SIA D

Overcurrent relay

USER MANUAL

1. RECEPTION, HANDLING, INSTALLATION

1.1. Unpacking

Relays must only be handled by qualified personnel and special care must be taken to protect all of their parts from any damage while they are being unpacked and installed. The use of good illumination is recommended to facilitate the equipment visual inspection.

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

1.2. Reception of relays

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

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

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

1.3. Handling electronic equipment

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

Just by moving, a person can build up an electrostatic potential of several thousand volts. Discharging this energy into electronic components can cause serious damage to electronic circuits. It is possible that this damage may not be detected straight away, but the electronic circuit reliability and life will be reduced. This electronic component in the equipment is well protected by the metal housing, which should not be removed as the equipment cannot be adjusted internally.

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

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

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

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

1.4. Installation, commissioning and service

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

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

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

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

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

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

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

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

1.5. Storage

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

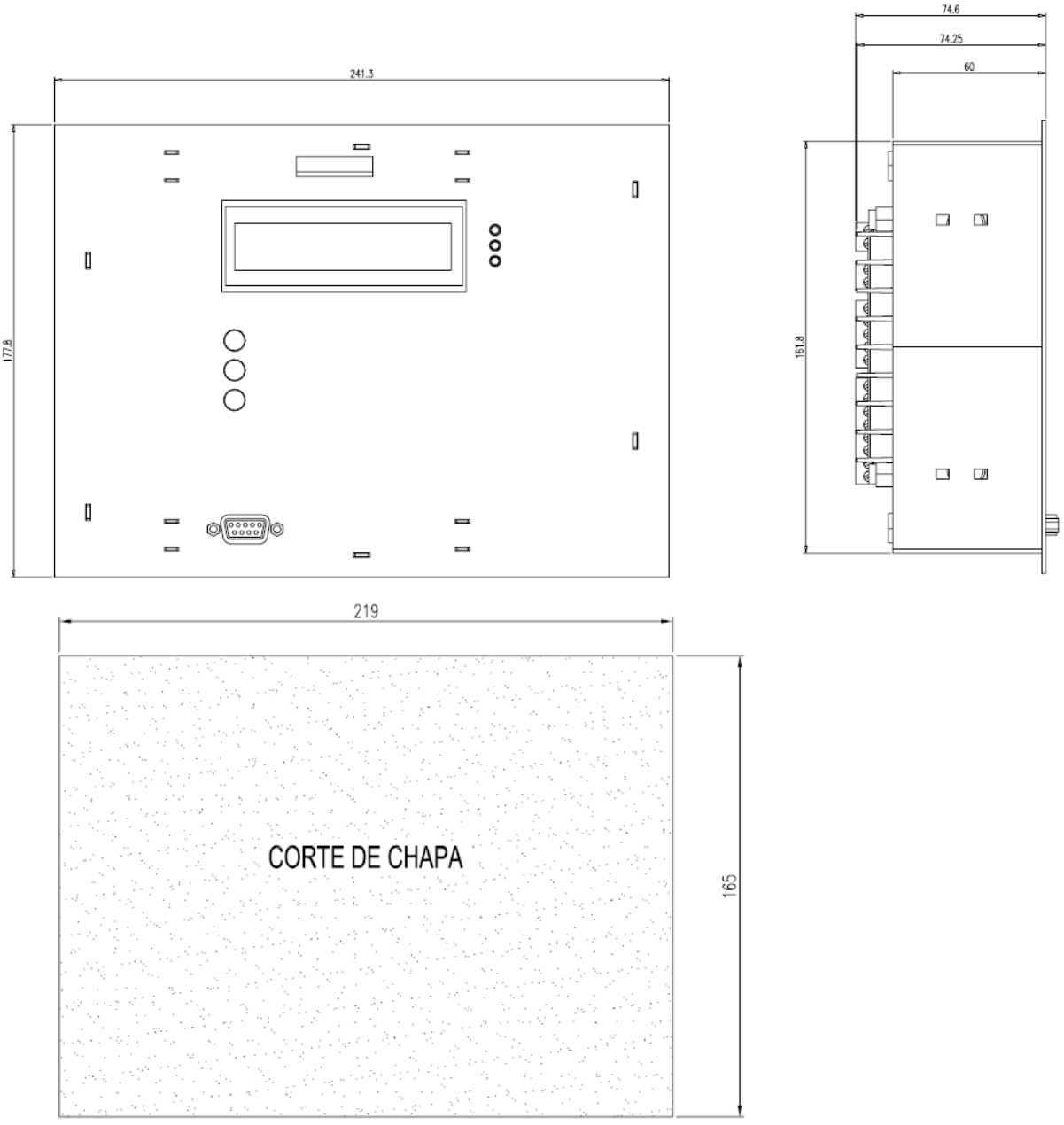
1.6. Recycling

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

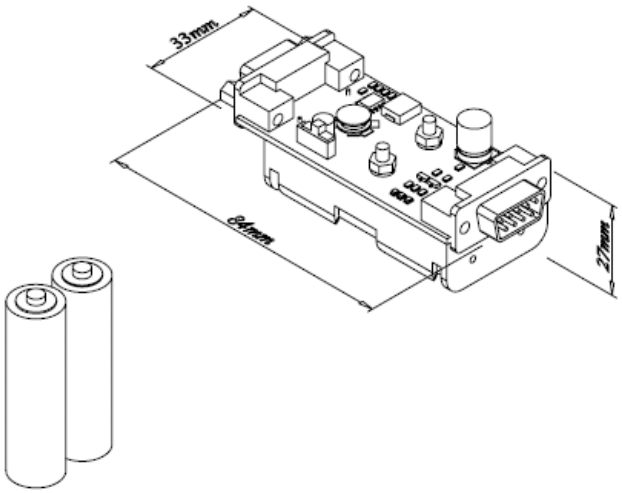
This product must be disposed of in a safe way. It should not be incinerated or brought into contact with water sources like rivers, lakes, etc…

2. DIMENSIONS AND CONNECTION DIAGRAMS

2.1. Case Dimensions mm

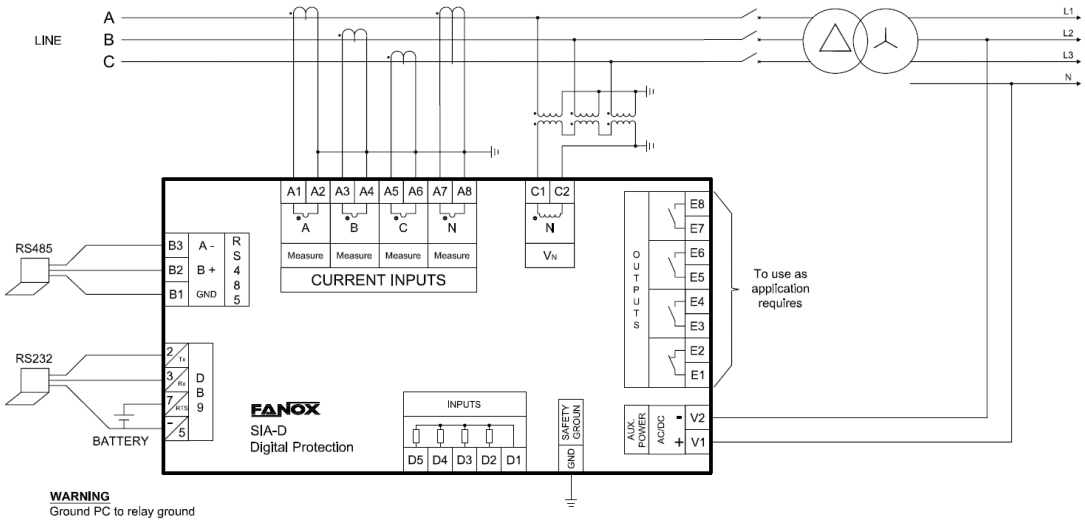


2.2. KITCOM Dimensions

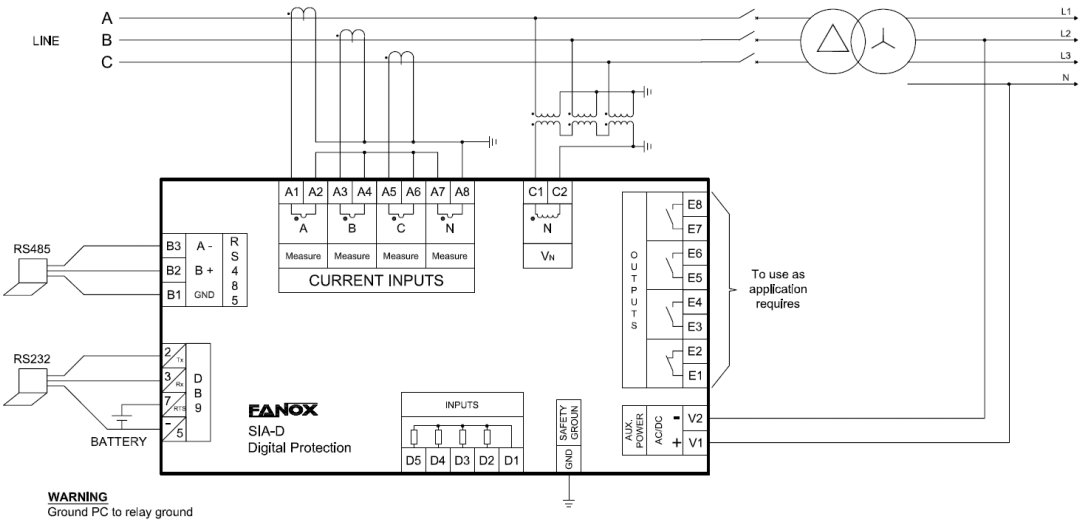


2.3. Connection Diagrams

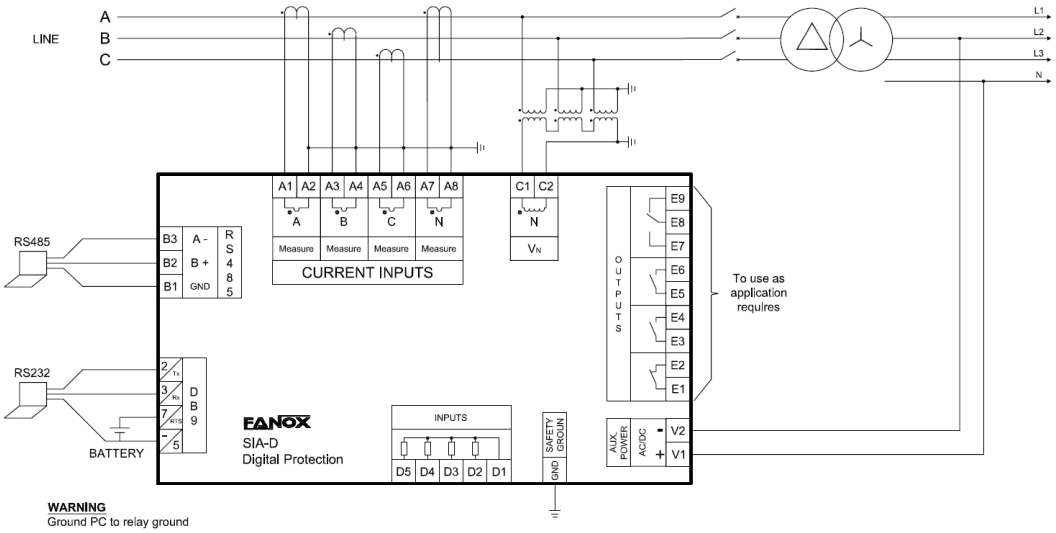
2.3.1. 3 Phase CT and neutral CT Connection (Revision A)



2.3.2. 3 Phase CT and residual neutral Connection (Revision A)

