relate to the parameters figuring in the following table:

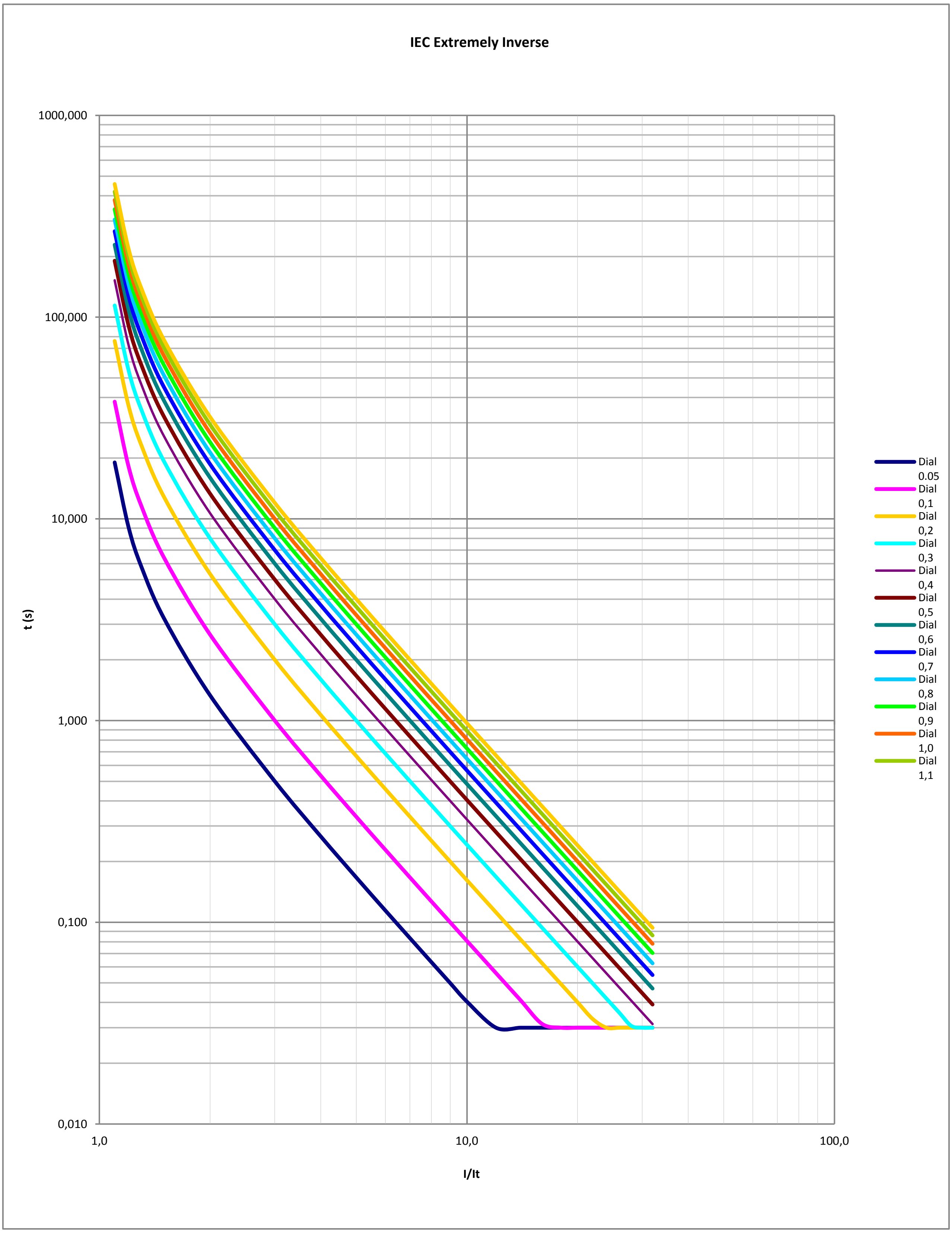
Parameters	A	P	Q	B	K
Ext. Inverse	80	2	1	0	0
Very Inverse	13.5	1	1	0	0
Inverse	0.14	0.02	1	0	0

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
1000,000
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 0,3
Dial 0,4
Dial 0,5
Dial 0,6
Dial 0,7
Dial 0,8
Dial 0,9
Dial 1,0
Dial 1,1
Dial 1,2


IEC 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 0,3
Dial 0,4
Dial 0,5
Dial 0,6
Dial 0,7
Dial 0,8
Dial 0,9


IEC 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 0,3
Dial 0,4
Dial 0,5
Dial 0,6
Dial 0,7
Dial 0,8
Dial 0,9
Dial 1,0
Dial 1,1

4.22. ANSI-IEEE Curves

The ANSI curves follow the following mathematical equation:

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

Where:

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

And we have the following curves:

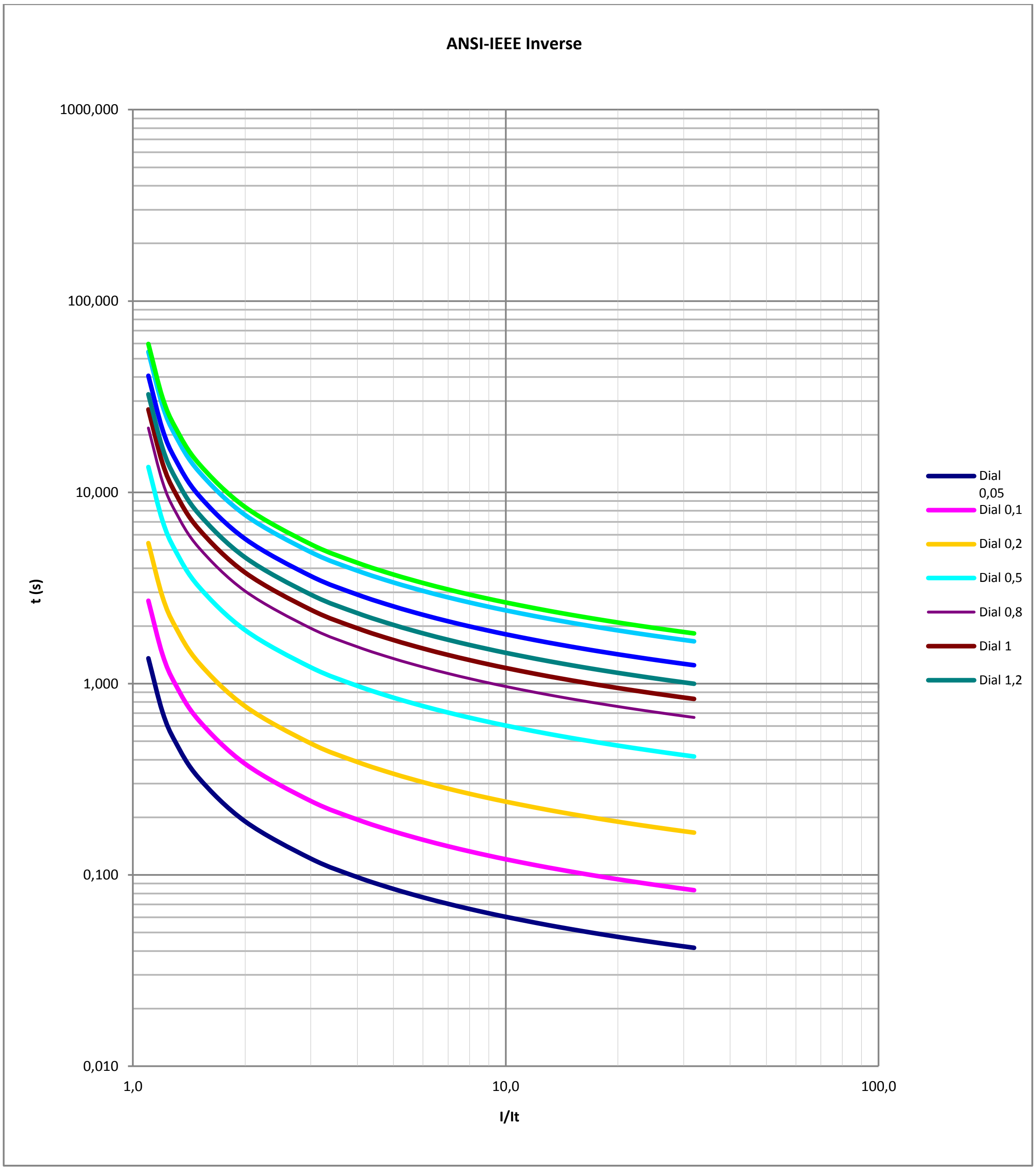
- Inverse Curve
- Very Inverse Curve
- Extremely Inverse Curve

Which relate to the parameters figuring in the following table:

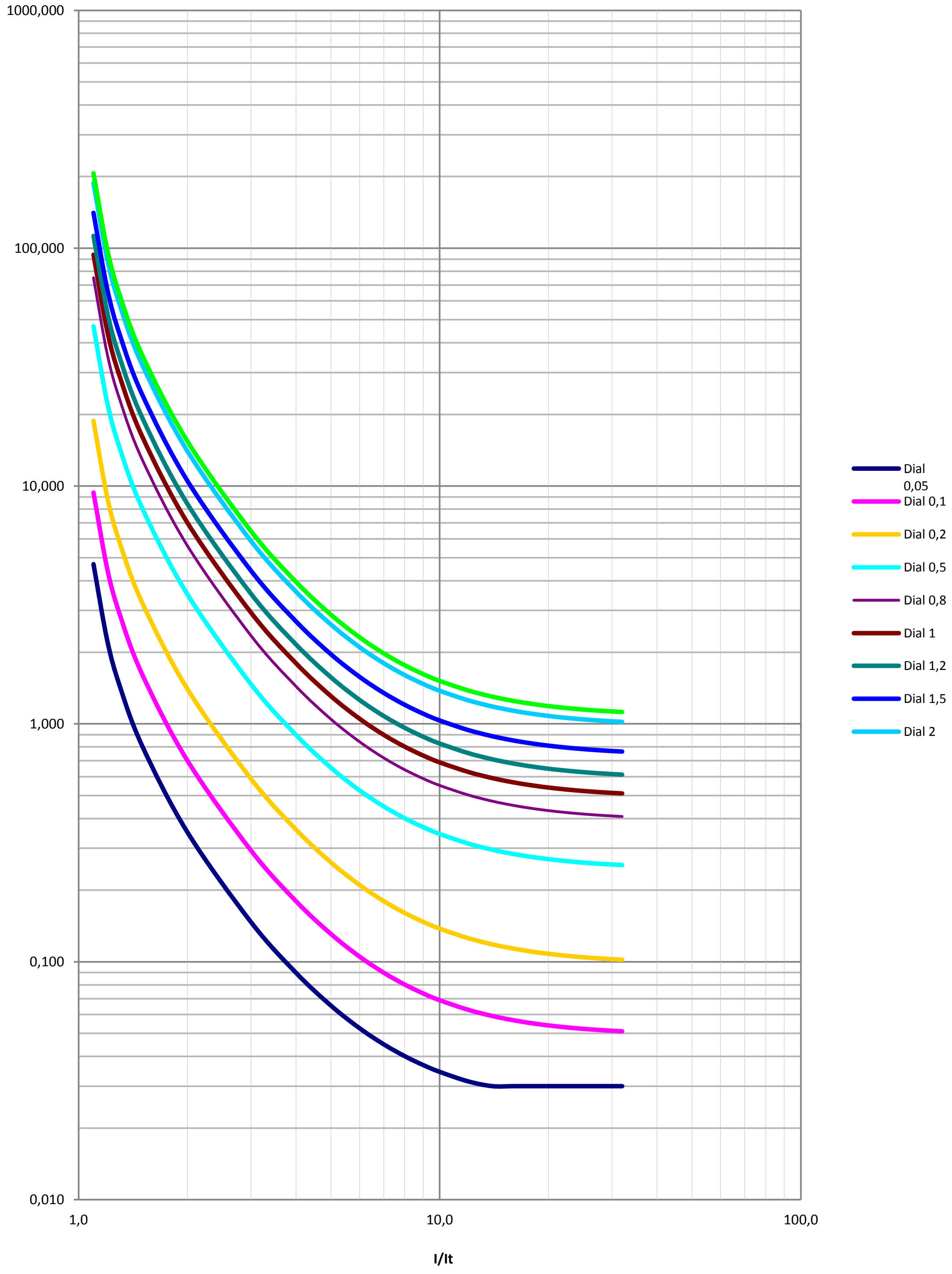
Parameters	A	P	B
Ext. Inverse	28.2	2	0.1217
Very Inverse	19.61	2	0.491
Inverse	0.0515	0.02	0.114

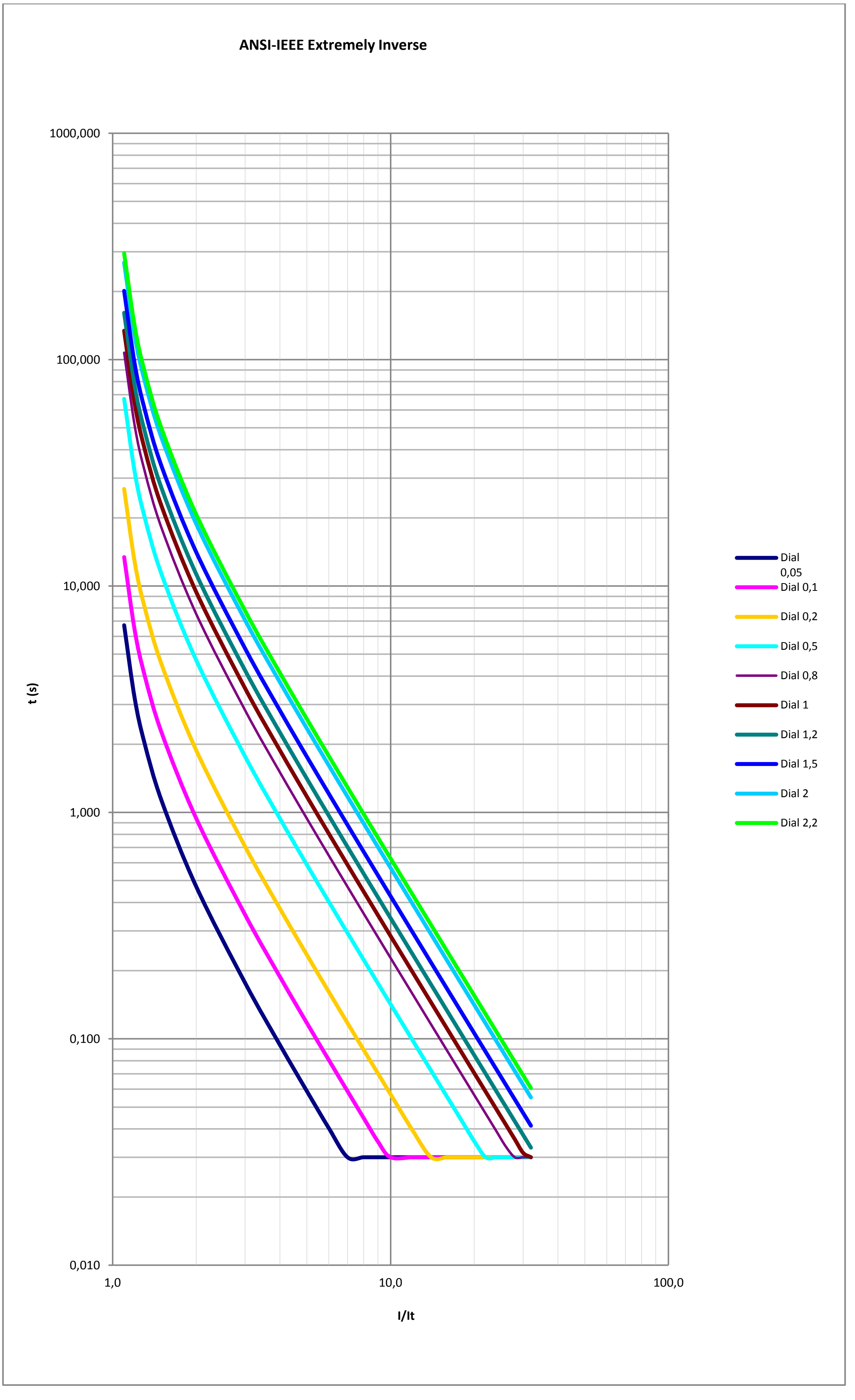
The curve can move from its axis using the TD time selection device, which the user can adjust.

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


ANSI-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

ANSI-IEEE Very Inverse




ANSI-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

4.23. Application examples

It is important to know that if both overcurrent protection functions (50 and 51), phase or neutral, are enable, definite time function (function 50) must be more restrictive. So, if overcurrent fault values are low, inverse time overcurrent function (function 51) must work, and if overcurrent fault reaches a certain value, definite time overcurrent function will always work. This is because, when overcurrent fault reach high values (I>>), it is necessary to be sure that trip is going to be instantaneous to get that the element we are protecting, does not be damaged.

It is shown somo examples below:

APPLICATION EXAMPLE 1

Starting from the following information:

***Line details**:*

- Transformation ratio of CT =100/1
- Primary current: I_p=100 A

51 function settings

- Curve type: IEC Inverse
- Dial: 0.05
- Tap: $1xI_n$

50 function settings

- Tap: $11xI_n$
- Operating time: 0.05 s

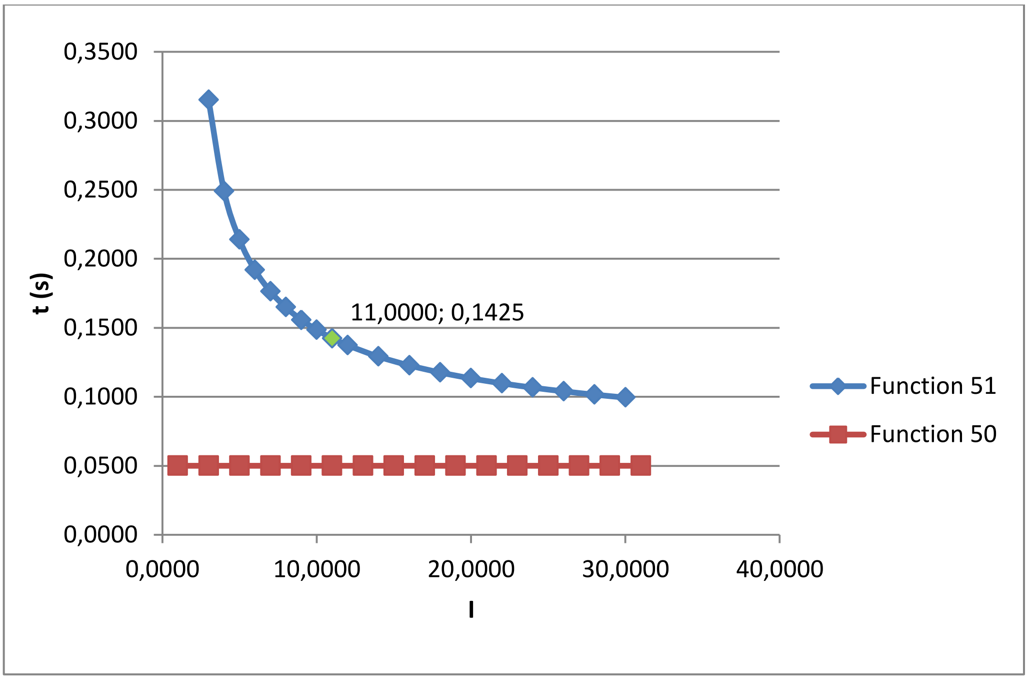


Figure 1. 50 y 51 IEC Inverse

If overcurrent fault is $11xI_n$=1100 Ap, IEC inverse curve defines a tripping value of 0.1425s (Figure1) for 51 function. It is considered that this time is too high, so when current fault reaches $11xI_n$, definite time overcurrent function will be work.

The figure below (Figure 2), shows the tripping curve of the relay:

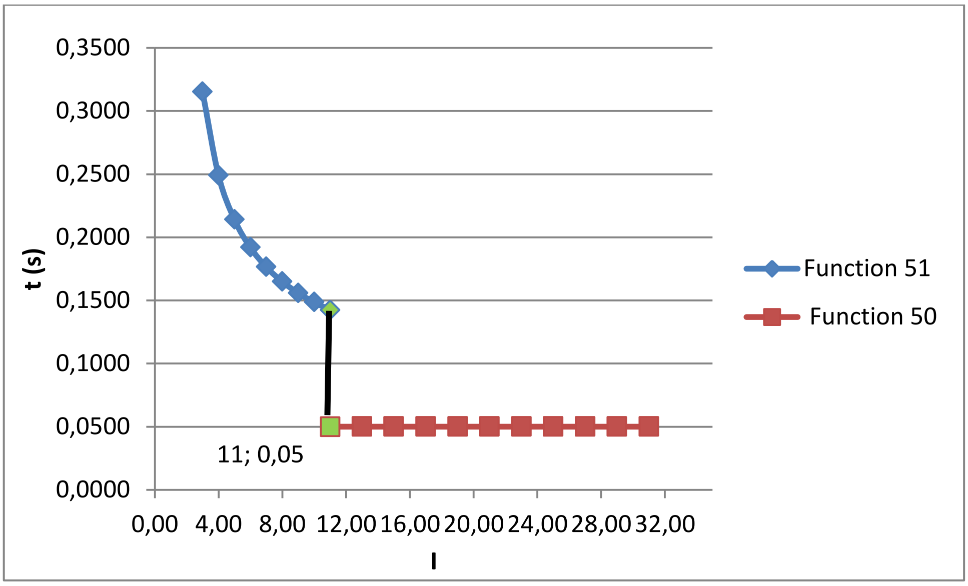


Figure 2. Relay tripping curve

APPLICATION EXAMPLE 2:

Starting from the following information:

***Line details**:*

- Transformation ratio of CT =500/1
- Primary current: I_p=500 A

51 function settings

- Curve type: ANSI Extremely Inverse
- Dial: 2.20
- Tap: 1xI_n

50 function settings

- Tap: 14xI_n
- Operating time: 0.1 s

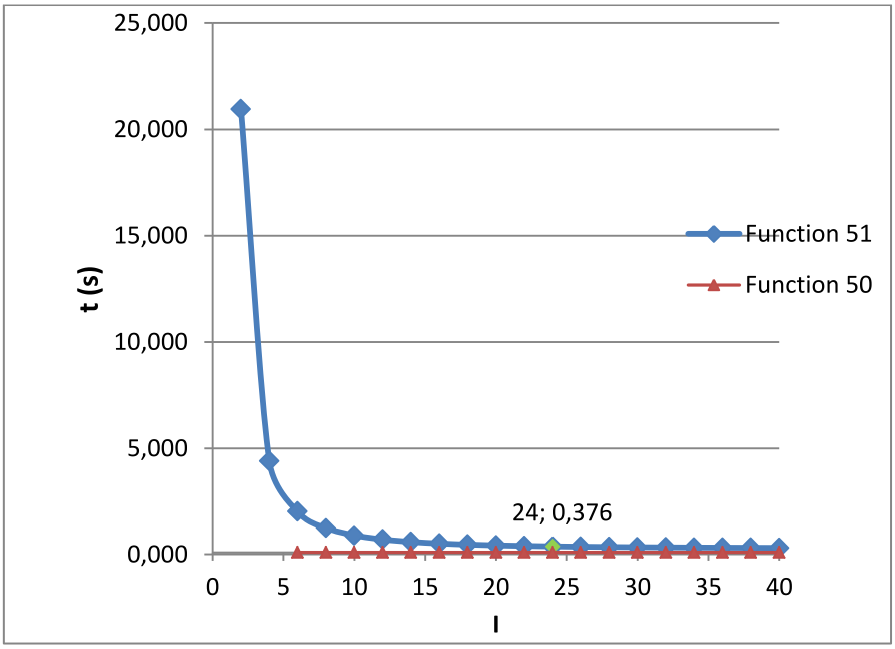


Figure 3. 50 y 51 ANSI Extremely Inverse

If overcurrent fault is 24xI_n=12000 Ap, ANSI Extremely inverse curve defines a tripping value of 0.376 s (Figure 3) for 51 function. It is considered that this time is too high, so when current fault reaches 24xI_n, definite time overcurrent function will be work. 50 function tap is adjusted at 14xIn so definite time overcurrent function will trip when current fault is higher than 14xIn (50 function does not wait to reach 24xIn)

The figure below (Figure 4), shows the tripping curve of the relay:

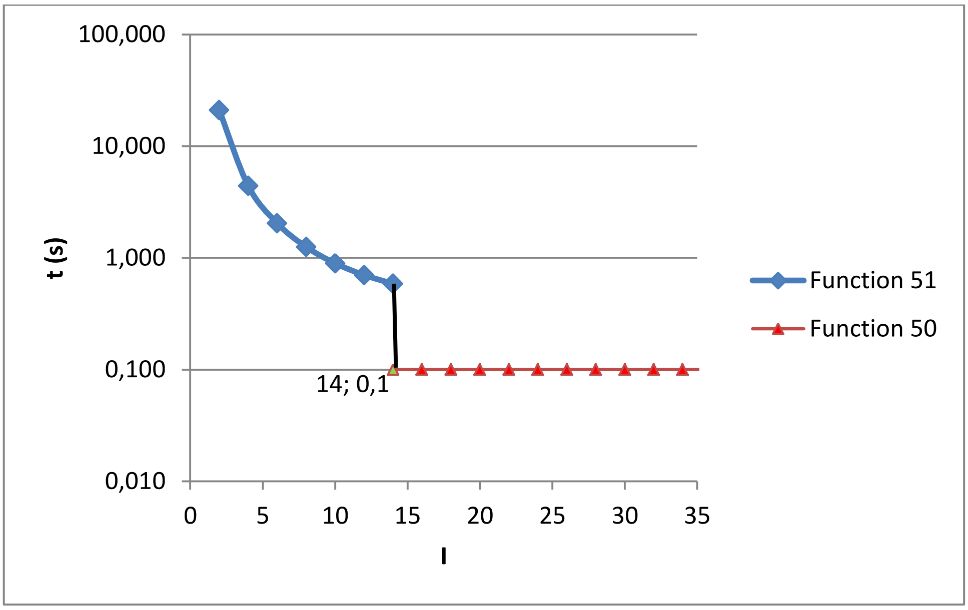


Figure 4. Relay tripping curve

APPLICATION EXAMPLE 3:

In this example it is explained what occurs when it is selected in curve type parameter “DEFINITE TIME”. In this case, 51 function works as 50 function.

Starting from the following information

***Line details**:*

- Transformation ratio of CT =100/1
- Primary current: Ip=100 A

51 function settings

- Curve type: Definite time
- Tap 1xIn
- Operating time: 5 s

50 function settings

- Tap: 15xIn
- Operating time: 1 s

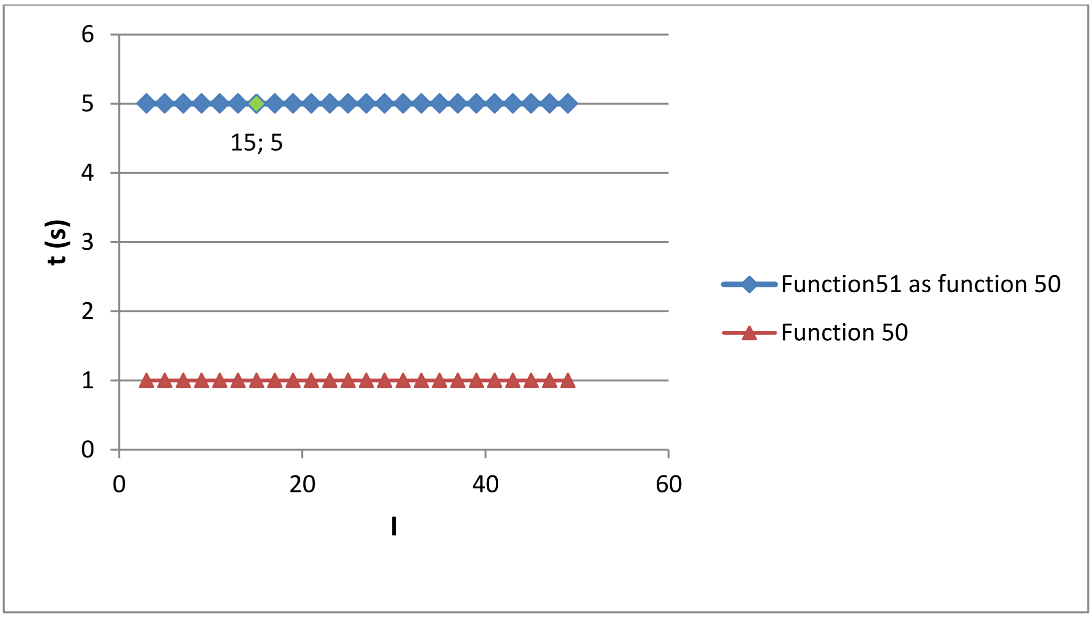


Figure 5. Function 51 (as 50) and function 50.

If overcurrent fault is $15xI_n$=1500 Ap, Definite time curve defines a tripping value of 5 s (Figure 5) for 51 function. It is considered that this time is too high, so when current fault reaches $15xI_n$, definite time overcurrent function will be work function 50).
The figure below (Figure 6), shows the tripping curve of the relay:

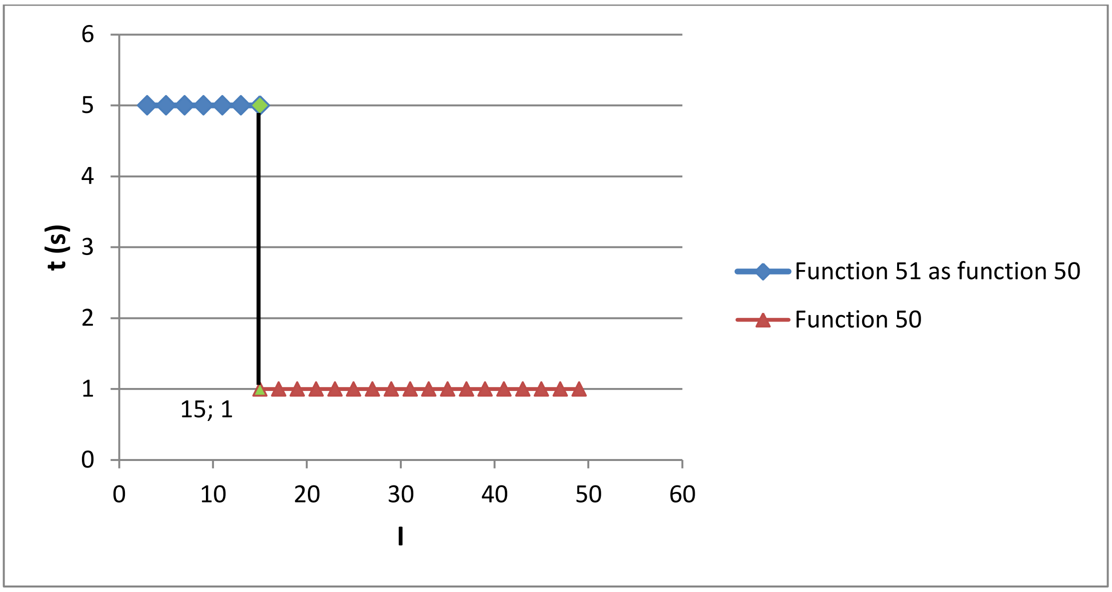


Figure 6. Relay tripping curve

5. MONITORING AND CONTROL

5.1. Measurements

The measurement precision is ±2% precision in a band covering ±20% of Rated Current and ±4% in the rest of the range of measurements. 16 samples/cycle are taken.

Frequency measurement is obtained by using the passing through zero of the voltage algorithm. To obtain line frequency and busbar voltage to get busbar frequency it is specifically used phase B voltage. The minimum value of this voltage to get frequency measurement are 30 volts. If the voltage of phase B is lower than 30 volts frequency mesuremint will be 0.00 Hz. The frequency measurement accuracy is ±0.01 Hz.

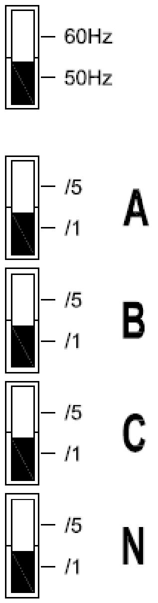
The following measurements are provided:

- Phase r.m.s. currents (IA, IB, IC)
- Neutral r.m.s. current (IN)
- Positive sequence current (I1)
- Negative sequence current (I2)
- Phase r.m.s. voltages (VA, VB, VC)
- Residual neutral voltage (VN), calculated internally from the sum of the phase voltages.
- Busbar phase B r.m.s. voltage (VBBus)
- Voltage between phases (U12, U23, U31)
- Angle current phase L1 respect to VL1(ang-IA)
- Angle current phase L2 respect to VL1(ang-IB)
- Angle current phase L3 respect to VL1(ang-IC)
- Total Active Power (P)
- Phase Active power (P-A, P-B, P-C)
- Total Reactive Power (Q)
- Phase Reactive power (Q-A, Q-B, Q-C)
- Total apparent power (S)
- Phase Apparent power (S-A, S-B, S-C)
- Power factor (cos Phi)
- Each phase Power factor (cos Phi-A, cos Phi-B, cos Phi-C)
- Thermal image
- Line frequency
- Busbar frequency
- Phase difference between phase B line voltage and busbar voltage

Below the measurement ranges for phase and neutral currents for the SIL-B models are provided; said values are defined as secondary current:

Model	Phase range	Neutral range	Rated phase I	Rated neutral I
SIL-B5*	1-150 A	*	5 A	*
SIL-B1*	0.2-30 A	*	1 A	*
SIL-B*5	*	1-150 A	*	5 A
SIL-B*1	*	0.2-30 A	*	1 A

In non compact SILB device, the rear parts of models 5 A and 1 A of the SIL-B equipment are fitted with the following switches to select the secondary current. Obviously, in the 5 A phase models the phase A, B and C switches must be set to position /5. In the 1 A phase models the phase A, B and C switches must be set to position /1.



Compact SILB devices will depend on the model. They will have a rated current equal to 1 Ampere or 5 Amperes and they will have a frequency equal to 50 or 60 Hz, but these values are not adjustable by user (there are not switches in the rear part).

The voltage measurement range is 4V to 130V.

5.2. Counters

The following counters are provided:

1. Positive active energy
2. Negative active energy
3. Positive reactive energy
4. Negative reactive energy
5. Number of openings of the circuit breaker
6. Amperes accumulated (I2t) during the openings of the circuit breaker
7. Number of shots
8. Thermal Image

It is possible to change tha values of the counters to a certain value, but firstly it is necessary to insert the correct password.

5.3. Statuses and Events

Statuses are real time information generated by the equipment. Some statuses are defined as a level, and others, like trips, are too brief to be displayed in real time.

