SIL-A

Overcurrent & Earth Fault Protection Relay

USER'S MANUAL

1 RECEPTION, HANDLING, INSTALLATION

1.1 Unpackaging

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

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

The facility must be clean and dry. 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 device 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. This damage may not be detected, but the electronic circuit reliability and life will be reduced. The electronic component in the device is well protected by the metal housing, which should not be removed as the device 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 electrostatic discharges 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 device reliability and the duration of the life cycle as designed by the manufacturer, taking the following actions:

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

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

1.4 Installation, commissioning and service

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

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

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 device 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 device 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 device must be used within the stipulated electrical and environmental limits.

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

1.5 Storage

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

1.6 Recycling

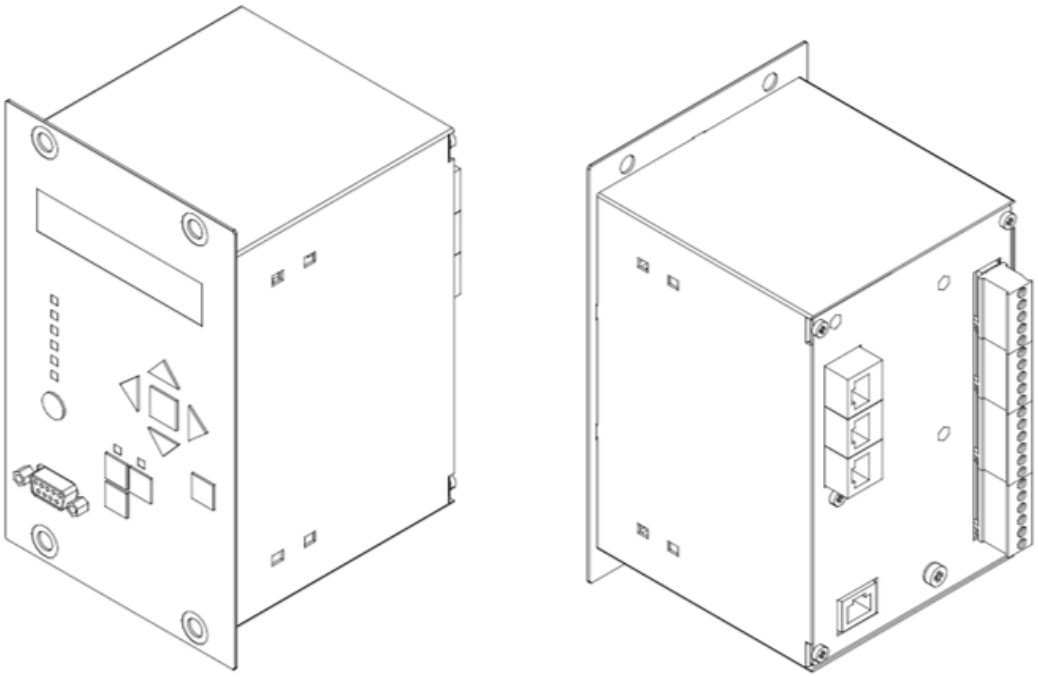
Before recycling the device, capacitors should be discharged through their external terminals. All electrical power sources should be removed before performing this operation to avoid the risk of electrical discharge.

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

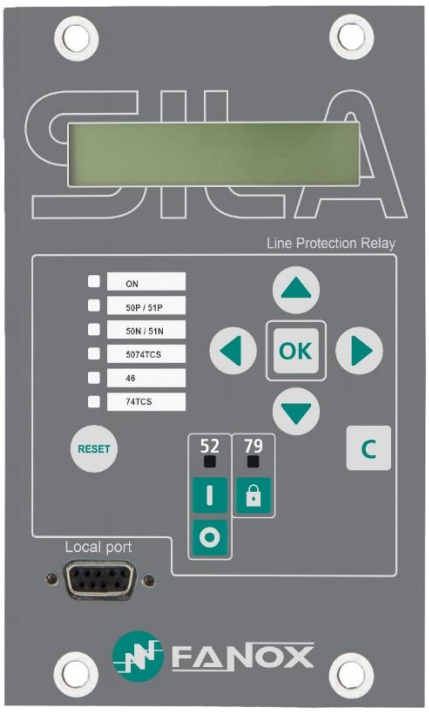
Fanox Electronic, S.L. adheres itself to the 1st additional disposal of the Spanish 11/97 Standard in which it is said that the final user of the containers should give them, properly segregated by materials, to an authorized recovery, recycler or valuer company.

2 DIMENSIONS AND CONNECTION DIAGRAMS

2.1 SILA LPCT model (SILAXX)

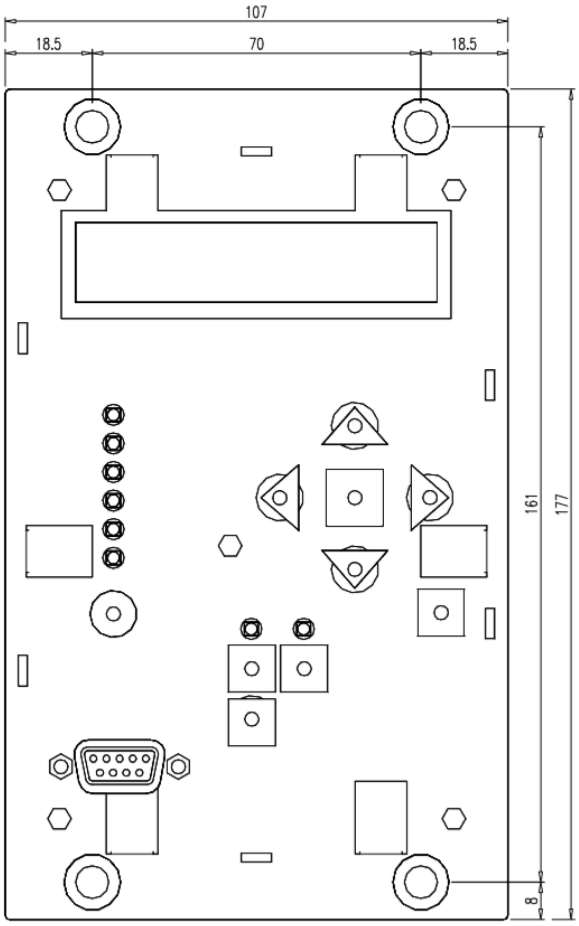


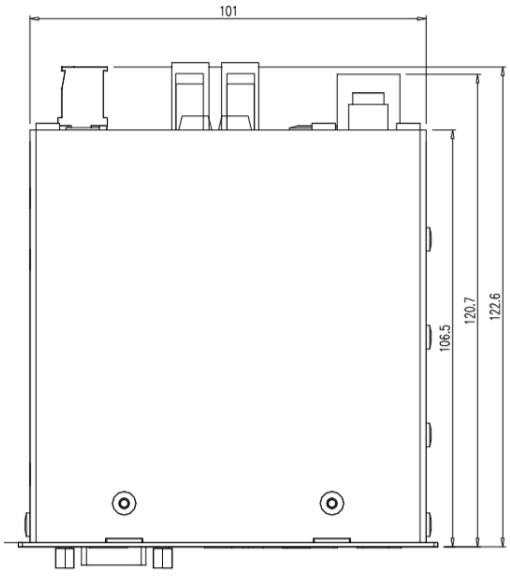
2.1.1 Front view



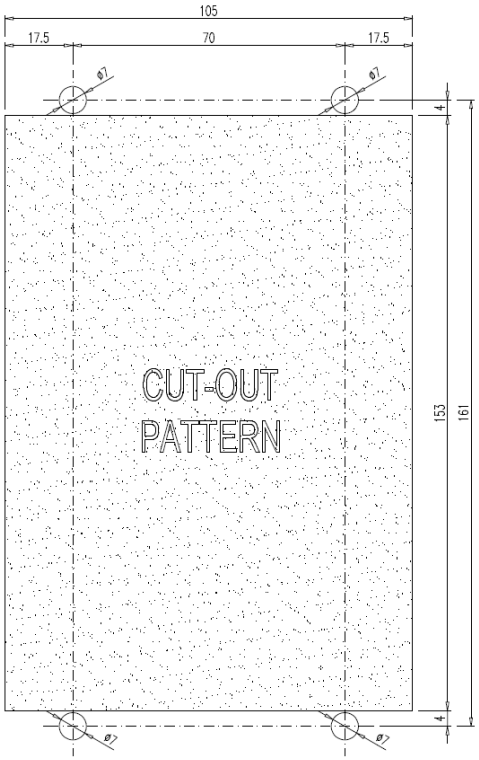
2.1.2 Case dimensions

The dimensions are in mm:



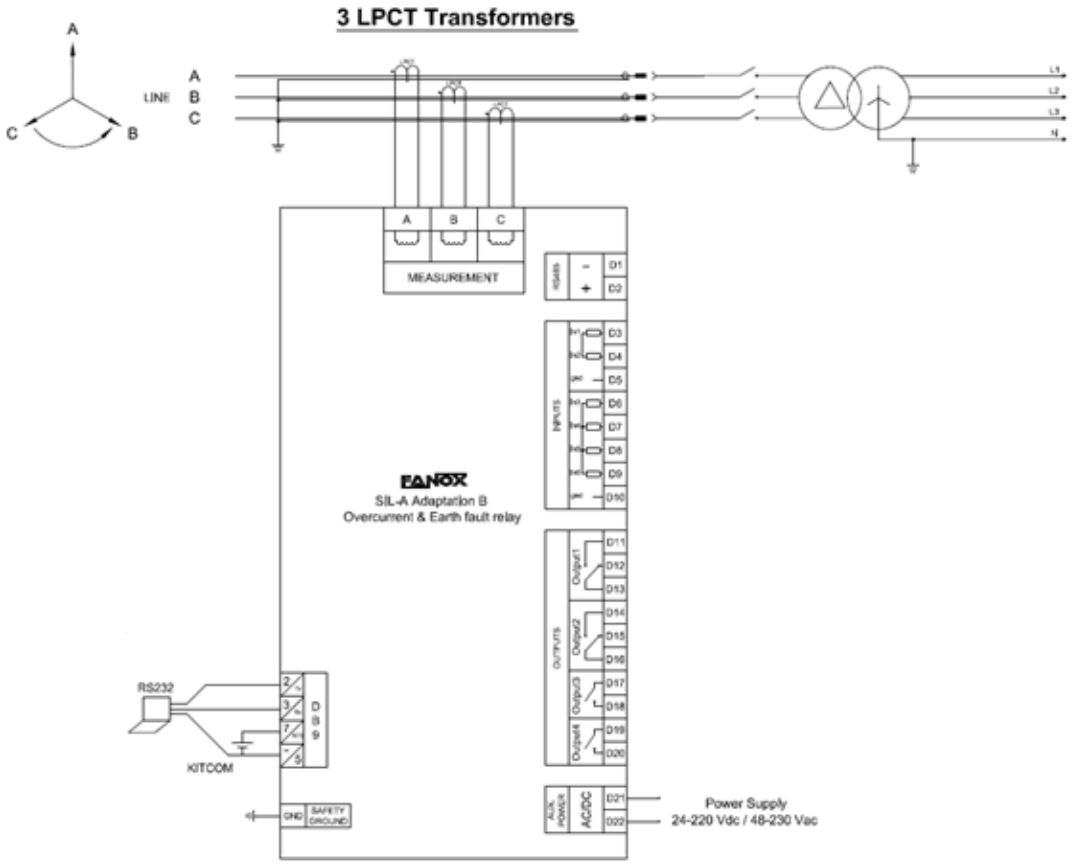


2.1.3 Cut-out pattern



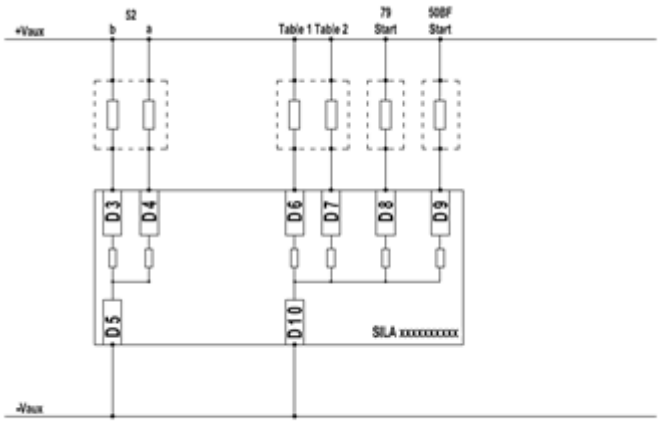
2.1.4 Connection diagrams

2.1.4.1 Analog connections

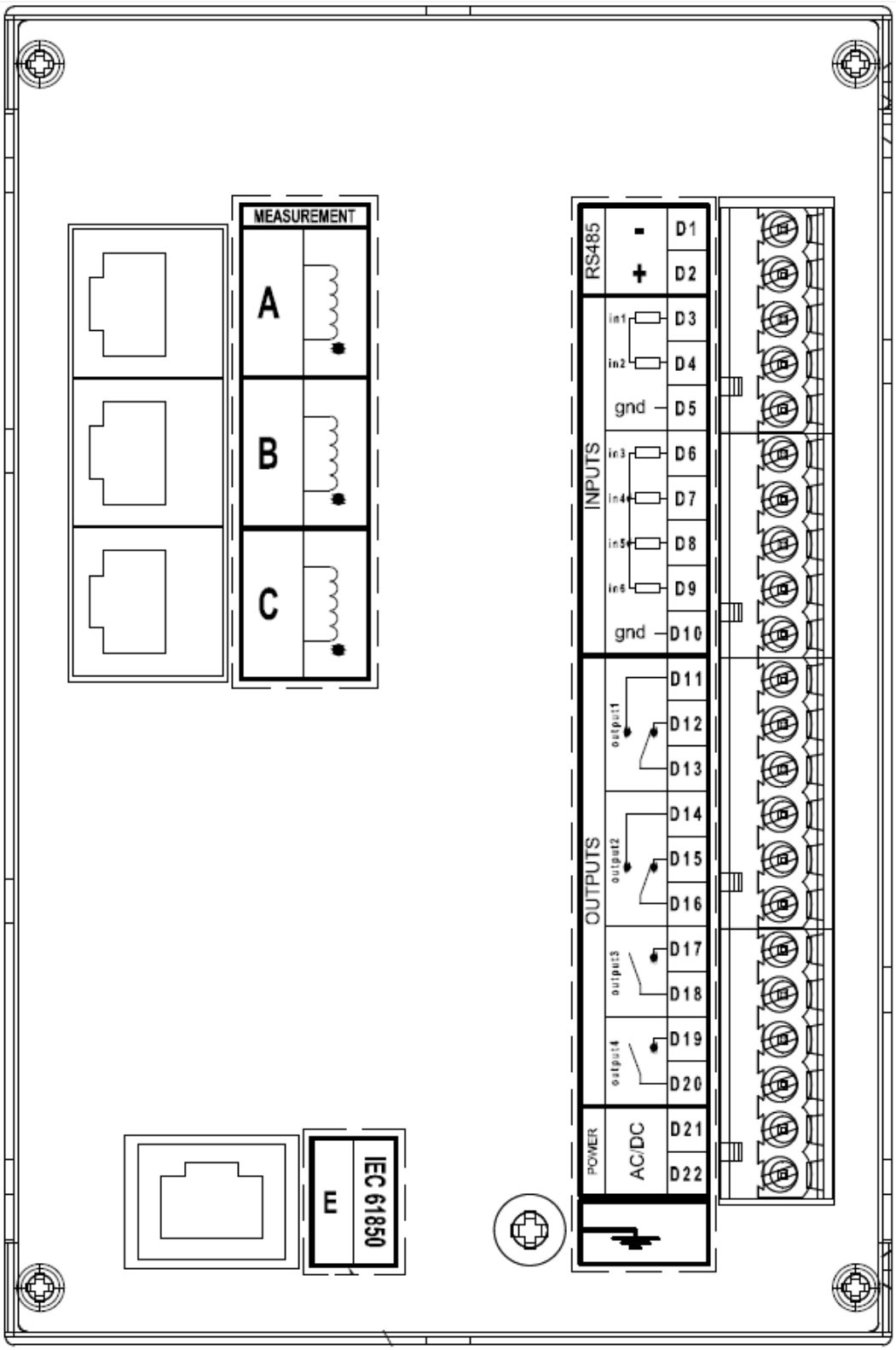


2.1.4.2 Digital connections

Following connection is an example. Configuration can be selected by the user.



2.1.5 Terminals

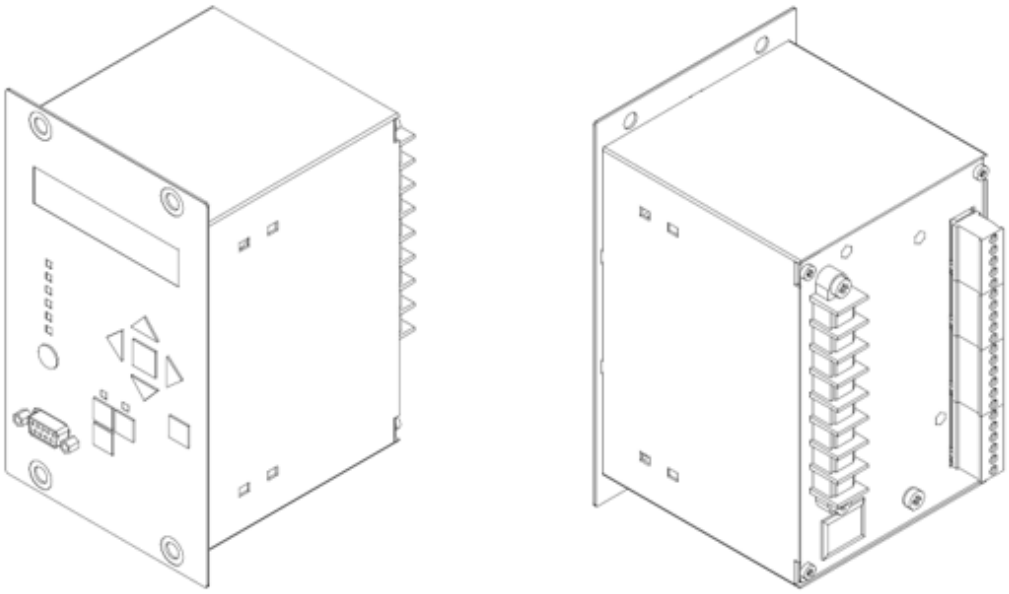


D1	+ RS485 Modbus RTU, DNP3.0 Serial or IEC60870-103 depending on model (*)
D2	– RS485 Modbus RTU, DNP3.0 Serial or IEC60870-103 depending on model (*)
D3	Digital input 1
D4	Digital input 2
D5	Common digital inputs 1 and 2
D6	Digital input 3
D7	Digital input 4
D8	Digital input 5
D9	Digital input 6
D10	Common digital inputs 3, 4, 5 and 6
D11	NO digital output 1
D12	NC digital output 1
D13	Digital 1 common output

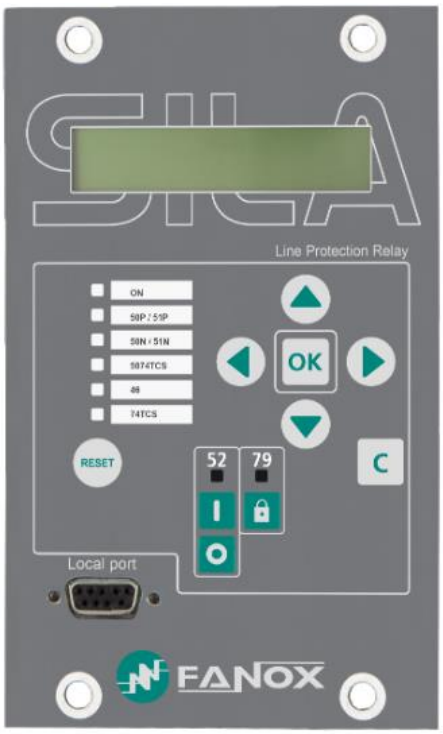
D14	NO digital output 2
D15	NC digital output 2
D16	Digital 2 common output
D17-D18	NO digital output 3
D19-D20	NO digital output 4
D21	+ Auxiliary voltage.
D22	- Auxiliary voltage.
A	Phase A current measurement
B	Phase B current measurement
C	Phase C current measurement
E	IEC 61850, DNP3.0 TCP/IP, IEC60870-104 or Modbus TCP/IP depending on model (*)

(*) When the model is chosen is very important to choose the communications protocols correctly. If ‘RS485’ port is chosen, then ‘E’ communications module is not available. If ‘E’ communications module is chosen, then ‘RS485’ port is not available.

2.2 Standard SILA



2.2.1 Front view



2.2.2 Case dimensions

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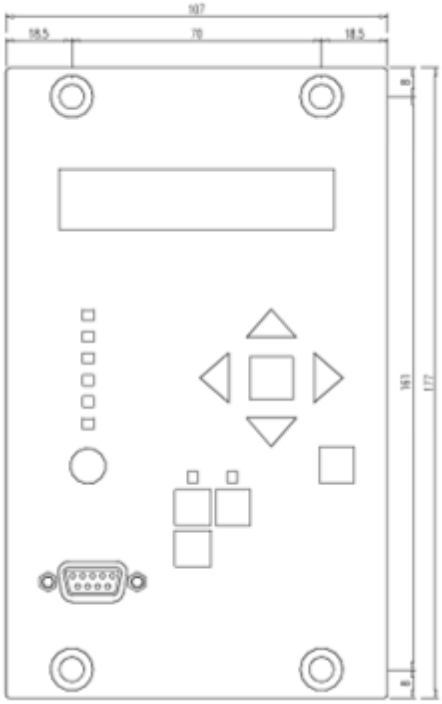
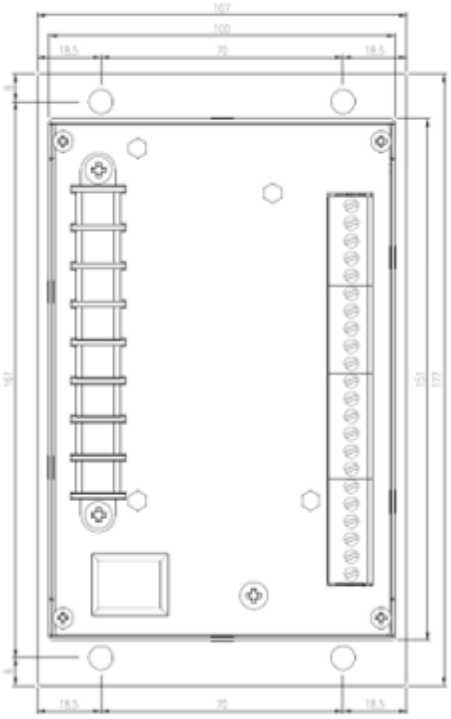
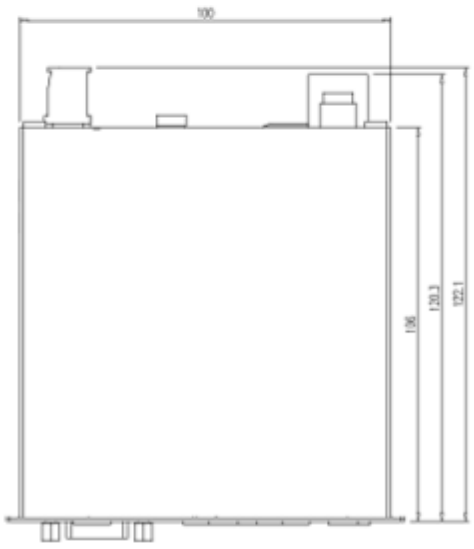
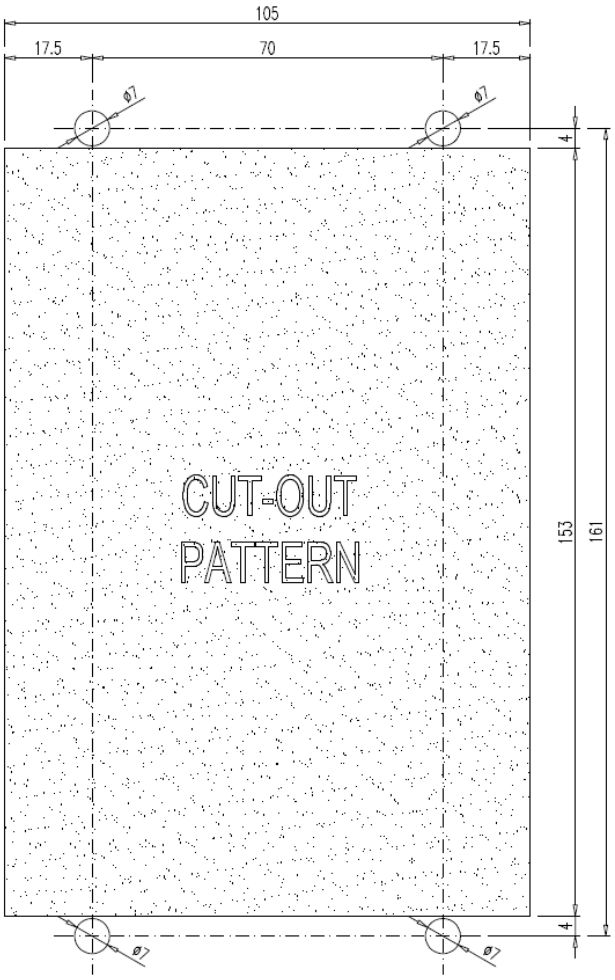






2.2.3 Cut-out pattern



2.2.4 Connection diagrams

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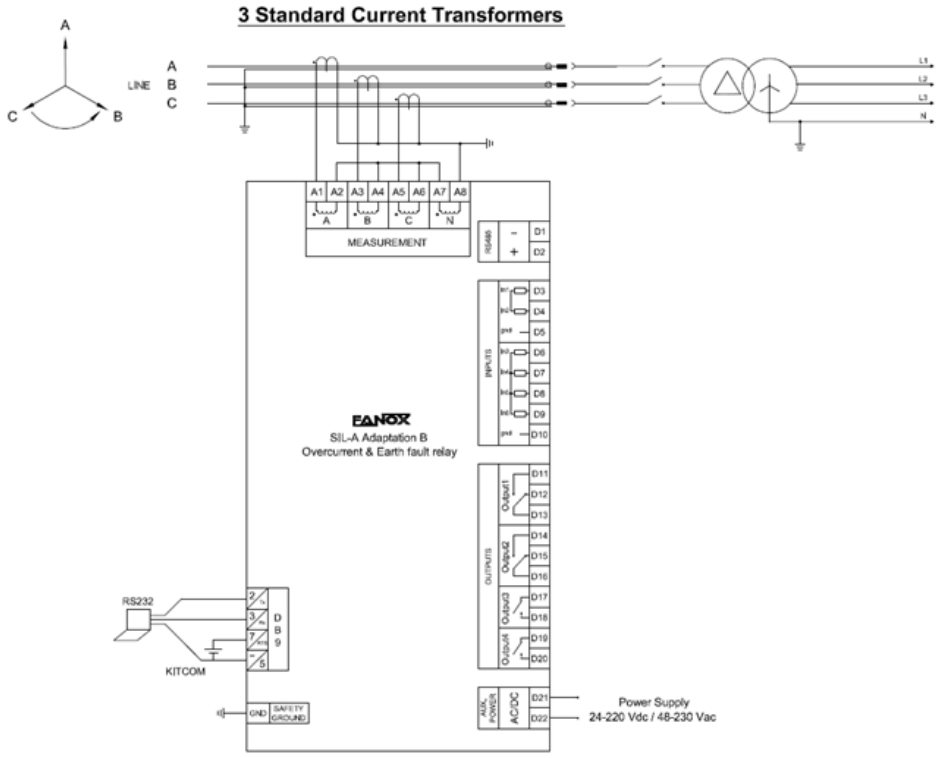
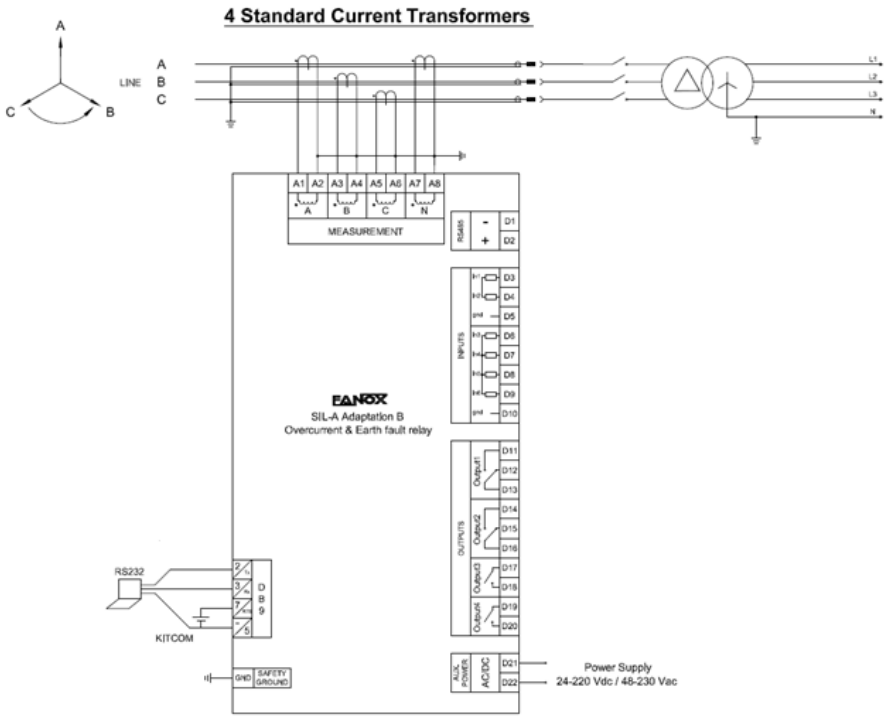
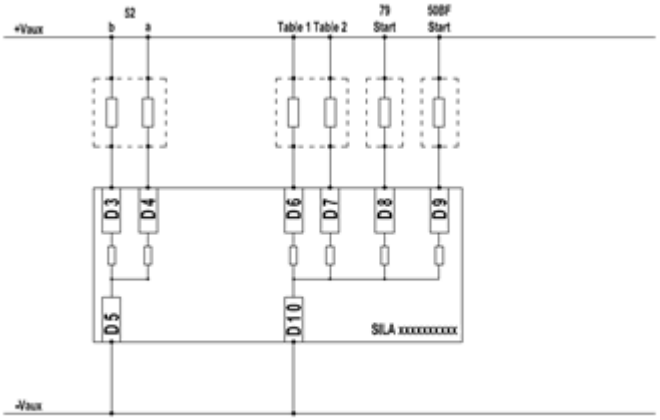


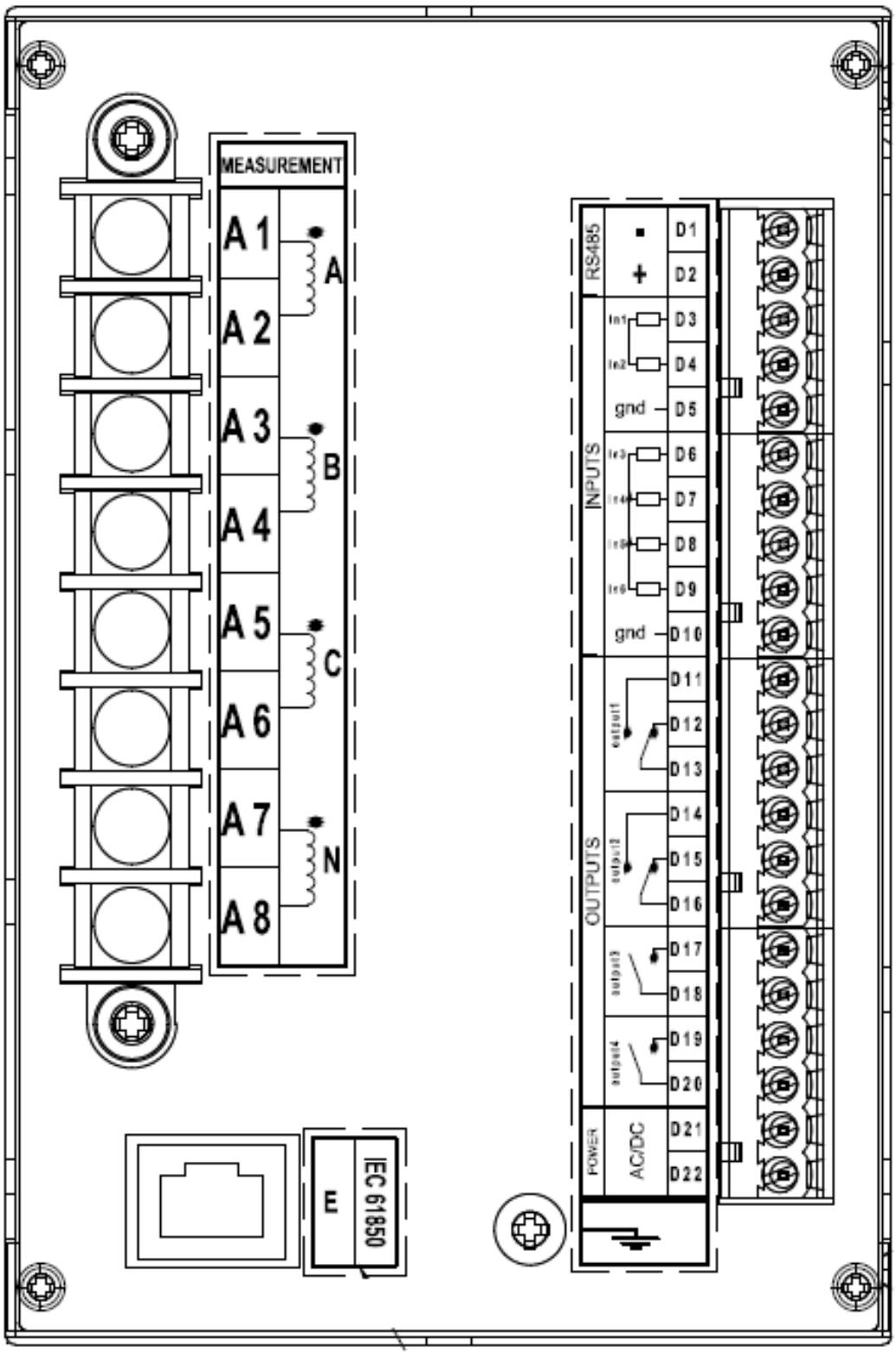


2.2.4.2 Digital connections

Following connection is an example. Configuration can be selected by the user.



2.2.5 Terminals



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D21	+ Auxiliary voltage.
D22	- Auxiliary voltage.
A1-A2	Phase A current measurement
A3-A4	Phase B current measurement
A5-A6	Phase C current measurement
A7-A8	Neutral current measurement
E	IEC 61850, DNP3.0 TCP/IP, IEC60870-104 or Modbus TCP/IP depending on model (*)

(*) When the model is chosen is very important to choose the communications protocols correctly. If ‘RS485’ port is chosen, then ‘E’ communications module is not available. If ‘E’ communications module is chosen, then ‘RS485’ port is not available.

3 DESCRIPTION

3.1 Introduction

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

The SIL- A relay is designed to protect secondary transformation and distribution centers of electric grids, using current functions. It is intended to work with a circuit breaker as cutting power element.

The protection functions can be activated by using both the front panel and the communications links to the SICom program, allowing a precise coordination with another relay.

Additionally, all the models have been designed to be powered from an external battery. This is aimed at facilitating event management and the commissioning of centers, as well as allowing it to operate properly under adverse conditions.

3.2 Description

SIL-A relays are digital based technology powered with an auxiliary voltage of 24-230 Vac/dc.

Besides the overcurrent line protection functions, instantaneous phase and neutral, with a circuit breaker and protection against phase and neutral inverse time overcurrent, the relay provides phase imbalance and circuit breaker fault functions as well as a thermal image protection.

As this is a line protection, a recloser is fitted. This automated control shall permit closure (up to five attempts) with the possibility of programming each reclosing time. It can be blocked by various means, from the HMI with a separate key to remote communications and inputs.

Further functions have been included which support line protection, such as the cold load pickup, or the trip circuit supervision.

All models include a circuit breaker management function, which monitors the state of the circuit breaker, the number of openings and the accumulated amps. It generates an indication if these are excessive, determines whether or not a fault has occurred and allows the circuit breaker to close and open through the commands located on HMI, or via the communications (either locally or remotely).

Depending on model different functions are optional.

All the models are provided with 50, 51/50, 50G, 50/51G, 52, 79, 74TCS, 46, 49T, CLP and 86.

Optionally:

Model SILAxxxx0xxxxx: 50_2, 50G_2 and 50BF.

Model SILAxxxx2xxxxx: 50_2, 50G_2, 50BF, 49, 74CT, 37, 46BC and trip block for switch disconnector.

Model SILAxxxx4xxxxx: 49, 46BC and SHB.

The SIL-A relay has 4 outputs that can be set by the user and configurable inputs that depending on model will be:

6 configurable inputs for adaptation B.

4 configurable inputs and 2 non-configurable inputs dedicated for 74TCS function for adaptation C.

The relay has an LCD with two lines and twenty columns and a membrane keyboard with six buttons. These allow the relay status, the current measurements in the primary winding and the events or incidents associated with the relay to be seen, and adjustments to be made to the protection criteria. Depending on the model, these events can be saved in a non-volatile memory to keep them when there is no power.

As well as the 6 keys to navigate the menus, there are also special keys:

- Reset. To reset the signals and events.
- 79 block. This one blocks and unblocks the recloser.
- 52 I/O. This serves to control the circuit breaker.

The SIL-A is fitted with 8 front LEDs, all of them configurable by the user.

It can store, up to 200 events, allowing any registered incidents to be analyzed.

To facilitate the analysis of the information recorded in the relay, 20 fault reports (24 events per report) are also included. Event recording consists on more general information, and fault reports will record just the events related with the fault situation, allowing the user to export these fault reports in COMTRADE format (IEEE C37.111-1991) to analyze the graphical representation of fault reports. SIL-A can store up to 5 COMTRADE records with 100 cycles each one (2 seconds at 50Hz, 1.666 seconds at 60Hz): 3 pre-fault cycles and 97 postfault cycles.

Current measurements are performed using the fundamental values, with an accuracy of 2% over a range of ±20% over the nominal current and 4% over the rest of the range. Standard 5 A and 1 A current transformers (CTs) are used. There are special models, SILA-XX where the current inputs have been replaced with low voltage signals, which are proportional to the primary current.

The relay is provided with 2 communications ports: one front port (RS232) and one rear port. The RS232 port allows a PC to be connected and the relay to be monitored using the SICom program in WINDOWS 7, WINDOWS 8, WINDOWS 8.1 or WINDOWS 10 (supplied by FANOX).

The rear communication ports are designed for different functions. While one is used for control, principally including the alarm and control functions, the other is designed for specific protection personnel consultations, with the possibility of consulting and changing, adjustment, or downloading of events and disturbance fault recording (DFR), all without affecting the control part operation. Depending on model, there are the following options respect to rear ports:

1. One RS485 port with selectable communication protocols (selectable by settings) between IEC60870-103 and Modbus RTU or DNP3.0 Serial and Modbus RTU, depending on model.
2. One RJ45 with IEC61850, DNP3.0, IEC60870-104 or Modbus TCP/IP depending on model.

Setting-up a session allows four levels of access to be set up with passwords that can be configured by the user through SICom communication software.

The protection functions, easy-to-use interface, low amount of maintenance and simple integration make the SIL-A a precise and practical solution to protect both industrial and public electrical grids and transformation and distribution centres. The SIL-A protection against earthing

faults is sensitive enough to be used on electric systems with low earthing fault currents. It can be adjusted to 0.1 times the rated current (or to 0.05 times on Adaptation C) and extremely low rated levels can be selected.

The main features of the relay are listed below, and these features will be explained in the rest of the manual:

Function	Description	SIL-A
Protection		
50_1	Instantaneous phase overcurrent	1
50_2	Instantaneous phase overcurrent	1 (Optional)
50G_1 (**)	Instantaneous measured neutral overcurrent	1
50G_2 (**)	Instantaneous measured neutral overcurrent	1 (Optional)
50/51	Inverse time phase overcurrent	1
50/51G (**)	Inverse time measured neutral overcurrent	1
46	Phase balance current protection	1
79	AC Reclosing Device	Up to 5 shots
50BF	Circuit breaker opening failure	1 (Optional)
74TCS	Trip circuit supervision	1 through configurable inputs or dedicated inputs depending on model.
86	Trip Output Lockout through PGC	✓
CLP	Cold load pickup	1
49T	External trip	1 (through configurable inputs)
49	Thermal image	Optional
74CT	Phase CT Supervision	1 (Optional)
37	Instantaneous phase undercurrent	1 (Optional)
46BC	Broken conductor detection	1 (Optional)
Trip block *	Trip block for switch disconnector	1 (Optional)
SHB *	Second Harmonic Blocking	1 (Optional)

*SIL-A relay has as optional SHB or Trip block, but it is not possible to have both in the same device

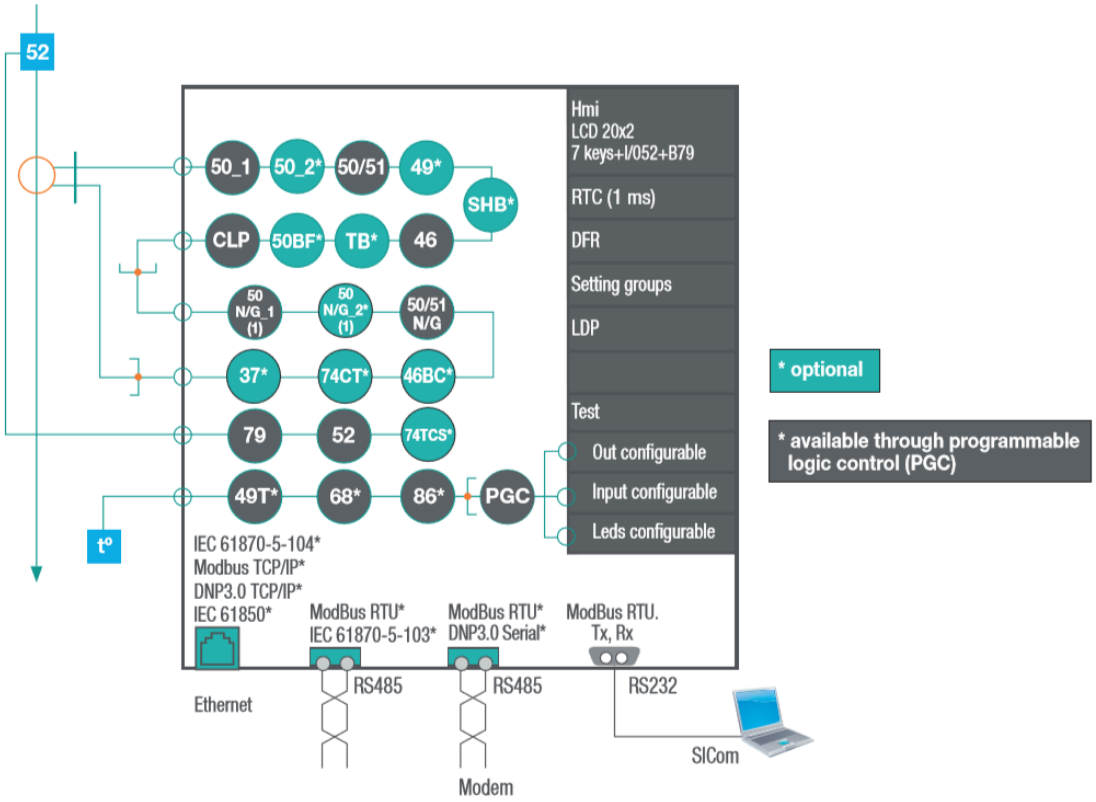
Circuit Breaker Monitoring		
52	State and control of the circuit breaker	✓
	Number of openings Counter	✓
	Accumulated amperes counter:	✓
	Maximum openings in a time window	✓
Measurements		
	Phase and neutral (1*) fundamental values with a precision of ±2% in a band of ±20% when compared to the rated current, and ±4% or ±5 mA in the rest of the range.	✓
	Positive sequence current	✓
	Negative sequence current	✓
	Phase A second harmonic current	Depending on model
	Phase B second harmonic current	Depending on model
	Phase C second harmonic current	Depending on model
	Maximum current	✓
	Thermal image	Depending on model
Inputs and Outputs		
	Inputs	6 configurable for model SILAxxxx0xxxxx and SILAxxxx2xxxxx 4 configurable and 2 non-configurable for model SILAxxxx4xxxxx
	Configurable outputs	4 outputs: 2 (NO/NC) + 2 (NO)
Communication		
	LOCAL Communication	✓ 1 Local port RS232: ModBus RTU
	REMOTE Communication	✓ (Optional) 1 remote port with the following options: 1 Remote port RS485: ModBus RTU or IEC 60870-5-103 (by general settings) 1 Remote port RS485: ModBus RTU or DNP3.0 (by general settings) 1 RJ45: IEC61850, DNP3.0, IEC 60870-104 or Modbus TCP/IP (depending on model)

HMI		
	SICom programme for Windows	✓
	Setting-up the session: 4 access levels with configurable passwords	✓
	HMI: LCD, 20x2	✓
	6 keys + 1 reset button + 2 keys for 52 control + 1 separate key for 79 Locking	✓
	LED Indicators	8 leds: All configurable
Power		
	Auxiliary voltage .	24-230Vac/dc
Monitoring and Recording		
	Sequential Event recording (SER)	200
	Disturbance Fault Recording (DFR)	20 fault reports (24 events each one) and 5 COMTRADE Records (100 cycles per record)
	Real-Time Clock (RTC 1 millisecond)	✓
	Test menu	✓
	Self-diagnosis	✓
Settings Groups		
	By general settings By Inputs	4 setting groups
Mechanical		
	Dimensions	4U x $^{1}/_{4}$ *R*ack
	Weight	1.5 kg

(**) LPCT model→50N/G and 50/51N/G : calculated neutral; in Standard model→50N/G and 50/51N/G: measured neutral

(1*) On SIL-AXX models(LPCT type), the accuracy of the measurement in the neutral is 8%

3.3 Functional diagram



(1) Note:

- LPCT model: neutral current is calculated so overcurrent protection functions are 50N(2) and 50/51N.
- Standard /1 or /5 models: neutral current is measured so overcurrent protection functions are 50N/G(2) and 50/51N/G.

3.4 Selection & Ordering codes

SIL-A											**Protection Functions** (2) 50 + 50/51 + (2) 50G(1) + 50/51G(1) + 52 + 50BF + 46 + 79 + 74TCS + CLP + 86 + 49T
	X 0 S										**Phase Measurement** LPCT (Primary In = 50 – 800 A). Standard: 1 A or 5 A. Sensitive 0.5 A or 2.5 A.
		X 0 S									**Neutral Measurement** LPCT (Neutral internally calculated). Standard: 1 A or 5 A. Sensitive 0.5 A or 2.5 A.
			0								**Net frequency** Defined by General Setting
				C							**Power Supply** 24-230 Vac/dc
					0 2 4						**Additional Functions** - + 49 + 74CT + 37 + 46BC + Trip Block + 49 + 46BC + SHB (Available only for Adaptation 'C')
						A B D 7 8					**Communications** RS232 (Modbus RTU) + RS485 (Modbus RTU or IEC 60870-5-103) RS232 (Modbus RTU) + RJ45 (IEC 61850) RS232 (Modbus RTU) + RJ45 (IEC 60870-5-104) RS232 (Modbus RTU) + RS485 (Modbus RTU or DNP3.0 serial) RS232 (Modbus RTU) + RJ45 (Modbus TCP/IP or DNP3.0 TCP/IP)
							1				**Inputs and Outputs** 6 Inputs + 4 Outputs.
								2			**Mechanics** Vertical Assembly
									A B C E		**Languages** English, Spanish and German English, Spanish and Turkish English, Spanish and French English, Turkish and Russian
										B C	**Adaptation** - Without 50-2, 50G-2 and 50BF (74TCS with dedicated inputs)

(1) LPCT model→50N and 50/51N: calculated neutral
Standard model→50N/G and 50/51N/G: measured neutral

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

3.5 Phase CT and neutral CT selection

Adaptation B: from 0.1 to 30 times the nominal current:

Model	Phase nominal current	Neutral nominal current	Phase range	Neutral range
SIL-A00	1 A or 5 A	Residual phase connection, 1A or 5A	0.1 -30 A or 0.5-150 A	0.1-30 A or 0.5-150 A
SIL-A0S	1 A or 5 A	Residual phase connection, 0.1A or 0.5A	0.1-30 A or 0.5-150 A	0.01-3A or 0.05-15A
SIL-AS0	0.5A or 2.5A	Residual phase connection, 1A or 5A	0.05-15 A or 0.25-75 A	0.1-30 A or 0.5-150 A
SIL-ASS	0.5A or 2.5A	Residual phase connection, 0.1A or 0.5A	0.05-15 A or 0.25-75 A	0.01-3A or 0.05-15A

Adaptation C: from 0.05 to 30 times the nominal current:

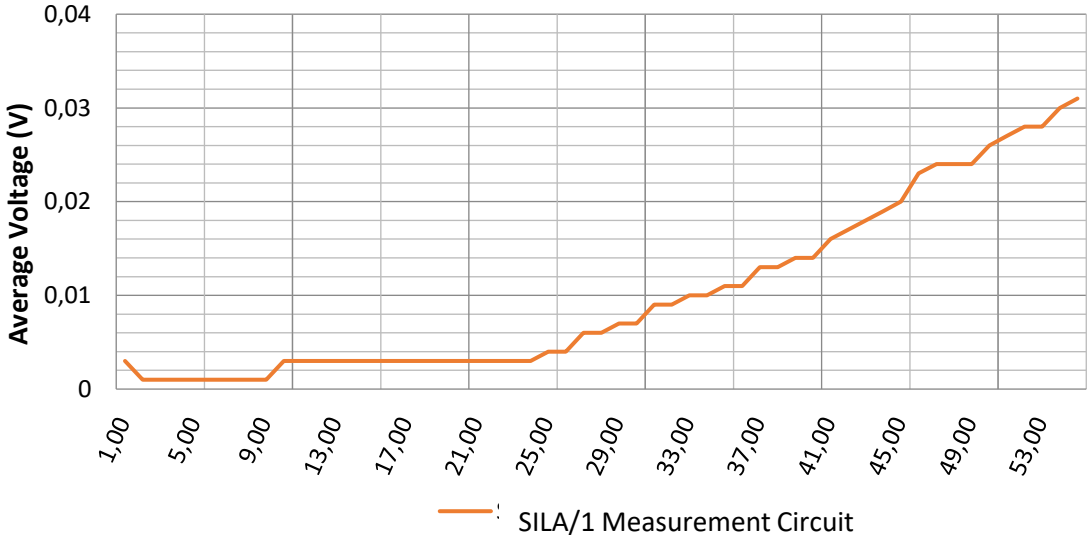
Model	Phase nominal current	Neutral nominal current	Phase range	Neutral range
SIL-A00	1 A or 5 A	Residual phase connection, 1A or 5A	0.05 -30 A or 0.25-150 A	0.05 -30 A or 0.25-150 A
SIL-A0S	1 A or 5 A	Residual phase connection, 0.1A or 0.5A	0.05 -30 A or 0.25-150 A	0.005-3A or 0.025-15A
SIL-AS0	0.5A or 2.5A	Residual phase connection, 1A or 5A	0.025-15 A or 0.125-75 A	0.05 -30 A or 0.25-150 A
SIL-ASS	0.5A or 2.5A	Residual phase connection, 0.1A or 0.5A	0.025-15 A or 0.125-75 A	0.005-3A or 0.025-15A

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 considered.

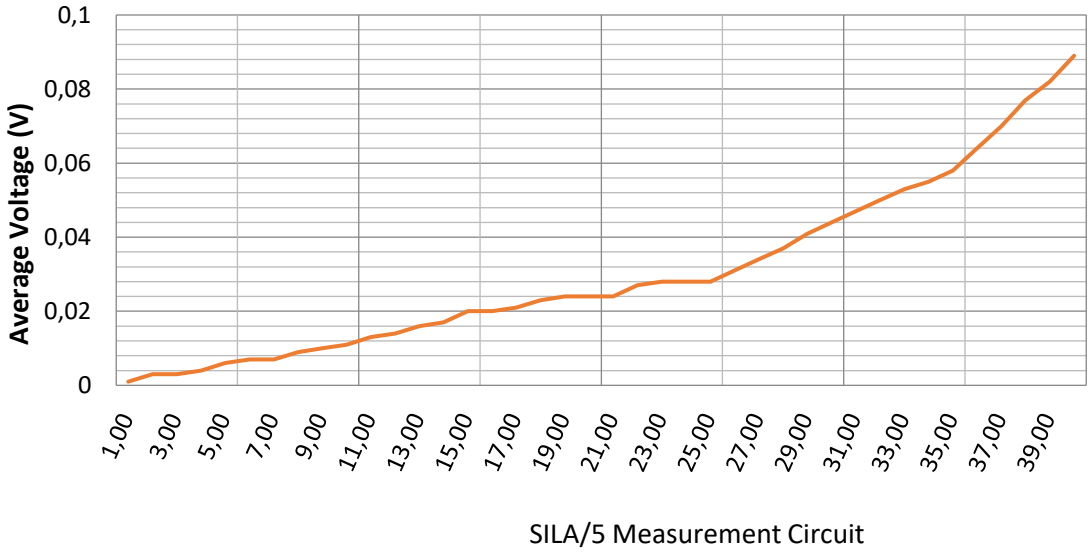
ACCURACY	BURDEN	RELAYS
5P10	0.5 VA	SIL-A/1
5P20	0.5 VA	SIL-A/1
5P30	0.5 VA	SIL-A/1
5P10	0.5 VA	SIL-A/5
5P20	0.5 VA	SIL-A/5
5P30	0.5 VA	SIL-A/5

The SILA-XX unit is fitted with standard inputs in accordance with standard IEC 60044-8. This standard established a rated voltage of 22.5mV for the rated current.