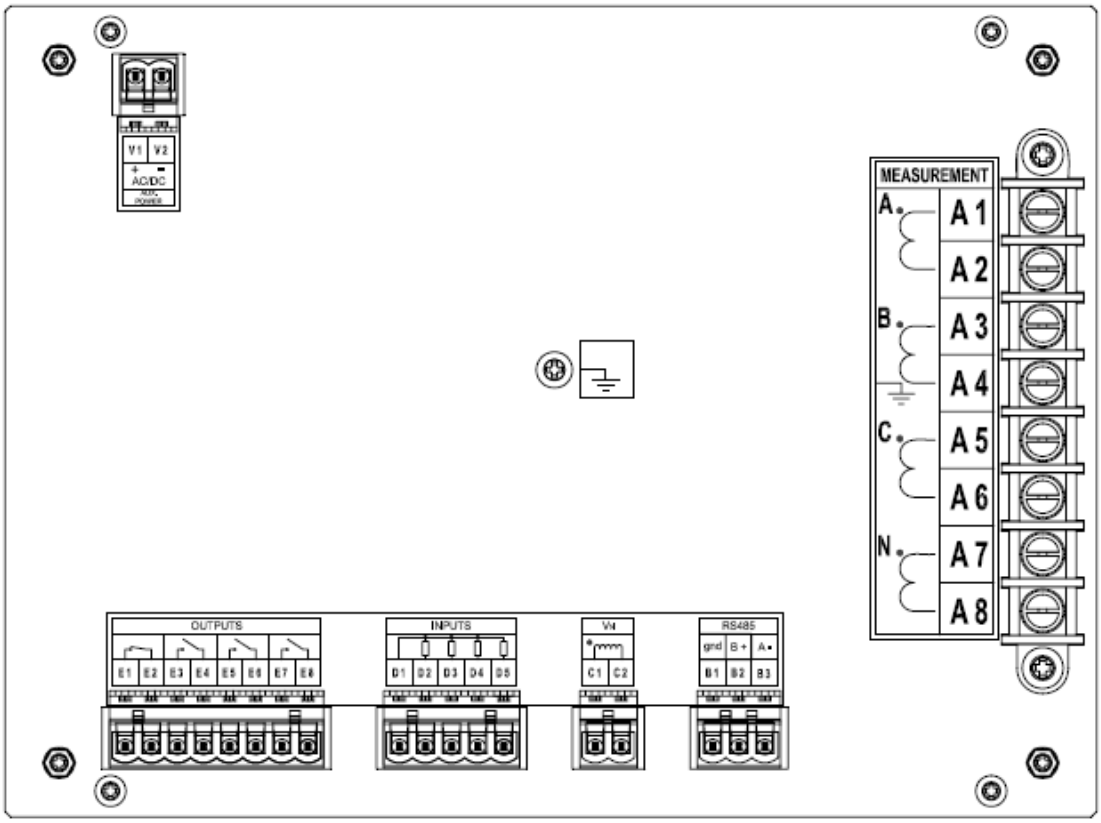


2.3.3. 3 Phase CT and neutral CT Connection (Revision B)



2.4. Terminals

2.4.1. Terminals of Revision A models



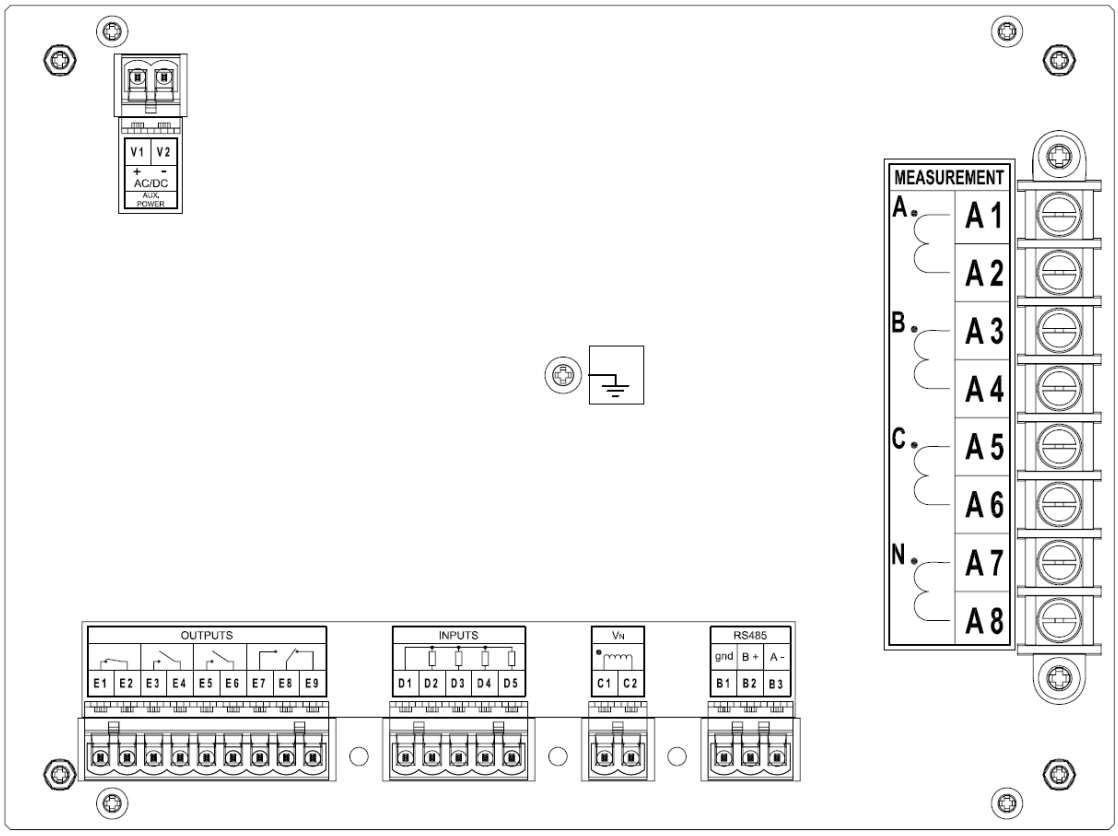
A1	A-phase current input for metering
A2	A-phase current output for metering
A3	B-phase current input for metering
A4	B-phase current output for metering

D1	Input common
D2	Input 1
D3	Input 2
D4	Input 3

A5	C-phase current input for metering
A6	C-phase current output for metering
A7	Neutral current input for metering
A8	Neutral current output for metering
B1	RS485 – gnd
B2	RS485 – B-
B3	RS485 – A+
C1	Voltage neutral input
C2	Neutral voltage output

D5	Input 4
E1-E2	Output 1
E3-E4	Output 2
E5-E6	Output 3
E7-E8	Output 4
V1	Auxiliary voltage +
V2	Auxiliary voltage -
⏚	Grounding bolt

2.4.2. Terminals of Revision B models



A1	A-phase current input for metering
A2	A-phase current output for metering
A3	B-phase current input for metering
A4	B-phase current output for metering
A5	C-phase current input for metering

D1	Input common
D2	Input 1
D3	Input 2
D4	Input 3
D5	Input 4

A6	C-phase current output for metering
A7	Neutral current input for metering
A8	Neutral current output for metering
B1	RS485 – gnd
B2	RS485 – B-
B3	RS485 – A+
C1	Voltage neutral input
C2	Neutral voltage output

E1-E2	Output 1, NC contact
E3-E4	Output 2
E5-E6	Output 3
E7	Output 4, NO contact
E8	Output 4, common contact
E9	Output 4, NC contact
V1	Auxiliary voltage +
V2	Auxiliary voltage -
⏚	Grounding bolt

3. DESCRIPTION

3.1. Introduction

Worldwide, the energy sector is currently undergoing a profound change as a result of high levels of energy demand; more distribution lines and advanced supervision systems are required. Given the need for creating intelligent infrastructure, FANOX has developed the SIA family of products to carry out this function.

The family of SIA relays is designed to protect the secondary transformation and distribution centres of electricity grids. Protection features include protection against instantaneous and inverse time overcurrent (for the phases and the neutral), and it also has external trip support (temperature, pressure, etc.) depending on the characteristics of each model.

The protection functions can be enabled selectively by using both the front panel and the communications links to the SIcom program, allowing for precise coordination with other equipment.

Additional benefits include that all of the models have been designed to be supplied from an external battery. This is aimed at facilitating event management and the commissioning of centres, as well as allowing it to operate properly under adverse conditions.

3.2. Equipment description

The SIA-D equipment is a protection relay designed for secondary distribution.

It is supplied with 110-230 Vac / 90-300 Vdc auxiliary voltage. It is possible to choose 24-48 Vdc auxiliary for each model. As for the rest of the SIA family, it can be supplied through its front RS-232 communications port via an external battery, using the KITCOM adapter. This facilitates the start-up of the centres and the management of events. The operation of the outputs is not guaranteed when the SIA-D equipment is supplied from an external battery.

As well as the functions to protect against instantaneous phase and neutral overcurrents and phase and neutral inverse time overcurrents, it is possible to choose two neutral directional units or one isolated neutral directional unit for each model. It is also equipped with a trip blocking to protect the switchgear in centres that combine switchgear and fuses.

All models include a breaker management block, which monitors the switch condition, the number of breaks and the accumulated amps. It generates an indication if these are excessive, it determines whether or not an Opening fault has occurred and allows the breaker close and open commands from the HMI and via the communications port (either locally or remotely).

Revision B includes in all the models two new characteristics:

- A general states bit which monitories 48 Vdc power source
- Tripping Bus (which requires two inputs and two outputs)

The SIA-D equipment has four inputs and four outputs that can be configured by the user.

In order to facilitate the analysis of events, it is fitted with two oscillographic records, each one with 33 cycles: 3 prefault cycles and 30 postfault cycles.

The oscillograph start can be configured by the user. Each oscillographic record shows the phase and neutral currents, the neutral voltage and up to 64 digital channels, which include pick-ups and trips of the protection functions, inputs, outputs, etc. The COMTRADE format is used (IEEE C37.111-1991).

The SIA-D equipment is housed in a metal box with galvanic isolation on all of its measurement or digital inputs and outputs (with the exception of ports for communications and battery power supply, as these are sporadic connections). This allows the equipment to have the best possible level of electromagnetic compatibility, both in terms of emission of, and immunity from, radiated and conducted interferences. These levels are the same as those established for primary substations.

The equipment has a LCD with two lines and twenty columns and a membrane keyboard with six buttons. These allow the display of the equipment status, the current measurements in the primary and the events or incidents associated with the equipment, and adjustments to be made to the protection criteria. Depending on the model, these events can be saved in a non-volatile memory to save them in case of power failures.

There are three bistable magnetic indicators on the front of the SIA-D equipment. These indicate the causes of trips, and continue to signal the indication even if the relay loses power. It is also fitted with three LED indicators, which blink to show the type of supply that is being used at any time.

The equipment has storage for up to 500 events, allowing any recorded incidents to be analysed. All SIA-D models are equipped with a real-time clock (RTC).

Current measurements are performed using RMS values, with an accuracy of 2%. Standard 5 A and 1 A current transformers (CTs) are used.

The equipment has two communication ports: a front port (RS232) and an optional rear port (RS485). The RS232 port allows a PC to be connected, which can be used to monitor the equipment using the SICom communications program (supplied by FANOX). A 12V battery can also be used to power the equipment through this front port by using the adapter (KITCOM). The rear port RS485 allows the equipment to be integrated as part of a system (SCADA). The Modbus RTU protocol is used in both ports. Setting-up a session allows four levels of access to be set up with passwords that can be configured by the user.

The protective functions provided, easy-to-use interface, low amount of maintenance and simple integration make the SIA-D a precise and practical solution for protecting both industrial and public electrical grids and transformation and distribution centres. It even provides these protective functions in situations where auxiliary power sources are not available or not reliable. The protection offered by the SIA-D against earth faults is sensitive enough to be used in electric systems where the earth fault current is low. It can be set to 0.2 times the rated neutral current and, depending on the model, the rated neutral current can go as low as 0.1 A.