Group	Status
50P_1	**Level1: Phase definite-time overcurrent**
	50P_1 Phase A pickup
	50P_1 Phase B pickup
	50P_1 Phase C pickup
	50P_1 Pickup
	50P_1 Phase A trip
	50P_1 Phase B trip
	50P_1 Phase C trip
	50P_1 Trip
50P_2	**Level2: Phase definite-time overcurrent**
	50P_2 Phase A pickup
	50P_2 Phase B pickup
	50P_2 Phase C pickup
	50P_2 Pickup
	50P_2 Phase A trip

	50P_2 Phase B trip
	50P_2 Phase C trip
	50P_2 Trip
67/51/50P_1	**Level1: Phase Inverse-time directional overcurrent**
	67P_1 Phase A pickup
	67P_1 Phase B pickup
	67P_1 Phase C pickup
	67P_1 pickup
	67P_1 Phase A trip
	67P_1 Phase B trip
	67P_1 Phase C trip
	67P_1 Trip
67/51/50 P_2	**Level 2: Phase Inverse-time directional overcurrent**
	67P_2 Phase A pickup
	67P_2 Phase B pickup
	67P_2 Phase C pickup
	67P_2 pickup
	67P_2 Phase A trip
	67P_2 Phase B trip
	67P_2 Phase C trip
	67P_2 Trip
50N_1	**Level1: Neutral definite-time overcurrent**
	50N_1 Pickup
	50N_1 Trip
50N_2	**Level2: Neutral definite-time overcurrent**
	50N_2 Pickup
	50N_2 Trip
67/51/50N_1	**Level1: Neutral inverse-time directional overcurrent**
	67N_1 S Pickup
	67N_1 Trip
67/51/50N_2	**Level2: Neutral inverse-time directional overcurrent**

	67N_2 Pickup
	67N_2 Trip
46	**Negative sequence inverse-time overcurrent**
	46 Pickup
	46 Trip
49	**Thermal image protection**
	49 Alarm
	49 Trip
37P_1	**Level1: Definite time undercurrent**
	37P_1 Phase A pickup
	37P_1 Phase B pickup
	37P_1 Phase C pickup
	37P_1 pickup
	37P_1 Phase A trip
	37P_1 Phase B trip
	37P_1 Phase C trip
	37P_1 Trip
37P_2	**Level2: Definite time undercurrent**
	37P_2 Phase A pickup
	37P_2 Phase B pickup
	37P_2 Phase C pickup
	37P_2 pickup
	37P_2 Phase A trip
	37P_2 Phase B trip
	37P_2 Phase C trip
	37P_2 Trip
59P_1	**Level1: Phase definite-time overvoltage**
	59P_1 Phase A pickup
	59P_1 Phase B pickup
	59P_1 Phase C pickup
	59P_1 Pickup

	59P_1 Phase A trip
	59P_1 Phase B trip
	59P_1 Phase C trip
	59P_1 Trip
59P_2	**Level2: Phase definite-time overvoltage**
	59P_2 Phase A pickup
	59P_2 Phase B pickup
	59P_2 Phase C pickup
	59P_2 Pickup
	59P_2 Phase A trip
	59P_2 Phase B trip
	59P_2 Phase C trip
	59P_2 Trip
59N_1	**Level1: Neutral definite-time overvoltage**
	59N_1 Pickup
	59N_1 Trip
59N_2	**Level2: Neutral definite-time overvoltage**
	59N_2 Pickup
	59N_2 Trip
27P_1	**Level1: Phase definite-time undervoltage**
	27P_1 Phase A pickup
	27P_1 Phase B pickup
	27P_1 Phase C pickup
	27P_1 Function pickup
	27P_1 Phase A trip
	27P_1 Phase B trip
	27P_1 Phase C trip
	27P_1 Trip
27P_2	**Level2: Phase definite-time undervoltage**
	27P_2 Phase A pickup
	27P_2 Phase B pickup

	27P_2 Phase C pickup
	27P_2 Function pickup
	27P_2 Phase A trip
	27P_2 Phase B trip
	27P_2 Phase C trip
	27P_2 Trip
32_1	**Level1: Definite-time directional overpower**
	32_1 Pickup
	32_1 Trip
32_2	**Level2: Definite-time directional overpower**
	32_2 Pickup
	32_2 Trip
32_3	**Level3: Definite-time directional overpower**
	32_3 Pickup
	32_3 Trip
32_4	**Level4: Definite-time directional overpower**
	32_4 Pickup
	32_4 Trip
81_1	**Level1: Underfrequency/Overfrequency**
	81_1 Pickup
	81_1 Trip
	81_ 1 Block
81_2	**Level2: Underfrequency/Overfrequency**
	81_2 Pickup
	81_2 Trip
	81_ 2 Block
81_3	**Level3: Underfrequency/Overfrequency**
	81_3 Pickup
	81_3 Trip
	81_ 3 Block
81_4	**Level4: Underfrequency/Overfrequency**

	81_4 Pickup
	81_4 Trip
	81_ 4 Block
CLP	**Cold Load Pickup**
	CLP Activation
50BF	**Circuit breaker opening fault**
	50BF Pickup
	50BF Trip
General	**General states**
	General trip
	Battery supply
	50Hz network frequency
	Magnetic module error
	Measurement error
	Ready
	Protection error
	Settings changed
	Manual closure
	Date and time synchronization
	Local telecontrol
	Default settings error
	e2prom error
	IRIG B presence
	e2prom values changed
	Event log error
Inputs	**Logical and physical inputs**
	Input 52 a
	Input 52 b
	Locking 50P input
	Locking 50N input
	External trip input

	Fault start
	Start 79 input
	Permission 79 input
	Locking 79 level input
	Active table input-1
	Active table input-2
	Lock pulse input 79
	Unlock pulse input 79
	50BF init
	Input 1
	Input 2
	Input 3
	Input 4
	Input 5
	Input 6
	Input 7
	Input 8
	Command voltage
	Continuity coil A
	Continuity coil B
Outputs	**Logical and physical outputs**
	Output 1
	Output 2
	Output 3
	Output 4
	Output 5
	Output 6
	Output 7
	Output 8
	Output 9
	Output 10

	Output 11
	Output 12
	Start 79
	Start 50BF
	Start fault
	Close 79 permission (models with function 25)
	Close 52 permission (models with function 25)
	LED ON
	LED 1
	LED 2
	LED 3
	LED 4
	LED 5
79	**Recloser**
	79 Inactive
	79 Reclosing time
	79 Open
	79 Hold time
	79 Closing time
	79 Reset time
	79 Lock out
	79 Safety time
	79 Definitive opening time
25	**Synchronism**
	LLLB: Live line, live bar
	LLDB: Live line, dead bar
	DLLB: Dead line, live bar
	DLDB: Dead line, dead bar
	Closure permission
52	**Circuit breaker monitoring**
	52 Start

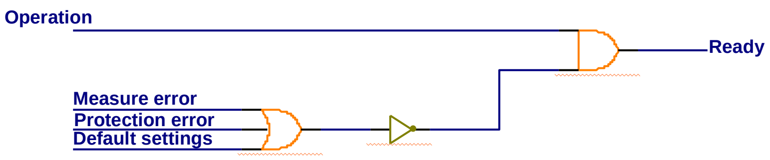
	52 Error
	52 Open
	52 Opening time
	52 Opening failure
	52 Close
	52 Closure time
	52 Closure failure
	52 Excess of openings
	52 Excess of accumulated amperes
	52 Excess of openings in a time window
	State 52 a
	State 52 b
74TCS	**Trip circuit monitoring**
	74TCS Pickup
	74TCS Activation
ModBus com	**Remote ModBus**
	Remote communication exists
	Command selection
	Open breaker
	Close breaker
	Lock 79
	Unlock 79
Remote com	**Remote com**
	Remote communication exists
	Command selection
	Open breaker
	Close breaker
	Lock 79
	Unlock 79
Local Com	**Local Modbus**
	Local communication exists

	HMI activity
	Local
	Command selection
	Open breaker
	Close breaker
	Lock 79
	Unlock 79
	Set Remote Control to Local
	Set Remote Control to Remote

In states 52 and 79, a bit has been assigned to each state of the automaton, so that the evolution of said automatism can be seen if the oscillography has to be observed.

A brief description of the general states can be found below:

- Trip: The equipment has tripped. This bit is the OR of all the trips, of any of the functions, plus the external trip input. If a certain function should not cause a trip, it must be individually prohibited. In the case of the external trip input, it should be just left unconfigured.
- 50 Hz network frequency: activates when the frequency setting is 50Hz, and deactivated when the frequency setting is 60Hz.
- The Ready bit encompasses the correct functioning of the relay and has the following logic:



This bit is normally assigned to a contact that has a NC contact.

- Magnetic module error: detects if there is a problem with the connection to the external magnetic module in non compact SILB (Compact SIL B does not have external magnetic module)
- Measurement error: The self-diagnostic algorithms have detected a problem in the measurement block.
- Protection error: The self-diagnostic algorithms have detected a problem in the measurement block.
- Setting change: Activates when a change is made to the settings.
- Date-time setting: Activates when the date-time is synchronized.

- Local: the sum of the "HMI activity" and "Local communication" bits in the "Local communication" state group
- Default settings: the equipment has its default settings, not executing the trip.
- Eeprom error: The self-diagnostic algorithms have detected a problem in the eeprom memory, which contains the settings.
- Eeprom change: activates when the settings or configuration are changed. The difference between this and the setting change is that this indication includes configuration changes, which are also stored in said memory.
- Error events: The self-diagnostic algorithms have detected a corrupt even in the circular buffer. This bit is reset by deleting the events (from the HMI or through communications)
- HMI activity: this state is active if any keys have been pressed in the last fifteen minutes. Pressing a key assumes that the relay is set to local mode.
- Remote Control to Local: whether or not the remote control is activated

Some states have an associated event, which is a log of the change that occurs in the state. Some states have one associated activation event, and other states have two associated events: activation and reset. These events are saved in a buffer with a capacity for up to 1000 events, and a time stamp precision of one millisecond.

Events can be viewed on the HMI and through communications. Reading the log does not delete it; it remains stored in the equipment. To clear the events from the HMI, navigate to the events menu and press and hold the "RESET" key until the number of events reads "1" and corresponds to "Deleted events". Use the corresponding "delete events" command to delete the events from communications.

Events have the following structure:

Identifier	Unique event identifier: e.g.: 51_1.4 = PICKUP OF 67P_1
Value	ON(Activated) /OFF(Deactivated): events are generated for the activation and the deactivation
Year	
Month	
Day	
Time	
Minutes	
Seconds	
Milliseconds	

The following list contains all the states of the equipment and their associated events:

Group	Status	Cause	Associated measurement
Level 1 phase definite-time overcurrent			
50P_1	50P_1 Phase A Pickup	Activation/Deactivation	Phase A current
	50P_1 Phase B Pickup	Activation/Deactivation	Phase B current
	50P_1 Phase C Pickup	Activation/Deactivation	Phase C current
	50P_1 Pickup	Activation/Deactivation	-
	50P_1 Phase A trip	Activation/Deactivation	Phase A current
	50P_1 Phase B trip	Activation/Deactivation	Phase B current
	50P_1 Phase C trip	Activation/Deactivation	Phase C current
	50P_1 Trip	Activation/Deactivation	-
Level 2 phase definite-time overcurrent			
50P_2	50P_2 Phase A Pickup	Activation/Deactivation	Phase A current
	50P_2 Phase B Pickup	Activation/Deactivation	Phase B current
	50P_2 Phase C Pickup	Activation/Deactivation	Phase C current
	50P_2 Pickup	Activation/Deactivation	-
	50P_2 Phase A trip	Activation/Deactivation	Phase A current
	50P_2 Phase B trip	Activation/Deactivation	Phase B current
	50P_2 Phase C trip	Activation/Deactivation	Phase C current
	50P_2 Trip	Activation/Deactivation	-
Level 1 phase Inverse-time directional overcurrent			
67/51/50P_1	67P_1 Phase A Pickup	Activation/Deactivation	Phase A current
	67P_1 Phase B Pickup	Activation/Deactivation	Phase B current
	67P_1 Phase C Pickup	Activation/Deactivation	Phase C current
	67P_1 Pickup	Activation/Deactivation	-
	67P_1 Phase A trip	Activation/Deactivation	Phase A current
	67P_1 Phase B trip	Activation/Deactivation	Phase B current
	67P_1 Phase C trip	Activation/Deactivation	Phase C current
	67P_1 Trip	Activation/Deactivation	-
Level 2 phase Inverse-time directional overcurrent			
67/51/50P_2	67P_2 Phase A Pickup	Activation/Deactivation	Phase A current

	67P_2 Phase B Pickup	Activation/Deactivation	Phase B current
	67P_2 Phase C Pickup	Activation/Deactivation	Phase C current
	67P_2 Pickup	Activation/Deactivation	-
	67P_2 Phase A trip	Activation/Deactivation	Phase A current
	67P_2 Phase B trip	Activation/Deactivation	Phase B current
	67P_2 Phase C trip	Activation/Deactivation	Phase C current
	67P_2 Trip	Activation/Deactivation	-
Level 1 neutral definite-time overcurrent			
50N_1	50N_1 Pickup	Activation/Deactivation	Neutral current
	50N_1 Trip	Activation/Deactivation	Neutral current
Level 2 neutral definite-time overcurrent			
50N_2	50N_2 Pickup	Activation/Deactivation	Neutral current
	50N_2 Trip	Activation/Deactivation	Neutral current
Level 1 neutral inverse-time directional overcurrent			
67/51/50N_1	67N_1 Pickup	Activation/Deactivation	Neutral current
	67N_1 Trip	Activation/Deactivation	Neutral current
Level 2 neutral inverse-time directional overcurrent			
67/51/50N_2	67N_2 Pickup	Activation/Deactivation	Neutral current
	67N_2 Trip	Activation/Deactivation	Neutral current
Negative sequence inverse-time overcurrent			
46	46 Pickup	Activation/Deactivation	Negative sequence current
	46 Trip	Activation/Deactivation	Negative sequence current
Thermal image			
49	49 Alarm	Activation/Deactivation	Thermal image measurement
	49 Trip	Activation/Deactivation	Thermal image measurement
Level1: Definite time undercurrent			
37P_1	37P_1 Phase A Pickup	Activation/Deactivation	Phase A current
	37P_1 Phase B Pickup	Activation/Deactivation	Phase B current
	37P_1 Phase C Pickup	Activation/Deactivation	Phase C current
	37P_1 Pickup	Activation/Deactivation	-
	37P_1 Phase A trip	Activation/Deactivation	Phase A current

	37P_1 Phase B trip	Activation/Deactivation	Phase B current
	37P_1 Phase C trip	Activation/Deactivation	Phase C current
	37P_1 Trip	Activation/Deactivation	-
Level2: Definite time undercurrent			
37P_2	37P_2 Phase A Pickup	Activation/Deactivation	Phase A current
	37P_2 Phase B Pickup	Activation/Deactivation	Phase B current
	37P_2 Phase C Pickup	Activation/Deactivation	Phase C current
	37P_2 Pickup	Activation/Deactivation	-
	37P_2 Phase A trip	Activation/Deactivation	Phase A current
	37P_2 Phase B trip	Activation/Deactivation	Phase B current
	37P_2 Phase C trip	Activation/Deactivation	Phase C current
	37P_2Trip	Activation/Deactivation	-
Level 1 phase definite-time overvoltage			
59P_1	59P_1 Phase A Pickup	Activation/Deactivation	Phase A voltage
	59P_1 Phase B Pickup	Activation/Deactivation	Phase B voltage
	59P_1 Phase C Pickup	Activation/Deactivation	Phase C voltage
	59P_1 Pickup	Activation/Deactivation	-
	59P_1 Phase A trip	Activation/Deactivation	Phase A voltage
	59P_1 Phase B trip	Activation/Deactivation	Phase B voltage
	59P_1 Phase C trip	Activation/Deactivation	Phase C voltage
	59P_1 Trip	Activation/Deactivation	-
Level 2 phase definite-time overvoltage			
59P_2	59P_2 Phase A Pickup	Activation/Deactivation	Phase A voltage
	59P_2 Phase B Pickup	Activation/Deactivation	Phase B voltage
	59P_2 Phase C Pickup	Activation/Deactivation	Phase C voltage
	59P_2 Pickup	Activation/Deactivation	-
	59P_2Phase A trip	Activation/Deactivation	Phase A voltage
	59P_2 Phase B trip	Activation/Deactivation	Phase B voltage
	59P_2 Phase C trip	Activation/Deactivation	Phase C voltage
	59P_2 Trip	Activation/Deactivation	-
Level 1 neutral definite-time overvoltage			

59N_1	59N_1 Pickup	Activation/Deactivation	Neutral voltage
	59N_1 Trip	Activation/Deactivation	Neutral voltage
Level 2 neutral definite-time overvoltage			
59N_2	59N_2 Pickup	Activation/Deactivation	Neutral voltage
	59N_2 Trip	Activation/Deactivation	Neutral voltage
Level 1 phase definite-time undervoltage			
27P_1	27P_1 Phase A Pickup	Activation/Deactivation	Phase A voltage
	27P_1 Phase B Pickup	Activation/Deactivation	Phase B voltage
	27P_1 Phase C Pickup	Activation/Deactivation	Phase C voltage
	27P_1 Pickup	Activation/Deactivation	-
	27P_1 Phase A trip	Activation/Deactivation	Phase A voltage
	27P_1 Phase B trip	Activation/Deactivation	Phase B voltage
	27P_1 Phase C trip	Activation/Deactivation	Phase C voltage
	27P_1 Trip	Activation/Deactivation	-
Level 2 phase definite-time undervoltage			
27P_2	27P_2 Phase A Pickup	Activation/Deactivation	Phase A voltage
	27P_2 Phase B Pickup	Activation/Deactivation	Phase B voltage
	27P_2 Phase C Pickup	Activation/Deactivation	Phase C voltage
	27P_2 Pickup	Activation/Deactivation	-
	27P_2 Phase A trip	Activation/Deactivation	Phase A voltage
	27P_2 Phase B trip	Activation/Deactivation	Phase B voltage
	27P_2 Phase C trip	Activation/Deactivation	Phase C voltage
	27P_2 Trip	Activation/Deactivation	-
Level 1 definite-time directional overpower			
32_1	32_1 Pickup	Activation/Deactivation	-
	32_1 Trip	Activation/Deactivation	-
Level 2 definite-time directional overpower			
32_2	32_2 Pickup	Activation/Deactivation	-
	32_2 Trip	Activation/Deactivation	-
Level 3 definite-time directional overpower			
32_3	32_3 Pickup	Activation/Deactivation	-

	32_3 Trip	Activation/Deactivation	-
Level 4 definite-time directional overpower			
32_4	32_4 Pickup	Activation/Deactivation	-
	32_4 Trip	Activation/Deactivation	-
Level1: Underfrequency/Overfrequency			
81_1	81_1 Pickup	Activation/Deactivation	Frequency
	81_ Trip	Activation/Deactivation	Frequency
	81_1 Block	Activation/Deactivation	-
Level2: Underfrequency/Overfrequency			
81_2	81_1 Pickup	Activation/Deactivation	Frequency
	81_ Trip	Activation/Deactivation	Frequency
	81_1 Block	Activation/Deactivation	-
Level3: Underfrequency/Overfrequency			
81_3	81_1 Pickup	Activation/Deactivation	Frequency
	81_ Trip	Activation/Deactivation	Frequency
	81_1 Block	Activation/Deactivation	-
Level4: Underfrequency/Overfrequency			
81_4	81_1 Pickup	Activation/Deactivation	Frequency
	81_ Trip	Activation/Deactivation	Frequency
	81_1 Block	Activation/Deactivation	-
Cold Load Pickup			
CLP	CLP Activation	Activation/Deactivation	-
Circuit breaker opening fault			
50BF	50BF Pickup	Activation/Deactivation	-
	50BF Trip	Activation/Deactivation	-
General:			
	Trip	Activation/Deactivation	-
	Battery supply	Activation/Deactivation	-
	Network frequency at 50Hz	Activation/Deactivation	-
	Magnetic module error (Non compact SILB)	Activation/Deactivation	-

	Measurement error	Activation/Deactivation	-
	Ready	Activation/Deactivation	-
	Protection error	Activation/Deactivation	-
	Settings changed	Activation/Deactivation	-
	Date-time synchronization	Activation	-
	Settings by default	Activation/Deactivation	-
	Manual closure	Activation/Deactivation	-
	Remote Control to Local	Activation/Deactivation	-
	E2prom by default	Activation/Deactivation	-
	E2prom error	Activation/Deactivation	-
	IRIG B presence	Activation/Deactivation	--
	Change of e2prom values	Activation/Deactivation	-
	Events error	Activation	-
	New oscillographic log	Activation	-
	Measurement error	Activation/Deactivation	-
	Events deleted	Activation	-
	Pickup of some neutral function	Activation/Deactivation	-
	Pickup of some phase A function	Activation/Deactivation	-
	Pickup of some phase B function	Activation/Deactivation	-
	Pickup of some phase C function	Activation/Deactivation	-
	Pickup of a function	Activation/Deactivation	-
	Phase A trip	Activation/Deactivation	-
	Phase B trip	Activation/Deactivation	-
	Phase C trip	Activation/Deactivation	-
	Trip of 50N_1 or 50N_2	Activation/Deactivation	-
	Trip of 50P_1 or 50P_2	Activation/Deactivation	-
Logical inputs			
	Input 52 a	Activation/Deactivation	-
	Input 52 b	Activation/Deactivation	-
	Locking 50P input	Activation/Deactivation	-

	Locking 50N input	Activation/Deactivation	-
	External trip input	Activation/Deactivation	-
	Input oscillography start	Activation/Deactivation	-
	Start 79 input	Activation/Deactivation	-
	Permission 79 input	Activation/Deactivation	-
	Locking 79 level input	Activation/Deactivation	-
	Active table input0	Activation/Deactivation	-
	Active table input1	Activation/Deactivation	-
	Lock pulse input 79	Activation/Deactivation	-
	Unlock pulse input 79	Activation/Deactivation	-
	Start 50BF	Activation/Deactivation	-
Physical inputs			
	Input 1	Activation/Deactivation	-
	Input 2	Activation/Deactivation	-
	Input 3	Activation/Deactivation	-
	Input 4	Activation/Deactivation	-
	Input 5	Activation/Deactivation	-
	Input 6	Activation/Deactivation	-
	Input 7	Activation/Deactivation	-
	Input 8	Activation/Deactivation	-
	Command voltage	Activation/Deactivation	-
	Continuity coil A	Activation/Deactivation	-
	Continuity coil B	Activation/Deactivation	-
Physical outputs			
	Output 1	Activation/Deactivation	-
	Output 2	Activation/Deactivation	-
	Output 3	Activation/Deactivation	-
	Output 4	Activation/Deactivation	-
	Output 5	Activation/Deactivation	-
	Output 6	Activation/Deactivation	-
	Output 7	Activation/Deactivation	-

	Output 8	Activation/Deactivation	-
	Output 9	Activation/Deactivation	-
	Output 10	Activation/Deactivation	-
	Output 11	Activation/Deactivation	-
	Output 12	Activation/Deactivation	-
Logical outputs			
	Start 79	Activation/Deactivation	-
	Start 50BF	Activation/Deactivation	-
	Start oscillography	Activation/Deactivation	-
	79 Closure permission (models with function 25)	Activation/Deactivation	-
	52 Closure permission (models with 25 function)	Activation/Deactivation	-
Recloser			
79	79 Inactive	Activation/Deactivation	-
	79 Reclosure time	Activation	Reclosure no.
	79 Open	Activation	Reclosure no.
	79 Hold time	Activation	Reclosure no.
	79 Closure time	Activation	Reclosure no.
	79 Reset time	Activation	Reclosure no.
	79 Lockout	Activation/Deactivation	Reclosure no.
	79 Safety time	Activation	Reclosure no.
	79 Definitive opening time	Activation	-
Synchronism			
25	25 LLLB: Live line, dead bar	Activation/Deactivation	-
	25 DLLB: Dead line, live bar	Activation/Deactivation	-
	25 LLDB: live line, dead bar	Activation/Deactivation	-
	25 DLDB: Dead line, dead bar	Activation/Deactivation	-
	25 Closure permission	Activation/Deactivation	-
Circuit breaker monitoring			
52	52 Start	Deactivation	-

	52 Error	Activation/Deactivation	-
	52 Open	Activation	Opening time
	52 Opening time	Activation	-
	52 Opening failure	Activation/Deactivation	-
	52 Close	Activation/Deactivation	Closure time
	52 Closure time	Activation	-
	52 Closure failure	Activation/Deactivation	-
	52 Total excess openings	Activation/Deactivation	-
	52 Excess accumulated amperes (I^2t)	Activation/Deactivation	-
	52 Excess of openings in a time window	Activation/Deactivation	-
	52 a	Activation/Deactivation	-
	52 b	Activation/Deactivation	-
Trip circuit monitoring			
74TCS	74TCS Pickup	Activation/Deactivation	-
	74TCS Activation	Activation/Deactivation	-
Remote control			
	Command selection	Activation	-
	Open 52	Activation	-
	Close 52	Activation	-
	Lock 79	Activation	-
	Unlock 79	Activation	-
Local control			
	Command selection	Activation	-
	Open 52	Activation	-
	Close 52	Activation	-
	Lock 79	Activation	-
	Unlock 79	Activation	-
	Set Remote Control to Local	Activation	-
	Set Remote Control to Remote	Activation	-

5.4. Fault Reports

A fault report is a record of specific events in the period of time when a fault occurs. On the one hand, an oscillography record is very extensive information, but only short regarding time for a significant number of faults. Also, event recording can be filled with general events, which provide no information of a fault (tables change, local pulsing, etc.) whereby it could be filled with general information, losing any fault information. Therefore, having a specific events record for the fault period is of significant help to resolve an incident.

This record has a 20 fault capacity, and each fault can store 80 events. At any moment, the information of the twenty most recent fault reports is available. Each new fault report generated is stored on the oldest, is lost, therefore, the information of this one. The fault report is time limited by means of a fault start and a fault end, and these must be clearly established.

The twenty fault reports are generated and they are registered in no-volatile FRAM memory. From the HMI, by pressing key "◄", you will gain access to fault reports. The information displayed is as follows:

- Date-time at which the fault started.
- List of all events occurred in the equipment during the fault

The fault start is the same as that of the oscillography, i.e. an oscillography shall always be associated to the fault report. The fault end shall depend on whether the recloser is active. If the recloser is prohibited, when all start ups disappear it is understood that the fault has disappeared (this includes the circuit breaker fault). With the recloser permitted, the fault end is given by the final condition of the recloser, regardless of whether it has been successful or it has become blocked. As a general rule, the following logic shall provide the fault end.

5.5. Real Time Clock (RTC)

For events, oscillographies and alarms the protection equipment required a clock for date and time stamping. This clock must keep the date and time even with no power supply, for up to 72 hours (With the capacity charged beforehand).

If there is an events queue, and the clock is synchronized with a date and time prior to the last stored event, the relay does not reorder the queue, but rather it stores the new events after the events already in the queue.

This clock can be synchronized with another clock in various ways:

- **From the HMI.** In this case the date and time can be entered using a keyboard. The relay will save a new event indicating that it has been synchronised.
- **By protocol.** There are two options in this case:
    - **Local protocol.** The performance is identical to the HMI, the relay synchronises the date and time and executes a new synchronisation event.
    - **Remote protocols.** These protocols can include continuous synchronisation sections. For this reason, the execution of synchronisation events is inappropriate.

5.6. Oscillography

The SIL-B relay stores 2 oscillographic logs, with a resolution of 16 samples/cycle and a size of 138 cycles, of which the first 10 correspond to the pre-fault.

The oscillography can be downloaded by communications from the front or rear port through the Modbus protocol (the protocol is documented in this manual). The SICom communications program allows the oscillography to be downloaded and saved in COMTRADE format (IEEE C37.111-1991).

The following information is included in each oscillographic log:

Number	Analogue 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	Busbar voltage

The primary current and voltage are expressed in amperes and volts.

As well as the analogue magnitudes, the relay stores 128 digital logs, with the same precision of 16 samples/cycle. These 128 bits have the following content:

1	50P_1 Pickup phase A	2	50P_1 Pickup phase B	3	50P_1 Pickup phase C
4	50P_1 Trip	5	50P_2 Pickup phase A	6	50P_2 Pickup phase B
7	50P_2 Pickup phase C	8	50P_2 Trip	9	67P_1 Pickup phase A
10	67P_1 Pickup phase B	11	67P_1 Pickup phase C	12	67P_1 Trip
13	67P_2 Pickup phase A	14	67P_2 Pickup phase B	15	67P_2 Pickup phase C
16	67P_2 Trip	17	50N_1 Pickup	18	50N_1 Trip
19	50N_2 Pickup	20	50N_2 Trip	21	67N_1 Pickup
22	67N_1 Trip	23	67N_2 Pickup	24	67N_2 Trip
25	46 Pickup	26	46 Trip	27	50BF Pickup
28	50BF Trip	29	CLP Activated	30	52 Error
31	52 Open	32	52 Opening failure	33	52 Close
34	General trip	35	79 Inactive	36	79 Reclosing time
37	79, 52 Open?	38	79 Hold time	39	79 Closure time
40	79 Reset time	41	79 Lockout	42	79 Safety time

43	79 Definite opening time
46	59P_1 Pickup phase C
49	59P_2 Pickup phase B
52	59N_1 Pickup
55	59N_2 Trip
58	27_1 Pickup phase C
61	27_2 Pickup phase B
64	32_1 Pickup
67	32_2 Trip
70	32_4 Pickup
73	74TCS Trip
76	81_1 Pickup
79	81_2 Trip
82	81_ 4 Pickup
85	37_1 Pickup phase A
88	37_1 Trip
91	37_2 Pickup phase C
94	Input 2
97	Input 5
100	Input 8
103	Blocking phase input
106	Oscillo starting input
109	79 blocking level input
112	79 Lock pulse input
115	50BF starting
118	Output 2
121	Output 5
124	Output 8
127	Output 11

44	59P_1 Pickup phase A
47	59P_1 Trip
50	59P_2 Pickup phase C
53	59N_1 Trip
56	27_1 Pickup phase A
59	27_1 Trip
62	27_2 Pickup phase C
65	32_1 Trip
68	32_3 Pickup
71	32_4 Trip
74	49 Alarm
77	81_1 Trip
80	81_3 Pickup
83	81_4 Trip
86	37_1 Pickup phase B
89	37_2 Pickup phase A
92	37_2 Trip
95	Input 3
98	Input 6
101	Input 52 a
104	Blocking neutral input
107	79 starting input
110	Active table input 0
113	79 unlock pulse input
116	79 starting
119	Output 3
122	Output 6
125	Output 9
128	Output 12

45	59P_1 Pickup phase B
48	59P_2 Pickup phase A
51	59P_2 Trip
54	59N_2 Pickup
57	27_1 Pickup phase B
60	27_2 Pickup phase A
63	27_2 Trip
66	32_2 Pickup
69	32_3 Trip
72	74TCS Pickup
75	49 Trip
78	81_2 Pickup
81	81_3 Trip
84	25 Closure permission
87	37_1 Pickup phase C
90	37_2 Pickup phase B
93	Input 1
96	Input 4
99	Input 7
102	Input 52 b
105	External trip input
108	79 permission input
111	Active table input 1
114	50BF starting input
117	Output 1
120	Output 4
123	Output 7
126	Output 10

The following additional information is included in the COMTRADE header file (*.hdr): oscillography date-time, oscillography number, relay identifier and a list with all the events generated in the equipment during the generation of the oscillography.

Below the format of a COMTRADE header file generated by the SICom program is provided:

```
   *******.HDR COMTRADE ***************************************

Pre-fault cycles =  10
Total cycles =  138
Analogue channels =  8
Digital channels =  120

Oscillo :  41458
Date/Time : 2008/10/15   11:29:11:85

Fault queue =  15
************************************************************
Oscillo events:
************************************************************
```

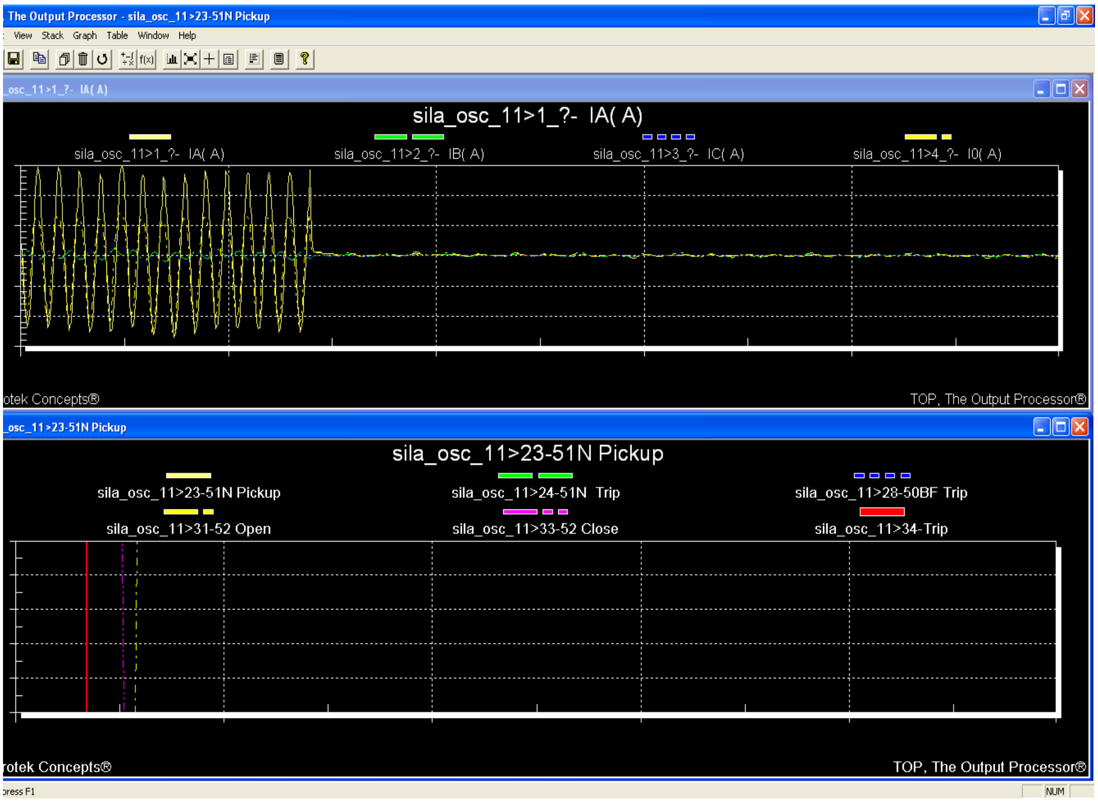
Indicator	**Value**	**Measurement1**	**Measurement2**	**Date**	**Time**
Oscillo start	1	0	0	2008/10/15	11:29:11:90
Oscillo start	0	0	0	2008/10/15	11:29:11:400

```
************************************************************
```

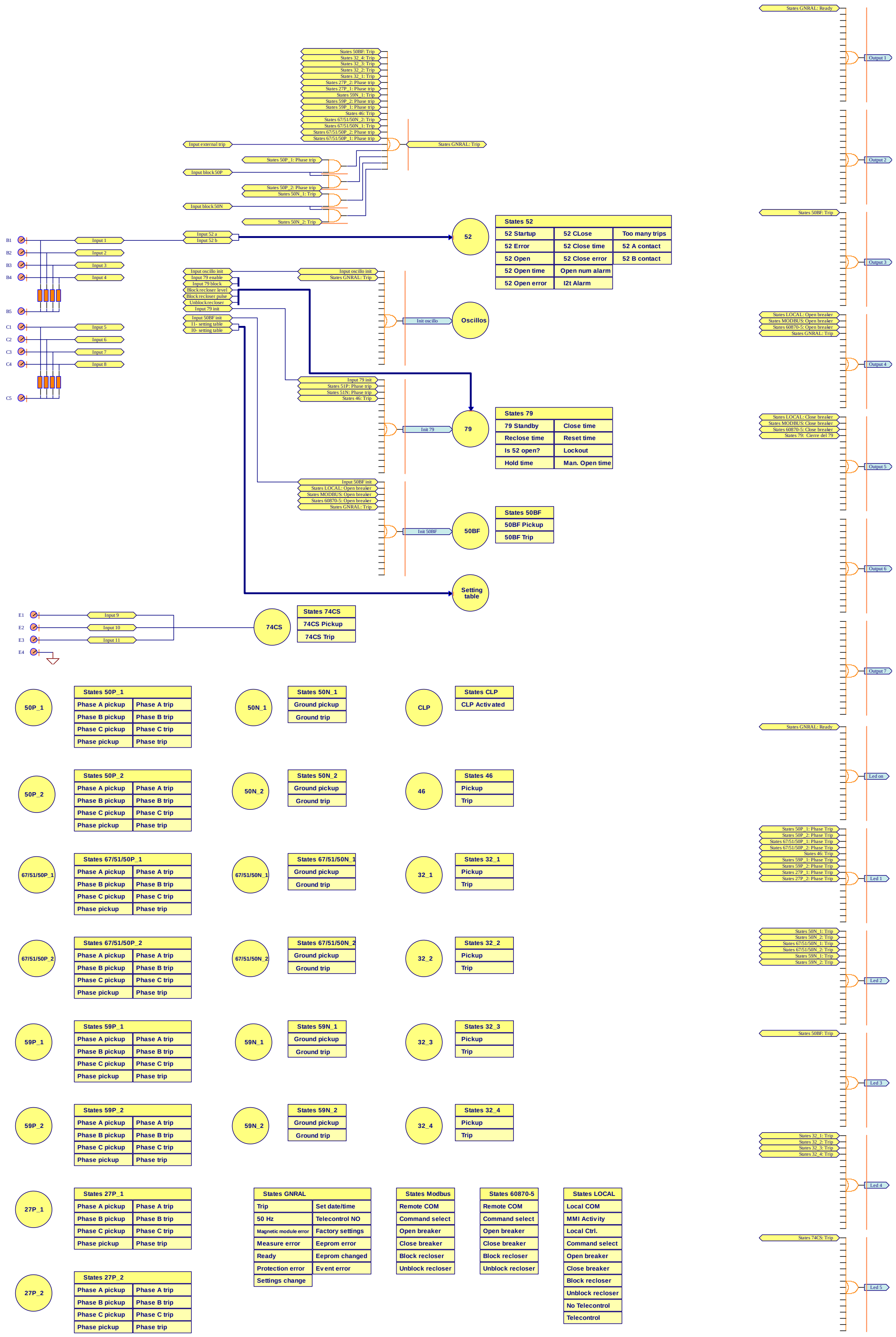
An oscillography is started when the "Start oscillography" state is activated; this is a configurable logical output. The default configuration is as follows:

- General trip
- Oscillography start input

There are different programs that allow the file to be viewed in COMTRADE format, such as *TOP*, *The Output Processor®*, which can be downloaded from the internet at www.pqsoft.com/top/



5.7. Data Diagram



5.8. Configurable inputs

The SIL-B has eight digital inputs that can be configured by the user. The inputs can be configured from the HMI or through the SICom program.