3.5.1 Load Curve for SIL-A (1A)



3.5.2 Load Curve for SIL-A (5A)



4 PROTECTION FUNCTIONS

4.1 Function 50. Instantaneous phase overcurrent

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

Group	Description	Minimum	Maximum	Step	Unit	Default
50-1 50-2 (*)	**Instantaneous phase overcurrent**					
	Function Enable	-	-	Yes/No/SHB(1)	-	No
	Current Tap	0.10	30.00	0.01	xIn	5.00
	Time Delay	0.00(1)	300.00	0.01	s	0.20

(*) Optional depending on model

(1) SHB option and T=0.00 s available only in SILAxxxx4xxxxx model. For other models the minimum is T=0.02 s.

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

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

The accuracy of the Time Delay is equal to:

The set time delay ±30ms or ±0.5% (whichever is greater) if 0.02 s <time delay<300 s.

The set time delay ±50ms or ±0.5% (whichever is greater) if 0.00 s <time delay<0.02 s

4.2 Function 50/51. Inverse time phase overcurrent

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

Group	Description	Minimum	Maximum	Step	Unit	Default
50/51	**Inverse time phase overcurrent**					
	Function Enable	-	-	Yes/No/SHB(1)	-	No
	Curve type	-	-	(2)	-	IEC Extrem. Inverse
	Time Dial (TMS)	0.02	2.20	0.01	-	1.25
	Current Tap	0.10	7.00	0.01	Inominal	1.00
	Time Delay	0.00(1)	300.00	0.01	s	0.02

(1) SHB option and T=0.00 s available only in SILAxxxx4xxxxx model. For other models the minimum is T=0.02 s.

(2) IEC Inverse, IEC Very Inverse, IEC Extremely Inverse, IEC Long Time Inverse, IEEE Inverse, IEEE Very Inverse, IEEE Extremely Inverse, Defined Time

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

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

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

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

The reset is instantaneous in both cases.

If the unit operates as defined time, the accuracy of the Time Delay is equal to:

The set time delay ±30ms or ±0.5% (whichever is greater) if 0.02 s <time delay<300 s.

The set time delay ±50ms or ±0.5% (whichever is greater) if 0.00 s <time delay<0.02 s

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

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

4.3 Function 50G. Instantaneous measured neutral overcurrent

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

Group	Description	Minimum	Maximum	Step	Unit	Default
50G-1 50G-2 (*)	**Instantaneous measured neutral overcurrent.**					
	Function Enable	-	-	Yes/No/SHB(1)	-	No
	Current Tap	0.05(2)	30.00	0.01	Inominal	1.00
	Time Delay	0.00(1)	300.00	0.01	s	0.20

NOTE: LPCT model→50N: calculated neutral; Standard model→50N/G: measured neutral

(*) Optional depending on model

(1) SHB option and T=0.00 s available only in SILAxxxx4xxxxx model. For other models SHB not available and the minimum is T=0.02 s.

(2) Current Tap=0.05 available only in SILAxxxx4xxxxx model. For other models the minimum is Current Tap=0.1.

The time delay is completely independent from the operating current that flows through the relay, 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 Time Delay is equal to:

The set time delay ±30ms or ±0.5% (whichever is greater) if 0.02 s <time delay<300 s.

The set time delay ±50ms or ±0.5% (whichever is greater) if 0.00 s <time delay<0.02 s

4.4 Function 50/51G. Inverse time measured neutral overcurrent

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

Group	Description	Minimum	Maximum	Step	Unit	Default
50/51G	**Inverse time measured neutral overcurrent**					
	Function Enable	-	-	Yes/No/SHB(1)	-	No
	Curve type	-	-	(2)	-	IEC Extrem. Inverse
	Time Dial (TMS)	0.02	2.20	0.01	-	1.25
	Current Tap	0.05(3)	7.00	0.01	Inominal	0.50
	Time Delay	0.00(1)	300.00	0.01	s	0.20

NOTE: LPCT model→50/51N: calculated neutral; Standard model→50/51N/G: measured neutral

(1) SHB option and T=0.00 s available only in SILAxxxx4xxxxx model. For other models the minimum is T=0.02 s.

(2) IEC Inverse, IEC Very Inverse, IEC Extremely Inverse, IEC Long Time Inverse, IEEE Inverse, IEEE Very Inverse, IEEE Extremely Inverse, Defined Time

(3) Current Tap=0.05 available only in SILAxxxx4xxxxx model. For other models the minimum is Current Tap=0.1.

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

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

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

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

The reset is instantaneous in both cases.

If the unit operates as defined time, the accuracy of the Time Delay is equal to:

The set time delay ±30ms or ±0.5% (whichever is greater) if 0.02 s <time delay<300 s.

The set time delay ±50ms or ±0.5% (whichever is greater) if 0.00 s <time delay<0.02 s

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

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

4.5 Function 46. Phase balance current protection

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

Group	Description	Minimum	Maximum	Step	Unit	Default
46	**Phase balance current protection**					
	Function Enable	-	-	Yes/No/SHB(1)	-	No
	Curve type	-	-	(2)	-	IEC Extrem. Inverse
	Time Dial (TMS)	0.02	2.20	0.01	-	1.25
	Current Tap	0.01	7.00	0.01	Inominal	1.00
	Time Delay	0.00(1)	300.00	0.01	s	0.20

(1) SHB option and T=0.00 s available only in SILAxxxx4xxxxx model. For other models the minimum is T=0.02 s.

(2) IEC Inverse, IEC Very Inverse, IEC Extremely Inverse, IEC Long Time Inverse, IEEE Inverse, IEEE Very Inverse, IEEE Extremely Inverse, Defined Time

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

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

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

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

The reset is instantaneous in both cases.

If the unit operates as defined time, the accuracy of the Time Delay is equal to:

The set time delay ±30ms or ±0.5% (whichever is greater) if 0.02 s <time delay<300 s.

The set time delay ±50ms or ±0.5% (whichever is greater) if 0.00 s <time delay<0.02 s

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

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

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4.6 Function 46BC. Broken conductor detection

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

Function	Description	Minimum	Maximum	Step	Unit	Default
46BC (*)	**Brocken conductor protection**					
	Function Enable	-	-	Yes/No	-	No
	Current Tap	15	100	1	%	50
	Time Delay	0.00 (1)	300.00	0.01	s	50

(*) Optional depending on model

(1) T=0.00 s available only in SILAxxxx4xxxxx model. For other models the minimum is T=0.02 s

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

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

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

The accuracy of the time delay is equal to:

The set time delay ±30ms or ±0.5% (whichever is greater) if 0.02 s <time delay<300 s.

The set time delay ±50ms or ±0.5% (whichever is greater) if 0.00 s <time delay<0.02 s

4.7 Function 49. Thermal image

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

Function	Description	Minimum	Maximum	Step	Unit	Default
49(*)	**Thermal image**					
	Function Enable	-	-	Yes/No	-	No
	Current Tap	0.10	2.40	0.01	I nominal	1.20
	ζ heating	3	600	1	min	3
	ζ cooling	1	6	1	ζ heating	1
	Alarm	20	99	1	%	80

(*) Optional depending on model

Thermal image is a measurement of heating and cooling of an electric machine. Contrary to an overcurrent protection time is not counted when a fault is detected. It continues calculating the thermal status of the monitored machine. Tripping time depends on adjusted thermal constants, operative current and previous thermal status of the machine.

Thermal image is calculated based on next equation:

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

where:

I, maximum three phase fundamental current

It, adjusted tap current

ζ, thermal constant

θ'0, initial thermal status

Tripping time is determined by next equation:

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

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

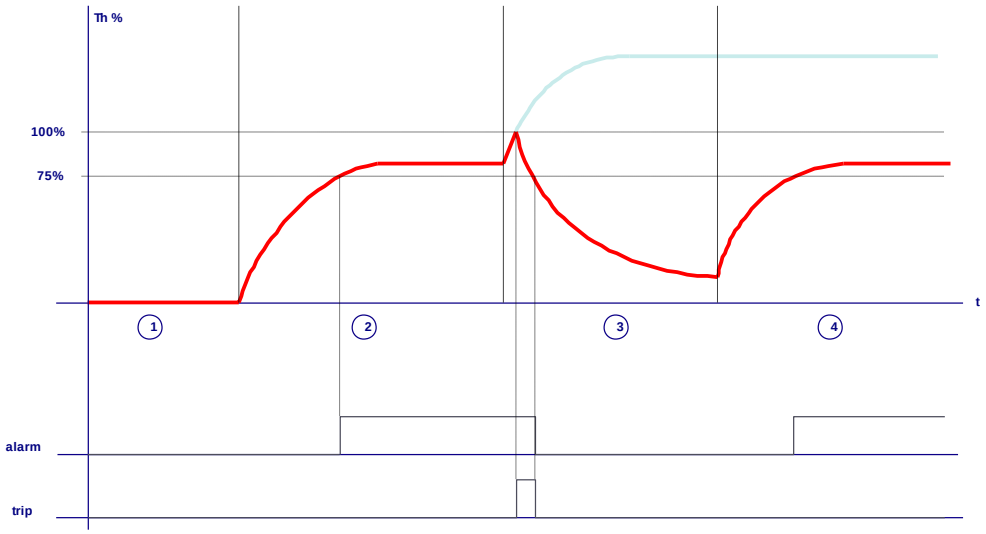
The algorithm uses the maximum current of the three phase currents. If the maximum current is higher than the adjusted tap, heating thermal constant is applied. If maximum current is lower than the adjusted tap, cooling thermal constant is applied.

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

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

4.7.1 Thermal image measurement evolution graphic

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



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

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

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

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

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

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

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

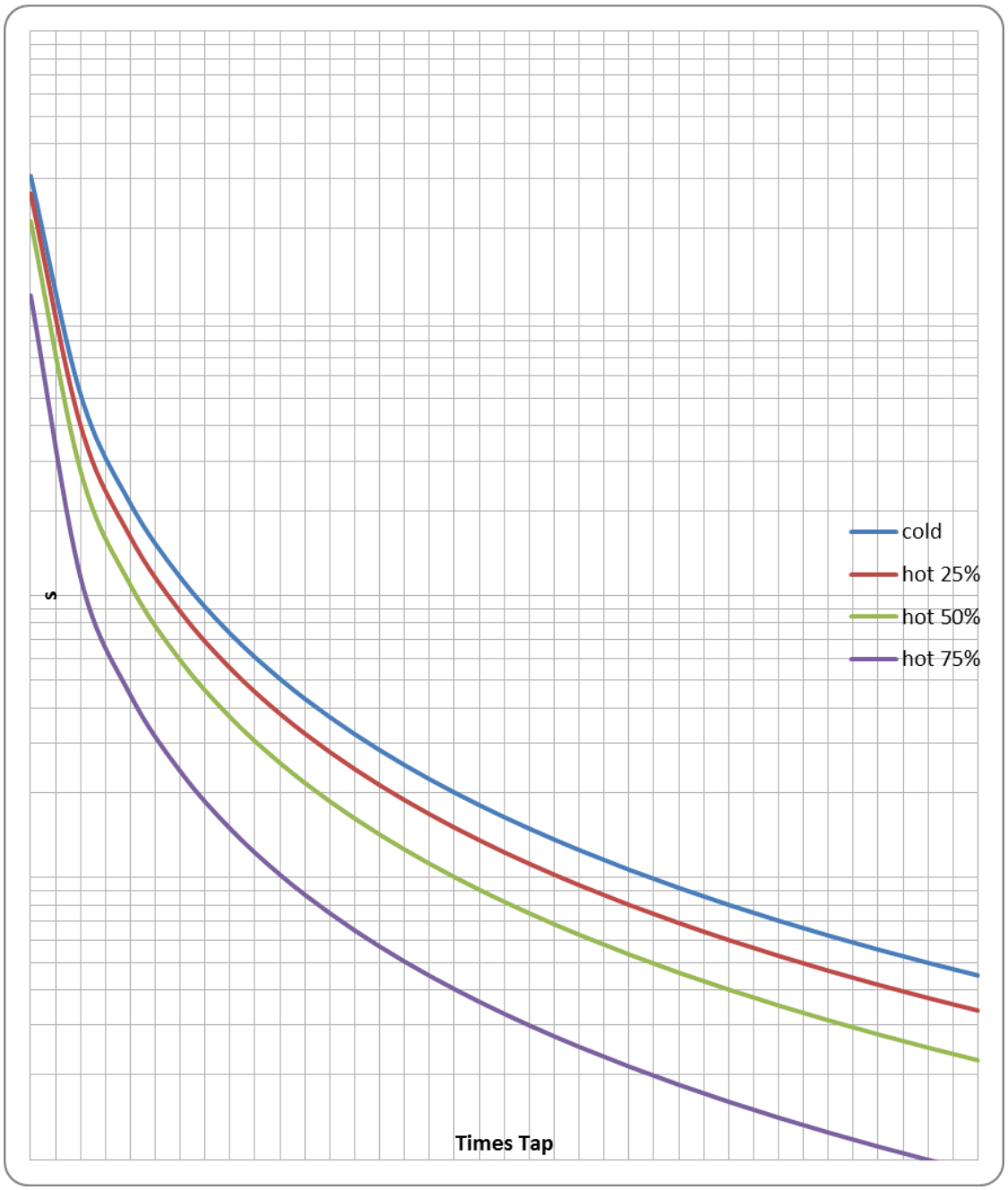
4.7.2 Thermal image with memory

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

4.7.3 Thermal image measurement display. Reset.

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

4.7.4 Thermal protection curves



This is the thermal curve for ζ = 3 minutes.

4.8 Function 49T. External trip

The relay has 6 configurable inputs and any of them can be configured as external trip input. This input is normally connected to a bimetallic contact fitted to the power transformer. This serves as a backup to the overcurrent functions.

4.9 Function 52. Circuit Breaker monitoring

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

Group	Description	Minimum	Maximum	Step	Unit	Default
52	**Circuit breaker monitoring**					
	Maximum number of openings	1	10000	1	-	500
	Maximum accumulated amperes	1	100000	1	M(A^2)	1000
	Maximum Opening time	0.02	30.00	0.01	s	0.10
	Maximum Closing time	0.02	30.00	0.01	s	0.10
	Excessive repeated openings	1	10000	1	-	3
	Time of excessive repeated openings	1.00	300.0	1	min	9.00

NOTE: The 'Maximum accumulated amperes' adjustment units are M(A^2) (square mega amperes) whilst the 'Accumulated amperes counter' units are K(A^2) (square kilo amperes).

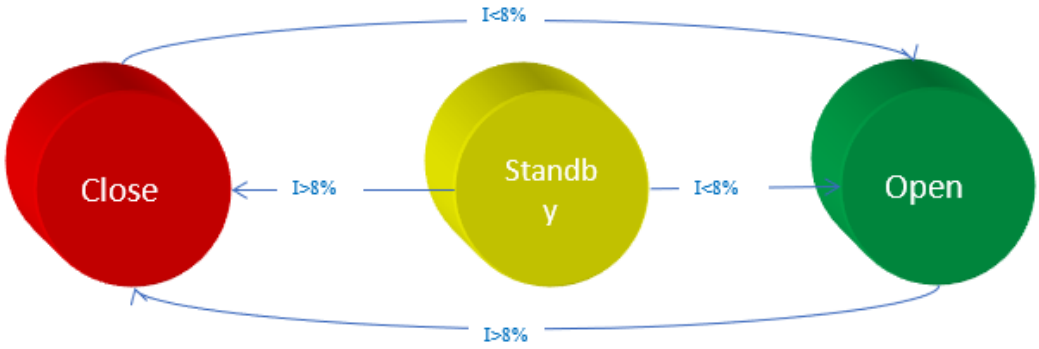
This function allows to monitor the status of the circuit breaker and to perform preventive maintenance.

The following statuses are associated with this function:

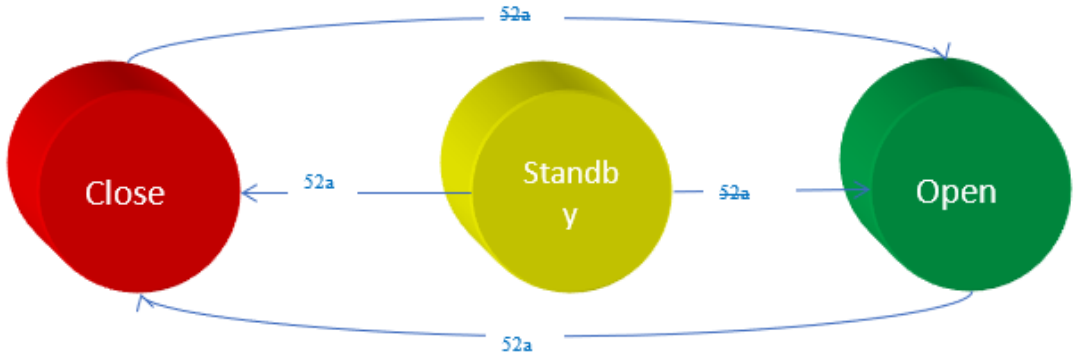
Function	Status	Description
52	Startup	These are the different statuses of the circuit breaker automatic control. The function only is initialized on Start when the relay is switched on. If the relay doesn't lose power supply, the last state is maintained.
	Error	
	Open	
	Opening time	
	Opening error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

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

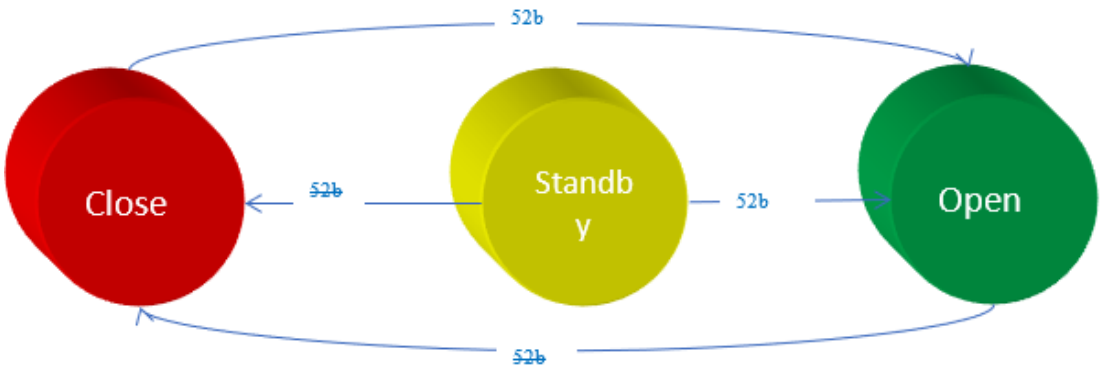
If **no breaker contacts** are used, the monitoring of the circuit breaker is made through the current measurement. This is, if less than 8% of rated current is detected it is considered the breaker is open and if more than 8% of rated current is available, it is considered the breaker is closed.



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

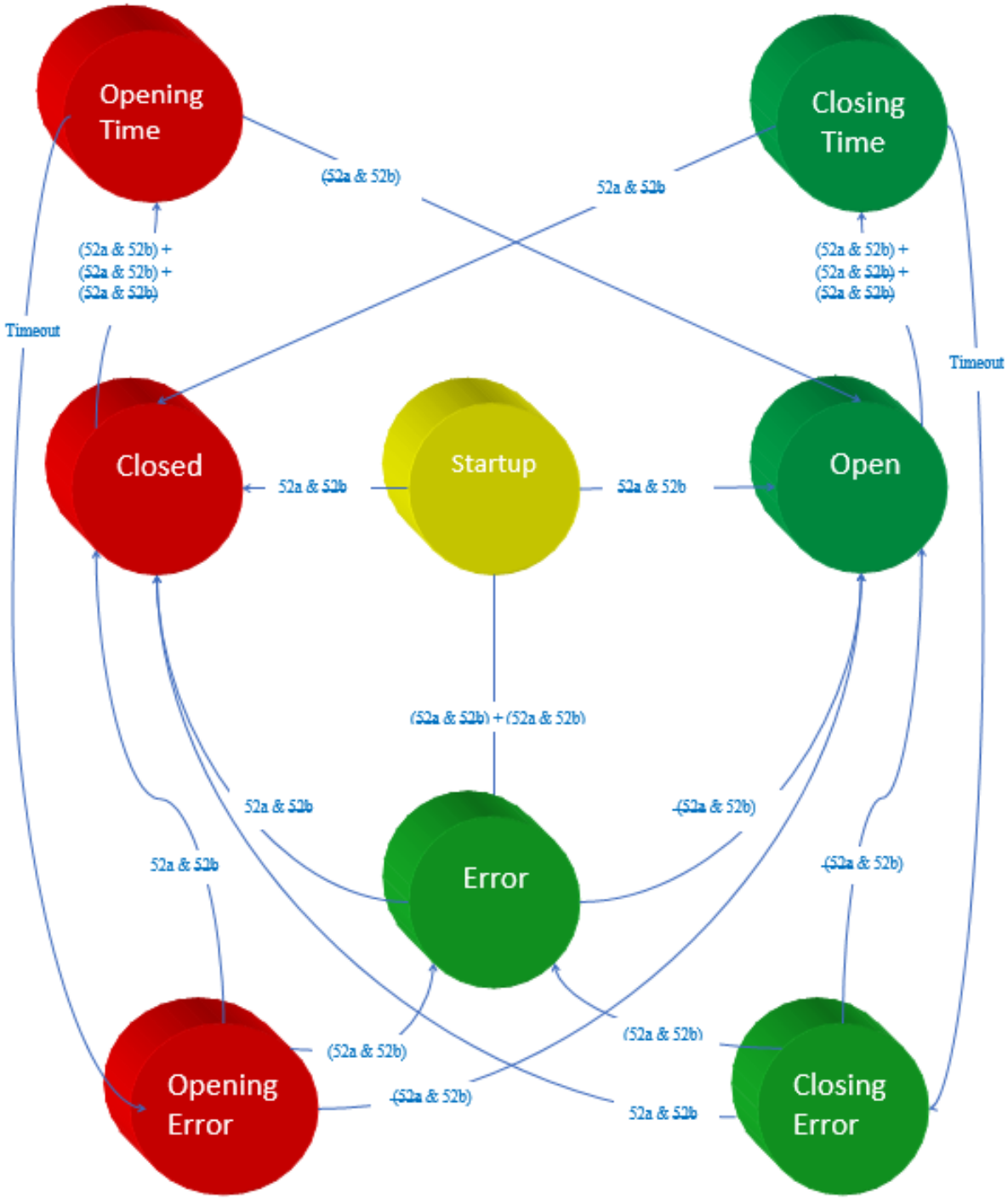


If only the circuit breaker **52b contact** is available, it should be wired to the corresponding physical input. This physical input is then assigned to the '52b Input' logical input. The 52a logical input is calculated internally as the negative of 52b. The circuit breaker performance is shown in the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



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

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



4.9.1 Circuit Breaker opening and closing commands

The circuit breaker opening and closing commands are implemented. These commands can be executed from the HMI commands menu or using the HMI's specific keypad or from local or remote communications. To execute the command with the specific keys, the relay shall be in standby screen.

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

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

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

4.9.2 Counter to register the number of openings

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

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

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

4.9.3 Accumulated amperes counter: I^2t

There is also an 'Accumulated amperes' counter. This counter accumulates broken amperes by circuit breaker with its openings. The unit is K(A^2) (square kilo amperes).

When a circuit breaker opening happens the maximum of primary amperes are detected in any phase. This reading is squared and divided by 1000 (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 with 'Openings Number' counter, as an estimation of aging of circuit breaker.

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

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

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

4.9.4 Maximum openings in a time window

As well as counting the number of times the circuit breaker opens, the SIL-A relay 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 ‘Openings excess/time alarm’ status is activated and its corresponding event is generated.

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

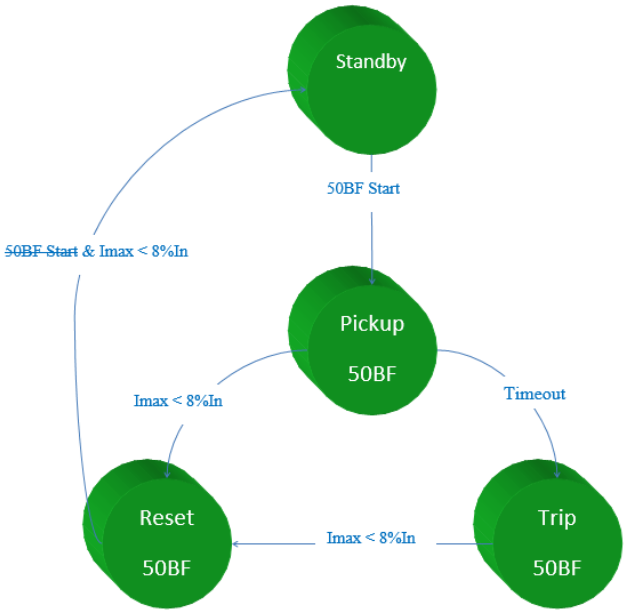
4.10 Function 50BF. Circuit Breaker opening failure

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

Group	Description	Minimum	Maximum	Step	Unit	Default
50BF(*)	**Circuit breaker opening failure**					
	Function Enable	-	-	Yes/No	-	No
	Time Delay	0.02	1.00	0.01	s	0.20

(*) Optional depending on model

The following automaton describes the open failure function:



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

If the phase current exceeds its predetermined value 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 pickup (8%In).

4.11 Function 74TCS. Trip circuit supervision

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

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

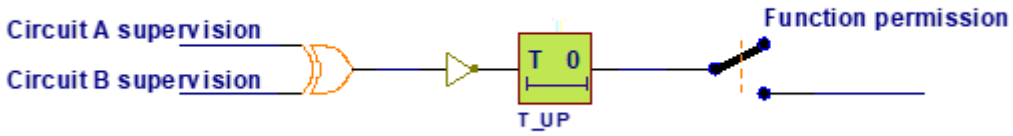
This function allows to monitor the circuit breaker trip circuits. This is performed verifying the continuity of the trip circuit, in both circuit breaker positions, both open and closed.

A weak injected current shall flow from the relay to the circuit breaker switch trip coil. Finally, to avoid spurious components this must be appropriately time delayed. The accuracy of the time will be the adjusted value plus 50 milliseconds or 5% (greater of both).

Depending on the model:

- **Adaptation B**: This functionality is achieved through configurable digital inputs.
- **Adaptation C**: This functionality is achieved through dedicated digital inputs (Input 5 and Input 6).

It is verified the continuity of the coils with the following scheme:



4.12 Function 79. AC Reclosing device

The reclosing function tries to reconnect the circuit breaker after a fault. It has up to five reclosing attempts capacity that can be selected in the **Number of reclosings** setting. After them, if the circuit breaker has not reclosed correctly, it goes to 'Lockout' state. The reclose can be disable if it is not required, by setting the **Function Enable** to No.

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

Each reclosing cycle has its own specific operation time (**Reclose # Time**) that can be set independently. Up to 4 logical signals can be configured to the reclosing start (logic signal - **79 Start**)

Once the cycle is initiated, another permission (logic signal - **79Enable**) can be used to indicate that the recloser must wait another period of time (**Hold time**) before closure. During this waiting time, usually an external condition wired to an external input, such as closure synchronism, give the authorization to reconnect. To consider this logic signal, the **Hold Enable** setting shall be set to Yes. In case **Hold Enable** is set to 'No time' the relay will consider **79 Enable** logical signal but without considering the '**Hold Time**', this is, the algorithm will stay in 'Hold Time' position until the external condition is complied without considering any settable time.

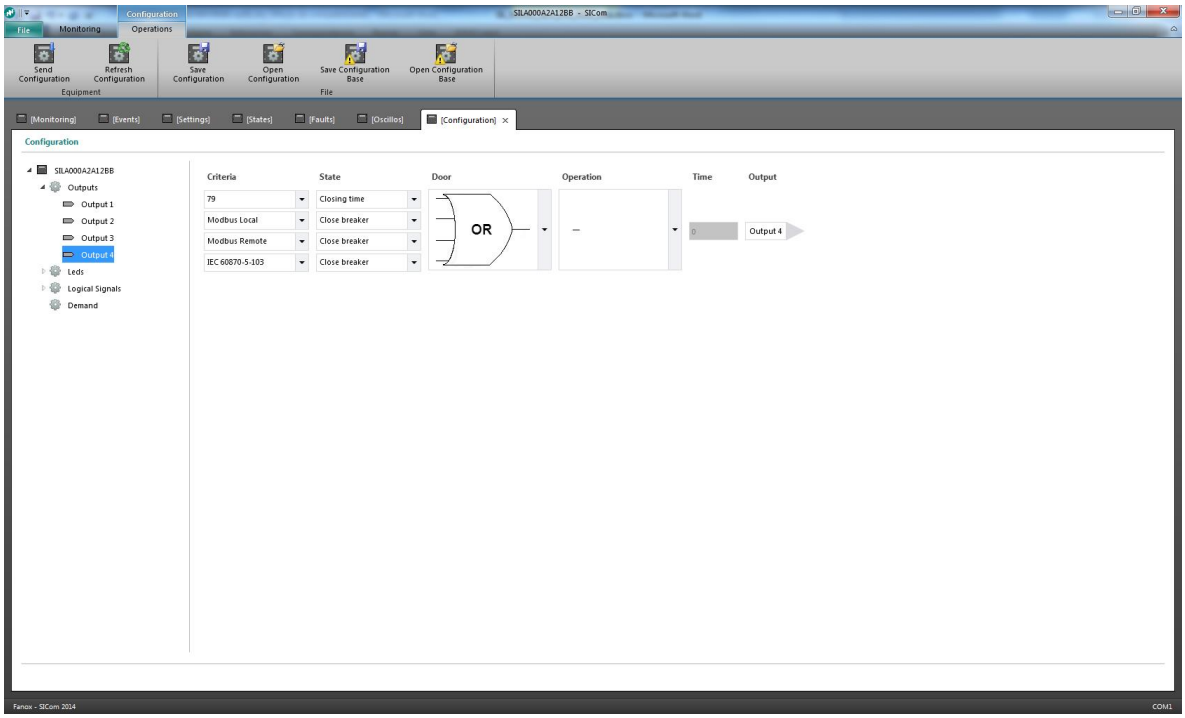
Each reclosing cycle has its own specific operation time that can be set (reclose time). Apart from these times, a further t times must be set:

- ✓ **Reset time**. This is the waiting time for the recloser for a final closure. If during this time, there is another trip, the recloser counter will increase.
- ✓ **Safe time:** Is the safety time used by the recloser when it leaves the Lockout state. If, during this time, there is not a trip, it shall go to Standby.
- ✓ **Manual opening time:** 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 setting value is the same as Safe Time.

Group	Description	Minimum	Maximum	Step	Unit	Default
79	**AC Reclosing device**					
	Function Enable	-	-	Yes/No	-	No
	Hold Enable	-	-	Yes/No/No Time	-	No
	Number of reclosings	0	4	1	-	0
	Reclose 1 time	0.02	2000	0.01	s	0.8
	Reclose 2 time	0.02	2000	0.01	s	1.6
	Reclose 4 time	0.02	2000	0.01	s	3
	Reclose 4 time	0.02	2000	0.01	s	9
	Reclose 5 time	0.02	2000	0.01	s	5.0
	Hold time	0.02	2000	0.01	s	0.2
	Reset Time	0.02	2000	0.01	s	5
	Safe Time	0.02	2000	0.01	s	30

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

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



It must be possible to block the recloser, particularly if maintenance tasks are carried out on the substation. There are several SIL-A blocking and unblocking possibilities:

- ✓ **From the HMI.** There is a specific key marked 79, plus a specific signal led, allowing recloser operation, blocking or unblocking it.

- ✓ **From the HMI.** This command can be executed from the control menu.

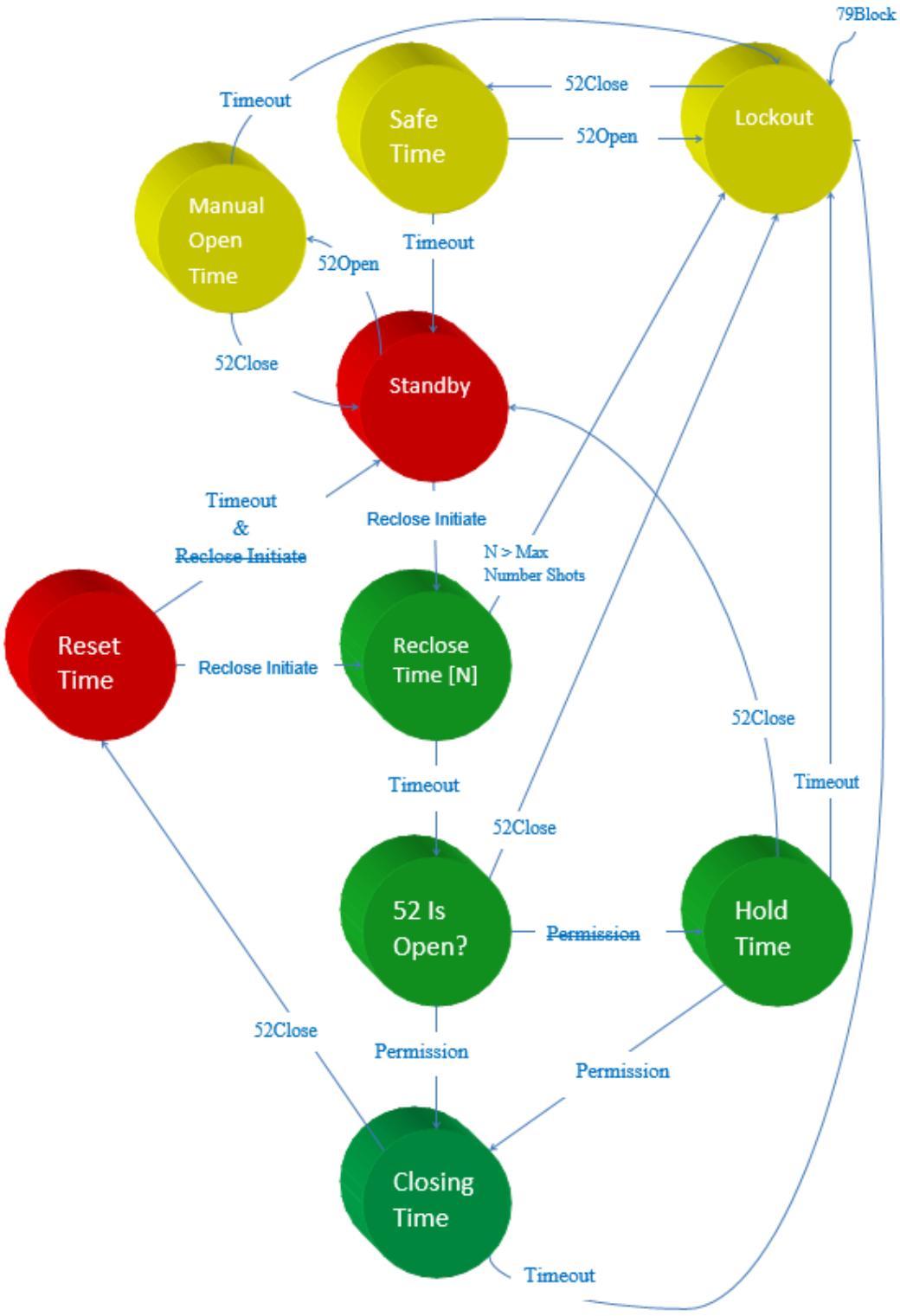
- ✓ **From two inputs.** If the substation is equipped with a conventional remote control, two pulse outputs are usually assigned to logical signals (**79 Block** and **79 Unblock**), where one blocks the recloser and the other unblocks it.

- ✓ **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 Block/Unblock command is received via remote control this shall be ignored.

- ✓ **From a level input.** In this case the recloser monitors the status of the logical signal (**79 Level Block**). This may be of use if the company has a handle with a key.

In the first four cases, the device stores the lock situation in the non-volatile memory, as the last control must be known 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.



On Standby. The recloser can leave this mode via three conditions.

- ✓ **Recloser block**, via a command.
- ✓ **Manual or remote control opening of the circuit breaker**. In this situation it shall await the manual 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.

On Lockout. The recloser can leave this mode via two 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.
- ✓ **Unblocking of the recloser.** Via a command (if it has achieved this state with a Blocking command) and with the closing of the circuit breaker.

4.12.1 Counter to record the number of reclosings

The SIL-A relay is fitted with a counter that records the number of reclosings.

4.13 Function CLP. Cold Load Pickup

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

Function	Description	Minimum	Maximum	Step	Unit	Default
CLP	**Cold Load Pickup**					
	Function Enable	-	-	Yes/No	-	No
	Settings group	1	4	1	-	4
	No Load time	0.02	300.00	0.01	s	15.00
	Cold Load Time	0.02	300.00	0.01	s	15.00

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

These two parameters have the following meaning:

- **No Load Time**: If the circuit has been open for less time than the setting, the Cold Load Pickup function is not in working conditions.
- **Cold Load Time**: If the Cold load Pickup function is in working conditions, after the circuit has been closed, during this time the new setting group is applied. After this time, the relay returns to the adjusted setting group.

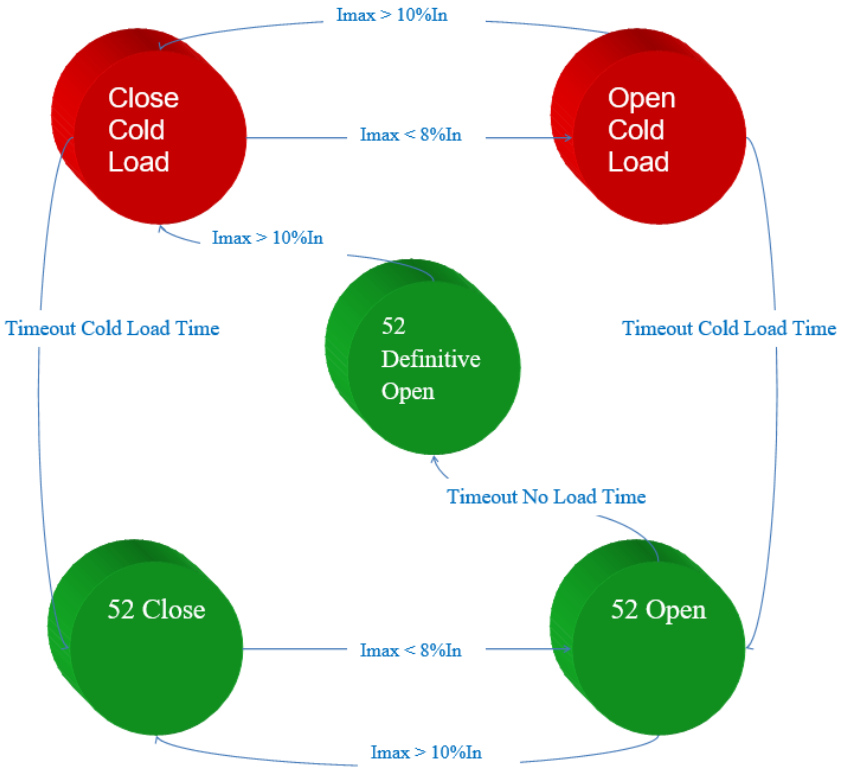
The function operates according to the following automaton. The automaton consists of five states, in three of those states the relay works with normal setting group (the group adjusted in general settings), and in the other two, with the new settings group.

The relay uses the current level to determine the circuit breaker state (open or closed). If the current is less than 8 % 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 Cold Load is in working condition.

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

Once the circuit breaker is closed, CLP function picks-up and 'Cold load time' starts to count. During this time the relay will work with the new setting group regardless of the circuit breaker situation, this is, without taking into account whether the circuit breaker is maintained closed or is open.

When the setting group changed occurs, not all the protection functions change, only 50, 50/51, 50N/G, 50/51N/G and 46 functions are modified to new settings.



4.14 Function 74CT. Phase CT Supervision

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

Function	Description	Minimum	Maximum	Step	Unit	Default
74CT (*)	**Phase CT Supervision**					
	Function Enable	-	-	Yes/No	-	No
	Time Delay	0.02	300.00	0.01	s	2.00

(*) Optional depending on model

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

If a current lower than 8% of the nominal current is detected in one phase during more than 40ms, the adjusted time starts to count, and the trip occurs after the set time delay.

The reset is instantaneous when a current higher than 8% of nominal current is detected.

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

4.15 Function 37. Instantaneous phase undercurrent

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

Function	Description	Minimum	Maximum	Step	Unit	Default
37(*)	**Instantaneous phase undercurrent**					
	Function Enable	-	-	Yes/No	-	No
	Current Tap	0.10	30.00	0.01	Inominal	1.00
	Time delay	0.02	300.00	0.01	s	0.20
	Dead Tap	0.10	30	0.01	Inominal	0.50

(*) Optional depending on model

The time delay is completely independent of the operating current through the relay, 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 dead tap indicates the minimum level of current it is necessary to measure to work with the function. This is, if the measured current is lower than the 'Dead tap' setting the pickup will reset automatically and will not trip.

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

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

4.16 Function TB. Trip Block for switch disconnector

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

Group	Description	Minimum	Maximum	Step	Unit	Default
TB (*)	**Trip block protection for the switchgear**					
	Function Enable	-	-	Yes/No	-	No
	Current Tap	1.50	30.00	0.01	I nominal	7.00

(*) Optional depending on model

Some transformation centers use a combination of switchgear and fuses for cutting out.

Switchgears have a limited opening current, so the fuses are responsible for cutting out the circuit for high current short circuits, as the switchgear would be destroyed if opened in this situation. In order to deal with these situations, tripping is blocked when the phase current exceeds a pre-set value.

When trip block function is permitted, the accuracy for the tripping times will be the accuracy described for each function plus up to 50 milliseconds for short det time delays.

Once the trip block is activated, and the function is reset, the block will be maintained 230 milliseconds to avoid any undesired trip.

4.17 Function SHB. Second Harmonic Blocking

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

Group	Description	Minimum	Maximum	Step	Unit	Default
SHB(*)	**Second harmonic blocking**					
	Function Enable	-	-	Yes/No	-	No
	Current tap	5	50	1	%	5
	Reset time	0.00	300.00	0.01	s	0.00
	Block Threshold	0.10	30.0	0.01	xIn	10.00

(*) Optional depending on model

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

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

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

There is also a 2nd harmonic blocking threshold. This setting allows to block this function if the fundamental current exceeds the value specified in the setting. The SHB will only be applied in functions that have this feature. When the Function Enable of these protection functions is set to 'SHB', the second harmonic blocking will supervise the protection function. As a result, tolerances for tripping times could be higher than indicated on the functions.

4.18 Function 68. Zone selection interlocking (ZSI)

The relay is provided with configurable outputs, inputs and logic signals which can be used to implement zone selection interlocking feature.

Configuration:

FEEDER RELAY

Output 1: startup of function 50 or 50/51

Output 2: startup of function 50N/G or 50/51N/G

SUPPLY RELAY

Input 1: block the trip of functions 50 and 50/51

Input 2: block the trip of functions 50N/G and 50/51N/G

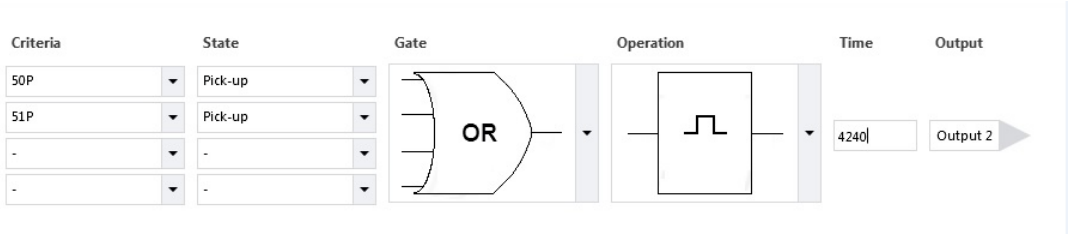
Relays with feeder functionality must activate the output 1 when detect the startup of function 50 or 50/51 and must activate the output 2 when detect the startup of function 50N/G or 50/51N/G.

Relays with supply functionality, block the trip of functions 50 and 50/51 when detect the activation of input 1 and block the trip of functions 50N/G and 50/51N/G when detect the activation of input 2.

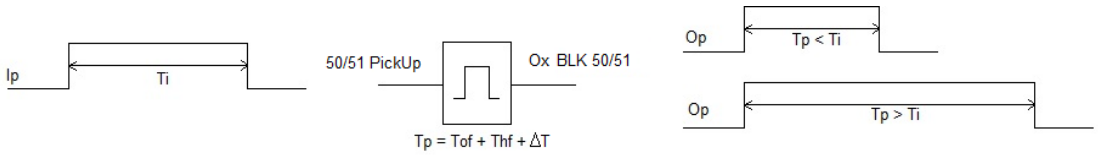
The physical connection which is needed to perform is next: output 1 of feeders must be connected to the input 1 of the supply device and outputs 2 of feeder devices must be connected to the input 2 of the supply device.

Once the physical connections are made, logical signals must be configured to physical inputs and outputs:

The pickup signals of the feeder relay should be connected to the outputs through an OR gate and a PULSE operation. The adjusted time must be the time of feeder's functions (time delay setting), plus the trip holding time (in SIL-A this time is around 200 ms), plus the security time (to ensure the signal has dropped off).

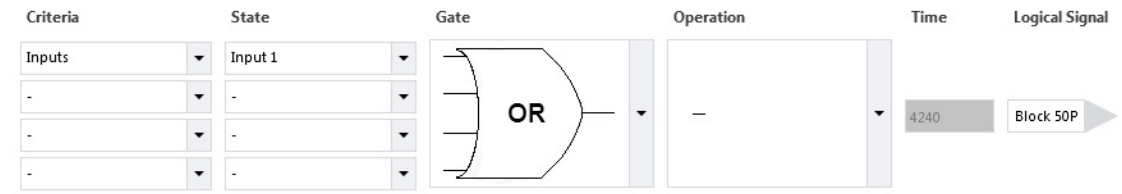


The PULSE operation provides a pulse signal that will block the supply functions enough time to allow the feeder relay to trip, to open its breaker and to make the fault disappear. The pulse operation guarantees that the output of the pulse will be activated the adjusted time, once the input of the pulse is active, independently of the time the input remains active.



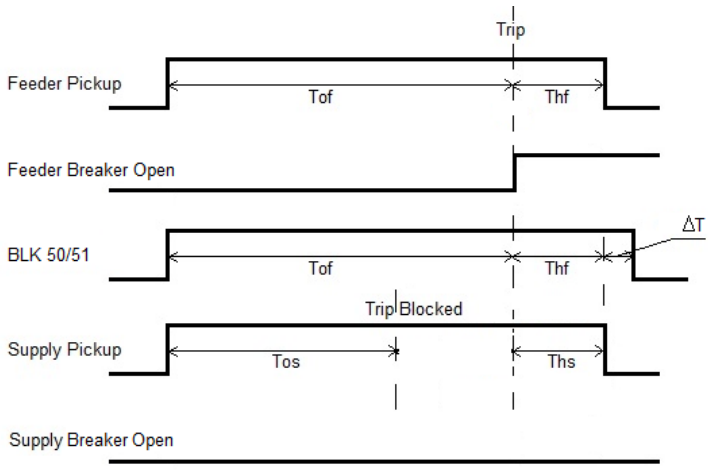
Tp = Time of the pulse (ms)
Tof = Time of operation of the feeder (ms)
Thf = Time of trip holding of the feeder (200ms)
ΔT = Security time (aproximately 40ms)
Tos = Time of operation of the supply (ms)
Ths = Time of trip holding of the supply (200ms)

The inputs of the supply relay should be connected to the blocking signals directly through an OR.

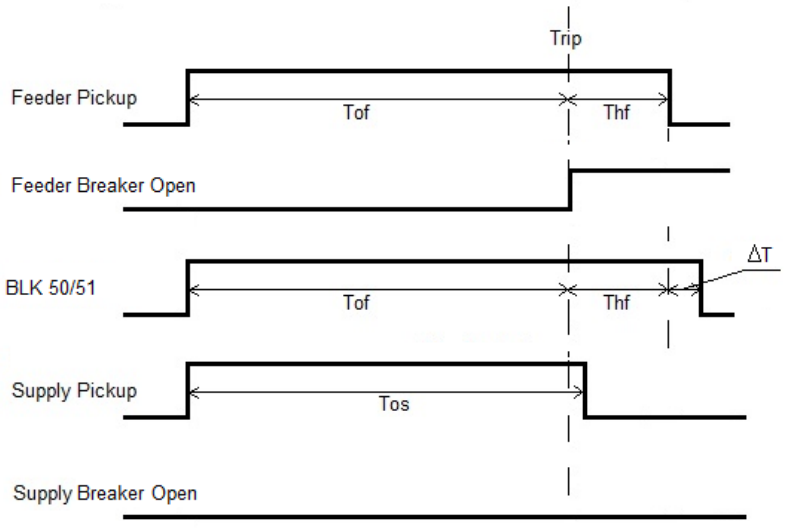


Next, different cases will be described.

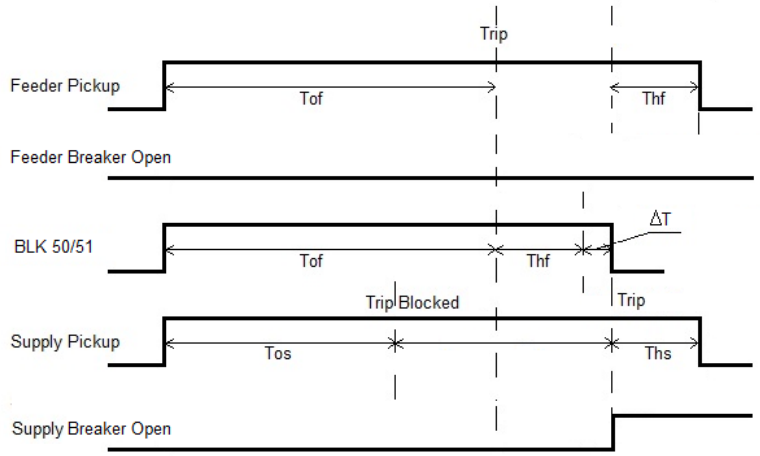
- The feeder and supply will trip their functions as they see the fault. Supply's time of operation is shorter than feeder's time, so the feeder will open its breaker, making the fault disappear, and it will block the supply trip output preventing the opening of the supply's breaker.



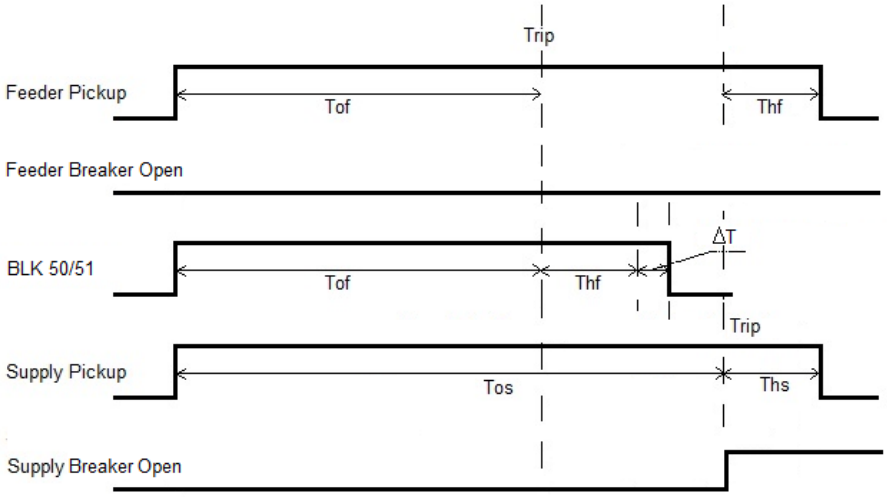
- The feeder and supply will trip their functions as they see the fault. Supply's time of operation is larger than feeder's time, so the feeder will open its breaker, making the fault disappear, and block the supply function. The supply will not trip because the feeder makes the fault disappear before its time of operation is finished.



- The feeder and supply will trip their functions as they see the fault. Supply's time of operation is shorter than feeder's time, so the supply function will trip but it will be blocked by the feeder. When the feeder trips, it is not able to open its breaker so the supply will trip once the block disappears since it can still see the fault.



- The feeder and supply will trip their functions as they see the fault. Supply's time of operation is larger than feeder's time, so the feeder will trip but it will not be able to open its breaker. The feeder will block the supply the adjusted time, but in this case, the time of operation of the supply is larger that this blocking time, so the supply will trip once its time of operation finishes since it can still see the fault.



5 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 setting group.

Group	Description	Minimum	Maximum	Step	Unit	Default
	General					
	Identification	-	-	-	-	'free text'
	Frequency	-	-	60/50	Hz	50
	Serial Number	-	-	-	-	0
	Language	0	3	1	-	English
	Active Settings Group	1	4	1	-	1
	Phase Nominal Current	-	-	Standard model: 1, 5, 0.5 or 2.5 LPCT model: 50-800 A	A	Standard:1 LPCT: 100
	Neutral Nominal Current (*)	0.1	5	Standard model: 0.1, 0.5, 1 or 5	A	1
	CT phase ratio (*)	1.0	3000.0	0.1	-	1
	CT neutral ratio (*)	1.0	3000.0	0.1	-	1
	Local COM Address	1	247	1	-	1
	Remote address (*)	1	247	1	-	2
	Remote baudrate (*)	4800	115200	4800, 9600, 19200, 38400 or 115200	-	19200
	Remote Protocol (*)	-	-	(**)	-	DNP3.0
	DNP3.0 Master Address (*)	1	247	1	-	1
	DNP3.0 Serial Settings (*)	1	8	8-N-1, 8-N-2, 8-E-1, 8-E-2, 8-O-1, 8-O-2, 9-N-1, 9-N-2	-	8-N-1
	DNP3.0 IA Deadband (*)	5	100	1	%	20
	DNP3.0 IB Deadband (*)	5	100	1	%	20
	DNP3.0 IC Deadband (*)	5	100	1	%	20
	DNP3.0 IN Deadband (*)	5	100	1	%	10

Serial Number is only a reading setting

(*) Available depending on model.
(**) Remote protocols depend on model (protocol options: IEC60870-5-103 or Modbus RTU; IEC61850; IEC60870-5-104; DNP3.0 or Modbus RTU; ModbusTCP/IP or DNP3.0 TCP/IP)

Next points must be considered referring general settings:

The settings can be changed either from the HMI or through communications.