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

Function	Description	SIA-D
Protection		

50P	Phase instantaneous overcurrent protection function	1
50N	Neutral instantaneous overcurrent protection function	1
51P	Phase inverse time overcurrent protection function	1
51N	Neutral inverse time overcurrent protection function	1
Fuse + Switchgear	Trip blocking to protect the switchgear	1
67N	Neutral directional overcurrent protection	2 (optional)
67NA	Isolated neutral directional overcurrent protection	1 (optional)
Circuit breaker		
	Status and control of the circuit breaker	✓
	Number of breaks	✓
	Accumulated amps	✓
Function	**Description**	**SIA-D**
Measurements		
	Phase and neutral RMS measurement with 2% accuracy	✓
Inputs and Outputs		
	Configurable Inputs	4
	Configurable outputs	4
Communication and HMI		
	Front port: RS232 (ModBus, RTU 19200)	✓
	Rear port: RS485 (ModBus, RTU 19200)	Optional
	SICom Program	✓
	Login in: 4 access levels with configurable passwords	✓
Control and signalling		
	HMI: LCD, 20x2 and 6 keys + 1 reset button	✓
	Bistable magnetic indicators	Up to 3
	LED Indicators	Up to 3
	Tripping Bus (2 inputs and 2 outputs) (3*)	✓
Power supply		
	Auxiliary voltage 110-230 Vac / 90-300 Vdc	✓
	Auxiliary voltage: 24-48 Vdc	Optional
	Battery power: 12V with an RS232 adapter (2)	✓

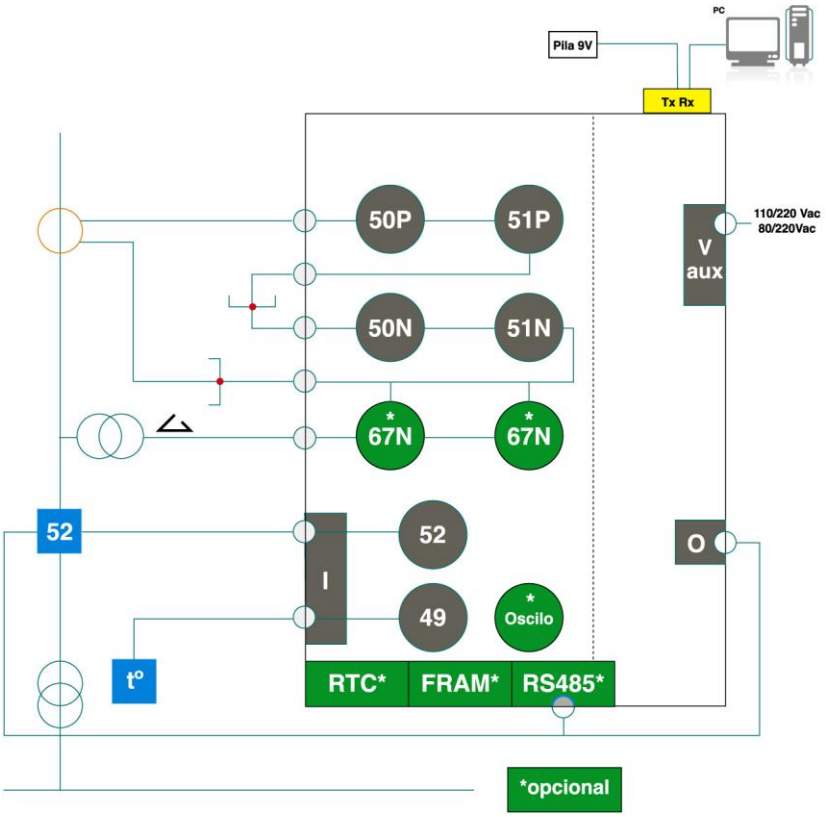
Monitoring and Recording		
	Events saved in the volatile RAM* memory (1)	✓
	Events saved in the non-volatile FRAM* memory	Optional
	Real-Time Clock (RTC)	✓
	Oscillographic records	2 (optional)
	Test menu	✓
	Self-diagnosis	✓

(1) Events stored in the RAM are deleted in the case of electrical power failure. Events recorded in the FRAM are saved if there is a power failure, as it is a non-volatile memory. A maximum of 500 events can be stored.

(2) The operation of the outputs is not guaranteed when battery power is used.

(3*) Available only in Revision B models.

3.3. Functions Diagram



3.4. Phase CT and neutral CT selection

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

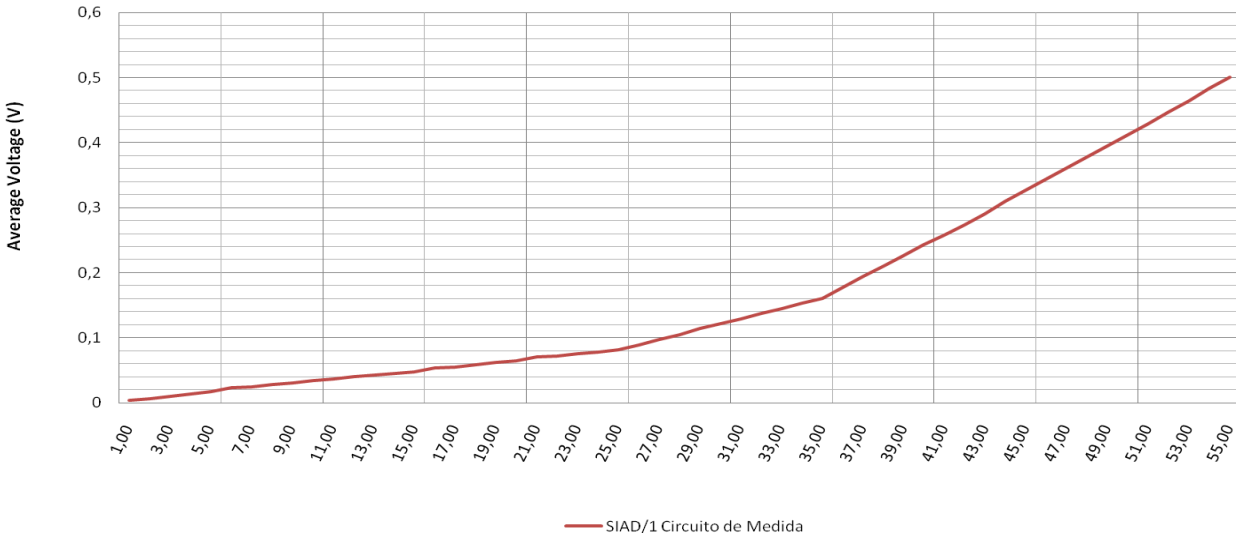
Model	Phase	Neutral	Phase range	Neutral range

SIAD55	CT 5 A	Residual phase connection	1-150 A	1-150 A
SIAD11	CT 1 A	Residual phase connection	0,2-30 A	0,2-30 A
SIAD51	CT 5 A	CT 1 A	1-150 A	0,2-30 A
SIAD5A	CT 5 A	CT 0,1 A	1-150 A	0,02-3 A
SIAD1A	CT 1 A	CT 0,1 A	0,2-30 A	0,02-3 A
SIAD5B	CT 5 A	CT 0,2 A	1-150 A	0,04-6 A
SIAD1B	CT 1 A	CT 0,2 A	0,2-30 A	0,04-6 A

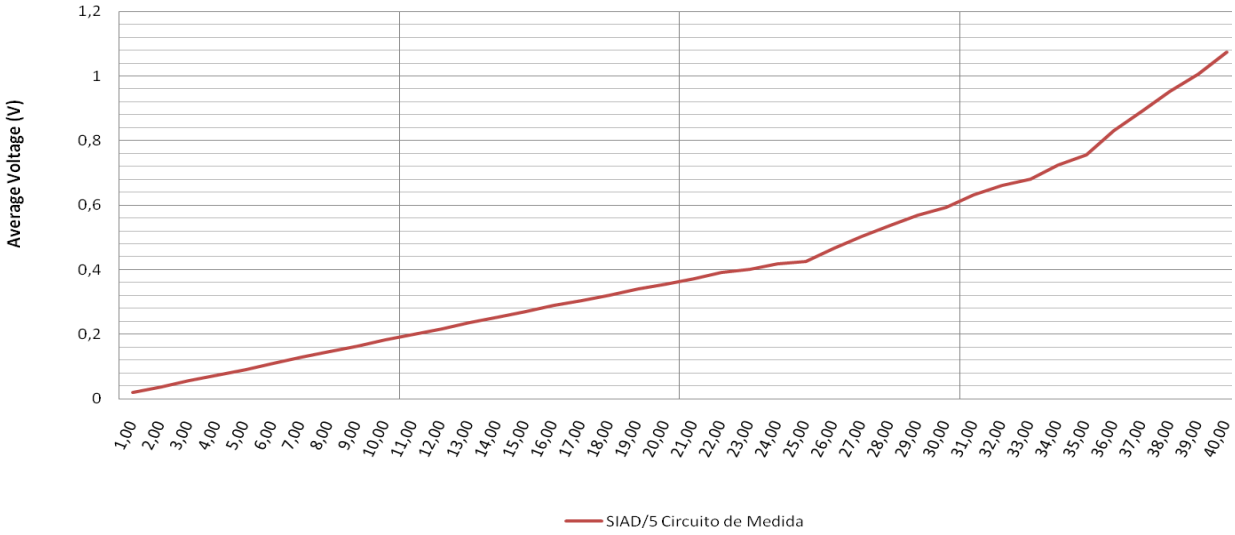
In order to assure a correct running of the relay, it is necessary to use the proper current transformer. Therefore, the load of measurement circuits of the relay and the load of connection cables between CT's and relay must be taken into account.

PRECISSION	BURDEN	RELAYS
5P10	0,5 VA	SIA-D/1
5P20	0,5 VA	SIA-D/1
5P30	0,5 VA	SIA-D/1
5P10	1 VA	SIA-D/5
5P20	1 VA	SIA-D/5
5P30	1 VA	SIA-D/5

LOAD CURVE FOR RELAY SIA-D/1



LOAD CURVE OF RELAY SIA-D/5



3.5. Model list SIA-D

TYPE	PHASE MEASURE	NEUTRAL MEASURE	NET PREQUENCY	SUPPLY	EXTRA FUNCTION	COMMUNICATIONS	INPUTS/ OUPTUTS	EVENTS	LANGUAGE	REVISION	
D											50P + 51P + 50N + 51N + 52
	1 2 5										1 A 2 A 5 A
		A B 1 5									0,1 A 0,2 A 1 A 5 A
			5 6 7 8								50 Hz + Breaker 50 Hz + Circuit Breaker 60 Hz + Breaker 60 Hz + Circuit Breaker
				2 3							110-230 Vac 90-300 Vdc 24-48 Vdc

					0 1 2						Without 67N With 67N1 and 67N2 With67NA (isolated neutral)
						0 1					ModBus (RS 232) ModBus (RS 232) and(RS 485)
							2				4O + 4I
								0 1 2			With volatile RAM memory With non-volatile RAM memory With non-volatile RAM (events + osc)
									A B C		English, Spanish, French English, Spanish, French, Turkish English, Spanish, French, Polish
										- A B	First Revision Second Revision Third Revision

3.6. Revisions Historic

Revisions	Hardware	Software
A	All the models with RTC	Multilanguage
B	Output 4 of revision A was normally open and in revision B provides the contact normally open and the contact normally closed.	All the models with Tripping bus and one bit for power supply monitoring.

4. PROTECTION FUNCTIONS AND FEATURES

4.1. Power supply

The SIA-D equipment is designed to be supplied from an auxiliary voltage of 110-230 Vac / 90-300 Vdc or 24-48 Vdc (can be selected for each model).

It can also be supplied from a 12V battery. The external 12 V battery is connected to the equipment through an adapter that is plugged into the front communications port (KITCOM). It is useful for cases like commissioning operations, discharges and repairs to the transformation centre as these are situations when there is no auxiliary voltage or current in the line, and normally cause more events, ground connections, forgotten tools, poor terminations, etc.

The operation of the digital output is not guaranteed when a battery power is used.

Using battery power supply does not inhibit the RS232 communications port, as it can be used simultaneously.

When the equipment is being powered from a 12 V battery, it is capable of operating for 2 hours.

4.2. 50P Function. Phase instantaneous phase overcurrent

This protection function can be set by using three parameters:

Function	Description	Minimum	Maximum	Step	Unit	Default
50P	Phase instantaneous overcurrent					
	Permission	-	-	Yes/No	-	No
	Tap	0,10	30,00	0,01	I nominal	5,00
	Operating time	0,02	300,0	0,01	s	0,02

The operating time is independent from the operating current flowing through the equipment, so if the phase current exceeds its predetermined value for an equal or greater amount of time than this preset value, the protection function activates (trips) and does not reset itself until the 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 operating time is equal to the preset time plus a maximum of 30 ms.

4.3. 51P Function. Phase inverse time overcurrent

This protection function can be set by using five parameters:

Function	Description	Minimum	Maximum	Step	Unit	Default
51P	Phase inverse time overcurrent					
	Permission	-	-	Yes/No	-	No
	Curve	-	-	(1*)	-	Extremely Inverse
	Dial	0,05	1,25	0,01	-	1,25
	Tap	0,10	7,00	0,01	Inominal	1,00
	Operating time	0,02	300,0	0,01	s	0,02

(1*) Inverse, Very inverse, 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 operating time is set by the parameter "Operating time".

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

If the unit operates with 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 120% of the set tap value, and it deactivates at 100%.

The reset is instantaneous in both cases.

The activation time is accurate to ±5% or ±30ms, whichever is greater, of the theoretical activation time.

The curves used are IEC255-4/BS-142, which are described in the "Curves" section.

4.4. 50N Function. Neutral instantaneous overcurrent

This protection function can be set by using three parameters:

Function	Description	Minimum	Maximum	Step	Unit	Default
50N	Neutral instantaneous overcurrent					
	Permission	-	-	Yes/No	-	No
	Tap	0,10	30,00	0,01	I nominal	1,00
	Operating time	0,02	300,00	0,01	s	0,02

The operating time is completely independent from the operating current that flows through the equipment, so if the neutral current exceeds its predetermined value for an equal or greater amount of time than this preset value, the protection function activates (trips) and does not reset itself until the 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 operation time is equal to the preset time plus a maximum of 30 ms.