Firstly, we will define the concepts of physical input and logical input. Physical inputs are the equipment's real inputs. The SIL-B has eight physical inputs: Input 1, Input 2, Input 3,... up to Input 8. These physical inputs can be associated with the logical inputs. The SIL-B has the following logical inputs:

Logical inputs	Description
Input 52 a	Circuit breaker contact a
Input 52 b	Circuit breaker contact b
Locking phase input	Function 50P1 and 50P2 trip lock
Locking neutral input	Function 50N1 and 50N2 trip lock
External trip input	External trip start. If a pulse of more than 20 ms is received (to avoid false signals), a 200 ms pulse is generated to be used in the trip output.
Oscillography Pickup Input	Oscillography Start
Input Start 79	Start of 79 through external protection
Permission 79 input	Permission to close 79
Locking 79 level input	Lock of 79 through a level input
Input-0 Table Active	Active table assignment
Input-1 Table Active	Active table assignment
Locking 79 input pulse	Lock of 79 through a pulse input of an RTU
Unlock 79 pulse input	Unlock of 79 through a pulse input of a RTU
Input start 50BF	Start of circuit breaker fault through external protection

The inputs are configured by associating the logical inputs with the required physical input, or to none if the logical input is not used. Therefore, a single physical input can be assigned to more than one logical input.

In the following example:

- input 1 is assigned to contact a of the circuit breaker,
- input 2 is assigned to contact b of the circuit breaker,
- input 3 is assigned to the function 50P locking,
- input 4 is assigned to the function 50N locking,
- In addition, it is understood that there is an additional protection, which starts up 79 and assigns input 5 to said start. As well as bouncing the trip, this input allows the oscillography to start up.
- A key is provided (input 6), which allows the 79 to be locked.
- Similarly, this protection starts up the circuit breaker fault with input 7
- and finally, the active table is controlled with input 8
- The 79 permission function is not assigned to anything in particular, as a synchronizer is not necessary for closure. However, in this case it is best to prohibit the wait time of the recloser.

Logical inputs	Inp1	Inp2	Inp3	Inp4	Inp5	Inp6	Inp7	Inp8
Not configured								
Input 52 a	X							
Input 52 b		X						
Locking 50P input			X					
Locking 50N input				X				
External trip input					X			
Oscillography Pickup Input			X					
Input Start 79					X			
Permission 79 input								
Locking 79 level input						X		
Input-0 Table Active								
Input-1 Table Active								X
Locking 79 input pulse								
Unlock 79 pulse input								
Input start 50BF							X	

The default configuration of the inputs is as follows:

Logical inputs	Inp1	Inp2	Inp3	Inp4	Inp5	Inp6	Inp7	Inp8
Not configured								
Input 52 a								
Input 52 b	X							
Locking 50P input								
Locking 50N input								
External trip input								
Oscillography Pickup Input								
Input Start 79								
Permission 79 input								
Locking 79 level input								
Input-0 Table Active								
Input-1 Table Active								
Locking 79 input pulse								
Unlock 79 pulse input								
Input start 50BF								

The "Input configuration menu" section describes the process for configuring the inputs.

5.9. Configurable Outputs

The SIL-B has physical outputs and logical outputs. The physical outputs are the output relays and the logical outputs are digital states that are used internally in the relay to activate its functions. The outputs can be configured from the HMI or through the SICom program.

The following logical outputs are used internally:

Local outputs
Start 79
Start 50BF
Oscillography Start
79 Closure permission
52 Closure permission

Any available state may be assigned to an output. Up to 16 different states may be assigned to a single output basing on the following logic:

LOGICAL GATE	HMI SYMBOL
OR	
NOR	τ
OR_LACTH	C
NOR_LACTH	τ C

The default output configuration is as follows:

Outputs	Description	Status
Output 1	Device alarm	Ready
Output 2	Not configured	Not configured
Output 3	50BF trip	50BF trip
Output 4	Trip/Open	Open Modbus (local) / HMI Open Modbus (remote) Open remote (remote) General trip
Output 5	Reclose/Close	Close Modbus (local) / HMI Close Modbus (remote) Close Remote(remote) Recloser closure state
Output 6	Not configured	Not configured
Output 7	Not configured	Not configured
Start 79	Start 79	Trip 67P_1 Trip 67N_1 Trip 46 Start 79 input
Start 50BF	Start 50BF	Start input 50BF Open Modbus (local) / HMI Open Modbus (remote) Open remote (remote) General trip
Start oscillography	Start oscillography	General trip Oscillography start input
79 Closure permission	79 closure supervision because of syncronism	Not configured
52 closure permission	52 closure supervision because of syncronism	Not configured

The “Output configuration menu” section describes the process to configure the outputs.

5.10. 86 Function. Trip output lockout

When the trip utput is configured as OR_LATCH this output is locked thanks to programmable logic.

5.11. Configurable Leds

The device features 8 LEDs, 6 of which are configurable, while the other two are assigned to fixed purposes:

- Breaker status: on when the breaker is closed.
- Recloser status: on when the recloser is operational.

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

LED	Description	Status	Blinking	Latch	Negated
LED ON	Ready	Ready	x		
LED 1	50P/67P_1	50P_1 Trip 50P_2 Trip 67P_1 Trip 67P_2 Trip 46 Trip 59P_1 Trip 59P_2 Trip 27P_1 Trip 27P_2 Trip		x	
LED 2	50N/67N_1	50N_1 Trip 50N_2 Trip 67N_1 Trip 67N_2 Trip 59N_1 Trip 59N_2 Trip		x	
LED 3	50BF	50BF_Trip		x	
LED 4	32/40	32_1 Trip 32_2 Trip 32_3 Trip 32_4 Trip		X	
LED 5	74TCS	74TCS_Activation		X	

Although the ON LED is configurable, it is recommended that its default configuration as “Ready” not be modified.

5.12. Self-diagnosis

Diagnostic algorithms are run on device Pickup 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 is capable of working 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:

Measurement error	Problem in measurement block
Protection error	Problem in protection block
EEPROM error	Problem in EEPROM memory, one of the tables is corrupted
Events error	Event log error
Magnetic module error (Non compact SILB)	Connection fault detected between the device and the external magnetic module

Conversely, “Default settings” indicates that the relay is working with the factory settings, with all protection functions deactivated.

5.13. Commands

	HMI	Local Comms: ModBus	Remote Comms: Modbus IEC 60870-5-103 IEC 61850 DNP 3.0
Open 52	✓	✓	✓
Close 52	✓	✓	✓
Lock 79	✓	✓	✓
Unlock 79	✓	✓	✓
Remote Control to Local	✓	-	-
Remote control	✓	-	-

- To execute commands remotely (ModBus, IEC60870-5-103, IEC 61850 or DNP 3.0) the device must be operating in REMOTE CONTROL mode.
- Commands may be executed by HMI or local communications (ModBus), whether or not the device is in remote control mode.

5.14. Remote Control

Changing the mode to remote control or local control can only be undertaken through the HMI.

If remote control is used, it is recommended that an LED be configured to indicate when remote control is permitted and when it is not.

5.15. Date-Time synchronization. IRIG B

The device can be synchronized by HMI or by remote or local communications.

Depending on model, it is possible to synchronize the relay with a time code IRIG B.

IRIG-B is one of the time code IRIG (Inter-Range Instrumentation Group time codes) which is definied in standard IRIG-STANDARD 200-04

The time code IRIG B encoding is based on the following specification:

B	Format B 100 pps
1	Modulación: 0, encoded digital signal by pulse wide 1, sinusoidal modulated signal in amplitude 2, modulated signal with Manchester codification
2	Frequency/Resolution: 2, 1kHz / 1ms
X	Encoded information: 0, BCD_{TOY} , CF, SBS 1, BCD_{TOY} , CF 2, BCD_{TOY} 3, BCD_{TOY} , SBS 4, BCD_{TOY} , BCD_{YEAR}, CF, SBS 5, BCD_{TOY} , BCD_{YEAR}, CF 6, BCD_{TOY} , BCD_{YEAR} 7, BCD_{TOY} , BCD_{YEAR}, SBS

BCD_{TOY} , time of year encoded in BCD (Binay Coded Decimal)

BCD_{YEAR} , year encoded in BCD

CF, Control functions

SBS, SBS time of day, seconds of day

5.16. Test program

The SIL-B device features a test menu for use in verifying the working of the LEDs and outputs.

The following table shows elements that can be verified, and their state, depending on whether they are activated or deactivated:

LED-1	Not activated	LED-1 not activated
	Activated	LED-1 activated
LED-2	Not activated	LED-2 not activated
	Activated	LED-2 activated
LED-3	Not activated	LED-3 not activated
	Activated	LED-3 activated
LED-4	Not activated	LED-4 not activated
	Activated	LED-4 activated
LED-5	Not activated	LED-5 not activated
	Activated	LED-5 activated
LED-79	Not activated	LED-79 not activated
	Activated	LED-79 activated
LED-52	Not activated	LED-52 not activated
	Activated	LED-52 activated
LED-ON	Not activated	LED-ON not activated
	Activated	LED-ON activated
Output 1	Not activated	Output not activated
	Activated	Output activated
Output 2	Not activated	Output not activated
	Activated	Output activated
Output 3	Not activated	Output not activated
	Activated	Output activated
Output 4	Not activated	Output not activated
	Activated	Output activated
Output 5	Not activated	Output not activated
	Activated	Output activated
Output 6	Not activated	Output not activated
	Activated	Output activated

Output 7	Not activated	Output not activated
	Activated	Output activated

The key sequence to access the test menu is as follows: From the main menu enter the key sequence “◄”, “▼”, “►” and then press and hold “OK” until the “Test menu” is displayed, indicating that while the test menu is active, protection is deactivated. Pressing “OK” bring up the passcode introduction menu; if the correct passcode is introduced, the text menu is accessed by pressing “OK” again. Navigate the menu using the “▲” and “▼” 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.

Inputs can be verified using the state menu.

For more detailed information, see the section on keypad and display for explanations of menu navigation.

5.17. Power Supply

The unit’s power consumption is less than 4 Watts.

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

In the cases of 110V AC/230V AC, ±20% of the established values is guaranteed (110 or 230): so at 150V AC, the device may function, but 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.

6. TECHNICAL SPECIFICATIONS AND STANDARDS

6.1. Technical specifications

50P_1 **50P_2**	Function permission : yes/no
	Operating range: 0.10 to 30 xIn (step 0.01)
	Operating time: 0.02 to 300.00 s (step 0.01 s)
	Activation level: 100%
	Deactivation level: 95%
	Instantaneous deactivation
	Timing accuracy: 30 ms
50N_1/50G_1 **50N_2/50G_2**	Function permission : yes/no
	Operating range: 0.10 to 30 xIn (step 0.01)
	Operating time: 0.02 to 300.00 s (step 0.01 s)
	Activation level: 100%
	Deactivation level: 95%
	Instantaneous deactivation
	Timing accuracy: 30 ms
67/51/50P_1 **67/51/50P_2**	Function permission : yes/no
	Operating range I: 0.10 to 7 xIn (step 0.01)
	Operating range V: 4 to 110V (step 1 V)
	IEC 60255-151 and ANSI curves
	Operating time: Inverse curve, very inverse curve, extremely inverse curve. Defined time: 0.02 to 300 s (step 0.01 s)
	Dial: 0.05 to 2.20 (step 0.01)
	Directionality: yes/no
	Operating angle: 0 to 359º (step 1º)
	Half cone angle: 0 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: 5% or 30 ms (whichever is higher)
67/51/50N_1 **67/51/50N_2**	Function permission : yes/no
	Operating range I: 0.10 to 7 xIn (step 0.01)
	Operating range V: 4 to 110 V (step 1 V)
	IEC 60255-151 and ANSI curves
	Operating time: Inverse curve, very inverse curve, extremely inverse curve. Defined time: 0.02 to 300 s (step 0.01 s)
	Dial: 0.05 to 2.20 (step 0.01)
	Directionality: yes/no
	Operating angle: 0 to 359º (step 1º)
	Half cone angle: 0 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: 5% or 30 ms (whichever is higher)
46	Function permission : yes/no
	Operating range: 0.10 to 1 xIn (step 0.01)
	IEC 60255-151 and ANSI curves
	Operating time: Inverse curve, very inverse curve, extremely inverse curve. Defined time: 0.02 to 300 s (step 0.01 s)
	Dial: 0.05 to 2.20 (step 0.01)
	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: 5% or 30 ms (whichever is higher)
49	Function permission : yes/no
	Tap: 0.10 a 2.40 Inominal (step 0.01)
	ζ heating: 3 a 600 minutos (step 1 min)
	ζ cooling: 1 a 6 veces ζ heating (step 1)
	Alarm level: 20 a 99% (step 1%)
	Trip level: 100%
	Deactivation level: 95% of alarm level
	Timing accuracy: ± 5% respect of theorical value.
	Trip time curves are valid under 20 times the adjusted tap. With currents higher than 20 times the adjusted tap, trip time and thermal image value are truncated to 20 times the adjusted tap.
37_1 **37_2**	Function permission : yes/no
	Operating range: 0.10 to 30 xIn (step 0.01)
	Operating time: 0.02 to 300 s (step 0.01 s)
	Activation level: 100%
	Deactivation level: 105%
	Instantaneous reset
	Timing accuracy: 30 ms
59P_1 **59P_2**	Function permission : yes/no
	Operating range: 4 to 110V (step 1 V)
	Operating time: 0.02 to 300 s (step 0.01 s)
	Reset time: 0.2 to 1200.0 s (step 0.1 s)
	Activation level: 100%
	Deactivation level: 95%
	Temporized deactivation
	Timing accuracy: 30 ms
59N_1 **59N_2**	Function permission : yes/no
	Operating range: 4 to 110V (step 1 V)
	Operating time: 0.02 to 300 s (step 0.01 s)
	Reset time: 0.2 to 1200.0 s (step 0.1 s)

	Activation level: 100%
	Deactivation level: 95%
	Temporized deactivation
	Timing accuracy: 30 ms
27P_1 **27P_2**	Function permission : yes/no
	Operating range: 4 to 110V (step 1 V)
	Operating time: 0.02 to 300 s (step 0.01 s)
	Reset time: 0.2 to 1200.0 s (step 0.1 s)
	Activation level: 100%
	Deactivation level: 105%
	Temporized deactivation
	Timing accuracy: 30 ms
32_1 **32_2** **32_3** **32_4**	Function permission : yes/no
	Operating range: 0 to 10000 VA (step 1 VA) – secondary values
	Operating angle: 0 to 359º (step 1º)
	Operating time: 0.02 to 300 s (step 0.01 s)
	Activation level: 100%
	Deactivation level: 95%
	Instantaneous deactivation
81_1 **81_2** **81_3** **81_4**	Function permission : yes/no
	Type: Underfrequency or overfrecuency
	Operating range: 45.00 a 65.00 Hz (step 0.01 Hz)
	Operating timr: 0.02 a 300 s (step 0.01 s)
	Reset time: 0.2 a 1200.0 s (step 0.1 s)
	Block function if phase b voltage is lower than 30 volts
	Activation level: 100%
	Underfrequency reset level: activation level + 50mHz Overfrequency reset level: activation level – 50 mHz
	Temporized deactivation
	Timing accuracy: 30 ms

Circuit breaker monitoring	Breaker state: start, open, closed, error, opening time, opening error, closure time, closure error
	52a input and/or 52b input
	Opening and closure commands
	Maximum number of openings alarm: 1 a 10000
	Total amps alarm: 0 to 100000 ($M(A^2)$)
	Excess repeated openings: 1 a 10000
	Repeated openings excess time: 1 to 300 min
50BF	Function permission : yes/no
	Opening failure time: 0.02 to 1.00 s (step 0. 01 s)
	Open breaker activation threshold: 8% In
	Open breaker reset time: 10% In
	Function start: Device trip, opening failure input activation, breaker opening command activation
79	Function permission : yes/no
	Wait permission: yes/no
	Number of reclosings: 1 to 5
	Reclosure times 1, 2, 3, 4, 5 : 0.02 to 300.00 s (step 0.01 s)
	Hold time: 0.02 to 300 s (step 0.01 s)
	Locking possibilities: pulse inputs, level inputs, commands.
	Replacement time: 0.02 to 300.00 s (step 0.01 s)
	Definitive opening time: 0.02 to 300 s (step 0.01 s)
25	Closure permission LLLB, LLDB, DLLB, DLDB: yes/no
	Live line/bar voltage level: 30 to 110 V (step 0.1 V)
	Dead line/bar voltage level: 4 to 110 V (step 0.1 V)
	Voltage supervisión temporisation: 0.02 to 300 s (step 0.01 s)
	Line-bar voltage difference: 4 to 110 V (step 0.1 V)
	Line-bar phase difference: 0 to 359º (step 1 º)
	Line-bar frequency difference : 0.02 to 0.50 Hz (step 0.01 Hz)
	Synchro temporization: 0.02 to 300 s (step 0.01 s)
	Phase B line voltage and busbar voltage Modules and phases using DFT Frequency using hardware circuit with the passing through zero detection.

	Permission signal minimum time 150 ms
74TCS	Function permission: yes/no
	Operating time: 0.02 to 300 s (step 0.01 s)
	Command voltage presence: -40%
	Trip continuity, in circuit a and b.
CLP	Function permission : yes/no
	50P_1 multiplier range: 1 to 5
	50P_2 multiplier range: 1 to 5
	67P_1 multiplier range: 1 to 5
	67P_2 multiplier range: 1 to 5
	50N_1/50G_1 multiplier range: 1 to 5
	50N_2/50G_2 multiplier range: 1 to 5
	67N_1 multiplier range: 1 to 5
	67N_2 multiplier range: 1 to 5
	Time to pass to CLP: 1 a 18000 s (step 1 s)
	CLP duration time: 1 a 18000 s (step 1 s)
	CLP activation threshold: 8% In
	CLP deactivation threshold: 10% In
86	Allows to latch (lock out) the contact trip due to programmable logic (PLC: OR_LATCH).
Settings tables	1 general settings table
	3 protection criteria tables
	Selectable by input or general setting.
RTC	Condenser charge time: 10 minutes
	Functioning without auxiliary voltage: 72 hours
Oscillography	16 samples/cycle
	Oscillo starting configuration
	2 records: 10 cycles pre-fault and 128 post-fault
	COMTRADE IEEE C37.111-1991
	8 analogue channels and 120 digital channels
Fault report	20 fault reports with 80 events in each
8 configurable inputs	The voltage of the inputs is the same as the auxiliary power supply

7 configurable outputs	250 V AC – 8 A 30 V DC – 5 A
	Output 1 and output 2:Commuted (NC + NO) Others: NO
Frequency	50/60Hz
Current measurement	Phase currents (IA,IB,IC), neutral (IN), positive sequence (I1) and negative sequence (I2)
	Real RMS
	Sampling: 16 samples/cycle
	2% precision in a band covering ±20% of nominal current and ±4% in the rest of the range
Voltage measurement	Phase voltage (VA,VB,VC), phase-phase voltage (VAB,VBC,VCA), neutral voltage (VN), bus voltage (VBB)
	The neutral voltage is calculated internally from the phase voltages.
	Real RMS
	Sampling: 16 samples/cycle
	2% precision in a band covering ±20% of nominal current and 4% in the rest of the range
Angle accuracy	±2º
Power measurement	Total and per phase active power
	Total and per phase reactive power
	Total and per phase apparent power
	Total and per phase power factor
	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 measurement	Starting from phase B line voltage, passing through zero detection to line frequency Starting from phase B busbar voltage, passing through zero detection to busbar frequency.
	Minimum voltage: 30V
	Accuracy: ±0.01 Hz
Communications	Local port (RS232 or USB): Modbus RTU
	Remote port RS485: Modbus RTU
	Remote port RS485: IEC 60870-5-103
	Remote port RJ45: IEC 61850 , DNP3.0 and IEC60870-5-104

Auxiliary power supply	90 V DC – 300V DC / 110 V AC – 230 V AC ±20%
	24V DC - 48 V DC ±20%
Environmental conditions	Operating temperature: -10 to 70ºC
	Storage temperature: -20 to 80 ºC
	Relative humidity: 95%
Mechanical characteristics	Metal case
	Panel mounting
	1/2 Rack – 4 U
	IP-54

6.2. Standards

IEC 61000-4-2	Electrostatic discharge immunity tests	Level 4 Contact ±8kV Air ±15kV
IEC 61000-4-3	Testing for immunity to RF electromagnetic field interference	Level 4: 30 V/m at MHz 80-1000 800-960 1400-6000
IEC61000-4-4	Immunity to fast transients	Level 4: ±4kV – 5kHz and 0.75 ms ±20% 100kHz
IEC 61000-4-5	Surge immunity	Level 4, Class 5 ±2kV Line-Line ±4kV Line-Ground
IEC 61000-4-6	Immunity to conducted disturbances induced by radio frequency fields	Level 3 0.15 – 80 MHz 140 dB (µV) 10V
IEC 61000-4-8	Power frequency magnetic field immunity test	Level 5 Continuous: 100 A/m 3s: 1000 A/m
IEC 61000-4-9	Pulse magnetic field immunity	Level 5: 1000 A/m
IEC 61000-4-10	Immunity to damped oscillatory magnetic fields	Level 5: 100 A/m

IEC 61000-4-11	Voltage dip, short interruption and voltage variation immunity	Class 3 Voltage: 0.5 period 0% 1 period 0% 10/12 periods 40% 25/30 periods 70% 250/300 periods 80% Interruptions: 250/300 periods 0%
IEC 61000-4-12	Interruptions: Damped RF oscillatory wave immunity	Level 4: ±2kV Line-Line ±4kV Line-Ground
IEC 61000-4-14	Voltage fluctuation immunity	Class 3: 12%
IEC 61000-4-17	Ripple on DC input power port immunity	Level 4: 15% V DC
IEC 61000-4-18	Damped oscillatory wave immunity test (100kHz – 30MHz)	Slowwaves: Level 3 25kV common mode 1kV differential mode Fastwaves: Level 4 4kV common mode 4kV differential mode
IEC 61000-4-27	Imbalance	Class 3
IEC 61000-4-29	Voltage dip, short interruption and voltage variation on DC input power port immunity	Dips: 40% and 70% 1s Interruption: 1s
IEC 60255-5	Dielectric strength	Level 4
IEC 60255-5	Insulation strength	500 V DC Line-Ground
IEC 60255-5	Impulse voltage	±1kV Line-Line ±1kV Line-Ground
EN 60068-2-1	Cold	Essay Ab, -10ºC, 72h
EN 60068-2-2	Dry heat	Essay Bb +85ºC, 72h
EN 60068-2-14	Temperature change	Essay -25ºC y + 79ºC 3h (5 cycles)
IEC 60255-21-1	Sinusoidal vibrations	Class 2: 1g 10Hz – 150Hz
IEC 60255-21-2	Shock and bump tests	Class 2: 10g/11ms
IEC 60255-21-3	Seismic tests	Class 2: 2g horizontal axis 1g vertical axis
EN 50263	Generic standard for measuring relays and protective equipment	
EN 61000-6-4	Emission standard for industrial environments	

EN 61000-6-2	General standard for immunity in industrial environments	
EN 55011 **EN 55022**	RF energy emissions	Limitations for group 1, class A
IEC 60255-22-1	Interruptions: Damped RF oscillatory wave immunity	Level 3
	ISO 9001:2000 Quality Management System	

Fanox Quality Management System its certify according to standard ISO 9001:2008.

7. COMMUNICATION AND HMI

The SIL-B relay features the following communications ports:

1	LOCAL (front)	RS232 or USB	Modbus RTU
2	REMOTE (rear)	RS485	Modbus RTU
3	REMOTE (rear)	RS485	IEC 60870-5-103 (Depending on model)
4	REMOTE (rear)	RJ45	IEC 61850 (Depending on model)
5	REMOTE (rear)	RJ45	DNP 3.0 (Depending on model)

7.1. Local communication port. RS232

An RS232 port is featured on the front of the device. In non compact version the connector used is DB-9 female – DCE. The protocol used is Modbus RTU (19200 -8 bit – no parity – 1 bit stop). The map and documentation on the protocol can be found in an annex to this manual.

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

The RS232 communication system is insulated from the auxiliary voltage, but not from the shared voltage of the relay processors, so the cable connecting the PC to the relay should not be excessively long in order to avoid potential electromagnetic interference with the device.

In compact SIL the frontal port is a USB port.

7.2. Remote communications ports. RS485

SILB with two ports RS485 one for ModBus and the other one for IEC60870-5-103

The device features 2 exterior RS485 connections through three terminals (+, - y GND) located on the back of the unit. The protocols used are IEC 60870-5-103 and Modbus RTU

These ports can be used for the continuous monitoring of the device from a remote PC or SCADA system. Up to 32 units can be connected to one bus, each with its own modbus address. Speed and direction are configurable.

In order to minimize communications errors due to noise, a shielded twisted conductor cable is the recommended physical medium. In order to make the connection, connect all + terminals on one side and all – terminals on the other side.

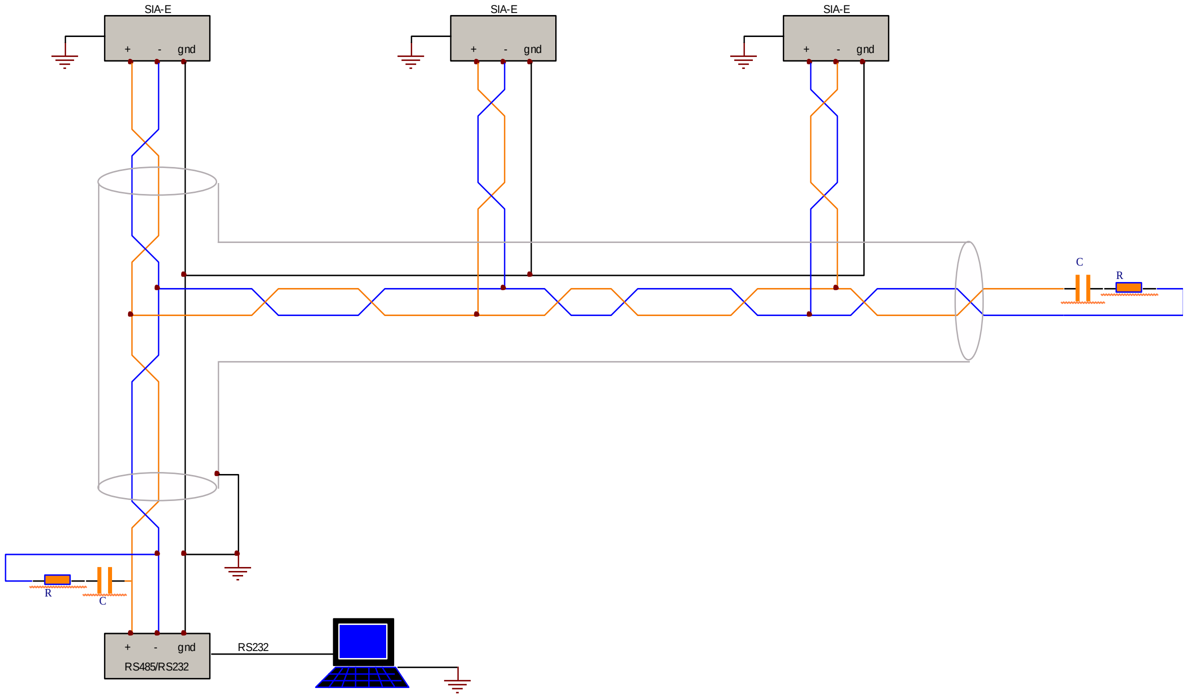
If a 3 strand cable is used for communication, the ground terminals (GND) should be connected to the earth cable.

If a 2 strand cable is used for communication, the ground terminals (GND) should be connected to the cable shielding. The shielding should be connected to GND at only one point, so as to avoid circular currents.

Resistance loads must be used at both ends if a very long cable is used. The best solution for avoiding signal reflection is the addition of resistance loads at both ends of the cable. The value of these resistance loads should be the same as the impedance of the cable.

rs485 are insulated from the auxiliary voltage, but there is no insulation between the two ends of rs485 terminals. In highly aggressive environments fiber optics can be used, with the corresponding converters.

Connection diagram of an RS485 bus:



SILB with one RS485 port for ModBus and one RJ45 port for IEC61850 or DNP3.0

The device features 1 exterior RS485 connections through three terminals (+, - y GND) located on the back of the unit. The protocol used is Modbus RTU

These ports can be used for the continuous monitoring of the device from a remote PC or SCADA system. Up to 32 units can be connected to one bus, each with its own modbus address. Speed and direction are configurable.

In order to minimize communications errors due to noise, a shielded twisted conductor cable is the recommended physical medium. In order to make the connection, connect all + terminals on one side and all – terminals on the other side.

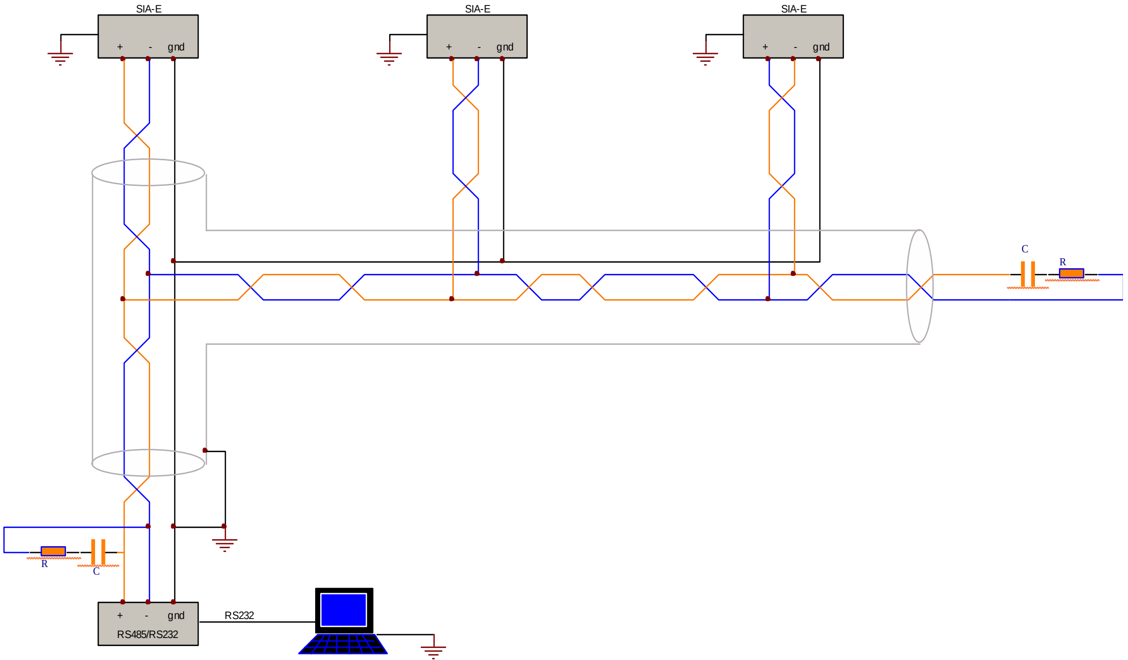
If a 3 strand cable is used for communication, the ground terminals (GND) should be connected to the earth cable.

If a 2 strand cable is used for communication, the ground terminals (GND) should be connected to the cable shielding. The shielding should be connected to GND at only one point, so as to avoid circular currents.

Resistance loads must be used at both ends if a very long cable is used. The best solution for avoiding signal reflection is the addition of resistance loads at both ends of the cable. The value of these resistance loads should be the same as the impedance of the cable.

RS485 are insulated from the auxiliary voltage, but there is no insulation between the two ends of rs485 terminals. In highly aggressive environments fiber optics can be used, with the corresponding converters.

Connection diagram of an RS485 bus:



Besides, there is another rear communication RJ45 port using IEC61850 or DNP3.0.

7.3. LCD and keypad

The front of the SIL-B relay is fitted with an alphanumeric LCD screen, measuring 20x2. 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, LEDs return to their initial position. The "**Reset**" key can also be used to delete all of the events in the "Events" menu.

This is equipped with a specific key marked with 79, which permits operation on the recloser, locking and unlocking it.

It is also equipped with a specific key marked with 52, which permits operation on the circuit breaker, opening and closing it.

7.4. SICom Communications program

The SIcom program, which works with the Windows® 2000/XP/7 operating system is provided, and can be used to gain access to all of the equipment 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
- Reading and changing settings
- Reading and deleting events
- Changing the user passwords
- Loading settings files
- Date-time synchronisation
- Checking the versions of the equipment
- Inputs, outputs and leds configuration

7.5. Setting up the session: Password and access levels

Users must identify themselves with a password in order to start communications and to change the equipment 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.

ACCESS LEVEL	Read-only permission: Status and measurements Settings Events	Permission to: Change settings Download and delete the events buffer	Permission to: Execute commands	Permission to: Change configuration	Permission to Change protected settings
1	YES	YES	NO	NO	YES
2	YES	YES	NO	NO	NO
3	YES	NO	YES	NO	NO
4	YES	YES	YES	NO	NO
5	YES	YES	YES	YES	NO

Four passwords and their associated levels of access are set up when the equipment is configured using the SIcom program. By default, the equipment is programmed with the following passwords and their associated levels:

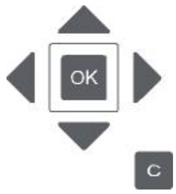
PASSWORD	ACCESS LEVEL
2222	2
3333	3
4444	4
5555	5

7.6. Menus

7.6.1. Default screen

The default screen shows the device model and the currents in phase A, phase B, phase C, and Neutral. Press “OK” to select a menu: measurements, states, settings, and events. If the HMI is left in any state, it will return to the default screen after 5 minutes without any key being pressed.

SILB555B2000BA
0.00 0.00 0.00 0.00

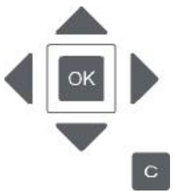


If an error is detected through the diagnostics, an error message will appear on the second line of the main screen (in place of the currents) showing the following information, as applicable: (see the section on diagnostics)

- PROTECTION ERROR
- MEASUREMENT ERROR
- EEPROM ERROR
- MAGNETIC MODULE ERROR

7.6.2. Last Trip screen

When a trip occurs, the default screen alternates with the last trip screen, showing the cause of the trip and the time and date of its occurrence.



Trip 27P1
13/01/11 13:51:44825

Even is auxiliary power is lost, when the SIL-B regains power, it will retain information on the last trip. The last trip screen will only disappear when the “RESET” button is pressed and held down.

7.6.3. Menu access

Use the ▲, ▼, ◄ and ► keys to access different menus and options. To select and enter an option or menu, use the “OK” key. To go back one level of the menu system, use the “C” key.

No password or passcode is necessary to view parameters, measurements, settings, etc.

A 4 digit passcode is necessary to change any parameter.

After returning to the main screen after changing a setting, the passcode must be entered again to make any additional changes.

To switch between units in a parameter, use the ◄ and ► keys. To modify a setting, use the ▲ and ▼ keys to increase or decrease the value. If an incorrect value is input during this process, use the “C” key to delete it.

The following section gives the most graphical description possible of menu navigation.

7.6.4. Date-Time menu

From the default screen, press the "►" key to access the date-time menu. Press the "OK" key to modify the date and/or time. Use the "►" and "◄" to select the digit to be changed, and then modify the digit using "▲" and "▼" keys. Once the date and time are correct, press "OK" to accept the changes. Pressing "C" will return to the default screen.