Any change of set values will restart all functions, irrespective they are activated or not.

The Deadband is a DNP3.0 setting. Once the deadband is set (in % of In), in case that the current exceeds the setting above or below, the relay will show the value of the current measurement.

Deadband of three-phase currents (I-A, I-B and I-C) and neutral current (I-N) are provided.

6 SETTINGS GROUP

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

- Changing the active Setting group settings. In the general settings there is a setting which establishes which Setting group is active (Setting group 1, Setting group 2, Setting group 3 or Setting group 4).

- By means of two inputs. To this end four possibilities are defined.

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

Setting group 4 is not possible to be selected through inputs, only through general settings.

NOTE: Settings groups general setting should be different to the set in CLP function. If they are equal, the relay will work with Setting group 1.

In the zero position the active item is defined by the active Setting group 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 Setting group 1 or Setting group 2.

7 AVALIABLE CURVES

7.1 IEC 60255-151 Curves

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

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

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

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

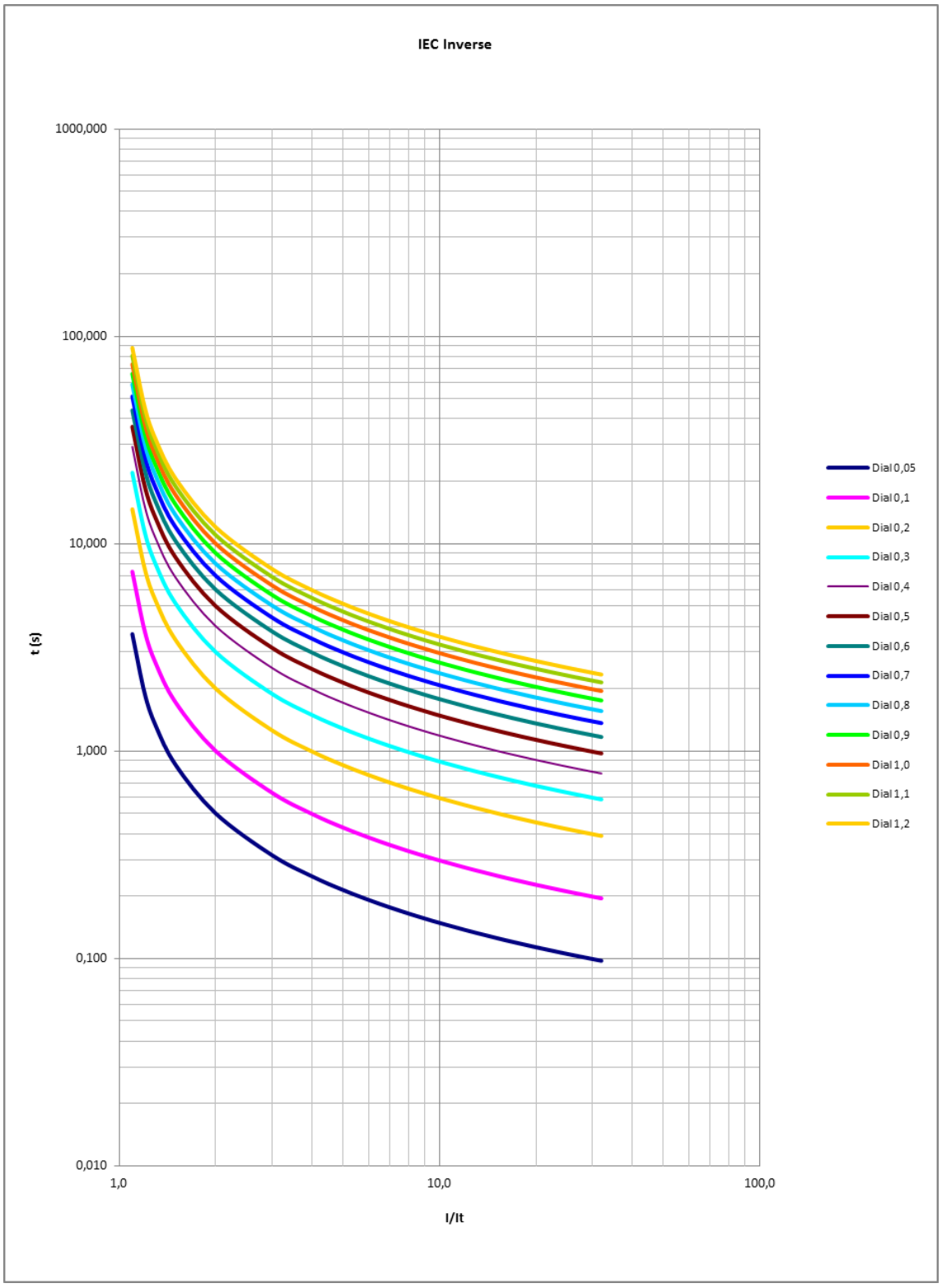
Where:

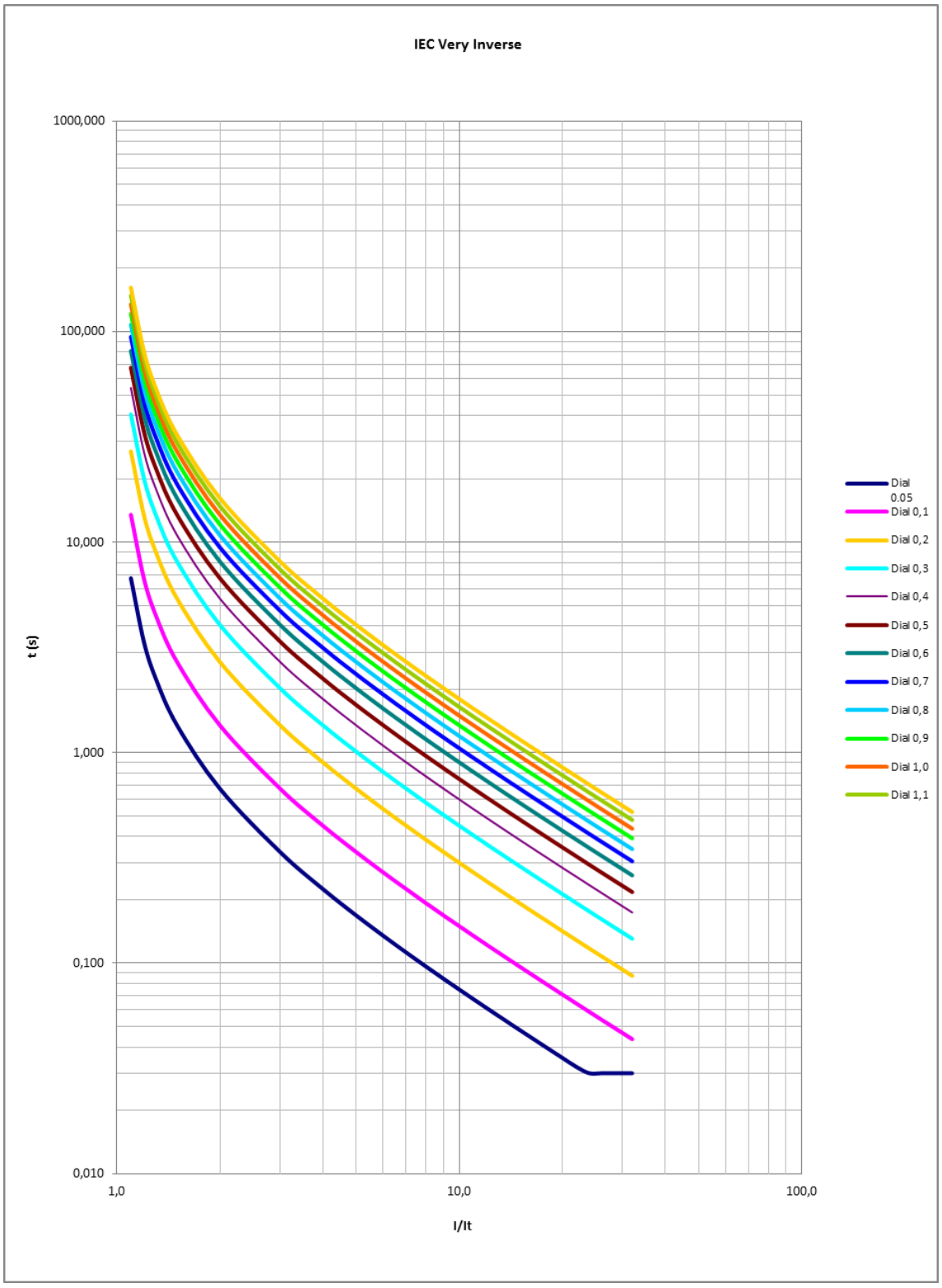
$$V = \frac{I}{I_{adjusted}}$$

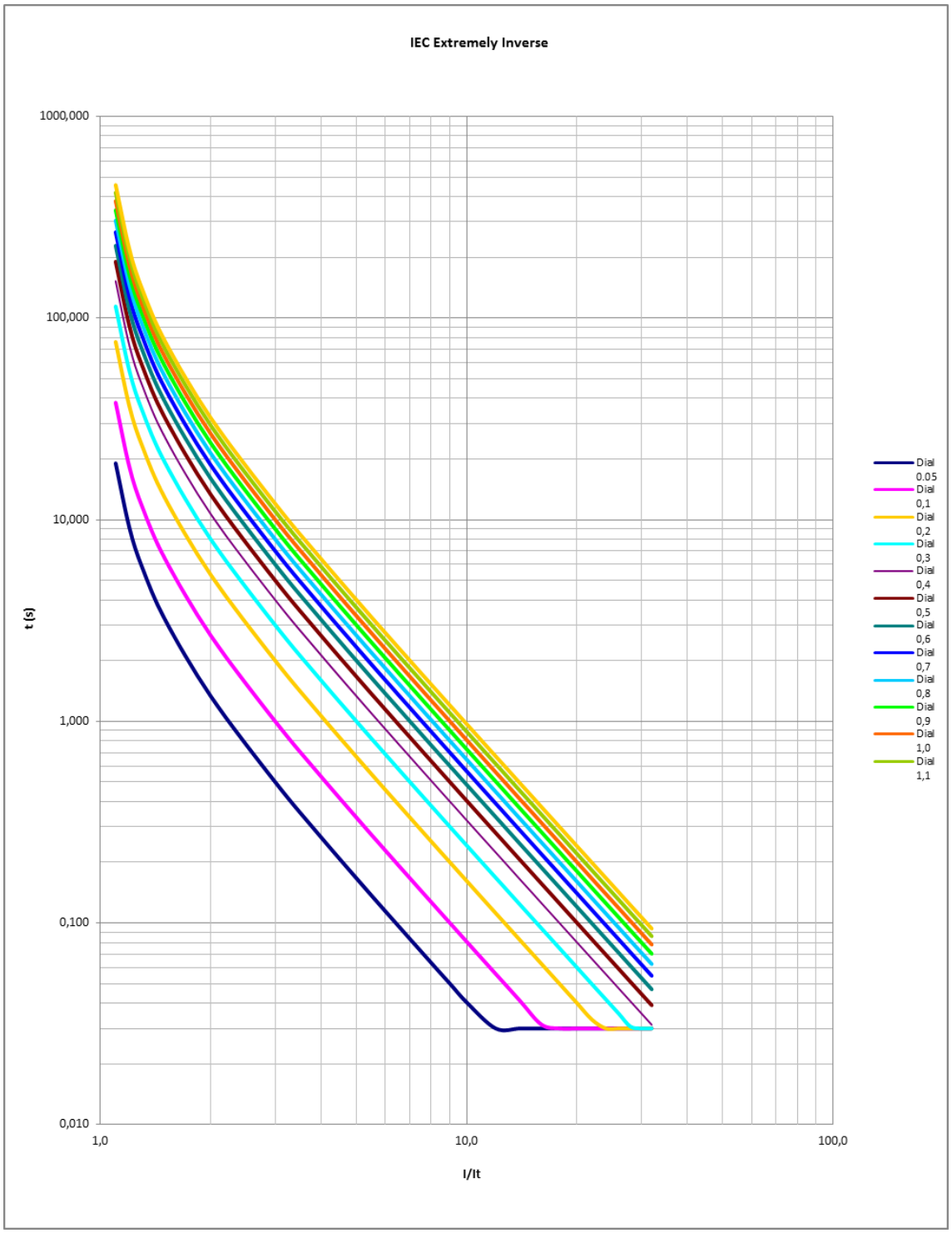
Parameters	A	P	Q	B	K
Long Time Inverse	120	1	1	0	0
Ext. Inverse	80	2	1	0	0
Very Inverse	13,5	1	1	0	0
Inverse	0,14	0,02	1	0	0

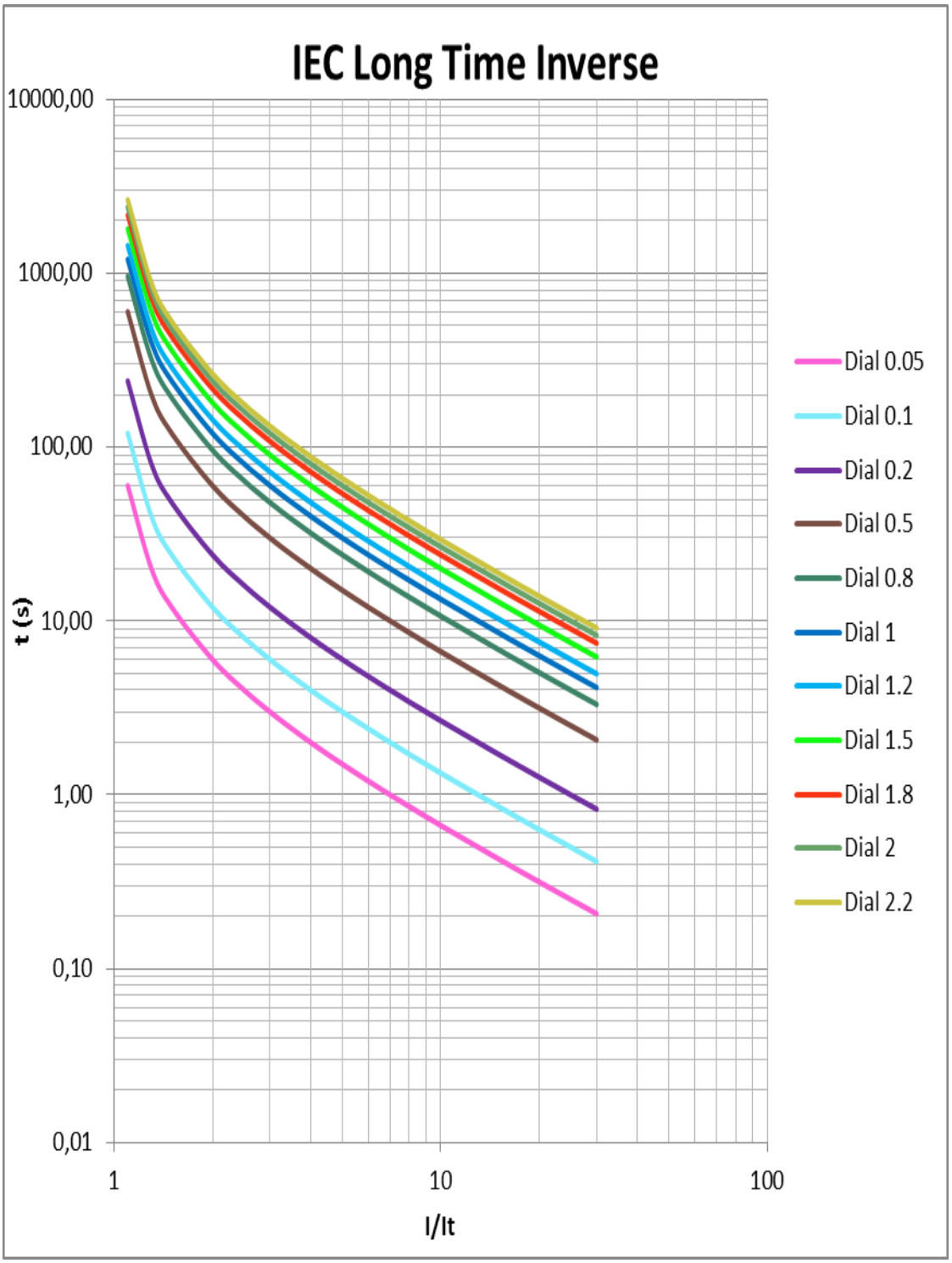
The curve can mode from its axis using the D time selection device, which the user can adjust.

$I_{adjusted}$ 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
Dial 1,0
Dial 1,1


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


IEC Long Time Inverse
10000,00
1000,00
100,00
10,00
1,00
0,10
0,01
t (s)
1
10
100
I/It
Dial 0.05
Dial 0.1
Dial 0.2
Dial 0.5
Dial 0.8
Dial 1
Dial 1.2
Dial 1.5
Dial 1.8
Dial 2
Dial 2.2

7.2 IEEE Curves

The SILA relay complies with the curves shown in standard IEEE:

- Inverse Curve
- Very Inverse Curve
- Extremely Inverse Curve

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

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

Where:

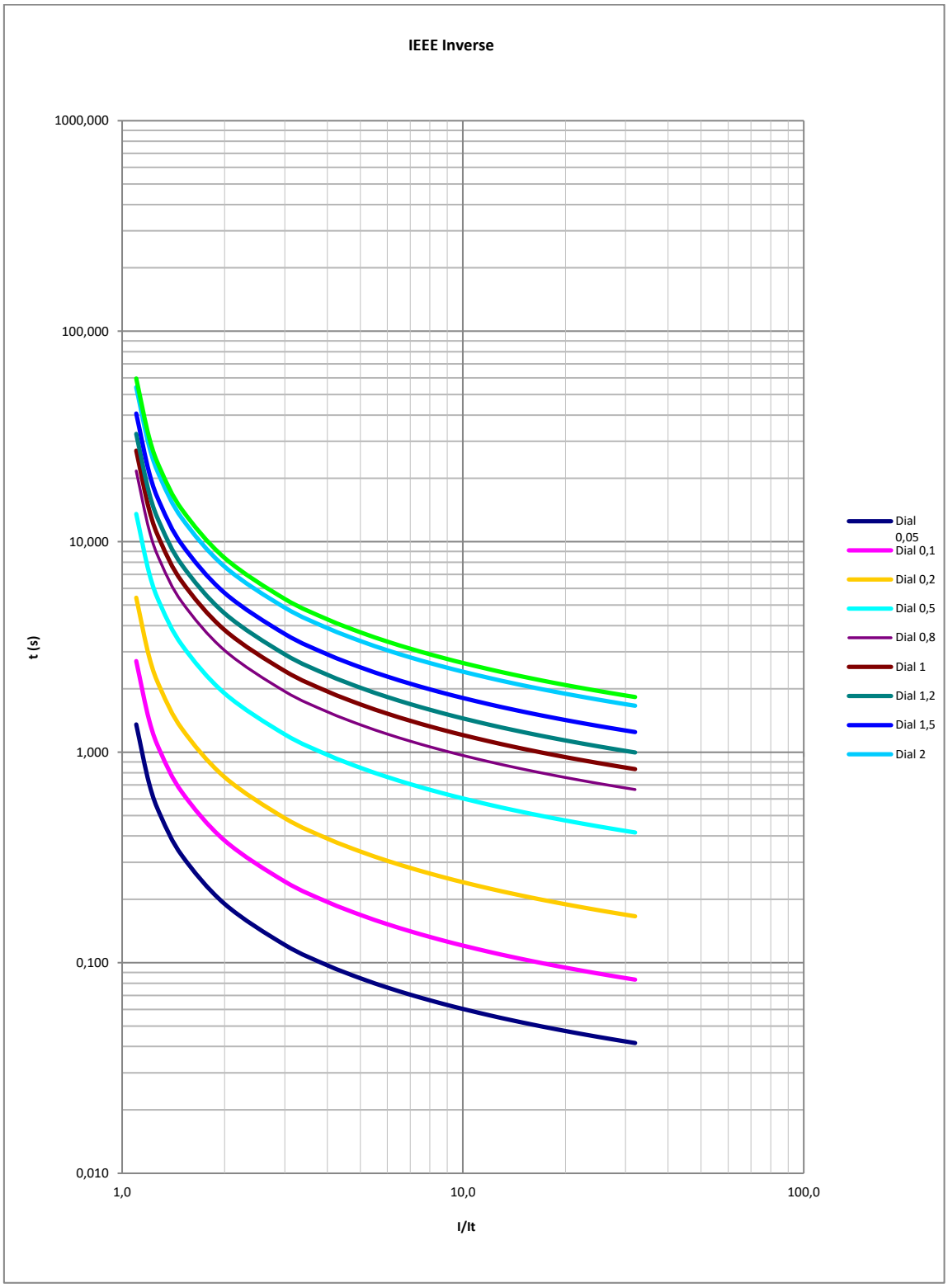
$$V = \frac{I}{I_{adjusted}}$$

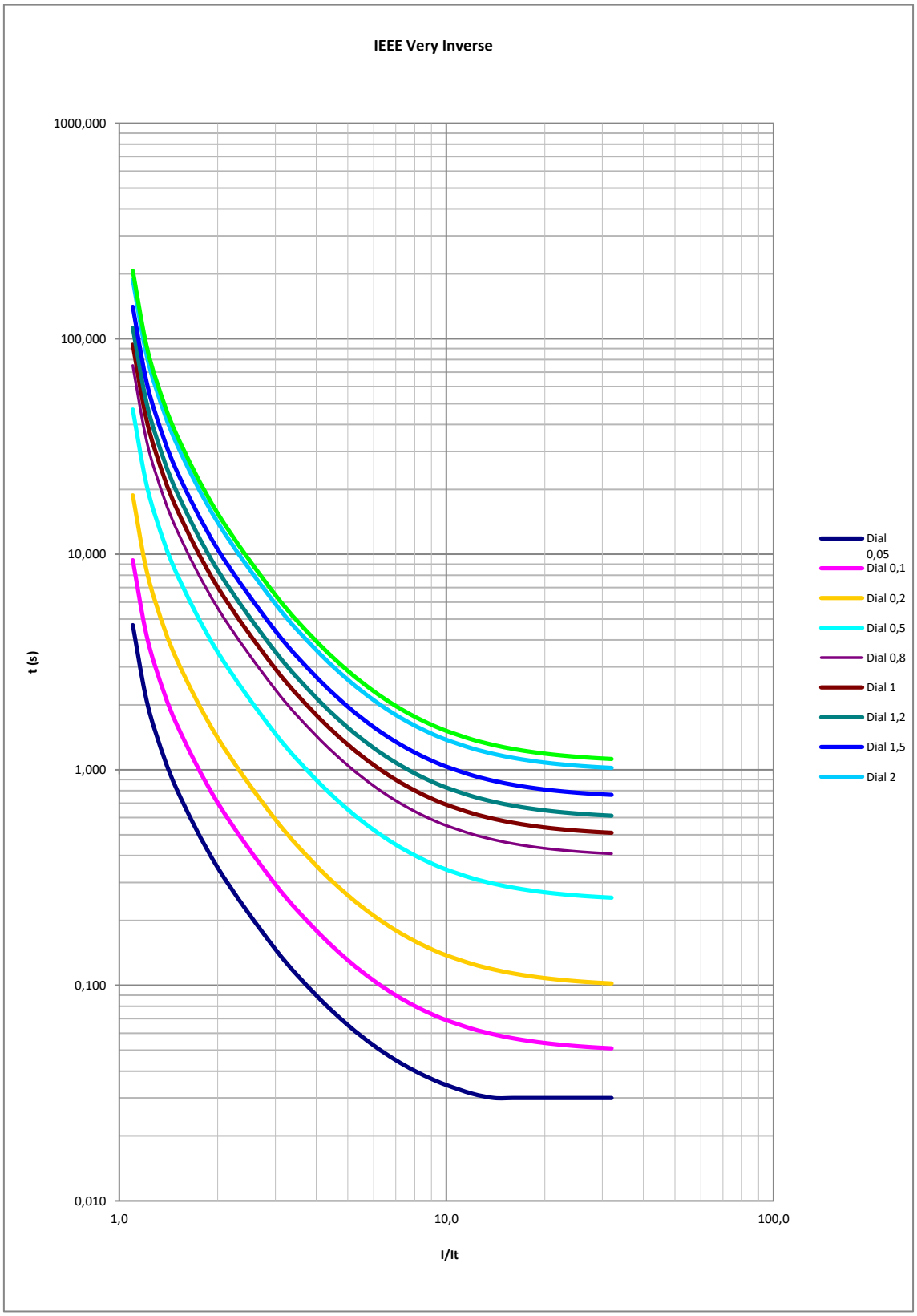
Which relate to the parameters figuring in the following table:

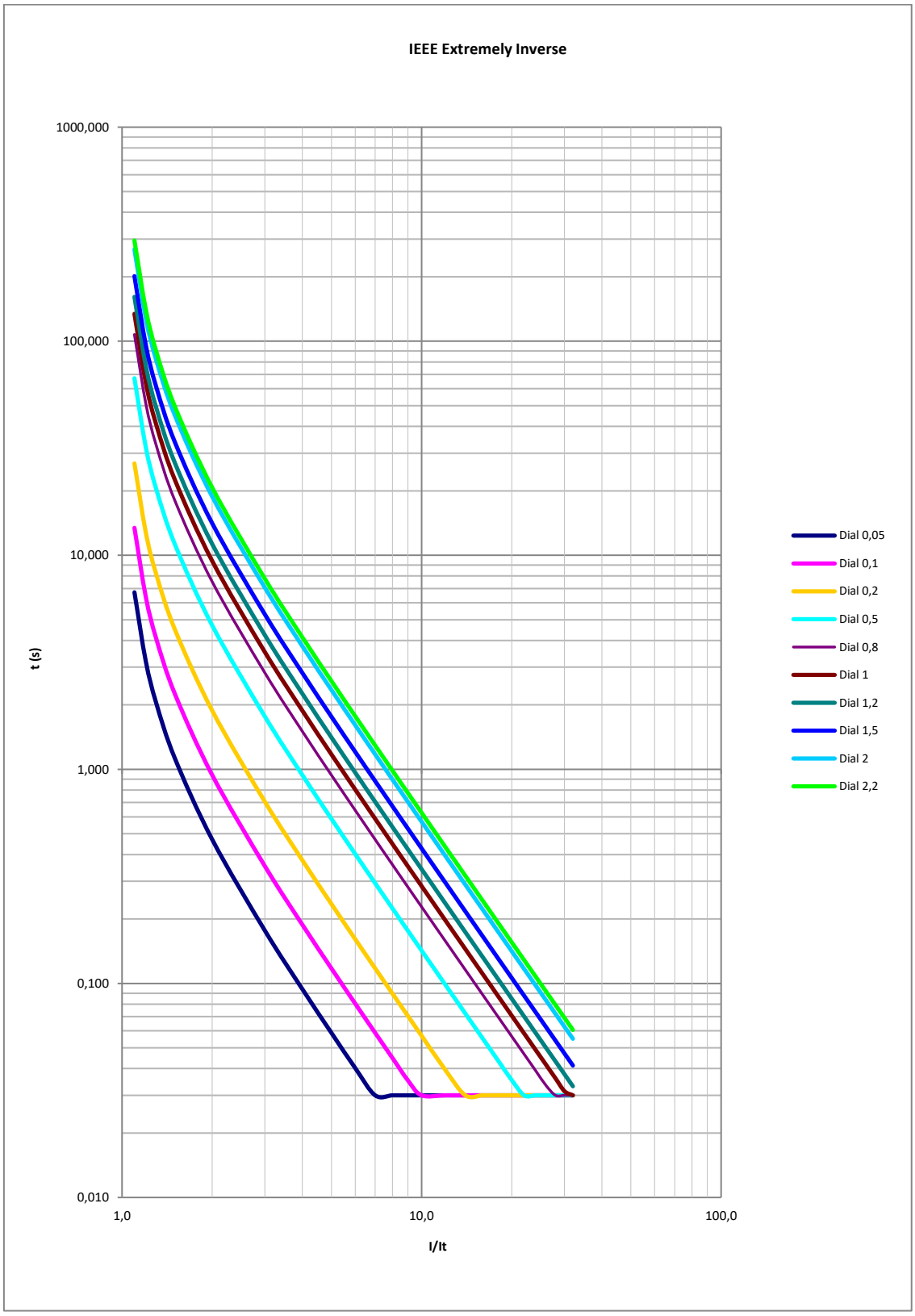
Parameters	A	P	B
Ext. Inverse	28,2	2	0,1217
Very Inverse	19,61	2	0,491
Inverse	0,0515	0,02	0,114

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.


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
Dial 1,5
Dial 2


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


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

7.3 Application examples

It is important to know that if both overcurrent protection functions (50 and 50/51), 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 50/51) must work, and if overcurrent fault reaches a certain value, definite time overcurrent function will always work. This is because, when overcurrent fault reaches 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.

Some examples are shown below:

APPLICATION EXAMPLE 1

Starting from the following information:

***Line details**:*

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

50/51 function settings

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

50 function settings

- Tap: 11xI_n
- Time delay: 0.05 s

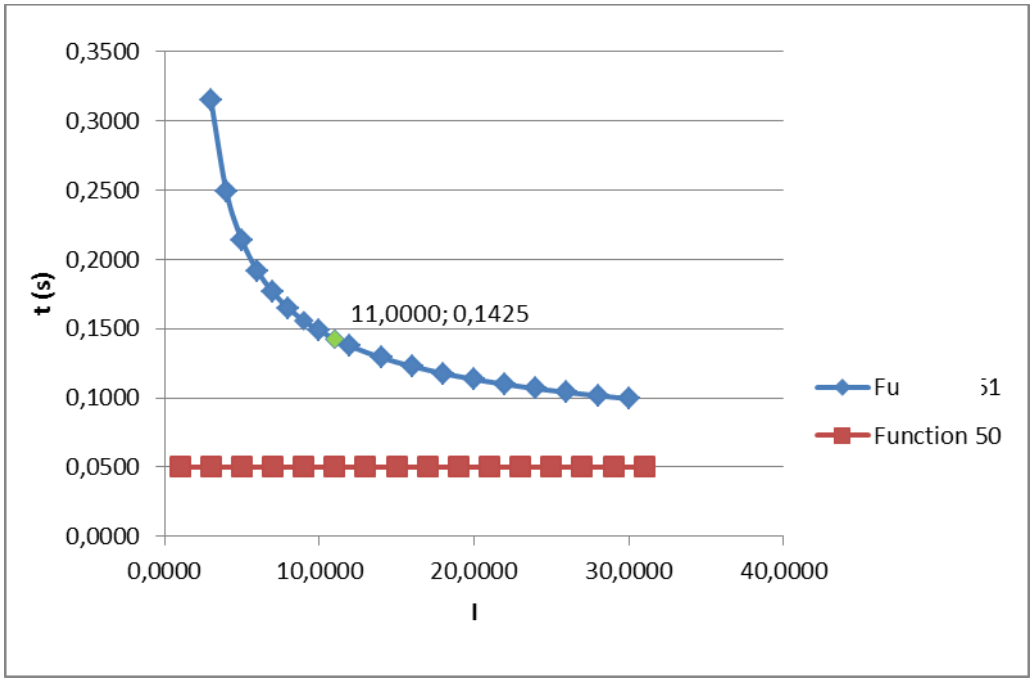


Figure 1. 50 y 50/51 IEC Inverse

If overcurrent fault is 11xI_n=1100 A, IEC inverse curve defines a tripping value of 0.1425s (Figure1) for 50/51 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:

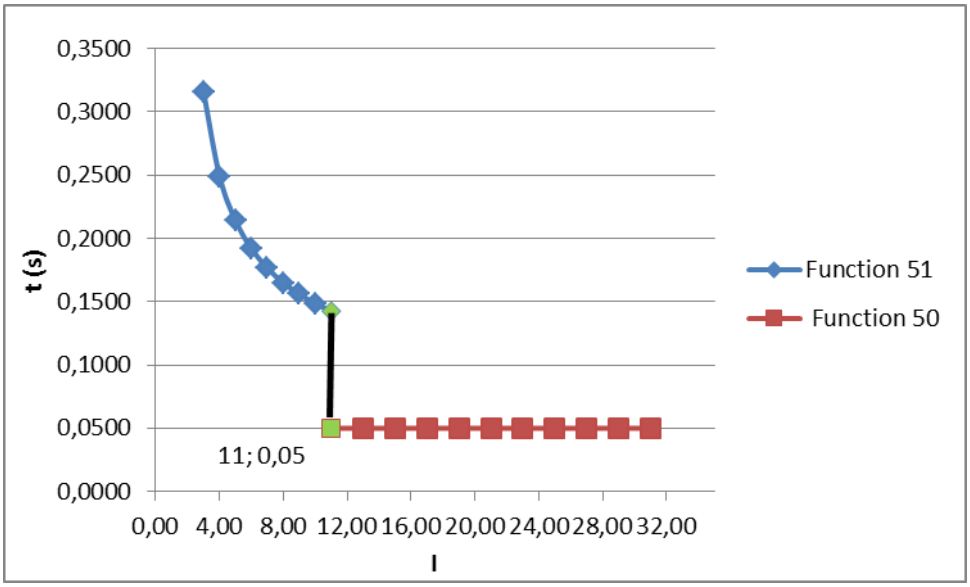


Figure 2. Relay tripping curve

APPLICATION EXAMPLE 2:

Starting from the following information:

***Line details**:*

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

50/51 function settings

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

50 function settings

- Tap: 14xI_n
- Time delay: 0.1 s

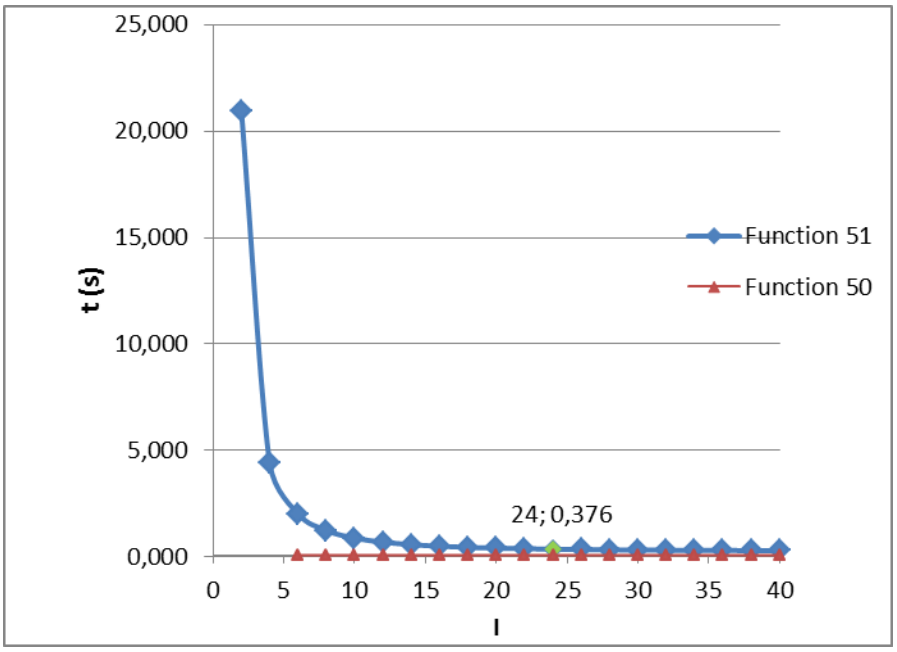


Figure 3. 50 y 50/51 IEEE Extremely Inverse

If overcurrent fault is 24xI_n=12000 Ap, IEEE Extremely inverse curve defines a tripping value of 0.376 s (Figure 3) for 50/51 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:

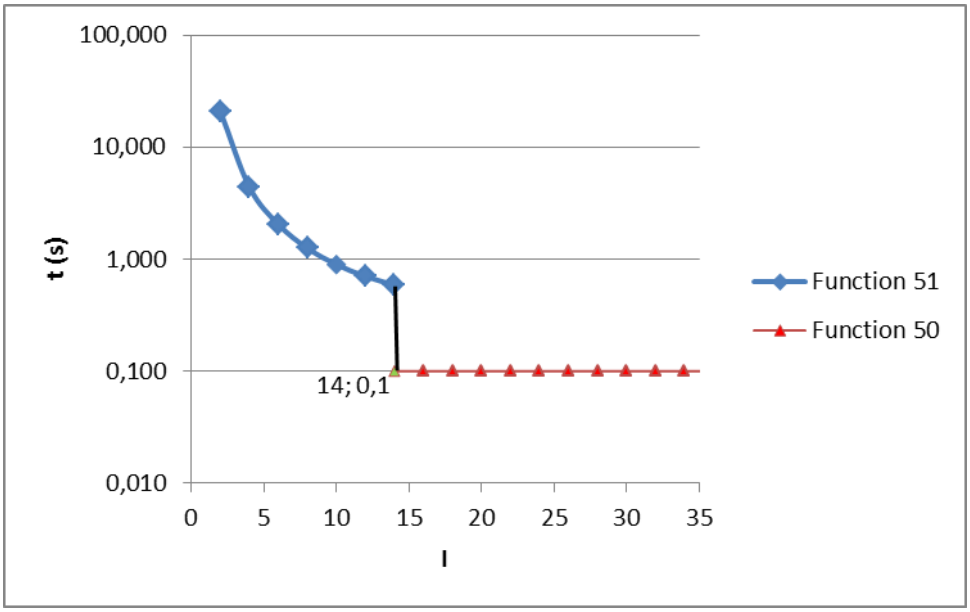


Figure 4. Relay tripping curve

8 MONITORING AND CONTROL

8.1 Measurements

In **Adaptation B**, three-phase currents (I-A, I-B and I-C), neutral current (I-N), positive sequence current (I-1), negative sequence current (I-2), maximum current (Imax) and thermal image (TI) are given as fundamental values (DFT).

In **Adaptation C**, three-phase currents (I-A, I-B and I-C), neutral current (I-N), positive sequence current (I-1), negative sequence current (I-2), second harmonic of each phase (IA-2H, IB-2H and IC-2H), maximum current (Imax) and thermal image (TI) are given as fundamental values (DFT).

The accuracy of the phases and neutral measurements in Standard SILA is ±2% in a band of ± 20% the nominal current and ±4% in the rest of the band for Adaptation 'B' and ±2% in a band of ± 20% the nominal current and ±4% or ±5 mA (greater of both) in the rest of the band for Adaptation 'C'.

The accuracy of the phases and neutral measurements in SILAXX (LPCT model) is 8%. In case of the second harmonics currents the relay shows the measurements in amperes (although the function is set in percentage).

8.2 Load Data Profiling (LDP)

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

- Number of records: 168
- Recording mode circular
- Sampling rate (interval): configurable through communications: 1 – 60 min
- Record format:

  Date/Time
  IMAX (in interval)
  IMAX (actual)
  IA
  IB
  IC
  IN

NOTE: Once the demand setting is changed, it is necessary to switch the relay off and to switch it on again to ensure that the new setting is recorded correctly.

8.3 Counters

The following counters are provided:

1. Number of openings of the circuit breaker
2. Amperes accumulated (I2t) during the openings of the circuit breaker
3. Number of reclosings

8.4 States and Events

The state is given by real-time information generated by the relay. Some states have an event associate with them, which is a register of a change made to the state. There are states that have an activation event associated with them, and other states have two associated events: activation and deactivation. These events are registered in a circular memory (buffer) with a capacity for up to 200 events. The memory timestamp is accurate to 1 millisecond.

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

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

Events have the following structure:

Identifier	Unique event identifier: e.g.: 51_1.4 = 50/51 PICKUP
Value	ON(Activated) /OFF(Deactivated): an event is generated for Activation and deActivation
Year	
Month	
Day	
Time	
Minutes	
Seconds	
Milliseconds	

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

Group	Status	Event	Cause	Measurement
General				
	Trip	Trip	Activation/Deactivation	-
	50 Hz	-	-	-
	Trip Block enable / SHB enable	Trip Block / SHB enable	Activation/Deactivation	-
	Measurement error	Measurement error	Activation/Deactivation	-
	Ready	Ready	Activation/Deactivation	-
	Settings Change	Change of settings	Activation/Deactivation	-
	Set date/time	Set date/time	Activation	-
	Local Control	Local Control	Activation/Deactivation	-
	Factory Settings	Factory Settings	Activation/Deactivation	-
	Error Eeprom	Error Eeprom	Activation/Deactivation	-
	Eeprom changed	Eeprom changed	Activation/Deactivation	-
	Events error	-	-	-
	Reset	Reset	Activation	-
	Pickup	-	-	-
	Phase A Pickup	-	-	-
	Phase B Pickup	-	-	-
	Phase C Pickup	-	-	-
	Ground Pickup	-	-	-
	Phase A Trip	-	-	-
	Phase B Trip	-	-	-
	Phase C Trip	-	-	-
	Ground Trip	-	-	-
	50 Trip	-	-	-
	50N Trip	-	-	-
	Phase Trip	-	-	-
	-	New DFR	Activation/Deactivation	Fault report NO.
	-	Active group by input	Activation	Setting group NO.
	-	Events erased	Activation	-

Group	Status	Event	Cause	Measurement
Disturbance fault Recording (DFR)				
	-	IA	Activation	Phase current
	-	IB	Activation	Phase current
	-	IC	Activation	Phase current
	-	IN	Activation	Neutral current
	-	Neutral Tap	Activation	Function tap
	-	Phase Tap	Activation	Function tap
	--	Reports erased	Activation	-
Level 1 phase instant overcurrent				
50_1	50_1 Phase A pickup	50_1 Phase A pickup	Activation/Deactivation	Phase A current
	50_1 Phase B pickup	50_1 Phase B pickup	Activation/Deactivation	Phase B current
	50_1 Phase C pickup	50_1 Phase C pickup	Activation/Deactivation	Phase C current
	50_1 pickup	50_1 pickup	Activation/Deactivation	-
	50_1 Phase A trip	50_1 Phase A trip	Activation	Phase A current
	50_1 Phase B trip	50_1 Phase B trip	Activation	Phase B current
	50_1 Phase C trip	50_1 Phase C trip	Activation	Phase C current
	50_1 Trip	50_1 Trip	Activation	-
Level 2 phase instant overcurrent				
50_2 (*)	50_2 Phase A pickup	50_2 Phase A pickup	Activation/Deactivation	Phase A current
	50_2 Phase B pickup	50_2 Phase B pickup	Activation/Deactivation	Phase B current
	50_2 Phase C pickup	50_2 Phase C pickup	Activation/Deactivation	Phase C current
	50_2 pickup	50_2 pickup	Activation/Deactivation	-
	50_2 Phase A trip	50_2 Phase A trip	Activation	Phase A current
	50_2 Phase B trip	50_2 Phase B trip	Activation	Phase B current
	50_2 Phase C trip	50_2 Phase C trip	Activation	Phase C current
	50_2 Trip	50_2 Trip	Activation	-

Group	Status	Event	Cause	Measurement
Phase inverse time overcurrent				
50/51	50/51 Phase A pickup	50/51 Phase A pickup	Activation/Deactivation	Phase A current
	50/51 Phase B pickup	50/51 Phase B pickup	Activation/Deactivation	Phase B current
	50/51 Phase C pickup	50/51 Phase C pickup	Activation/Deactivation	Phase C current
	50/51 pickup	50/51 pickup	Activation/Deactivation	-
	50/51 Phase A trip	50/51 Phase A trip	Activation	Phase A current
	50/51 Phase B trip	50/51 Phase B trip	Activation	Phase B current
	50/51 Phase C trip	50/51 Phase C trip	Activation	Phase C current
	50/51 Trip	50/51 Trip	Activation	-
Level 1 neutral instant overcurrent				
50N/G_1	50N/G_1 pickup	50N/G_1 pickup	Activation/Deactivation	Neutral current
	50N/G_1 Trip	50N/G_1 Trip	Activation/Deactivation	Neutral current
Level 2 neutral instant overcurrent				
50N/G_2 (*)	50N/G_2 pickup	50N/G_2 pickup	Activation/Deactivation	Neutral current
	50N/G_2 Trip	50N/G_2 Trip	Activation/Deactivation	Neutral current
Neutral inverse time overcurrent				
50/51N/G	50/51N/G pickup	50/51N/G pickup	Activation/Deactivation	Neutral current
	50/51N/G Trip	50/51N/G Trip	Activation/Deactivation	Neutral current
Cold Load Pickup				
CLP	CLP Disable	-	-	-
	52 Close	-	-	-
	52 Open	-	-	-
	52 definitive Open	-	-	-
	Close Cold Load	-	-	-
	Open Cold Load	-	-	-
	Cold Load pickup	Cold load Pickup	Activation/Deactivation	Phase current

Group	Status	Event	Cause	Measurement
Breaker failure Supervision				
50BF (*)	50BF pickup	50BF pickup	Activation/Deactivation	Phase current
	50BF Trip	50BF Trip	Activation/Deactivation	Phase current
Recloser				
79	79 Standby	79 Standby	Activation/Deactivation	-
	79 Reclosing time	79 Reclosing time	Activation	Auto-reclosing No.
	79 Open	79 Open	Activation	Reclose No.
	79 Hold time	79 Hold time	Activation	Auto-reclosing No.
	79 Closing time	79 Closing time	Activation	Auto-reclosing No.
	79 Reset time.	79 Reset time.	Activation	Reclose No.
	79 Lockout	79 Lockout	Activation/Deactivation	Reclose No.
	79 Safety time	79 Safety time	Activation	Reclose No.
	79 Final opening time	79 Final opening time	Activation	-
	79 Enabled	-	-	-
Circuit Breaker monitoring				
52	52 Start	52 Start	Deactivation	-
	52 Error	52 Error	Activation/Deactivation	-
	52 Open	52 Open	Activation/Deactivation	Opening Time
	52 Opening time	52 Opening time	Activation	-
	52 Opening error	52 Opening error	Activation/Deactivation	Opening Time
	52 Closed	52 Closed	Activation/Deactivation	Closing time
	52 Closing time	52 Closing time	Activation	-
	52 Closing error	52 Closing error	Activation/Deactivation	Closing time
	52 Excessive total openings	52 Excessive total openings	Activation/Deactivation	-
	52 Excessive accumulated amperes (I2t).	52 Excessive accumulated amperes (I2t).	Activation/Deactivation	-
	52 Excessive openings in a time window	52 Excessive openings in a time window	Activation/Deactivation	-
	52 a	52 a	Activation/Deactivation	-
	52 b	52 b	Activation/Deactivation	-

Group	Status	Event	Cause	Measurement
Negative sequence overcurrent				
46	46 Pickup	46 Pickup	Activation/Deactivation	Negative sequence current
	46 Trip	46 Trip	Activation/Deactivation	Negative sequence current
Trip circuit supervision				
74TCS	74TCS Pickup	74TCS Pickup	Activation/Deactivation	-
	74TCS Alarm	74TCS Alarm	Activation/Deactivation	-
Thermal image				
49 (*)	49 Alarm	49 Alarm	Activation/Deactivation	Thermal image
	49 Trip	49 Trip	Activation/Deactivation	Thermal image
Current transformer supervision				
74CT (*)	74CT Pickup	74CT Pickup	Activation/Deactivation	-
	74CT Alarm	74CT Alarm	Activation/Deactivation	-
Broken conductor detection				
46BC (*)	46BC pickup	46BC pickup	Activation/Deactivation	I2/I1
	46BC Trip	46BC Trip	Activation/Deactivation	I2/I1
Undercurrent protection				
37 (*)	37 Phase A pickup	37 Phase A pickup	Activation/Deactivation	Phase A current
	37Phase B pickup	37Phase B pickup	Activation/Deactivation	Phase B current
	37 Phase C pickup	37 Phase C pickup	Activation/Deactivation	Phase C current
	37 pickup	37 pickup	Activation/Deactivation	-
	37 Phase A trip	37 Phase A trip	Activation	Phase A current
	37 Phase B trip	37 Phase B trip	Activation	Phase B current
	37 Phase C trip	37 Phase C trip	Activation	Phase C current
	37 Trip	37 Trip	Activation	-
Trip Block for switch disconnector / SHB (**)				
Trip Block / SHB (*)	Phase A Block	Phase A Block	Activation/Deactivation	-
	Phase B block	Phase B block	Activation/Deactivation	-
	Phase C block	Phase C block	Activation/Deactivation	-
	Phase Block	Phase Block	Activation/Deactivation	

Group	Status	Event	Cause	Measurement
Inputs				
	Input 1	Input 1	Activation/Deactivation	-
	Input 2	Input 2	Activation/Deactivation	-
	Input 3	Input 3	Activation/Deactivation	-
	Input 4	Input 4	Activation/Deactivation	-
	Input 5	Input 5	Activation/Deactivation	-
	Input 6	Input 6	Activation/Deactivation	-
Outputs				
	Output 1	Output 1	Activation/Deactivation	-
	Output 2	Output 2	Activation/Deactivation	-
	Output 3	Output 3	Activation/Deactivation	-
	Output 4	Output 4	Activation/Deactivation	-
Leds				
	Led 1	-	-	-
	Led 2	-	-	-
	Led 3	-	-	-
	Led 4	-	-	-
	Led 5	-	-	-
	Led 6	-	-	-
	Led 52	-	-	-
	Led 79	-	-	-
Logic				
	52 a	52 a	Activation/Deactivation	-
	52 b	52 b	Activation/Deactivation	-
	External trip	External trip	Activation/Deactivation	-
	50BF Start	50BF Start	Activation/Deactivation	-
	DFR Start	DFR Start	Activation/Deactivation	-
	50/51 Block	50 Block	Activation/Deactivation	-
	50/51G Block	50N/G Block	Activation/Deactivation	-
	Reset	Reset	Activation/Deactivation	-

	Settings group 1	Settings group 1	Activation/Deactivation	-
	Settings Group 2	Settings Group 2	Activation/Deactivation	-
	79 Start	79 Start	Activation/Deactivation	-
	79 Enable	79 Enable	Activation/Deactivation	-
	79 Level Block	79 Level Block	Activation/Deactivation	-
	79 Block	79 Block	Activation/Deactivation	-
	79 Unblock	79 Unblock	Activation/Deactivation	-
	74TCS Continuity A (*)	74TCS Continuity A	Activation/Deactivation	-
	74TCS Continuity B (*)	74TCS Continuity B	Activation/Deactivation	-
	Logical signal 1 (*)	-	-	-
	Logical signal 2 (*)	-	-	-
Remote Modbus				
	Remote communication	-	-	--
	Open circuit breaker	Open circuit breaker	Activation	Command identifier
	Close circuit breaker	Close circuit breaker	Activation	Command identifier
	79 Block	79 Block	Activation	Command identifier
	79 Unblock	79 Unblock	Activation	Command identifier
	Local control	Local control	Activation	Command identifier
	Remote Control	Remote Control	Activation	Command identifier
	Reset	Reset	Activation	Command identifier
	Reset TI	Reset TI	Activation	Command identifier
IEC60870-5-103				
	IEC60870-5-103 Communication	-	--	-
	Open circuit breaker	Open circuit breaker	Activation	Command identifier
	Close circuit breaker	Close circuit breaker	Activation	Command identifier
	79 Block	79 Block	Activation	Command identifier
	79 Unblock	79 Unblock	Activation	Command identifier
	Local control	Local control	Activation	Command identifier
	Remote Control	Remote Control	Activation	Command identifier
	Reset	Reset	Activation	Command identifier
	Reset TI	Reset TI	Activation	Command identifier

Local communication				
	Local COM.	-	-	-
	HMI Activity	-	-	-
	Open circuit breaker	Open circuit breaker	Activation	Command identifier
	Close circuit breaker	Close circuit breaker	Activation	Command identifier
	79 Pulse Lock 79	79 Pulse Lock 79	Activation	Command identifier
	79 Pulse Unlock 79	79 Pulse Unlock 79	Activation	Command identifier
	Local control	Local control	Activation	Command identifier
	Remote Control	Remote Control	Activation	Command identifier
	Reset	Reset	Activation	Command identifier
	Reset TI	Reset TI	Activation	Command identifier

NOTE: LPCT model→50N/G, 50/51N: calculated neutral; Standard model→50N/G, 50/51N/G: measured neutral

(*) Optional depending on model

(**) The SIL-A will have the SHB or the Trip block as optional function, it is not possible to have both optional functions in the same model.

A brief description of the general states is given below:

- **Trip**: The relay has tripped.
- **External Trip**: A trip has been caused by the activation of the excess temperature input (external trip).
- **50 Hz**: If activated, the relay works at 50 Hz, if deactivated it works at 60Hz.
- **Trip Block Enable**: If the Trip Block functions is available in the model, it has been enabled.
- **Measurement error**: The self-diagnosis algorithms have detected a problem in the measurement block.
- **Ready**: No errors
- **Setting change**: Activated when the settings are changed.
- **Set date/time**: Activated when the date-time are synchronized.
- **Local**: Activated when the device is in Local Control mode.
- **Factory settings**: the relay is set to default settings and does not execute the trip.
- **Eeprom error**: The self-diagnosis algorithms have detected a problem in the Eeprom memory, which contains the settings.
- **Eeprom change**: Activated when the settings or configuration (user passwords) are changed.
- **Events error**: since the events buffer is circular, new events overwrite the older events once the buffer is full, and the older events are lost. To show this situation, the 'Events error' bit is activated. This bit is reset by deleting the events (from the HMI or by using communications).

8.5 Disturbance Fault Recording (DFR)

Disturbance fault recording includes the disturbance records in COMTRADE format and the data of each COMTRADE (fault reports). The relay can store, in FRAM memory, up to 20 fault reports with 24 events in each. From the standby mode screen, press 'OK' key to access the first line of menus. Use the '▲' and '▼' keys to position the cursor over the 'FAULTS' screen. They are also accessible by pressing '◄' from the standby menu. The next information can be checked:

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

To delete the fault reports buffer, position the cursor over the fault report menu and press and hold the 'RESET' key, until there are no fault reports. There will be an event 'Fault reports erased'.

Besides, the relay can store the last 5 fault reports in COMTRADE format - cyclic recording by FIFO method - (with 100 cycles per record – resolution 16 samples/cycle). The first three of these cycles correspond to pre-fault.

The DFR start is configurable by the user (by default it is configured to the general trip). The DFR closure will happen when the time is finished (100 cycles) or when the events record is full (24 events).