4.5. 51N Function. Neutral inverse time overcurrent

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

Function	Description	Minimum	Maximum	Step	Unit	Default
51N	Neutral inverse time overcurrent					
	Permission	-	-	Yes/No	-	No
	Curve	-	-	(1*)	-	Extremely Inverse
	Dial	0,05	1,25	0,01	-	1,25
	Tap	0,10	7,00	0,01	Inominal	0,50
	Operating time	0,02	300,0	0,01	s	0,02

(1*) Inverse, Very inverse, 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 operating time is adjusted by using the parameter "Operating time".

If a curve (inverse, very inverse or extremely inverse) is selected for the curve setting, the operating time 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 120% of the set tap value, and it deactivates at 100%. The reset is instantaneous in both cases.

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

The curves used are IEC255-4/BS-142, which are described in the "Curves" section.

4.6. Trip blocking protection for the switchgear

Some transformation centres use a combination of switchgear and fuses for cutting out. Switchgears have a limited opening current. As a result, 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 preset value.

Group	Description	Minimum	Maximum	Step	Unit	Default
	Breaker blocking					
	Blocking	-	-	Yes/No	-	Yes
	Blocking limit	7,00	20,00	0,01	I nominal	7,00

4.7. Function 52. Circuit breaker monitoring

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

Group	Description	Minimum	Maximum	Step	Unit	Default
52	Circuit breaker monitoring					
	Excessive number of openings	1	10000	1	-	10
	Maximum accumulated amps	1	100000	1	MA^2	1000
	Opening time	0,02	300,0	0,01	s	0,10
	Closing time	0,02	300,0	0,01	s	0,10
	Excessive repeated openings	1	10000	1	-	3
	Time of excessive repeated openings	1,00	300,0	0,01	min	9,00

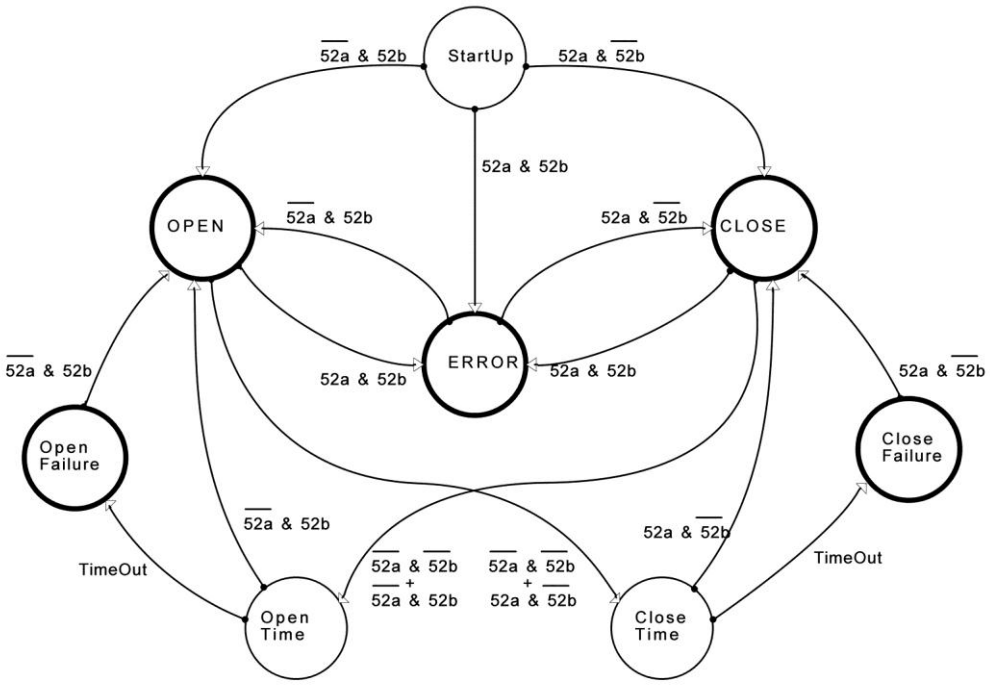
It is also necessary to assign the logical inputs 52a and/or 52b to a physical input.

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

The following statuses are associated with this function:

Function	Status	Description
52	Home	Energized/Unenergized These are the different statuses of the circuit breaker automatic control
	Error	
	Open	
	Opening time	
	Opening fault	
	Closed	
	Closing time	
	Closing fault	
	No. of configured openings exceeded	Activated if the meter that measures the number of openings exceeds the "Excessive number of openings" setting
	No. of configured accumulated (I2t) amps exceeded	Activated if the accumulated amps meter exceeds "Maximum accumulated amps" setting
	Repeated Trips	Activated if the number of openings exceeds the setting in "Excessive repeated openings" for the time set in "Time of excessive repeated openings"

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



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

If only the circuit breaker 52a contact is available, it should be wired to the corresponding physical input. This physical input is then assigned to the "52a Input" logical input. The 52b logical input is calculated internally as the negative of 52a. The circuit breaker automata is considered as having four statuses: start, open, closed and error.

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 automata is considered as having four statuses: start, open, closed and error.

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

4.7.1. Circuit breaker opening and closing commands

The circuit breaker opening and closing commands are implemented. These commands can be executed from the HMI command menu or through communications.

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

4.7.2. Counter to register the number of openings

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

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

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

4.7.3. Accumulated amps counter: I2t

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

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

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

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

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

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

4.7.4. Excessive openings in a time window

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

When this number is exceeded, the "Repeated Trips" status is activated and its corresponding event is generated.

4.8. 67N1 and 67N2 Function. Neutral directional overcurrent protection

Two neutral directional overcurrent units are fitted: 67N1 and 67N2.

This function uses residual voltage as a polarisation variable and residual current as an operating variable. The working range is defined in the following way: the operating angle is turned clockwise based on the residual voltage to give the maximum torque direction. Over this maximum torque direction, a cone is drawn with the adjusted semicone angle.

If the directional option is not activated, the 67N function behaves like a 50N function.

The actuation time is started when the following conditions are met simultaneously:

- Residual voltage that is higher than the setting
- Residual current that is higher than the setting
- The phase difference of the residual current and the residual voltage is at a level where the residual current is within the working range.

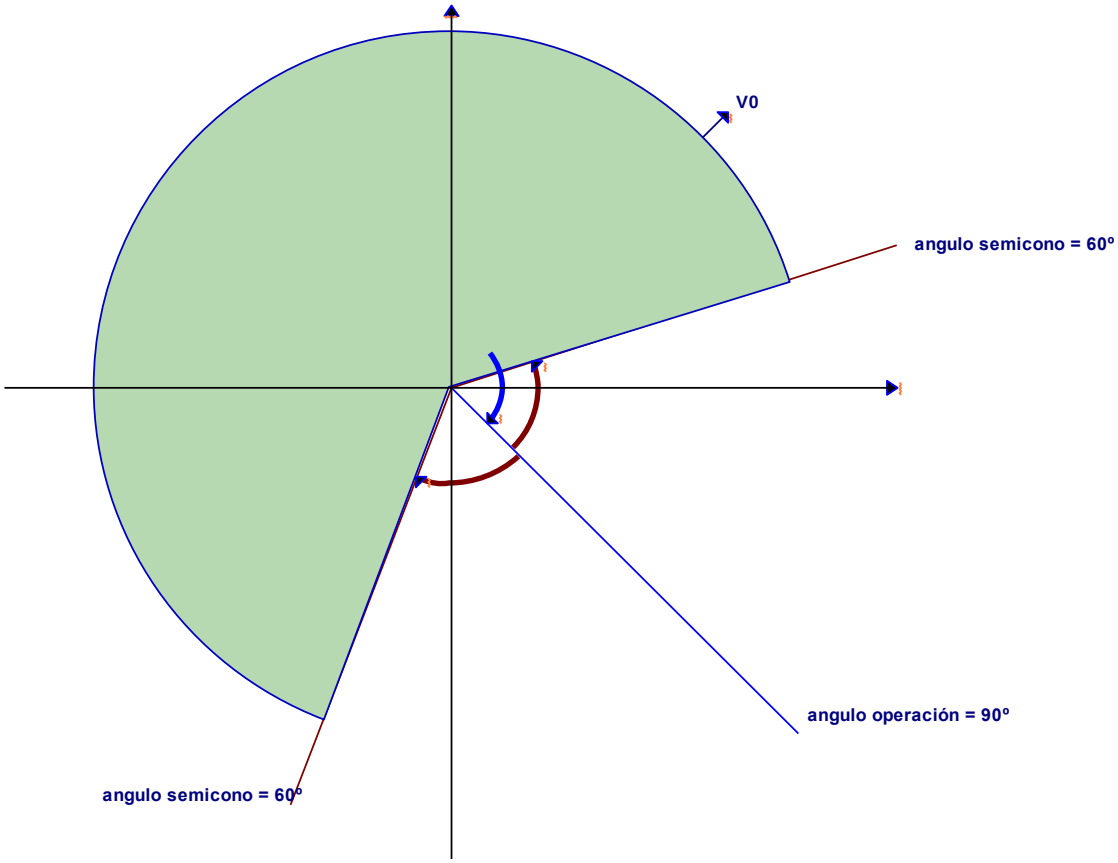
The function settings are shown below:

Group	Description	Minimum	Maximum	Step	Unit	Default
67N	Neutral directional overcurrent					
	Permission	-	-	Yes/No	-	No
	Tap	0,10	30,00	0,01	I nominal	5,00
	Operating time	0,02	300,0	0,01	s	0,02
	Directionality	-	-	Yes/No	-	No
	Residual voltage	4,00	110,00	0,1	V	5
	Operating angle	0	359	1	º	90
	Half-cone angle	0	170	1	º	90

The residual current's activation level is 100% and the reset level is 95%. The residual voltage's activation level is 100% and the reset level is 95%. The reset is instantaneous.

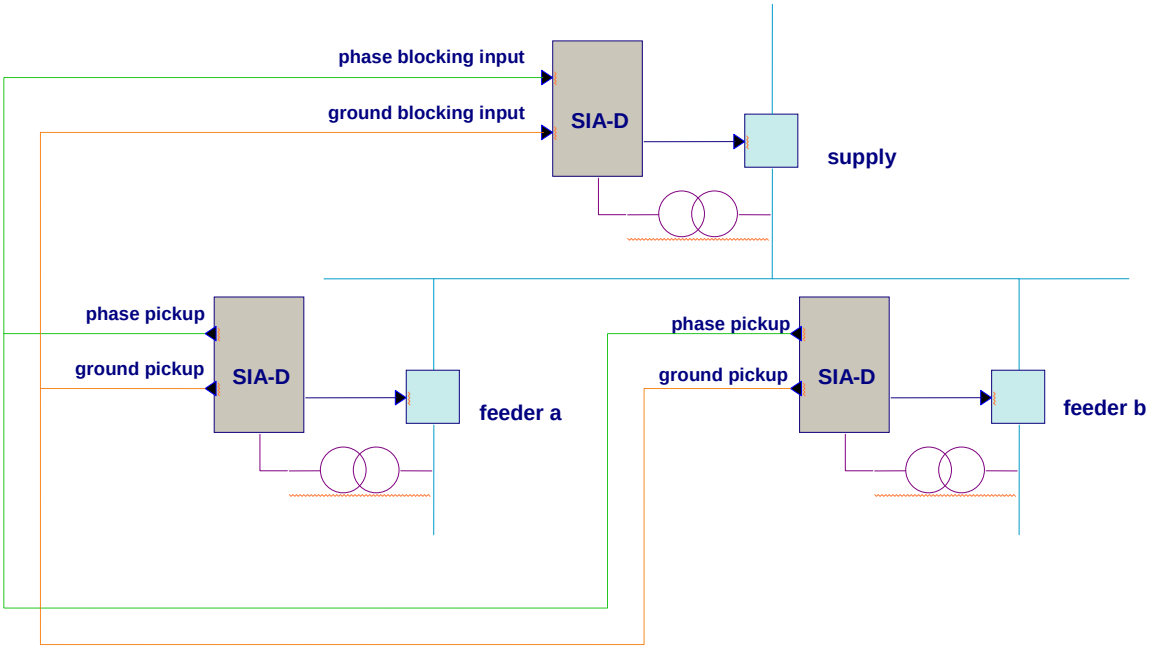
The accuracy of the operation time is equal to the preset time plus a maximum of 30 ms.

The operation area of the directional adjusted to an operation angle of 90º and a semi-cone angle of 60º is graphically shown below.