Access date and time information from the main screen by pressing ►.

```
DATE AND TIME              C    SILB555B2000BA
01/01/2000 01:43:25             0.00  0.00  0.00  0.00

                           OK   ↓                          C
                                01/01/2000 01:43
```

7.6.5. Fault report

From the default screen, press the "◄" key to access the fault report menu. Use the "▲" and "▼" keys to select the report of interest, and press "OK", to access the events contained in the fault report.

Access fault report information from the main screen by pressing ◄.

```
FAULT REPORT 535           C    SILB555B2000BA
02/08/12 11:18:52435            0.00  0.00  0.00  0.00

                           OK   12/04/12 01:57:03260    C   FAULT REPORT 535        C
                                ┘ New Osc. Regist           02/08/12 11:18:52435

                                                        OK  1/9: 535                C
                                                            ┐ New Osc. Regist

                           ▲▼   FAULT REPORT 534        C
                                02/08/12 11:17:12545
```

7.6.6. Versions and communications parameters

From the default screen, press and hold the "▲" key to access the versions:

```
Vers:  COM   DSP   PIC
       1.56  1.51  1.06
```

c

```
  SILB555B2000BA
0.00  0.00  0.00  0.00
```

▲

```
serial number:
  0
```

c

From the default screen, press and hold "▼" key to access to communications parameters:

```
LOCAL COM Settings
1  19200-8-N-1
```

c

```
  SILB555B2000BA
0.00  0.00  0.00  0.00
```

▼

```
REMOTE COM Settings
(*)
```

c

▼

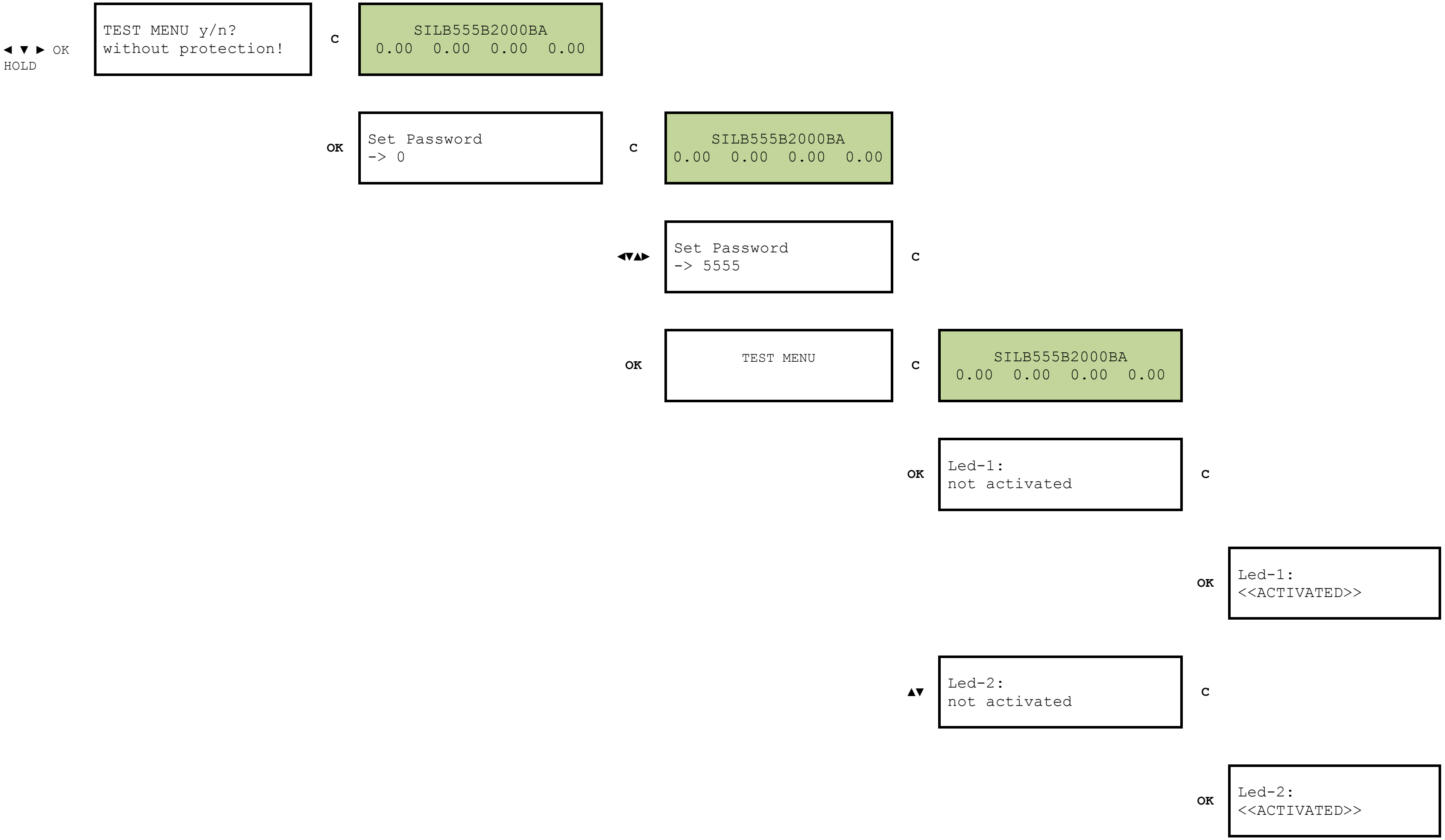
```
MODBUS COM Settings
2  19200-8-N-1
```

c

(*) REMOTE COM parameters depend on model (the protocol that it is used can be IEC61850, DNP3.0 or IEC60870-5-103 depending on model)

7.6.7. Test menu

From the default screen, enter the key sequence “◄”, “▼” , “►”, then press and hold “OK” to access the “Test menu”. Press “OK” to access the item to be tested.



▲▼

```
Led-3:
not activated
```

C

OK

```
Led-3:
<<ACTIVATED>>
```

▲▼

```
Led-4:
not activated
```

C

OK

```
Led-4:
<<ACTIVATED>>
```

▲▼

```
Led-5:
not activated
```

C

OK

```
Led-5:
<<ACTIVATED>>
```

▲▼

```
Led-79:
not activated
```

C

OK

```
Led-79:
<<ACTIVATED>>
```

▲▼ Led-52:
not activated C

OK Led-52:
<<ACTIVATED>>

▲▼ Led-ON:
not activated C

OK Led-ON:
<<ACTIVATED>>

▲▼ Output 1:
not activated C

OK Output 1:
<<ACTIVATED>>

▲▼ Output 2:
not activated C

OK Output 2:
<<ACTIVATED>>

▲▼

```
Output 3:
not activated
```

C

OK

```
Output 3:
<<ACTIVATED>>
```

▲▼

```
Output 4:
not activated
```

C

OK

```
Output 4:
<<ACTIVATED>>
```

▲▼

```
Output 5:
not activated
```

C

OK

```
Output 5:
<<ACTIVATED>>
```

▲▼

```
Output 6:
not activated
```

C

OK

```
Output 6:
<<ACTIVATED>>
```

▲▼

```
Output 7:
not activated
```

C

OK

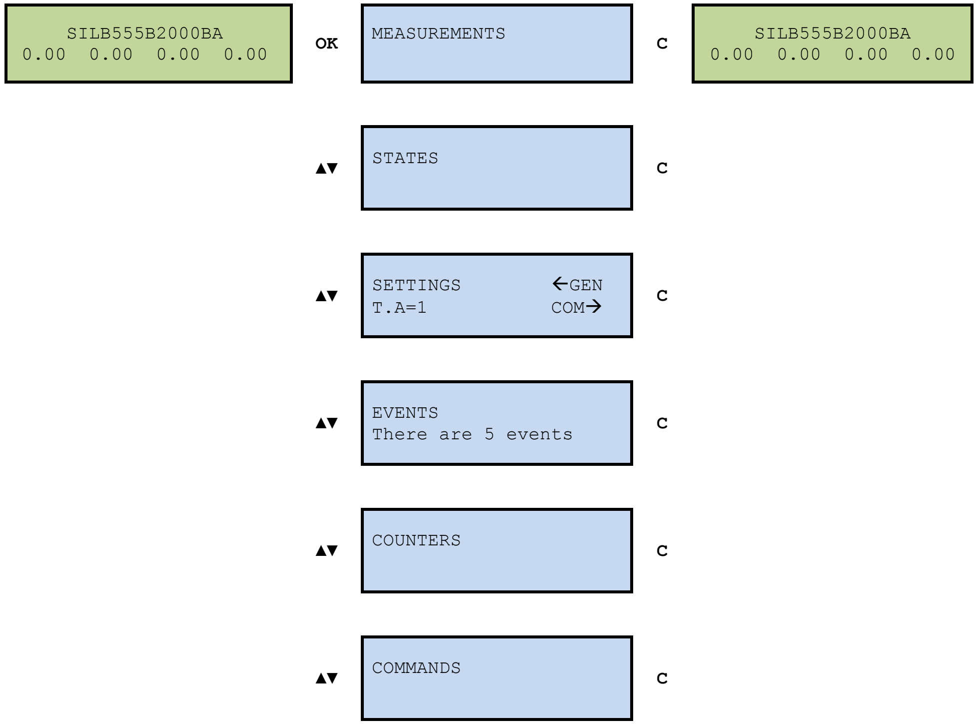
```
Output 7:
<<ACTIVATED>>
```

☞ **NOTE:** Ensure that the output configured as Trip is activated. When the device is installed it will open the circuit as though there were a trip.

7.6.8. Functions menu

The SIL-B relay's menu is divided into 6 main locks:

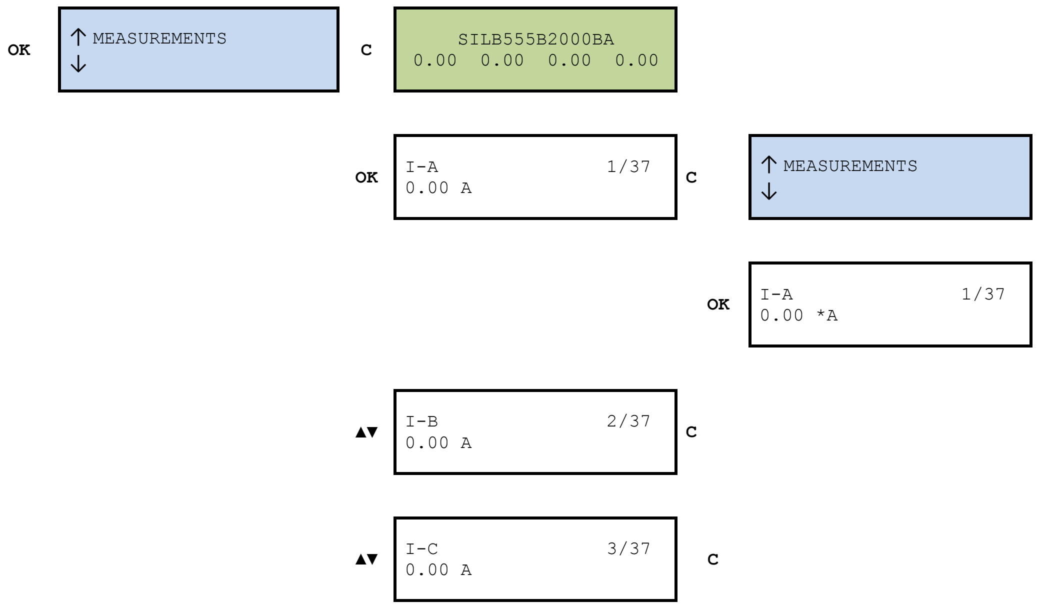
- Measurements
- States
- Settings
- Events
- Meters
- Commands



To access the second level from the main screen, press the “OK” key At the second level, to move from one menu section to another use the ▲ and ▼ keys. To return to a higher level, use the “C” key.

7.6.9. Measurements menu

From the default screen, press the “OK” key to access the first level of menus. Use the “▲” and “▼” keys to select “MEASURES” and press “OK”. Use the “▲” and “▼” keys to select the measurement of interest and view its value



▲▼	I-0 4/37 0.00 A	C
▲▼	I-1 5/37 0.00 A	C
▲▼	I-2 6/37 0.00 A	C
▲▼	V-A 7/37 0.00 V	C
▲▼	V-B 8/37 0.00 V	C
▲▼	V-C 9/37 0.00 V	C
▲▼	V-0 10/37 0.00 V	C
▲▼	V-BB 11/37 0.00 V	C
▲▼	V-AB 12/37 0.00 V	C

▲▼	V-BC 13/37 0.00 V	C
▲▼	ang I-A 15/37 0. deg	C
▲▼	ang I-B 16/37 0. deg	C
▲▼	ang I-C 17/37 0. deg	C
▲▼	P 18/37 0.00 W	C
▲▼	P-A 19/37 0.00 W	C
▲▼	P-B 20/37 0.00 W	C
▲▼	P-C 21/37 0.00 W	C

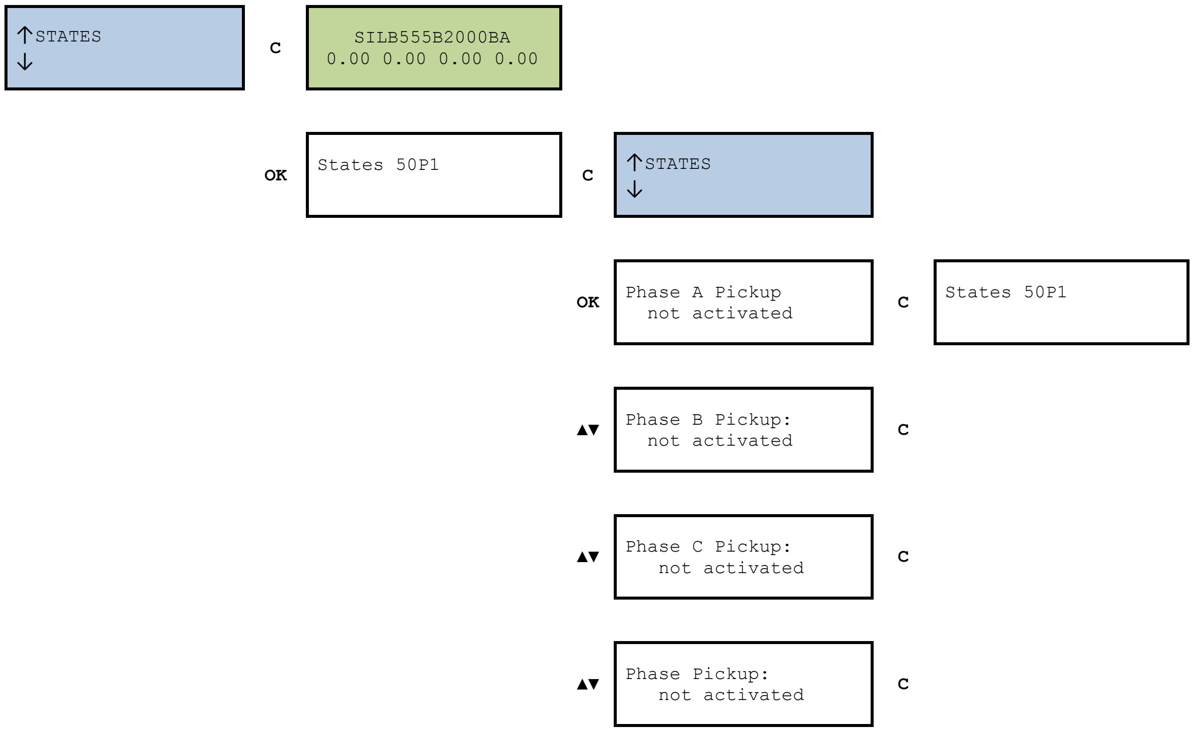
▲▼	Q 22/37 0.00 VAR	C
▲▼	Q-A 23/37 0.00 VAR	C
▲▼	Q-B 24/37 0.00 VAR	C
▲▼	Q-C 25/37 0.00 VAR	C
▲▼	S 26/37 0.00 VA	C
▲▼	S-A 27/37 0.00 VA	C
▲▼	S-B 28/37 0.00 VA	C
▲▼	S-C 29/37 0.00 VA	C
▲▼	cos Phi 30/37 0.00	C

```
▲▼  cosPhiA          31/37   C
    0.00

▲▼  cosPhiB          32/37   C
    0.00

▲▼  cosPhiC          33/37   C
    0.00

▲▼  Thermal Image    34/37   C
    0.

▲▼  Lin.Frequency    35/37   C
    0.00 Hz

▲▼  Bar.Frequency    36/37   C
    0.00 Hz

▲▼  PhaseDifferenc   37/37   C
    0. deg
```

7.6.10. Status menu

From the default screen, press the “OK” key to access the first level of menus. Use the “▲” and “▼” keys to select “STATES” and press “OK”. This gives the menu for groups of states. Use the “▲” and “▼” keys to select a group of states, and press “OK” to access the states belonging to the group. Use the “▲” and “▼” keys to select different states. The information provided for each state is whether or not it is active. In the menus of groups of states, the message “>Active” appears beneath the name if the group contains any state that is active.

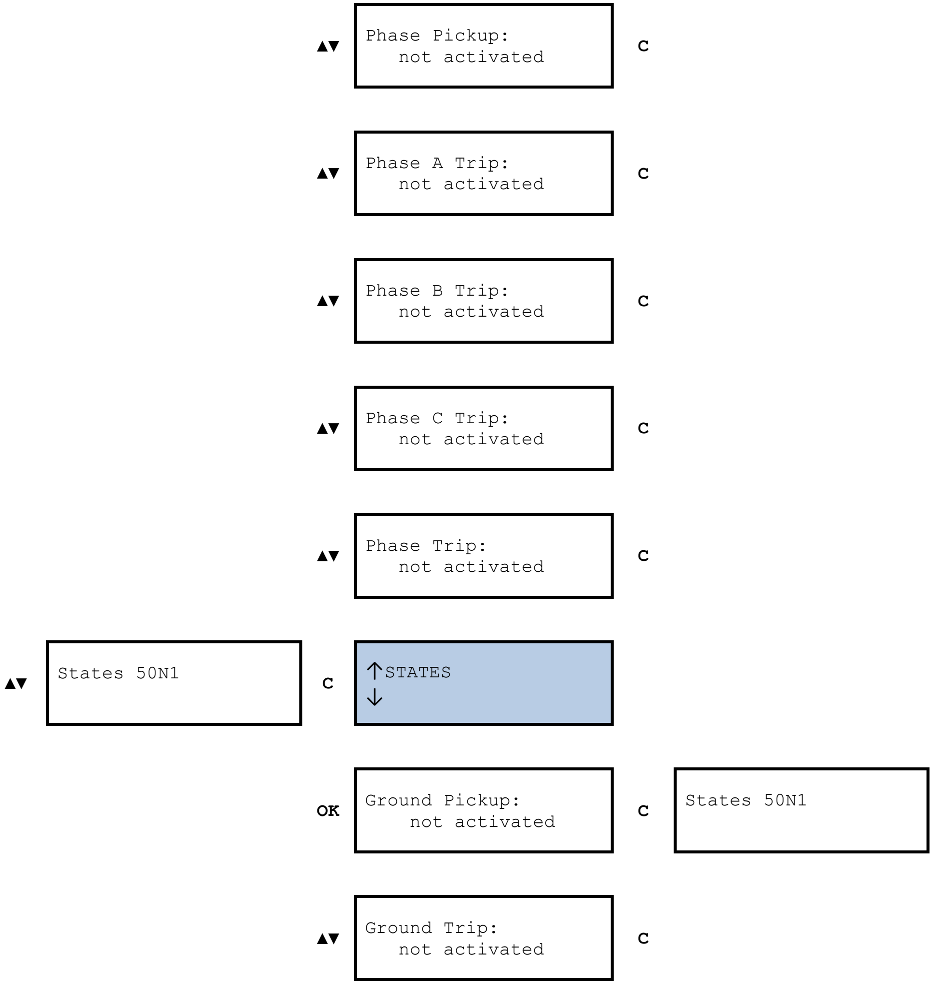
The following diagrams give a graphical representation of navigation in the state menu.



		▲▼	Phase A Trip: not activated	C	
		▲▼	Phase B Trip: not activated	C	
		▲▼	Phase C Trip: not activated	C	
		▲▼	Phase Trip: not activated	C	
▲▼	States 50P2	C	↑STATES ↓		
		OK	Phase A Pickup: not activated	C	States 50P2
		▲▼	Phase B Pickup: not activated	C	
		▲▼	Phase C Pickup: not activated	C	
		▲▼	Phase Pickup: not activated	C	

		▲▼	Phase A Trip: not activated	C	
		▲▼	Phase B Trip: not activated	C	
		▲▼	Phase C Trip: not activated	C	
		▲▼	Phase Trip: not activated	C	
▲▼	States 67P1	C	↑STATES ↓		
		OK	Phase A Pickup: not activated	C	States 67P1
		▲▼	Phase B Pickup: not activated	C	
		▲▼	Phase C Pickup: not activated	C	

			▲▼	Phase Pickup: not activated	C	
			▲▼	Phase A Trip: not activated	C	
			▲▼	Phase B Trip: not activated	C	
			▲▼	Phase C Trip: not activated	C	
			▲▼	Phase Trip: not activated	C	
▲▼	States 67P2	C		↑STATES ↓		
			OK	Phase A Pickup: not activated	C	States 67P2
			▲▼	Phase B Pickup: not activated	C	
			▲▼	Phase C Pickup: not activated	C	



▲▼
Phase Pickup:
not activated
C
▲▼
Phase A Trip:
not activated
C
▲▼
Phase B Trip:
not activated
C
▲▼
Phase C Trip:
not activated
C
▲▼
Phase Trip:
not activated
C
▲▼
States 50N1
C
↑STATES
↓
OK
Ground Pickup:
not activated
C
States 50N1
▲▼
Ground Trip:
not activated
C

▲▼	States 50N2	C	↑STATES ↓		
		OK	Ground Pickup: not activated	C	States 50N2
		▲▼	Ground Trip: not activated	C	
▲▼	States 67N1	C	↑STATES ↓		
		OK	Ground Pickup: not activated	C	States 67N1
		▲▼	Ground Trip: not activated	C	
▲▼	States 67N2	C	↑STATES ↓		
		OK	Ground Pickup: not activated	C	States 67N2
		▲▼	Ground Trip: not activated	C	

▲▼	States CLP	C	↑STATES ↓		
		OK	Pickup: not activated	C	States CLP
▲▼	States 50BF	C	↑STATES ↓		
		OK	Pickup: not activated	C	States 50BF
		▲▼	Trip: not activated	C	
▲▼	States 46	C	↑STATES ↓		
		OK	Pickup: not activated	C	States 46
		▲▼	Trip: not activated	C	

▲▼ States 59P1 C ↑STATES ↓

OK Phase A Pickup: not activated C States 59P1

▲▼ Phase B Pickup: not activated C

▲▼ Phase C Pickup: not activated C

▲▼ Phase Pickup: not activated C

▲▼ Phase A Trip: not activated C

▲▼ Phase B Trip: not activated C

▲▼ Phase C Trip: not activated C

▲▼ Phase Trip: not activated C

▲▼	States 59P2	C	↑STATES ↓		
		OK	Phase A Pickup: not activated	C	States 59P2
		▲▼	Phase B Pickup: not activated	C	
		▲▼	Phase C Pickup: not activated	C	
		▲▼	Phase Pickup: not activated	C	
		▲▼	Phase A Trip: not activated	C	
		▲▼	Phase B Trip: not activated	C	
		▲▼	Phase C Trip: not activated	C	

▲▼ Phase Trip: not activated C

▲▼ States 59N1 C ↑STATES ↓

OK Ground Pickup: not activated C States 59N1

▲▼ Ground Trip: not activated C

▲▼ States 59N2 C ↑STATES ↓

OK Ground Pickup: not activated C States 59N2

▲▼ Ground Trip: not activated C

▲▼ States 27P1 C ↑STATES ↓

OK Phase A Pickup: not activated C States 27P1

▲▼ Phase B Pickup: not activated C

▲▼ Phase C Pickup: not activated C

▲▼ Phase Pickup: not activated C

▲▼ Phase A Trip: not activated C

▲▼ Phase B Trip: not activated C

▲▼ Phase C Trip: not activated C

▲▼ Phase Trip: not activated C

▲▼ States 27P2 C ↑STATES ↓

OK	Phase A Pickup: not activated	C	States 27P2
▲▼	Phase B Pickup: not activated	C	
▲▼	Phase C Pickup: not activated	C	
▲▼	Phase Pickup: not activated	C	
▲▼	Phase A Trip: not activated	C	
▲▼	Phase B Trip: not activated	C	
▲▼	Phase C Trip: not activated	C	
▲▼	Phase Trip: not activated	C	

▲▼	States 32-1	C	↑STATES ↓

		OK	Pickup: not activated	C	States 32-1
		▲▼	Trip: not activated	C	
▲▼	States 32-2	C	↑STATES ↓		
		OK	Pickup: not activated	C	States 32-2
		▲▼	Trip: not activated	C	
▲▼	States 32-3	C	↑STATES ↓		
		OK	Pickup: not activated	C	States 32-3
		▲▼	Trip: not activated	C	

▲▼	States 32-4	C	↑STATES ↓		
		OK	Pickup: not activated	C	States 32-4
		▲▼	Trip: not activated	C	
▲▼	States 49	C	↑STATES ↓		
		OK	Pickup: not activated	C	States 49
		▲▼	Trip: not activated	C	

▲▼	States 81-1	C	↑STATES ↓		
		OK	Pickup: not activated	C	States 81-1
		▲▼	Trip: not activated	C	
		▲▼	Function blocked: <<ACTIVATED>>	C	
▲▼	States 81-2	C	↑STATES ↓		
		OK	Pickup: not activated	C	States 81-2
		▲▼	Trip: not activated	C	
		▲▼	Function blocked: <<ACTIVATED>>	C	

▲▼	States 81-3	C	↑STATES ↓		
		OK	Pickup: not activated	C	States 81-3
		▲▼	Trip: not activated	C	
		▲▼	Function blocked: <<ACTIVATED>>	C	
▲▼	States 81-4	C	↑STATES ↓		
		OK	Pickup: not activated	C	States 81-4
		▲▼	Trip: not activated	C	
		▲▼	Function blocked: <<ACTIVATED>>	C	

▲▼	States 25 >Activated	C	↑STATES ↓		
		OK	Live L & Live B: not activated	C	States 25 >Activated
		▲▼	Live L & Dead B: not activated	C	
		▲▼	Dead L & Live B: not activated	C	
		▲▼	Dead L & Dead B: <<ACTIVATED>>	C	
		▲▼	Synchrocheck: not activated	C	

▲▼ States 37-1 C ↑STATES ↓

OK Phase A Pickup: not activated C States 37-1

▲▼ Phase B Pickup: not activated C

▲▼ Phase C Pickup: not activated C

▲▼ Phase Pickup: not activated C

▲▼ Phase A Trip: not activated C

▲▼ Phase B Trip: not activated C

▲▼ Phase C Trip: not activated C

▲▼ Phase Trip:
not activated C

▲▼ States 37-2 C ↑STATES ↓

OK Phase A Pickup:
not activated C States 37-2

▲▼ Phase B Pickup:
not activated C

▲▼ Phase C Pickup:
not activated C

▲▼ Phase Pickup:
not activated C

▲▼ Phase A Trip:
not activated C

▲▼ Phase B Trip:
not activated C

▲▼ Phase C Trip:
not activated C

		▲▼	Phase Trip: not activated	C	
▲▼	States GENERAL	C	↑STATES ↓		
		OK	Trip: not activated	C	States GENERAL
		▲▼	Battery Supply: not activated	C	
		▲▼	50 Hz: <<ACTIVATED>>	C	
		▲▼	Mag.M. error: not activated	C	
		▲▼	Measure error: not activated	C	
		▲▼	Ready: <<ACTIVATED>>	C	

▲▼

```
Protecti error:
   not activated
```

C

▲▼

```
Setting change:
   not activated
```

C

▲▼

```
Manual Close:
   not activated
```

C

▲▼

```
Set Date/Time:
   not activated
```

C

▲▼

```
No Telecontrol:
   not activated
```

C

▲▼

```
FactorySetting:
   not activated
```

C

▲▼

```
Eeprom error:
   not activated
```

C

▲▼

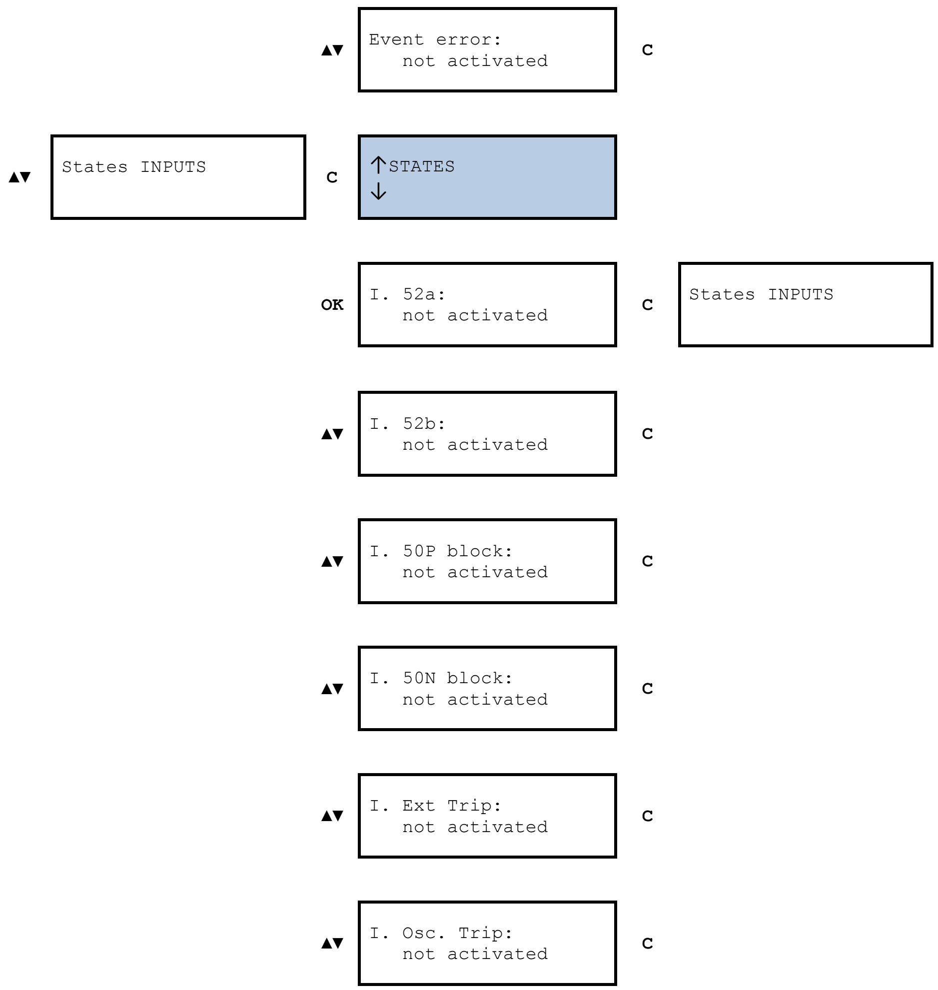
```
IRIG-B present:
   not activated
```

C

▲▼

```
Eeprom changed:
   not activated
```

C



▲▼
Event error:
not activated
C
▲▼
States INPUTS
C
STATES
OK
I. 52a:
not activated
C
States INPUTS
▲▼
I. 52b:
not activated
C
▲▼
I. 50P block:
not activated
C
▲▼
I. 50N block:
not activated
C
▲▼
I. Ext Trip:
not activated
C
▲▼
I. Osc. Trip:
not activated
C

▲▼
```
I. 79 Init:
   not activated
```
C

▲▼
```
I. 79 Enable:
   not activated
```
C

▲▼
```
I. 79 Block:
   not activated
```
C

▲▼
```
I0-Sett Table:
   not activated
```
C

▲▼
```
I1-Sett Table:
   not activated
```
C

▲▼
```
Block Recloser:
   not activated
```
C

▲▼
```
UnBlock Reclos:
   not activated
```
C

▲▼
```
I. 50BF Init:
   not activated
```
C

▲▼
```
Input 1:
   not activated
```
C

▲▼ | Input 2:
not activated | C
▲▼ | Input 3:
not activated | C
▲▼ | Input 4:
not activated | C
▲▼ | Input 5:
not activated | C
▲▼ | Input 6:
not activated | C
▲▼ | Input 7:
not activated | C
▲▼ | Input 8:
not activated | C
▲▼ | Control Voltage:
not activated | C

▲▼ Continuity A: not activated C

▲▼ Continuity B: not activated C

▲▼ States OUTPUTS C ↑STATES ↓

OK LedON: not activated C

▲▼ Led1: not activated C

▲▼ Led2: not activated C

▲▼ Led3: not activated C

▲▼ Led4: not activated C

▲▼ Led5: not activated C

▲▼ Output 1:
not activated C

▲▼ Output 2:
not activated C States OUTPUTS

▲▼ Output 3:
not activated C

▲▼ Output 4:
not activated C

▲▼ Output 5:
not activated C

▲▼ Output 3:
not activated C

▲▼ Output 6:
not activated C

▲▼ Output 7:
not activated C

▲▼	Output 8 : not activated	C

▲▼	Output 8 : not activated	C
▲▼	Output 9 : not activated	C
▲▼	Output 10: not activated	C
▲▼	Output 11: not activated	C
▲▼	Output 12: not activated	C
▲▼	79 Init: not activated	C
▲▼	50BF Init: not activated	C
▲▼	Osc Init: not activated	C
▲▼	79 Enable: not activated	C

▲▼ | Close Ena: not activated | C

▲▼ | States 79 | C | ↑STATES ↓

OK | Standby: not activated | C

▲▼ | Reclose Time: not activated | C

▲▼ | 79 Is 52 Open?: not activated | C

▲▼ | 79 Hold Time: not activated | C

▲▼ | 79 Close Time: not activated | C

▲▼ | 79 Reset Time: not activated | C

		▲▼	79 Lockout: not activated	C
		▲▼	79 Security T.: not activated	C
		▲▼	79 Manual Open: not activated	C
▲▼	States 52 >52 Open Error	C	↑STATES ↓	
		OK	52 Startup: not activated	C
		▲▼	52 Error: not activated	C
		▲▼	52 Open: not activated	C
		▲▼	52 Open Time: not activated	C
		▲▼	52 Open Error: <<ACTIVATED>>	C

▲▼
```
52 Close:
   not activated
```
C

▲▼
```
52 Close Time:
   not activated
```
C

▲▼
```
52 Close Error:
   not activated
```
C

▲▼
```
Open Num. Alarm:
<<ACTIVATED>>
```
C

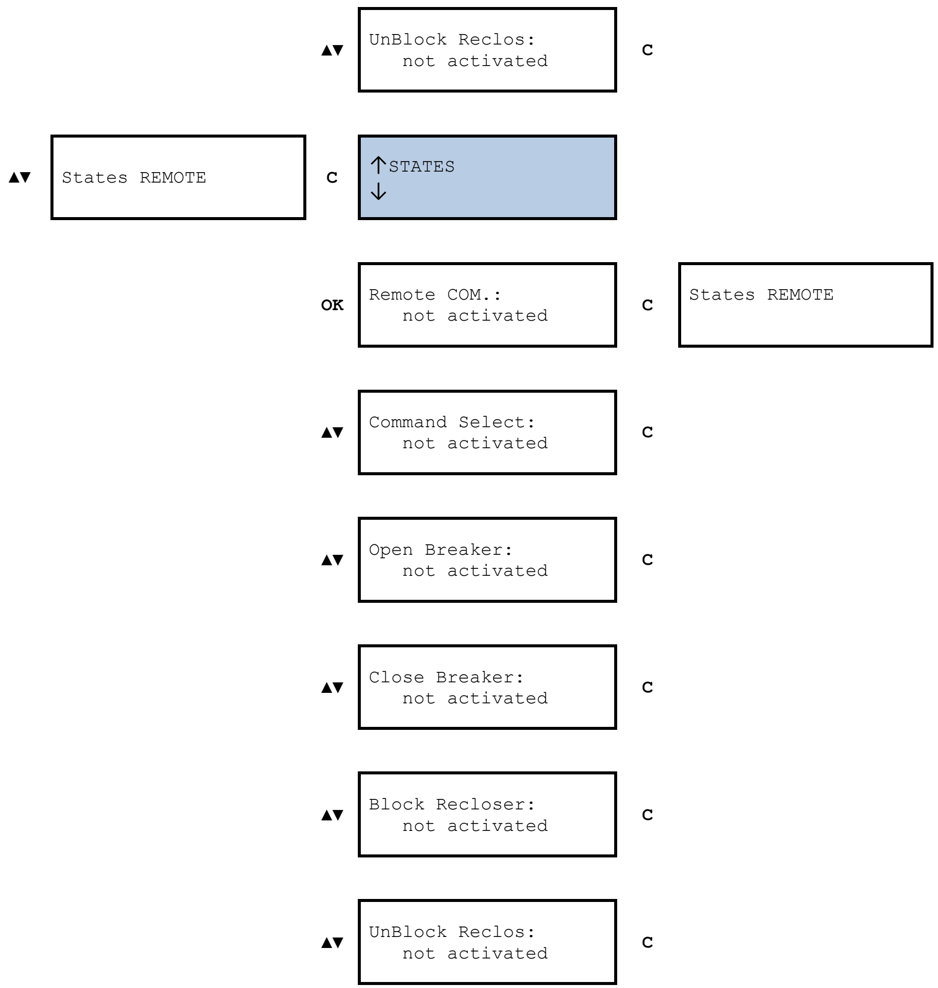
▲▼
```
I2t Alarm:
<<ACTIVATED>>
```
C

▲▼
```
Too Many Trips:
   not activated
```
C

▲▼
```
52A contact:
   not activated
```
C

▲▼
```
52B contact:
   not activated
```
C

▲▼	States 74TCS	C	↑STATES ↓		
		OK	74TCS Pickup: not activated	C	States 74TCS
		▲▼	74TCS Alarm: not activated	C	
▲▼	States MODBUS	C	↑STATES ↓		
		OK	Remote COM.: not activated	C	States MODBUS
		▲▼	Command Select: not activated	C	
		▲▼	Open Breaker: not activated	C	
		▲▼	Close Breaker: not activated	C	
		▲▼	Block Recloser: not activated	C	


▲▼
UnBlock Reclos:
not activated
C
▲▼
States REMOTE
C
STATES
OK
Remote COM.:
not activated
C
States REMOTE
▲▼
Command Select:
not activated
C
▲▼
Open Breaker:
not activated
C
▲▼
Close Breaker:
not activated
C
▲▼
Block Recloser:
not activated
C
▲▼
UnBlock Reclos:
not activated
C

▲▼	States LOCAL >Activated	C	↑STATES ↓		
		OK	Local COM.: not activated	C	States LOCAL >Activated
		▲▼	MMI Activity: <<ACTIVATED>>	C	
		▲▼	Local Ctrl.: not activated	C	
		▲▼	Command Select: not activated	C	
		▲▼	Open Breaker: not activated	C	
		▲▼	Close Breaker: not activated	C	
		▲▼	Block Recloser: not activated	C	
		▲▼	UnBlock Reclos: not activated	C	

▲▼

```
No Telecontrol:
   not activated
```

C

▲▼

```
Telecontrol Yes:
   not activated
```

C

7.6.11. Settings menu

From the default screen, press the “OK” key to access the first level of menus. Use the “▲” and “▼” keys to select the “SETTINGS” screen and press “OK”. This gives the menu for groups of settings. Use the “▲” and “▼” keys to select a group of settings, and press “OK” to access the settings belonging to the group. Use the “▲” and “▼” keys to select different settings. The value of each setting is shown below the name of the setting. The first time that a setting is modified, the passcode must be entered. Once entered, settings can be modified until the unit returns to the default screen, either manually or automatically. The device will return to the default screen automatically if no key is pressed for a period of 5 minutes.