The COMTRADE file is downloaded by communications through the front or rear port using the Modbus protocol. The SICom communications program allows the user to download and save the reports in COMTRADE format (IEEE C37.111-1991).

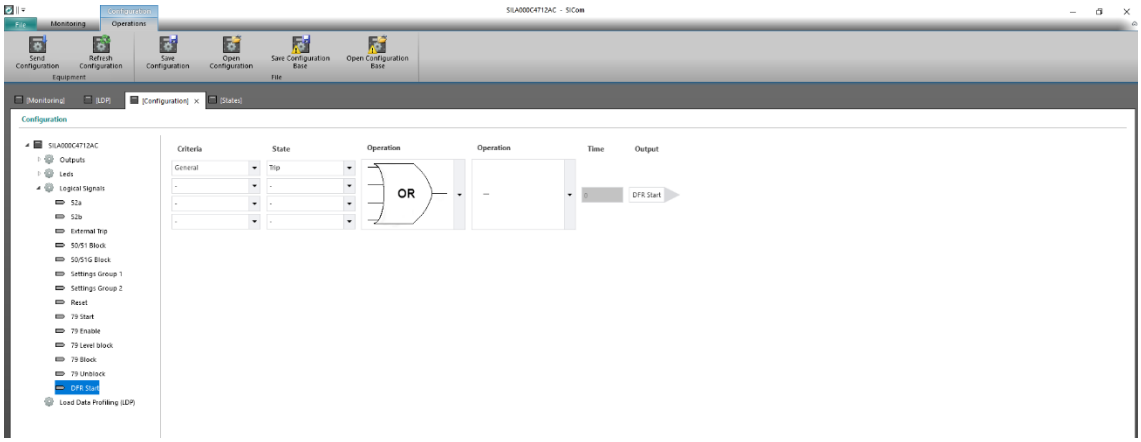
Once the COMTRADE is saved 3 files are generated:

- File '.dat': The information of the COMTRADE record in data format.
- File '.cfg' The information of the COMTRADE record in graphic format (this is the file to open to analyze the waves and the signals involved in the DFR).
- File '.hdr': This is the COMTRADE header file that includes: date-time of the record, number of COMTRADE record, pre-fault and post-fault cycles and analog/digital channels.

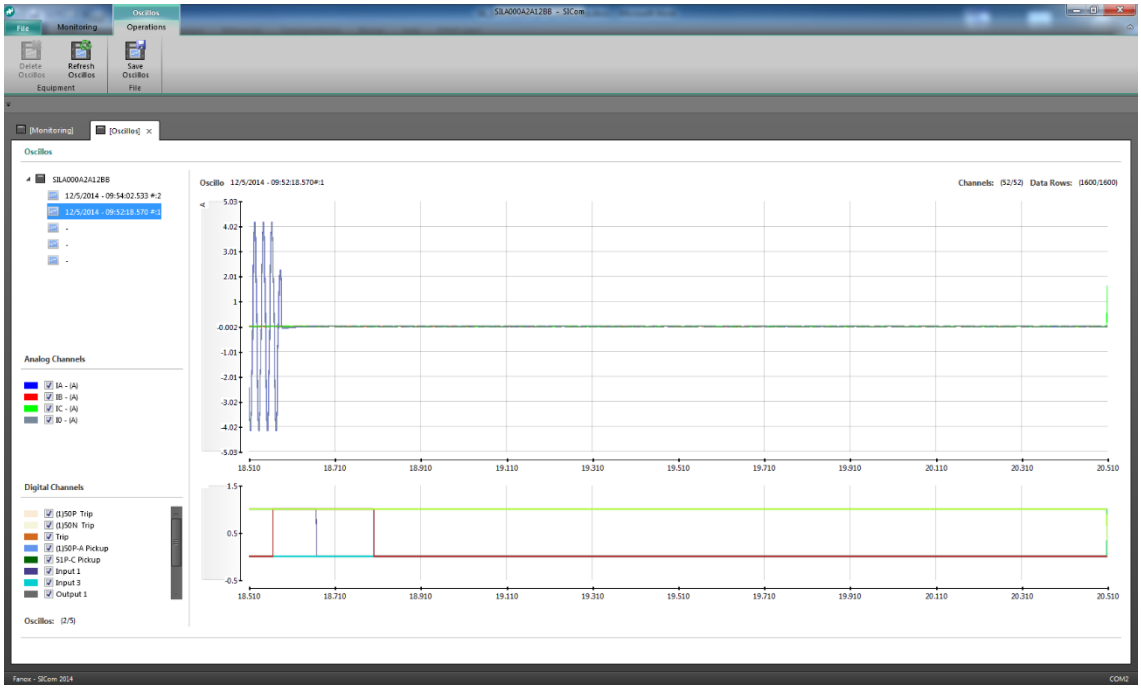
The format of a COMTRADE header file can be shown below:

```
******************** .HDR COMTRADE ****************************
************************************************************
Cycles pre-fault = 3
Total cycles = 100
Analog channels = 4
Digital channels = 48
COMTRADE = 2
Date/Time = 1/8/2019 - 16:27:36.588
************************************************************
```

A DFR starts when the configurable logical signal ‘DFR Start’ signal is activated. The default configuration is as follows:



It is possible to visualize the DFR using SICom software and to save it as a COMTRADE file.



8.5.1 SIL-A Adaptation B

The following information is included in each COMTRADE record:

Number	Analog channels
1	Phase A current
2	Phase B current
3	Phase C current
4	Neutral current

This current is already in primary amps.

As well as the analogue magnitudes, the relay saves 48 digital records, with the same precision as 16 cycle samples. These 48 bits shall contain the following:

No.	Digital channels
1	50_1 Trip
2	50_2 Trip
3	51 Trip
4	50N_1 Trip
5	50N_2 Trip
6	51N Trip
7	46 Trip
8	49 Trip
9	46BC Trip
10	37 Trip
11	External Trip
12	General trip
13	Phase Block
14	50_1 Phase A Pickup
15	50_1 Phase B Pickup
16	50_1 Phase C Pickup

No.	Digital channels
17	50_2 Phase A Pickup
18	50_2 Phase B Pickup
19	50_2 Phase C Pickup
20	50/51 Phase A Pickup
21	50/51 Phase B Pickup
22	50/51 Phase C Pickup
23	50N/G_1 Pickup
24	50N/G_2 Pickup
25	51N/G Pickup
26	46 Pickup
27	49 Alarm
28	50BF Pickup
29	50BF Trip
30	46BC Pickup
31	Input 1
32	Input 2

No.	Digital channels
33	Input 3
34	Input 4
35	Input 5
36	Input 6
37	Output 1
38	Output 2
39	Output 3
40	Output 4
41	CLP
42	74TCS Alarm
43	74CT Alarm
44	52 Open
45	52 Close
46	79 Standby
47	79 Lockout
48	79 Reclosing time

8.5.2 SIL-A Adaptation C

The following information is included in each COMTRADE file:

Number	Analog channels
1	Phase A current
2	Phase B current
3	Phase C current
4	Neutral current

This current is already in primary amps.

As well as the analogue magnitudes, the relay saves 37 digital records, with the same precision as 16 cycle samples. These 37 bits shall contain the following:

No.	Digital channels
1	50_1 Trip
2	50N/G_1 Trip
3	51 Trip
4	51N/G Trip
5	46 Trip
6	46BC Trip
7	49 Trip
8	External Trip
9	General trip
10	Phase Block
11	50_1 Phase A Pickup
12	50_1 Phase B Pickup
13	50_1 Phase C Pickup
14	50/51 Phase A Pickup
15	50/51 Phase B Pickup
16	50/51 Phase C Pickup
17	50N/G_1 Pickup
18	51N/G Pickup
19	46 Pickup

No.	Digital channels
20	46BC Pickup
21	49 Alarm
22	Input 1
23	Input 2
24	Input 3
25	Input 4
26	Input 5
27	Input 6
28	Output 1
29	Output 2
30	Output 3
31	Output 4
32	CLP
33	52 Open
34	52 Closed
35	79 Standby
36	79 Lockout
37	79 Reclosing time

8.6 Configurable inputs

The SIL-A adaptation B has 6 digital inputs that can be set by the user. The adaptation C has also 6 digital inputs, but two of them, 74TCS A and 74TCS B are configured to supervise the trip circuit. One bit is fixed for this purpose. The other 4 bits can be configured depending on users´ requirements. These inputs can be configured from the HMI, or by using the SICom program. The default input configuration is shown below:

Logic	In1	In2	In3	In4	In5 (**)	In6 (**)
Not configured						
52a						
52b	X					
External trip						
50/51 Block						
50/51G Block						
79 Start						
79 Enable						
79 Level Block						
79 Pulse Block						
79 Pulse Unblock						
50BF Start (*)						
Setting group 1						
Setting group 2						
Reset						
74TCS Continuity A (*)						
74TCS Continuity B (*)						
Logical signal 1 (*)						
Logical signal 2 (*)						
DFR Start						

(*) Depending on model / (**) Inputs 74TCS Coil A and 74TCS Coil B in adaptation C.

8.7 Digital outputs

SIL-A is fitted 4 digital outputs. The outputs can be configured from the HMI or through the SICom program.

The configuration of the outputs is described in point 8.8 Programmable Logic Control.

8.8 Programmable Logic Control (PGC)

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

Physical inputs are the real inputs of the device. SIL-A device has physical inputs (6 inputs). These inputs are translated to internal binary states which later, can be assigned to logical signal to get a specific operation.

Physical outputs are the real outputs of the Device. SIL-A has 4 outputs and up to 8 configurable leds, which receive the same treatment as the physical outputs, some working on output relays and others working on led diodes.

Logical signals are internal binary states resulting from control programmable logic. Each logical signal has a specific meaning and is intended to be used by the functions of the device.

8.8.1 SIL-A Adaptation B

LEDs	LED 1
	LED 2
	LED 3
	LED 4
	LED 5
	LED 6
	LED 52
	LED 79
PHYSICAL OUTPUTS	Output 1
	Output 2
	Output 3
	Output 4

LOGICAL SIGNALS	52a
	52b
	External Trip
	50BF Start
	DFR Start
	79 Start
	79 Enable
	79 Level Block
	79 Block
	79 Unblock
	Block 50/51
	Block 50/51G
	Reset
	Settings group 1
	Settings group 2
	74TCS Continuity A
	74TCS Continuity B
	Logic Signal 1
	Logic Signal 2

By default, outputs configuration is:

SILAxxxxx2xxxx

	OUTPUT	*LOGICAL GATE*	BINARY STATES
LEDs	LED 1	*OR4_PULSES*	• Ready
	LED 2	*OR4_LATCH*	• 50-1 Trip • 50-2 Trip • 51 Trip
	LED 3	*OR4_LACTH*	• 50G1 Trip • 50G2 Trip • 51G Trip
	LED 4	*OR4_LACTH*	• 50BF Trip
	LED 5	*OR4_LACTH*	• 46 Trip
	LED 6	*OR4_LACTH*	• 74TCS Alarm
	LED 52	*OR4*	• 52 Closed
	LED 79	*OR4*	• 79 Standby
PHYSICAL OUTPUTS	Output 1	*OR4*	• Ready
	Output 2	*OR4*	• 50BF Trip
	Output 3	*OR4*	• 79 Close time • Local close breaker • Remote Modbus close breaker • Remote DNP3.0 close breaker
	Output 4	*OR4*	• General trip • Local open breaker • Remote Modbus open breaker • Remote DNP3.0 open breaker

LOGICAL SIGNALS	52a	*No configured*	-
	52b	*OR4*	• Input 1
	External Trip	*No configured*	-
	50BF start	*OR4*	• General trip
	DFR start	*OR4*	• General trip
	50/51 block	*Not configured*	-
	50/51G block	*Not configured*	-
	Reset	*OR4_PULSE*	• Local reset • Remote Modbus reset • Remote DNP3.0 reset
	Settings group 1	*Not configured*	-
	Settings group 2	*Not configured*	-
	79 Start	*OR4*	• General trip
	79 Enable	*Not configured*	-
	79 Level Block	*Not configured*	-
	79 Block	*Not configured*	-
	79 Unblock	*Not configured*	-
	74TCS Continuity A	*Not configured*	-
	74TCS Continuity B	*Not configured*	-
	Logical signal 1	*Not configured*	-
	Logical signal 2	*Not configured*	-

8.8.2 SIL-A Adaptation C

LEDs	LED 1
	LED 2
	LED 3
	LED 4
	LED 5
	LED 6
	LED 52
	LED 79
PHYSICAL OUTPUTS	Output 1
	Output 2
	Output 3
	Output 4
LOGICAL SIGNALS	52a
	52b
	External Trip
	50/51 Block
	50/51N/G Block
	Settings group 1
	Settings group 2
	Reset
	79 Start
	79 Enable

	79 Level Block
	79 Block
	79 Unblock
	DFR Start

By default, outputs configuration is:

SILAxxxxx4xxxx

	OUTPUT	*LOGICAL GATE*	BINARY STATES
LEDs	LED 1	*OR4_PULSES*	• Ready
	LED 2	*OR4_LATCH*	• 50-1 Trip • 51 Trip
	LED 3	*OR4_LACTH*	• 50N1 Trip • 51N Trip
	LED 4	*OR4*	• SHB
	LED 5	*OR4_LACTH*	• 46 Trip
	LED 6	*OR4_LACTH*	• 74TCS Alarm
	LED 52	*OR4*	• 52 Closed
	LED 79	*OR4*	• 79 Standby
PHYSICAL OUTPUTS	Output 1	*OR4*	• Ready
	Output 2	*OR4*	• 46 Trip • 46BC Trip
	Output 3	*OR4*	• 79 Closing time • Local close breaker • Remote modbus close breaker • Remote DNP3.0 close breaker
	Output 4	*OR4*	• General trip • Local open breaker • Remote modbus open breaker

			• Remote DNP3.0 open breaker
LOGICAL SIGNALS	52a	*No configured*	-
	52b	*OR4*	• Input 1
	External Trip	*No configured*	-
	50/51 Block	*Not configured*	-
	50/51G Block	*Not configured*	-
	Reset	*OR4_PULSE*	• Local reset • Remote modbus reset • Remote DNP3.0 reset
	Settings group 1	*Not configured*	-
	Settings group 2	*Not configured*	-
	79 Start	*OR4*	• General trip
	79 Enable	*Not configured*	-
	79 Level Block	*Not configured*	-
	79 Block	*Not configured*	-
	79 Unblock	*Not configured*	-

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

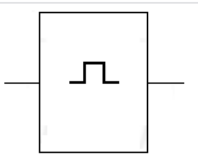
For each output there is a LOGICAL GATE. It can perform a logical operation up to 4 binary states to obtain other binary result.

n V3 of the PGC the LOGICAL GATES that are supported by SIL-A are:

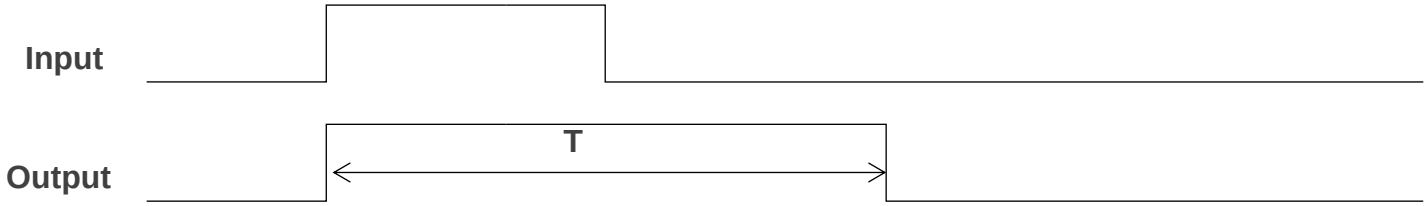
LOGICAL GATE	HMI SYMBOL
OR4	+
NOR4	τ
OR4_LACTH	c
NOR4_LACTH	Φ
OR4_PULSES	J
AND4	&
NAND4	§
AND4_PULSES	$
OR_TIMER_UP	O
NOR_TIMER_UP	P
AND_TIMER_UP	Q
NAND_TIMER_UP	R
OR_PULSE	o
NOR_PULSE	p
AND_PULSE	q
NAND_PULSE	r

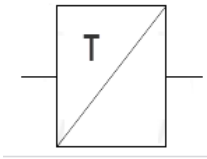
In the SICom the logic is as follows:

Logical gate selection guide

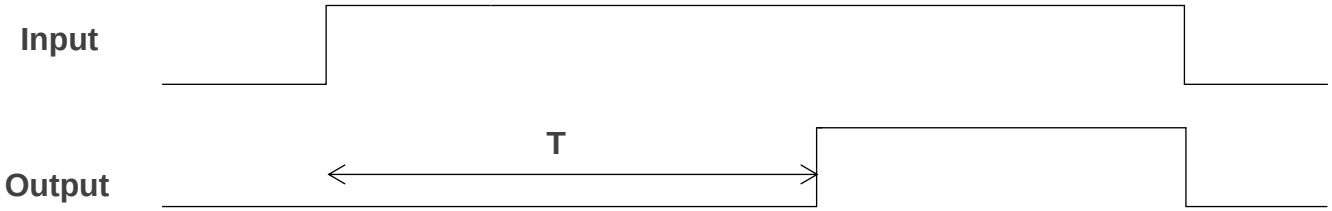


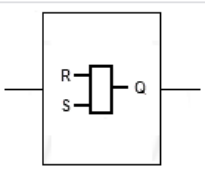
The configured signal will make a pulse of the adjusted milliseconds once the input signal is activated.



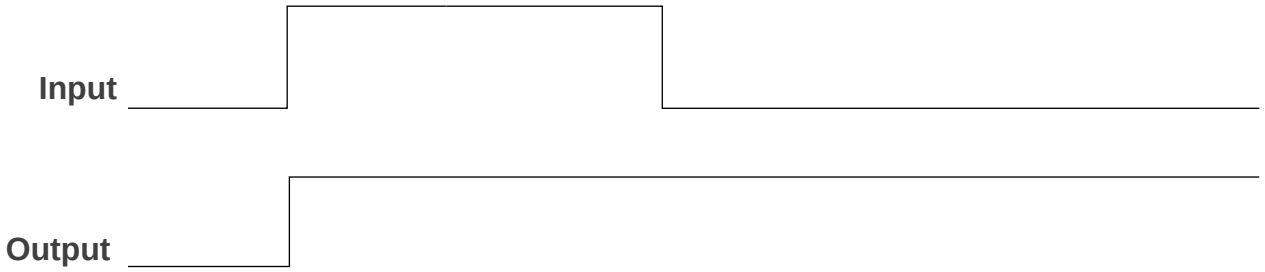


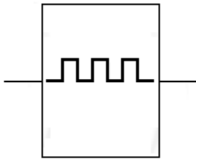
The configured signal waits the adjusted milliseconds to activate itself.



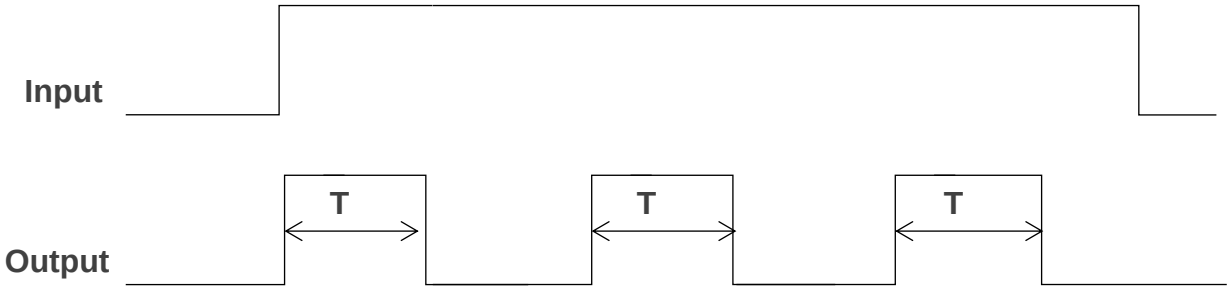


The configured signal will be activated till it is externally reset (command, reset key, communications…), though the input signal drops off.





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



8.9 Function 86. Trip output lockout

When the trip output is configured like OR_LACTH the programmable logic allows this output to be blocked.

8.10 Self-diagnosis

Diagnostic algorithms are run while the relay is being picked up and continuously when the relay is operating. This diagnostic is a preventative process to guarantee that the relay is in good operational condition.

The following general considerations are applicable:

- Communications between different CPUs are confirmed by the corresponding integrity checks. In the case of continuous faults, the relay shall be re-picked up.
- The settings details are confirmed with the corresponding checks. Also, the settings groups are folded and the relay can operate with one setting group damaged but not with two damaged.
- There is a WatchDog mechanism between the different main CPUs, as well as on the CPUs themselves. Loss of activity on any of these will result in the resetting of the relay, and this will be recorded as an event.

The following status bits are associated with this process:

Measurement error	Problem in the measurement block
Eeprom Error	Problem in the eeprom memory, a setting group is corrupt.
Event error	Problem in the events recording

8.11 Commands

	HMI	Local Com. ModBus	Remote com: Modbus IEC 60870-5-103 IEC61850 IEC 60870-5-104 DNP 3.0 Modbus TCP/IP
52 open	✓	✓	✓
52 close	✓	✓	✓
79 Block	✓	✓	✓
79 Unblock	✓	✓	✓
Local control	✓	✓	-
Remote control	✓	✓	-
Reset	✓	✓	✓
Reset TI	✓	✓	✓

To carry out commands from the remote communications (ModBus, IEC60870-5-103, IEC61850, IEC60870-5-104, Modbus TCP/IP or DNP 3.0 depending on model) the relay must be in Remote control mode. Operations can be performed from the HMI or from local communications (ModBus), regardless of whether or not the relay is in remote control.

8.12 Remote Control

The relay can be set to Remote control or to Local control from the HMI or through local communications software (SICom).

If remote control is used, it is recommended to configure a led to display when it is permitted and when it is not.

8.13 Date/time synchronization

The relay can be synchronized from the HMI or by communications.

8.14 Test program

The SIL-A relay is equipped with a test menu from where the led and outputs operation can be checked. The following tables show the components that can be tested, along with their status depending on whether they are activated or deactivated:

From standby screen, press ◄,▼,► sequentially and hold OK until the 'Test menu' appears on the display. The relay will ask for the password '5555' to be entered in the test menu (or other if the customer password by default is '5555' has been modified).

The test menu is accessed by pressing the 'OK' key again, and the '▲' and '▼' keys can be used to navigate through the different menu items. Each item can be activated or deactivated by pressing 'OK' on it (if the item is deactivated, it is activated by pressing OK; if the item is activated, it is deactivated by pressing 'OK'). Press the 'C' key to exit the test menu.

8.14.1 SIL-A Adaptation B

LED-1	Deactivated	LED-1 deactivated
	Activated	LED-1 activated
LED-2	Deactivated	LED-2 deactivated
	Activated	Led-2 activated
LED-3	Deactivated	LED-3 deactivated
	Activated	LED-3 activated
LED-4	Deactivated	LED-4 deactivated
	Activated	LED-4 activated
LED-5	Deactivated	LED-5 deactivated
	Activated	LED-5 activated
LED-6	Deactivated	LED-6 deactivated
	Activated	LED-6 activated
LED-79	Deactivated	LED-79 deactivated
	Activated	LED-79 activated
LED-52	Deactivated	LED-52 deactivated
	Activated	LED-52 activated
Output 1	Deactivated	Output deactivated
	Activated	Output activated
Output 2	Deactivated	Output deactivated
	Activated	Output activated

Output 3	Deactivated	Output deactivated
	Activated	Output activated
Output 4	Deactivated	Output deactivated
	Activated	Output activated

8.14.2 SIL-A Adaptation C

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

OUTPUT 1	Deactivated	Output 1 deactivated
	Activated	Output 1 activated
OUTPUT 2	Deactivated	Output 2 deactivated
	Activated	Output 2 activated
OUTPUT 3	Deactivated	Output 3 deactivated
	Activated	Output 3 activated
OUTPUT 4	Deactivated	Output 4 deactivated
	Activated	Output 4 activated

8.15 Power Supply

SIL-A is designed to be powered with an auxiliary voltage of 24-230 Vac/dc.

The relay power consumption is less than 4 watts.

The supply guarantees between -20%/+10% of the auxiliary voltage. Outside this range the relay could operate, but this is not guaranteed.

8.16 Thermal load of the current circuits

The SILAXX models are prepared for LPCT transformers. This implies that the measurement inputs do not have rated currents /1 /5, but rather 22.5 mvolts, for the rated current of the switchgear.

8.17 Date and Time by Real Time Clock (RTC)

The protection devices require a clock, enabling them to have a date and time stamped for events and registers. This clock is maintained while the internal commissioning battery works (the lifetime of this battery is 20 years).

This clock can be synchronized by any of the two following procedures:

- **From the HMI.** In this case the date and time can be entered via the keyboard. The relay will store the new event indicating that it has been synchronized.

- **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.

9 TECHNICAL SPECIFICATIONS AND STANDARDS

9.1 Technical Specifications

9.1.1 SIL-A Adaptation B

50_1 **50_2**	Function Enable : Yes/No
	Current Tap: 0.10 to 30 xIn (step 0.01)
	Time Delay: 0.02 to 300 s (step 0.01 s)
	Activation level 100%
	Deactivation level 95%
	Instantaneous deactivation
	Timing accuracy: ±30 ms or ±0.5% (greater of both)
50G_1 (1) **50G_2**	Function Enable : Yes/No
	Current Tap: 0.1 to 30 xIn (step 0.01)
	Time Delay: 0.02 to 300 s (step 0.01 s)
	Activation level 100%
	Deactivation level 95%
	Instantaneous deactivation
	Timing accuracy: ±30 ms or ±0.5% (greater of both)
50/51	Function Enable : Yes/No
	Current Tap: 0.10 to 7 xIn (step 0.01)
	Curves IEC 60255-151 and IEEE
	Curve Type: IEC Inverse curve, IEC very inverse curve, IEC extremely inverse curve IEC long time inverse, IEEE Inverse curve, IEEE very inverse curve, IEEE extremely inverse curve, Defined Time. Time Delay: 0.02 to 300 s (step 0.01 s)
	Time Dial (TMS): 0.02 to 2.20 (step 0.01)
	Curve, activation level 110%

	Curve, deactivation level 100%
	Defined time, activation level 100%
	Defined time, deactivation level 95%
	Instantaneous deactivation
	Timing accuracy for IEC and IEEE curves selection: ± 30 ms or ± 5% (greater of both). Timing accuracy for defined time curve selection: ± 30 ms or ± 0.5% (greater of both).
50/51G (1)	Function Enable : Yes/No
	Current Tap: 0.1 to 7 xIn (step 0.01)
	Curves IEC 60255-151 and IEEE
	Curve Type: IEC Inverse curve, IEC very inverse curve, IEC extremely inverse curve IEC long time inverse, IEEE Inverse curve, IEEE very inverse curve, IEEE extremely inverse curve, Defined Time. Time Delay: 0.02 to 300 s (step 0.01 s)
	Time Dial (TMS): 0.02 to 2.20 (step 0.01)
	Curve, activation level 110%
	Curve, deactivation level 100%
	Defined time, activation level 100%
	Defined time, deactivation level 95%
	Instantaneous deactivation
	Timing accuracy for IEC and IEEE curves selection: ± 30 ms or ± 5% (greater of both). Timing accuracy for defined time curve selection: ± 30 ms or ± 0.5% (greater of both).
46	Function Enable : Yes/No
	Current Tap: 0.10 to 7.00 xIn (step 0.01)
	Curves IEC 60255-151 and IEEE

	Curve Type: IEC Inverse curve, IEC very inverse curve, IEC extremely inverse curve IEC long time inverse, IEEE Inverse curve, IEEE very inverse curve, IEEE extremely inverse curve, Defined Time. Time Delay: 0.02 to 300 s (step 0.01 s)
	Time Dial (TMS): 0.02 to 2.20 (step 0.01)
	Curve, activation level 110%
	Curve, deactivation level 100%
	Defined time, activation level 100%
	Defined time, deactivation level 95%
	Instantaneous deactivation
	Timing accuracy for IEC and IEEE curves selection: ± 30 ms or ± 5% (greater of both). Timing accuracy for defined time curve selection: ± 30 ms or ± 0.5% (greater of both).
Circuit breaker monitoring	Maximum number of openings: 1 to 10,000 (step 1)
	Maximum accumulated amperes: 0 to 100,000 (M(A^2)) (step 1)
	Opening time: 0.02 to 30 s (step 0.01 s)
	Closing time: 0.02 to 30 s (step 0.01 s)
	Excessive repeated openings: 1 to 10,000 (step 1)
	Repetitive openings/Time: 1 to 300 min (step 1 min)
	Open circuit breaker activation threshold: 8% In
	Open circuit breaker reset threshold: 10% In
50BF	Function Enable : Yes/No
	Time Delay: 0.02 to 1.00 s (step 0.01 s)
	Open circuit breaker activation threshold: 8% In
	Open circuit breaker reset threshold: 10% In
	Configurable function pickup

79	Function Enable : Yes/No
	Hold Enable: Yes/No/No Time
	Number of reclosings: 1 to 5
	Reclose time 1, 2, 3, 4, 5 : 0.02 to 300 s (step 0.01 s)
	Hold time: 0.02 to 300 s (step 0.01 s)
	Reset time: 0.02 to 300 s (step 0.01 s)
	Safe time: 0.02 to 300 s (step 0.01 s)
	Locking possibilities: pulse inputs, level inputs, commands.
74TCS	Function Enable : Yes/No
	Time Delay: 0.02 to 300 s (step 0.01 s)
	Continuity in circuits A and B
	Configurable inputs
CLP	Function Enable : Yes/No
	Settings group: 1 to 4 (step 1)
	No load Time: 0.02 to 300 s (step 0.01 s)
	Cold load Time: 0.02 to 300 s (step 0.01 s)
	CLP activation threshold: 8% In
	CLP reset threshold: 10% In
PGC	OR4, OR4_LATCH, OR4_PULSES, OR4_TIMERUP, OR4_PULSE, NOR4, NOR4_LATCH, NOR4_TIMERUP, NOR4_PULSE, AND4, AND4_PULSES, AND4_TIMERUP, AND4_PULSE, NAND4, NAND4_TIMERUP, NAND4_PULSE
86	Allows to latch (lock out) the contact trip due to programmable logic (PLC: LATCH).
49T	Available through configurable inputs thanks to the programmable logic
49 (*)	Function Enable : Yes/No
	Current Tap: 0.1 to 2.4 xIn (step 0.01)

	ζ heating: 3 to 600 min (step 1 min)
	ζ cooling: 1 to 6 ζ heating (step 1)
	Alarm: 20 to 99 % (step 1%)
	Trip level: 100%
	Deactivation level: 95% of alarm level
	Trip time accuracy: ± 5% over the theoretical value
74CT (*)	Function Enable : Yes/No
	Time Delay: 0.02 to 300 s (step 0.01 s)
	Timing accuracy: ±30 ms or ±0.5% (greater of both)
37 (*)	Function Enable : Yes/No
	Current Tap: 0.10 to 30 xIn (step 0.01)
	Time Delay: 0.02 to 300 s (step 0.01 s)
	Activation level: 100%
	Deactivation level: 105%
	Instantaneous reset
	Timing accuracy: ±30 ms or ±0.5% (greater of both)
46BC (*)	Function Enable : Yes/No
	Current tap: 15 to 100 %(step 1%)
	Time Delay: 0.02 to 300 s (step 0.01 s)
	Timing accuracy: ±30 ms or ±0.5% (greater of both)
TB (*)	Function Enable : Yes/No
	Current Tap: 1.5 to 20 x In (step 0.01)
68	Available through configurable inputs and outputs thanks to programmable logic

Settings Groups	4 settings groups
	Activated by inputs or by general settings.
Events	200 events
Disturbance fault recording (DFR)	16 samples/cycle
	Fault start configurable
	20 fault reports with 24 events each one
	5 COMTRADE records of 100 cycles: 3 prefault and 97 postfault cycles
	COMTRADE IEEE C37.111-1991
	4 analog channels and 48 digital channels
Load Data Profiling (LDP)	Demand of current with the following characteristics: • Number of records: 168 • Recording mode circular • Sampling rate (interval): configurable through communications: 1 – 60 min • Record format: Date/Time IMAX (in interval) IMAX (actual) IA IB IC IN
Inputs	Same voltage as the auxiliary power supply 6 configurable inputs
Outputs	250 Vac – 8 A 30 Vdc – 5 A
	4 configurable outputs • Output 1 and output 2: NC + NO • Output 3 and output 4: NO
Frequency	50/60 Hz selectable by general settings
Current measurement	Phase current (IA, IB, IC), neutral (IN), positive sequence (I1), negative sequence(I2), maximum current (Imax) and thermal image (TI)
	Fundamental values (DFT)

	Sampling: 16 samples/cycle
	±2% Accuracy over a band of ±20% over the nominal current and 4% over the rest of the range
	Saturation limit: 30 times rated current
Communications	LOCAL COMMUNICATION 1 Local port RS232: ModBus RTU
	REMOTE COMMUNICATION (*) 1 remote port with the following options: • 1 Remote port RS485: ModBus RTU, IEC 60870-5-103 or DNP3.0 Serial (by general settings) • 1 Remote port RJ45: IEC 61850, DNP3.0 TCP/IP, Modbus TCP/IP or IEC 60870-5-104 (depending on model)
Auxiliary power	24-230 Vac/dc (-20%/+10%)
Environmental conditions	Operating temperature : -10 to 70ºC
	Storage temperature: -20 to 80ºC
	Relative humidity: 95%
Transformers	Measurement 3 or 4 CT /5 or /1
	Measurement 3 LPCT (current transformers with voltage output)
Mechanical Characteristics	Metallic box
	Panel mounted.
	Height x Width: 177 x 107 (mm)
	Depth: 122.1 mm
	Weight: 1.5 Kg
	IP-54 on pannel

(*) Optional depending on model

(1) LPCT model→50N/G, 50/51N: calculated neutral;

Standard model→50N/G, 50/51N/G: measured neutral

9.1.2 SIL-A Adaptation C

50_1	Function Enable : Yes/No/SHB
	Current Tap: 0.10 to 30 xIn (step 0.01)
	Time Delay: 0.00 to 300 s (step 0.01 s)
	Activation level 100%
	Deactivation level 95%
	Instantaneous deactivation
	Timing accuracy: If Time Delay 0.00 to 0.02 s: ± 50 ms or ± 0.5% (greater of both). If Time Delay 0.02 to 300 s: ± 30 ms or ± 0.5% (greater of both).
50G_1	Function Enable : Yes/No/SHB
	Current Tap: 0.05 to 30 xIn (step 0.01)
	Time Delay: 0.00 to 300 s (step 0.01 s)
	Activation level 100%
	Deactivation level 95%
	Instantaneous deactivation
	Timing accuracy: If Time Delay 0.00 to 0.02 s: ± 50 ms or ± 0.5% (greater of both). If Time Delay 0.02 to 300 s: ± 30 ms or ± 0.5% (greater of both).
50/51	Function Enable : Yes/No/SHB
	Current Tap: 0.10 to 7 xIn (step 0.01)
	Curves IEC 60255-151 and IEEE
	Curve Type: IEC Inverse curve, IEC very inverse curve, IEC extremely inverse curve IEC long time inverse, IEEE Inverse curve, IEEE very inverse curve, IEEE extremely inverse curve, Defined Time. Time Delay: 0.00 to 300 s (step 0.01 s)
	Time Dial (TMS): 0.02 to 2.20 (step 0.01)

	Curve, activation level 110%
	Curve, deactivation level 100%
	Defined time, activation level 100%
	Defined time, deactivation level 95%
	Instantaneous deactivation
	Timing accuracy for IEC and IEEE curves selection: ± 30 ms or ± 5% (greater of both). Timing accuracy for defined time curve selection: If Time Delay 0.00 to 0.02 s: ± 50 ms or ± 0.5% (greater of both). If Time Delay 0.02 to 300 s: ± 30 ms or ± 0.5% (greater of both).
50/51G	Function Enable : Yes/No/SHB
	Current tap: 0.05 to 7 xIn (step 0.01)
	Curves IEC 60255-151 and IEEE
	Curve Type: IEC Inverse curve, IEC very inverse curve, IEC extremely inverse curve IEC long time inverse, IEEE Inverse curve, IEEE very inverse curve, IEEE extremely inverse curve, Defined Time. Time Delay: 0.00 to 300 s (step 0.01 s)
	Time Dial (TMS): 0.02 to 2.20 (step 0.01)
	Curve, activation level 110%
	Curve, deactivation level 100%
	Defined time, activation level 100%
	Defined time, deactivation level 95%
	Instantaneous deactivation
	Timing accuracy for IEC and IEEE curves selection: ± 30 ms or ± 5% (greater of both). Timing accuracy for defined time curve selection: If Time Delay 0.00 to 0.02 s: ± 50 ms or ± 0.5% (greater of both). If Time Delay 0.02 to 300 s: ± 30 ms or ± 0.5% (greater of both).

46	Function Enable : Yes/No/SHB
	Current Tap: 0.10 to 7.00 xIn (step 0.01)
	Curves IEC 60255-151 and IEEE
	Curve Type: IEC Inverse curve, IEC very inverse curve, IEC extremely inverse curve IEC long time inverse, IEEE Inverse curve, IEEE very inverse curve, IEEE extremely inverse curve, Defined Time. Time Delay: 0.00 to 300 s (step 0.01 s)
	Time Dial (TMS): 0.02 to 2.20 (step 0.01)
	Curve, activation level 110%
	Curve, deactivation level 100%
	Defined time, activation level 100%
	Defined time, deactivation level 95%
	Instantaneous deactivation
	Timing accuracy for IEC and IEEE curves selection: ± 30 ms or ± 5% (greater of both). Timing accuracy for defined time curve selection: If Time Delay 0.00 to 0.02 s: ± 50 ms or ± 0.5% (greater of both). If Time Delay 0.02 to 300 s: ± 30 ms or ± 0.5% (greater of both).
Circuit breaker monitoring	Maximum number of openings: 1 to 10,000 (step 1)
	Maximum accumulated amperes: 0 to 100,000 ($M(A^2)$) (step 1)
	Opening time: 0.02 to 30 s (step 0.01 s)
	Closing time: 0.02 to 30 s (step 0.01 s)
	Excessive repeated openings: 1 to 10,000 (step 1)
	Repetitive openings/Time: 1 to 300 min (step 1 min)
	Open circuit breaker activation threshold: 8% In
	Open circuit breaker reset threshold: 10% In
79	Function Enable : Yes/No

	Hold Enable: Yes/No/No Time
	Number of reclosings: 1 to 5
	Reclose time 1, 2, 3, 4, 5 : 0.02 to 300 s (step 0.01 s)
	Hold time: 0.02 to 300 s (step 0.01 s)
	Reset time: 0.02 to 300 s (step 0.01 s)
	Safe time: 0.02 to 300 s (step 0.01 s)
	Locking possibilities: pulse inputs, level inputs, commands.
74TCS	Function Enable : Yes/No
	Time Delay: 0.02 to 300 s (step 0.01 s)
	Continuity in circuits A and B
	Dedicated inputs
CLP	Function Enable : Yes/No
	Settings group: 1 to 4 (step 1)
	No load Time: 0.02 to 300 s (step 0.01 s)
	Cold load Time: 0.02 to 300 s (step 0.01 s)
	CLP activation threshold: 8% In
	CLP reset threshold: 10% In
PGC	OR4, OR4_LATCH, OR4_PULSES, OR4_TIMERUP, OR4_PULSE, NOR4, NOR4_LATCH, NOR4_TIMERUP, NOR4_PULSE, AND4, AND4_PULSES, AND4_TIMERUP, AND4_PULSE, NAND4, NAND4_TIMERUP, NAND4_PULSE
86	Allows to latch (lock out) the contact trip due to programmable logic (PLC: LATCH).
49T	Available through configurable inputs thanks to the programmable logic
49	Function Enable : Yes/No
	Current Tap: 0.1 to 2.4 xIn (step 0.01)
	ζ heating: 3 to 600 min (step 1 min)

	ζ cooling: 1 to 6 ζ heating (step 1)
	Alarm: 20 to 99 % (step 1%)
	Trip level: 100%
	Deactivation level: 95% of alarm level
	Trip time accuracy: ± 5% over the theoretical value
46BC	Function Enable : Yes/No
	Current tap: 15 to 100 %(step 1%)
	Time Delay: 0.02 to 300 s (step 0.01 s)
	Timing accuracy: ±30 ms or ±0.5% (greater of both)
SHB	Function Enable : Yes/No
	Current tap: 5 to 50 % (step 1%)
	Reset time: 0.00 to 300 (step 0.01s)
	Block Threshold: 0.1 to 30 xIn (step 0.01)
68	ZSI available through configurable inputs and outputs thanks to programmable logic
Settings Groupss	4 settings groups
	Activated by inputs or by general settings.
Events	200 events
Disturbance fault recording (DFR)	16 samples/cycle
	Fault start configurable
	20 fault reports with 24 events each one
	5 COMTRADE records of 100 cycles: 3 prefault and 97 postfault cycles
	COMTRADE IEEE C37.111-1991
	4 analog channels and 35 digital channels

Load Data Profiling (LDP)	Demand of current with the following characteristics: • Number of records: 168 • Recording mode circular • Sampling rate (interval): configurable through communications: 1 – 60 min • Record format: Date/Time IMAX (in interval) IMAX (actual) IA IB IC IN
Inputs	Same voltage as the auxiliary power supply 4 configurable inputs + 2 non-configurable inputs
Outputs	250 Vac – 8 A 30 Vdc – 5 A
	4 configurable outputs • Output 1 and output 2: NC + NO • Output 2 and output 4: NO
Frequency	50/60 Hz selectable by general settings
Current measurement	Phase current (IA, IB, IC), neutral (IN), positive sequence (I1), negative sequence (I2), phase second harmonic current (IA-2H, IB-2H and IC-2H), maximum current (Imax) and thermal image (TI)
	Fundamental values (DFT)
	Sampling: 16 samples/cycle
	±2% Accuracy over a band of ±20% over the nominal current and ±4% or ±5 mA (greater of both) over the rest of the range
	Saturation limit: 30 times rated current
Communications	LOCAL COMMUNICATION 1 Local port RS232: ModBus RTU
	REMOTE COMMUNICATION (*) 1 remote port with the following options: • 1 Remote port RS485: ModBus RTU, IEC 60870-5-103 or DNP3.0 Serial (by general settings) • 1 Remote port RJ45: IEC 61850, DNP3.0 TCP/IP, Modbus TCP/IP or IEC 60870-5-104 (depending on model)

Auxiliary power	24-230 Vac/dc (-20%/+10%)
Environmental conditions	Operating temperature : -10 to 70ºC
	Storage temperature: -20 to 80ºC
	Relative humidity: 95%
Transformers	Measurement 3 or 4 CT /5 or /1
	Measurement 3 LPCT (current transformers with voltage output)
Mechanical Characteristics	Metallic box
	Panel mounted.
	Height x Width: 177 x 107 (mm)
	Depth: 122.1 mm
	Weight: 1.5 Kg
	IP-54 on pannel

(*) Optional depending on model

9.2 Thermal resistence

- 4 times rated current continously.
- 20 times rated current for 10 s.
- 80 times rated current for 1s.

9.3 Standards

1. EMC requirements		
- Emission		
1.1. Radiated emission	IEC 60255-26 EN 55022 EN 55011	Radiated emission limit for Class A (group 1 for EN 55011) on Enclosure port. Frequency range 30MHz - 230MHz (Quasi Peak 40dBµV/m). Frequency range 230MHz - 1000MHz (Quasi Peak 47dBµV/m)
1.2. Conducted emission	IEC 60255-26 EN 55022 EN 55011	Conducted emission limit for Class A (group 1 for EN 55011) on Auxiliary power supply port. Frequency range 0.15MHz – 0.5MHz (Quasi Peak 79µV, Avg 66µV). Frequency range 0.5MHz – 30MHz (Quasi Peak 73µV, Avg 60µV)
- Immunity		
1.3. 1MHz damped oscillatory waves	IEC 60255-26 IEC 61000-4-18	Class 3, Repetition frequency 400Hz, Duration of each application 3s. Common mode for all terminals ±2.5kV. Differential mode for all terminals excepts Communication port ±1kV
1.4. Electrostatic discharge	IEC 60255-26 IEC 61000-4-2	Level 4, Contact discharge ±8kV. Air discharge ±15kV
1.5. Radiated radiofrequency electromagnetic fields	IEC 60255-26 IEC 61000-4-3	Level 3, Test field strenght 10V/m, Frequency 80MHZ - 1000MHz and 1400MHz - 2000MHz, AM Modulation 80% for 1KHz carrier sinusoidal signal
1.6. Electrical fast transients	IEC 60255-26 IEC 61000-4-4	Level 4, Power supply to Earth terminals ±4kV, Signal and control terminals ±2kV. Repetition frequency 5KHz, Burst duration 75s.

1.7. Surge	IEC 60255-26 IEC 61000-4-5	Level 4, Line to earth for all terminals ±4kV. Line to Line for all terminals excepts Communication port ±2kV
1.8. Conducted disturbance induced by radio frequency fields	IEC 60255-26 IEC 61000-4-6	Level 3, Applied voltage 10V, Frequency 0.15MHz - 80 MHz, AM Modulation 80% for 1KHz carrier sinusoidal signal, Dwell time 1s, Test duration >10s.
1.9. Voltage dips, short interruptions and voltage variations	IEC 60255-26 IEC 61000-4-11 IEC 61000-4-29	DC Voltage Dips: 40%, 130ms and 70%, 100ms, 3 times every 10s. DC Voltage Interruption: 100ms, 3 times every 10s.
1.10. Ripple on DC input power port	IEC 60255-26 IEC 61000-4-17	Level 4, Ripple 15%, 50Hz and 100Hz
1.11. Power frequency magnetic field	IEC 60255-26 IEC 61000-4-8	Level 5, Continuous field strength 100 A/m. Short field strength for a duration of 3s. 1000 A/m. Frequency 50Hz.
1.12. 100KHz damped oscillatory waves	IEC 61000-4-18	Class 3, Repetition frequency 40Hz, Duration of each application 3s. Common mode: ±2.5kV. Differential mode: ±1kV
1.13. Pulse magnetic fields	IEC 61000-4-9	Field strength 1000 A/m, Cadence between pulses 40s.
1.14. Damped oscillatory magnetic fields	IEC 61000-4-10	Level 5, Field strength 100 A/m, Frequency 100KHz and 1MHz, Repetition frequency 40 trans./s at 100KHz, 400 trans/s at 1MHz, Duration of each application 3s.
1.15. Ring wave immunity test	IEC 61000-4-12	Level 4, Line to earth for all terminals ±4kV. Line to Line for all terminals excepts Communication port ±2kV

2. Product safety requirements (including thermal short time rating)		
2.1. Impulse voltage	IEC 60255-27 IEC 60255-5	Each group to earth and with rest of the groups in short-circuit ±5kV. Differential mode for each one of the groups ±1kV
2.2. AC or DC dielectric voltage	IEC 60255-27 IEC 60255-5	Each group to earth and with rest of the groups in short-circuit 2kVac, 50Hz, 1 minute
2.3. Insulation resistance	IEC 60255-27 IEC 60255-5	500V applied between each group to earth and with rest of the groups in short-circuit
2.4. Protective bonding resistance	IEC 60255-27	Test current 2xIn, Test voltage 12Vac during 60s. Resistance shall be less than 0.1 ohm
3. Burden		
3.1. AC burden for CT	IEC 60255-1	Declared on manual
3.2. AC, DC burden for power supply		
3.3. AC, DC burden for binary inputs		
4. Contact performance		
	IEC 60255-27	
5. Communication requirements		
	ModBus RTU Modbus TCP/IP IEC 61850 IEC 60870-5-103 IEC 60870-5-104 DNP 3.0 Serial DNP 3.0 TCP/IP	

6. Climatic environmental requirements	**IEC 60255-27**	
6.1. Cold	IEC 60068-2-1	Cold Operation Ab, -25ºC, 72h Cold transport & Storage Ad, -40ºC, 72h
6.2 Dry heat	IEC 60068-2-2	Dry Heat Operation Bb, +70ºC, 72h Dry Heat transport & Storage Bd, +85ºC, 72h
6.3 Change of temperature	IEC 60068-2-14	Change of Temperature Nb, Upper temp +70ºC, Lower temp -25ºC, 5 cycles, Exposure time 3h, Transfer time 2 min.
6.4 Damp heat	IEC 60068-2-30	Damp Heat Cyclic Db, Upper temp +40ºC, Humidity 93%, 2 cycles. Relay energized
	IEC 60068-2-78	Damp Heat Steady State Test Cab, Upper temp +40ºC, Humidity 85%, 2 days. Relay not energized
7. Mechanical requirements	**IEC 60255-27**	
7.1. Vibration	IEC 60255-21-1 IEC 60068-2-6	Vibration response, Class 1, 10Hz to 59Hz, 0,035mm and 59Hz to 150Hz, $0.5g_n$ Vibration endurance, Class 1, 10Hz to 150Hz, $1g_n$
7.2. Shock	IEC 60255-21-2 IEC 60068-21-2	Shock Response, Class 1, $5g_n$, Shock Withstands, Class 1, $15g_n$
7.3. Bump	IEC 60255-21-2 IEC 60068-21-2	Bump, Class 1, $10g_n$
7.4. Seismic	IEC 60255-21-3 IEC 60068-21-3	Single Axis Sine Sweep, Class 1, X Axis: 1 to 9Hz, 3.5mm and 9 to 35Hz, $1g_n$; Y Axis: 1 to 9Hz, 1.5mm and 9 to 35Hz, $0.5g_n$
8. Electrical environmental requirements		
8.1. CT Input continuous overload	IEC 60255-27	3xIn without damage for continuous operation
8.2. CT Input short time overload	IEC 60255-27	70xIn without damage for 1s short time overloading
9. Enclosure protection		
	IEC 60255-27 IEC 60529	IP-54

Quality Management System **ISO 9001:2008**

10 COMMUNICATION AND HMI

The SIL-A relay is equipped with the following communications ports, depending on model:

1	LOCAL (front)	RS232	Modbus RTU
2	REMOTE (rear)	RS485	Modbus RTU or IEC 60870-5-103 or DNP3.0 Serial (by general settings)
3	REMOTE (rear)	RJ45	IEC 61850
4	REMOTE (rear)	RJ45	DNP 3.0 TCP/IP or Modbus TCP/IP (by general settings)
5	REMOTE (rear)	RJ45	IEC60870-5-104

10.1 Local communication port. RS232

The RS232 communications port is installed on the front of the relay. The connector that is used is a DB-9 female – DCE. The protocol that is used is Modbus RTU (19200 -8bit – no parity – 1 stop bit for adaptation B and 115200-8bit – no parity – 1 stop for adaptation C).

The PC earth should be connected to the same earth as the relay to avoid communication problems.

The RS232 communication is fitted with auxiliary voltage insulation, but no insulation with regards to the relay processors. Therefore, the connection cable between the pc and relay must not be very long so as to prevent possible electromagnetic interferences with the relay.

10.2 Remote communications port

SILA with 1 port RS485 for ModBus or for IEC60870-5-103 or DNP3.0 serial

In this case, there are 1 RS485 port, it is possible to select ModBus RTU protocol or IEC60870-5-103 or DNP3.0 serial protocol thanks to the general settings. The RS485 port output has two terminals (+,-), located on the rear of the relay.

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

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

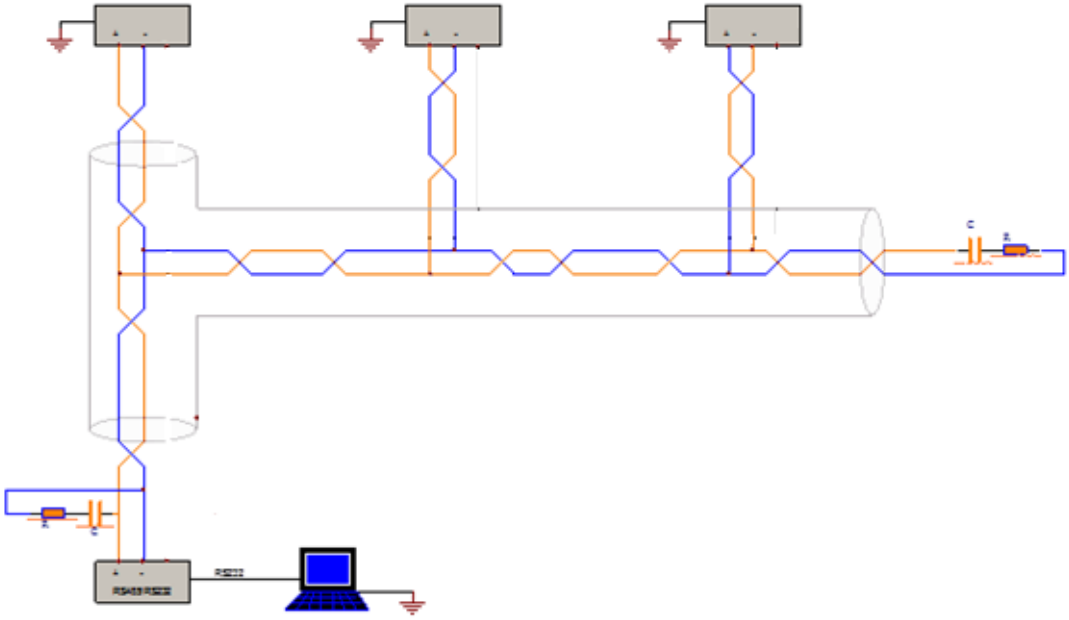
If a 3-wire cable is used, ground terminals (GND) should be connected to ground cable.

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

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

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

Connection diagram for a RS485 bus:



SILA with one RJ45 port for IEC61850, DNP3.0, IEC60870-5-104 or Modbus TCP

In this case there is one RJ45 port for IEC 61850 protocol, for DNP 3.0 TCP/IP protocol, for IEC 60870-5-104 protocol or Modbus TCP/IP depending on model.

10.3 LCD and keypad

The front of the SIL A 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, the LEDs indicators return to their initial position. The '**Reset**' key can also be used to delete all of the events in the 'Events' menu, the Fault Reports and the LDP.

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.