4.9. Tripping Bus

Since revision B, all models include the possibility of tripping bus:



By using relays SIA-D a tripping bus is implemented. Based on the figure, there are 2 relays with the function of feeder and 1 relay with the function of supply.

Tripping bus criteria has 2 logical inputs and 2 associated states:

- Phase bocking logical input
- Neutral blocking logical input
- Phase activation state
- Neutral activation state

Relays with feeder function, active the phase activation state when detect the staring up of function 50P or 51P and actívate the neutral activation state when detect the starting up of function 50N, 51N, 67N1 or 67N2. Phase and neutral activation states must be redirected to the physical outputs using the outputs configuration.

Relays with supply function, block the trip of functions 50P and 51P when detect the activation of phase blocking logical input and block the trip of functions 50N, 51N, 67N1 and 67N2 when detect the activation of neutral blocking logical input. Physical inputs must be assigned to logical inputs associated to the tripping bus using inputs configuration.

Physical connection is the following:

- Outputs associated to the phase activation of feeder equipments must be connected to the input associated to the phase blocking of supply equipment.
- Outputs associated to the neutral activation of feeder equipments must be connected to the input associated to the neutral blocking of supply equipment.

Each one of the involved functions in the tripping bus (50P, 51P, 50N, 51N, 67N1 and 67N2) has an associated permission. If the permission associated to the function is not enabled in the feeder equipment, the starting up of this function does not activate the corresponding state. If the associated permission is not enabled in the supply equipment, the activation of the corresponding input does not block the trip of this function.

Phase and neutral blocking signalling times are used by the feeder application.

- When these times are adjusted to zero, feeder signalling outputs are activated and desactivated following the staring up state of corresponding functions.
- When phase blocking signaling time is adjusted to a value different from zero, once activated 50P or 51P starting up, phase activation state remains activated during this time.
- When neutral blocking signalling time is adjusted to a value different from zero, once activated 50N, 51N, 67N1 or 67N2 starting up, neutral activation state remains activated during this time. The objective is not keeping blocked supply relay during an undefined time when the feeder relay fails in clearing the fault. In this case the typical value of adjustement of this time is the feeder adjusted tripping time plus the opening failure time.

Phase and neutral blocking times are used by the supply application.

- When these times are adjusted to zero, blocking and releasing of the functions' trip is produced with the activation and disconnection of corresponding inputs.
- When phase blocking time is adjusted to a value different from zero, once activated the phase blocking input, 50P and 51P functions' block remains activated during this time.
- When neutral blocking time is adjusted to a value different from zero, once activated the the neutral blocking input, 50N, 51N, 67N1 and 67N2 functions' block remains activated during this time. The objective is not keeping blocked the functions during an undefined time when the supply equipment inputs remain activated. In this case the typical value of adjustement of these times is the feeder tripping time plus two times the feeder opening failure time.

Settings associated to tripping bus are the following:

Function	Description	Minimum	Maximum	Pass	Unit	Default
TRIPPING BUS	Tripping Bus					
	Application	-	-	(1*)	-	Not activated
	50P Tripping bus permission	-	-	Yes/no	-	Yes
	51P Tripping bus permission	-	-	Yes/no	-	Yes
	50N Tripping bus permission	-	-	Yes/no	-	Yes
	51N Tripping bus permission	-	-	Yes/no	-	Yes
	67N1 Tripping bus permission	-	-	Yes/no	-	Yes
	67N2 Tripping bus permission	-	-	Yes/no	-	Yes
	Phase blocking time	0	300	0,01	s	0
	Neutral blocking time	0	300	0,01	s	0
	Phase blocking signalling time	0	300	0,01	s	0
	Neutral blocking signalling time	0	300	0,01	s	0

(1*) Not activated, Feeder, Supply, Feeder and Supply

States associated to tripping bus are the following:

Group	State	Cause	Associated measurement
TRIPPING BUS	50P block	Activation /Deactivation	-
	51P block	Activation /Deactivation	-
	50N block	Activation /Deactivation	-
	51N block	Activation /Deactivation	-
	67N1 block	Activation /Deactivation	-
	67N2 block	Activation /Deactivation	-
	50P block signalling	Activation /Deactivation	-
	51P block signalling	Activation /Deactivation	-
	50N block signalling	Activation /Deactivation	-
	51N block signalling	Activation /Deactivation	-
	67N1 block signalling	Activation /Deactivation	-
	67N2 block signalling	Activation /Deactivation	-

4.10. Equipment settings

The SIA-D's settings are listed below with their description, maximums, minimums, units and the values for the factory settings.

Group	Description	Minimum	Maximum	Step	Unit	Default
50P	**Phases instantaneous overcurrent**					
	Permission	-	-	Yes/No	-	No
	Tap	0,10	30,00	0,01	Inominal	5,00
	Operating time	0,02	300,0	0,01	s	0,02
51P	**Phase inverse time overcurrent**					
	Permission	-	-	Yes/No	-	No
	Curve	-	-	(1*)	-	Extremely inverse
	Dial	0,05	1,25	0,01	-	1,25
	Tap	0,10	7,00	0,01	I nominal	1,00
	Operating time	0,02	300,0	0,01	s	0,02
50N	**Neutral instantaneous overcurrent**					
	Permission	-	-	Yes/No	-	No
	Tap	0,20	30,00	0,01	I nominal	1,00
	Operating time	0,02	300,0	0,01	s	0,02
51N	**Neutral inverse time overcurrent**					
	Permission	-	-	Yes/No	-	No
	Curve	-	-	(1*)	-	Extremely inverse
	Dial	0,05	1,25	0,01	-	1,25
	Tap	0,10	7,00	0,01	I nominal	0,50
	Operating time	0,02	300,0	0,01	s	0,02
	Breaker blocking					
	Blocking	-	-	Yes/No	-	Yes
	Blocking limit	7,00	20,00	0,01	I nominal	7,00

52	**Circuit breaker monitoring**					
	Excessive number of openings	1	10000	1	-	10
	Maximum accumulated amps	1	100000	1	MA^2	1000
	Opening time	0,02	300,0	0,01	s	0,10
	Closing time	0,02	300,0	0,01	s	0,10
	Excessive repeated openings	1	10000	1	-	3
	Time of excessive repeated openings	1,00	300,0	0,01	min	9,00
67N1	**Neutral directional overcurrent**					
	Permission	-	-	Yes/No	-	No
	Tap	0,10	30,00	0,01	I nominal	5,00
	Operating time	0,02	300,0	0,01	s	0,02
	Directionality	-	-	Yes/No	-	No
	Residual voltage	4,00	110,00	0,1	V	5
	Operating angle	0	359	1	º	90
	Half-cone angle	0	170	1	º	90
67N2	**Neutral directional overcurrent**					
	Permission	-	-	Yes/No	-	No
	Tap	0,10	30,00	0,01	I nominal	5,00
	Operating time	0,02	300,0	0,01	s	0,02
	Directionality	-	-	Yes/No	-	No
	Residual voltage	4,00	110,00	0,1	V	5
	Operating angle	0	359	1	º	90
	Half-cone angle	0	170	1	º	90

Group	Description	Minimum	Maximum	Step	Unit	Default
	Tripping bus					
	Application	-	-	(3*)	-	No activado
	50P tripping bus permission	-	-	Yes/No	-	Yes
	51P tripping bus permission	-	-	Yes/No	-	Yes
	50N tripping bus permission	-	-	Yes/No	-	Yes
	51N tripping bus permission	-	-	Yes/No	-	Yes
	67N1 tripping bus permission	-	-	Yes/No	-	Yes
	67N2 tripping bus permission	-	-	Yes/No	-	Yes
	Phase blocking time	0	300,0	0,01	s	0
	Neutral blocking time	0	300,0	0,01	s	0
	Phase signalling time	0	300,0	0,01	s	0
	Neutral signalling time	0	300,0	0,01	s	0
	General					
	Equipment's identifier	-	-	-	-	“www.fanox.com” (1*)
	TI phase relation	1	2000	1	-	100
	TI neutral relation	1	2000	1	-	100
	Frequency	-	-	60/50	Hz	50 (2*)
	Language	0	3	1	-	ENGLISH
	TT neutral relation	1	2000	1	-	100

(1*) The equipment identifier setting can only be set through communications.

(2*) The frequency setting is read only. The equipment frequency is selected from the list of models.

(3*) Not activated, Feeder, Supply, Feeder and Supply

The rest of 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.

4.11. IEC255-4/BS142 Curves

The SIA-D relay complies with the curves shown in standard IEC255-4/BS-142:

- Inverse Curve
- Very Inverse Curve
- Extremely Inverse Curve

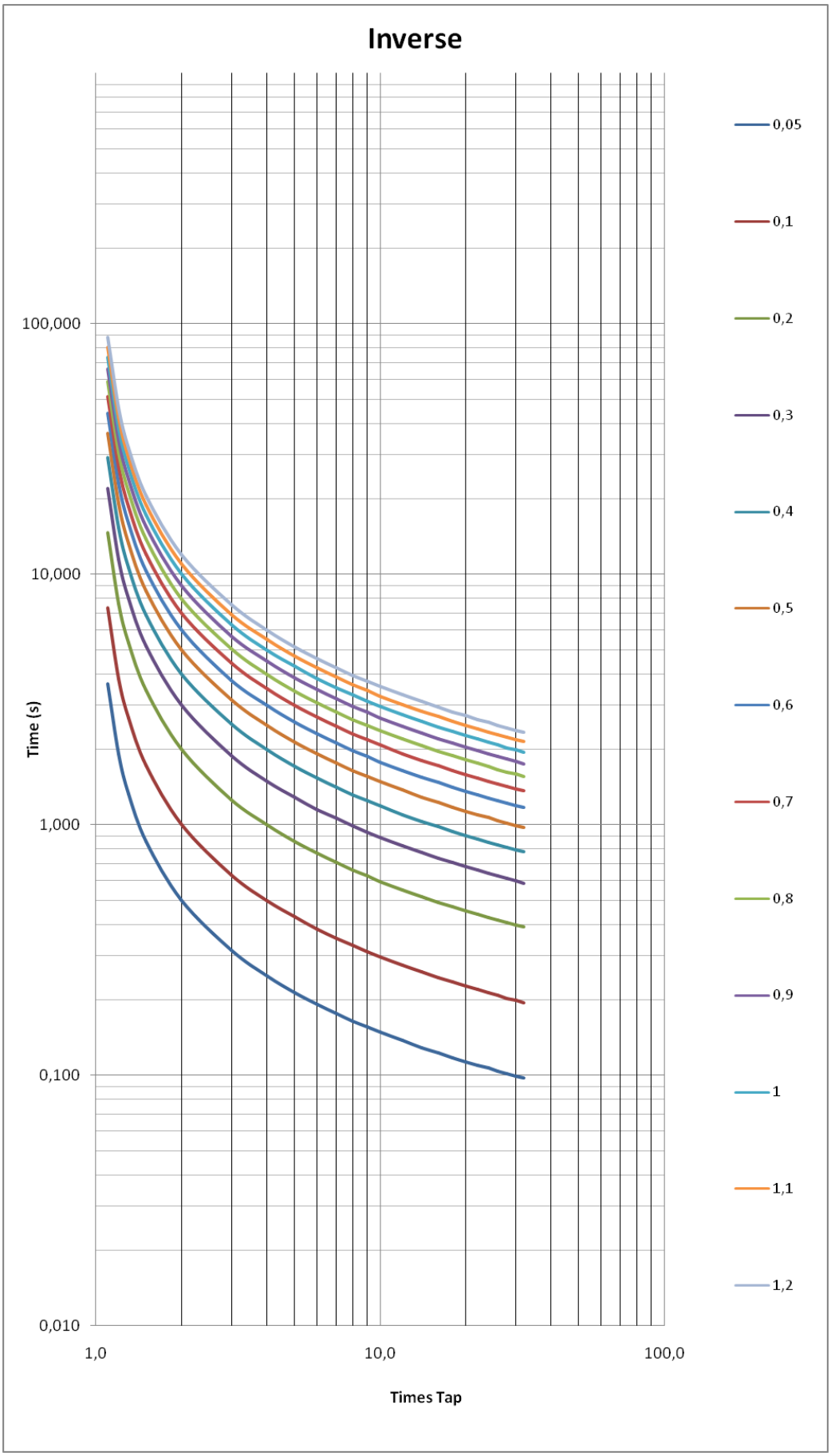
There is a general mathematical equation that defines the time in seconds as a function of the current:

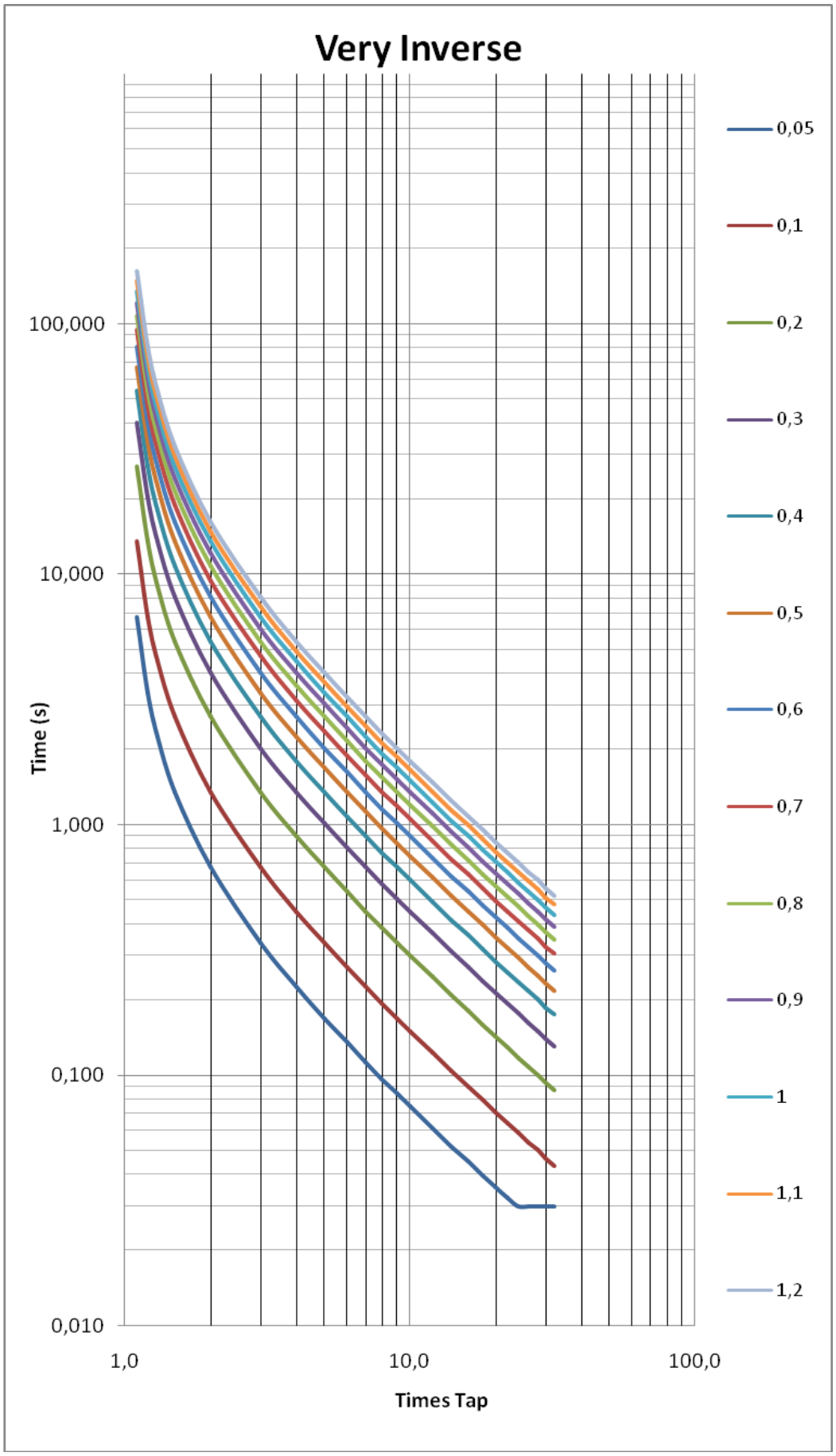
$$t = \frac{A \times D}{V^P - Q} + B \times D + K \qquad V = \frac{I}{I_{adjusted}}$$

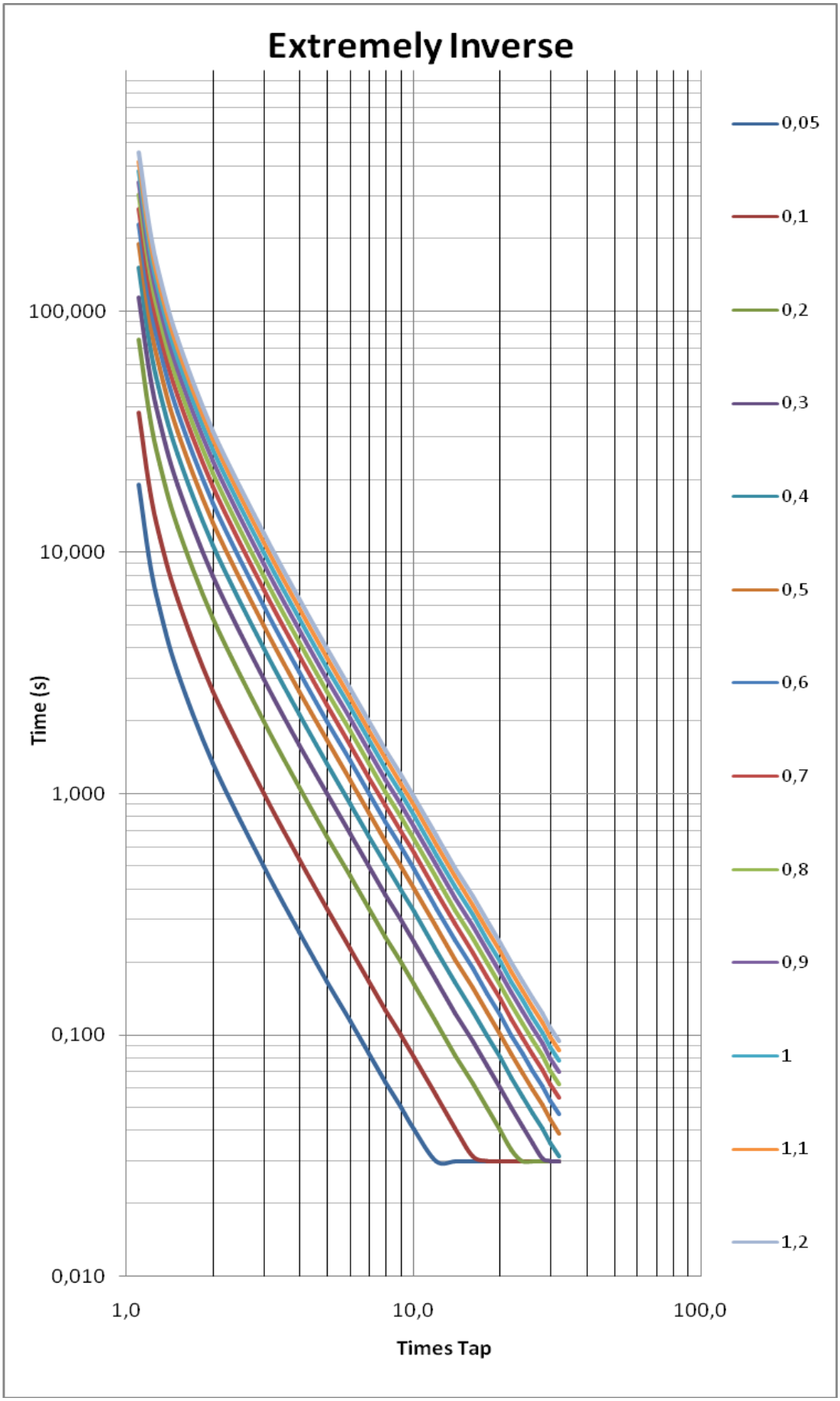
Using the following values for the parameters:	A	P	Q	B	K
Ext. Inverse	80	2	1	0	0
Very Inverse	13,5	1	1	0	0
Inverse	0,14	0,02	1	0	0

The curve can be displaced on the axis using the time dial, **D**, which can be adjusted by the user. **V** is Times Tap

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


Inverse
100,000
10,000
1,000
0,100
0,010
Time (s)
1,0
10,0
100,0
Times Tap
0,05
0,1
0,2
0,3
0,4
0,5
0,6
0,7
0,8
0,9
1
1,1
1,2


Very Inverse
100,000
10,000
1,000
0,100
0,010
Time (s)
1,0
10,0
100,0
Times Tap
0,05
0,1
0,2
0,3
0,4
0,5
0,6
0,7
0,8
0,9
1
1,1
1,2


Extremely Inverse
100,000
10,000
1,000
0,100
0,010
Time (s)
1,0
10,0
100,0
Times Tap
0,05
0,1
0,2
0,3
0,4
0,5
0,6
0,7
0,8
0,9
1
1,1
1,2

5. MONITORING AND CONTROL

5.1. Measurements

Measurements of the three-phase currents and the neutral current are given in RMS. A sampling of 16 samples/cycle is performed.

The accuracy of the measurement is ±2% over a band of ±20% of rated current and ±5% over the rest of the measurement range.

- Frequency 50 Hz or 60 Hz rated. ± 3 Hz
- Thermal resistance Twice the continuous rated current

5.2. Status and Events

The status is given by real-time information generated by the equipment. Some statuses have an event associate with them, which is a register of a change made to the status. There are statuses that have an activation event associated with them, and other statuses have two associated events: activation and reset. These events are registered in a circular memory (buffer) with a capacity for up to 500 events. The memory timestamp is accurate to 1 millisecond.

On the models list can be found the following options related to events:

- Without memory
- With FRAM non-volatile memory
- With FRAM non-volatile memory and RTC
- With FRAM non-volatile memory with events and oscillography
- With FRAM non-volatile memory and RTC with events and oscillography

With the option "Without Memory", the equipment has events, but these events are lost in the case of power failure.

With the option "With non-volatile FRAM memory", both the events are conserved even if the equipment is not powered. If the Real Time Clock is used, the relay keeps and processes the correct date and time, even without electrical power, for up to 72 hours.

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 equipment. To delete the events using the HMI, you have to go to the events menu and press and hold the "RESET" key until the number of events reads 1, and this event is registered as "Events deleted". To delete the events using communications, use the corresponding "delete events" command.

Events have the following structure:

Identify	Unique event identifier: e.g.: 51_1.4 = 51P START
Value	ON(Activated) /OFF(Deactivated): an event is generated for activations and deactivations
Year	
Month	
Day	
Time	
Minutes	
Seconds	

Milliseconds	

The following list shows all of the statuses of the equipment and their associated events:

Group	Status	Cause	Associated Event
Phase inverse time overcurrent			
51P	51P Phase A pick-up	Activation/Deactivation	Phase A current
	51P Phase B pick-up	Activation/Deactivation	Phase B current
	51P Phase C pick-up	Activation/Deactivation	Phase C current
	51P Pick-up	Activation/Deactivation	-
	51P A Trip	Activation/Deactivation	Phase A current
	51P B Trip	Activation/Deactivation	Phase B current
	51P C Trip	Activation/Deactivation	Phase C current
	51P Trip	Activation/Deactivation	-
Instantaneous phase overcurrent			
50P	50P Phase A pick-up	Activation/Deactivation	Phase A current
	50P Phase B pick-up	Activation/Deactivation	Phase B current
	50P Phase C pick-up	Activation/Deactivation	Phase C current
	50P Pick-up	Activation/Deactivation	-
	50P A Trip	Activation/Deactivation	Phase A current
	50P B Trip	Activation/Deactivation	Phase B current
	50P C Trip	Activation/Deactivation	Phase C current
	50P Trip	Activation/Deactivation	-
Neutral inverse time overcurrent			
51N	51N Pick-up	Activation/Deactivation	Neutral current
	51N Trip	Activation/Deactivation	Neutral current
Instantaneous neutral overcurrent			
50N	50N Pick-up	Activation/Deactivation	Neutral current
	50N Trip	Activation/Deactivation	Neutral current
Directional Neutral Overcurrent			
67N_1	67N1 I0 Activaction	-	-
	67N1 V0 Activation	-	-

	67N1 Directionality	-	-
	67N1 Start up	Activaction/Desactivation	Neutral Current
	67N1 Trip	Activaction/Desactivation	Neutral Current
Directional Neutral Overcurrent			
67N_2	67N2 I0 Activaction	-	-
	67N2 V0 Activation	-	-
	67N2 Directionality	-	-
	67N2 Start up	Activaction/Desactivation	Neutral Current
	67N2 Trip	Activaction/Desactivation	Neutral Current
Breaker			
	Phase A breaker blocking	Activation/Deactivation	Phase A current
	Phase B breaker blocking	Activation/Deactivation	Phase B current
	Phase C breaker blocking	Activation/Deactivation	Phase C current
	Breaker blocking	Activation/Deactivation	-
Circuit breaker			
52	52 Start	-	-
	52 Error	Activation/Deactivation	-
	52 Open	Activation/Deactivation	-
	52 Opening time	Activation	-
	52 Opening error	Activation/Deactivation	-
	52 Closed	Activation/Deactivation	-
	52 Closing time	Activation	-
	52 Closing error	Activation/Deactivation	-
	Number of openings alarm	Activation	-
	I2t alarm	Activation	-
	Contact 52a	-	-
	Contact 52b	-	-
Tripping bus			
	50P blocking	Activation/Deactivation	-
	51P blocking	Activation/Deactivation	-
	50N blocking	Activation/Deactivation	-