The factory default passcode is 5555. It can be changed using SICom.

Use the ▲, ▼, ◄ and ► keys to enter the passcode. Use the ▲ and ▼ keys to change a value or character, and the ◄ and ► keys to move between digits. If a character or number of the passcode entered must be changed due to an entry error, it can be deleted with the “C” key. Press “OK” to validate the passcode.

↑ SETTINGS ← GEN ↓ T.A.=1 COM →"	C	SILB555B2000BA 0.00 0.00 0.00 0.00						
	OK	↑ Select table ↓ 1 = T.Activated	C	↑ SETTINGS ← GEN ↓ T.A.=1 COM →"				
	▲▼	↑ Select table ↓ 2	C					
	▲▼	↑ Select table ↓ 3	C					
	OK	Settings 50P1	C	↑ SETTINGS ← GEN ↓ T.A.=1 COM →				
			OK	Function Enable NO	C	Settings 50P1		
					OK	Set Password -> 0	C	Function Enable NO
							◄▼▲►	Set Password -> 5555
							OK	Function Enable NO -> NO

▲▼

Function Enable
NO -> YES

OK

Function Enable
NO > YES y/n

OK

SETTING CHANGED
Function Enable

OK

Function Enable
YES

▲▼

Current Tap
1.00 xIn

C

▲▼

Operating Time
0.02 s

C

▲▼

Settings 50P2

C

↑ SETTINGS ← GEN
↓ T.A.=1 COM →

OK

Function Enable
NO

C

Settings 50P2

▲▼ Current Tap 0.20 xIn C

▲▼ Operating Time 5.00 s C

▲▼ Settings 67P1 C ↑↓ SETTINGS T.A.=1 ← GEN COM →

OK Function Enable NO C Settings 67P1

▲▼ Curve type Def Tim C

▲▼ Time Dial 0.05 C

▲▼ Current Tap 0.20 xIn C

▲▼ Operating Time 5.00 s C

▲▼ Directional YES C

▲▼

```
Polarization V
35.0 V
```

C

▲▼

```
Operating Angle
180
```

C

▲▼

```
Halfcone Angle
3
```

C

▲▼	Settings 67P2	C	↑ SETTINGS ← GEN ↓ T.A.=1 COM →				
		OK	Function Enable NO	C	Settings 67P2		
		▲▼	Curve type Def Tim	C			
		▲▼	Time Dial 0.05	C	Settings 67P2		
				OK	Set Password -> 0	C	Time Dial 0.05
						◄ ▼ ▲ ►	Set Password -> 5555
						OK	Time Dial 0.05 -> 0
						◄ ▼ ▲ ►	Time Dial 0.05 -> 1.25
						OK	Time Dial 0.05 > 1.25 y/n

OK

SETTING CHANGED Time Dial

OK

Time Dial 1.25

▲▼	Current Tap 1.00 xIn	C
▲▼	Operating Time 0.02 s	C
▲▼	Directional YES	C
▲▼	Polarization V 35.0 V	C
▲▼	Operating Angle 180	C
▲▼	Halfcone Angle 3	C

▲▼	Settings 50N1	C	↑ SETTINGS ← GEN ↓ T.A.=1 COM →		
		OK	Function Enable NO	C	Settings 50N1
		▲▼	Current Tap 0.50 xIn	C	
		▲▼	Operating Time 1.00 s	C	
▲▼	Settings 50N2	C	↑ SETTINGS ← GEN ↓ T.A.=1 COM →		
		OK	Function Enable NO	C	Settings 50N2
		▲▼	Current Tap 0.30 xIn	C	
		▲▼	Operating Time 2.00 s	C	
▲▼	Settings 67N1	C	↑ SETTINGS ← GEN ↓ T.A.=1 COM →		

OK	Function Enable NO	C	Settings 67N1
▲▼	Curve type Def Tim	C	
▲▼	Time Dial 0.05	C	
▲▼	Current Tap 0.20 xIn	C	
▲▼	Operating Time 5.00 s	C	
▲▼	Directional YES	C	
▲▼	Polarization V 35.0 V	C	
▲▼	Operating Angle 180	C	

		▲▼	Halfcone Angle 3	C		
▲▼	Settings 67N2	C	↑ SETTINGS ← GEN ↓ T.A.=1 COM →			
		OK	Function Enable NO	C	Settings 67N2	
		▲▼	Curve type Def Tim	C		
		▲▼	Time Dial 1.00	C		
		▲▼	Current Tap 1.00 xIn	C		
		▲▼	Operating Time 0.02 s	C		
		▲▼	Directional YES	C		
		▲▼	Polarization V 35.0 V	C		

		▲▼	Operating Angle 180	C	
		▲▼	Halfcone Angle 3	C	
▲▼	Settings CLP	C	↑ SETTINGS ← GEN ↓ T.A.=1 COM →		
		OK	Function Enable NO	C	Settings CLP
		▲▼	Multiplier 50P1 1.00	C	
		▲▼	Multiplier 50P2 1.00	C	
		▲▼	Multiplier67P1 1.00	C	
		▲▼	Multiplier 67P2 1.00	C	

▲▼ | Multiplier 50N1
1.00 | C

▲▼ | Multiplier 50N2
1.00 | C

▲▼ | Multiplier 67N1
1.00 | C

▲▼ | Multiplier 67N2
1.00 | C

▲▼ | No Load Time
15 s | C

▲▼ | Cold Load Time
15 s | C

▲▼ | Settings 50BF | C | ↑ SETTINGS ← GEN
↓ T.A.=1 COM →

OK | Function Enable
NO | C | Settings 50BF

▲▼ | Operating Time
0.02 s | C

▲▼	Settings 46	C	↑ SETTINGS ← GEN ↓ T.A.=1 COM →		
		OK	Function Enable NO	C	Settings 46
		▲▼	Curve type Def Tim	C	
		▲▼	Time Dial 0.05	C	
		▲▼	Current Tap 0.20 xIn	C	
		▲▼	Operating Time 0.02 s	C	
▲▼	Settings 59P1	C	↑ SETTINGS ← GEN ↓ T.A.=1 COM →		
		OK	Function Enable NO	C	Settings 59P1

▲▼ Tap 10.0 V C

▲▼ Operating Time 0.02 s C

▲▼ Reset Time 0.2 s C

▲▼ Settings 59P2 C ↑ SETTINGS ← GEN ↓ T.A.=1 COM →

OK Function Enable NO C Settings 59P2

▲▼ Tap 5.0 V C

▲▼ Operating Time 5.00 s C

▲▼ Reset Time 0.2 s C

▲▼ Settings 59N1 C ↑ SETTINGS ← GEN ↓ T.A.=1 COM →

		OK	Function Enable NO	C	Settings 59N1
		▲▼	Tap 10.0 V	C	
		▲▼	Operating Time 0.02 s	C	
		▲▼	Reset Time 0.2 s	C	
▲▼	Settings 59N2	C	↑ SETTINGS ← GEN ↓ T.A.=1 COM →		
		OK	Function Enable NO	C	Settings 59N2
		▲▼	Tap 8.0 V	C	
		▲▼	Operating Time 10.00 s	C	

▲▼ Reset Time
0.2 s C

▲▼ Settings 27P1 C ↑ SETTINGS ← GEN
↓ T.A.=1 COM →

OK Function Enable
NO C Settings 27P1

▲▼ Tap
4.0 V C

▲▼ Operating Time
0.02 s C

▲▼ Reset Time
0.2 s C

▲▼ Settings 27P2 C ↑ SETTINGS ← GEN
↓ T.A.=1 COM →

OK Function Enable
NO C Settings 27P2

▲▼ Tap
10.0 V C

		▲▼	Operating Time 5.00 s	C		
		▲▼	Reset Time 10.0 s	C		
▲▼	Settings 32-1	C	↑ SETTINGS ← GEN ↓ T.A.=1 COM →			
		OK	Function Enable NO	C	Settings 32-1	
		▲▼	Tap 10 VA	C		
		▲▼	Operating Angle 90	C		
		▲▼	Operating Time 5.00 s	C		
▲▼	Settings 32-2	C	↑ SETTINGS ← GEN ↓ T.A.=1 COM →			

		OK	Function Enable NO	C	Settings 32-2
		▲▼	Tap 50 VA	C	
		▲▼	Operating Angle 90	C	
		▲▼	Operating Time 2.00 s	C	
▲▼	Settings 32-3	C	↑ SETTINGS ← GEN ↓ T.A.=1 COM →		
		OK	Function Enable NO	C	Settings 32-3
		▲▼	Tap 100 VA	C	
		▲▼	Operating Angle 90	C	
		▲▼	Operating Time 1.00 s	C	

▲▼	Settings 32-4	C	↑ SETTINGS ← GEN ↓ T.A.=1 COM →			
		OK	Function Enable NO	C	Settings 32-4	
		▲▼	Tap 200 VA	C		
		▲▼	Operating Angle 90	C		
		▲▼	Operating Time 0.02 s	C		
▲▼	Settings 49	C	↑ SETTINGS ← GEN ↓ T.A.=1 COM →"			
		OK	Function Enable NO	C	Settings 49	
		▲▼	Current Tap 1.00xIn	C		

		▲▼	z Heating constant 3 min	C		
		▲▼	z Cooling constant 1	C		
		▲▼	Alarma Level 80	C		
▲▼	Settings 81-1	C	↑ SETTINGS ← GEN ↓ T.A.=1 COM →			
		OK	Function Enable NO	C	Settings 81-1	
		▲▼	Function Type OVER	C		
		▲▼	Activation level 60.00 Hz	C		
		▲▼	Operating Time 0.02 s	C		
		▲▼	Reset Time 0.2 s	C		

▲▼	Settings 81-2	C	↑ SETTINGS ← GEN ↓ T.A.=1 COM →		
		OK	Function Enable NO	C	Settings 81-2
		▲▼	Function Type OVER	C	
		▲▼	Activation level 50.00 Hz	C	
		▲▼	Operating Time 5.00 s	C	
		▲▼	Reset Time 0.2 s	C	
▲▼	Settings 81-3	C	↑ SETTINGS ← GEN ↓ T.A.=1 COM →		
		OK	Function Enable NO	C	Settings 81-3

▲▼ | Function Type
UNDER | C

▲▼ | Activation level
50.00 Hz | C

▲▼ | Operating Time
5.00 s | C

▲▼ | Reset Time
0.2 s | C

▲▼ | Settings 81-4 | C | ↑ SETTINGS ← GEN
↓ T.A.=1 COM →

OK | Function Enable
NO | C | Settings 81-4

▲▼ | Function Type
UNDER | C

▲▼ | Activation level
45.00 Hz | C

▲▼ | Operating Time
0.02 s | C

		▲▼	Reset Time 0.2 s	C	
▲▼	Settings 25	C	↑ SETTINGS ← GEN ↓ T.A.=1 COM →		
		OK	Live L & Live B NOT ALW	C	Settings 25
		▲▼	Live L & Dead B NOT ALW	C	
		▲▼	Dead L & Live B NOT ALW	C	
		▲▼	Dead L & Dead B NOT ALW	C	
		▲▼	Voltage Difference 15.0 V	C	
		▲▼	Phase Difference 10	C	

▲▼ | Frequency Differer.
0.02 Hz | C

▲▼ | Synchrocheck Time
0.02 s | C

▲▼ | Live Line Tap
50.0 V | C

▲▼ | Dead Line Tap
30.0 V | C

▲▼ | Live Busbar Tap
50.0 V | C

▲▼ | Dead Busbar Tap
30.0 V | C

▲▼ | Voltage DelayTime
0.02 s | C

▲▼ | Settings 37-1 | C | ↑ SETTINGS ← GEN
↓ T.A.=1 COM →

OK | Function Enable
NO | C | Settings 37-1

		▲▼	Current Tap 0.20xIn	C	
		▲▼	Operating Time 5.00 s	C	
▲▼	Settings 37-2	C	↑ SETTINGS ← GEN ↓ T.A.=1 COM →		
		OK	Function Enable NO	C	Settings 37-2
		▲▼	Current Tap 0.20xIn	C	
		▲▼	Operating Time 1.00 s	C	
▲▼	Settings 79	C	↑ SETTINGS ← GEN ↓ T.A.=1 COM →		
		OK	Function Enable NO	C	Settings 79

▲▼	Hold Enable NO	C
▲▼	Recloser Number 1	C
▲▼	Reclose 1 Time 0.02 s	C
▲▼	Reclose 2 Time 0.02 s	C
▲▼	Reclose 3 Time 1.00 s	C
▲▼	Reclose 4 Time 1.00 s	C
▲▼	Reclose 5 Time 1.00 s	C
▲▼	Hold Time 1.00 s	C
▲▼	Reset Time 1.00 s	C

		▲▼	Man. Open Time 1.00 s	C		
▲▼	Settings 52	C	↑ SETTINGS ← GEN ↓ T.A.=1 COM →			
		OK	Max Acumulated Open 10	C	Settings 52	
		▲▼	Max Acumulated Amp 1000 MA2	C		
		▲▼	Max. Open Time 0.10 s	C		
		▲▼	Max. Close Time 0.10 s	C		
		▲▼	Repetitive Open Num 3	C		
		▲▼	Repetitiv Open Time 9.00 min	C		

▲▼	Settings 74TCS	C	↑ SETTINGS ← GEN ↓ T.A.=1 COM →			
		OK	Function Enable NO	C	Settings 74TCS	
		▲▼	Operating Time 0.02 s	C		

To access the general settings from the “SETTINGS” menu, press “◄”.

The general setting “Device name” can be read from the HMI but can only be modified using SICom.

The value of the general settings “Phase TI ratio” and “Neutral TI ratio” is the simplified ratio of the primary to the secondary. For example: With TI 500/5, the setting would be 100.

To access the general settings from the “SETTINGS” menus, press “◄”.

To access the communication parameters from the “SETTINGS” menus, press “◄”.

◄

```
Identification
free text
```

C

```
↑   SETTINGS   ← GEN
↓   T.A.=1     COM →
```

▲▼

```
CT Phase Ratio
10
```

C

▲▼

```
CT Neutral Ratio
10
```

C

▲▼

```
TT Ratio
100
```

C

▲▼

```
Frequency
50 Hz
```

C

▲▼

```
Language
ENGLISH
```

C

		▲▼	Active Settings T. 1	C
►	ModBus address 2	C	↑ SETTINGS ← GEN ↓ T.A.=1 COM →	
		▲▼	ModBus BaudRate 19200	C

7.6.12. Events menu

From the default screen, press the “OK” key to access the first level of menus. Use the “▲” and “▼” keys to select the “EVENTS” menu; the device will return information on the number of event reports stored in the buffer. Press “OK” and use the “▲” and “▼” keys to select each event.

↑ EVENTS ↓ There are 5	C	SILB555B2000BA 0.00 0.00 0.00 0.00			
	OK	12/04/12 01:57:03260 ┘ Eeprom changed	C	↑ EVENTS ↓ There are 5	
	▲▼	12/04/12 01:57:03180 ┐ 52 Open Error	OK	4/5: 0 ┐ 52 Open Error	C
	RESET	Set Password -> 0	C	↑ EVENTS ↓ There are 5	

◄▼▲►
```
Set Password
-> 5555
```
C

OK
```
Confirm
Erased Events y/n?
```
C

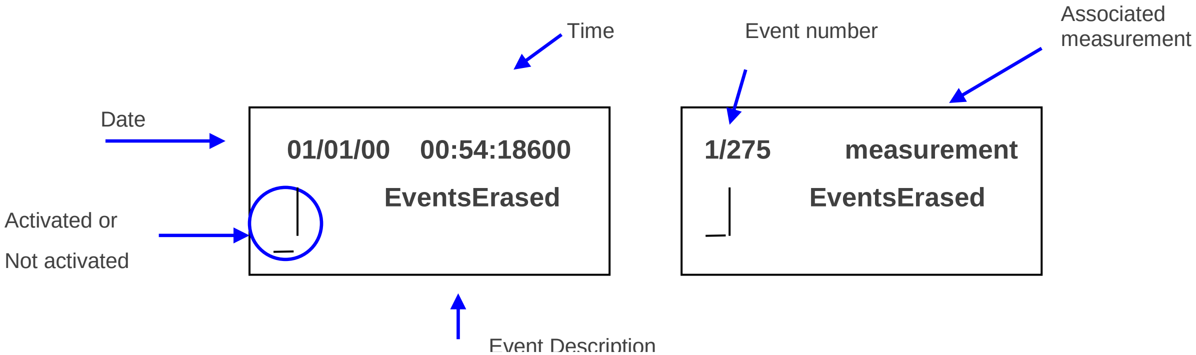
OK
```
↑        EVENTS
↓        There are 1
```
C

The “┘” and “┐” symbols indicate whether the event was due to activation or the reset of the associated state.

To clear the events buffer, select the events menu and hold down the “RESET” key, until the number of events reads 1. This one event is “Events erased”.

Each event report includes the following information:

- Date-time
- Event description
- Size of events buffer
- Position of the event in the events list
- Event caused by state generation or reset
- Associated measurement (if applicable)



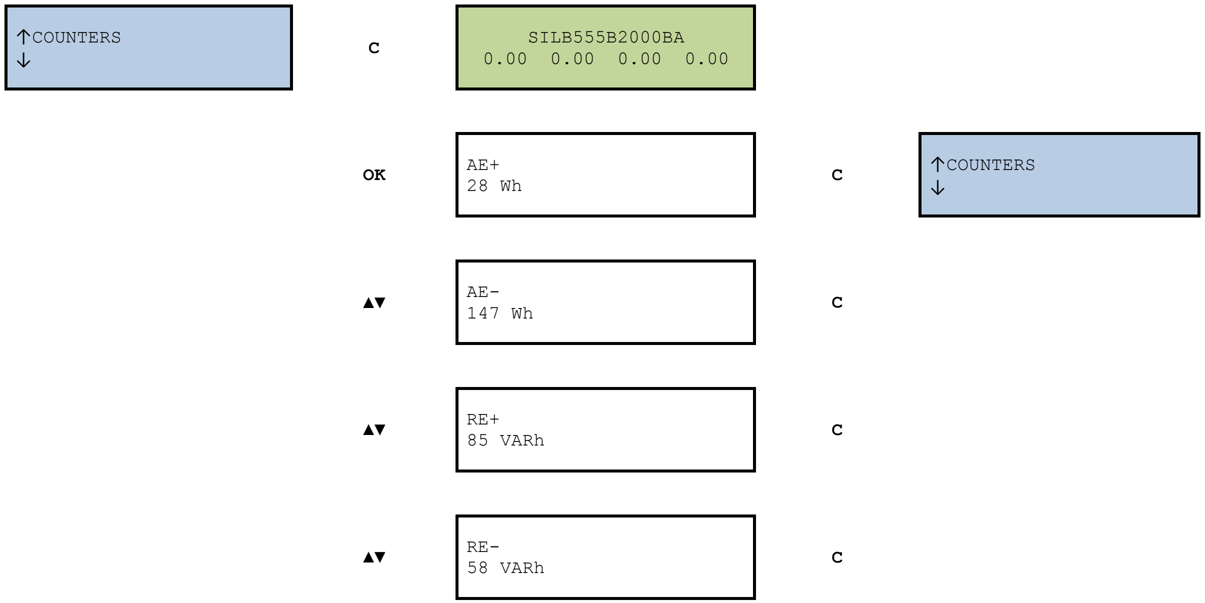
7.6.13. Counters menu

From the default screen, press “OK” to access the top level of menus. Use the “▲” and “▼” keys to proceed through the screens and select “COUNTERS”, then press “OK”,. Use the “▲” and “▼” keys to view the different counters. The value of the counter is shown under the name of the counter.

The first time that the value of a counter is changed or reset, the passcode must be entered. Once the passcode is entered, counters may be changed until the unit is returned to the default screen, either manually or automatically. The device will return to the default screen automatically if no key is pressed for a period of 5 minutes.

The factory default passcode is 5555. It can be changed using SICom.

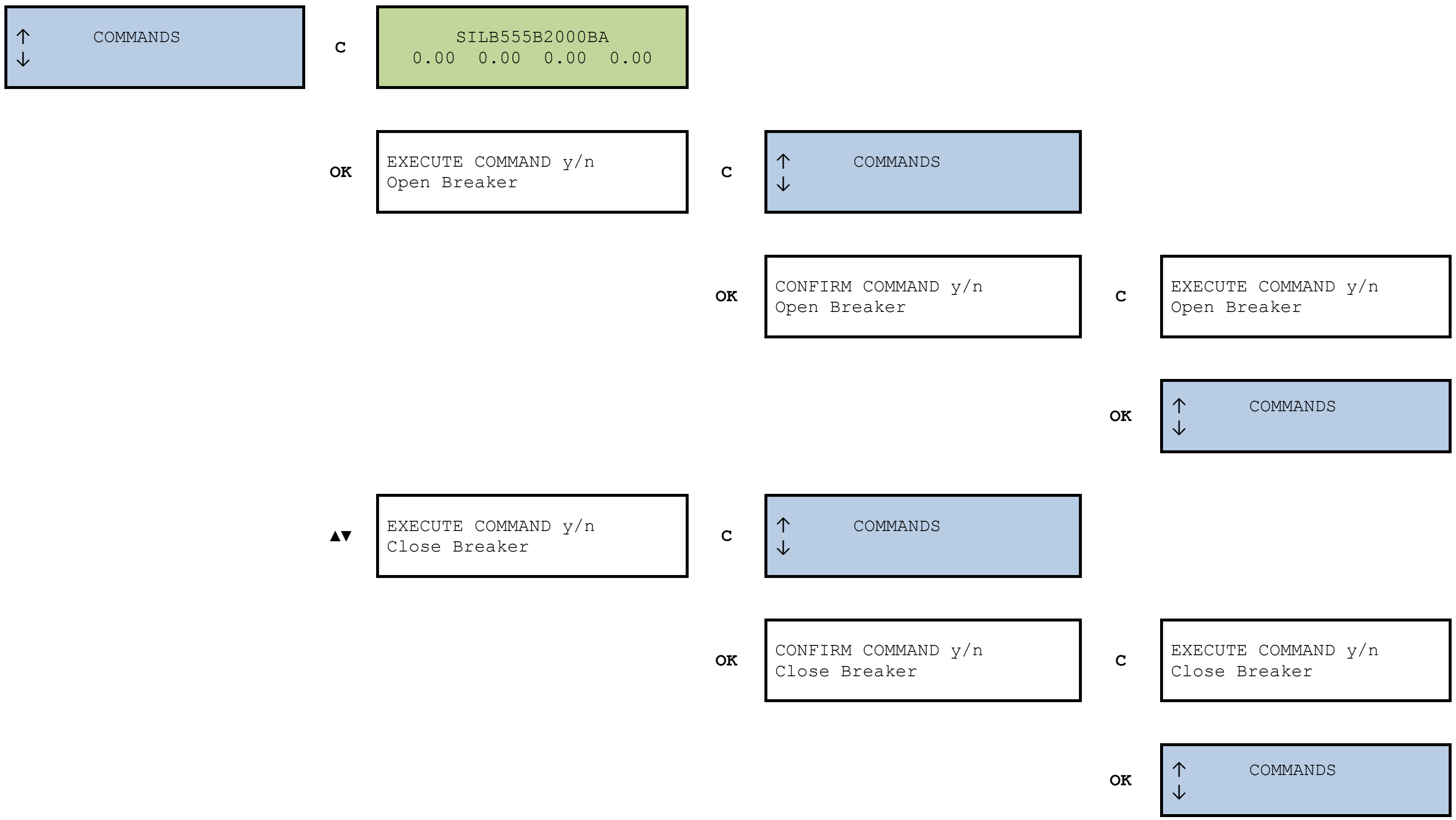
Use the ▲, ▼, ◄ and ► keys to enter the passcode. Use the ▲ and ▼ keys to change a value or character, and the ◄ and ► keys to move between digits. If a character or number of the passcode entered must be changed due to an entry error, it can be deleted with the “C” key. Press “OK” to validate the passcode.



▲▼	Openings Number 133	C
▲▼	Accumulated Amps 14011325 k(A2)	C
▲▼	Reclosing Numbers 25	C
▲▼	Thermal Image 75	C

7.6.14. Commands menu

From the default screen, press “OK” to access the top level of menus. Use the “▲” and “▼”keys to proceed through the screens and select “COMMANDS”, then press “OK”. Use the “▲” and “▼” keys to view available commands. To execute a command, press “OK”, and then confirm the command by pressing “OK” again.



▲▼

EXECUTE COMMAND y/n
Block Recloser

C

↑ COMMANDS
↓

OK

CONFIRM COMMAND y/n
Block Recloser

C

EXECUTE COMMAND y/n
Block Recloser

OK

↑ COMMANDS
↓

▲▼

EXECUTE COMMAND y/n
UnBlock Reclos

C

↑ COMMANDS
↓

OK

CONFIRM COMMAND y/n
UnBlock Reclos

C

EXECUTE COMMAND y/n
UnBlock Reclos

OK

↑ COMMANDS
↓

▲▼

EXECUTE COMMAND y/n
no Telecontrol

C

↑ COMMANDS
↓

OK

CONFIRM COMMAND y/n
no Telecontrol

C

EXECUTE COMMAND y/n
no Telecontrol

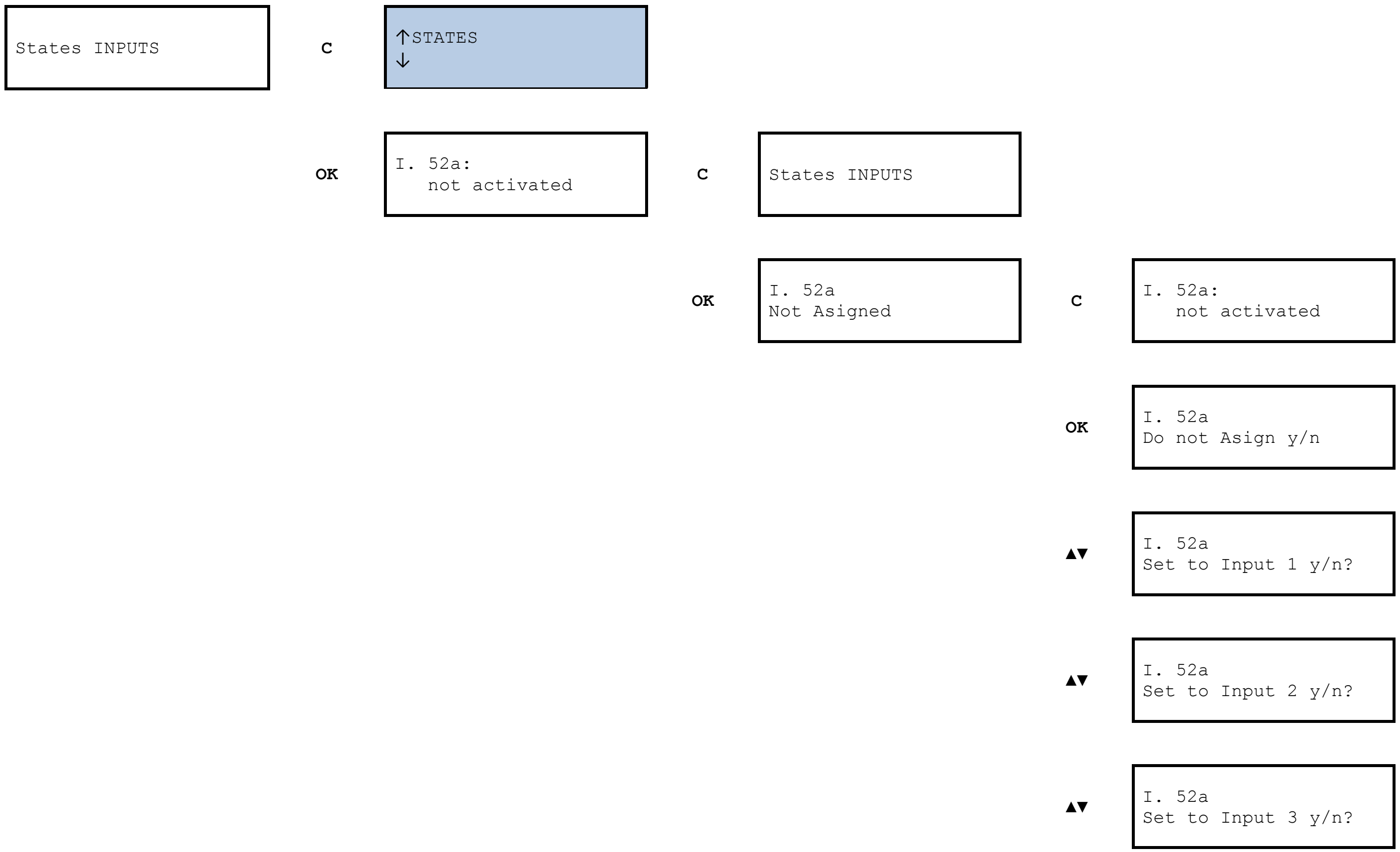
OK

↑ COMMANDS
↓

▲▼	EXECUTE COMMAND y/n Telecontrol Yes	C	↑ COMMANDS ↓			
		OK	CONFIRM COMMAND y/n Telecontrol Yes	C	EXECUTE COMMAND y/n Telecontrol Yes	
				OK	↑ COMMANDS ↓	

7.6.15. Input configuration menu

To assign a logical input to a physical input, navigate to the STATE menu of INPUTS. On viewing the state of the input (activated or deactivated), press “OK” to view the physical input associated with that logical input, rather than the current state of the logical input. To change the associated physical input, press “OK” and use the “▲” and “▼” keys to navigate to the desired physical input; confirm your choice by pressing “OK”. Use the “C” key to return to previous menus.

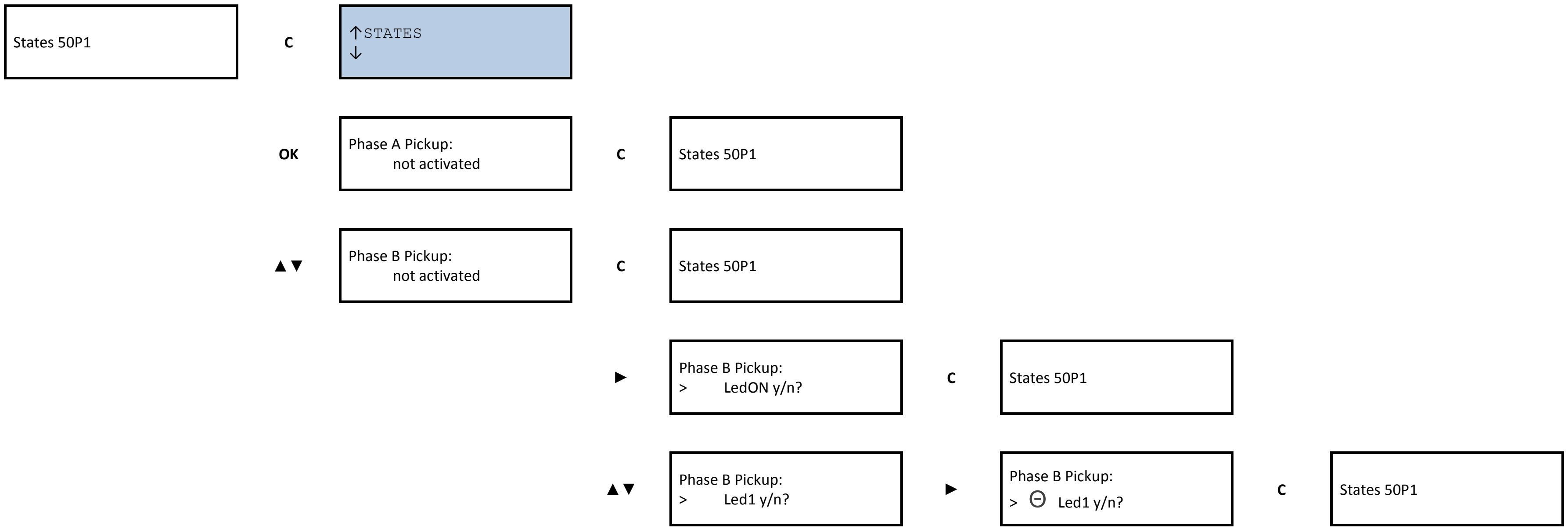


▲▼	I. 52a Set to Input 4 y/n?	C	States INPUTS	
		OK	Configuration Processing...	
			I. 52a Asigned to Input 4	OK
▲▼	I. 52a Set to Input 5 y/n?			
▲▼	I. 52a Set to Input 6 y/n?			
▲▼	I. 52a Set to Input 7 y/n?			
▲▼	I. 52a Set to Input 8 y/n?			