10.4 SICom Communications program

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

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

- Status reading
- Measurement reading
- Read and change settings
- Read and change configuration
- Read and delete events
- Read and delete DFR
- Configure and check the demand (LDP)
- Date-time synchronisation
- Set Counters
- Execute Commands

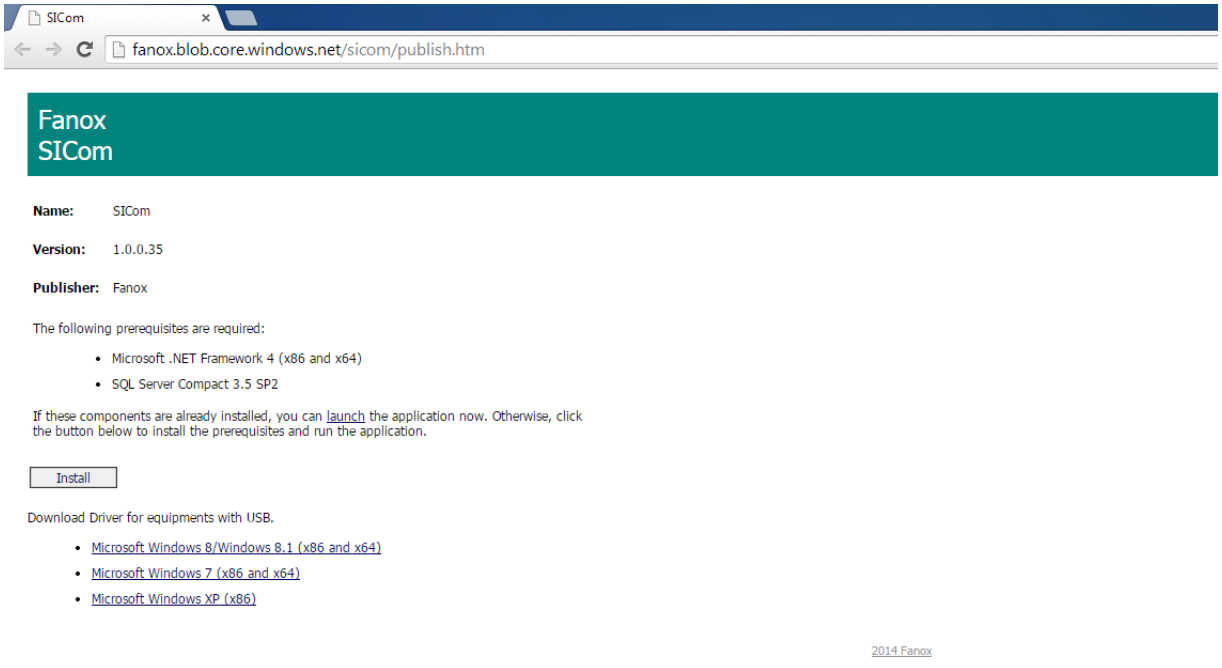
- Changing the user passwords
- Loading settings files
- Loading configuration files
- Checking the versions of the relay
- Configure Modbus address

10.4.1 How to install SICOM Software

To install the SICom it is necessary the following link:

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

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



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

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

10.5 Setting up the session: Password and access levels

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

ACCESS LEVEL	Read-only permission: Status and measurements Settings Configuration Events/DFR	Permission to: Change settings	Permission to: Delete Events Delete DFR	Permission to: Execute Commands Set Counters	Permission to: Change Configuration	Permission to Change Protected Settings
2	YES	YES	YES	NO	NO	NO
3	YES	NO	NO	YES	NO	NO
4	YES	YES	YES	YES	NO	NO
5	YES	YES	YES	YES	YES	NO

Four passwords and their associated levels of access are set up when the relay is configured using the SICom program. Four passwords and their associated levels of access are set up when the relay is configured using the SICom program. It is possible to change the passwords The password must have 4 characters. By default, the relay is programmed with the following passwords and their associated levels:

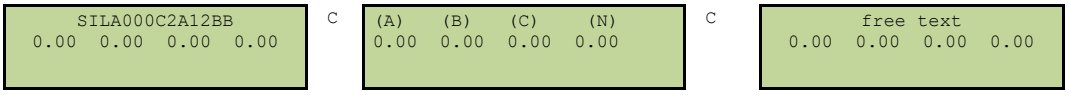
PASSWORD	ACCESS LEVEL
2222	2
3333	3
4444	4
5555	5

SIL-A relay is not provided with protected settings.

10.6 Menus

10.6.1 Standby mode 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, events, counters, commands, LDP and Fault Reports. If the HMI is left in any state, it will return to the default screen after 5 minutes without any key being pressed.

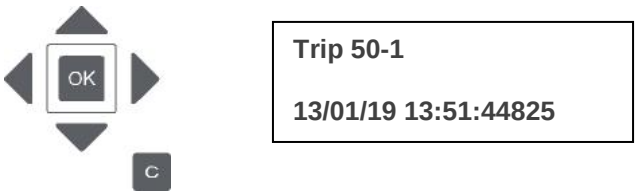


If any error is detected by the self-diagnosis, an error message appears in the second line (instead of the currents) on the main screen, which can show any of the following information: (see inside self-diagnosis section).

- MEASUREMENT ERROR
- EEPROM ERROR
- EVENTS ERROR

10.6.2 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.



Even if auxiliary power is lost, when the SIL-A 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.

10.6.3 Accessing the menus

The keys ▲, ▼, ◄ and ► are used to navigate through the different options and menus. The '**OK**' key is used to accept and to enter and menu or an option. The '**C**' key is used to move up through the menu levels.

It is not necessary to enter any password to read or view the parameters, measurements or settings.

A 4-character password must be entered in order to modify any parameter.

After returning to the main screen, the password must be entered again to make any further modifications.

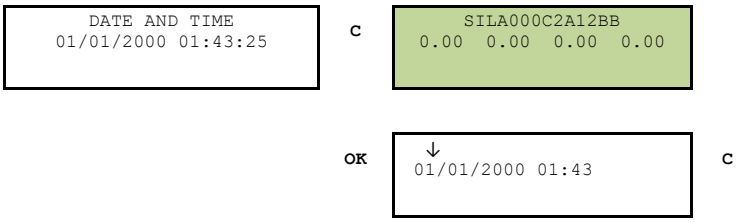
The keys ◄ and ► are used to navigate from one item to another within a parameter. The keys ▲ and ▼ are used to increase or decrease the value. If an invalid value is entered during the process, the '**C**' key can be used to delete it.

The navigation through the menus is described as graphically as possible below.

10.6.4 Date-Time Menu

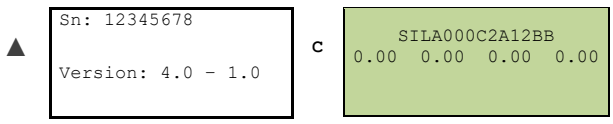
The date-time menu can be accessed by pressing the '►' key from the standby mode screen. From here, press the 'OK' key to access the date-time modification screen. Use the '►' and '◄' keys to position the cursor over the digit that you want to change, and assign a value to this digit using the '▲' and '▼' keys. Once the date-time has been entered, press 'OK' to change the relay date. Press the 'C' key to return to the standby mode screen.

The date-time information can be viewed by pressing the '►' key from the main screen.



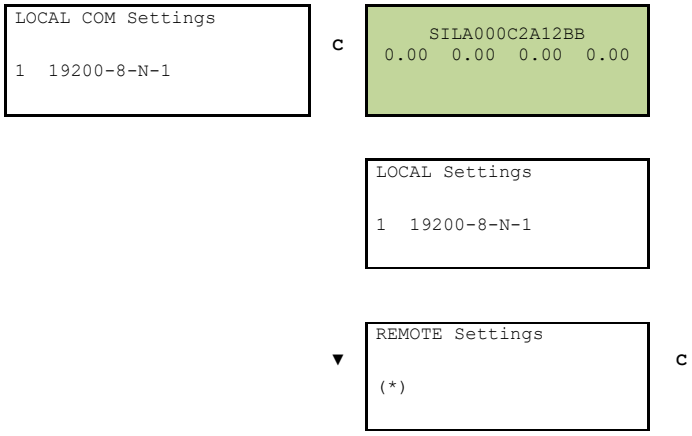
10.6.5 Versions

From the standby mode screen, hold the '▲' key to access to the relay versions where the microcontrollers software versions are displayed. Pressing 'C' key it is returned to the standby screen.



10.6.6 Communication parameters

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



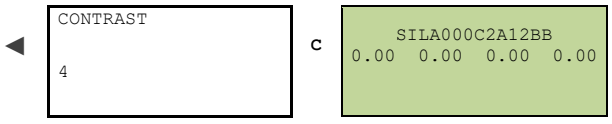
(*) REMOTE comunication name and parameters depend on model (the protocol that it is used can be IEC61850, DNP3.0, Modbus TCP/IP, IEC60870-5-104 or IEC60870-5-103 depending on model)

10.6.7 Contrast

From the standby mode screen, hold the '◄' key to visualize contrast menu.

Pressing '▲' and '▼' keys the contrast level can be changed.

Pressing 'C' key it is returned to the standby screen.



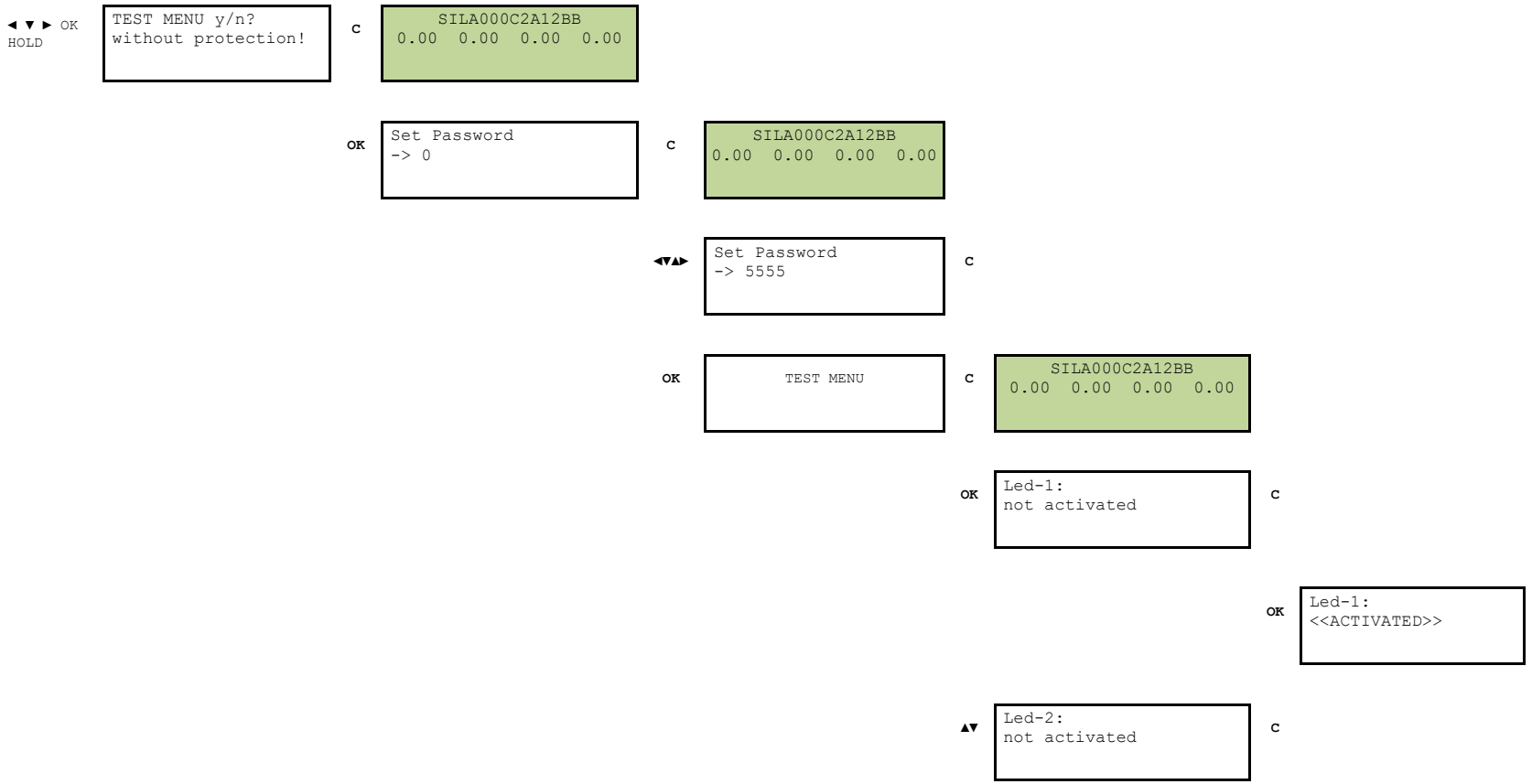
10.6.8 Fault report

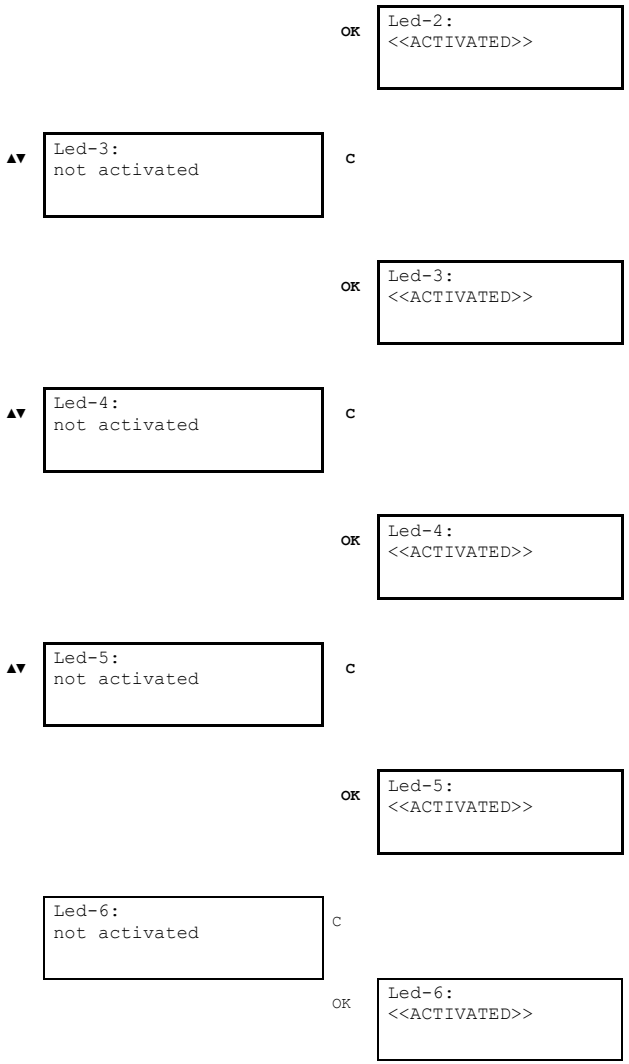
From the standby mode screen, press the '◄' key to access the fault report menu. It is possible to access to fault report menu navigating through main menus too. Using the '▲' and '▼' keys we can move onto the report we wish to display, and, pressing 'OK' provides access to the events each fault report contains.

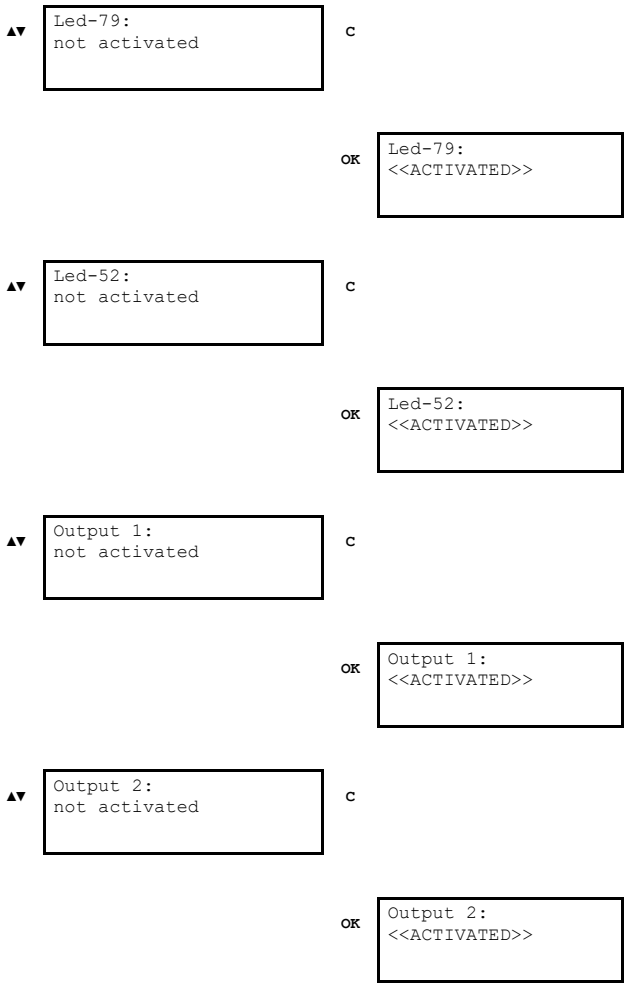
10.6.9 Test Menu

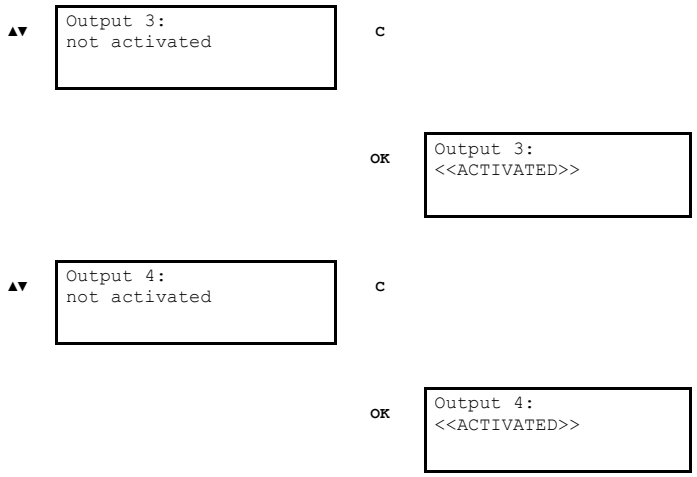
The ‘Test menu’ is accessed from the standby mode screen by sequentially pressing the ‘◄’, ‘▼’ and ‘►’ keys, and then holding down the ‘OK’ key. From here, press ‘OK’ to access the components that can be tested.

SIL-A Adaptation B




OK
Led-2:
<<ACTIVATED>>
▲▼
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-6:
not activated
C
OK
Led-6:
<<ACTIVATED>>

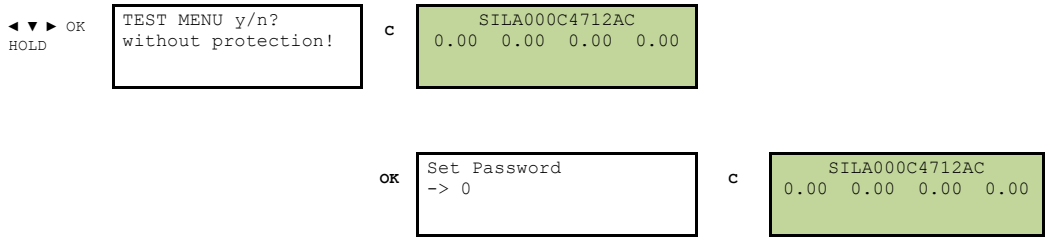

▲▼
Led-79:
not activated
C
OK
Led-79:
<<ACTIVATED>>
▲▼
Led-52:
not activated
C
OK
Led-52:
<<ACTIVATED>>
▲▼
Output 1:
not activated
C
OK
Output 1:
<<ACTIVATED>>
▲▼
Output 2:
not activated
C
OK
Output 2:
<<ACTIVATED>>

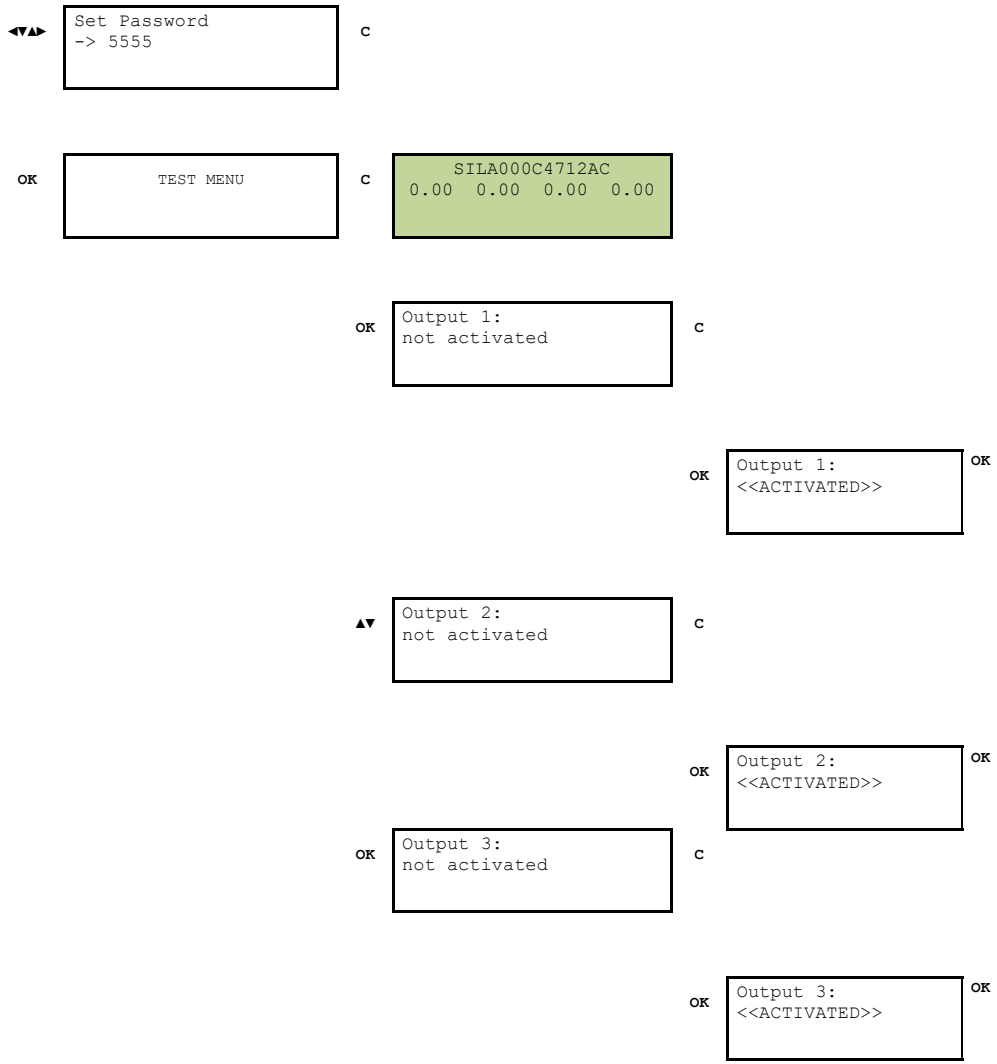


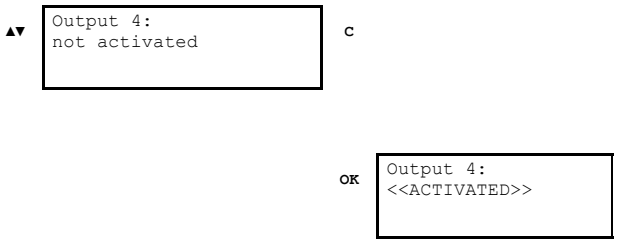
✋ **NOTE:** Be careful when activating the output which is set to trip. When the relay is installed it will open the circuit as if it were a trip.

SIL-A Adaptation C

Once the relay is in test menu mode all the LEDs will be activated simultaneously.




◄▼▲►
Set Password
-> 5555
C
OK
TEST MENU
C
SILA000C4712AC
0.00 0.00 0.00 0.00
OK
Output 1:
not activated
C
OK
Output 1:
<<ACTIVATED>>
OK
▲▼
Output 2:
not activated
C
OK
Output 2:
<<ACTIVATED>>
OK
OK
Output 3:
not activated
C
OK
Output 3:
<<ACTIVATED>>
OK

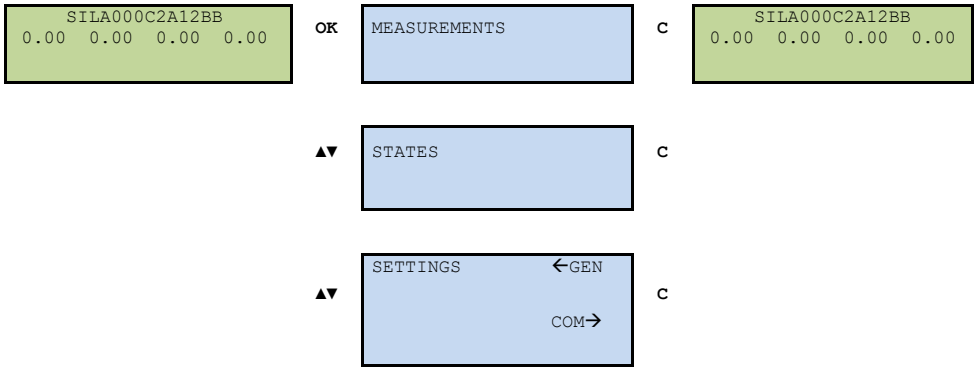


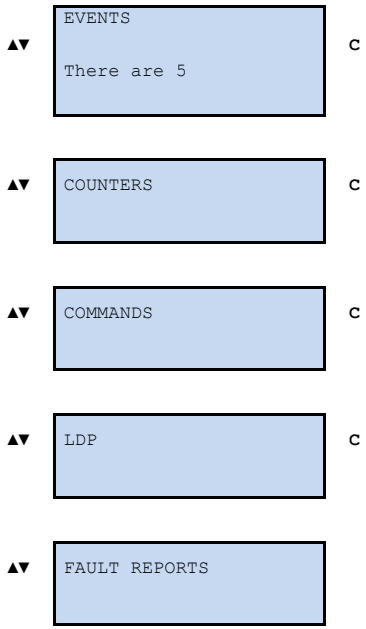
NOTE : Be careful when activating the output which is set to trip. When the relay is installed it will open the circuit as if it were a trip.

10.6.10 Functional Menu

The SIL-A relay menu is split up into 8 main parts:

- Measurements.
- Status.
- Settings.
- Events.
- Counters.
- Commands.
- LDP.
- Fault report

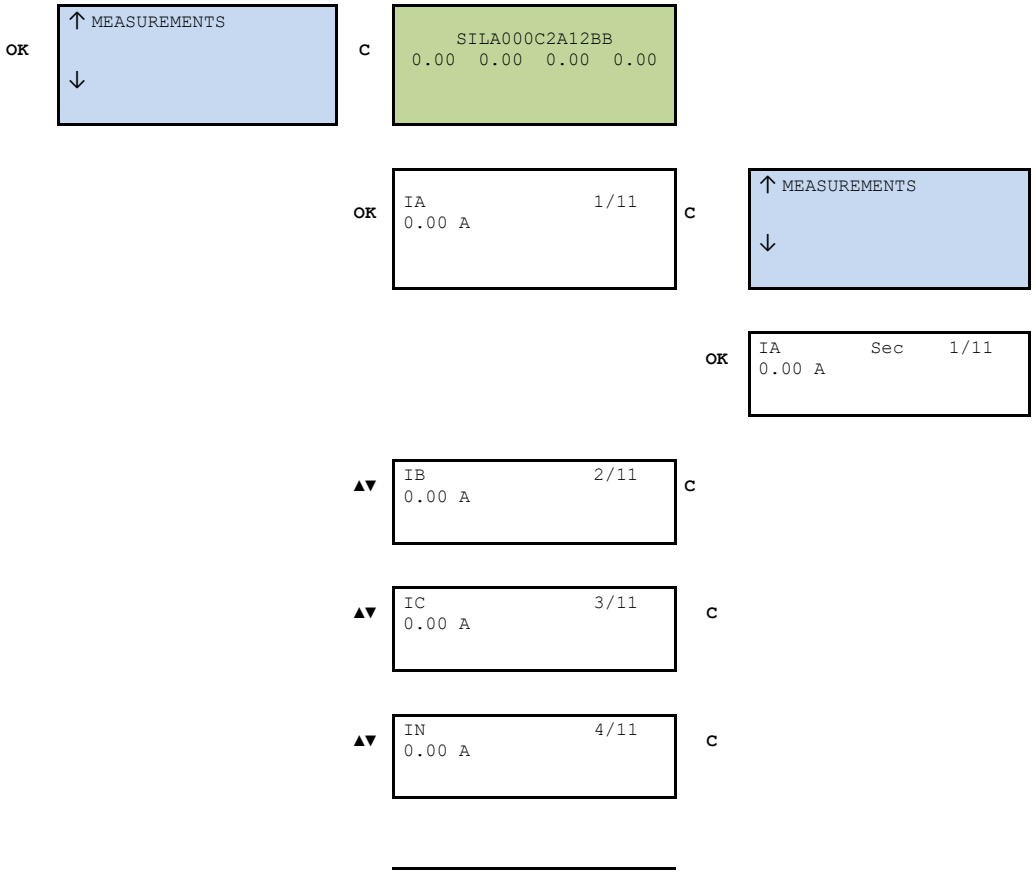


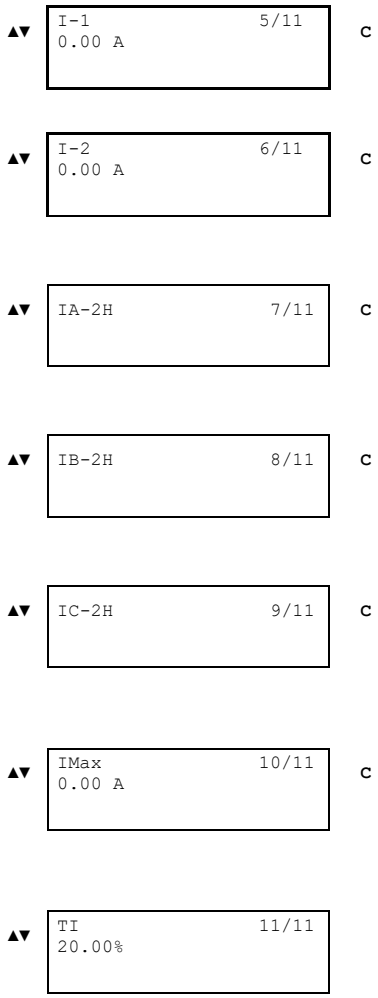


Press the '**OK**' key to access the second level from the main screen. Use the ▲ and ▼ keys to move from one menu section to another in the second level. Use the '**C**' key to return to a higher level.

10.6.11 Measurements Menu

From the standby mode screen, press the ‘OK’ key to access the first line of menus. Use the ‘▲’ and ‘▼’ keys to position the cursor over the ‘MEASUREMENTS’ screen and press ‘OK’. Use the ‘▲’ and ‘▼’ keys to position the cursor over the measurement and to see its value.

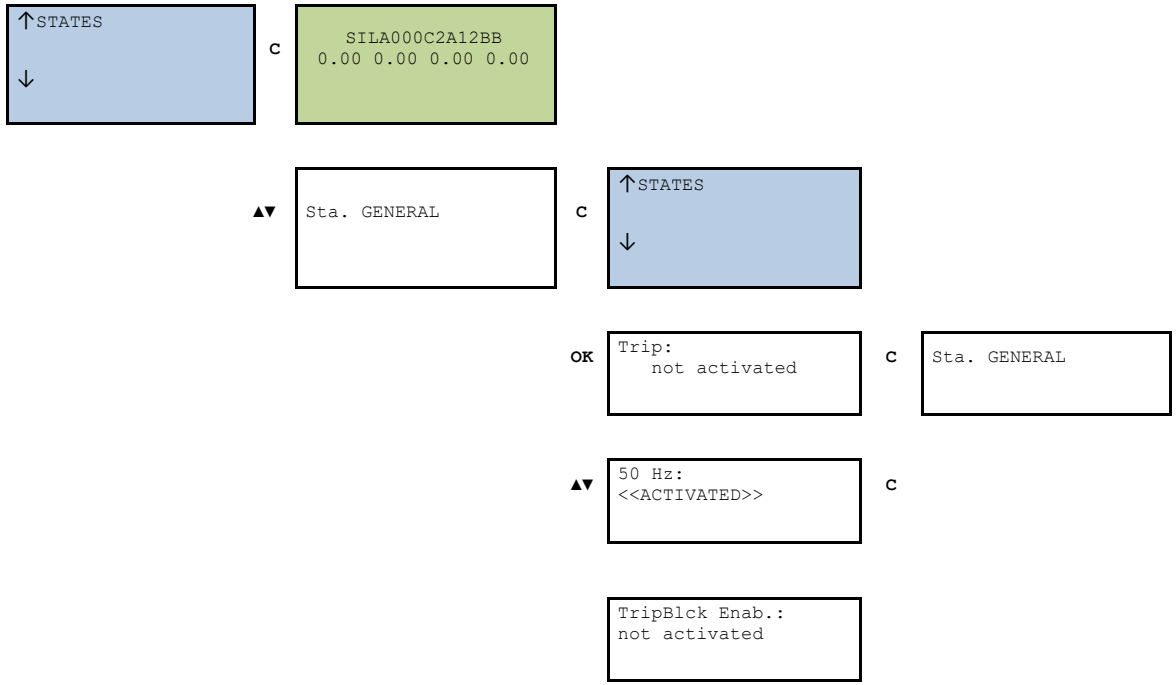


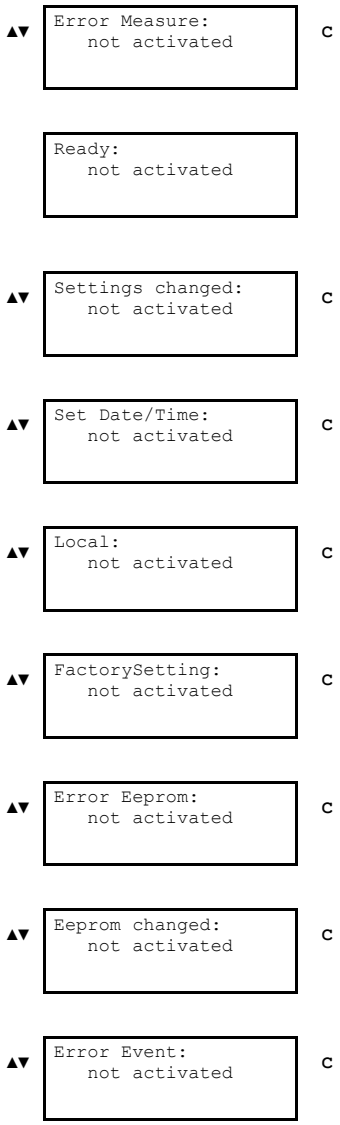

▲▼
I-1 5/11
0.00 A
C
▲▼
I-2 6/11
0.00 A
C
▲▼
IA-2H 7/11
C
▲▼
IB-2H 8/11
C
▲▼
IC-2H 9/11
C
▲▼
IMax 10/11
0.00 A
C
▲▼
TI 11/11
20.00%

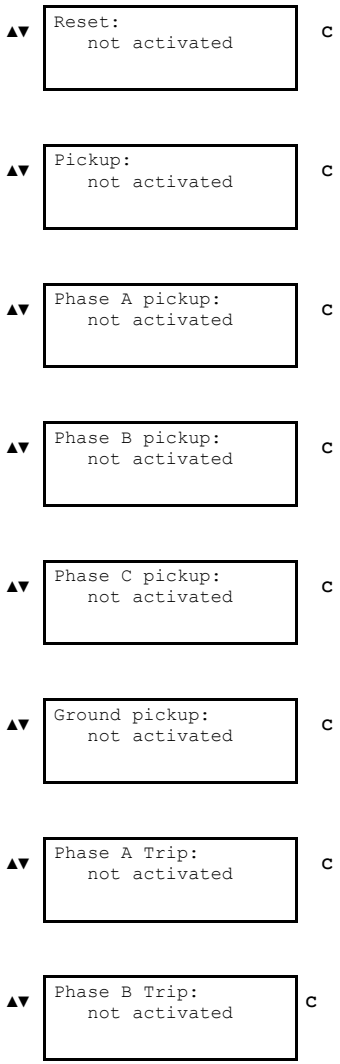
10.6.12 States Menu

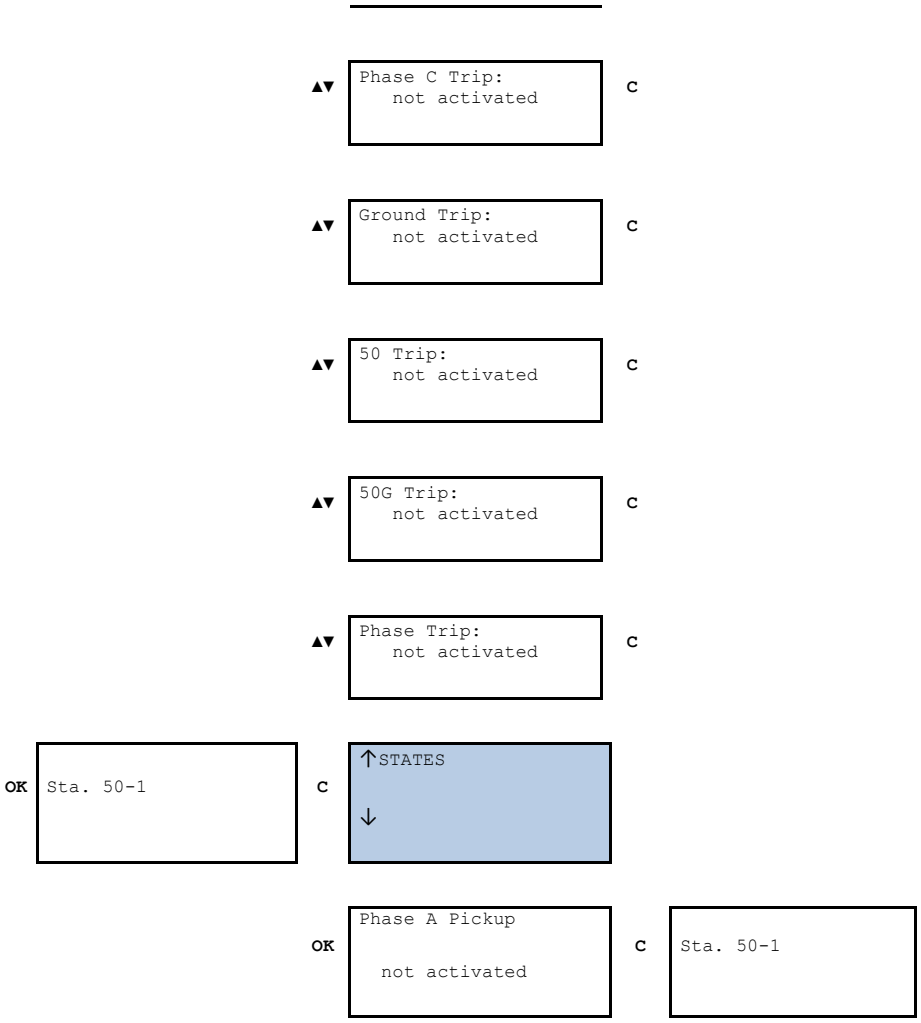
From the standby mode screen, press the ‘OK’ key to access the first line of menus. Use the ‘▲’ and ‘▼’ keys to position the cursor over the ‘STATUS’ screen and press ‘OK’. This takes you to the status groups line. Use the ‘▲’ and ‘▼’ keys to position the cursor over a group of statuses and press the ‘OK’ key to access the statuses that belong to this group. Use the ‘▲’ and ‘▼’ keys to browse through the different statuses. The information shows whether each status is active. The message ‘>Activated’ appears under the name of the group in the status group menus if any of the statuses in that group are active.

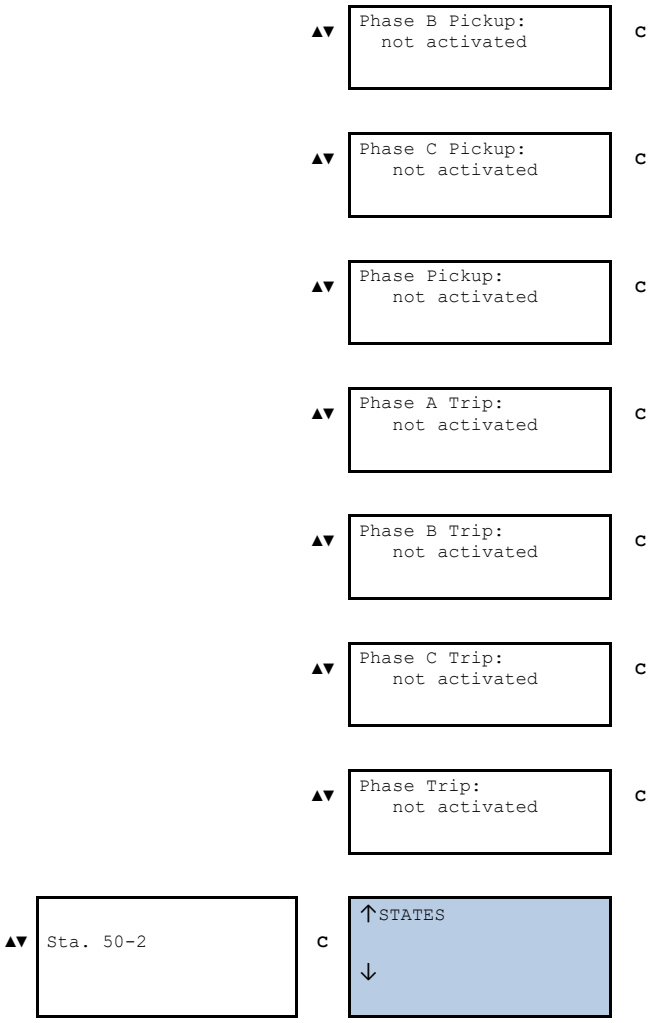
The method for navigating through the status menu is shown graphically below.



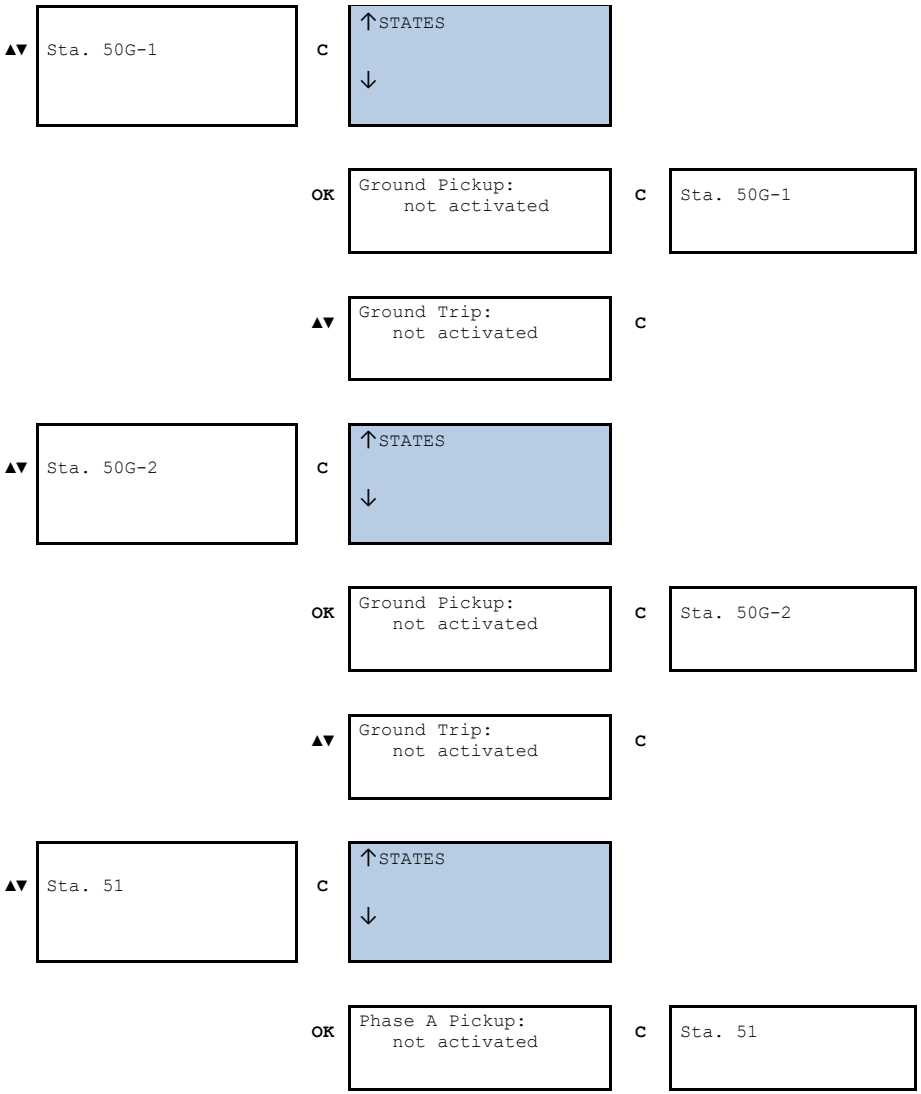

▲▼
Error Measure:
not activated
C
Ready:
not activated
▲▼
Settings changed:
not activated
C
▲▼
Set Date/Time:
not activated
C
▲▼
Local:
not activated
C
▲▼
FactorySetting:
not activated
C
▲▼
Error Eeprom:
not activated
C
▲▼
Eeprom changed:
not activated
C
▲▼
Error Event:
not activated
C

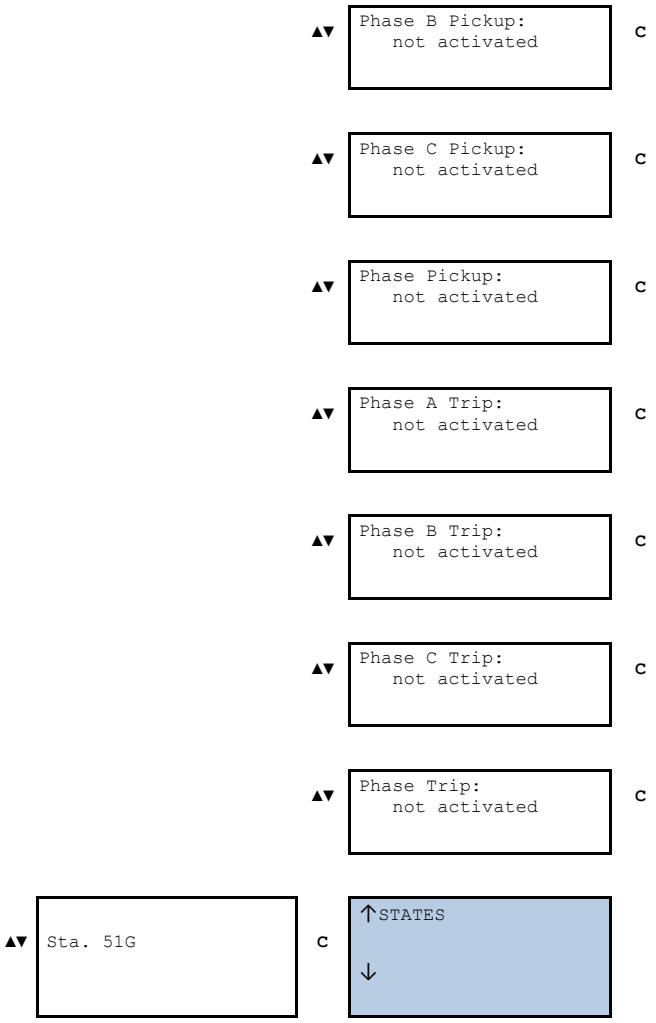

▲▼
Reset:
not activated
C
▲▼
Pickup:
not activated
C
▲▼
Phase A pickup:
not activated
C
▲▼
Phase B pickup:
not activated
C
▲▼
Phase C pickup:
not activated
C
▲▼
Ground pickup:
not activated
C
▲▼
Phase A Trip:
not activated
C
▲▼
Phase B Trip:
not activated
C

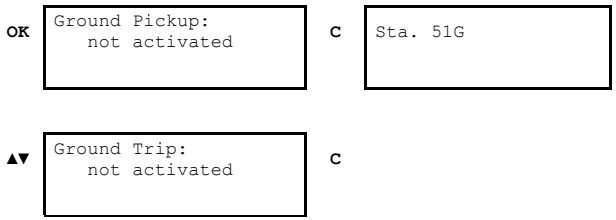

▲▼
Phase C Trip:
not activated
C
▲▼
Ground Trip:
not activated
C
▲▼
50 Trip:
not activated
C
▲▼
50G Trip:
not activated
C
▲▼
Phase Trip:
not activated
C
OK
Sta. 50-1
C
↑STATES
↓
OK
Phase A Pickup
not activated
C
Sta. 50-1

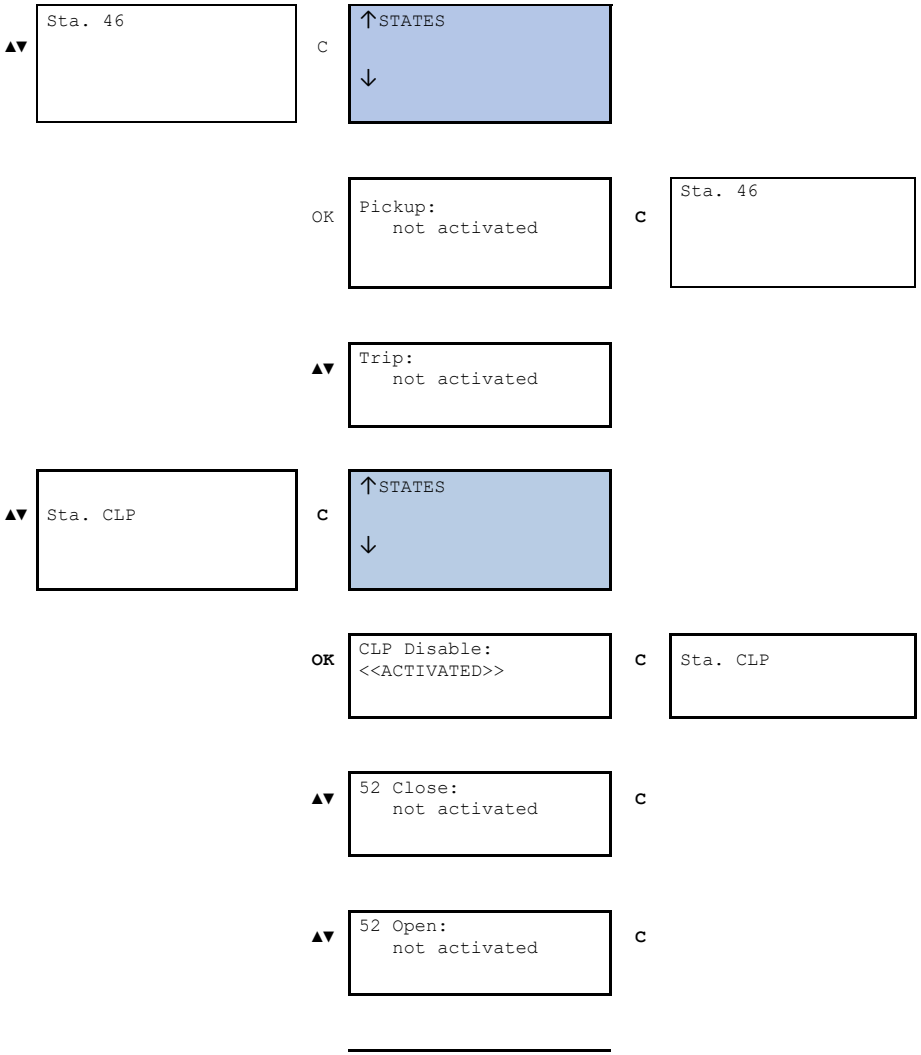

▲▼
Phase B Pickup:
not activated
C
▲▼
Phase C Pickup:
not activated
C
▲▼
Phase Pickup:
not activated
C
▲▼
Phase A Trip:
not activated
C
▲▼
Phase B Trip:
not activated
C
▲▼
Phase C Trip:
not activated
C
▲▼
Phase Trip:
not activated
C
▲▼
Sta. 50-2
C
↑STATES
↓

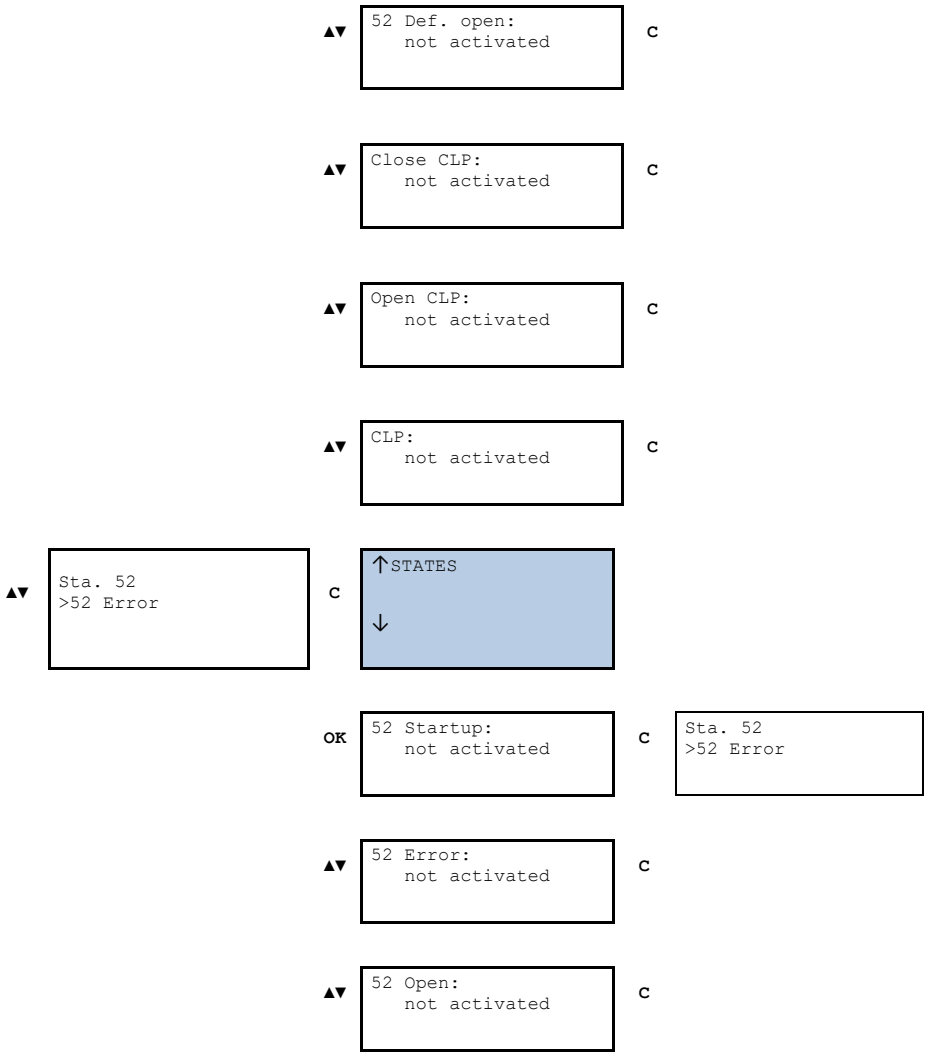

OK
Phase A Pickup:
not activated
C
Sta. 50-2
▲▼
Phase B Pickup:
not activated
C
▲▼
Phase C Pickup:
not activated
C
▲▼
Phase Pickup:
not activated
C
▲▼
Phase A Trip:
not activated
C
▲▼
Phase B Trip:
not activated
C
▲▼
Phase C Trip:
not activated
C
▲▼
Phase Trip:
not activated
C