	51N blocking	Activation/Deactivation	-
	67N1 blocking	Activation/Deactivation	
	67N2 blocking	Activation/Deactivation	-
	50 P block signalling	Activation/Deactivation	-
	51P block signalling	Activation/Deactivation	-
	50N block signalling	Activation/Deactivation	-
	51N block signalling	Activation/Deactivation	-
	67N1 block signalling	Activation/Deactivation	-
	67N2 block signalling	Activation/Deactivation	-
Inputs			
	Input 52a	-	-
	Input 52b	-	-
	Phase blocking	Activation/Deactivation	-
	Neutral blocking	Activation/Deactivation	-
	External trip	Activation/Deactivation	-
	Start oscillography	Activation/Deactivation	-
	Input 1	Activation/Deactivation	-
	Input 2	Activation/Deactivation	-
	Input 3	Activation/Deactivation	-
	Input 4	Activation/Deactivation	-
Outputs			
	Output 1	Activation/Deactivation	-
	Output 2	Activation/Deactivation	-
	Output 3	Activation/Deactivation	-
	Output 4	Activation/Deactivation	-
General			
	Trip	Activation/Deactivation	The maximum phase current between the activation and the deactivation of the trip in the event deactivation.
	External trip	Activation/Deactivation	-
	Trip blocking	Activation/Deactivation	-
	48 Vdc power supply alarm	Activation/Deactivation	-
	Measurement error	Activation/Deactivation	-

	Protection error	Activation/Deactivation	-
	Change of settings	Activation/Deactivation	-
	Date-time set	Activation/Deactivation	-
	Local communication	Activation/Deactivation	-
	Eeprom by default	Activation/Deactivation	-
	Eeprom Error	Activation/Deactivation	-
	Eeprom change	Activation/Deactivation	-
	Events error	Activation/Deactivation	-
	Auxiliary power	Activation/Deactivation	-
	Battery power	Activation/Deactivation	-
	Equipment start	Activation/Deactivation	-
	New oscillographic register	Activation/Deactivation	-
Control			
	Local communication	-	-
	HMI Activity	-	-
	Command selection	Activation	-
	Circuit breaker opening	Activation	-
	Circuit breaker closure	Activation	-

A brief description of the general statuses is given below:

- Trip: The equipment has tripped.
- Temperature trip: A trip has been caused by the activation of the excess temperature input (external trip).
- 48 Vcd power supply alarm: When power supply auxiliary voltage is 48 Vdc, this voltage is monitored. If the voltage varies a 15%, alarm is activated.
- Measurement error: The self-diagnosis algorithms have detected a problem in the measurement block.
- Protection error: The self-diagnosis algorithms have detected a problem in the protection block.
- Setting change: This activates when the settings are changed.
- Date-time set: This activates when the date-time are synchronised.
- Communication in local: this is the sum of the "MMI activity" and "Local communication" bits from the "Local communication" status group
- Eeprom by default: the equipment 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: this activates when the settings or configuration (user passwords) are changed.
- Events error: due to the fact that 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).

- MMI activity: this state is active if any key has been pressed in the last 15 minutes.
- Local communication: this status becomes active if communications are detected in the front RS232 port.

5.3. Real-time clock (RTC)

The Protection equipments require a clock for events, alarms and oscillography, enabling them to have a date and time stamped. This clock has a capacitor that allows operation while maintaining the date and time even without power, up to 72 hours (It is understood that the capacitor was previously loaded).

If an event queue occurs, and if synchronized with a date-time previous to the last stored event, the relay will not rearrange the queue but will store the new events immediately after the stored events.

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.
- Protocol. The behaviour is identical to the HMI. The relay will synchronize the date and time, and a new synchronization event is carried out.

5.4. Oscillography and Fault reports

The SIA-D relay stores two oscillographic registers, with a resolution of 16 samples/cycle and a size of 33 cycles. The first three of these cycles correspond to pre-fault.

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

A fault report is generated in association to each oscillation. From the HMI, by pressing key "◄", you will gain access to fault reports. The information displayed is as follows:

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

The fault reports of the two last faults occurred will be available at all moment. Each new fault report is overwritten on the previous one, and therefore the information contained in the previous report will be lost.

The following information is included in each oscillographic register:

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

Number	Digital channels
1	Phase A 50P Pick-up
2	Phase B 50P Pick-up
3	Phase C 50P Pick-up
4	Phase A 50P trip
5	Phase B 50P trip
6	Phase C 50P trip
7	Phase A 51P Pick-up
8	Phase B 51P Pick-up
9	Phase C 51P Pick-up
10	Phase A 51P trip
11	Phase B 51P trip
12	Phase C 51P trip
13	50N Pick-up
14	50N Trip
15	51N Pick-up
16	51N Trip
17	67N1 Pick-up
18	67N1 Trip
19	67N2 Pick-up
20	67N2 Trip
21	Phase A trip blocking activation
22	Phase B trip blocking activation
23	Phase C trip blocking activation
24	Input 52a
25	Input 52b
26	50P function blocking
27	51P function blocking
28	External trip activation
29	Oscillograph start
30	Input 1

Number	Digital channels
31	Input 2
32	Input 3
33	Input 4
34	Output 1
35	Output 2
36	Output 3
37	Output 4
38	52 error
39	52 open
40	52 opening fault
41	52 closed
42	Trip
43	48 Vdc power supply alarm
44	50P blocking supply tripping bus
45	51P blocking supply tripping bus
46	50N blocking supply tripping bus
47	51N blocking supply tripping bus
48	67N1 blocking supply tripping bus
49	67N2 blocking supply tripping bus
50	50P blocking feeder tripping bus
51	51P blocking feeder tripping bus
52	50N blocking feeder tripping bus
53	51N blocking feeder tripping bus
54	67N1 blocking feeder tripping bus
55	67N2 blocking feeder tripping bus

The following additional information is included in the COMTRADE header file (*.hdr): date-time of the oscillograph, oscillograph number, relay identification and a list of all the events that occurred in the equipment while the oscillograph was being generated.

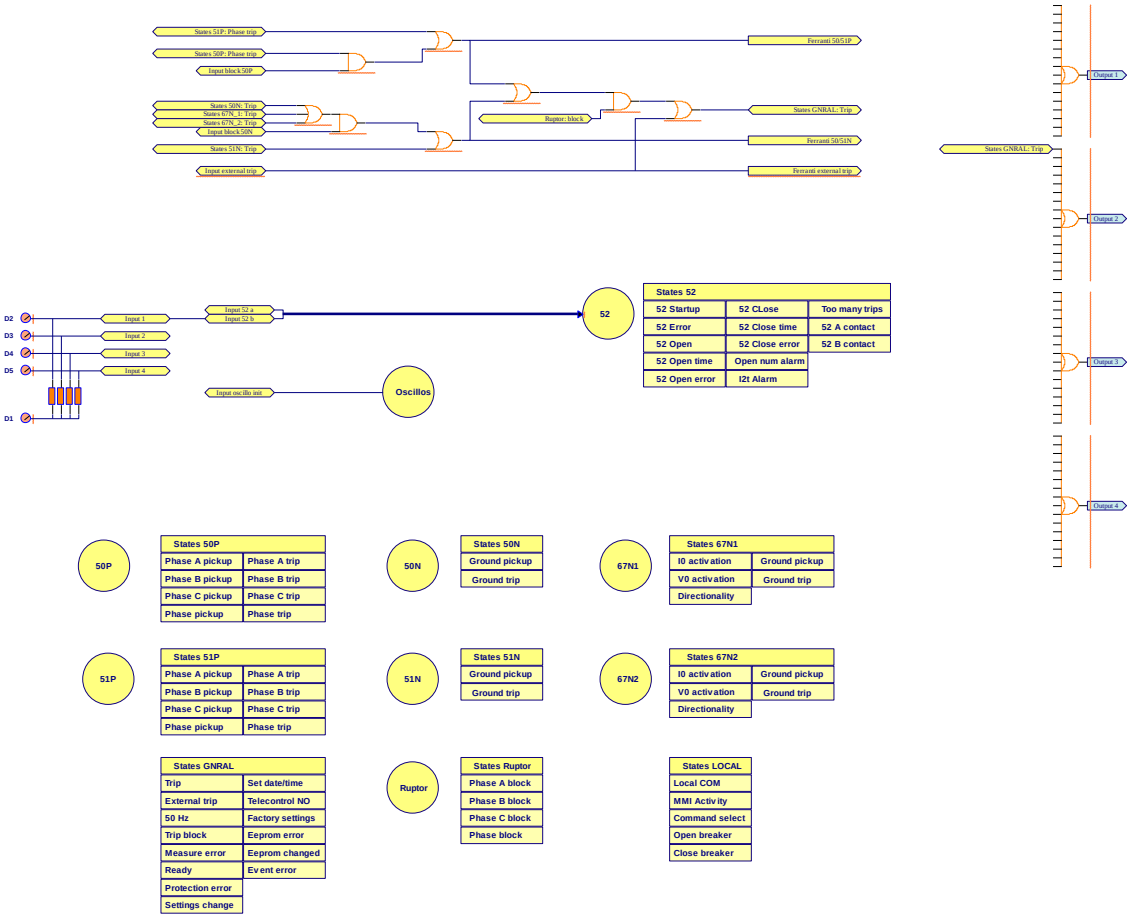
Shown below is the format of a COMTRADE header file, generated by the SICom program:

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

    Ciclos prefalta =  3
    Ciclos totales =  33
    Canales analógicos =  8
    Canales digitales =  64