7.6.16. Menu for configuration of physical outputs, logical outputs, and LEDs

The same steps are followed to assign an instantaneous state to a physical output, to an LED, or to a logical output. Navigate through the STATE menu to the desired instantaneous state. Once the state is selected, press ► to enter the output configurations menu. Use the "▲" and "▼" keys to navigate to the desired physical output, LED, or logical output. LEDs can be configured as NEGATED by pressing the "RESET" key, and this state is then indicated with the symbol "¯". LEDs can be configured as FLASHING by pressing the "◄" key, and this state is then indicated with the symbol "Φ". LEDs can be configured as LATCHED by pressing the "►" key, and this state is then indicated with the symbol "Θ". Press "OK" to confirm.

After confirmation, the screen will show an index of 1 to 16 associated with the instantaneous state in the configuration. Use the "C" key to return to previous menus.



OK

Configuration
Processing...

Con 1/16 Led1
Phase B Pickup

OK

◄

Phase B Pickup:
> Φ Led1 y/n?

RESET

Phase B Pickup:
> _ Led1 y/n?

▲▼

Phase B Pickup:
> Led2 y/n?

▲▼

Phase B Pickup:
> Led3 y/n?

▲▼

Phase B Pickup:
> Led4 y/n?

▲▼

Phase B Pickup:
> Led5 y/n?

▲▼

Phase B Pickup:
> Output 1 y/n?

▲▼

Phase B Pickup:
> Output 2 y/n?

▲▼

Phase B Pickup:
> Output 3 y/n?

▲▼

Phase B Pickup:
> Output 4 y/n?

▲▼

Phase B Pickup:
> Output 5 y/n?

▲▼

Phase B Pickup:
> Output 6 y/n?

▲▼

Phase B Pickup:
> Output 7 y/n?

▲▼

Phase B Pickup:
> Output 8 y/n?

▲▼

Phase B Pickup:
> Output 9 y/n?

▲▼

```
Phase B Pickup:
>        Output 10 y/n?
```

▲▼

```
Phase B Pickup:
>        Output 11 y/n?
```

▲▼

```
Phase B Pickup:
>        Output 12 y/n?
```

▲▼

```
Phase B Pickup:
>        79 Init y/n?
```

▲▼

```
Phase B Pickup:
>        50BF Init y/n?
```

▲▼

```
Phase B Pickup:
>        Osc Init y/n?
```

▲▼

```
Phase B Pickup:
>        79 Permit y/n?
```

▲▼

```
Phase B Pickup:
>        52 Permit y/n?
```

To view or to unassign instantaneous states that are assigned to an output, navigate to the menu of STATE of OUTPUTS. On viewing the current state (activated or deactivated) of the output, press “OK” to switch to viewing the first instantaneous state associated with the output and its index, from 1 to 16; from this menu, use the “▲” and “▼” keys to view each state (up to 16) associated with the physical output.

From the screen showing any instantaneous state associated with the output and its index from 1 to 16, press and hold the “RESET” key to unassign the physical output.

8. MODBUS RTU PROTOCOL

The communication parameters are as follows:

- Adjustable Speed and Direction
- 8 data bits
- No parity
- 1 stop bit

This document describes the steps to follow to read and write data on the SIL B relay, as per the ModBUS/RTU protocol. This memory map is only valid for one piece of equipment and one version of the memory. The positions of existing objects in the memory remain fixed from one version to the next, but new objects will naturally have new addresses which will, in turn, remain fixed in future versions. The memory map is described further on.

The standard ModBUS/RTU protocol is used, so any program or PC can communicate easily with the equipment.

The SIL B always acts as a slave, which means that it never initiates communications. The master is always responsible for initiating communications.

Only a subset of the ModBUS/RTU functions is implemented:

- Reading function 3.
- Writing function 16.

The ModBUS/RTU protocol is independent from the hardware. Therefore, the physical layer can exist in different hardware configurations: RS232, RS485, fiber optic or Ethernet.

Specifically, the relay has a front RS232 port and, as an option, a rear RS485 port. The data stream in any of the configurations is “half-duplex”.

Each byte of data is transmitted asynchronously and is made up of: 1 start bit, 8 data bits, 1 stop bit and 1 parity bit, if this is how it is programmed. Therefore, the data has 10 or 11 bits, depending on whether or not it includes parity.

When the equipment has a single front port, the address can be configured but the rest of the parameters are fixed: the speed is 19200, without parity and with 1 stop bit.

The equipment has two ports, one front and one rear, the following features can be configured: speed (4800, 9600, 19200 or 38400) and the address (1 to 247).

The master must know the address of the slave that it is going to communicate with. No unit will act on requests from the master if the message is not addressed to them. The exception is when the 0 address, or “broadcast” address, is used, in which case the relay will act but will not send an answer of any type.

Communications are made in packages or frames, which are groups of data that are sent asynchronously. The master transmits a frame to the slave, and the slave then replies with another frame (except in the case of “broadcast” messages).

The end of the frame is marked by a dead time or silence time in the communication medium. The length of this time of silence varies depending on the transmission speed, as it is equivalent to 3 characters.

The following table shows the generic package format that is valid for transmission and reception. However, each function has its own peculiarities, as will be described further on.

8.1. ModBus package format

CLIENT ADDRESS	1 byte	Each device on a communications bus must have a unique address, as otherwise two devices could answer the same request at the same time. All of the ports of the relay will use this address, which can be programmed with a value between 1 and 247. When the master device transmits a packet to the slave address 0, this is a broadcast packet. All of the slave devices on the bus will execute the requested action, but none will reply to the master. Broadcast will only be accepted for write commands, as there is no meaning in transmitting a read request on broadcast, given that no device will reply to it.
FUNCTION CODE	1 byte	This is one of the function codes supported by the device. In this case, the only supported function codes are 3 for read and 16 for write. When the slave has to reply to one of these packets with an exception, this is indicated by setting the Most Significant Bit of the corresponding function to 1. Thus, an exception for function 3 will be indicated with 0x83 as function code, and an exception to code 16, or 0x10 in hexadecimal, is indicated with 0x90.
DATA	N bytes	This part of the packet consists of a variable number of bytes, depending on the function code. It can include: addresses, data strings, settings, commands, or exception codes sent by the client.
CRC	2 bytes	Two byte control code. ModBUS/RTU includes a 16 byte CRC in each packet, for error detection. If the slave detects an erroneous packet, through the inclusion of an incorrect CRC, it will take no action, nor will it reply to the master. The CRC ordering is LSB-MSB.
DEAD TIME	Time necessary to transmit 3.5 bytes.	A packet is taken to have ended when nothing is received for a period of 3.5 bytes. That is: 15 ms at 2400 bps 2 ms at 19200 bps ...etc.

8.2. Function codes

CODE HEX DEC	MODBUS NAME	DEFINITION	COMMENT
0x03 3	Read Holding Logs	Read any value	This function allows the master to read 1 or more consecutive addresses in a relay. The logs are always 16 bits, with the most significant byte first. The maximum number of logs that can be read in one packet is 60.
0x10 16	Preset Multiple Logs	Write	This function allows the writing of one or more logs, representing one or more settings. The logs are values 2 bytes in length, transmitted with the most significant byte first. The maximum number of logs that can be written in one packet is 60.

8.3. Exceptions and error responses

The error codes defined in the Modbus protocol are as follows:

01	ILLEGAL FUNCTION	The slave does not support the function with function code specified in the message received.
02	ILLEGAL DATA ADDRESS	The master is attempting to execute an operation with an incorrect address.
03	ILLEGAL DATA VALUE	The slave has detected that a value sent by the master is not valid.
04	SLAVE DEVICE FAILURE	Indicates that an error has occurred in the slave while it was attempting to execute the request received from the master.
05	ACKNOWLEDGE	Generic recognition
06	SLAVE DEVICE BUSY	The slave is busy and cannot execute the required operation.
07	NEGATIVE ACKNOWLEDGE	Generic non-recognition

8.4. Data types

Type	Length	Description
UCHAR	1/2	Unsigned 1 byte
BYTE	1/2	Signed 1 byte integer
BIT16	1	Bit type in groups of 16. Example: 0x1A41 = 0001101001000001b
BIT32	2	Bit type in groups of 32 in 32.
ENUM	1	Unsigned 16 bit integer. Each possible value of this integer has a corresponding value in the auxiliary table of the database. This table shows the corresponding string that should be shown for each value. Only an integer will be received into memory. Example: 0, 1 correspond to “CLOSED”, “OPEN”
DENUM	2	Unsigned 32 bit integer.
UINT	1	Unsigned two byte integer
INT	1	Signed two byte integer
LONG	2	Unsigned 4 byte integer
DWORD	2	Signed 4 byte integer
FLOAT	2	4 byte floating point number
ASCIIxx	xx/2	String: Variable length string of characters. The end of the string is marked with ‘\0’ Example: “ABC” 0x41x42x43x00....
MILIS	3	Minutes (passed since 00:00 on 1/1/2000 (LONG). Milliseconds (UINT)

FH	5	Year (UINT), month(UCHAR), day(UCHAR), hours(UCHAR), minutes(UCHAR), seconds(UCHAR), hundredths(UCHAR), thousandths(UINT)
CONT	13	Index(UINT).Value(DWORD).Description(ASCII20)
EVENT	9	Criterion index(UINT).Event identifier(UINT).Value(UINT).Associated measurement(UINT).Date and time(FH)
EVENT	10	Age(UINT).Event(EVENT)
CCRIT	6	Criterion number(UINT).Criterion index(UINT).Descriptive text(ASCII8)
PEST	61	Number of states(UINT).Protection state-1(BIT16). … Protection state-60(BIT16)
PCRIT	61	Number of criteria(UINT).Criterion index-1(UINT). … Criterion index-60(UINT).
CMED	8	Measurement number(UINT).Descriptive text(ASCII7).Unit(ASCII3).Primary unit(ASCII5).Number of decimals(UCHAR)
GAJU	61	Number of groups(UINT).Criterion index-1(UINT).Criterion first setting index-1(UINT). … Criterion index-30(UINT). Criterion first setting index -30(UINT).

When a data type format occupies more than one byte, in communications the most significant byte is always sent first, and the least significant byte last.

8.5. SIL-B memory map

Function	Description	Start address	Number of logs	Format	
03	Read model and version	100	44	ASCII88	
03	Read device state	160	2	BIT32	See passcodes and access levels
03	Read access level	162	4	UCHAR8	See passcodes and access levels
16	Write access passcode	168	2	UCHAR4	See passcodes and access levels
03	Read date and time	170	5	FH	
16	Write date and time	170	5	FH	
16	Write counter index	175	1	UINT	See counter map
03	Read counters	176	13	CONT	See counter map
16	Write counters	176	13	CONT	See counter map
16	Command selection	200	1	UINT	See commands map
16	Command confirmation	201	1	UINT	See commands map
16	Write event index	400	1	UINT	See commands map

03	Read an event	401	10	EVENT	See events list
03	Read and delete the oldest event	433	9	EVENT	See events list
16	Delete all events	465	1	Dummy	
16	Write protection criteria index	500	1	UINT	See protection criteria map
03	Reading of protection states	501	61	PEST	See state map
03	Read which protection criteria the device implements	561	61	PCRIT	See protection criteria map
03	Read the characteristics of a protection criterion	681	6	CCRIT	See protection criteria map
16	Write the measurements index	1000	1	UINT	See measures map
03	Read measure on secondary	1001	2	FLOAT	See measures map
03	Read measure on primary	1401	2	FLOAT	See measures map
03	Read the characteristics of a measurement	1801	8	CMED	See measures map
16	Write settings table number	3000	1	UINT	
03	Read a setting	3001	2	See settings map	
16	Write a setting	3001	2	See settings map	
16	Write-Confirmation of a setting	5001	2	See settings map	
03	Read the first setting index of each protection criterion	7001	61	GAJU	See settings map

8.6. Counter map

1	Active positive 3 phase energy counter
2	Active negative 3 phase energy counter
3	Reactive positive 3 phase energy counter
4	Reactive negative 3 phase energy counter
5	Counter for the number of openings
6	Total amps counter: I^2t
7	Reclosures counter
8	Thermal image

8.7. Commands map

1	Open breaker
2	Close breaker
3	Lock recloser
4	Unlock recloser
5	Local control
6	Remote control

8.8. Measurements map

1	IA	Phase A current
2	IB	Phase B current
3	IC	Phase C current
4	IN	Neutral current
5	I1	Positive sequence current
6	I2	Negative sequence current
7	VA	Phase A voltage
8	VB	Phase B voltage
9	VC	Phase C voltage
10	VN	Neutral voltage
11	VBBus	Phase B Busbar voltage
12	VAB	Voltage between phases A and B
13	VBC	Voltage between phases B and C
14	VCA	Voltage between phases C and A
15	Angle A	Angle between voltage and current in phase A
16	Angle B	Angle between voltage and current in phase B
17	Angle C	Angle between voltage and current in phase C
18	P	3 phase active power
19	PA	Active power, phase A
20	PB	Active power, phase B
21	PC	Active power, phase C

22	Q	3 phase reactive power
23	QA	Reactive power, phase A
24	QB	Reactive power, phase B
25	QC	Reactive power, phase C
26	S	3 phase apparent power
27	SA	3 phase apparent power, phase A
28	SB	3 phase apparent power, phase B
29	SC	3 phase apparent power, phase C
30	cos φ	Power factor
31	cos φA	Power factor, phase A
32	cos φB	Power factor, phase B
33	cos φC	Power factor, phase C
34	Thermal image	Thermal image mesurement
35	Line frequency	Line phase b frequency
36	Busbar frequency	Busbar phase b frequency
37	Phase difference	Phase difference between phase B line voltage and phase b bar voltage

8.9. Protection criteria map

Criterion number	Criteria index	Criterion name
1	50*256+5	50P_1
2	50*256+5+32	50P_2
3	67*256+2	67/51/50P_1
4	67*256+2+32	67/51/50P_2
5	150*256+5	50N_1
6	150*256+5+32	50N_2
7	167*256+2	67/51/50N_1
8	167*256+2+32	67/51/50N_2
9	203*256+2	Cold Load Pickup (CLP)
10	24*256+1	50BF
11	46*256+2	46 (Negative sequence)

12	59*256+1	59P_1
13	59*256+1+32	59P_2
14	159*256+1	59N_1
15	159*256+1+32	59N_2
16	27*256+1	27P_1
17	27*256+1+32	27P_2
18	32*256+1	32_1
19	32*256+1+32	32_2
20	32*256+1+64	32_3
21	32*256+1+96	32_4
22	49*256+1	49_1
23	81*256+1	81_1
24	81*256+1+32	81_2
25	81*256+1+64	81_3
26	81*256+1+96	81_4
27	25*256+1	25 (sinchronism)
28	37*256+1	37_1
29	37*256+1+32	37_2
30	200*256+3	General state
31	255*256+6 255*256+7	Measurements SILBxxxx0xxxx Mesurements: models SILBxxxx1xxxx and SILBxxxx2xxxx
32	253*256+8	Inputs
33	254*256+16 254*256+23	Outputs: SILBxxxx0xxxx Outputs: models SILBxxxx1xxxx and SILBxxxx2xxxx
34	79*256+1	79 (Autorecloser)
35	52*256+1	52 (Breakers)
36	74*256+1	74TCS
37	252*256+3	Oscillography
38	249*256+2	Remote Modbus protocol
39	240*256+2	Remote IEC 60870-5-103 protocol
40	249*256+1	Local Modbus protocol

8.9.1. States map

Criterion		States
50P_1 **50P_2**	bit-0	Pickup, phase A
	bit-1	Pickup, phase B
	bit-2	Pickup, phase C
	bit-3	Pickup
	bit-8	Phase A Trip
	bit-9	Phase B Trip
	bit-10	Phase C Trip
	bit-11	Trip
67/51/50P_1 **67/51/50P_2**	bit-8	Pickup, phase A
	bit-9	Pickup, phase B
	bit-10	Pickup, phase C
	bit-11	Pickup
	bit-12	Phase A Trip
	bit-13	Phase B Trip
	bit-14	Phase C Trip
	bit-15	Trip
50N1 **50N2**	bit-4	Pickup
	bit-12	Trip
67/51/50N_1 **67/51/50N_2**	bit-4	Pickup
	bit-12	Trip
CLP	bit-12	Activated
50BF	bit-4	Pickup
	bit-12	Trip
46	bit-4	Pickup
	bit-12	Trip
49	bit-4	Alarm
	bit-12	Trip

37P_1 **37P_2**	bit-0	Pickup, phase A
	bit-1	Pickup, phase B
	bit-2	Pickup, phase C
	bit-3	Pickup
	bit-8	Phase A Trip
	bit-9	Phase B Trip
	bit-10	Phase C Trip
	bit-11	Trip
59P_1 **59P_2**	bit-0	Pickup, phase A
	bit-1	Pickup, phase B
	bit-2	Pickup, phase C
	bit-3	Pickup
	bit-8	Phase A Trip
	bit-9	Phase B Trip
	bit-10	Phase C Trip
	bit-11	Trip
59N_1 **59N_2**	bit-4	Pickup
	bit-12	Trip
27P_1 **27P_2**	bit-0	Pickup, phase A
	bit-1	Pickup, phase B
	bit-2	Pickup, phase C
	bit-3	Pickup
	bit-8	Phase A Trip
	bit-9	Phase B Trip
	bit-10	Phase C Trip
	bit-11	Trip
32_1, 32_2, 32_3, 32_4	bit-4	Activation
	bit-12	Trip
General:	bit-0	Trip
	bit-6	50 Hz network frequency
	bit-14	Magnetic module error

	bit-15	Measurement error
	bit-16	Device Pickup
	bit-17	Protection error
	bit-18	Settings changed
	bit-20	Date and time synchronization
	bit-21	Remote Control to Local
	bit-22	Default settings error
	bit-23	EEPROM error
	bit-27	EEPROM values changed
	bit-28	Events log error
	bit-31	New Events
	bit-48	Pickup, Neutral
	bit-49	Pickup, phase A
	bit-50	Pickup, phase B
	bit-51	Pickup, phase C
	bit-52	Pickup, GENERAL
	bit-53	Phase A Trip
	bit-54	Phase B Trip
	bit-55	Phase C Trip
	bit-56	50N Trip
	bit-57	50P Trip
Inputs	bit-0	Input 52a
	bit-1	Input 52b
	bit-2	Blocking phase input
	bit-3	Blocking neutral input
	bit-4	External trip input
	bit-5	Oscillography Pickup Input
	bit-6	Input Start 79
	bit-7	Permission 79 input
	bit-8	Locking 79 level input
	bit-9	Input-0 Table Active

	bit-10	Input-1 Table Active
	bit-11	Lock pulse input 79
	bit-12	Input pulse Unlock 79
	bit-13	Input start 50BF
	bit-16	Input -1
	bit-17	Input -2
	bit-18	Input -3
	bit-19	Input -4
	bit-20	Input -5
	bit-21	Input -6
	bit-22	Input -7
	bit-23	Input -8
	bit-24	Control voltage
	bit-25	Coil A continuity
	bit-26	Coil B continuity
Outputs (model SILBxxxx0xxxx)	bit-0	Output – 1
	bit-1	Output – 2
	bit-2	Output – 3
	bit-3	Output – 4
	bit-4	Output – 5
	bit-5	Output - 6
	bit-6	Output - 7
	bit-7	Start 79
	bit-8	Start 50BF
	bit-9	Start Fault
	bit-10	LED-ON
	bit-11	LED -1
	bit-12	LED -2
	bit-13	LED -3
	bit-14	LED -4
	bit-15	LED -5

Outputs (model SILBxxxx1xxxx and SILBxxxx2xxxx)	bit-0	Led-On
	bit-1	Led-1
	bit-2	Led-2
	bit-3	Led-3
	bit-4	Led-4
	bit-5	Led-5
	bit-6	Output-1
	bit-7	Output -2
	bit-8	Output -3
	bit-9	Output -4
	bit-10	Output -5
	bit-11	Output -6
	bit-12	Output -7
	bit-13	Output -8
	bit-14	Output -9
	bit-15	Output -10
	bit-16	Output -11
	bit-17	Output-12
	bit-18	Start 79
	bit-19	Start 50BF
	bit-20	Start fault
	bit-21	79 Permit
	bit-22	52 Permit
79	bit-0	State 79 Inactive
	bit-1	State 79 Reclosure Time
	bit-2	State 79 Open
	bit-3	State 79 Wait Time
	bit-4	State 79 Closure Time
	bit-5	State 79 Reset Time
	bit-6	State 79 in Lockout
	bit-7	State 79 Safety Time

	bit-8	State 79 Definitive Opening Time
25	bit-0	Live line, live bar
	bit-1	Live line, dead bar
	bit-2	Dead line, live bar
	bit-3	Dead line, dead bar
	bit-15	Synchronism permission
52	bit-0	State 52 Error
	bit-1	State 52 Open
	bit-2	State 52 Opening Time
	bit-3	State 52 Opening Fault
	bit-4	State 52 Closed
	bit-5	State 52 Closure Time
	bit-6	State 52 Closure Fault
	bit-7	State 52 Excess Openings
	bit-8	State 52 Excess Total Amps
	bit-9	State 52 Excess Openings per Minute
	bit-10	State 52-A
	bit-11	State 52-B
	bit-12	State 52 Error
74TCS	bit-4	Pickup
	bit-12	Trip
Remote ModBus	bit-0	Remote communications
	bit-16	Command selection
	bit-17	Open breaker
	bit-18	Close breaker
	bit-19	Lock 79
	bit-20	Unlock 79
Remote	bit-0	Remote communications
	bit-16	Command selection
	bit-17	Open breaker
	bit-18	Close breaker

	bit-19	Lock 79
	bit-20	Unlock 79
Local ModBus	bit-0	Local communications
	bit-1	HMI activity
	bit-16	Command selection
	bit-17	Open breaker
	bit-18	Close breaker
	bit-19	Lock 79
	bit-20	Unlock 79
	bit-21	Set Remote Control to Local
	bit-22	Set Remote Control to Remote

8.10. Event list

Criterion	Event nº	Event identifier
50P_1 **50P_2**	1	50 Pickup A
	2	50 Pickup B
	3	50 Pickup C
	4	50 Pickup P
	5	50 Trip A
	6	50 Trip B
	7	50 Trip C
	8	50 Trip P
67/51/50P_1 **67/51/50P_2**	1	67 Pickup A
	2	67 Pickup B
	3	67 Pickup C
	4	67 Pickup P
	5	67 Trip A
	6	67 Trip B
	7	67 Trip C
	8	67 Trip P

50N_1 **50N_2**	1	50 Pickup N
	2	50 Trip N
67/51/50N1 **67/51/50N2**	1	67 Pickup N
	2	67 Trip N
CLP	1	Activation
50BF	1	Pickup
	2	Activation
46	1	Pickup
	2	Activation
49	1	Pickup
	2	Activation
37P_1 **37P_2**	1	37 Pickup A
	2	37 Pickup B
	3	37 Pickup C
	4	37 Pickup P
	5	37 Trip A
	6	37 Trip B
	7	37 Trip C
	8	37 Trip P
59P_1 **59P_2**	1	59 Pickup A
	2	59 Pickup B
	3	59 Pickup C
	4	59 Pickup P
	5	59 Trip A
	6	59 Trip B
	7	59 Trip C
	8	59 Trip P
59N_1 **59N_2**	1	59 Pickup N
	2	59 Trip N

27P_1 **27P_2**	1	27 Pickup A
	2	27 Pickup B
	3	27 Pickup C
	4	27 Pickup P
	5	27 Trip A
	6	27 Trip B
	7	27 Trip C
	8	27 Trip P
32_1, 32_2, 32_3, 32_4	1	32 Pickup
	2	32 Trip
General:	1	General Trip
	7	General 50Hz
	17	General Ready
	18	General Protection Error
	19	General Setting changed
	21	General time synching
	22	General Local Remote Control
	23	General EEPROM with default values
	24	General EEPROM error
	28	General EEPROM values changed
	29	General Events Error
	30	General New waveform captured
	38	General Measurement error
	40	Magnetic module error
	48	General Events Erased
	49	Pickup, neutral
	50	Pickup, phase A
	51	Pickup, phase B
	52	Pickup, phase C
	53	Pickup, GENERAL
	54	Phase A Trip

	55	Phase B Trip
	56	Phase C Trip
	57	50N Trip
	58	50P Trip
Inputs	1	Input 52 a
	2	Input 52 b
	3	Locking 50P input
	4	Locking 50N input
	5	External trip input
	6	Oscillography start input
	7	Start 79 input
	8	Permission 79 input
	9	Locking 79 level input
	10	Input-0 Table selection
	11	Input-1 Table selection
	12	Lock pulse input 79
	13	Unlock pulse input 79
	14	Start input 50BF
	17	Input 1
	18	Input 2
	19	Input 3
	20	Input 4
	21	Input 5
	22	Input 6
	23	Input 7
	24	Input 8
Outputs	1	Output 1
	2	Output 2
	3	Output 3
	4	Output 4
	5	Output 5

	9	Output 6
	10	Output 7
	6	Start 79
	7	Start 50BF
	8	Start oscillography
	16	Permission 79
	17	Closure permission 52
79	1	State 79 Inactive
	2	State 79 Reclosure Time
	3	State 79 Open
	4	State 79 Hold Time
	5	State 79 Closure Time
	6	State 79 Reset Time
	7	State 79 in Lockout
	8	State 79 Safety Time
	9	State 79 Definitive Opening Time
52	1	State 52 Error
	2	State 52 Open
	3	State 52 Opening Time
	4	State 52 Opening Fault
	5	State 52 Closed
	6	State 52 Closure Time
	7	State 52 Closure Fault
	8	State 52 Excess Openings
	9	State 52 Excess Total Amps
	10	State 52 Excess Openings per Minute
	11	State 52-A
	12	State 52-B
	13	State 52 Error
74TCS	1	Pickup
	2	Activation

Remote ModBus	1	Command selection
	2	Open breaker
	3	Close breaker
	4	Lock 79
	5	Unlock 79
Remote	1	Command selection
	2	Open breaker
	3	Close breaker
	4	Lock 79
	5	Unlock 79
Local ModBus	1	Command selection
	2	Open breaker
	3	Close breaker
	4	Lock 79
	5	Unlock 79
	6	Set Remote Control to Local
	7	Set Remote Control to Remote

8.11. Settings map

Start address for Modbus read and write	Start address for Modbus confirm.	Type	Category	Function
3001	5001	ASCII20	General:	Device identifier
3006	5006	LONG	General:	Phase CT ratio
3007	5007	LONG	General:	Neutral CT ratio
3008	5008	LONG	General:	VT ratio
3009	5009	DENUM 5060Hz	General:	Frequency
3010	5010	DENUM LANGUAGE	General:	Language
3011	5011	LONG	General:	Settings group
3012	5012	LONG	Communications	Address 60870-5-103

3013	5013	DENUM BAUDRATE	Communications	Speed 60870-5-103
3014	5014	LONG	Communications	ModBus address
3015	5015	DENUM BAUDRATE	Communications	ModBus data rate
3016	5016	DENUM NOSI	50P_1	Permission
3017	5017	FLOAT	50P_1	Pickup
3018	5018	FLOAT	50P_1	Operating time
3019	5019	DENUM NOSI	50P_2	Permission
3020	5020	FLOAT	50P_2	Pickup
3021	5021	FLOAT	50P_2	Operating time
3022	5022	DENUM NOSI	50N_1	Permission
3023	5023	FLOAT	50N_1	Pickup
3024	5024	FLOAT	50N_1	Operating time
3025	5025	DENUM NOSI	50N_2	Permission
3026	5026	FLOAT	50N_2	Pickup
3027	5027	FLOAT	50N_2	Operating time
3028	5028	DENUM NOSI	67P_1	Permission
3029	5029	DENUM CURVAEXT	67P_1	Curve
3030	5030	FLOAT	67P_1	Dial
3031	5031	FLOAT	67P_1	Pickup
3032	5032	FLOAT	67P_1	Operating time
3033	5033	DENUM NOSI	67P_1	Directionality
3034	5034	FLOAT	67P_1	Polarization voltage
3035	5035	LONG	67P_1	Operating angle
3036	5036	LONG	67P_1	Half-cone angle
3037	5037	DENUM NOSI	67P_2	Permission
3038	5038	DENUM CURVAEXT	67P_2	Curve
3039	5039	FLOAT	67P_2	Dial
3040	5040	FLOAT	67P_2	Pickup
3041	5041	FLOAT	67P_2	Operating time

3042	5042	DENUM NOSI	67P_2	Directionality
3043	5043	FLOAT	67P_2	Polarization voltage
3044	5044	LONG	67P_2	Operating angle
3045	5045	LONG	67P_2	Half-cone angle
3046	5046	DENUM NOSI	67N_1	Permission
3047	5047	DENUM CURVAEXT	67N_1	Curve
3048	5048	FLOAT	67N_1	Dial
3049	5049	FLOAT	67N_1	Pickup
3050	5050	FLOAT	67N_1	Operating time
3051	5051	DENUM NOSI	67N_1	Directionality
3052	5052	FLOAT	67N_1	Polarization voltage
3053	5053	LONG	67N_1	Operating angle
3054	5054	LONG	67N_1	Half-cone angle
3055	5055	DENUM NOSI	67N_2	Permission
3056	5056	DENUM CURVAEXT	67N_2	Curve
3057	5057	FLOAT	67N_2	Dial
3058	5058	FLOAT	67N_2	Pickup
3059	5059	FLOAT	67N_2	Operating time
3060	5060	DENUM NOSI	67N_2	Directionality
3061	5061	FLOAT	67N_2	Polarization voltage
3062	5062	LONG	67N_2	Operating angle
3063	5063	LONG	67N_2	Half-cone angle
3064	5064	DENUM NOSI	50BF	Permission
3065	5065	FLOAT	50BF	Opening failure time
3066	5066	DENUM NOSI	46	Permission
3067	5067	DENUM CURVAEXT	46	Curve
3068	5068	FLOAT	46	Dial
3069	5069	FLOAT	46	Pickup
3070	5070	FLOAT	46	Operating time

3071	5071	LONG	52	Excess number of openings
3072	5072	LONG	52	Maximum accumulated amperes
3073	5073	FLOAT	52	Opening time
3074	5074	FLOAT	52	Closure time
3075	5075	LONG	52	Excess repeated openings
3076	5076	FLOAT	52	Repeated openings excess time
3077	5077	DENUM NOSI	79	Permission
3078	5078	DENUM NOSI	79	Wait permission
3079	5079	LONG	79	Number of reclosings
3080	5080	FLOAT	79	Reclosure 1 time
3081	5081	FLOAT	79	Reclosure 2 time
3082	5082	FLOAT	79	Reclosure 3 time
3083	5083	FLOAT	79	Reclosure 4 time
3084	5084	FLOAT	79	Reclosure 5 time
3085	5085	FLOAT	79	Wait time
3086	5086	FLOAT	79	Reset Time
3087	5087	FLOAT	79	Definitive opening time
3088	5088	DENUM NOSI	59P_1	Permission
3089	5089	FLOAT	59P_1	Tap
3090	5090	FLOAT	59P_1	Operating time
3091	5091	FLOAT	59P_1	Reset Time
3092	5092	DENUM NOSI	59P_2	Permission
3093	5093	FLOAT	59P_2	Tap
3094	5094	FLOAT	59P_2	Operating Time
3095	5095	FLOAT	59P_2	Reset Time
3096	5096	DENUM NOSI	59N_1	Permission
3097	5097	FLOAT	59N_1	Tap
3098	5098	FLOAT	59N_1	Operating time
3099	5099	FLOAT	59N_1	Reset Time
3100	5100	DENUM NOSI	59N_2	Permission

3101	5101	FLOAT	59N_2	Tap
3102	5102	FLOAT	59N_2	Operating time
3103	5103	FLOAT	59N_2	Reset Time
3104	5104	DENUM NOSI	27P_1	Permission
3105	5105	FLOAT	27P_1	Tap
3106	5106	FLOAT	27P_1	Operating time
3107	5107	FLOAT	27P_1	Reset Time
3108	5108	DENUM NOSI	27P_2	Permission
3109	5109	FLOAT	27P_2	Tap
3110	5110	FLOAT	27P_2	Operating Time
3111	5111	FLOAT	27P_2	Reset Time
3112	5112	DENUM NOSI	32_1	Permission
3113	5113	FLOAT	32_1	Tap
3114	5114	LONG	32_1	Characteristic angle
3115	5115	FLOAT	32_1	Time
3116	5116	DENUM NOSI	32_2	Permission
3117	5117	FLOAT	32_2	Pickup
3118	5118	LONG	32_2	Characteristic angle
3119	5119	FLOAT	32_2	Time
3120	5120	DENUM NOSI	32_3	Permission
3121	5121	FLOAT	32_3	Pickup
3122	5122	LONG	32_3	Characteristic angle
3123	5123	FLOAT	32_3	Time
3124	5124	DENUM NOSI	32_4	Permission
3125	5125	FLOAT	32_4	Pickup
3126	5126	LONG	32_4	Characteristic angle
3127	5127	FLOAT	32_4	Time
3128	5128	DENUM NOSI	49	Permission
3129	5129	FLOAT	49	Tap
3130	5130	FLOAT	49	ζheating
3131	5131	FLOAT	49	ζcooling

3132	5132	FLOAT	49	Alarm
3133	5133	DENUM NOSI	74TCS	Permission
3134	5134	FLOAT	74TCS	Timing
3135	5135	DENUM NOSI	CLP	Permission
3136	5136	FLOAT	CLP	50P_1 multiplier
3137	5137	FLOAT	CLP	50P_2 multiplier
3138	5138	FLOAT	CLP	67P_1 multiplier
3139	5139	FLOAT	CLP	67P_2 multiplier
3140	5140	FLOAT	CLP	50N_1 multiplier
3141	5141	FLOAT	CLP	50N_2 multiplier
3142	5142	FLOAT	CLP	67N_1 multiplier
3143	5143	FLOAT	CLP	67N_2 multiplier
3144	5144	FLOAT	CLP	Cold Load pass time
3145	5145	FLOAT	CLP	CLP duration time
3128	5128	DENUM NOSI	49	Permission
3129	5129	FLOAT	49	Tap
3130	5130	FLOAT	49	ζheating
3131	5131	FLOAT	49	ζcooling
3132	5132	FLOAT	49	Alarm
3133	5133	DENUM NOSI	81_1	Permission
3134	5134	DENUM	81_1	Type
3135	5135	FLOAT	81_1	Activation level
3136	5136	FLOAT	81_1	Operating time
3137	5137	FLOAT	81_1	Reset time
3138	5138	DENUM NOSI	81_2	Permission
3139	5139	DENUM	81_2	Type
3140	5140	FLOAT	81_2	Activation level
3141	5141	FLOAT	81_2	Operating time
3142	5142	FLOAT	81_2	Reset time
3143	5143	DENUM NOSI	81_3	Permission
3144	5144	DENUM	81_3	Type

3145	5145	FLOAT	81_3	Activation level
3146	5146	FLOAT	81_3	Operating time
3147	5147	FLOAT	81_3	Reset time
3148	5148	DENUM NOSI	81_4	Permission
3149	5149	DENUM	81_4	Type
3150	5150	FLOAT	81_4	Activation level
3151	5151	FLOAT	81_4	Operating time
3152	5152	FLOAT	81_4	Reset time
3153	5153	FLOAT	25	Live line voltage level
3154	5154	FLOAT	25	Dead line voltage level
3155	5155	FLOAT	25	Live bar voltage level
3156	5156	FLOAT	25	Dead bar voltage level
3157	5157	FLOAT	25	Voltage supervision temporisation
3158	5158	DENUM NOSI	25	Permission LLLB
3159	5159	DENUM NOSI	25	Permission LLDB
3160	5160	DENUM NOSI	25	Permission DLLB
3161	5161	DENUM NOSI	25	Permission DLDB
3162	5162	FLOAT	25	Line-bar voltage difference
3163	5163	FLOAT	25	Line-bar phase difference
3164	5164	FLOAT	25	Line-bar frequency difference
3165	5165	FLOAT	25	Synchronism time
3166	5166	DENUM NOSI	37P_1	Permiso
3167	5167	FLOAT	37P_1	Toma
3168	5168	FLOAT	37P_1	Tiempo operación
3169	5169	DENUM NOSI	37P_2	Permission
3170	5170	FLOAT	37P_2	Tap
3171	5171	FLOAT	37P_2	Operating Time
3172	5172	DENUM NOSI	74TCS	Permission
3173	5173	FLOAT	74TCS	Timing
3174	5174	DENUM NOSI	CLP	Permission

3175	5175	FLOAT	CLP	50P_1 multiplier
3176	5176	FLOAT	CLP	50P_2 multiplier
3177	5177	FLOAT	CLP	67P_1 multiplier
3178	5178	FLOAT	CLP	67P_2 multiplier
3179	5179	FLOAT	CLP	50N_1 multiplier
3180	5180	FLOAT	CLP	50N_2 multiplier
3181	5181	FLOAT	CLP	67N_1 multiplier
3182	5182	FLOAT	CLP	67N_2 multiplier
3183	5183	FLOAT	CLP	Cold Load pass time
3184	5184	FLOAT	CLP	CLP duration time

8.12. Examples of Modbus packets

Input access passcode “5555” to device number 1

addr	functi on	Start addr. MSB	Start addr. LSB	Reg. Num. MSB	Reg. Num. LSB	Num bytes	Key	checksum MSB	checksum LSB
01	10	00	A8	00	02	04	35,35,35,35	30	F4

And the response from the SIL-B:

addr	functio n	Start addr. MSB	Start addr. LSB	Reg. Num. MSB	Reg. Num. LSB	Num bytes	checksum MSB	checksum LSB
01	10	00	A8	00	02	04	29	93

Reading of the 4 primary measurements of device 1

addr	functio n	Start addr. MSB	Start addr. LSB	Reg. Num. MSB	Reg. Num. LSB	checksum MSB	checksum LSB
01	03	05	79	00	08	95	19

And the SIL-B responds with measurements IA, IB, IC, I0 in the FLOAT format:

addr	function	Num bytes	Measurement IA	Measurement IB	Measurement IC	Measurement IN	checksum MSB	checksum LSB
01	03	10	00,00,00,00	00,00,00,00	00,00,00,00	00,00,00,00	E4	59

Reading of protection states of device 1

addr	functio n	Start addr. MSB	Start addr. LSB	Reg. Num. MSB	Reg. Num. LSB	checksum MSB	checksum LSB
01	03	01	F5	00	3D	95	D5

And the SIL-B responds:

addr	functi on	Num bytes	State 50P	State 67P_1	State 50N	State 67N_1	General State	Inputs State	Output s State	COM State
01	03	7A	00,09	00,00	00,00	00,00	00,00,00,D2	80.21	00,00	00,03

RESERVED	checksum H	checksum L
00,00,00.01.00,00,00,00,……………………..,7C,B1,0A,AF,DD	3B	1D

9. IEC 60870-5-103 PROTOCOL

This section describes the implementation of the IEC 60870-5-103 protocol in the device.