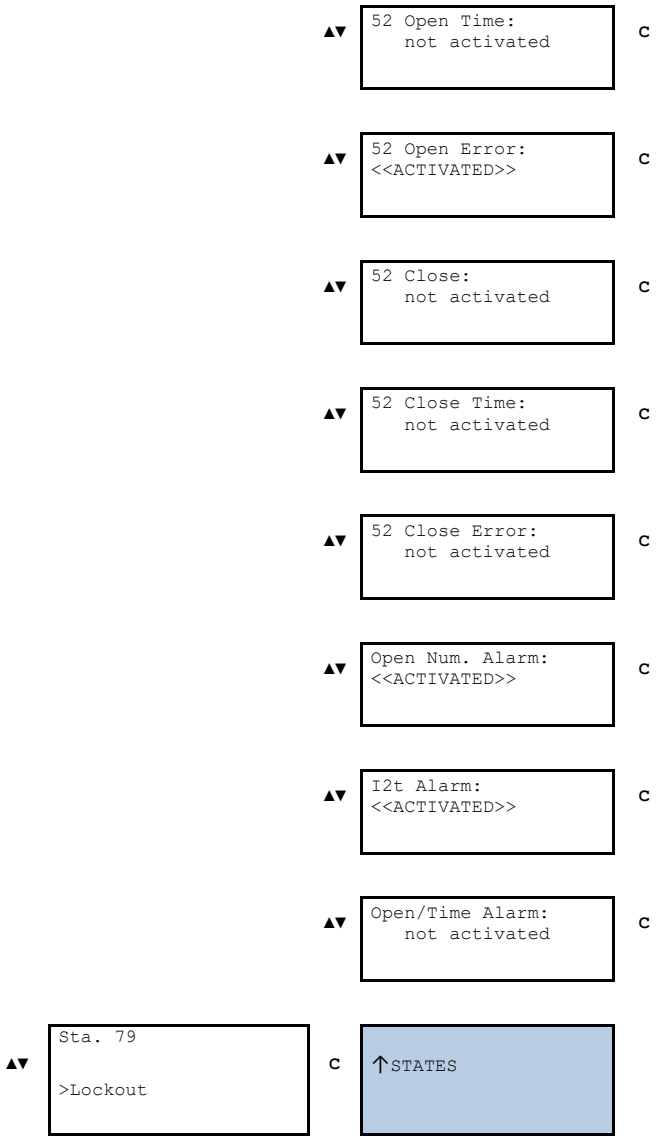

▲▼ Sta. 50G-1
C
↑STATES
↓
OK Ground Pickup:
not activated
C Sta. 50G-1
▲▼ Ground Trip:
not activated
C
▲▼ Sta. 50G-2
C
↑STATES
↓
OK Ground Pickup:
not activated
C Sta. 50G-2
▲▼ Ground Trip:
not activated
C
▲▼ Sta. 51
C
↑STATES
↓
OK Phase A Pickup:
not activated
C Sta. 51

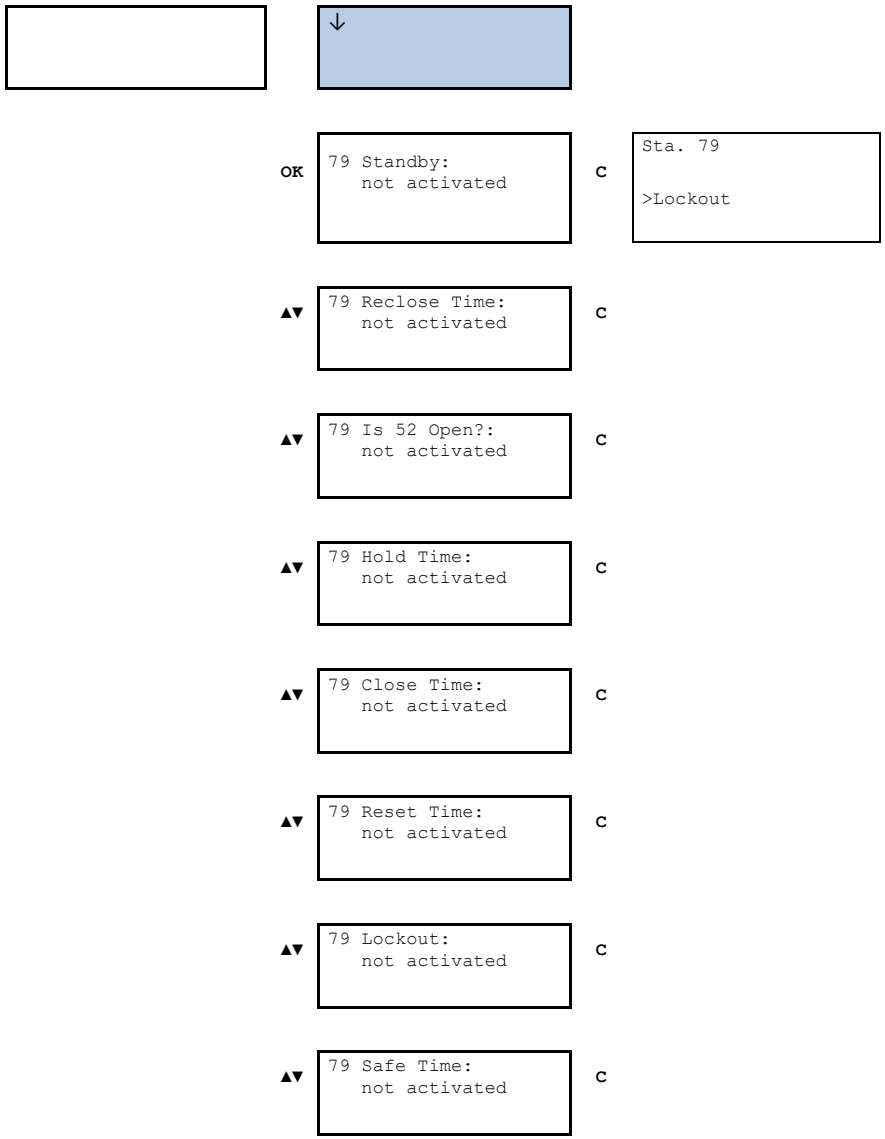

▲▼
Phase B Pickup:
not activated
C
▲▼
Phase C Pickup:
not activated
C
▲▼
Phase Pickup:
not activated
C
▲▼
Phase A Trip:
not activated
C
▲▼
Phase B Trip:
not activated
C
▲▼
Phase C Trip:
not activated
C
▲▼
Phase Trip:
not activated
C
▲▼
Sta. 51G
C
↑STATES
↓

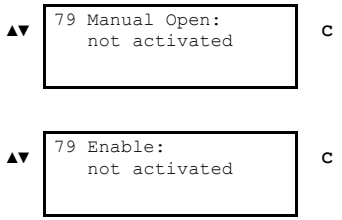

OK
Ground Pickup:
not activated
C
Sta. 51G
▲▼
Ground Trip:
not activated
C

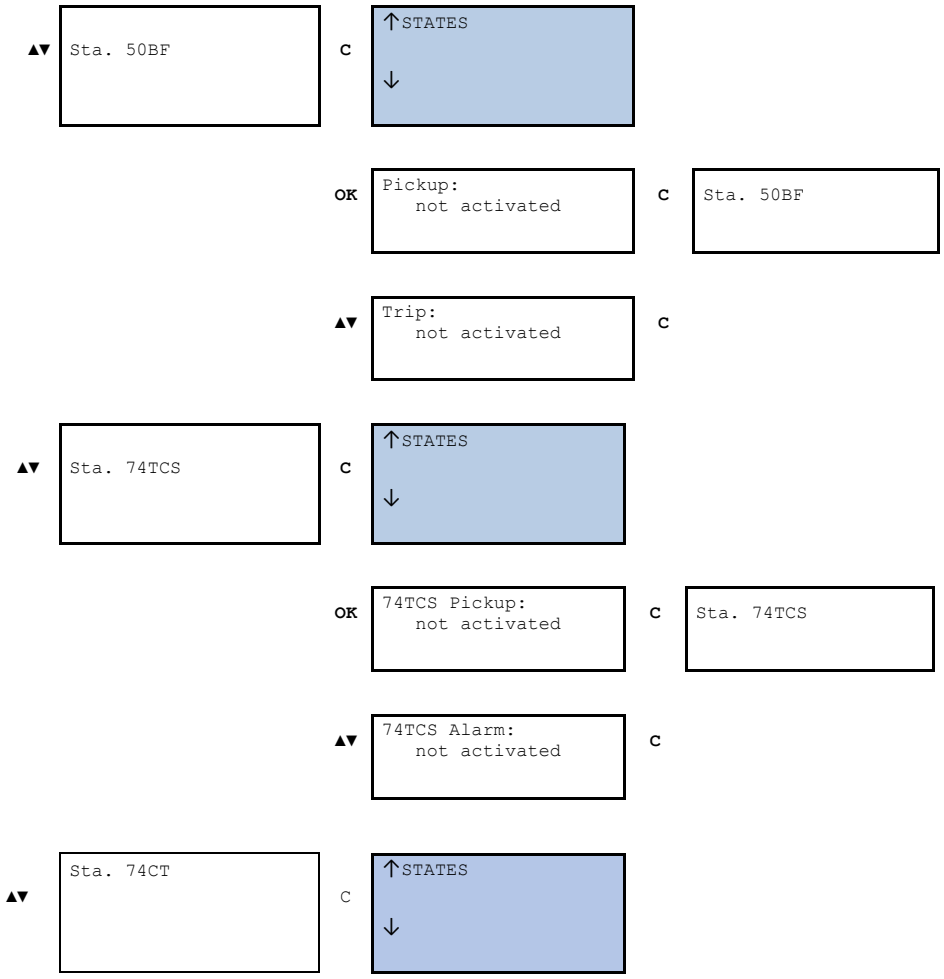

Sta. 46
C
↑STATES
↓
OK
Pickup:
not activated
C
Sta. 46
Trip:
not activated
Sta. CLP
C
↑STATES
↓
OK
CLP Disable:
<<ACTIVATED>>
C
Sta. CLP
52 Close:
not activated
C
52 Open:
not activated
C

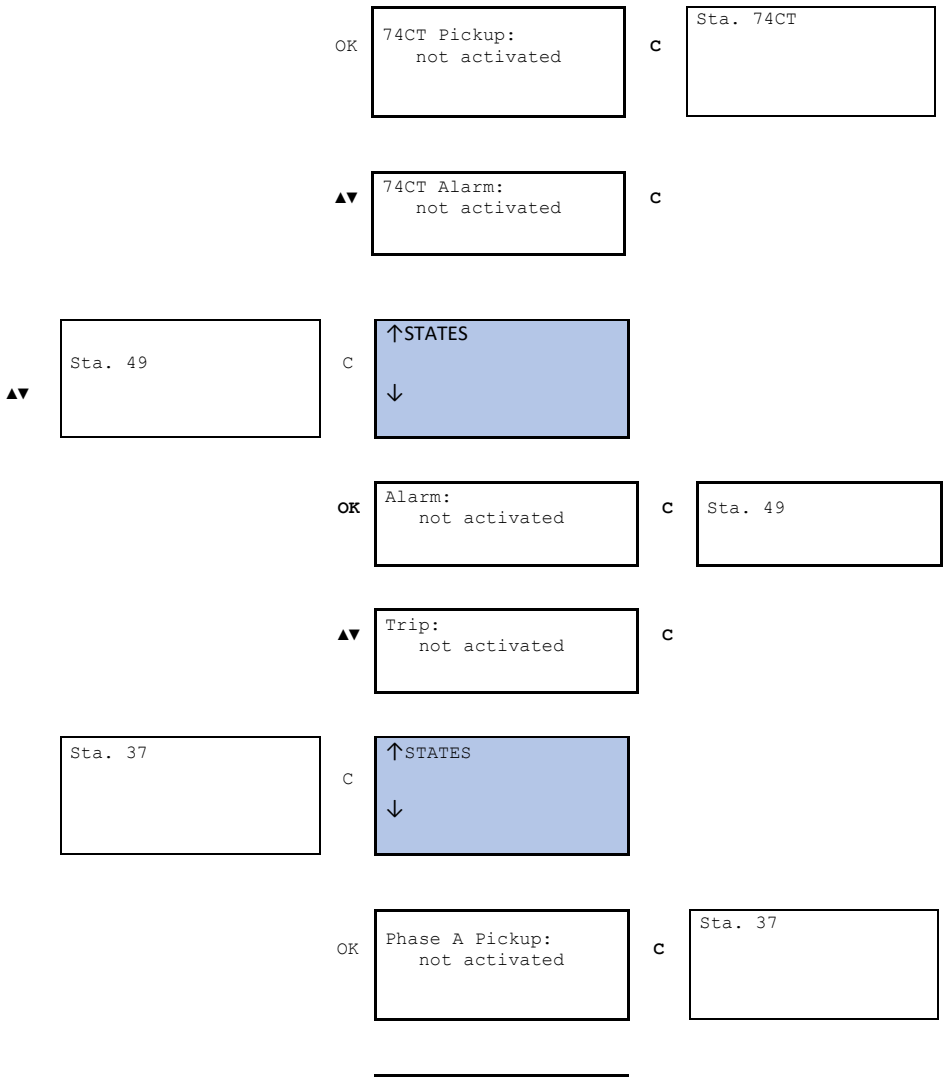

▲▼
52 Def. open:
not activated
C
▲▼
Close CLP:
not activated
C
▲▼
Open CLP:
not activated
C
▲▼
CLP:
not activated
C
▲▼
Sta. 52
>52 Error
C
↑STATES
↓
OK
52 Startup:
not activated
C
Sta. 52
>52 Error
▲▼
52 Error:
not activated
C
▲▼
52 Open:
not activated
C

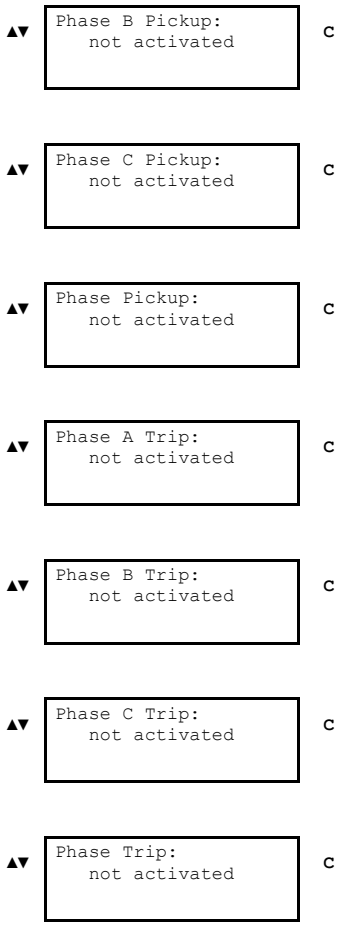

▲▼
52 Open Time:
not activated
C
▲▼
52 Open Error:
<<ACTIVATED>>
C
▲▼
52 Close:
not activated
C
▲▼
52 Close Time:
not activated
C
▲▼
52 Close Error:
not activated
C
▲▼
Open Num. Alarm:
<<ACTIVATED>>
C
▲▼
I2t Alarm:
<<ACTIVATED>>
C
▲▼
Open/Time Alarm:
not activated
C
▲▼
Sta. 79
>Lockout
C
↑STATES

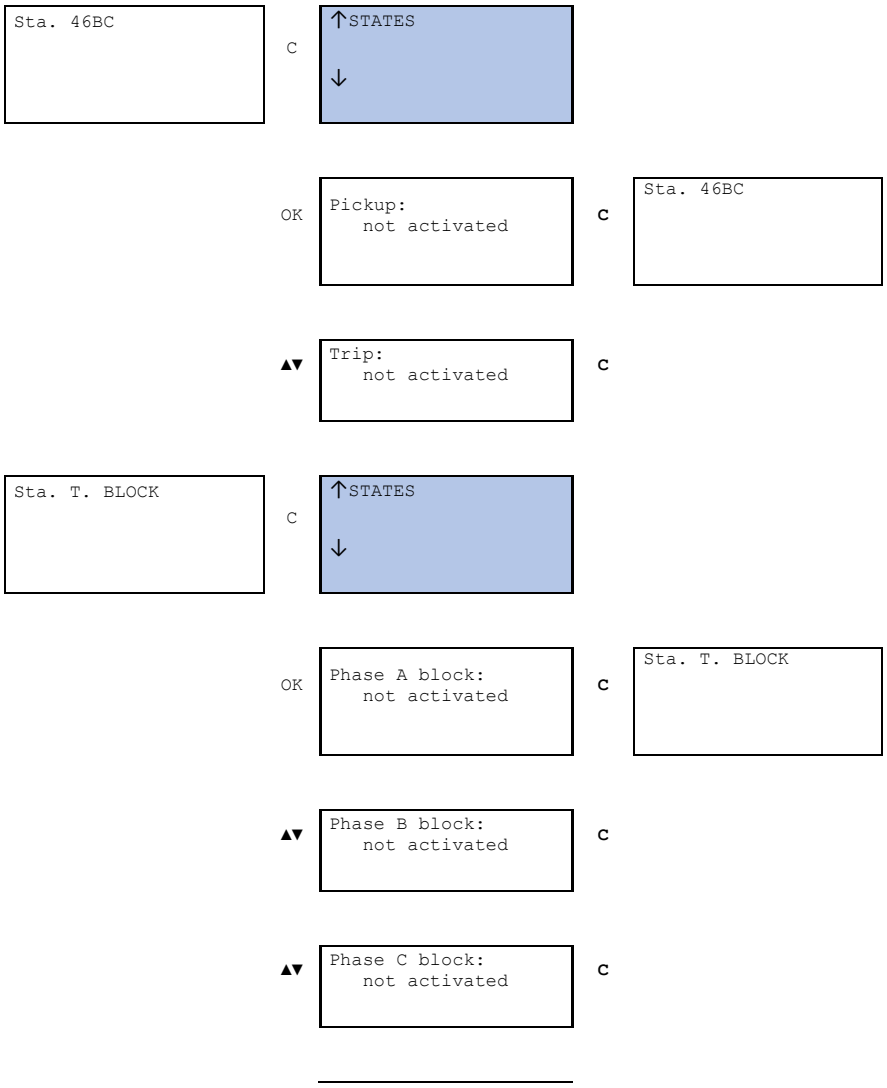

↓
OK
79 Standby:
not activated
C
Sta. 79
>Lockout
▲▼
79 Reclose Time:
not activated
C
▲▼
79 Is 52 Open?:
not activated
C
▲▼
79 Hold Time:
not activated
C
▲▼
79 Close Time:
not activated
C
▲▼
79 Reset Time:
not activated
C
▲▼
79 Lockout:
not activated
C
▲▼
79 Safe Time:
not activated
C

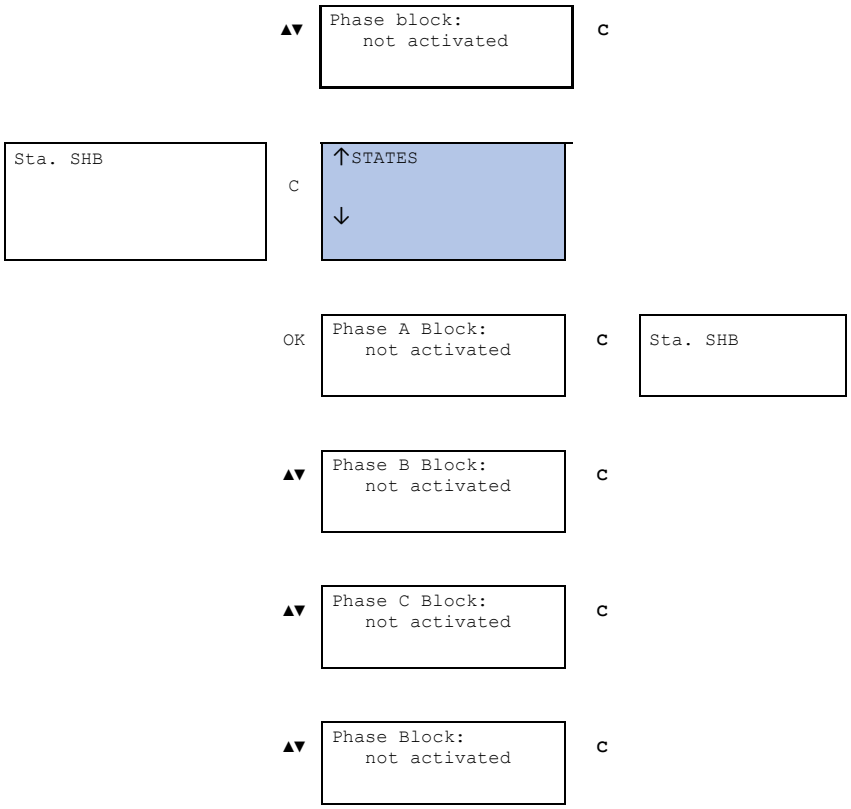

▲▼
79 Manual Open:
not activated
C
▲▼
79 Enable:
not activated
C

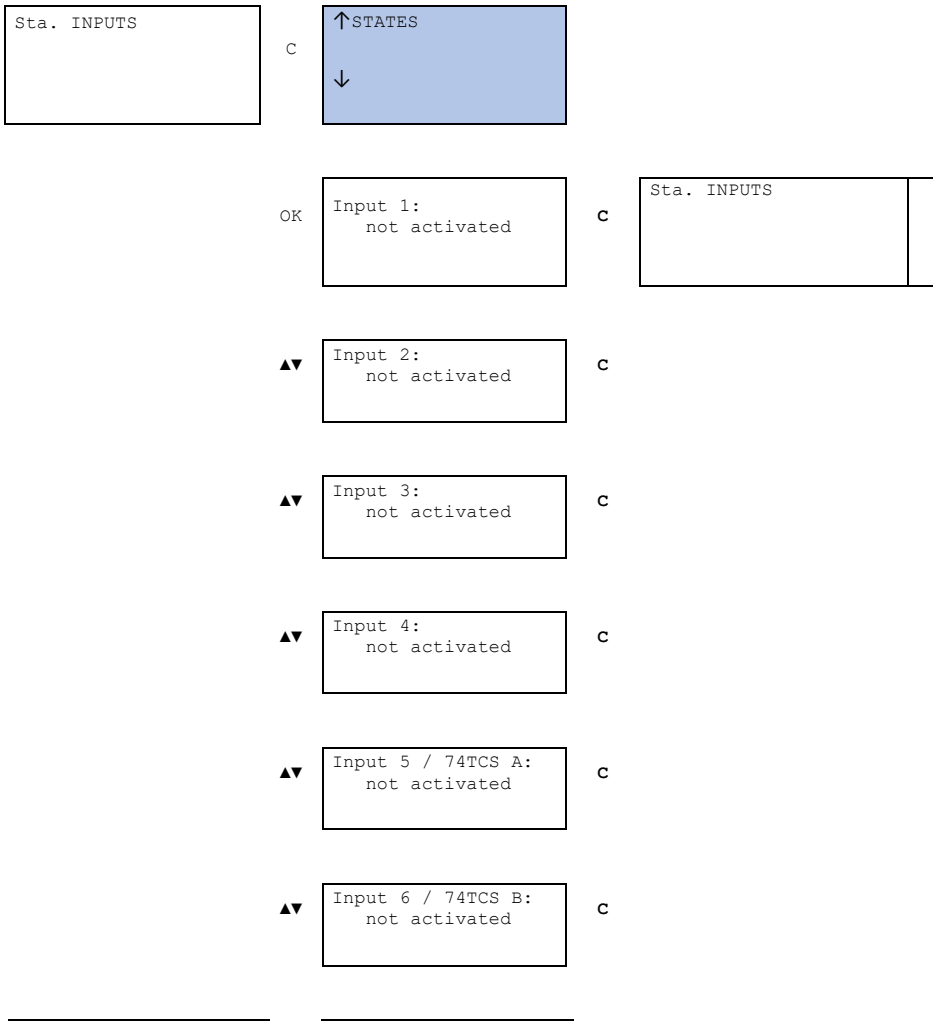

▲▼
Sta. 50BF
C
↑STATES
↓
OK
Pickup:
not activated
C
Sta. 50BF
▲▼
Trip:
not activated
C
▲▼
Sta. 74TCS
C
↑STATES
↓
OK
74TCS Pickup:
not activated
C
Sta. 74TCS
▲▼
74TCS Alarm:
not activated
C
▲▼
Sta. 74CT
C
↑STATES
↓

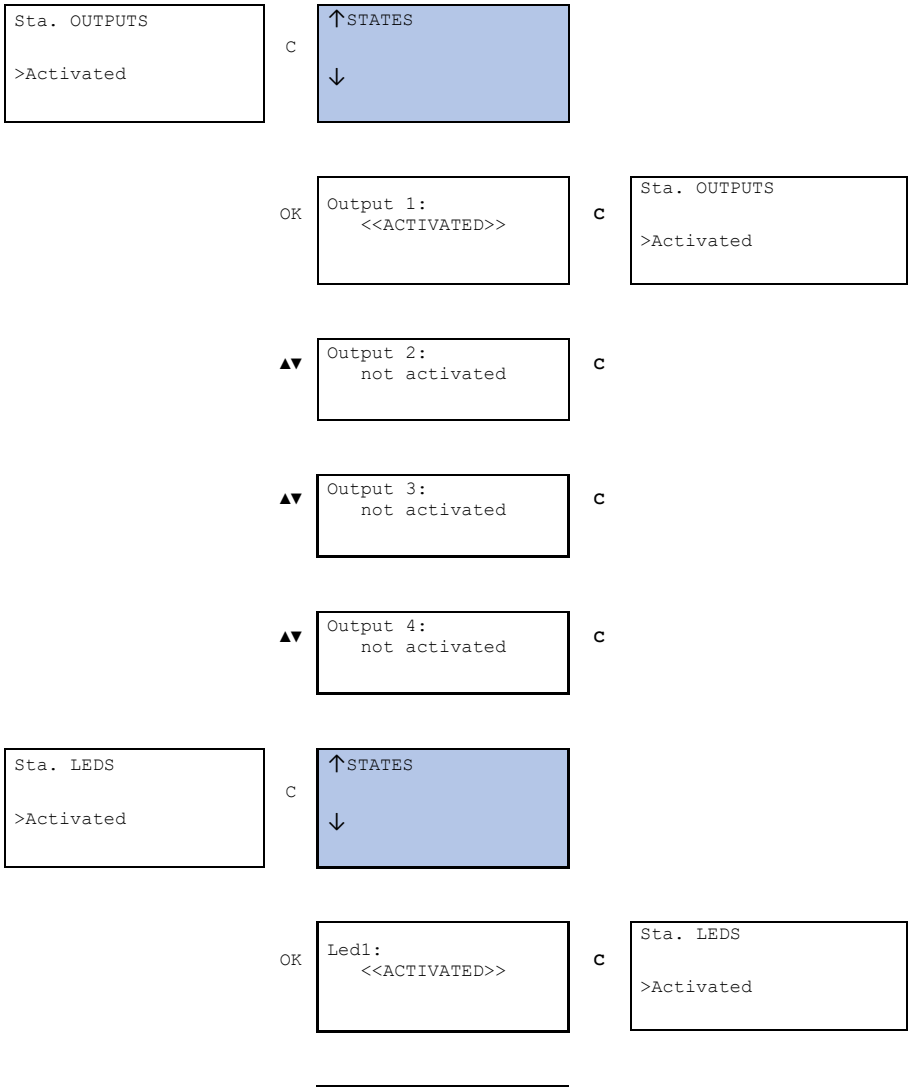

OK
74CT Pickup:
not activated
C
Sta. 74CT
▲▼
74CT Alarm:
not activated
C
▲▼
Sta. 49
C
↑STATES
↓
OK
Alarm:
not activated
C
Sta. 49
▲▼
Trip:
not activated
C
Sta. 37
C
↑STATES
↓
OK
Phase A Pickup:
not activated
C
Sta. 37

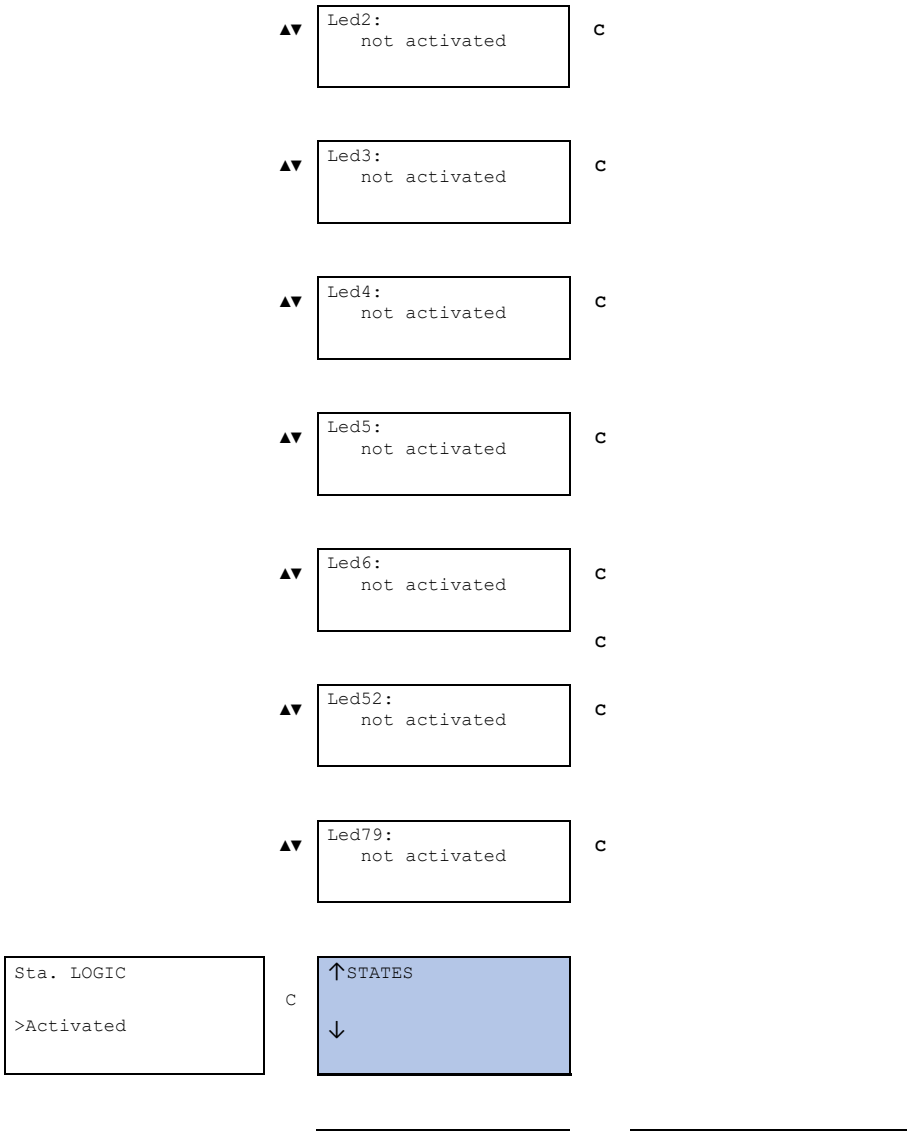

▲▼
Phase B Pickup:
not activated
C
▲▼
Phase C Pickup:
not activated
C
▲▼
Phase Pickup:
not activated
C
▲▼
Phase A Trip:
not activated
C
▲▼
Phase B Trip:
not activated
C
▲▼
Phase C Trip:
not activated
C
▲▼
Phase Trip:
not activated
C


Sta. 46BC
C
↑STATES
↓
OK
Pickup:
not activated
C
Sta. 46BC
▲▼
Trip:
not activated
C
Sta. T. BLOCK
C
↑STATES
↓
OK
Phase A block:
not activated
C
Sta. T. BLOCK
▲▼
Phase B block:
not activated
C
▲▼
Phase C block:
not activated
C

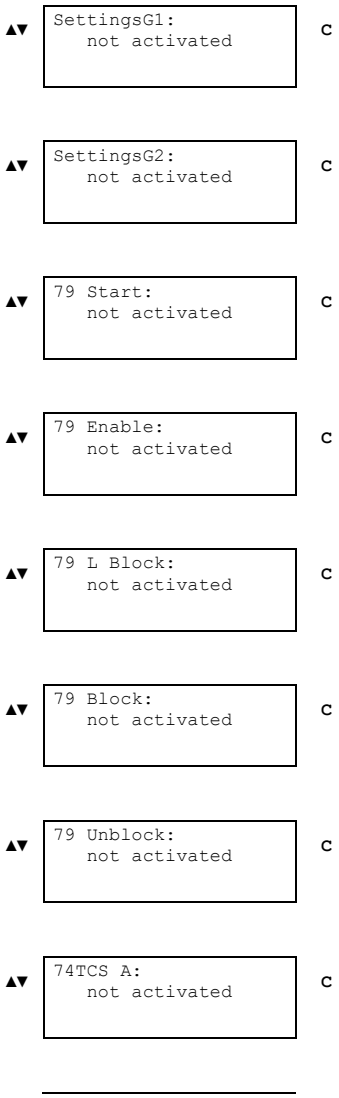

▲▼
Phase block:
not activated
C
Sta. SHB
C
↑STATES
↓
OK
Phase A Block:
not activated
C
Sta. SHB
▲▼
Phase B Block:
not activated
C
▲▼
Phase C Block:
not activated
C
▲▼
Phase Block:
not activated
C

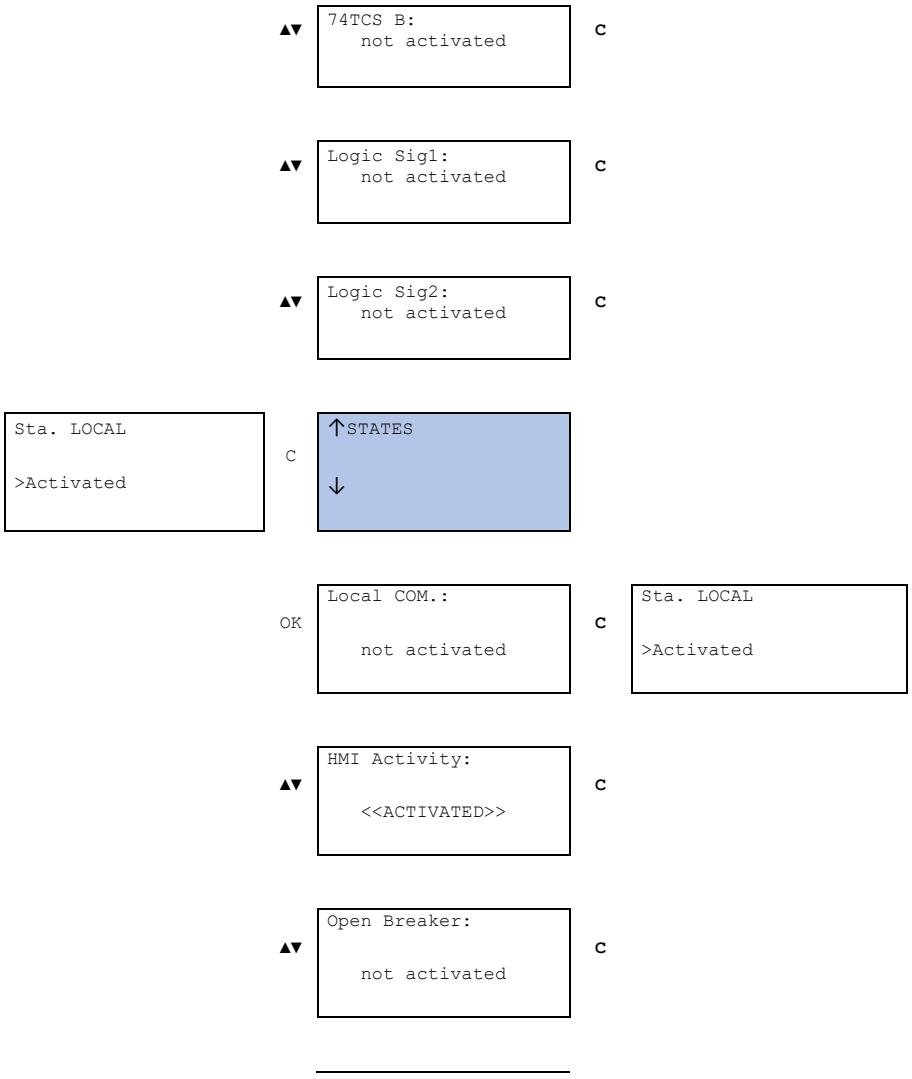

Sta. INPUTS
C
↑STATES
↓
OK
Input 1:
not activated
C
Sta. INPUTS
▲▼
Input 2:
not activated
C
▲▼
Input 3:
not activated
C
▲▼
Input 4:
not activated
C
▲▼
Input 5 / 74TCS A:
not activated
C
▲▼
Input 6 / 74TCS B:
not activated
C

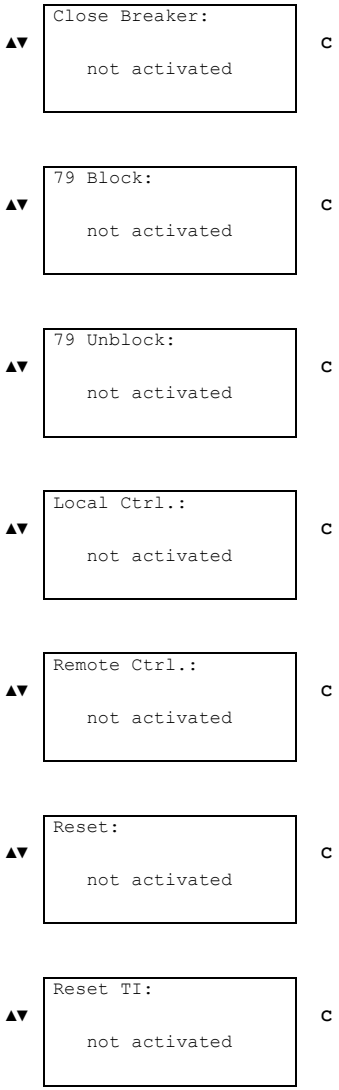

Sta. OUTPUTS
>Activated
C
↑STATES
↓
OK
Output 1:
<<ACTIVATED>>
C
Sta. OUTPUTS
>Activated
▲▼
Output 2:
not activated
C
▲▼
Output 3:
not activated
C
▲▼
Output 4:
not activated
C
Sta. LEDS
>Activated
C
↑STATES
↓
OK
Led1:
<<ACTIVATED>>
C
Sta. LEDS
>Activated

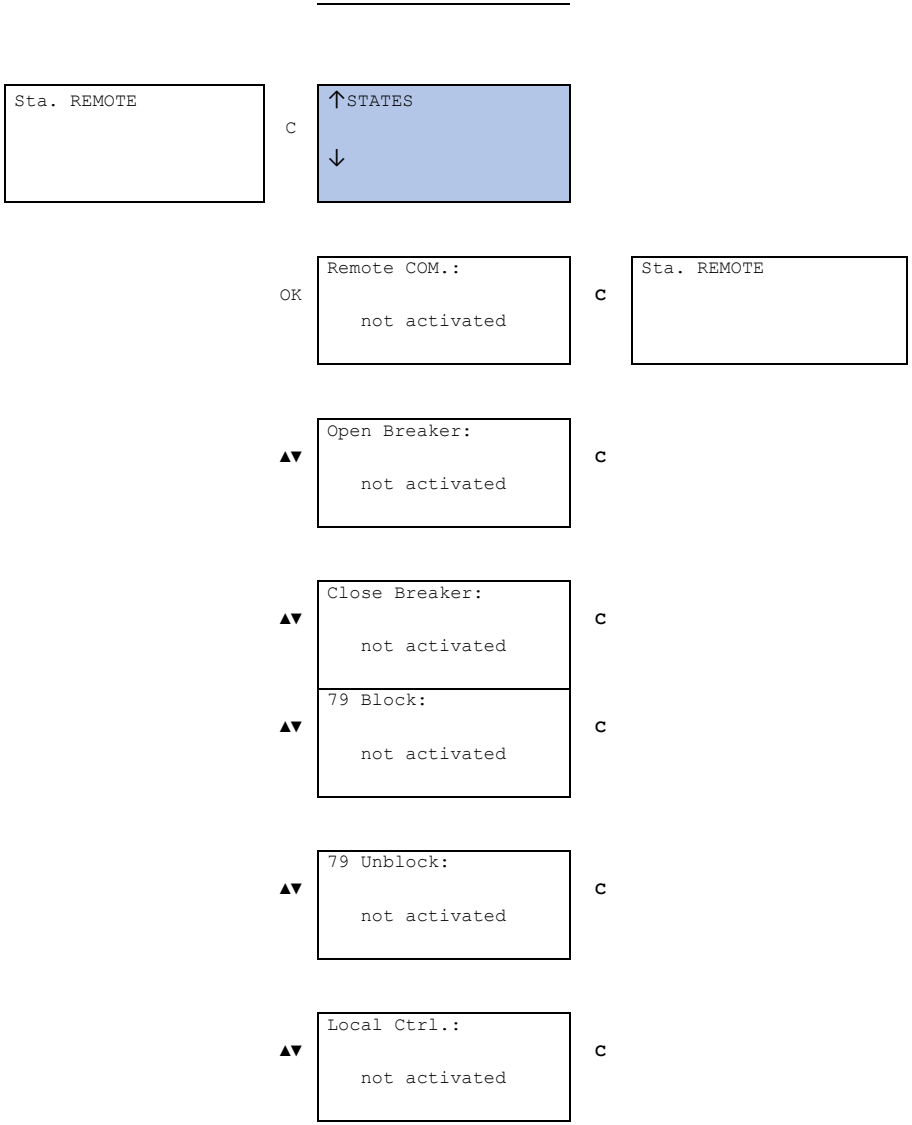

▲▼
Led2:
not activated
C
▲▼
Led3:
not activated
C
▲▼
Led4:
not activated
C
▲▼
Led5:
not activated
C
▲▼
Led6:
not activated
C
C
▲▼
Led52:
not activated
C
▲▼
Led79:
not activated
C
Sta. LOGIC
>Activated
C
↑STATES
↓

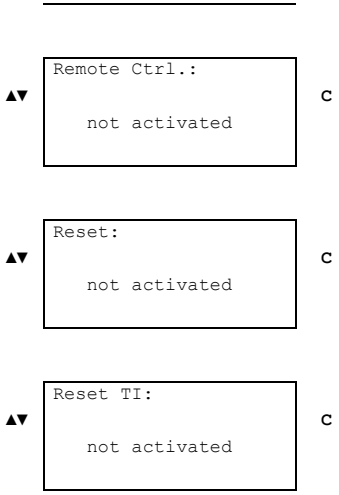

OK
52a:
not activated
c
Sta. LOGIC
>Activated
▲▼
52b:
not activated
c
▲▼
Ext Trip:
not activated
c
▲▼
50BF start:
not activated
c
▲▼
DFR Start:
not activated
c
▲▼
Blck. 50/51:
not activated
c
▲▼
Blck. 50/51G:
not activated
c
▲▼
Reset:
not activated
c


▲▼
SettingsG1:
not activated
C
▲▼
SettingsG2:
not activated
C
▲▼
79 Start:
not activated
C
▲▼
79 Enable:
not activated
C
▲▼
79 L Block:
not activated
C
▲▼
79 Block:
not activated
C
▲▼
79 Unblock:
not activated
C
▲▼
74TCS A:
not activated
C


▲▼
74TCS B:
not activated
C
▲▼
Logic Sig1:
not activated
C
▲▼
Logic Sig2:
not activated
C
Sta. LOCAL
>Activated
C
↑STATES
↓
OK
Local COM.:
not activated
C
Sta. LOCAL
>Activated
▲▼
HMI Activity:
<<ACTIVATED>>
C
▲▼
Open Breaker:
not activated
C


Close Breaker:
not activated
79 Block:
not activated
79 Unblock:
not activated
Local Ctrl.:
not activated
Remote Ctrl.:
not activated
Reset:
not activated
Reset TI:
not activated

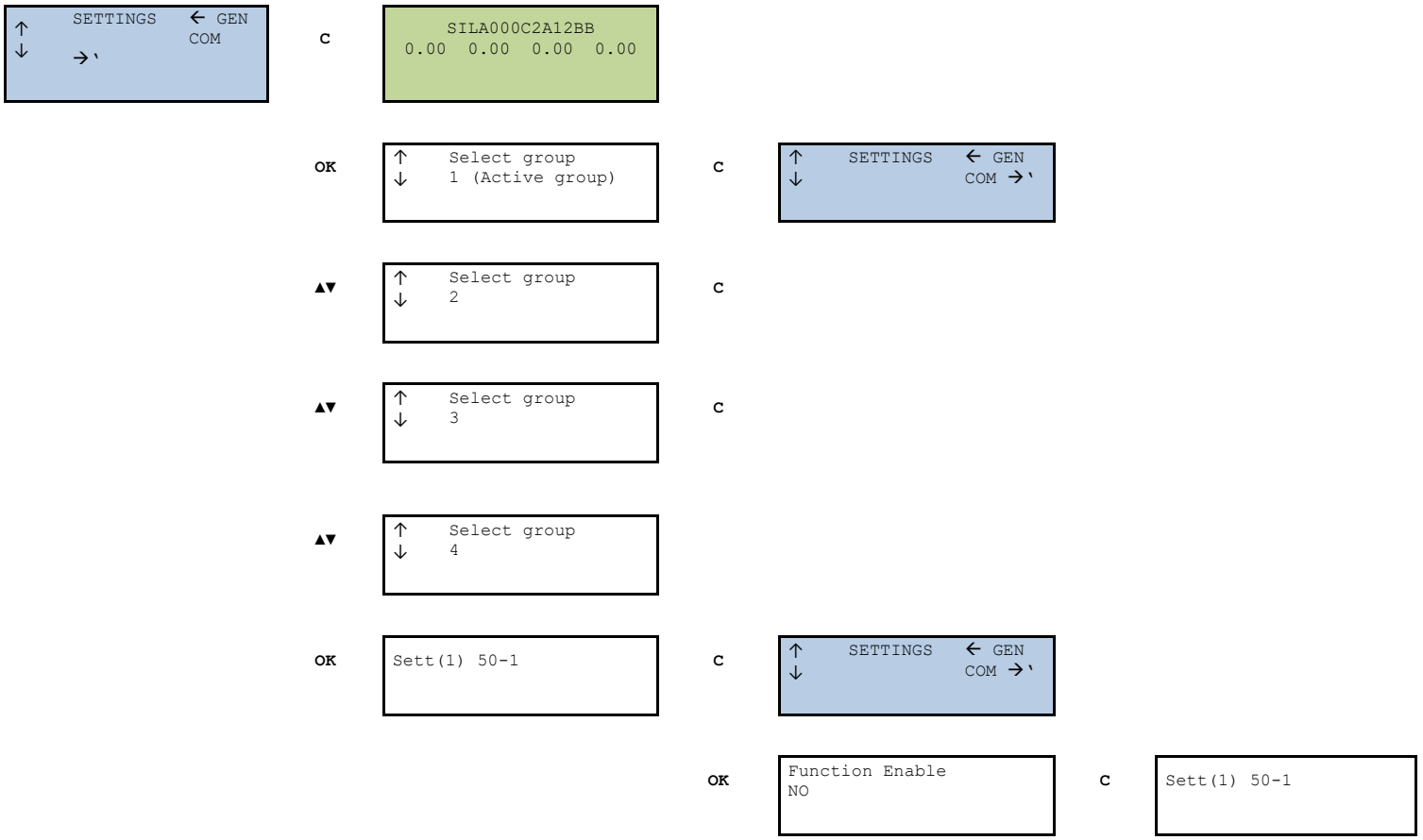

Sta. REMOTE
C
↑STATES
↓
OK
Remote COM.:
not activated
C
Sta. REMOTE
▲▼
Open Breaker:
not activated
C
▲▼
Close Breaker:
not activated
C
▲▼
79 Block:
not activated
C
▲▼
79 Unblock:
not activated
C
▲▼
Local Ctrl.:
not activated
C



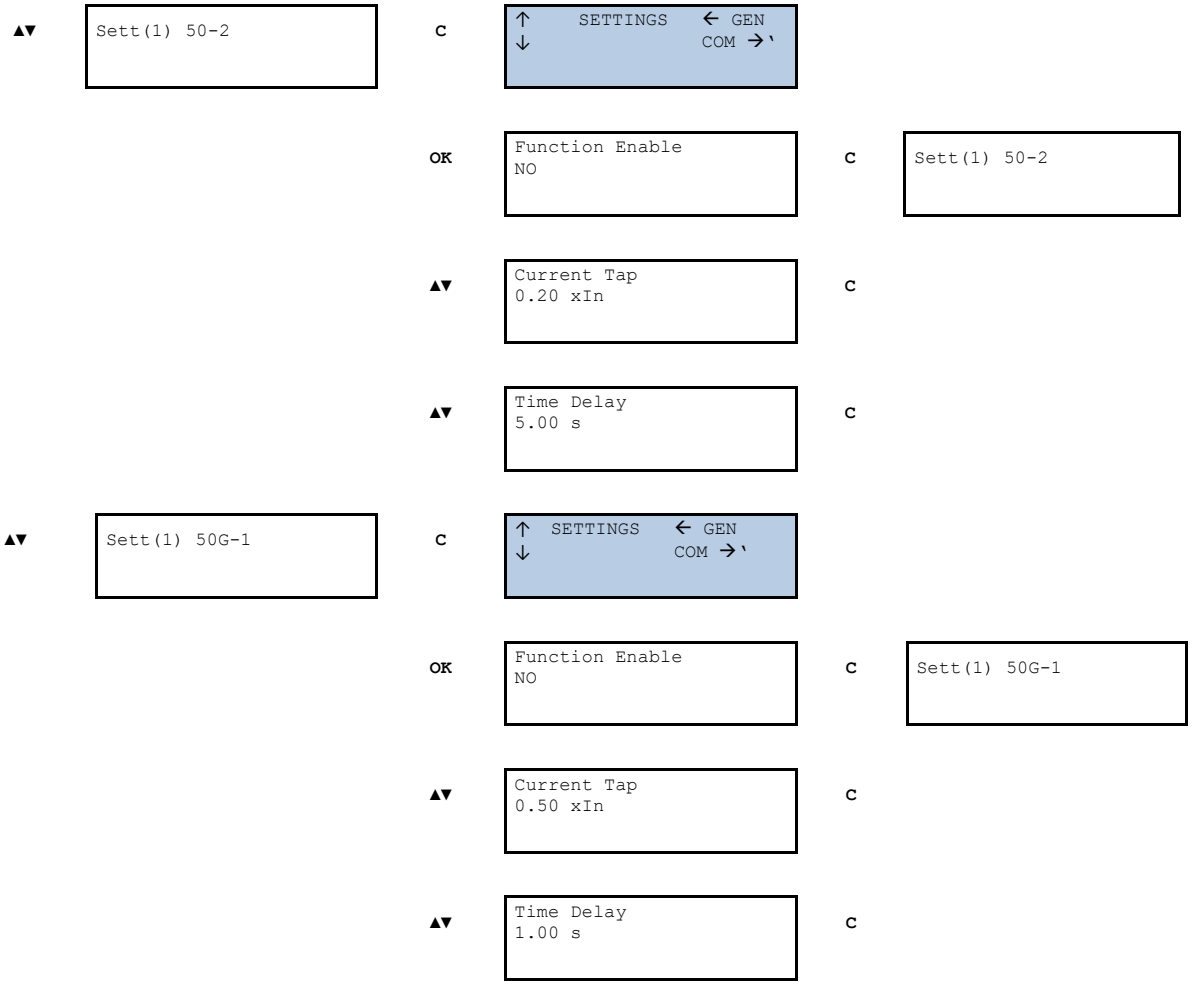
NOTE: REMOTE COM parameters depend on model (the used protocol can be IEC61850, DNP3.0, Modbus TCP, IEC60870-5-104, Modbus or IEC60870-5-103 depending on model). ***The SIL-A will have the SHB or the Trip block as optional function, it is not possible to have both optional functions in the same model**. ***On adaptation C, both remote protocols are shown, doesn't matter which one is selected. In the adaptation C, just the selected protocol is shown.**

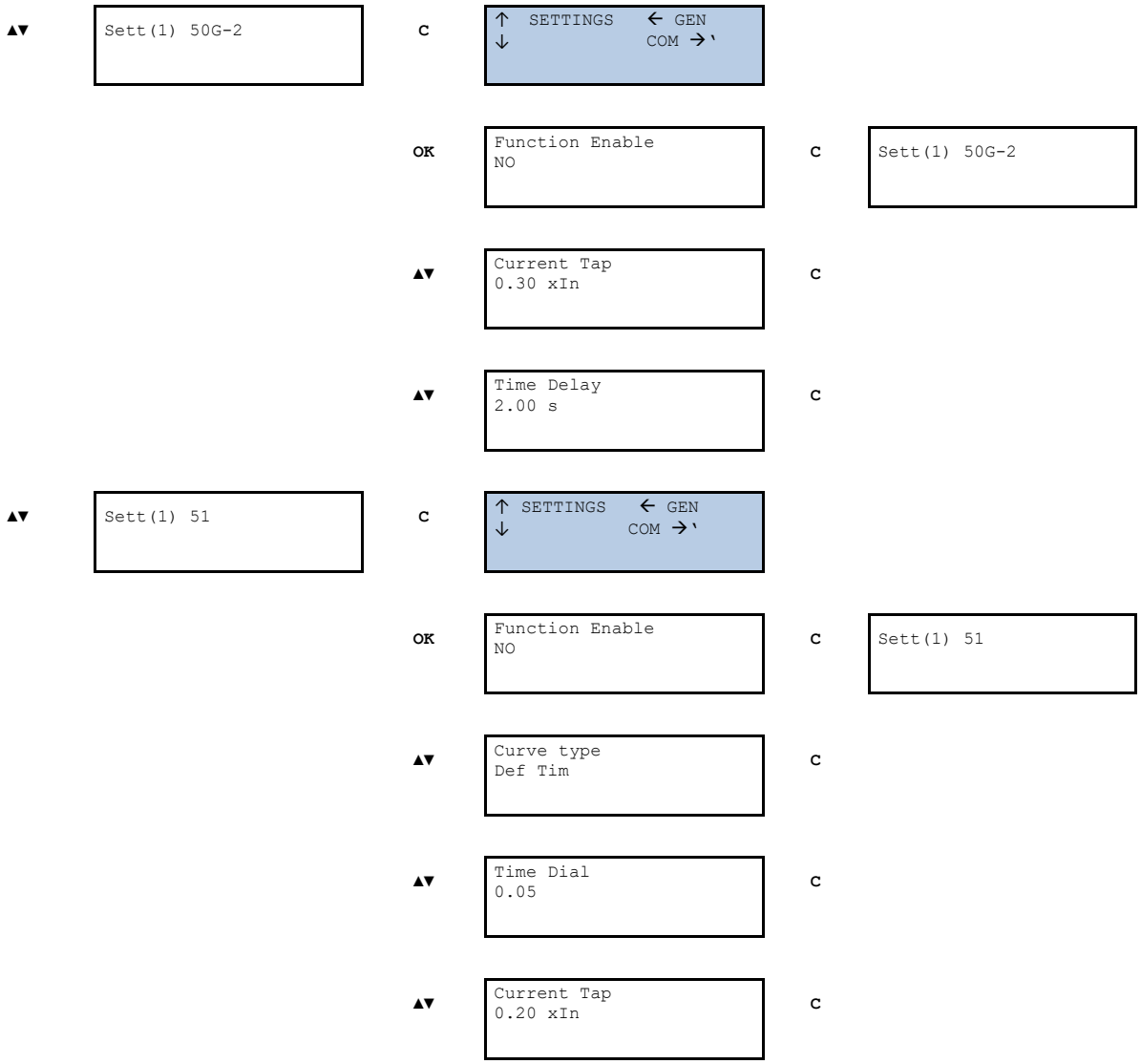
10.6.13 Settings Menu

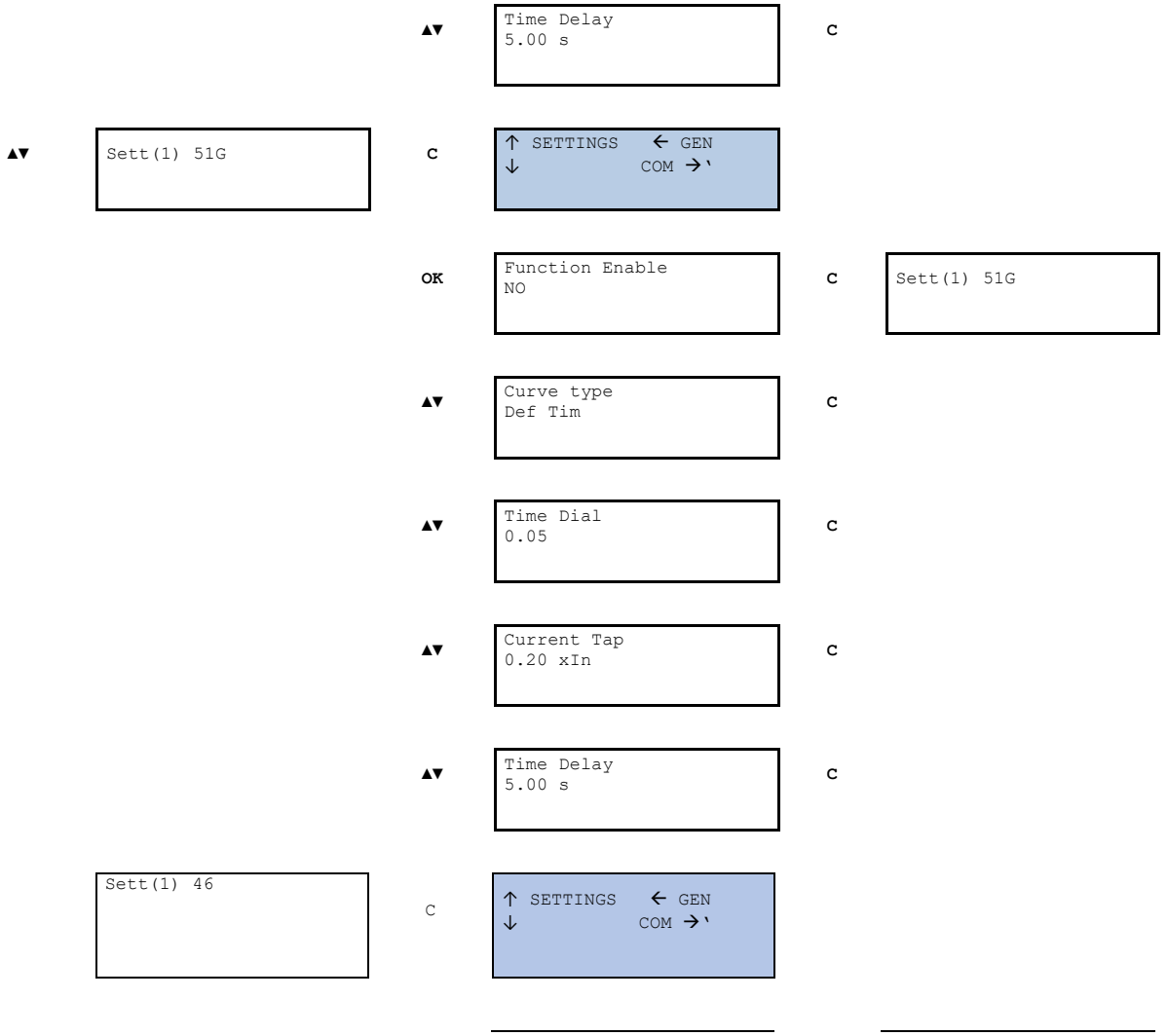
From the standby mode screen, press the ‘OK’ key to access the first line of menus. Use the ‘▲’ and ‘▼’ keys to position the cursor over the ‘SETTINGS’ screen and press ‘OK’. This takes you to the settings groups line. Use the ‘▲’ and ‘▼’ keys to position the cursor over a settings group and press the ‘OK’ key to access the settings that belong to this group. Use the ‘▲’ and ‘▼’ keys to move through the different settings. The information that appears underneath the setting name is its value.