9.1. Physical layer

Electrical interface

X	RS-485
32	Number of loads for one protection equipment

Communication rate

X	4800 bits/s
X	9600 bits/s
X	19200 bits/s
X	38400 bits/s

Transmission parameters

Data bits	8 bit
Parity	Even
Stop bits	1

9.2. Application layer

Application data transmission mode.

Mode 1 (octet least significant first), as defined in 4.10 of IEC 60870-5-4, is the only mode used in this company's standard.

The following functions are supported:

- Pickup
- General interrogation
- Synchronization
- Transmission of commands

Information in monitoring address:

<1>:= time-tagged message

<2>:= time-tagged message with relative time

<3>:= measures

<5>:= identification

<6>:= time synchronization

<8>:= general interrogation termination

Information in control address:

<6>:= time synchronization

<7>:= general interrogation

<20>:= general command

Shared ASDU address

X	A SHARED ASDU ADDRESS (the same as the station address)
	More than one SHARED ASDU ADDRESSES
255	GLOBAL ADDRESS

Selection of standard information numbers in monitoring address

SIL-B	FUN	INF	Description	TYP	COT
System functions in monitoring address					
X	160	<0>	General interrogation termination	8	End of GI
X	160	<0>	Synchronization	6	TS
X	160	<2>	Reset FCB	5	Reset FCB
X	160	<3>	Reset CU	5	Reset CU
X	160	<4>	Start/restart	5	Start/restart
	160	<5>	Power on		
State indications in monitoring address					
X	160	<16>	Autorecloser active	1	SE,GI
X	160	<17>	Remote protection active	1	SE,GI
X	160	<18>	Protection active	1	SE,GI
	160	<19>	LED reset		
	160	<20>	Monitoring address locked		
	160	<21>	Test mode		

X	160	<22>	Local parameter setting	1	GI
X	160	<27>	Auxiliary input 1	1	SE,GI
X	160	<28>	Auxiliary input 2	1	SE,GI
X	160	<29>	Auxiliary input 3	1	SE,GI
X	160	<30>	Auxiliary input 4	1	SE,GI
Monitoring address monitoring indication					
	160	<32>	Measuring monitoring I		
	160	<33>	Measuring monitoring V		
	160	<35>	Phase sequence monitoring		
X	160	<36>	Trip circuit monitoring	1	SE,GI
	160	<38>	VT fuse fault		
	160	<39>	Remote protection disturbance		
	160	<46>	Group warning		
	160	<47>	Group alarm		
Monitoring address ground fault indications					
	160	<48>	Ground fault L1		
	160	<49>	Ground fault L2		
	160	<50>	Ground fault L3		
	160	<51>	Ground fault front, e.g. line		
	160	<52>	Ground fault rear, e.g. bus		
Monitoring address fault indications					
X	160	<64>	L1 Pickup	2	SE
X	160	<65>	L2 Pickup	2	SE
X	160	<66>	L3 Pickup	2	SE
X	160	<67>	N Pickup	2	SE
X	160	<68>	General trip	2	SE
X	160	<69>	L1 trip	2	SE
X	160	<70>	L2 trip	2	SE
X	160	<71>	L3 trip	2	SE
	160	<73>	Localizer of fault X in ohms		
	160	<74>	Front fault / line		

	160	<75>	Front fault / bus		
	160	<76>	Remote protection signal transmitted		
	160	<77>	Remote protection signal received		
X	160	<84>	General Pickup	2	SE
X	160	<85>	Breaker fault	2	SE
X	160	<90>	Trip I>	2	SE
	160	<91>	Trip I>>	2	SE
X	160	<92>	Trip IN>	2	SE
	160	<93>	Trip IN>>	2	SE
Monitoring address autorecloser indications					
X	160	<128>	CB 'on' by AR	1	SE
	160	<129>	CB 'on' by long-time AR		
X	160	<130>	AR locked	1	SE,GI
Monitoring address measurements					
	160	<144>	Measurement I	3.1	CYC
	160	<145>	Measurements I, V	3.2	CYC
	160	<147>	Measurements In, Vn	3.4	CYC
X	160	<148>	Measurements $I_{L1,2,3}$, $V_{L1,2,3}$,P,Q,f	9	CYC
Monitoring address indications of particular states					
X	200	<1>	CB close / open	1	SE,GI
X	200	<2>	52 Status Closed	1	SE,GI
X	200	<3>	52 Status Open Time	2	SE
X	200	<4>	52 Status Open Failure	2	SE
X	200	<5>	52 Status Close Failure	2	SE
X	200	<6>	52 Status excessive openings	2	SE,GI
X	200	<7>	52 Status excessive sum of switched amperes	2	SE,GI
X	200	<8>	52 Status excessive openings per minute	2	SE,GI
X	200	<9>	52 Status excessive openings per minute	2	SE,GI
X	200	<10>	52-A Status	2	SE,GI
X	200	<11>	52-B Status	1	SE,GI
X	200	<12>	52 Status Error	1	SE

X	200	<16>	79 Status Reclose Time	2	SE
X	200	<17>	79 Status Wait Time	2	SE
X	200	<18>	79 Status Reclaim Time	2	SE
X	200	<19>	79 Status Security Time	2	SE
X	200	<20>	79 Status final open Time	2	SE
X	200	<21>	Start	2	SE
X	200	<23>	79 Status Wait Time	2	SE
X	200	<24>	GEN 50Hz	1	SE,GI
X	200	<25>	Magnetic module Error	1	SE,GI
X	200	<26>	GEN Measurand Error	1	SE,GI
X	200	<28>	GEN synchronism	2	SE
X	200	<29>	GEN Eeprom with default values	1	SE,GI
X	200	<30>	GEN eeprom Error	1	SE,GI
X	200	<31>	GEN Eeprom values changed	1	SE,GI
X	200	<32>	GEN Events Error	1	SE,GI
X	200	<33>	GEN New Oscillograph register	2	SE
X	200	<48>	52 a Input	1	SE. GI
X	200	<49>	52 b Input	1	SE. GI
X	200	<50>	Phase lockout input	1	SE. GI
X	200	<51>	Ground lockout input	1	SE. GI
X	200	<52>	External trip input	1	SE. GI
X	200	<53>	Oscillographic start input	1	SE. GI
X	200	<54>	79 Start input	1	SE. GI
X	200	<55>	79 Enable input	1	SE. GI
X	200	<56>	79 Level lockout input	1	SE. GI
X	200	<57>	0 Setting group input	1	SE. GI
X	200	<58>	1 Setting group input	1	SE. GI
X	200	<59>	79 pulse lockout input	1	SE. GI
X	200	<60>	79 pulse unlock input	1	SE. GI
X	200	<61>	50BF start input	1	SE. GI
X	200	<62>	Voltage command	1	SE. GI

X	200	<63>	Continuity A	1	SE. GI
X	200	<64>	Continuity B	1	SE. GI
X	200	<76>	Auxiliary input 5	1	SE. GI
X	200	<77>	Auxiliary input 6	1	SE. GI
X	200	<78>	Auxiliary input 7	1	SE. GI
X	200	<79>	Auxiliary input 8	1	SE. GI
X	200	<92>	Auxiliary output 1	1	SE. GI
X	200	<93>	Auxiliary output 2	1	SE. GI
X	200	<94>	Auxiliary output 3	1	SE. GI
X	200	<95>	Auxiliary output 4	1	SE. GI
X	200	<96>	Auxiliary output 5	1	SE. GI
X	200	<97>	Auxiliary output 6	1	SE. GI
X	200	<98>	Auxiliary output 7	1	SE. GI
X	200	<99>	Auxiliary output -8	1	SE. GI
X	200	<100>	Auxiliary output -9	1	SE. GI
X	200	<101>	Auxiliary output -10	1	SE. GI
X	200	<102>	Auxiliary output -11	1	SE. GI
X	200	<103>	Auxiliary output -12	1	SE. GI
X	200	<116>	79 start	1	SE. GI
X	200	<117>	50BF start	1	SE. GI
X	200	<118>	Oscillographic start	1	SE. GI
X	200	<119>	79 Enabled	1	SE. GI
X	200	<120>	52 Close enabled	1	SE. GI
X	200	<132>	Maneuver Selection	2	SE
X	200	<133>	CB Open	2	SE
X	200	<134>	CB Close	2	SE
X	200	<135>	79 Lockout	2	SE
X	200	<136>	79 Unlock	2	SE
X	200	<137>	Remote control into Local	2	SE
X	200	<138>	Telecontrol into Remote	2	SE
X	200	<140>	Switching selection	2	SE

X	200	<141>	Open CB	2	SE
X	200	<142>	Close CB	2	SE
X	200	<143>	Lockout 79	2	SE
X	200	<144>	Unlock 79	2	SE
X	200	<148>	Switching selection	2	SE
X	200	<149>	Open CB	2	SE
X	200	<150>	Close CB	2	SE
X	200	<151>	Lockout 79	2	SE
X	200	<152>	Unlock 79	2	SE
X	200	<160>	Activation	1	SE, GI
X	201	<1>	Start	2	SE
X	201	<2>	Trip	2	SE
X	201	<8>	Alarm	2	SE
X	201	<9>	Trip	2	SE
X	201	<16>	32 Start	2	SE
X	201	<17>	32 Trip	2	SE
X	201	<18>	32 Start	2	SE
X	201	<19>	32 Trip	2	SE
X	201	<20>	32 Start	2	SE
X	201	<21>	32 Trip	2	SE
X	201	<22>	32 Start	2	SE
X	201	<23>	32 Trip	2	SE
X	201	<24>	37 Start A	2	SE
X	201	<25>	37 Start B	2	SE
X	201	<26>	37 Start C	2	SE
X	201	<27>	37 Start P	2	SE
X	201	<28>	37 Trip A	2	SE
X	201	<29>	37 Trip B	2	SE
X	201	<30>	37 Trip C	2	SE
X	201	<31>	37 Trip P	2	SE
X	201	<32>	37 Start A	2	SE

X	201	<33>	37 Start B	2	SE
X	201	<34>	37 Start C	2	SE
X	201	<35>	37 Start P	2	SE
X	201	<36>	37 Trip A	2	SE
X	201	<37>	37 Trip B	2	SE
X	201	<38>	37 Trip C	2	SE
X	201	<39>	37 Trip P	2	SE
X	201	<40>	Start	2	SE
X	201	<41>	Activation	2	SE
X	201	<48>	50 Start N	2	SE
X	201	<49>	50 Trip N	2	SE
X	201	<50>	50 Start N	2	SE
X	201	<51>	50 Trip N	2	SE
X	201	<52>	50 Start A	2	SE
X	201	<53>	50 Start B	2	SE
X	201	<54>	50 Start C	2	SE
X	201	<55>	50 Start P	2	SE
X	201	<56>	50 Trip A	2	SE
X	201	<57>	50 Trip B	2	SE
X	201	<58>	50 Trip C	2	SE
X	201	<59>	50 Trip P	2	SE
X	201	<60>	50 Start A	2	SE
X	201	<61>	50 Start B	2	SE
X	201	<62>	50 Start C	2	SE
X	201	<63>	50 Start P	2	SE
X	201	<64>	50 Trip A	2	SE
X	201	<65>	50 Trip B	2	SE
X	201	<66>	50 Trip C	2	SE
X	201	<67>	50 Trip P	2	SE
X	201	<72>	51 Start N	2	SE
X	201	<73>	51 Trip N	2	SE

X	201	<76>	51 Start A	2	SE
X	201	<77>	51 Start B	2	SE
X	201	<78>	51 Start C	2	SE
X	201	<79>	51 Start P	2	SE
X	201	<80>	51 Trip A	2	SE
X	201	<81>	51 Trip B	2	SE
X	201	<82>	51 Trip C	2	SE
X	201	<83>	51 Trip P	2	SE
X	201	<96>	67 Start N	2	SE
X	201	<97>	67 Trip N	2	SE
X	201	<98>	67 Start N	2	SE
X	201	<99>	67 Trip N	2	SE
X	201	<100>	67 Start A	2	SE
X	201	<101>	67 Start B	2	SE
X	201	<102>	67 Start C	2	SE
X	201	<103>	67 Start P	2	SE
X	201	<104>	67 Trip A	2	SE
X	201	<105>	67 Trip B	2	SE
X	201	<106>	67 Trip C	2	SE
X	201	<107>	67 Trip P	2	SE
X	201	<108>	67 Start A	2	SE
X	201	<109>	67 Start B	2	SE
X	201	<110>	67 Start C	2	SE
X	201	<111>	67 Start P	2	SE
X	201	<112>	67 Trip A	2	SE
X	201	<113>	67 Trip B	2	SE
X	201	<114>	67 Trip C	2	SE
X	201	<115>	67 Trip P	2	SE
X	202	<1>	Live Line, Live Bus	1	SE, GI
X	202	<2>	Live Line, Dead Bus	1	SE, GI
X	202	<3>	Dead Line, Live Bus	1	SE, GI

X	202	<4>	Dead Line, Dead Bus	1	SE, GI
X	202	<5>	Synchronism Permmision	1	SE, GI
X	202	<8>	27 Start A	2	SE
X	202	<9>	27 Start B	2	SE
X	202	<10>	27 Start C	2	SE
X	202	<11>	27 Start P	2	SE
X	202	<12>	27 Trip A	2	SE
X	202	<13>	27 Trip B	2	SE
X	202	<14>	27 Trip C	2	SE
X	202	<15>	27 Trip P	2	SE
X	202	<16>	27 Start A	2	SE
X	202	<17>	27 Start B	2	SE
X	202	<18>	27 Start C	2	SE
X	202	<19>	27 Start P	2	SE
X	202	<20>	27 Trip A	2	SE
X	202	<21>	27 Trip B	2	SE
X	202	<22>	27 Trip C	2	SE
X	202	<23>	27 Trip P	2	SE
X	202	<24>	59 Start N	2	SE
X	202	<25>	59 Trip N	2	SE
X	202	<26>	59 Start N	2	SE
X	202	<27>	59 Trip N	2	SE
X	202	<28>	59 Start A	2	SE
X	202	<29>	59 Start B	2	SE
X	202	<30>	59 Start C	2	SE
X	202	<31>	59 Start P	2	SE
X	202	<32>	59 Trip A	2	SE
X	202	<33>	59 Trip B	2	SE
X	202	<34>	59 Trip C	2	SE
X	202	<35>	59 Trip P	2	SE
X	202	<36>	59 Start A	2	SE

X	202	<37>	59 Start B	2	SE
X	202	<38>	59 Start C	2	SE
X	202	<39>	59 Start P	2	SE
X	202	<40>	59 Trip A	2	SE
X	202	<41>	59 Trip B	2	SE
X	202	<42>	59 Trip C	2	SE
X	202	<43>	59 Trip P	2	SE
X	202	<48>	81 Start	2	SE
X	202	<49>	81 Trip	2	SE
X	202	<50>	81 Lockout	2	SE, GI
X	202	<51>	81 Start	2	SE
X	202	<52>	81 Trip	2	SE
X	202	<53>	81 Lockout	2	SE, GI
X	202	<54>	81 Start	2	SE
X	202	<55>	81 Trip	2	SE
X	202	<56>	81 Lockout	2	SE, GI
X	202	<57>	81 Start	2	SE
X	202	<58>	81 Trip	2	SE
X	202	<59>	81 Lockout	2	SE, GI

Selection of standard information numbers in control address

SIL-B	FUN	INF	Description	TYP	COT
System functions in control address					
X	160	<0>	Initiation of general interrogation	7	Init of GI
X	160	<0>	Synchronization	6	TS
General commands in control address					
X	160	<16>	Auto-recloser on / off	20	ACK,NACK
	160	<17>	Remote protection on / off		
	160	<18>	Protection on / off		
	160	<19>	LED reset		
Particular commands in control address					
X	200	<1>	CB open/close	20	ACK,NACK

10. IEC 61850 PROTOCOL

This section describes the implementation of IEC 61850 protocol in compact SILB.

IEC 61850 protocol defines a way of structuring the available information in each device, that is reflected in the Data Model and a way of managing and sending this information through communications using specific Services.

SILB device will be known as a Server IED (Intelligent Electronic Device), which services will be available using the Ethernet through its default IP (192.168.0.121)

MMS will be the used Ethernet protocol for the Client-Server communication and 102 will be the used port.

GOOSE fast messages is not a Client-Server communication like TCP/IP but a Multicast communication that sends messages directly to the Link Layer using MAC directions as destination directions for publishing the GOOSE.

10.1. Data model

Server IEDs have all the information of all their events, measures, parameters and services, organized in a hierachical structure with device's functional units as main ones.

The main level of the structure is the name of the IED, by default TEMPLATE, with its instance LD1

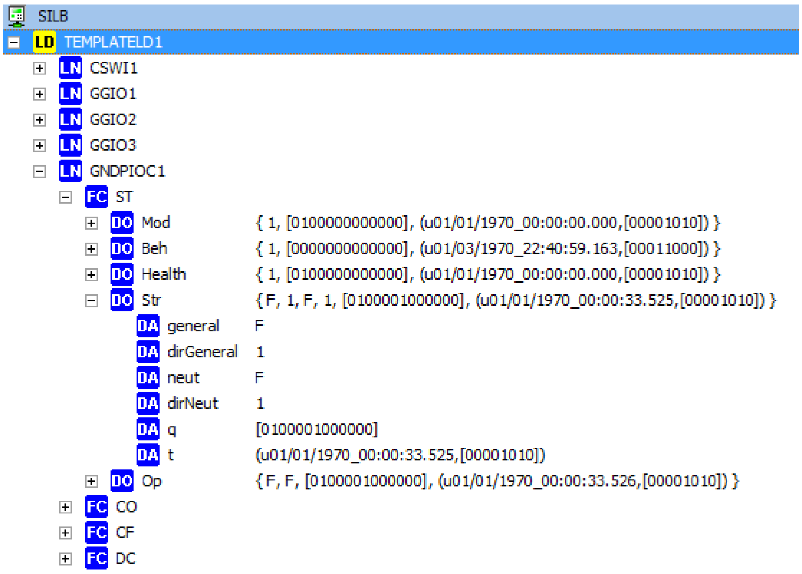
Down the IED there are Logical Nodes that represent the functional units of the IED (Protection, Control and measure units, status of external elements like circuit breaker, etc.)

Inside Logical Nodes there are Data objects that compose a functional unit, and inside each Data object, there are Data attributes that give complete information about this Data object.

As example, the ground overcurrent protection unit is represented in SILB according IEC 61850 as the logical node PIOC, with the prefix GND and the instance 1: GNDPIOC1

In the Logical Node, the starting of the unit is represented by its Data Object, *Str*, with a list of Data Attributes that give information about the starting:

Attribute *neut* indicates the status of the starting, *t* attribute indicates the time stamp when the starting has changed, etc.



The Data model of SILB according IEC 61850 is represented in the following tables:

Protection:

Function	Logical Node	Data Object	Data Attribute
General Start / Pick up	PTRC1	Str	general
Start / pick up L1	PTRC1	Str	phsA
Start / pick up L2	PTRC1	Str	phsB
Start / pick up L3	PTRC1	Str	phsC
Start / pick up N	PTRC1	Str	neut
General Trip	PTRC1	Tr	general
Trip L1	PTRC1	Op	phsA
Trip L2	PTRC1	Op	phsB
Trip L3	PTRC1	Op	phsC
50P_1 Start A	(PHS)PIOC1	Str	phsA
50P_1 Start B	(PHS)PIOC1	Str	phsB
50P_1 Start C	(PHS)PIOC1	Str	phsC
50P_1 Start P	(PHS)PIOC1	Str	general
50P_1 Trip A	(PHS)PIOC1	Op	phsA
50P_1 Trip B	(PHS)PIOC1	Op	phsB
50P_1 Trip C	(PHS)PIOC1	Op	phsC

50P_1 Trip P	(PHS)PIOC1	Op	general
50P_2 Start A	(PHS)PIOC2	Str	phsA
50P_2 Start B	(PHS)PIOC2	Str	phsB
50P_2 Start C	(PHS)PIOC2	Str	phsC
50P_2 Start P	(PHS)PIOC2	Str	general
50P_2 Trip A	(PHS)PIOC2	Op	phsA
50P_2 Trip B	(PHS)PIOC2	Op	phsB
50P_2 Trip C	(PHS)PIOC2	Op	phsC
50P_2 Trip P	(PHS)PIOC2	Op	general
67N_1 Start N	(GND)PTOC1	Str	general
67N_1 Trip N	(GND)PTOC1	Op	general
67N_2 Start N	(GND)PTOC2	Str	general
67N_2 Trip N	(GND)PTOC2	Op	general
67P_1 Start A	(PHS)PTOC1	Str	phsA
67P_1 Start B	(PHS)PTOC1	Str	phsB
67P_1 Start C	(PHS)PTOC1	Str	phsC
67P_1 Start P	(PHS)PTOC1	Str	general
67P_1 Trip A	(PHS)PTOC1	Op	phsA
67P_1 Trip B	(PHS)PTOC1	Op	phsB
67P_1 Trip C	(PHS)PTOC1	Op	phsC
67P_1 Trip P	(PHS)PTOC1	Op	general
67P_2 Start A	(PHS)PTOC2	Str	phsA
67P_2 Start B	(PHS)PTOC2	Str	phsB
67P_2 Start C	(PHS)PTOC2	Str	phsC
67P_2 Start P	(PHS)PTOC2	Str	general
67P_2 Trip A	(PHS)PTOC2	Op	phsA
67P_2 Trip B	(PHS)PTOC2	Op	phsB
67P_2 Trip C	(PHS)PTOC2	Op	phsC
67P_2 Trip P	(PHS)PTOC2	Op	general
CLP Activation	RCLP1	Op	general
46 Start	(NGS)PTOC1	Str	general

46 Trip	(NGS)PTOC1	Op	general
49 Alarm	PTTR1	AlmThm	general
49 Trip	PTTR1	Op	general
32_1 Start	PDOP1	Str	general
32_1 Trip	PDOP1	Op	general
32_2 Start	PDOP2	Str	general
32_2 Trip	PDOP2	Op	general
32_3 Start	PDOP3	Str	general
32_3 Trip	PDOP3	Op	general
32_4 Start	PDOP4	Str	general
32_4 Trip	PDOP4	Op	general
37P_1 Start A	PTUC1	Str	phsA
37P_1 Start B	PTUC1	Str	phsB
37P_1 Start C	PTUC1	Str	phsC
37P_1 Start P	PTUC1	Str	general
37P_1 Trip A	PTUC1	Op	phsA
37P_1 Trip B	PTUC1	Op	phsB
37P_1 Trip C	PTUC1	Op	phsC
37P_1 Trip P	PTUC1	Op	general
37P_2 Start A	PTUC2	Str	phsA
37P_2 Start B	PTUC2	Str	phsB
37P_2 Start C	PTUC2	Str	phsC
37P_2 Start P	PTUC2	Str	general
37P_2 Trip A	PTUC2	Op	phsA
37P_2 Trip B	PTUC2	Op	phsB
37P_2 Trip C	PTUC2	Op	phsC
37P_2 Trip P	PTUC2	Op	general
50BF Start	RBRF1	Str	general
Break Failure	RBRF1	OpEx	general
50BF Activation	RBRF1	OpIn	general
50N_1 Start	(GND)PIOC1	Str	general

50N_1 Trip	(GND)PIOC1	Op	general
50N_2 Start	(GND)PIOC2	Str	general
50N_2 Trip	(GND)PIOC2	Op	general
Live Line, Live Bus	RSYN1	LivLinBus	stVal
Live Line, Dead Bus	RSYN1	LivLin	stVal
Dead Line, Live Bus	RSYN1	LivBus	stVal
Dead Line, Dead Bus	RSYN1	DeaLinBus	stVal
Synchronism Permmision	RSYN1	Rel	stVal
27P_1 Start A	(PHS)PTUV1	Str	phsA
27P_1 Start B	(PHS)PTUV1	Str	phsB
27P_1 Start C	(PHS)PTUV1	Str	phsC
27P_1 Start P	(PHS)PTUV1	Str	general
27P_1 Trip A	(PHS)PTUV1	Op	phsA
27P_1 Trip B	(PHS)PTUV1	Op	phsB
27P_1 Trip C	(PHS)PTUV1	Op	phsC
27P_1 Trip P	(PHS)PTUV1	Op	general
27P_2 Start A	(PHS)PTUV2	Str	phsA
27P_2 Start B	(PHS)PTUV2	Str	phsB
27P_2 Start C	(PHS)PTUV2	Str	phsC
27P_2 Start P	(PHS)PTUV2	Str	general
27P_2 Trip A	(PHS)PTUV2	Op	phsA
27P_2 Trip B	(PHS)PTUV2	Op	phsB
27P_2 Trip C	(PHS)PTUV2	Op	phsC
27P_2 Trip P	(PHS)PTUV2	Op	general
59N_1 Start	(GND)PTOV1	Str	general
59N_1 Trip	(GND)PTOV1	Op	general
59N_2 Start	(GND)PTOV2	Str	general
59N_2 Trip	(GND)PTOV2	Op	general
59P_1 Start A	(PHS)PTOV1	Str	phsA
59P_1 Start B	(PHS)PTOV1	Str	phsB
59P_1 Start C	(PHS)PTOV1	Str	phsC

59P_1 Start P	(PHS)PTOV1	Str	general
59P_1 Trip A	(PHS)PTOV1	Op	phsA
59P_1 Trip B	(PHS)PTOV1	Op	phsB
59P_1 Trip C	(PHS)PTOV1	Op	phsC
59P_1 Trip P	(PHS)PTOV1	Op	general
59P_2 Start A	(PHS)PTOV2	Str	phsA
59P_2 Start B	(PHS)PTOV2	Str	phsB
59P_2 Start C	(PHS)PTOV2	Str	phsC
59P_2 Start P	(PHS)PTOV2	Str	general
59P_2 Trip A	(PHS)PTOV2	Op	phsA
59P_2 Trip B	(PHS)PTOV2	Op	phsB
59P_2 Trip C	(PHS)PTOV2	Op	phsC
59P_2 Trip P	(PHS)PTOV2	Op	general

Measures:

Function	Logical Node	Data Object	Data Attribute
Current Phase A	MMXU1	A.phsA	cVal.mag.i
Current Phase B	MMXU1	A.phsB	cVal.mag.i
Current Phase C	MMXU1	A.phsC	cVal.mag.i
Voltage Phase A	MMXU1	PhV.phsA	cVal.mag.i
Voltage Phase B	MMXU1	PhV.phsB	cVal.mag.i
Voltage Phase C	MMXU1	PhV.phsC	cVal.mag.i
Active Power	MMXU1	TotW	mag.i
Reactive Power	MMXU1	TotVAr	mag.i
Frequency	MMXU1	Hz	mag.i

System Functions:

Function	Logical Node	Data Object	Attribute
Teleprotection active	LLN0	LocKey	stVal

Protection active	LPHD1	PwrUp	stVal
Auxiliary Input 1	GGIO1	Ind1	stVal
Auxiliary Input 2	GGIO1	Ind2	stVal
Auxiliary Input 3	GGIO1	Ind3	stVal
Auxiliary Input 4	GGIO1	Ind4	stVal
Auxiliary Input 5	GGIO1	Ind5	stVal
Auxiliary Input 6	GGIO1	Ind6	stVal
Auxiliary Input 7	GGIO1	Ind7	stVal
Auxiliary Input 8	GGIO1	Ind8	stVal
Auxiliary Output 1	GGIO1	Ind9	stVal
Auxiliary Output 2	GGIO1	Ind10	stVal
Auxiliary Output 3	GGIO1	Ind11	stVal
Auxiliary Output 4	GGIO1	Ind12	stVal
Auxiliary Output 5	GGIO1	Ind13	stVal
Auxiliary Output 6	GGIO1	Ind14	stVal
Auxiliary Output 7	GGIO1	Ind15	stVal
Auxiliary Output 8	GGIO1	Ind16	stVal
Auxiliary Output 9	GGIO1	Ind17	stVal
Auxiliary Output 10	GGIO1	Ind18	stVal
Auxiliary Output 11	GGIO1	Ind19	stVal
Auxiliary Output 12	GGIO1	Ind20	stVal
79 Enabled	GGIO2	Ind1	stVal
Local Parameter Setting	GGIO2	Ind2	stVal
Trip Circuit Supervision	GGIO2	Ind3	stVal
Trip I>	GGIO2	Ind4	stVal
Trip IN>	GGIO2	Ind5	stVal
CB on by AR	GGIO2	Ind6	stVal
52 Status Open Failure	GGIO2	Ind7	stVal
52 Status Close Failure	GGIO2	Ind8	stVal
52 Status excessive openinigs	GGIO2	Ind9	stVal
52 Status excessive sum of	GGIO2	Ind10	stVal

switched amperes			
52 Status excessive openings per minute	GGIO2	Ind11	stVal
52-A Status	GGIO2	Ind12	stVal
52-B Status	GGIO2	Ind13	stVal
52 Status Error	GGIO2	Ind14	stVal
79 Status Reclose Time	GGIO2	Ind15	stVal
79 Status Open	GGIO2	Ind16	stVal
79 Status Wait Time	GGIO2	Ind17	stVal
79 Status Reclaim Time	GGIO2	Ind18	stVal
79 Status Security Time	GGIO2	Ind19	stVal
79 Status Final opne Time	GGIO2	Ind20	stVal
GEN 50Hz	GGIO2	Ind21	stVal
Magnetic module Error	GGIO2	Ind22	stVal
GEN Measurand Error	GGIO2	Ind23	stVal
GEN Synchronism	GGIO2	Ind24	stVal
GEN Eeprom with default values	GGIO2	Ind25	stVal
GEN eeprom Error	GGIO2	Ind26	stVal
GEN Eeprom values changed	GGIO2	Ind27	stVal
GEN Events Error	GGIO2	Ind28	stVal
GEN New Oscillograph register	GGIO2	Ind29	stVal
52 a Input	GGIO2	Ind30	stVal
52 b Input	GGIO2	Ind31	stVal
Phase lockout input	GGIO2	Ind32	stVal
Ground lockout input	GGIO3	Ind1	stVal
External trip input	GGIO3	Ind2	stVal
Oscillographic start input	GGIO3	Ind3	stVal
79 Start input	GGIO3	Ind4	stVal
79 Enable input	GGIO3	Ind5	stVal
79 Level lockout input	GGIO3	Ind6	stVal
0 Setting group input	GGIO3	Ind7	stVal
1 Setting group input	GGIO3	Ind8	stVal

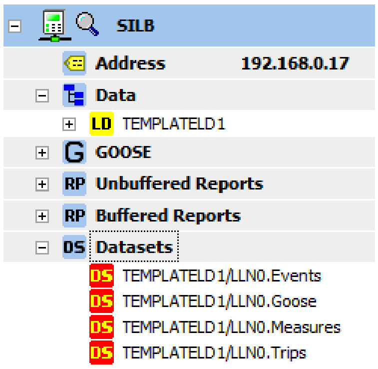
79 pulse lockout input	GGIO3	Ind9	stVal
79 pulse unlock input	GGIO3	Ind10	stVal
50BF start input	GGIO3	Ind11	stVal
Voltage command	GGIO3	Ind12	stVal
Continuity A	GGIO3	Ind13	stVal
Continuity B	GGIO3	Ind14	stVal
79 start	GGIO3	Ind15	stVal
50BF start	GGIO3	Ind16	stVal
79 Enabled	GGIO3	Ind17	stVal
52 Close enabled	GGIO3	Ind18	stVal
Start	SCBC1	ColFail	stVal
Trip Circuit Supervision	SCBC1	Mod	stVal
Oscillographic start	RDRE1	RcdStr	stVal
52 Status	XCBR1	Pos	stVal
52 Status Open Time	CSWI1	OpOpn	stVal
52 Status Close Time	CSWI1	OpCls	stVal
52 Open	CSWI1	Pos	Oper$ctlVal
52 Close	CSWI1	Pos	Oper$ctlVal

10.2. Services

Compact SILB disposes of the following services according IEC 61850:

DATASETS

A Dataset is a grouping of information from the data model of the IED:
These groupings can be used by other services for the sending of information (GOOSE, RCB, BRC).
The definition of Datasets has to be made in a IEC61850's file with extension .ICD (IED Capability Description) that is provided with the device.
By default there are 4 Datasets, grouped according the functionality (Trips, Measures, Events and Goose):



Trips, with the name of **Trips** and the following data objects:

Member
TEMPLATELD1/PTRC1STOp
TEMPLATELD1/PTRC1STStr
TEMPLATELD1/PHSPIOC1STOp
TEMPLATELD1/PHSPIOC1STStr
TEMPLATELD1/PHSPIOC2STOp
TEMPLATELD1/PHSPIOC2STStr
TEMPLATELD1/GNDPIOC1STOp
TEMPLATELD1/GNDPIOC1STStr
TEMPLATELD1/GNDPTOC2STOp
TEMPLATELD1/GNDPTOC2STStr
TEMPLATELD1/NGSPTOC1STOp
TEMPLATELD1/NGSPTOC1STStr
TEMPLATELD1/NGSPTOC2STOp
TEMPLATELD1/NGSPTOC2STStr
TEMPLATELD1/PHSPTUV1STOp
TEMPLATELD1/PHSPTUV1STStr
TEMPLATELD1/PHSPTUV2STOp
TEMPLATELD1/PHSPTUV2STStr
TEMPLATELD1/PHSPTOV1STOp
TEMPLATELD1/PHSPTOV1STStr
TEMPLATELD1/PHSPTOV2STOp
TEMPLATELD1/PHSPTOV2STStr
TEMPLATELD1/GNDPTOV1STOp
TEMPLATELD1/GNDPTOV1STStr
TEMPLATELD1/GNDPTOV2STOp
TEMPLATELD1/GNDPTOV2STStr
TEMPLATELD1/PHSPTUC1STOp
TEMPLATELD1/PHSPTUC1STStr
TEMPLATELD1/PHSPTUC2STOp
TEMPLATELD1/PHSPTUC2STStr
TEMPLATELD1/PDOP1STOp
TEMPLATELD1/PDOP1STStr
TEMPLATELD1/PDOP2STOp
TEMPLATELD1/PDOP2STStr
TEMPLATELD1/PDOP3STOp
TEMPLATELD1/PDOP3STStr
TEMPLATELD1/PDOP4STOp
TEMPLATELD1/PDOP4STStr
TEMPLATELD1/PTTR1STOp
TEMPLATELD1/RCLP1STOp

Measures, with the name of **Measures** and the following data objects:

Member
TEMPLATELD1/MMXU1MXTotW
TEMPLATELD1/MMXU1MXTotVAr
TEMPLATELD1/MMXU1MXHz
TEMPLATELD1/MMXU1MXPhV
TEMPLATELD1/MMXU1MXA

Events, with the name of **Events** and the following data objects:

Member
TEMPLATELD1/LLN0CFRemCtlBlk
TEMPLATELD1/LPHD1STPwrUp
TEMPLATELD1/GGIO2STInd1
TEMPLATELD1/GGIO2STInd2
TEMPLATELD1/GGIO2STInd3
TEMPLATELD1/GGIO2STInd4
TEMPLATELD1/GGIO2STInd5
TEMPLATELD1/GGIO2STInd6
TEMPLATELD1/GGIO2STInd7
TEMPLATELD1/GGIO2STInd8
TEMPLATELD1/GGIO2STInd9
TEMPLATELD1/GGIO2STInd10
TEMPLATELD1/GGIO2STInd11
TEMPLATELD1/GGIO2STInd12
TEMPLATELD1/GGIO2STInd13
TEMPLATELD1/GGIO2STInd14
TEMPLATELD1/GGIO2STInd15
TEMPLATELD1/GGIO2STInd16
TEMPLATELD1/GGIO2STInd17
TEMPLATELD1/GGIO2STInd18
TEMPLATELD1/GGIO2STInd19
TEMPLATELD1/GGIO2STInd20
TEMPLATELD1/GGIO2STInd21
TEMPLATELD1/GGIO2STInd22
TEMPLATELD1/GGIO2STInd23
TEMPLATELD1/GGIO2STInd24
TEMPLATELD1/GGIO2STInd25
TEMPLATELD1/GGIO2STInd26
TEMPLATELD1/GGIO2STInd27
TEMPLATELD1/GGIO2STInd28
TEMPLATELD1/GGIO2STInd29
TEMPLATELD1/GGIO2STInd30
TEMPLATELD1/GGIO2STInd31
TEMPLATELD1/GGIO2STInd32
TEMPLATELD1/GGIO3STInd1
TEMPLATELD1/GGIO3STInd2
TEMPLATELD1/GGIO3STInd3
TEMPLATELD1/GGIO3STInd4
TEMPLATELD1/GGIO3STInd5
TEMPLATELD1/GGIO3STInd6
TEMPLATELD1/GGIO3STInd7
TEMPLATELD1/GGIO3STInd8
TEMPLATELD1/GGIO3STInd9
TEMPLATELD1/GGIO3STInd10
TEMPLATELD1/GGIO3STInd11
TEMPLATELD1/GGIO3STInd12
TEMPLATELD1/GGIO3STInd13
TEMPLATELD1/GGIO3STInd14
TEMPLATELD1/GGIO3STInd15
TEMPLATELD1/GGIO3STInd16
TEMPLATELD1/GGIO3STInd17
TEMPLATELD1/GGIO3STInd18
TEMPLATELD1/GGIO3STInd19
TEMPLATELD1/GGIO3STInd20
TEMPLATELD1/GGIO3STInd21
TEMPLATELD1/GGIO3STInd22
TEMPLATELD1/GGIO3STInd23
TEMPLATELD1/RREC1STOp
TEMPLATELD1/RBRF1STStr
TEMPLATELD1/RBRF1STOpIn
TEMPLATELD1/RDRE1STRcdMade
TEMPLATELD1/SCBC1STColFail
TEMPLATELD1/XCBR1STPos
TEMPLATELD1/PTTR1STAlmThm

Goose, with the name of **Goose** and the following data attributes:

Member
TEMPLATELD1/PTRC1STOp$general
TEMPLATELD1/PTRC1STOp$q
TEMPLATELD1/PTRC1STTr$general
TEMPLATELD1/PTRC1STTr$q

REPORTS

The Report service is used for the sending of values from elements of a Dataset to a communication client that enables the report service (Central unit of Substation, remote unit o software application).