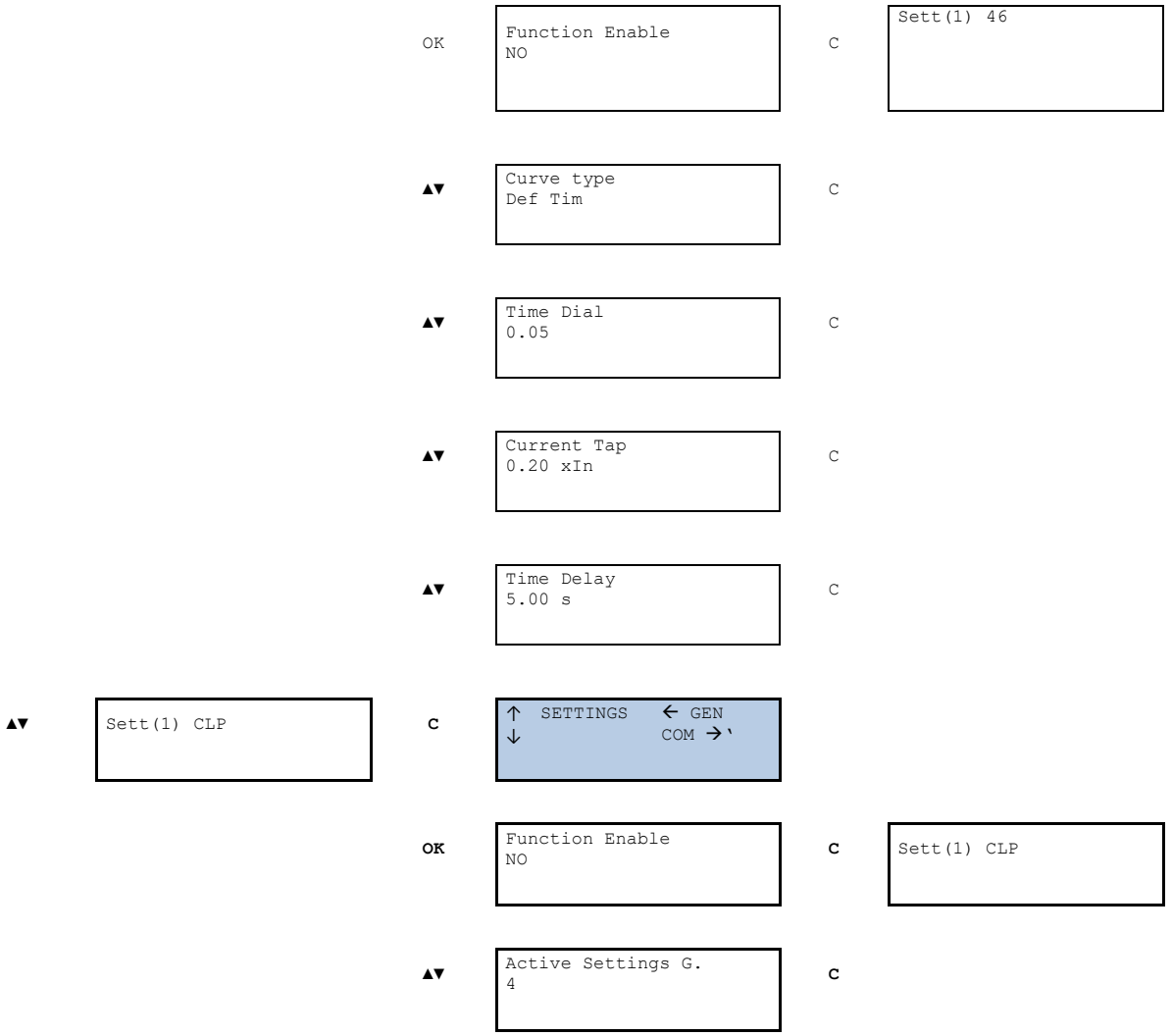


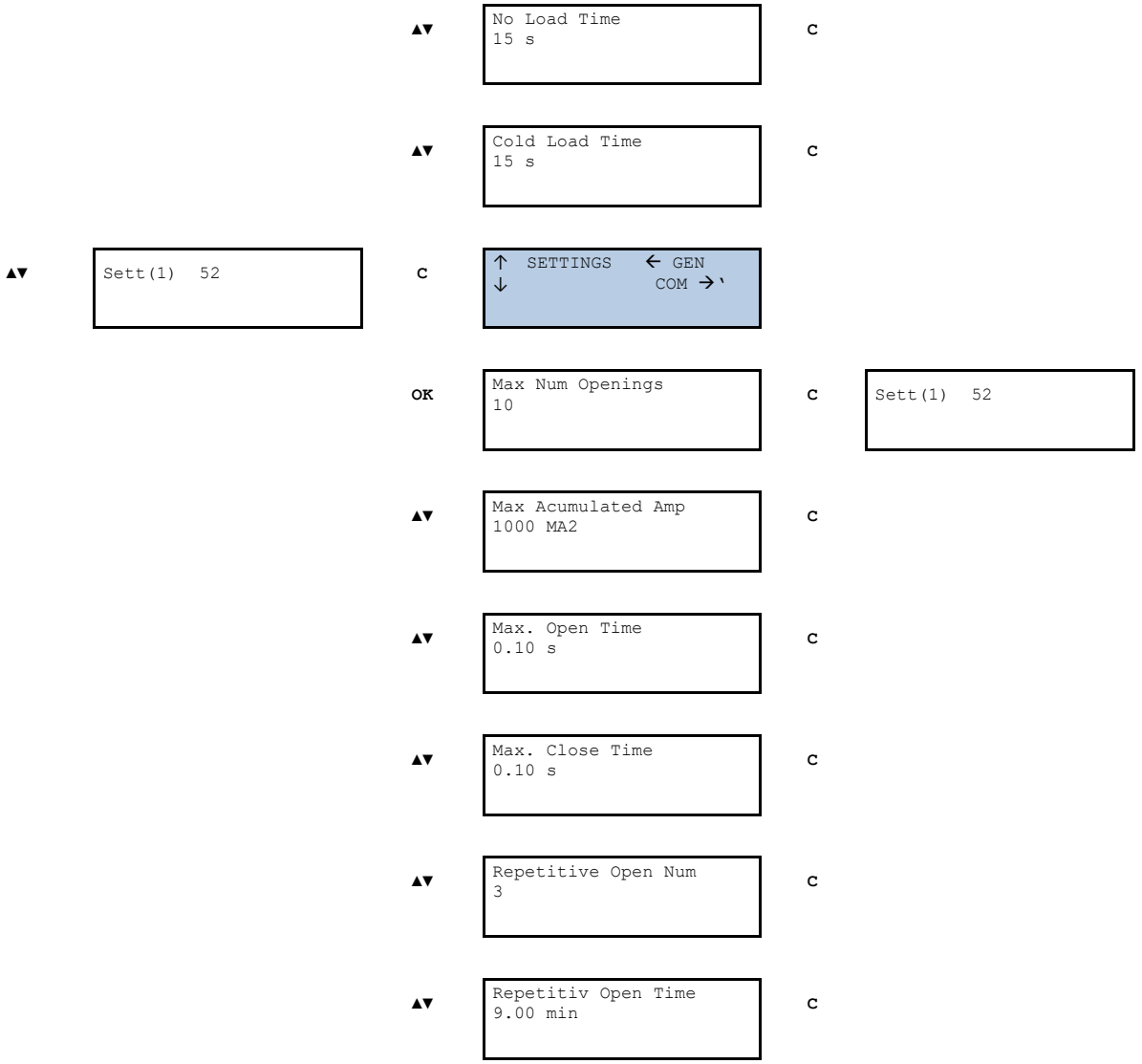

OK
Set Password
-> 0
C
Function Enable
NO
◄▼▲►
Set Password
-> 5555
OK
Function Enable
NO -> NO
▲▼
Function Enable
NO -> YES
OK
Function Enable
NO > YES y/n
OK
SETTING CHANGED
Function Enable
OK
Function Enable
YES
▲▼
Current Tap
1.00 xIn
C
▲▼
Time Delay
0.02 s
C

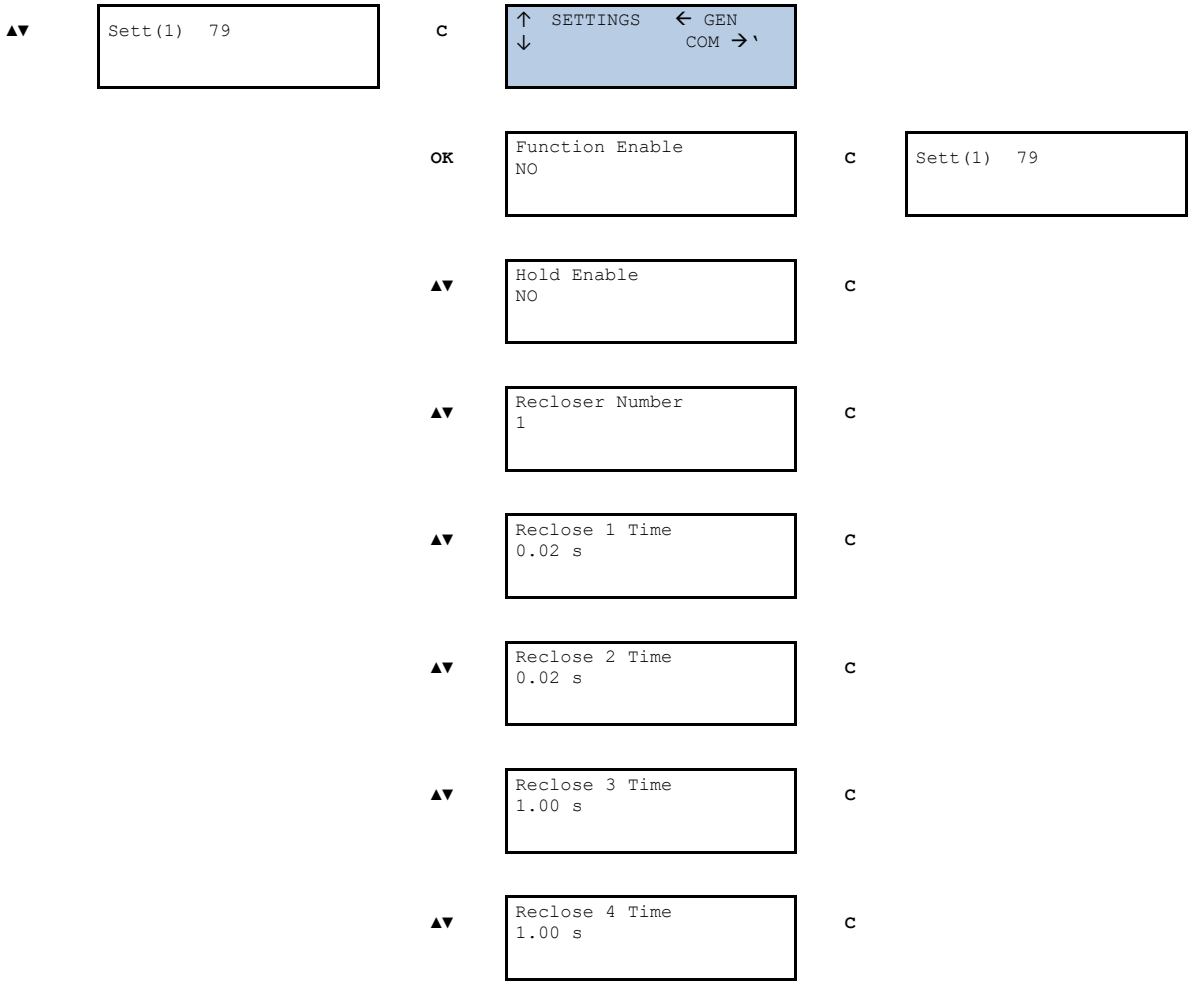

▲▼
Sett(1) 50-2
C
↑ SETTINGS ← GEN
↓ COM →`
OK
Function Enable
NO
C
Sett(1) 50-2
▲▼
Current Tap
0.20 xIn
C
▲▼
Time Delay
5.00 s
C
▲▼
Sett(1) 50G-1
C
↑ SETTINGS ← GEN
↓ COM →`
OK
Function Enable
NO
C
Sett(1) 50G-1
▲▼
Current Tap
0.50 xIn
C
▲▼
Time Delay
1.00 s
C

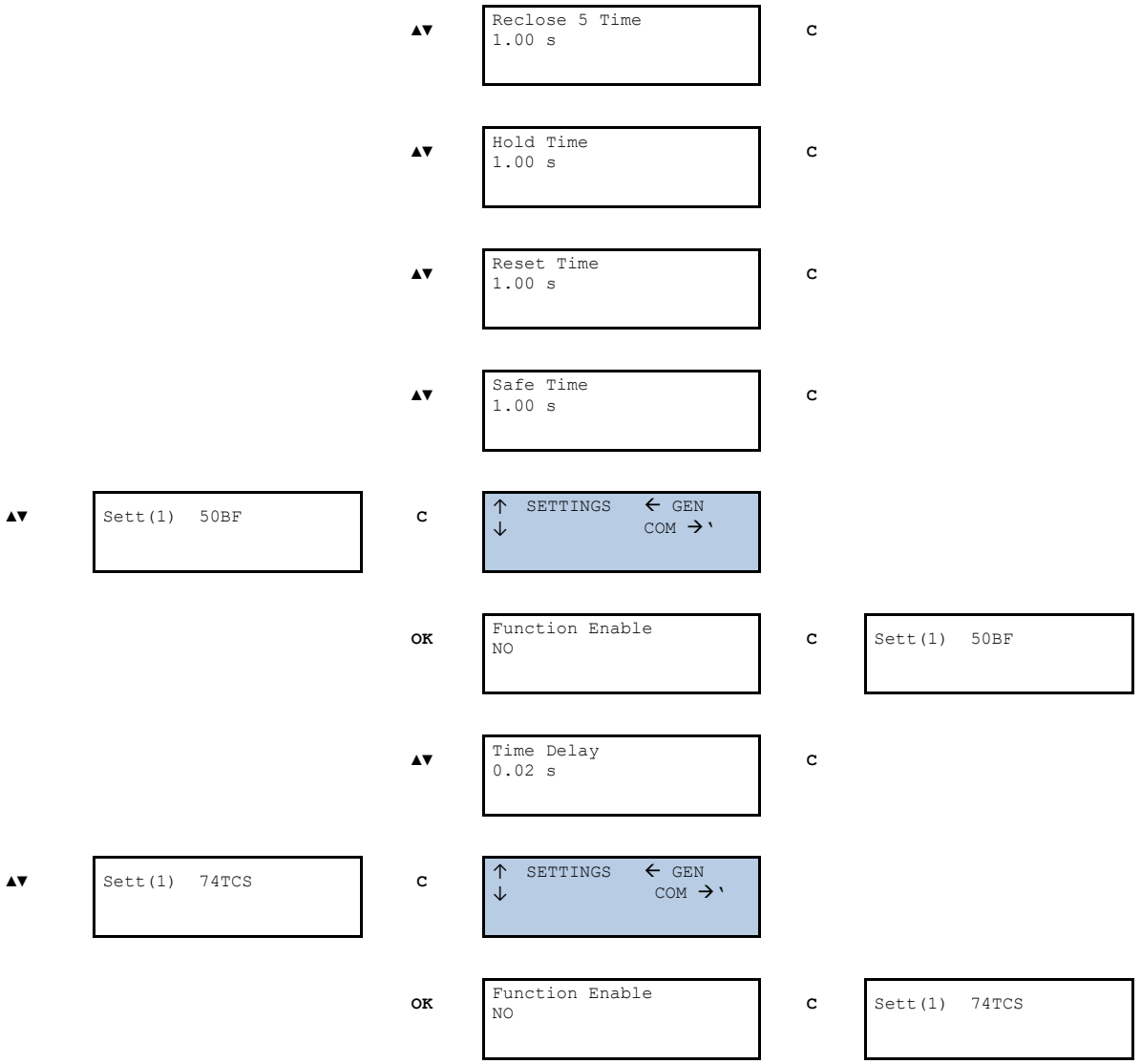

▲▼
Sett(1) 50G-2
C
↑ SETTINGS ← GEN
↓ COM →
OK
Function Enable
NO
C
Sett(1) 50G-2
▲▼
Current Tap
0.30 xIn
C
▲▼
Time Delay
2.00 s
C
▲▼
Sett(1) 51
C
↑ SETTINGS ← GEN
↓ COM →
OK
Function Enable
NO
C
Sett(1) 51
▲▼
Curve type
Def Tim
C
▲▼
Time Dial
0.05
C
▲▼
Current Tap
0.20 xIn
C

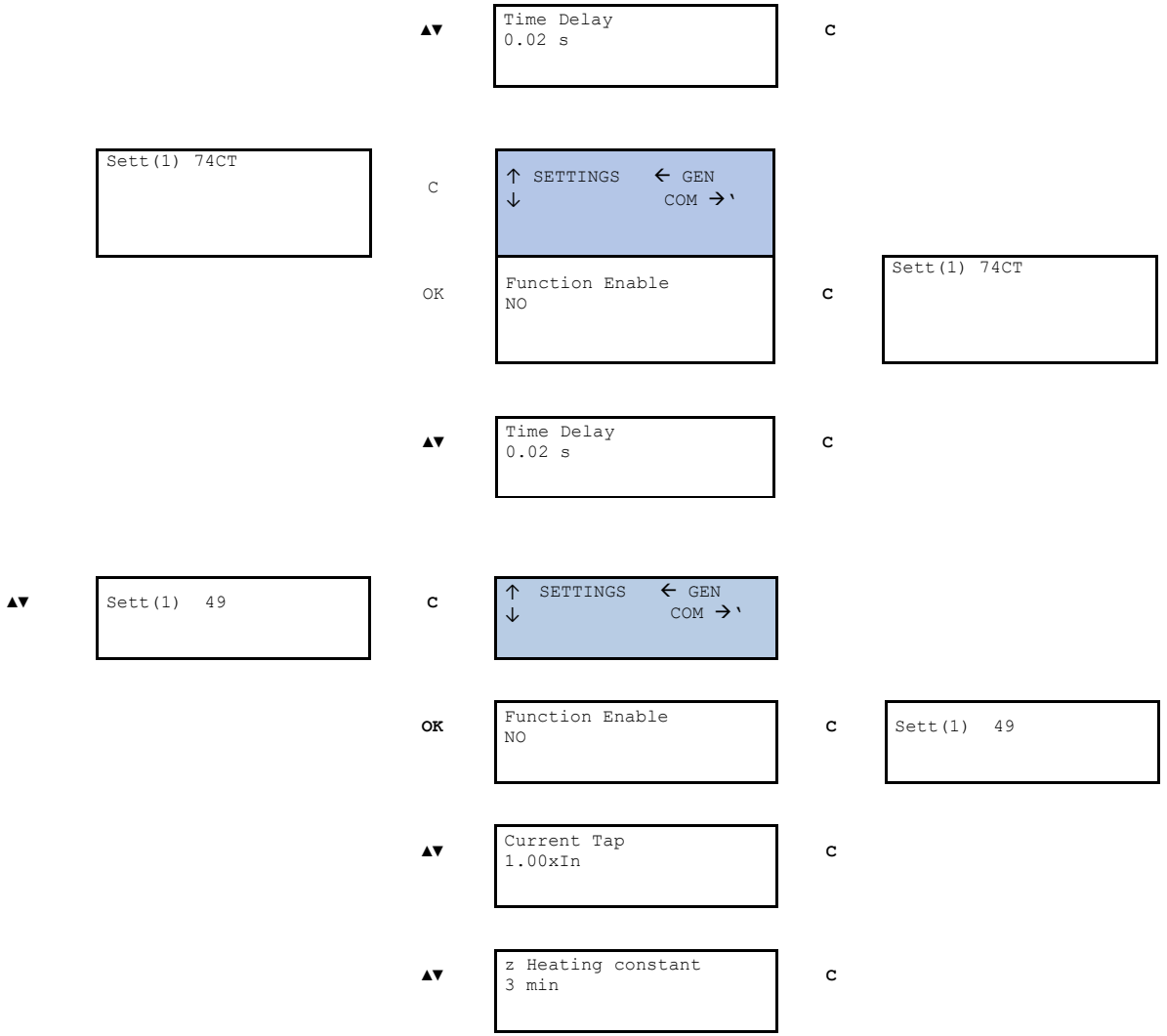

Time Delay
5.00 s
▲▼
C
Sett(1) 51G
▲▼
C
↑ SETTINGS ← GEN
↓ COM →
Function Enable
NO
OK
C
Sett(1) 51G
Curve type
Def Tim
▲▼
C
Time Dial
0.05
▲▼
C
Current Tap
0.20 xIn
▲▼
C
Time Delay
5.00 s
▲▼
C
Sett(1) 46
C
↑ SETTINGS ← GEN
↓ COM →

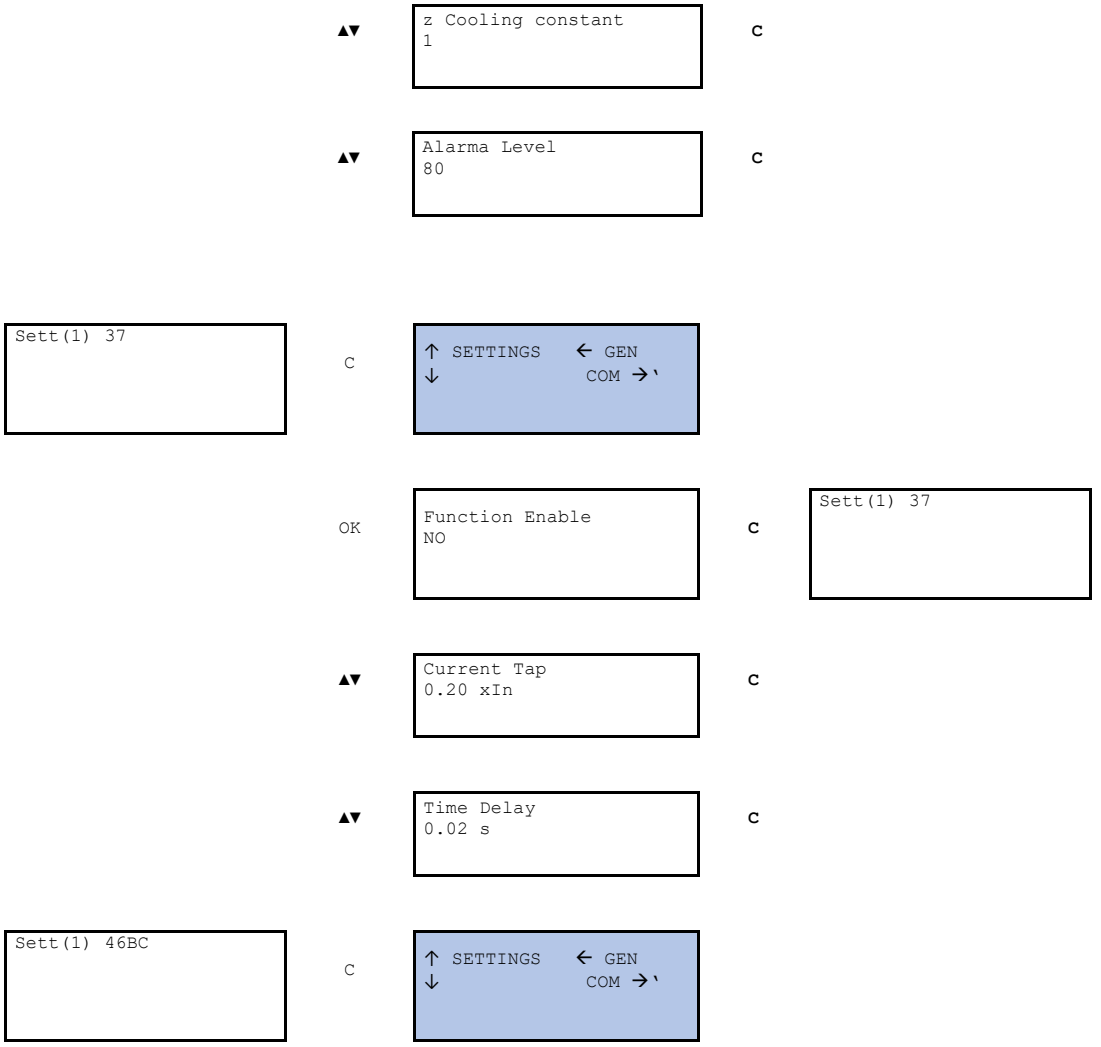

OK
Function Enable
NO
C
Sett(1) 46
▲▼
Curve type
Def Tim
C
▲▼
Time Dial
0.05
C
▲▼
Current Tap
0.20 xIn
C
▲▼
Time Delay
5.00 s
C
▲▼
Sett(1) CLP
C
↑ SETTINGS ← GEN
↓ COM →
OK
Function Enable
NO
C
Sett(1) CLP
▲▼
Active Settings G.
4
C

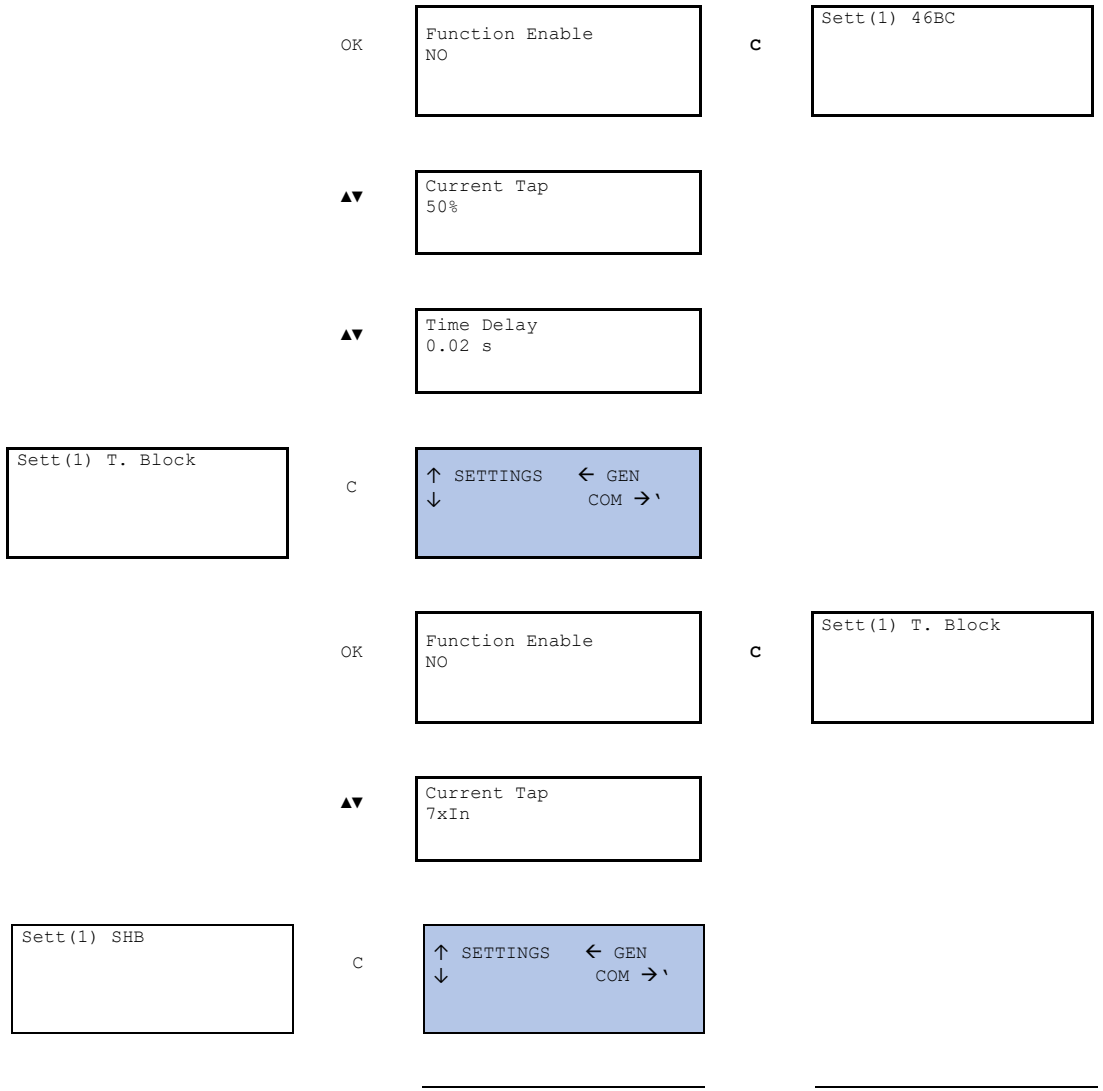

▲▼
No Load Time
15 s
C
▲▼
Cold Load Time
15 s
C
▲▼
Sett(1) 52
C
↑ SETTINGS ← GEN
↓ COM →
OK
Max Num Openings
10
C
Sett(1) 52
▲▼
Max Acumulated Amp
1000 MA2
C
▲▼
Max. Open Time
0.10 s
C
▲▼
Max. Close Time
0.10 s
C
▲▼
Repetitive Open Num
3
C
▲▼
Repetitiv Open Time
9.00 min
C

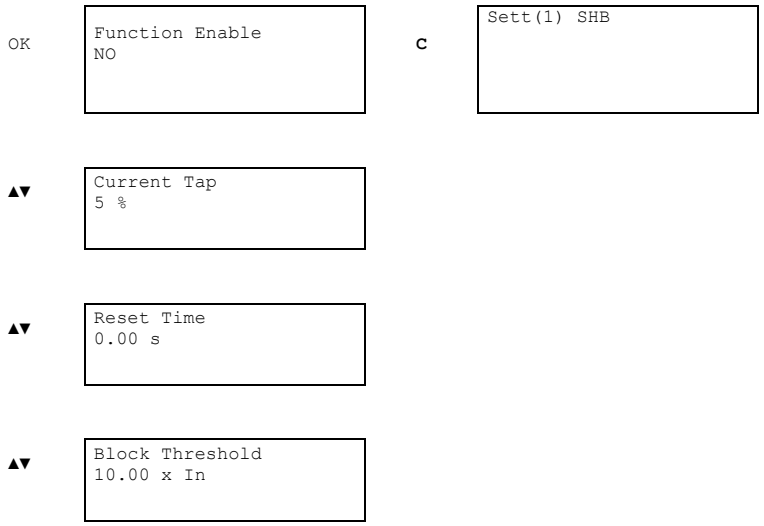

▲▼
Sett(1) 79
C
↑ SETTINGS ← GEN
↓ COM →
OK
Function Enable
NO
C
Sett(1) 79
▲▼
Hold Enable
NO
C
▲▼
Recloser Number
1
C
▲▼
Reclose 1 Time
0.02 s
C
▲▼
Reclose 2 Time
0.02 s
C
▲▼
Reclose 3 Time
1.00 s
C
▲▼
Reclose 4 Time
1.00 s
C


▲▼
Reclose 5 Time
1.00 s
C
▲▼
Hold Time
1.00 s
C
▲▼
Reset Time
1.00 s
C
▲▼
Safe Time
1.00 s
C
▲▼
Sett(1) 50BF
C
↑ SETTINGS ← GEN
↓ COM →
OK
Function Enable
NO
C
Sett(1) 50BF
▲▼
Time Delay
0.02 s
C
▲▼
Sett(1) 74TCS
C
↑ SETTINGS ← GEN
↓ COM →
OK
Function Enable
NO
C
Sett(1) 74TCS


▲▼
Time Delay
0.02 s
C
Sett(1) 74CT
C
↑ SETTINGS ← GEN
↓ COM →
OK
Function Enable
NO
C
Sett(1) 74CT
▲▼
Time Delay
0.02 s
C
▲▼
Sett(1) 49
C
↑ SETTINGS ← GEN
↓ COM →
OK
Function Enable
NO
C
Sett(1) 49
▲▼
Current Tap
1.00xIn
C
▲▼
z Heating constant
3 min
C


▲▼
z Cooling constant
1
C
▲▼
Alarma Level
80
C
Sett(1) 37
C
↑ SETTINGS ← GEN
↓ COM →'
OK
Function Enable
NO
C
Sett(1) 37
▲▼
Current Tap
0.20 xIn
C
▲▼
Time Delay
0.02 s
C
Sett(1) 46BC
C
↑ SETTINGS ← GEN
↓ COM →'


OK
Function Enable
NO
C
Sett(1) 46BC
▲▼
Current Tap
50%
▲▼
Time Delay
0.02 s
Sett(1) T. Block
C
↑ SETTINGS ← GEN
↓ COM →
OK
Function Enable
NO
C
Sett(1) T. Block
▲▼
Current Tap
7xIn
Sett(1) SHB
C
↑ SETTINGS ← GEN
↓ COM →



The SIL-A will have the SHB or the Trip block as optional function, it is not possible to have both optional functions in the same model.

Press the '◄' key to access the general settings from the 'SETTINGS' screen. The general setting 'Relay name' can be viewed and modified from the HMI and from SICom software.

The value of the 'CT Phase ratio' and 'CT Neutral ratio' general settings is the result given by dividing the number of turns on the primary winding by the number on the secondary winding. For example: With TI 500/5, the setting would be 100 in standard models. In LPCT models these settings correspond to the primary phase cuarrent and the primary neutral current.

Phase nominal current and neutral nominal current will depend on the model, this is:

SILA00xxxxxxxx:

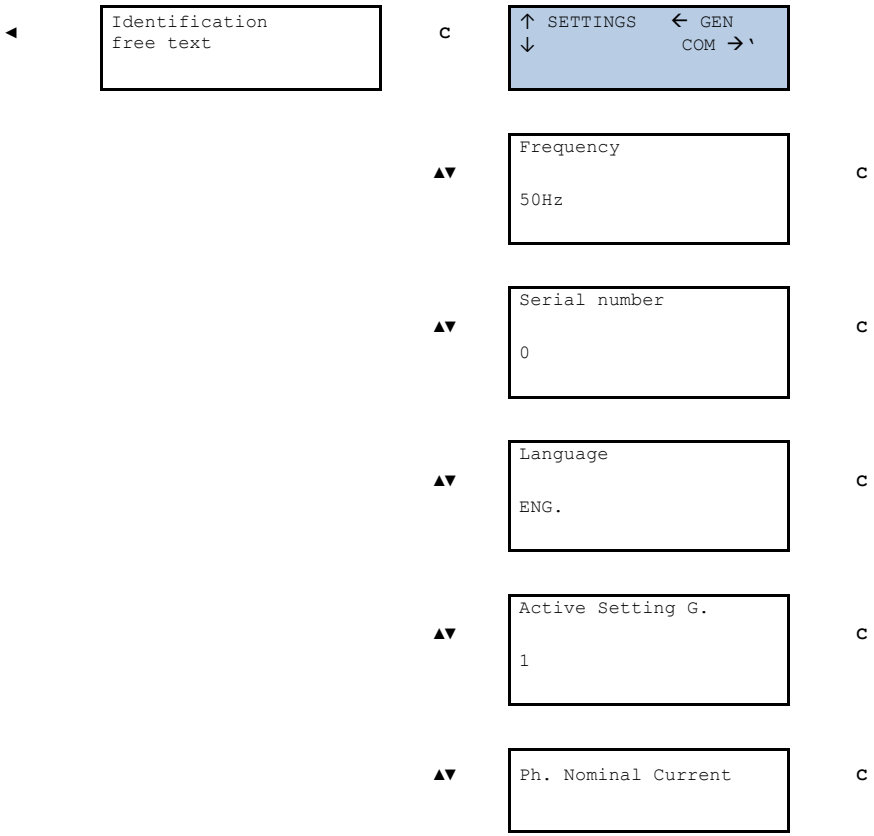
Phase nominal current could be 1 A or 5 A

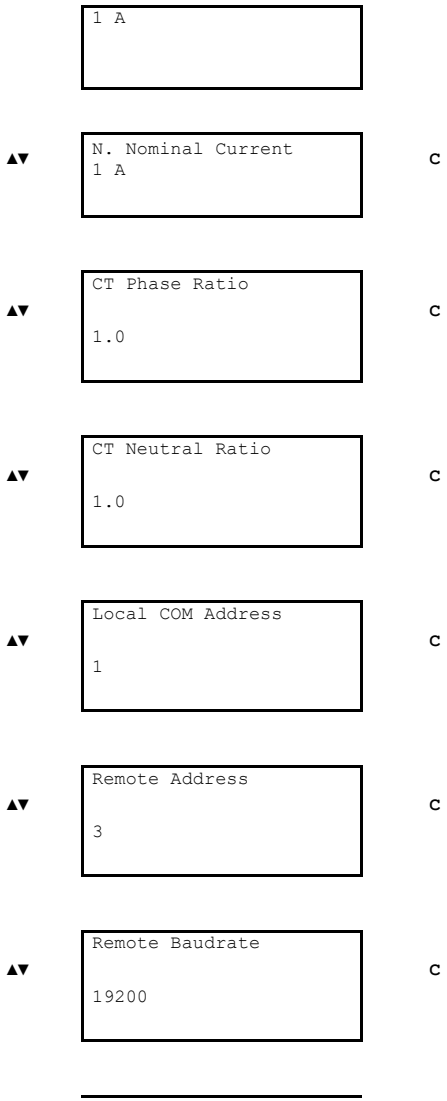
Neutral nominal current could be 1 A or 5 A

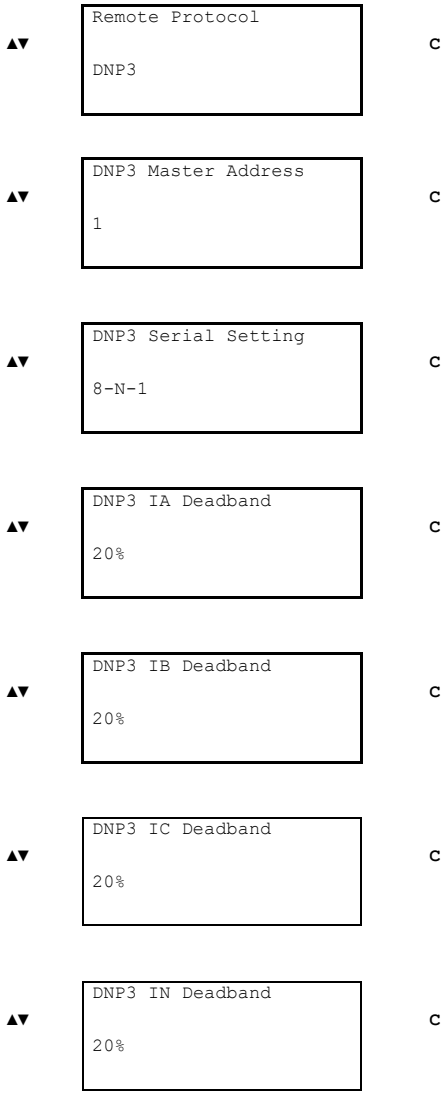
SILASSxxxxxxxx:

Phase nominal current could be 0.5 A or 2.5 A

Neutral nominal current could be 0.1 A or 0.5 A




1 A
▲▼
N. Nominal Current
1 A
C
▲▼
CT Phase Ratio
1.0
C
▲▼
CT Neutral Ratio
1.0
C
▲▼
Local COM Address
1
C
▲▼
Remote Address
3
C
▲▼
Remote Baudrate
19200
C


▲▼
Remote Protocol
DNP3
C
▲▼
DNP3 Master Address
1
C
▲▼
DNP3 Serial Setting
8-N-1
C
▲▼
DNP3 IA Deadband
20%
C
▲▼
DNP3 IB Deadband
20%
C
▲▼
DNP3 IC Deadband
20%
C
▲▼
DNP3 IN Deadband
20%
C

Changing remote protocol through general settings is only available for **SILAxxxxx(A,7,8)xxxx.** Remote protocol will depend on the model, this is:

SILAxxxxxAxxxx:

It is possible to select remote protocol between MODBUS RTU and IEC60870-5-103.

SILAxxxxx7xxxx:

It is possible to select remote protocol between MODBUS RTU and DNP3.0 serial.

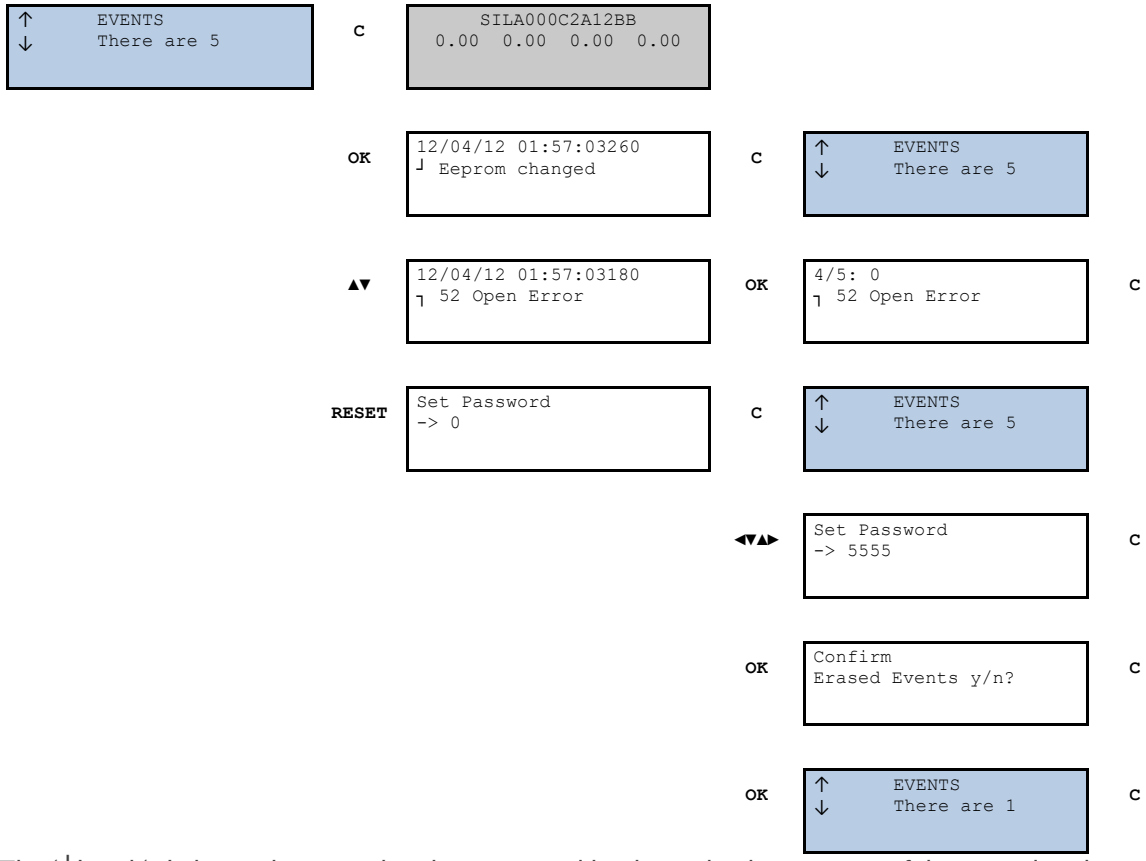
SILAxxxxx8xxxx:

It is possible to select remote protocol between MODBUS TCP/IP and DNP3.0 TCP/IP.

For models **SILAxxxxx(B,D)xxxx** remote protocol is imposed by the model. These protocols can be: IEC61850 or IEC60870-5-104.

10.6.14 Events Menu

From the standby mode screen, press the ‘OK’ key to access the first line of menus. Use the ‘▲’ and ‘▼’ keys to position the cursor over the ‘EVENTS’ screen and the number of events in the buffer will be displayed. Press ‘OK’ and use the ‘▲’ and ‘▼’ keys to position the cursor over the events.

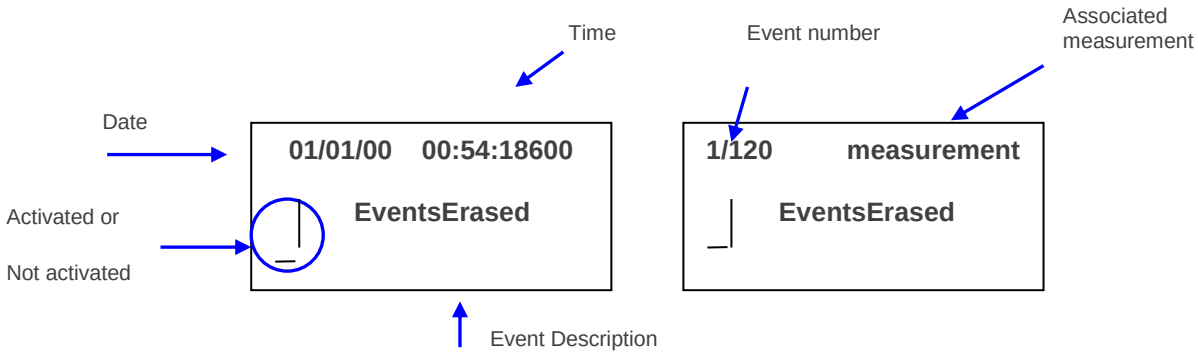


The ‘┘’ and ‘┐’ shows the event has been caused by the activation or reset of the associated status.

To delete the events buffer, position the cursor over the events menu and press and hold the ‘RESET’ key, until there is only one event shown. This one event is ‘Deleted events’.

Each event contains the following information:

- Date-time
- Description of the event
- Size of the events buffer
- Position of the event within the list of events
- Events generated by a status activation or reset
- Associated measurement (if it has one)



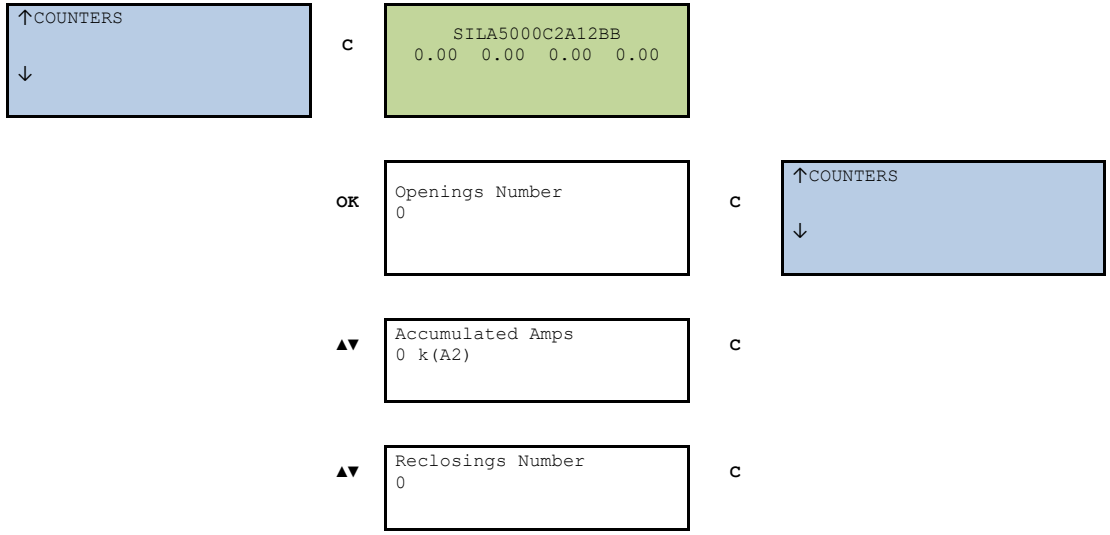
10.6.15 Counters Menu

The first line of menus can be accessed from the standby mode screen by pressing the 'OK' key. Use the '▲' and '▼' keys to move the cursor through the different screens until it is positioned over the 'COUNTERS' screen. Press 'OK' and use the '▲' and '▼' keys to view the different counters. The information displayed below the counter name is its value.

The password must be entered before attempting to change a counter for the first time. Counter changes are allowed once the password has been entered, until the standby mode screen is returned to automatically or manually. The system returns automatically to the standby mode screen if no key is pressed for five minutes.

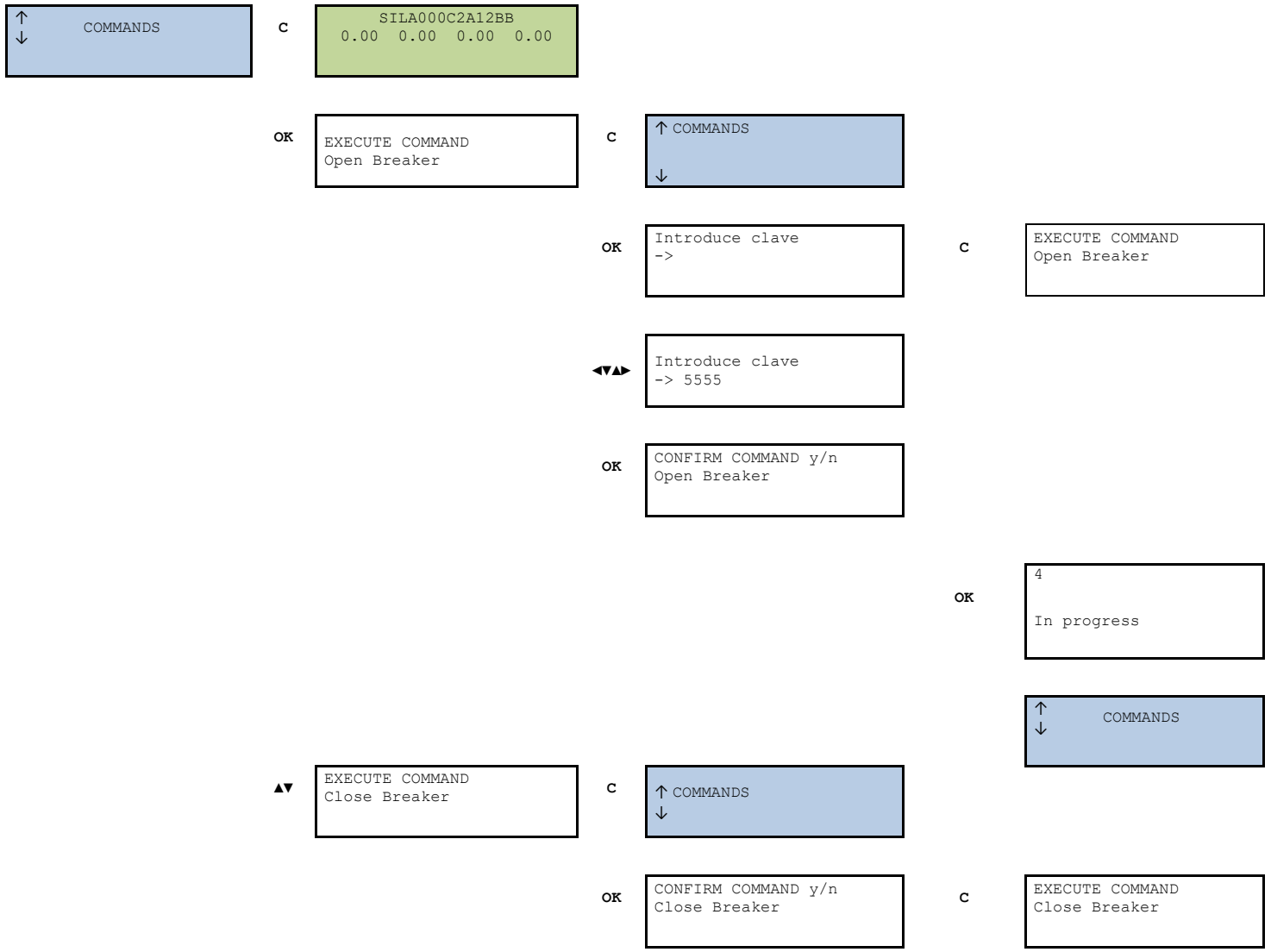
The factory setting password for the relay is 5555. The password can be changed using the SICom program.

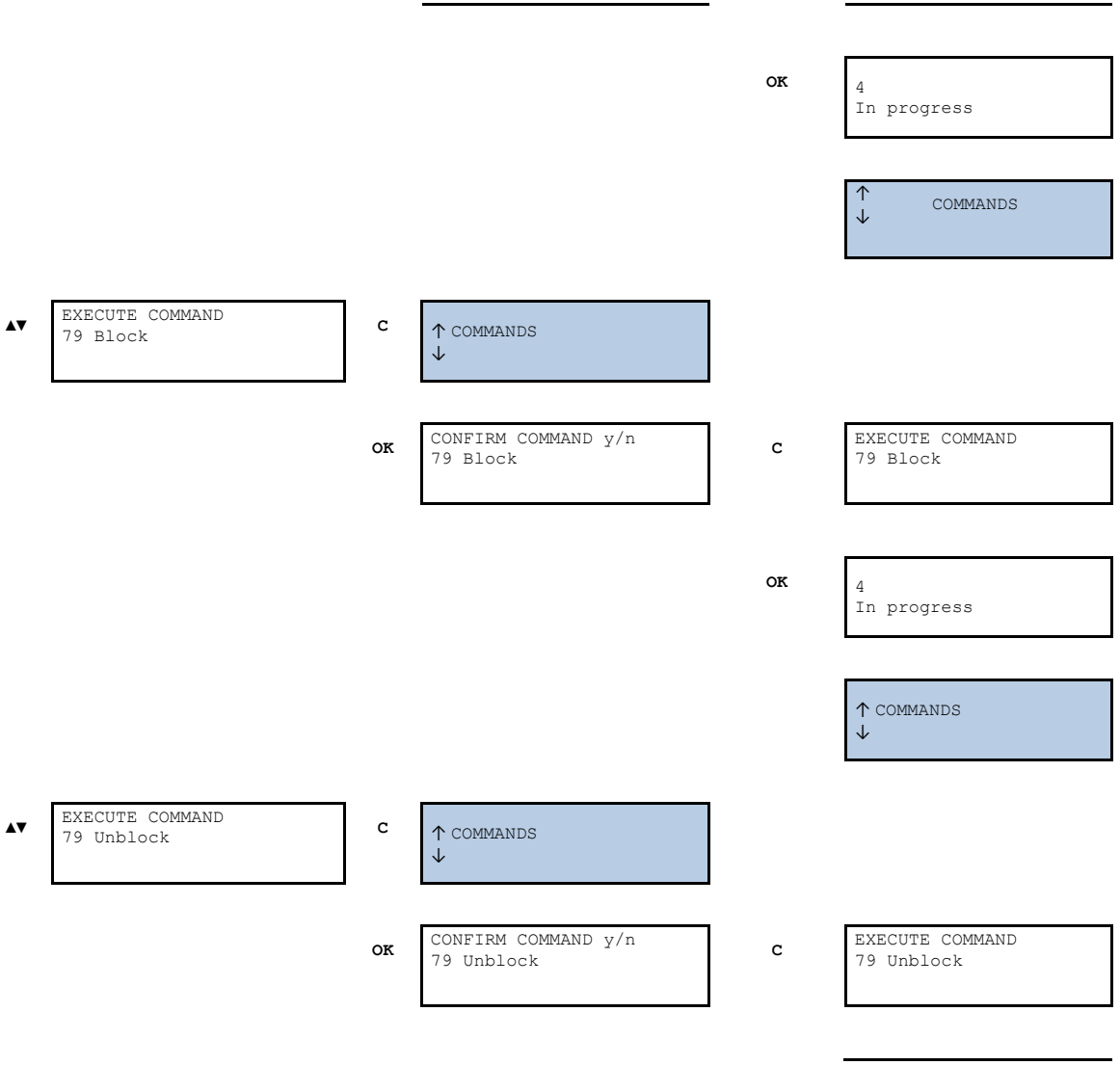
The keys ▲, ▼, ◄ and ► are used to enter the password. ▲ and ▼ are used to introduce a value or a character, and the ◄ and ► keys are used to move from one character to another. If it is necessary to change one of the password characters or numbers due to an error, press 'C' to delete it. Press 'OK' to validate the password.

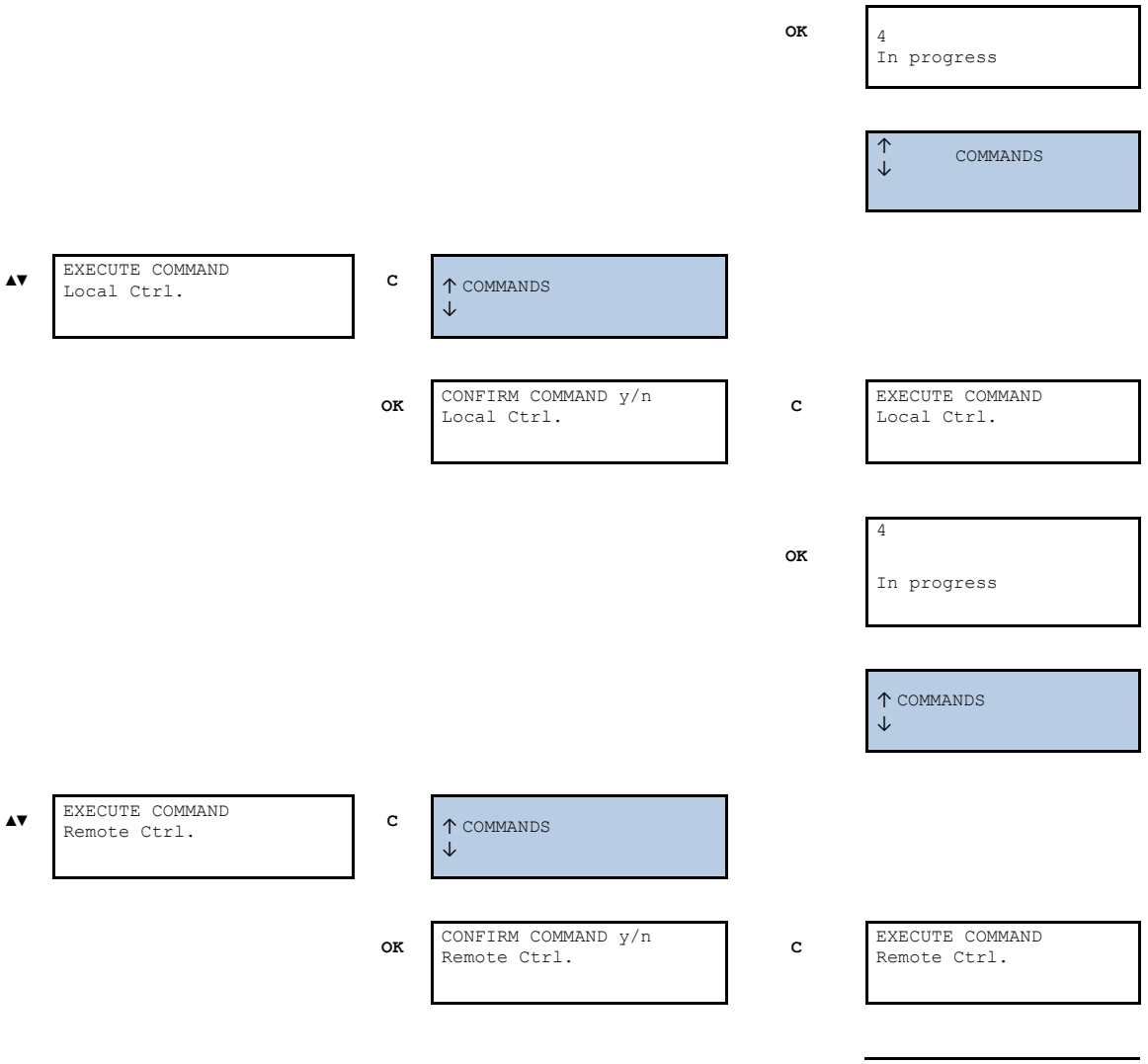


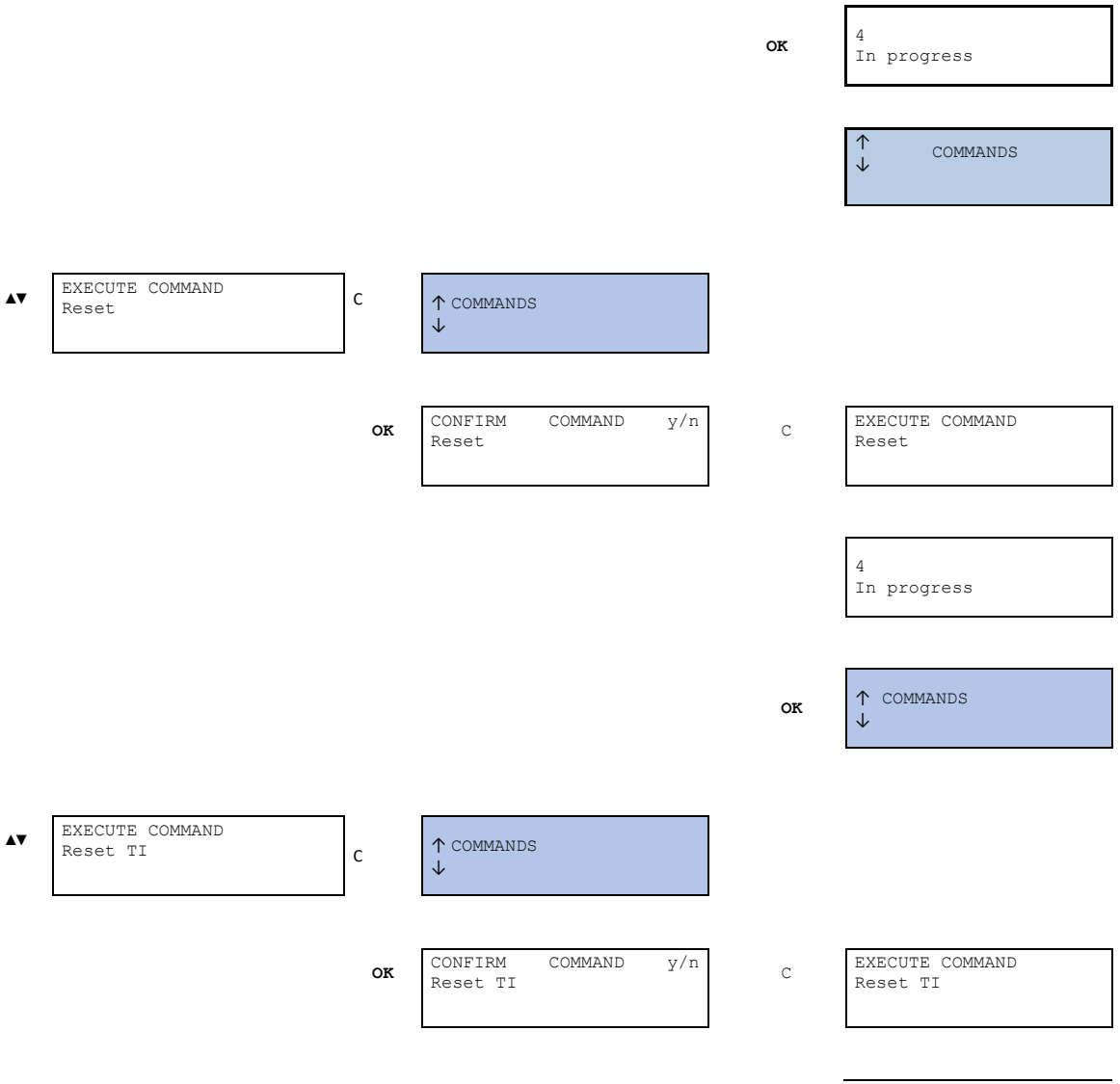
10.6.16 Commands Menu

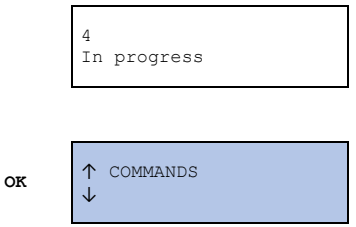
The first line of menus can be accessed from the standby mode screen by pressing the 'OK' key. Use the '▲' and '▼' keys to move the cursor through the different screens until it is positioned over the 'COMMANDS' screen. Press 'OK' and use the '▲' and '▼' keys to view the different possible operations. Press the 'OK' key to perform an operation and press the 'OK' key again to confirm the operation.


↑
↓
COMMANDS
C
SILA000C2A12BB
0.00 0.00 0.00 0.00
OK
EXECUTE COMMAND
Open Breaker
C
↑ COMMANDS
↓
OK
Introduce clave
->
C
EXECUTE COMMAND
Open Breaker
◄▼▲►
Introduce clave
-> 5555
OK
CONFIRM COMMAND y/n
Open Breaker
OK
4
In progress
↑
↓
COMMANDS
▲▼
EXECUTE COMMAND
Close Breaker
C
↑ COMMANDS
↓
OK
CONFIRM COMMAND y/n
Close Breaker
C
EXECUTE COMMAND
Close Breaker


OK
4
In progress
↑
↓
COMMANDS
▲▼
EXECUTE COMMAND
79 Block
C
↑ COMMANDS
↓
OK
CONFIRM COMMAND y/n
79 Block
C
EXECUTE COMMAND
79 Block
OK
4
In progress
↑ COMMANDS
↓
▲▼
EXECUTE COMMAND
79 Unblock
C
↑ COMMANDS
↓
OK
CONFIRM COMMAND y/n
79 Unblock
C
EXECUTE COMMAND
79 Unblock

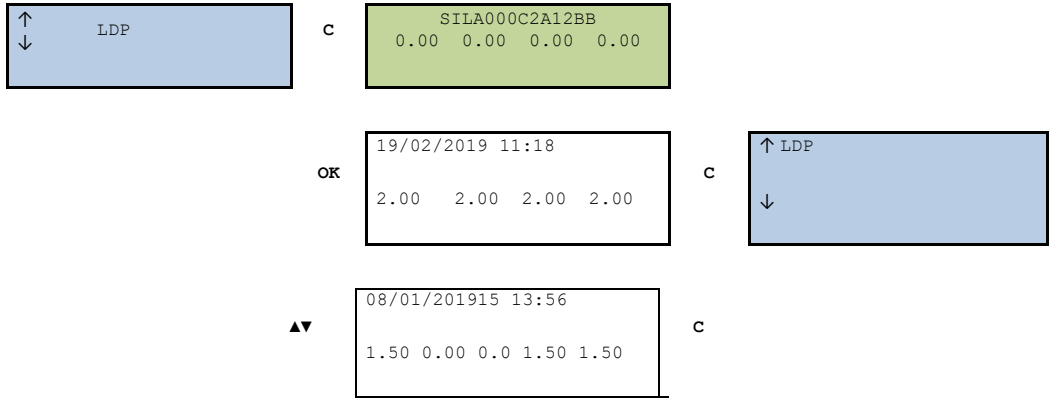

OK
4
In progress
↑
↓
COMMANDS
▲▼
EXECUTE COMMAND
Local Ctrl.
C
↑ COMMANDS
↓
OK
CONFIRM COMMAND y/n
Local Ctrl.
C
EXECUTE COMMAND
Local Ctrl.
OK
4
In progress
↑ COMMANDS
↓
▲▼
EXECUTE COMMAND
Remote Ctrl.
C
↑ COMMANDS
↓
OK
CONFIRM COMMAND y/n
Remote Ctrl.
C
EXECUTE COMMAND
Remote Ctrl.


OK
4
In progress
↑
↓
COMMANDS
▲▼
EXECUTE COMMAND
Reset
C
↑ COMMANDS
↓
OK
CONFIRM COMMAND y/n
Reset
C
EXECUTE COMMAND
Reset
4
In progress
OK
↑ COMMANDS
↓
▲▼
EXECUTE COMMAND
Reset TI
C
↑ COMMANDS
↓
OK
CONFIRM COMMAND y/n
Reset TI
C
EXECUTE COMMAND
Reset TI


4
In progress
OK
↑ COMMANDS
↓

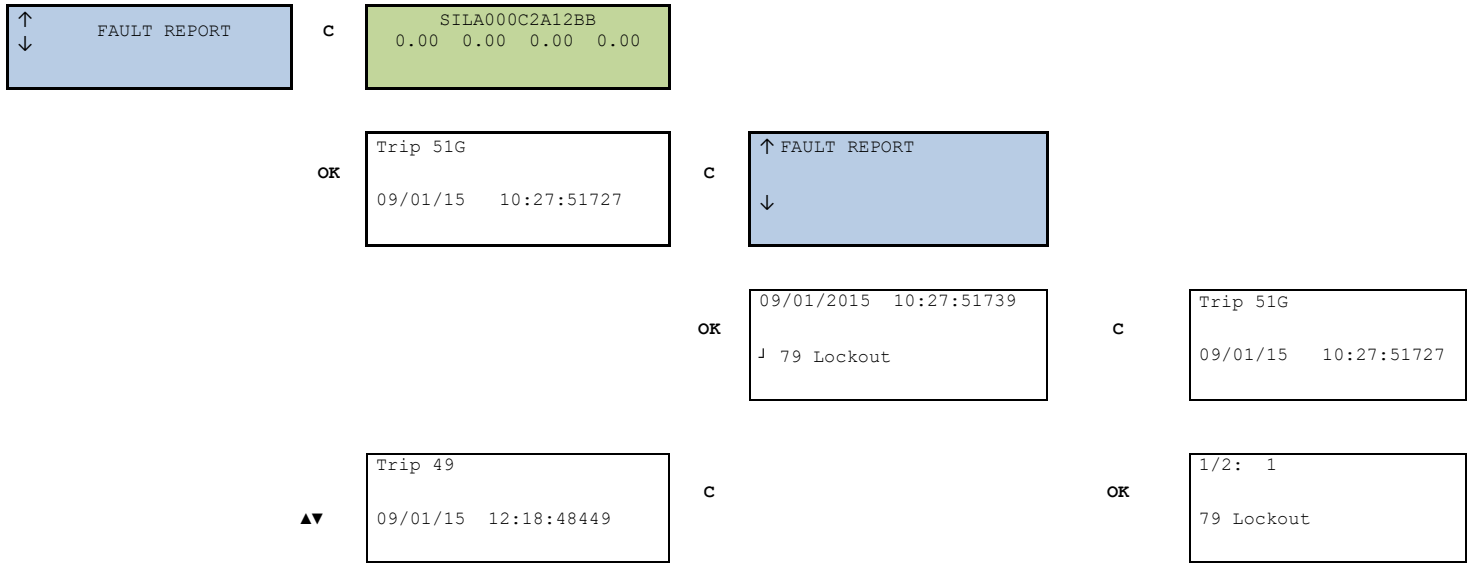
10.6.17 LDP menu

The first line of menus can be accessed from the standby mode screen by pressing the ‘OK’ key. Use the ‘▲’ and ‘▼’ keys to move the cursor through the different screens until it is positioned over the ‘LDP’ screen. Press ‘OK’ and use the ‘▲’ and ‘▼’ keys to view the different possible registers.



10.6.18 Fault report menu

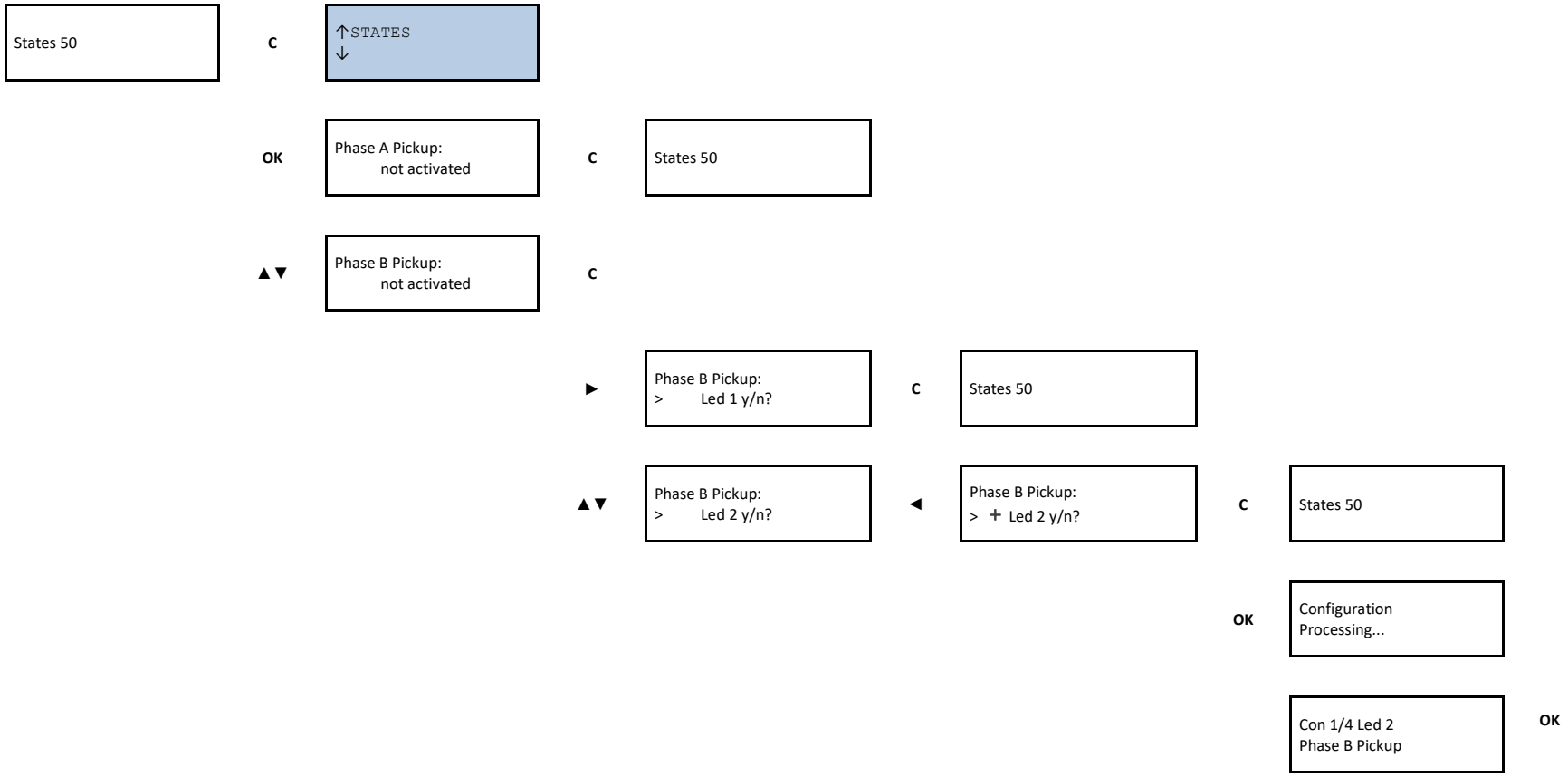
Dedicated fault report menu is available. Apart from this way it is also possible to access to fault reports by pressing ◄ key from standby screen.

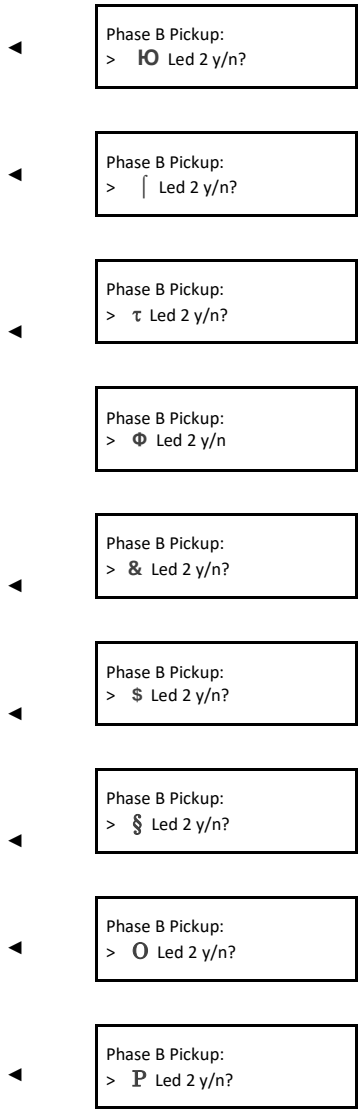


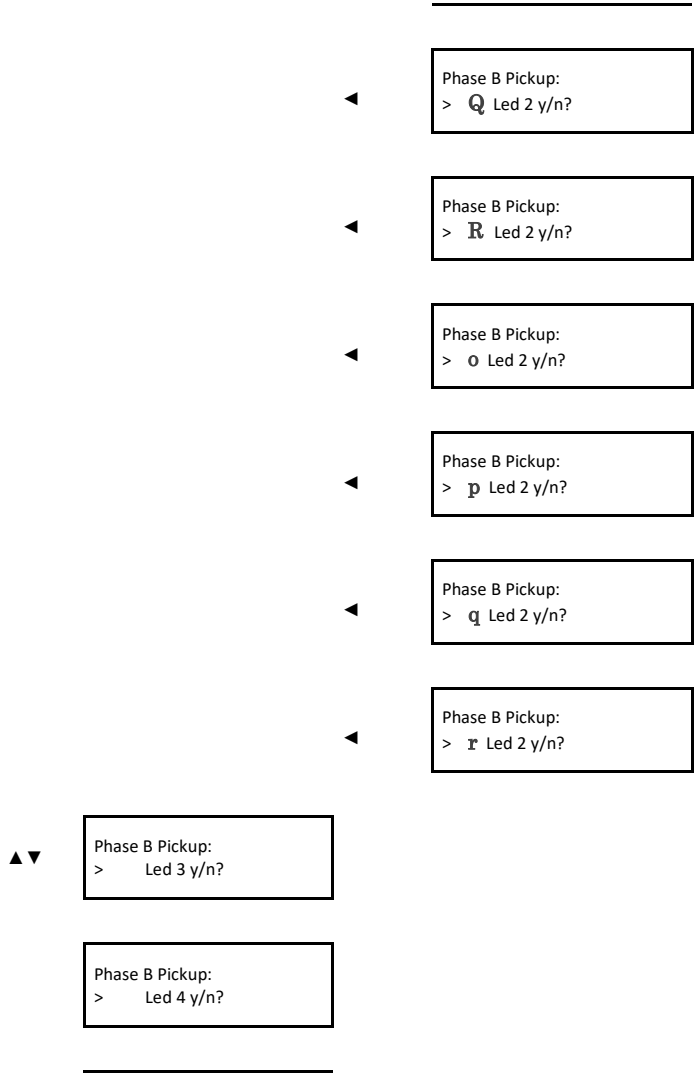
To delete the fault reports, go to the menu ‘FAULT REPORT’ and press and hold the RESET key. Once the password is confirmed, the relay shows an informative message indicating there is no reports.

10.6.19 Leds, logic signals and outputs configuration menu.

SIL-A Adaptation B




Phase B Pickup:
> Led 2 y/n?
Phase B Pickup:
> Led 2 y/n?
Phase B Pickup:
> Led 2 y/n?
Phase B Pickup:
> Led 2 y/n
Phase B Pickup:
> Led 2 y/n?
Phase B Pickup:
> Led 2 y/n?
Phase B Pickup:
> Led 2 y/n?
Phase B Pickup:
> Led 2 y/n?
Phase B Pickup:
> Led 2 y/n?


Phase B Pickup:
> Q Led 2 y/n?
Phase B Pickup:
> R Led 2 y/n?
Phase B Pickup:
> o Led 2 y/n?
Phase B Pickup:
> p Led 2 y/n?
Phase B Pickup:
> q Led 2 y/n?
Phase B Pickup:
> r Led 2 y/n?
▲▼
Phase B Pickup:
> Led 3 y/n?
Phase B Pickup:
> Led 4 y/n?

Phase B Pickup:
> Led 5 y/n?

Phase B Pickup:
> Led 6 y/n?

Phase B Pickup:
> Led 7 y/n?

Phase B Pickup:
> Led-52 y/n?

Phase B Pickup:
> Led-79 y/n?

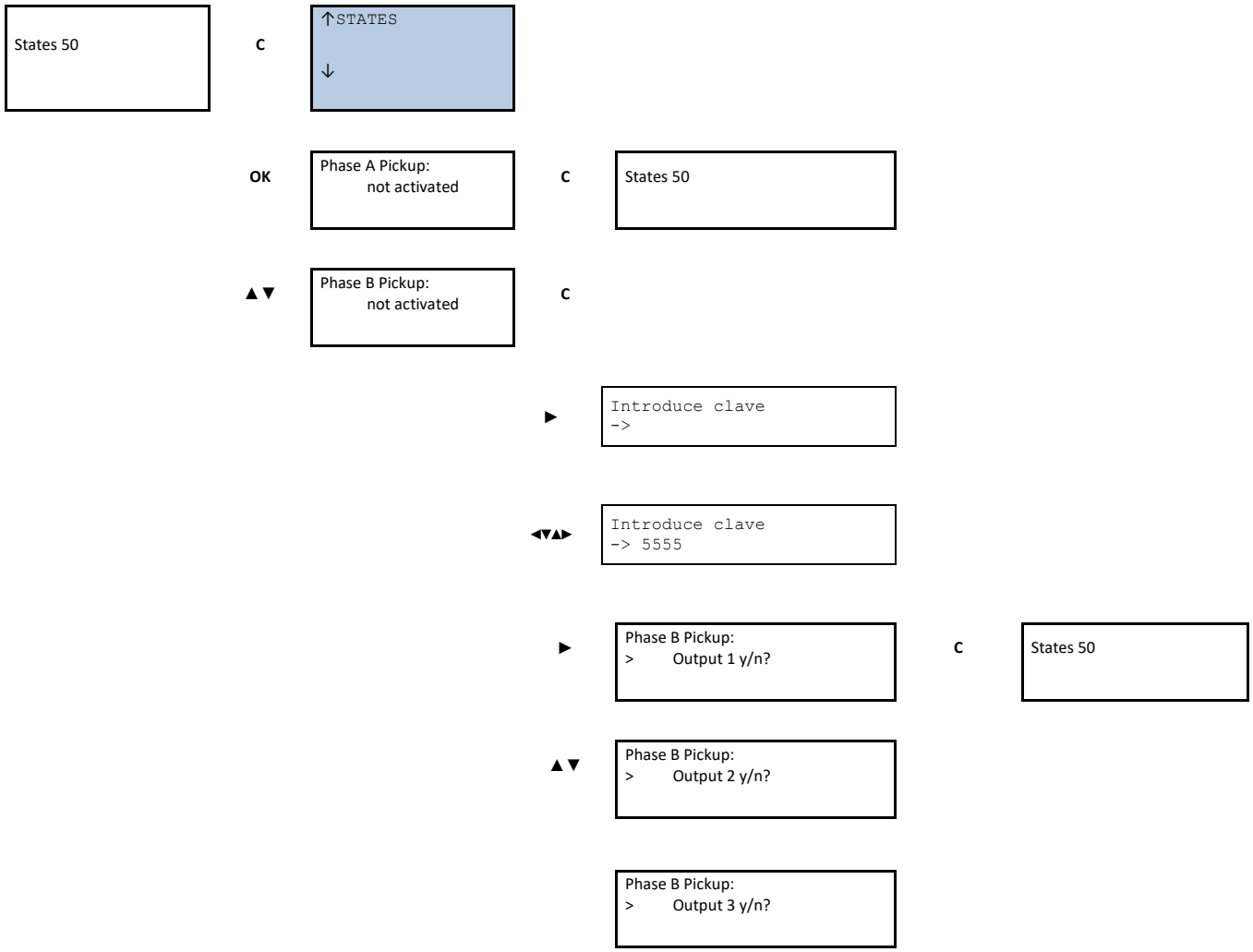
Phase B Pickup:
> Output 1 y/n?

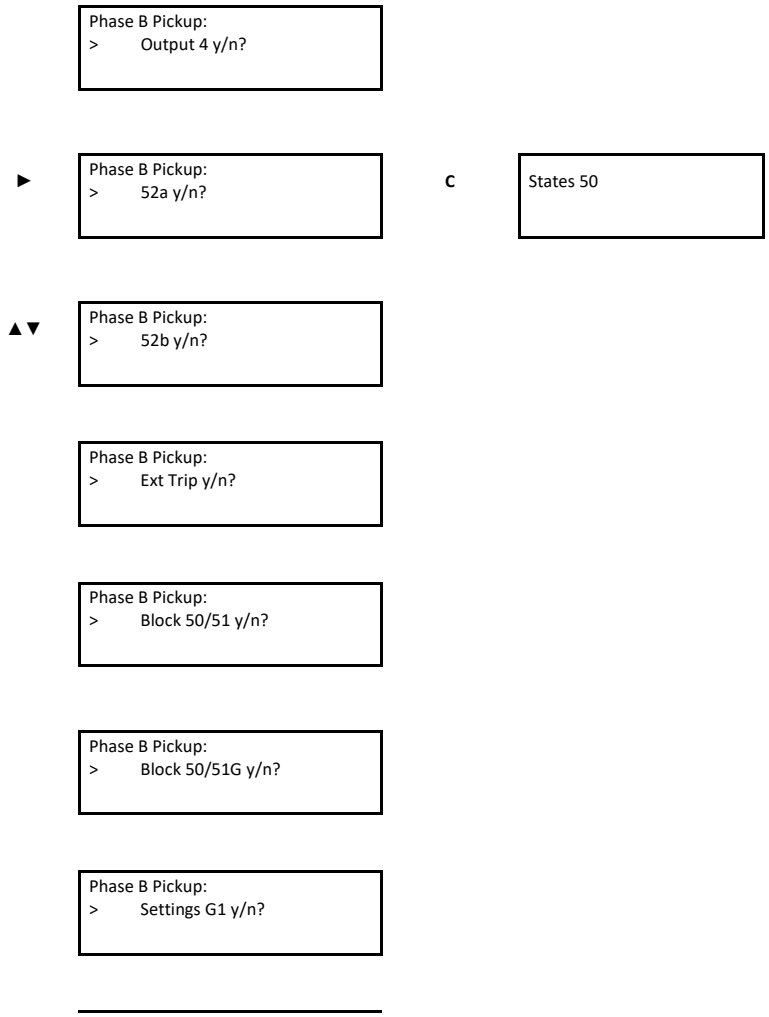
Phase B Pickup:
> Output 2 y/n?

Phase B Pickup:
> Output 3 y/n?

Phase B Pickup:
> Output 4 y/n?

SIL-A Adaptation C




Phase B Pickup:
> Output 4 y/n?
►
Phase B Pickup:
> 52a y/n?
C
States 50
▲▼
Phase B Pickup:
> 52b y/n?
Phase B Pickup:
> Ext Trip y/n?
Phase B Pickup:
> Block 50/51 y/n?
Phase B Pickup:
> Block 50/51G y/n?
Phase B Pickup:
> Settings G1 y/n?

Phase B Pickup:
> Settings G2 y/n?

Phase B Pickup:
> Reset y/n?

Phase B Pickup:
> 79 Start y/n?

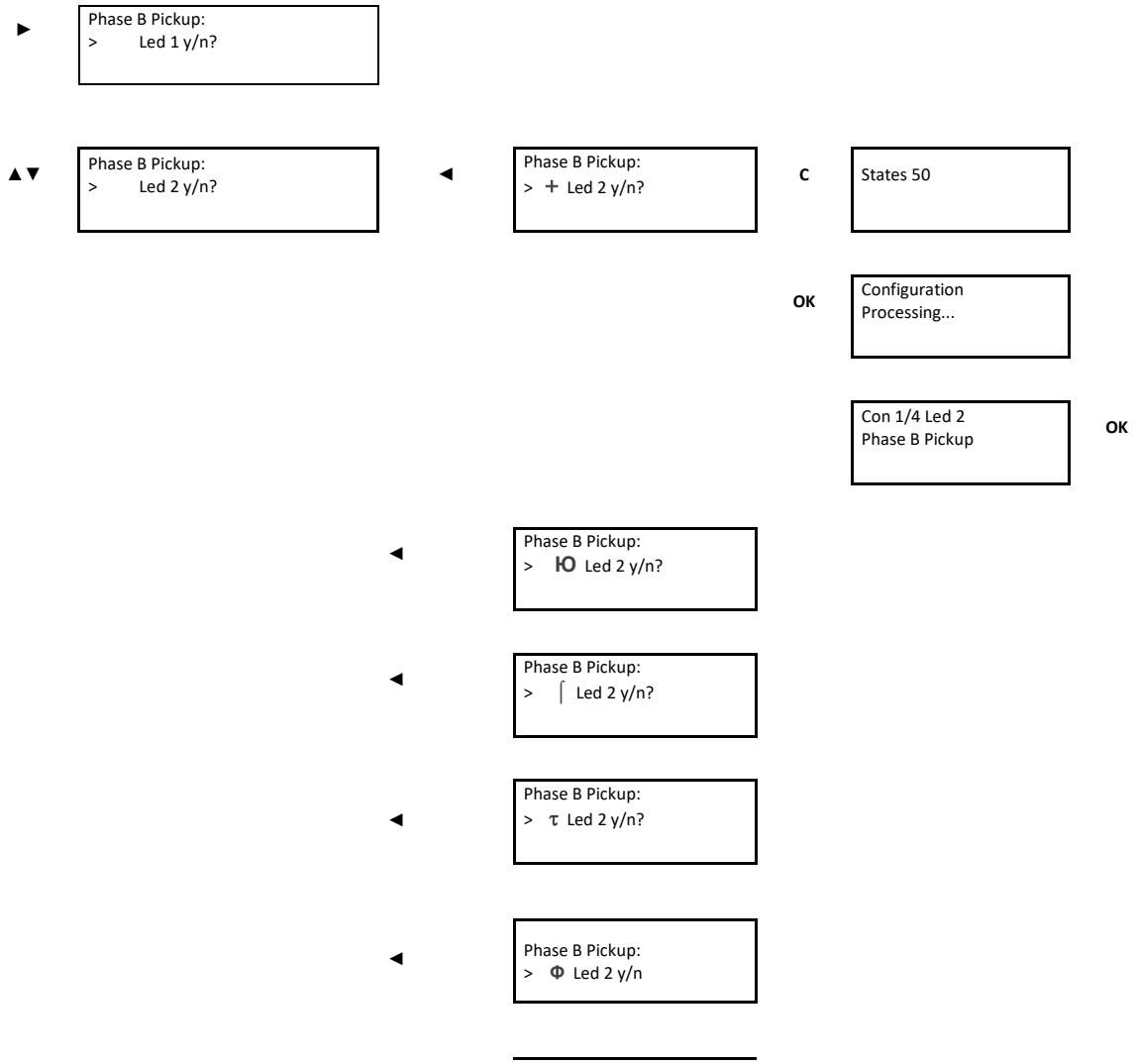
Phase B Pickup:
> 79 Enable y/n?

Phase B Pickup:
> 79 L Block y/n?

Phase B Pickup:
> 79 Block y/n?

Phase B Pickup:
> 79 Unblock y/n?

Phase B Pickup:
> DFR Start y/n?


►
Phase B Pickup:
> Led 1 y/n?
▲▼
Phase B Pickup:
> Led 2 y/n?
◄
Phase B Pickup:
> + Led 2 y/n?
C
States 50
OK
Configuration
Processing...
Con 1/4 Led 2
Phase B Pickup
OK
◄
Phase B Pickup:
> IO Led 2 y/n?
◄
Phase B Pickup:
> ⌠ Led 2 y/n?
◄
Phase B Pickup:
> τ Led 2 y/n?
◄
Phase B Pickup:
> Φ Led 2 y/n

◄ Phase B Pickup:
> & Led 2 y/n?

◄ Phase B Pickup:
> $ Led 2 y/n?

◄ Phase B Pickup:
> § Led 2 y/n?

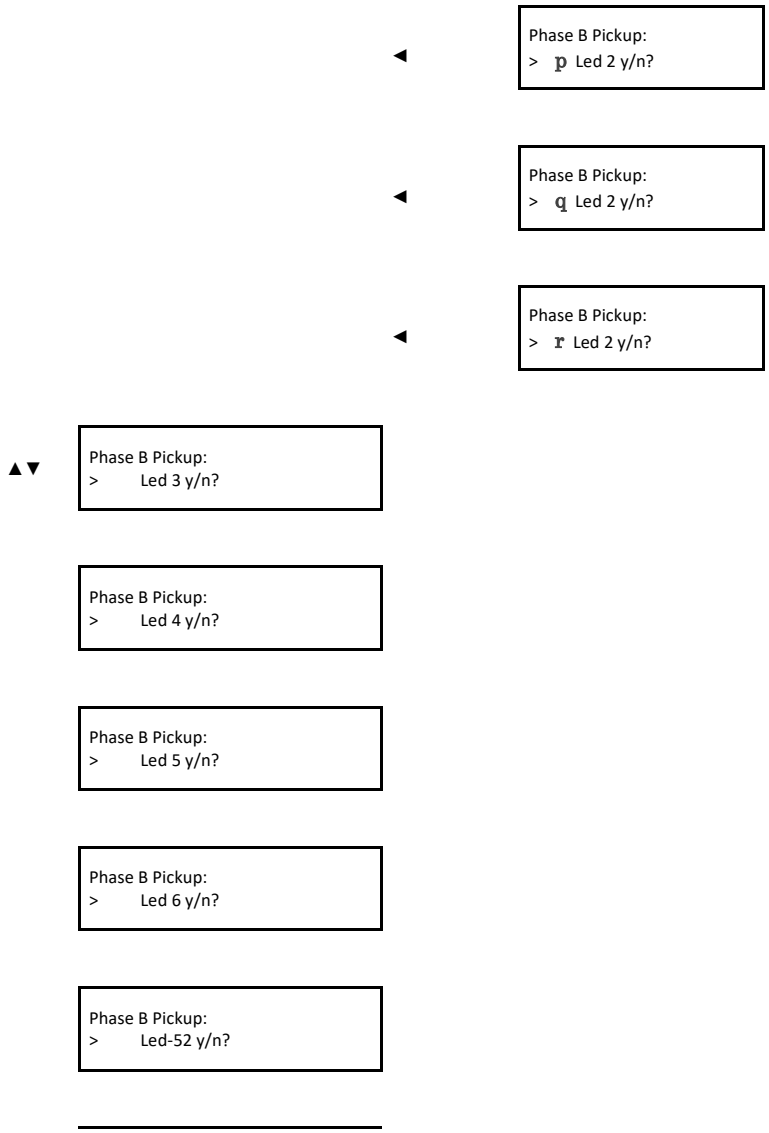
◄ Phase B Pickup:
> O Led 2 y/n?

◄ Phase B Pickup:
> P Led 2 y/n?

◄ Phase B Pickup:
> Q Led 2 y/n?

◄ Phase B Pickup:
> R Led 2 y/n?

◄ Phase B Pickup:
> o Led 2 y/n?


Phase B Pickup:
> p Led 2 y/n?
Phase B Pickup:
> q Led 2 y/n?
Phase B Pickup:
> r Led 2 y/n?
Phase B Pickup:
> Led 3 y/n?
Phase B Pickup:
> Led 4 y/n?
Phase B Pickup:
> Led 5 y/n?
Phase B Pickup:
> Led 6 y/n?
Phase B Pickup:
> Led-52 y/n?

```
Phase B Pickup:
>       Led-79 y/n?
```

11 APPENDIX

11.1 Identification:

Date: ……

Official: ……

Substation: ……..

Circuit: ……

Model: ……

Serial no.: ……..……

Software Versions: ……

11.2 Check:

Cabling check: ❒

Box earth: ❒

Vaux value: ❒

11.3 Test menu:

Led -1:	❒	Output 1:	❒
Led -2:	❒	Output 2:	❒
Led -3:	❒	Output 3:	❒
Led -4:	❒	Output 4:	❒
Led -5:	❒		
Led -79:	❒		
Led -52:	❒		

11.4 Register of commissioning settings:

Password: ……

Identification: ……..……..

Neutral and phase rated currents:

Phase nominal current: ……

Neutral nominal current: ……

50_1

Function Enable ❒ Yes ❒ No ❒ SHB

Current Tap ..... x In

Time Delay: ..... s

50_2

Function Enable ❒ Yes ❒ No ❒ SHB

Current Tap ..... x In

Time Delay: ..... s

50/51

Function Enable ❒ Yes ❒ No ❒ SHB

Current Tap ..... x In

Curve type ❒IEC Inverse ❒IEC Very inverse ❒IEC Extr. Inverse

❒IEC LT Inverse ❒IEEE Inverse ❒IEEE Very Inverse

❒IEEE Extr Inverse ❒Defined time

Time Dial (TMS) .....

Time Delay ..... s

50N/G_1

Function Enable ❒ Yes ❒ No ❒ SHB

Current Tap ..... x In

Time Delay: ..... s

50N/G_2

Function Enable ❒ Yes ❒ No ❒ SHB

Current Tap ..... x In

Time Delay: ..... s

50/51N/G

Function Enable ❒ Yes ❒ No ❒ SHB

Current Tap ..... x In

Curve type ❒IEC Inverse ❒IEC Very inverse ❒IEC Extr. Inverse

❒IEC LT Inverse ❒IEEE Inverse ❒IEEE Very Inverse

❒IEEE Extr Inverse ❒Defined time

Time Dial (TMS).....

Time Delay ..... s

Cold Load Pickup

Function Enable ❒ Yes ❒ No

Settings group .....

No load time: .....

Cold load time: .....

50BF

Function Enable ❒ Yes ❒ No

Time Delay: .....s

46

Function Enable ❒ Yes ❒ No ❒ SHB

Current Tap ..... x In

Curve type ❒IEC Inverse ❒IEC Very inverse ❒IEC Extr. Inverse

❒IEC LT Inverse ❒IEEE Inverse ❒IEEE Very Inverse

❒IEEE Extr Inverse ❒Defined time

Time Dial (TMS) .....

Time Delay ..... s

49

Function Enable ❒ Yes ❒ No

Current Tap……xIn

ζ heating……min

ζ cooling……ζ heating

Alarm……%

79

Function Enable ❒ Yes ❒ No

Hold Enable ❒ Yes ❒ No ❒ No Time

Number of reclosings ……

1st reclose time ……s

2nd reclose time ……s

3rd reclose time ……s

4th reclose time ……s

5th reclose time ……s

Hold Time ……s

Reset Time ……s

Safe time ……s

52

Maximum number of openings ……

Maximum number of accumulated amperes ……

Maximum opening time ……..

Maximum closing time ……

Repetitive openings number/Time: ……..……

Repetitive Time for Repet. Openings: ……

74TCS

Function Enable ❒ Yes ❒ No

Time Delay: ……..…s

74CT

Function Enable ❒ Yes ❒ No

Time Delay: ……..…s

37

Function Enable ❒ Yes ❒ No

Current Tap ..... x In

Time Delay: ……..…s

46BC

Function Enable ❒ Yes ❒ No

Current Tap ..... %

Time Delay: ……..…s

11.5 Inputs:

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

11.6 Outputs:

Output -1: ❒

Output -2: ❒

Output -3: ❒

Output -4: ❒

11.7 LEDs:

LED -1:	❒	LED -5:	❒
LED -2:	❒	LED -6:	❒
LED -3:	❒	LED -52:	❒
LED -4:	❒	LED -79:	❒

11.7.1 Leds configuration template:

SIL-A – Adaptation B

ON
50/51
50N/51N
50BF
46
74TCS

SIL-A – Adaptation C

ON
50/51
50N/51N
SHB
46
74TCS

11.8 Logical signals

52 a

Inputs: ……..… ……..… ……..… ……..…

Logic gate: ……..…

52 b

Inputs: ……..… ……..… ……..… ……..…

Logic gate: ……..…

50/51 Block

Inputs: ……..… ……..… ……..… ……..…

Logic gate: ……..…

50/51G Block

Inputs: ……..… ……..… ……..… ……..…

Logic gate: ……..…

DFR Start

Inputs: ……..… ……..… ……..… ……..…

Logic gate: ……..…

79 Start

Inputs: ……..… ……..… ……..… ……..…

Logic gate: ……..…

79 Enable

Inputs: ……..… ……..… ……..… ……..…

Logic gate: ……..…

79 L Block

Inputs: ……..… ……..… ……..… ……..…

Logic gate: ……..…

79 Block

Inputs: ……..… ……..… ……..… ……..…

Logic gate: ……..…

79 Unblock

Inputs: …….. …….. …….. ……..

Logic gate: ……..

50BF Start

Inputs: …….. …….. …….. ……..

Logic gate: ……..

Reset

Inputs: …….. …….. …….. ……..

Logic gate: ……..

Settings G1

Inputs: …….. …….. …….. ……..

Logic gate: ……..

Settings G2

Inputs: …….. …….. …….. ……..

Logic gate: ……..

External trip

Inputs: …….. …….. …….. ……..

Logic gate: ……..

74TCS Continuity A

Inputs: …….. …….. …….. ……..

Logic gate: ……..

74TCS Continuity B

Inputs: …….. …….. …….. ……..

Logic gate: ……..

Logical Signal 1

Inputs: …….. …….. …….. ……..

Logic gate: ……..

Logical Signal 2

Inputs: …….. …….. …….. ……..

Logic gate: ……..

11.9 Comments

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Person in charge of commissioning…….....…….....……..Date…….....

Maintenance performed on the…….. by ……..……

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