The use of Reports optimizes the communication when the information of the associated Dataset is only sent when there is a change of value, when is requested or time integrity is enabled.

There are 2 kind of Reports, BRCB and URCB.

BRCB have a time buffer to store reports in the case a client has disconnected or the information had lost.

It is usually used for reporting events, alarms and trips.

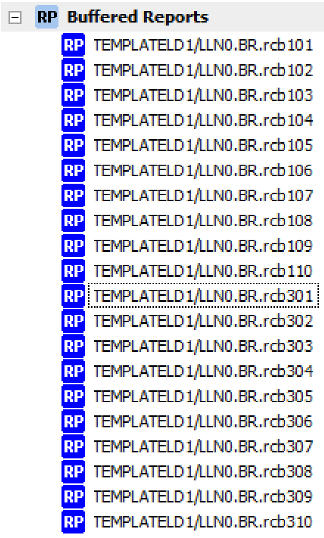
URCB have not this time buffer and it is not possible recovering lost or past reports.

They are usually used for reporting of measures.

Compact SILB device is pre configured with 10 URCB associated to the Measures Dataset:

RP **Unbuffered Reports**
- RP TEMPLATELD1/LLN0.RP.rcb201
- RP TEMPLATELD1/LLN0.RP.rcb202
- RP TEMPLATELD1/LLN0.RP.rcb203
- RP TEMPLATELD1/LLN0.RP.rcb204
- RP TEMPLATELD1/LLN0.RP.rcb205
- RP TEMPLATELD1/LLN0.RP.rcb206
- RP TEMPLATELD1/LLN0.RP.rcb207
- RP TEMPLATELD1/LLN0.RP.rcb208
- RP TEMPLATELD1/LLN0.RP.rcb209
- RP TEMPLATELD1/LLN0.RP.rcb210

10 BRCB associated to Events Dataset and another 10 to Trips Dataset:



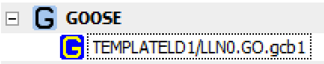
This way, up to 10 different clients can dispose of the whole information of events and measures.

GOOSE

Goose service allows the Multicast sending (to multiple devices) of the existing information in a Dataset.

Goose message is an Ethernet message that is continuously cast to the Ethernet and every device can analyze it.

Compact SILB disposes by default a Goose message associated to the Goose Dataset:



This message is sent to the Ethernet with a latency time of 30 seconds till one of the values of the element of the Dataset changes, then the message is sent immediately in a repeating way in a short time, increasing till reaching the latency time.

10.3. Operation

Compact SILB is pre configured with a sample configuration to be integrated in an IEC 61850 system.

It disposes all the Data model with all the functionallity available via MMS (using a software application like IEDScout) or via Reports (with their Event, measure or Trip Datasets) in case a client needs to receive information from the device.

To retrieve the data model from the device to a PC with an IEC 61850 tool, it is only required the IP of the device (by default 192.168.0.121).The tool has to be able of asking the data model automatically.

The name of the IED is by default TEMPLATELD1 and below it there is the data model with its logical nodes, data objects and data attributes according IEC 61850.

The common way to integrate a new IED in a SCADA is using reports and the ICD files from SILB provided for this purpose.

From the ICD file of SILB, the client device has to select a Report with the associated Dataset. This way, client will have a list of signals that will use to configure its own database. Once client device is configured, the communication between server could be initiated by the client by enabling the report and receving the existing information from the report.

Each client has different ways of configuring, so it will be necessary referring to IEC61850's configuration chapter from the client's manual.

Goose message is activated by default and is published with the information from the Goose dataset (General Trips and Starts) into the net.

One IED that requires the information from a Goose has to be configured using the ICD file from SILB. In this file appears the default parameters of the Goose message.

11. DNP 3.0 PROTOCOL

11.1. Device profile document

DNP V3.00

DEVICE PROFILE DOCUMENT

This document must be accompanied by : **Implementation Table** and **Point List**.

Vendor Name: **FANOX Electronic, S.L.**

Device Name: **SIL-B**

Highest DNP Level Supported:	Device Function:
For Requests **2** For Responses **2**	☐ Master ☒ **Slave**

Notable objects, functions, and/or qualifiers supported in addition to the Highest DNP Levels Supported (the complete list is described in the attached table):

For static (non-change-event) object requests, request qualifier codes 07 and 08 (limited quantity), and 17 and 28 (index) are supported. Static object requests sent with qualifiers 07, or 08, will be responded with qualifiers 00 or 01.

16-bit, 32-bit and Floating Point Analog Change Events with Time may be requested.

Maximum Data Link Frame Size (octets):	Maximum Application Fragment Size (octets):
Transmitted **292** Received **292**	Transmitted **2048** Received **2048**

Maximum Data Link Re-tries:	Maximum Application Layer Re-tries:
☐ None ☐ Fixed at ____ ☒ **Configurable, from 0 to 255** **Default, 3**	☒ **None** ☐ Configurable

Requires Data Link Layer Confirmation:

☐ Never
☐ Always
☐ Sometimes. If 'Sometimes', when? ____
☒ **Configurable as Never, Only for multi-frame messages, or Always. Default Never**

Requires Application Layer Confirmation:

☐ Never
☐ Always (not recommended)
☐ When reporting Event Data (Slave devices only)
☐ When sending multi-fragment responses (Slave devices only)

☐ Sometimes. If 'Sometimes', when?
☒ **Configurable as: "Only when reporting event data", or "When reporting event data or multi-fragment messages."**

Timeouts while waiting for:

Data Link Confirm	☐ None	☐ Default at 5000ms	☐ Variable	☒ **Configurable**
Complete Appl. Fragment	☒ **None**	☐ Fixed at ____	☐ Variable	☐ Configurable
Application Confirm	☐ None	☐ Default at 5000ms	☐ Variable	☒ **Configurable**
Complete Appl. Response	☒ **None**	☐ Fixed at ____	☐ Variable	☐ Configurable

Others **Need Time Interval, configurable, default Enable**
Need Restart IIN, configurable, default Disable
Unsolicited Response Retry Delay, configurable, default 2000ms
Unsolicited Offline Interval, configurable, default 3000ms

Sends/Executes Control Operations:

WRITE Binary Outputs	☒ **Never**	☐ Always	☐ Sometimes	☐ Configurable
SELECT (3) / OPERATE (4)	☒ **Never**	☐ Always	☐ Sometimes	☐ Configurable
DIRECT OPERATE (5)	☐ Never	☒ **Always**	☐ Sometimes	☐ Configurable
DIRECT OPERATE - NO ACK (6)	☐ Never	☒**Always**	☐ Sometimes	☐ Configurable
Count > 1	☒ **Never**	☐ Always	☐ Sometimes	☐ Configurable
Pulse On	☐ Never	☒**Always**	☐ Sometimes	☐ Configurable
Pulse Off	☐ Never	☒**Always**	☐ Sometimes	☐ Configurable
Latch On	☐ Never	☒**Always**	☐ Sometimes	☐ Configurable
Latch Off	☐ Never	☒**Always**	☐ Sometimes	☐ Configurable
Queue	☒ **Never**	☐ Always	☐ Sometimes	☐ Configurable
Clear Queue	☒ **Never**	☐ Always	☐ Sometimes	☐ Configurable

Attach explanation:

All points support the same Function Codes :Direct Operate and Direct Operate-No ACK
All points support the same Control Codes : Pulse ON, Latch ON, Latch OFF, Pulse OFF and Trip-Pulse ON.

FILL OUT THE FOLLOWING ITEMS FOR SLAVE DEVICES ONLY:	
Reports Binary Input Change Events when no specific variation requested: ☐ Never ☐ Only time-tagged ☒ **Only non-time-tagged** ☐ Configurable to send both, one or the other (attach explanation)	Reports time-tagged Binary Input Change Events when no specific variation requested: ☐ Never ☐ Binary Input Change With Time ☒ **Binary Input Change With Relative Time** ☐ Configurable (attach explanation)
Sends Unsolicited Responses: ☐ Never ☐ Configurable ☒ **Only certain objects (Class 1)** ☐ Sometimes (attach explanation) ☒ **ENABLE/DISABLE UNSOLICITED Function codes supported**	Sends Static Data in Unsolicited Responses: ☒ **Never** ☐ When Device Restarts ☐ When Status Flags Change No other options are permitted.
Default Counter Object/Variation: ☒ **No Counters Reported** ☐ Configurable (attach explanation) ☐ Default Object ____________ Default Variation ____________ ☐ Point-by-point list attached	Counters Roll Over at: ☒ **No Counters Reported** ☐ Configurable (attach explanation) ☐ 16 Bits ☐ 32 Bits ☐ Other Value ____________ ☐ Point-by-point list attached
Sends Multi-Fragment Responses: ☒ Yes ☐ No	

QUICK REFERENCE FOR DNP3.0 LEVEL 2 FUNCTION CODES & QUALIFIERS

Function Codes

1	Read
2	Write
3	Select
4	Operate
5	Direct Operate
6	Direct Operate-No ACK
13	Cold Start
14	Warm Start
20	Enable Unsol. Messages
21	Disable Unsol. Messages
23	Delay Measurement
129	Response
130	Unsolicited Message

7	6	5	4	3	2	1	0
	Index Size			Qualifier Code			

Index Size

0- No Index, Packed
1- 1 byte Index
2- 2 byte Index
3- 4 byte Index
4- 1 byte Object Size
5- 2 byte Object Size
6- 4 byte Object Size

Qualifier Code

0- 8-Bit Start and Stop Indices
1- 16-Bit Start and Stop Indices
2- 32-Bit Start and Stop Indices
3- 8-Bit Absolute address Ident.
4- 16-Bit Absolute address Ident.
5- 32-Bit Absolute address Ident.
6- No Range Field (all)
7- 8-Bit Quantity
8- 16-Bit Quantity
9- 32-Bit Quantity
11-(0xB) Variable array

11.2. Implementation table

OBJECT			REQUEST (BCD will parse)		RESPONSE (BCD will respond)		
Obj	**Var**	**Description**	**Func Codes (dec)**	**Qual Codes (hex)**	**Func Codes (dec)**	**Qual Codes (hex)**	**Notes**
1	0	Binary Input – All variations	1	6			
1	1	Binary Input			129	1	Assigned to Class 0.
2	0	Binary Input Change – All variations	1	6,7,8			
2	1	Binary Input Change without Time	1	6,7,8	129		
2	2	Binary Input Change with Time	1	6,7,8	129,130	28	Assigned to Class 1.
2	3	Binary Input Change with Relative Time	1	6,7,8	129		
10	0	Binary Outputs – All variations	1	6	129		
12	1	Control Relay Output Block	4,5,6	17,28	129	17,28	
30	0	Analog Input – All variations	1	6			
30	2	16-Bit Analog Input			129	1	Assigned to Class 0.
32	0	Analog Change Event – All variations	1	6,7,8			
32	4	16-Bit Analog Change Event with Time			129,130	28	Assigned to Class 2.
50	1	Time and Date	2	7 count=1	129		
52	2	Time Delay Fine	23		129	7 count=1	
60	1	Class 0 Data	1	6			
60	2	Class 1 Data	1	6,7,8			
			20,21	6			
60	3	Class 2 Data	1	6,7,8			
			20,21	6			
60	4	Class 3 Data	1	6,7,8			
			20,21	6			
80	1	Internal Indications	2	0 index=7			
--	--	No Object (Cold Start)	13				
--	--	No Object (Warm Start)	14				

--	--	No Object (Delay Measurement)	23				

11.3. Point list

BINARY INPUT (OBJECT 1) -> Assigned to Class 0. BINARY INPUT CHANGE (OBJECT 2) -> Assigned to Class 1.		
Index	**Description**	
0	Protection active	
1	Auxiliary input 1	
2	Auxiliary input 2	
3	Auxiliary input 3	
4	Auxiliary input 4	
5	Auxiliary input 5	
6	Auxiliary input 6	
7	Auxiliary input 7	
8	Auxiliary input 8	
9	Auxiliary output 1	
10	Auxiliary output 2	
11	Auxiliary output 3	
12	Auxiliary output 4	
13	Auxiliary output 5	
14	Auxiliary output 6	
15	Auxiliary output 7	
16	Auxiliary output 8	
17	Auxiliary output 9	
18	Auxiliary output 10	
19	Auxiliary output 11	
20	Auxiliary output 12	
21	Auto-recloser active	
22	Teleprotection active	
23	Local parameter setting	
24	Trip circuit supervision	
25	Start / pick-up L1	
26	Start / pick-up L2	
27	Start / pick-up L3	
28	Start / pick-up N	
29	General trip	
30	Trip L1	
31	Trip L2	
32	Trip L3	
33	General start / pick-up	
34	Breaker failure	
35	Trip I>>	
36	Trip IN>>	
37	CB 'on' by AR	
38	AR blocked	
39	CB close / open	
40	52 Status Closed	
41	52 Status Open Time	
42	52 Status Open Failure	
43	52 Status Close Failure	
44	52 Status excessive openings	
45	52 Status excessive sum of switched amperes	

BINARY INPUT (OBJECT 1) -> Assigned to Class 0. BINARY INPUT CHANGE (OBJECT 2) -> Assigned to Class 1.		
Index	**Description**	
46	52 Status excessive openings per minute	
47	52-A Status	
48	52-B Status	
49	52 Status Error	
50	79 Status Reclose Time	
51	79 Status Open	
52	79 Status Wait Time	
53	79 Status Reclaim Time	
54	79 Status Security Time	
55	79 Status final open Time	
56	Start Trip Circuit Supervision	
57	GEN 50Hz	
58	Magnetic module Error	
59	Measurand Error	
60	synchronism	
61	Eeprom with default values	
62	eeprom Error	
63	Eeprom values changed	
64	Events Error	
65	New Oscillograph register	
66	52 a Input	
67	52 b Input	
68	Phase lockout input	
69	Ground lockout input	
70	External trip input	
71	Oscillographic start input	
72	79 Start input	
73	79 Enable input	
74	79 Level lockout input	
75	0 Setting group input	
76	1 Setting group input	
77	79 pulse lockout input	
78	79 pulse unlock input	
79	50BF start input	
80	Voltage command	
81	Continuity A	
82	Continuity B	
83	79 start	
84	50BF start	
85	Oscillographic start	
86	79 Enabled	
87	52 Close enabled	
88	Maneuver Selection (local)	
89	CB Open (local)	
90	CB Close (local)	
91	79 Lockout (local)	
92	79 Unlock (local)	
93	Remote control into Local	
94	Telecontrol into Remote	
95	Maneuver Selection (Modbus remote)	
96	Open CB (Modbus remote)	
97	Close CB (Modbus remote)	
98	Lockout 79 (Modbus remote)	

BINARY INPUT (OBJECT 1) -> Assigned to Class 0. BINARY INPUT CHANGE (OBJECT 2) -> Assigned to Class 1.		
Index	**Description**	
99	Unlock 79 (Modbus remote)	
100	Maneuver Selection (remote)	
101	Open CB (remote)	
102	Close CB (remote)	
103	Lockout 79 (remote)	
104	Unlock 79 (remote)	
105	CLP Activation	
106	46 Start	
107	46 Trip	
108	49 Alarm	
109	49 Trip	
110	32_1 Start	
111	32_1 Trip	
112	32_2 Start	
113	32_2 Trip	
114	32_3 Start	
115	32_3 Trip	
116	32_4 Start	
117	32_4 Trip	
118	37_1 Start A	
119	37_1 Start B	
120	37_1 Start C	
121	37_1 Start P	
122	37_1 Trip A	
123	37_1 Trip B	
124	37_1 Trip C	
125	37_1 Trip P	
126	37_2 Start A	
127	37_2 Start B	
128	37_2 Start C	
129	37_2 Start P	
130	37_2 Trip A	
131	37_2 Trip B	
132	37_2 Trip C	
133	37_2 Trip P	
134	50BF Start	
135	50BF Activation	
136	50_1 Start N	
137	50_1 Trip N	
138	50_2 Start N	
139	50_2 Trip N	
140	50_1 Start A	
141	50_1 Start B	
142	50_1 Start C	
143	50_1 Start P	
144	50_1 Trip A	
145	50_1 Trip B	
146	50_1 Trip C	
147	50_1 Trip P	
148	50_2 Start A	
149	50_2 Start B	
150	50_2 Start C	
151	50_2 Start P	

BINARY INPUT (OBJECT 1) -> Assigned to Class 0. BINARY INPUT CHANGE (OBJECT 2) -> Assigned to Class 1.		
Index	**Description**	
152	50_2 Trip A	
153	50_2 Trip B	
154	50_2 Trip C	
155	50_1 Trip P	
156	67_1 Start N	
157	67_1 Trip N	
158	67_2 Start N	
159	67_2 Trip N	
160	67_1 Start A	
161	67_1 Start B	
162	67_1 Start C	
163	67_1 Start P	
164	67_1 Trip A	
165	67_1 Trip B	
166	67_1 Trip C	
167	67_1 Trip P	
168	67_2 Start A	
169	67_2 Start B	
170	67_2 Start C	
171	67_2 Start P	
172	67_2 Trip A	
173	67_2 Trip B	
174	67_2 Trip C	
175	67_2 Trip P	
176	Live Line, Live Bus	
177	Live Line, Dead Bus	
178	Dead Line, Live Bus	
179	Dead Line, Dead Bus	
180	Synchronism Permmision	
181	27_1 Start A	
182	27_1 Start B	
183	27_1 Start C	
184	27_1 Start P	
185	27_1 Trip A	
186	27_1 Trip B	
187	27_1 Trip C	
188	27_1 Trip P	
189	27_2 Start A	
190	27_2 Start B	
191	27_2 Start C	
192	27_2 Start P	
193	27_2 Trip A	
194	27_2 Trip B	
195	27_2 Trip C	
196	27_2 Trip P	
197	59_1 Start N	
198	59_1 Trip N	
199	59_2 Start N	
200	59_2 Trip N	
201	59_1 Start A	
202	59_1 Start B	
203	59_1 Start C	
204	59_1 Start P	

BINARY INPUT (OBJECT 1) -> Assigned to Class 0. BINARY INPUT CHANGE (OBJECT 2) -> Assigned to Class 1.		
Index	**Description**	
205	59_1 Trip A	
206	59_1 Trip B	
207	59_1 Trip C	
208	59_1 Trip P	
209	59_2 Start A	
210	59_2 Start B	
211	59_2 Start C	
212	59_2 Start P	
213	59_2 Trip A	
214	59_2 Trip B	
215	59_2 Trip C	
216	59_2 Trip P	
217	81_1 Start	
218	81_1 Trip	
219	81_1 Lockout	
220	81_2 Start	
221	81_2 Trip	
222	81_2 Lockout	
223	81_3 Start	
224	81_3 Trip	
225	81_3 Lockout	
226	81_4 Start	
227	81_4 Trip	
228	81_4 Lockout	

CONTROL RELAY OUTPUT BLOCK (OBJECT 12)		
Index	**Description**	
0	Lock/Unlock 79	
1	52 open/close	

ANALOG INPUT (OBJECT 30) -> Assigned to Class 0. ANALOG INPUT CHANGE (OBJECT 32) -> Assigned to Class 2.			
Index	**Description**	**Full Scale Range (Referenced to In=1A or In=5A)**	
0	Phase A current	0 to 6 / 0 to 1,2 Amps	(0 to 4095).
1	Phase B current	0 to 6 / 0 to 1,2 Amps	(0 to 4095).
2	Phase C current	0 to 6 / 0 to 1,2 Amps	(0 to 4095).
3	Phase A voltage	0 to 76,2 Volts	(0 to 4095).
4	Phase B voltage	0 to 76,2 Volts	(0 to 4095).
5	Phase C voltage	0 to 76,2 Volts	(0 to 4095).
6	Active Power	0 to 228,6 / 0 to 1143 Watts	(0 to 4095).
7	Reactive Power	0 to 228,6 / 0 to 1143 Watts	(0 to 4095).
8	Frequency	0 to 60 / 0 to 72 Hz	(0 to 4095).

11.4. DNP3 protocol settings

Setting Name	Type	Minimum Value	Maximum Value	Default Value	Step	Current Value
RTU Address	Integer	0	65535	1	1	
Validate Source Address	Boolean	0 (No)	1 (Yes)	0	1	
Application Confirm Timeout	Integer	0	4294967295	5000	1	msec.
Enable Unsol. Report	Boolean	0 (No)	1 (Yes)	1 (Yes)	1	
Source Address	Integer	0	65534	4	1	
Unsol. Retry Delay	Integer	0	4294967295	2000	1	msec.
Unsol. Max Retries	Integer	0	65535	3	1	
Unsol. Offline Retry Delay	Integer	0	4294967295	3000	1	msec.

RTU Address : Remote Terminal Unit Address.
Validate Source Address: Slave respond only if the source address in received requests matches configured source.

Application Confirm Timeout: Specifies how long the slave DNP device will wait for an application layer confirmation from the master.

Enable Unsolicited Reporting: Enables or disables Unsolicited responses.

Source Address: Destination address of the Master device to which the unsolicited responses are to be sent.

Unsolicited Retry Delay: Specifies the time to delay after an unsolicited confirm timeout before retrying the unsolicited response.

Unsolicited Max. Retries: How many times should this slave resend Unsols before declaring the station offline

Unsolicited Offline Retry Delay: How often to retry unsolicited responses after maxRetries attempts

12. APPENDIX

12.1. Identification

Date: ………………………………………………….…………………………………………

Person responsible:…………………………………………...……………………

Substation:………………………………………………………………………………………

Circuit: …………………………………………..………………………………………………

Model : …………………………………………………………………………………………

Serial Nº: ………………………………………………………………………………..……

Software versions: ………………………………………………………………………

MODEL SELECTION TABLE

Example: SILB515B0000AA

Position	Code	Description
S I L B		
5	1	1 A phase measurement
	5	5 A phase measurement
6	1	1 A neutral measurement
	5	5 A neutral measurement
7	5	50 Hz
	6	60 Hz
8	A	24- 48 Vdc
	B	90 Vdc – 300 Vdc / 110 Vac – 230 Vac
9	0	-
	1	+ 81U/O(4) + 25 + 37(2)
	2	+ 81U/O(4) + 25 + 37(2) + IRIG-B
10		---*(in compact & non compact version)* ---
	0	RS485: ModBus + IEC 60870-5-103
	1	FOP: ModBus + IEC 60870-5-103
	2	FOC-ST: ModBus + IEC 60870-5-103
		---(*in compact version)* ---
	3	IEC61850 + ModBus (RS485)
	4	DNP3.0 (TCP/IP) + ModBus (RS485)
	5	IEC 60870-5-104 + ModBus (RS485)
11	0	7 outputs - 8 inputs
12	0	4U x ½ rack + External MMS
	1	Compact: 4U x ½ rack
13	A	English, Spanish, French and German
	B	English, Spanish, French and Turkish
	D	English, Spanish, French and Russian
14	A	-

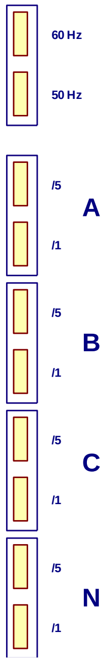
12.2. Checks

Cabling verification: ❐

Case earth: ❐

Vaux value: ❐

12.3. Switch configurations



12.4. Test menu

LED -1:	❐	Output 1:	❐
LED -2:	❐	Output 2:	❐
LED -3:	❐	Output 3:	❐
LED -4:	❐	Output 4:	❐
LED -5:	❐	Output 5:	❐
LED -79:	❐	Output 6:	❐
LED -52:	❐	Output 7:	❐
LED -ON:	❐		

12.5. Acceptance setting log

Password: ……………………………………..…………………………………………………….

Identification: ……………………….………………….....................…………………………………..

Rated phase and neutral currents:

Rated phase current: ……………………………………………………………….

Rated neutral current: ……………………………………………………………….

50P_1

Permission ❒ Permitted ❒ Prohibited

Current pickup …………………xIn

Definite-time …………s

50P_2

Permission ❒ Permitted ❒ Prohibited

Current tap …………………xIn

Definite time …………s

67/51/50P_1

Permission ❒ Permitted ❒ Prohibited

Current pickup ……………….. xIn

Curve type ❒IEC Inverse ❒IEC Very Inverse ❒IEC Extr Inverse

❒ANSI Inverse ❒ANSI Very Inverse ❒ANSI Extr Inverse

❒Definite-time

Dial …………………………

Definite-time ……… s

Directionality ❒ Permitted ❒ Prohibited

Polarization voltage ……………… V

Operating angle ……………… º

Half-cone angle ……………… º

67/51/50P_2

Permission ❒ Permitted ❒ Prohibited

Current pickup ……………….. xIn

Curve type ❒IEC Inverse ❒IEC Very Inverse ❒IEC Extr Inverse

❒ANSI Inverse ❒ANSI Very Inverse ❒ANSI Extr Inverse

❒Definite-time

Dial …………………………

Definite-time ……… s

Directionality ❒ Permitted ❒ Prohibited

Polarization voltage ……………… V

Operating angle ……………… º

Half-cone angle ……………… º

50N_1

Permission ❐ Permitted ❐ Prohibited

Current pickup ……………….. xIn

Definite-time ……… s

50N_2

Permission ❐ Permitted ❐ Prohibited

Current pickup ……………….. xIn

Definite-time ……… s

67/51/50N_1

Permission ❐ Permitted ❐ Prohibited

Current pickup ………………. xIn

Curve type ❐IEC Inverse ❐IEC Very Inverse ❐IEC Extr Inverse

❐ANSI Inverse ❐ANSI Very Inverse ❐ANSI Extr Inverse

❐Definite-time

Dial …………………………

Definite-time ……… s

Directional ❐ Permitted ❐ Prohibited

Polarization voltage ……………… V

Operating angle ……………… º

Half-cone angle ……………… º

67/51/50N_2

Permission ❐ Permitted ❐ Prohibited

Current pickup ………………. xIn

Curve type ❐IEC Inverse ❐IEC Very Inverse ❐IEC Extr Inverse

❐ANSI Inverse ❐ANSI Very Inverse ❐ANSI Extr Inverse

❐Definite-time

Dial …………………………

Definite-time ……… s

Directional ❐ Permitted ❐ Prohibited

Polarization voltage ……………… V

Operating angle ……………… º

Half-cone angle ……………… º

46

Permission ❒ Permitted ❒ Prohibited

Current pickup .... xIn

Curve type ❒IEC Inverse ❒IEC Very Inverse ❒IEC Extr Inverse

❒ANSI Inverse ❒ANSI Very Inverse ❒ANSI Extr Inverse

❒Definite-time

Dial ....

Definite-time .... s

49

Permission ❒ Permitted ❒ Prohibited

Current tap .... xIn

ζ heating .... min

ζcooling. .... x ζ heating

Alarm .... %

37_1

Permission ❒ Permitted ❒ Prohibited

Tap ....xIn

Operating time ....s

37_2

Permission ❒ Permitted ❒ Prohibited

Tap ....xIn

Operating time ....s

59P_1

Permission ❒ Permitted ❒ Prohibited

Voltage pickup V

Definite-time ....s

Reset time ....s

59P_2

Permission ❒ Permitted ❒ Prohibited

Voltage pickup V

Definite-time ....s

Reset time ....s

59N_1

Permission ❒ Permitted ❒ Prohibited

Voltage pickup …………………V

Definite-time ………..s

Reset time ………..s

59N_2

Permission ❒ Permitted ❒ Prohibited

Voltage pickup …………………V

Definite-time ………..s

Reset time ………..s

27P_1

Permission ❒ Permitted ❒ Prohibited

Voltage pickup …………………V

Definite-time ………..s

Reset time ………..s

27P_2

Permission ❒ Permitted ❒ Prohibited

Voltage pickup …………………V

Definite-time ………..s

Reset time ………..s

32_1

Permission ❒ Permitted ❒ Prohibited

Tap …………………xIn

Operating time …………………s

Characteristic angle …………………°

32_2

Permission ❒ Permitted ❒ Prohibited

Tap …………………xIn

Operating time …………………s

Characteristic angle …………………°

32_3

Permission ❒ Permitted ❒ Prohibited

Tap ………………….xIn
Operating time ………………….s
Characteristic angle ………………….°

32_4

Permission ❒ Permitted ❒ Prohibited
Tap ………………….xIn
Operating time ………………….s
Characteristic angle ………………….°

81_1

Permission ❒ Permitted ❒ Prohibited
Type ❒ Underfrequency ❒ Overfrequency
Activation level ………………… Hz
Operating time ………………… s
Reset time ………………… s

81_2

Permission ❒ Permitted ❒ Prohibited
Type ❒ Underfrequency ❒ Overfrequency
Activation level ………………… Hz
Operating time ………………… s
Reset time ………………… s

81_3

Permission ❒ Permitted ❒ Prohibited
Type ❒ Underfrequency ❒ Overfrequency
Activation level ………………… Hz
Operating time ………………… s
Reset time ………………… s

81_4

Permission ❒ Permitted ❒ Prohibited
Type ❒ Underfrequency ❒ Overfrequency
Activation level ………………… Hz
Operating time ………………… s
Reset time ………………… s

Cold Load Pickup

Permission	❒ Permitted	❒ Prohibited
50P_1 multiplier	…………………………………………….	
50P_2 multiplier	…………………………………………….	
67P_1 multiplier	…………………………………………….	
67P_2 multiplier	…………………………………………….	
50N_1 multiplier	…………………………………………….	
50N_2 multiplier	…………………………………………….	
67N_1 multiplier	....	
67N_2 multiplier	....	
Time to pass to CLP	……………………………………	
CLP duration time	…………………………………………….	

50BF

Permission	❒ Permitted	❒ Prohibited
Operation time	……..… s	

79

Permission	❒ Permitted	❒ Prohibited
Wait permission	❒ Permitted	❒ Prohibited
Number of reclosings	…………….	
1st reclosure time	…………………… s	
2nd reclosure time	…………………… s	
3rd reclosure time	…………………… s	
4th reclosure time	…………………… s	
5th reclosure time	…………………… s	
Wait time	…………………… s	
Reset time	…………………… s	
Definitive opening time	…………………….s	

25

Permission LLLB	❒ Permitted	❒ Prohibited
Permission LLDB	❒ Permitted	❒ Prohibited
Permission DLLB	❒ Permitted	❒ Prohibited
Permission DLDB	❒ Permitted	❒ Prohibited

Live line voltage level ……………………………..V

Dead line voltage level ………………………........V

Live bar voltage level …………………………......V

Dead bar voltage level……………………………..……V

Voltage supervisión temporisation ………………..s

Line-bar voltage difference ………………………..V

Line-bar phase difference ………………………..…º

Line-bar frequency difference -barra …………mHz

Synchronism time ………………………………… s

52

Maximum number of openings ……………………….

Maximum number of accumulated amps ……………..

Maximum opening time ………………………………..

Maximum closure time ……………………….

Number openings/time: number of openings …………………

Time period …………………… ..min

74TCS

Permission ❒ Permitted ❒ Prohibited

Operation time ……..… s

12.6. Inputs

Input -1:	❒	Input -5:	❒
Input -2:	❒	Input -6:	❒
Input -3:	❒	Input -7:	❒
Input -4:	❒	Input -8:	❒

12.7. Input configuration

Logical inputs	Inp1	Inp2	Inp3	Inp4	Inp5	Inp6	Inp7	Inp8
Not configured								
52 a								
52 b								
50P locking								
50N locking								
Oscillography start input								
Input Start 79								
79 permission								
79 level locking								
79 pulse locking								
79 pulse unlocking								
Input start 50BF								
Table 0								
Table 1								
External trip								

12.8. Output configuration

Outputs				
Output 1				
Output 2				
Output 3				
Output 4				
Output 5				
Output 6				
Output 7				
Start 79				

Start 50BF				
Start oscillography				
79 Closure permission				
52 closure permission				

12.9. LED's configuration

LEDs	Blinking	Latch	Negated				
LED On							
LED 1							
LED 2							
LED 3							
LED 4							
LED 5							

12.9.1. LED's configuration template

ON
Phase Trip
Neutral Trip
50BF
32/40
74TCS

12.10. Comments

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Acceptance approved by……………………………..

Date……………

Maintenance undertaken on……………………… by …….…………………………………...

NOTES:

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