    Oscilo :  41458
    Fecha/Hora : 2008/10/15   11:29:11:85

    Fila de falta =  15
    Mascara 1 =  0
    Mascara 2 =  4096
    Mascara 3 =  0
    Mascara 4 =  0
    Mascara 3 = 0
    ***************************************************************
    **
    Eventos de Oscilo:
    ***************************************************************
    ***
```

Indicador	Valor	Medida1	Medida2	Fecha	Hora
Inicio Oscilo	1	0	0	2008/10/15	11:29:11:90
Inicio Oscilo	0	0	0	2008/10/15	11:29:11:400

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

5.5. Data diagram: allocation of inputs and outputs configuration



5.6. Configurable Inputs

The SIA-D has four digital inputs that can be configured by the user. These inputs can be configured from the HMI, or by using the SICom program.

First of all, we will define the concepts of physical input and logical input. The physical inputs are the equipment's real inputs. The SIA-D has four physical inputs: Input 1, Input 2, Input 3 and Input 4. These physical inputs can be associated with the logical inputs. The SIA-D has the following logical inputs:

Logical inputs	Description
Input 52 a	Circuit breaker contact a
Input 52 b	Circuit breaker contact b
Phase blocking	Phase functions block for tripping bus
Neutral blocking	Neutral functions block for tripping bus
External trip	If it receives a pulse in excess of 20 ms (to avoid spurious components), it generates a 200 ms pulse to be used in the trip output.
Oscillograph start	Oscillograph start

The inputs are configured by associating the logical inputs with the physical input that they require, or else no association is made if that logical input is not in use. Therefore, a single physical input can be associated with more than one logical input.

An example of this is shown in the table below:

	Input 1	Input 2	Input 3	Input 4
No configuration				
52 a	X			
52 b		X		
50P blocking			X	
50N blocking				X
External trip				
Oscillograph start			X	

In this example, input 1 is assigned to the circuit breaker contact a, input 2 is assigned to the circuit breaker contact b, input 3 is assigned to the 50P function blocking and to the oscillograph start and input 4 is assigned to the 50N function blocking. The external trip input is not associated with any physical input.

The default input configuration is shown below:

	Input 1	Input 2	Input 3	Input 4
No configuration		x	x	x
52 a				
52 b	x			
50P blocking				
50N blocking				
External trip				
Oscillograph start				

The process used to configure the inputs is described in the “Input configuration menu” section.

5.7. Configurable outputs

The SIA-D has four digital outputs that can be configured by the user. These outputs can be configured from the HMI, or by using the SICom program.

Any available status can be assigned to a physical output. Each physical output allows an OR of up to 16 statuses. In other words, up to 16 different statuses can be assigned to the same physical output.

The default output configuration is shown below:

Physical outputs	Status
Output 1	Not assigned
Output 2	Trip
Output 3	Not assigned
Output 4	Not assigned

The process used to configure the outputs is described in the “Output configuration menu” section.

5.8. Self-diagnosis

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

As general considerations, we should point the following:

- Communications between different CPUs are confirmed by the corresponding integrity checking. If continuous anomalies are detected, the equipment will be reset.
- Data related to set values are confirmed by the corresponding checking. Likewise, all setting tables are doubled, and the relay has the capability for working with a damage table, but not with two damaged tables.
- There is a WatchDog device both between and in main CPUs. If any CPU goes out of operation the equipment will be reset and this condition will be identified as an event.

The following status bits are associated with this process:

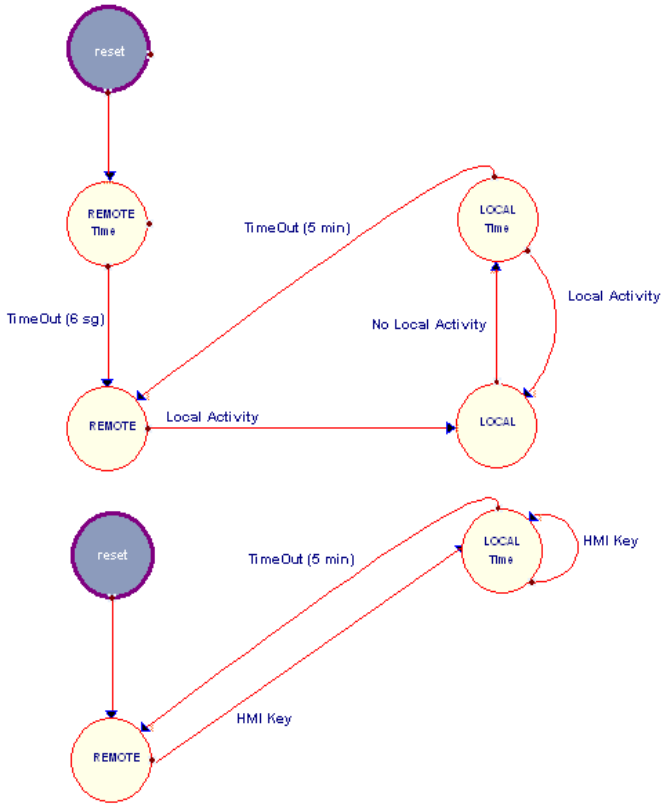
Measurement error	Problem in the measurement block
Protection error	Problem in the protection block
Eeprom Error	Problem in the eeprom memory, default settings
Events Error	Error in the register of events

On the other hand, “Default settings” means that the equipment is operating under factory settings, being all protection functions disabled.

5.9. Communication

The SIA-C relay can communicate with a local computer through its front RS232 port, or through a remote SCADA system through the rear RS485 port. The rear RS485 port is optional and must be specified on the list of models.

The ports RS232 and RS485 are switched. The RS232 port has preference.



5.10. Front Communication. RS232

The RS232 communications port is installed on the front of the equipment. 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). The protocol map and documentation that are used are attached in an appendix to this manual.

The adapter (KITCOM) can be connected to this communications port to supply the equipment with an external battery. It should be pointed out that this port can be used simultaneously for communication, even when the equipment is being powered by an external battery.

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

5.11. Rear Communication. RS485

An option exists to fit the SIA-D with a rear communications port RS485, which must be specified when the model is selected.

The RS485 port output has three terminals (+,- and GND), located on the rear of the equipment. The protocol that is used is Modbus RTU (19200 -8bit – no parity – 1 stop bit).

The protocol map and documentation that are used are attached in an appendix to this manual.

This port can be used to continuously monitor the equipment from a remote PC or SCADA system. Up to 32 pieces of equipment can be connected to one bus; each piece with a different modbus address. The equipment modbus address can be configured using the SIcom program.

To minimise 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.

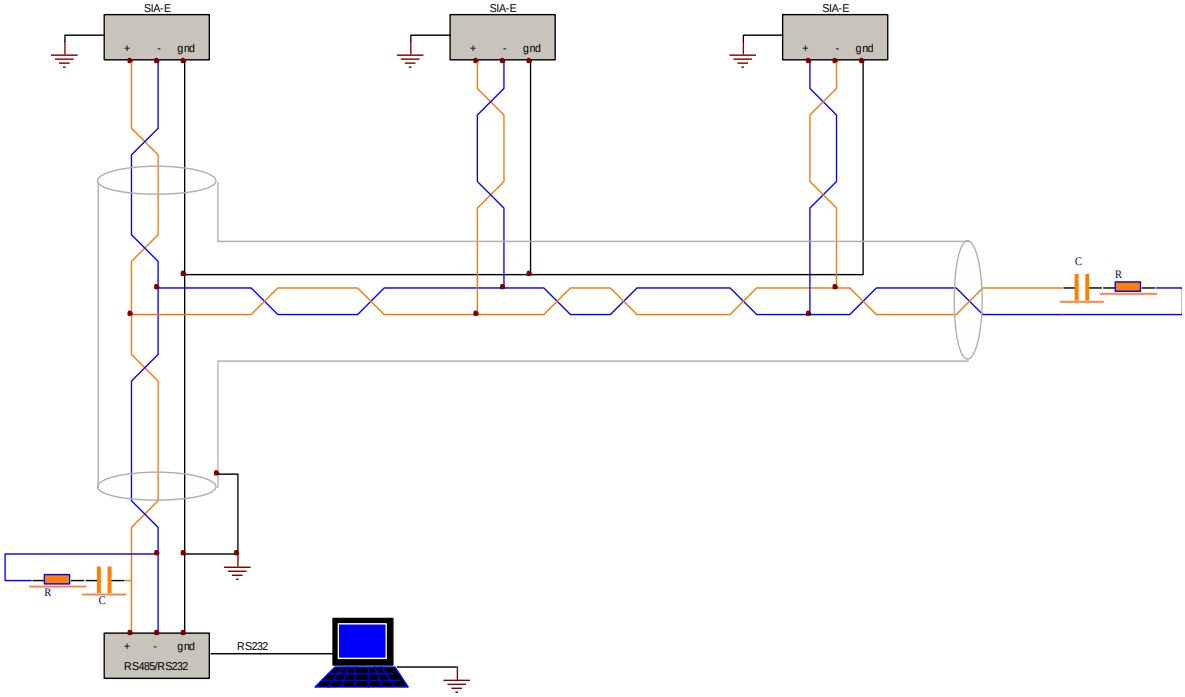
If a 3 strand cable is used for communication, the GND terminals must be connected to the earth cable.

If a 2 strand cable is used for communication, the GND terminals must be connected to the shielding. The shielding must be connected to the GND at only one point to avoid circular 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.

Fibre optics can be used in very aggressive environments, and they are connected by using the corresponding converters.

Connection diagram for a RS485 bus:



5.12. Modbus RTU Protocol

The protocol documentation and the modbus memory map are shown in the appendix to this manual.

5.13. Test Program

The SIA-D equipment has a test menu that can be used to check the operation of the signalling components (LEDs and magnetic indicators) and the outputs. It is important to point out that the operation of the outputs is not guaranteed if the test is performed with the battery.

The following table shows the components that can be tested, along with their status depending on whether they are activated or deactivated:

Vaux power LED	Deactivated	Vaux LED off
	Activated	Vaux LED blinking
Self-power LED	Deactivated	Self-power LED off
	Activated	Self-power LED blinking
Battery LED	Deactivated	Battery LED off
	Activated	Battery LED blinking
“50/51P” magnetic indicator	Deactivated	“50/51P” magnetic indicator deactivated (black)
	Activated	“50/51P” magnetic indicator activated (orange)
“50/51N” magnetic indicator	Deactivated	“50/51N” magnetic indicator deactivated (black)
	Activated	“50/51N” magnetic indicator activated (orange)
“External trip” magnetic indicator	Deactivated	“External trip” magnetic indicator deactivated (black)
	Activated	“External trip” magnetic indicator activated (orange)
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

The following key sequence is used to gain access to the test menu: from the main menu, press the keys “◄”, “▼”, and “►” in sequence and then press and hold the "OK" key until the "Test menu"

appears on the display. 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.

To obtain more detailed information, the method for navigating the menus is explained graphically in the keypad and display section.

6. TECHNICAL SPECIFICATIONS AND STANDARDS

6.1. Technical Specifications

Function 50P	Permission: yes/no
	Operating range: 0,10 to 30 x In (step 0,01)
	Operating time: 0,02 to 300 s (step 0,01)
	Activation level 100%
	Deactivation level 95%
	Instantaneous deactivation
Function 50N	Permission: yes/no
	Operating range: 0,10 to 30 x In (step 0,01)
	Operating time: 0,02 to 300 s (step 0,01)
	Activation level 100%
	Deactivation level 95%
	Instantaneous deactivation
Function 51P	Permission: yes/no
	Operating range: 0,10 to 7 x In (step 0,01)
	Curves: IEC 255-4/BS-142
	Operating time: inverse curve, very inverse curve, extremely inverse curve. Defined time: 0,02 to 300 s (step 0,01 s)
	Dial: 0,05 to 1,25
	Curve, activation level 120%
	Curve, deactivation level 100%
	Defined time, activation level 100%
	Defined time, deactivation level 95%
	Instantaneous deactivation
	Timing accuracy: 5% or 30 ms (greater of both)
Function 51N	Permission: yes/no
	Operating range: 0,10 to 7 x In (step 0,01)
	Curves: IEC 255-4/BS-142
	Operating time: inverse curve, very inverse curve, estremely inverse curve. Defined time: 0,02 to 300 s (step 0,01 s)
	Dial: 0,05 to 1,25

...Function 51N	Curve, activation level 120%
	Curve, deactivation level 100%
	Defined time, activation level 100%
	Defined time, deactivation level 95%
	Instantaneous deactivation
	Timing accuracy: 5% or 30 ms (greater of both)
Trip blocking	Blocking level: 7 to 20 x In (step 0,01)
Function 67N **(2 units)**	Permission: yes/no
	Operating range I0: 0,10 to 30,00 x In (step 0,01)
	Operating range V0: 4,00 to 110,00 V (step 0,1 V)
	Operating time: 0,02 to 300 s (step 0,01 s)
	Directionality: yes/no
	Current, activation level 100%
	Current, deactivation level 95%
	Voltage, activation level 100%
	Voltage, deactivation level 95%
	Operating angle: 0 to 359º (step 1º)
	Semicone angle: 0 to 170º (step 1º)
Circuit breaker monitoring	Circuit Brecker status: start, open, closed, error, opening time, opening error, closing time, closing error
	Input 52a and/or input 52b
	Opening and closing command
	Alarm, maximum number of openings: 1 a 10000
	Alarm, accumulated amps: 0 a 10000 (kA^2)
	Excessive repeated openings: 1 a 10000
	Time of excessive repeated openings: 1 a 300 min
Bus de disparo	Application: not activated, feeder, supply and feeder-supply
	50P block permission: yes/no
	51P block permission: yes/no
	50N block permission: yes/no
	51N block permission: yes/no

	67N1 block permission: yes/no
	67N2 block permission: yes/no
	Phase blocking time: 0 to 300s (pass 0,01 s)
	Neutral blocking time: 0 to 300s (pass 0,01 s)
	Phase block signaling time: 0 to 300s (pass 0,01 s)
	Neutral block signaling time: 0 to 300s (pass 0,01 s)
Oscillography	16 records per cycle
	The beginning of the oscillography is configurable
	2 register:3 cycle previous to the fault and 30 after fault
4 inputs configurables	The same voltage as auxiliary power supply
4 outputs configurables	250 Vac – 8 A 30 Vdc – 5 A Resistive load (cos φ = 1)
Frequency	50/60Hz
Current measure	True RMS
	Sampling: 16 samples/cycle
	Accuracy of ±2% in a band of 20% over the rated current and 5% for the rest of measurement range
Communications	RS232 port: Modbus RTU
	RS485 port: Modbus RTU
Auxiliary power supply	110-230 Vac / 90-300 Vdc ±20%
	24-48 Vdc ±20%
Battery supply	With KITCOM adapter DB9
Environment	Operating temperature: -10 to 60ºC
	Storage temperature: -20 to 70 ºC
	Humidity: 95%
Transformers	Power supply and measurement CT /5 or /1
Mechanical features	Metallic box
	Panel Mounting
	1/2 Rack – 4 U
	Depth: 74,6 mm
	IP-52

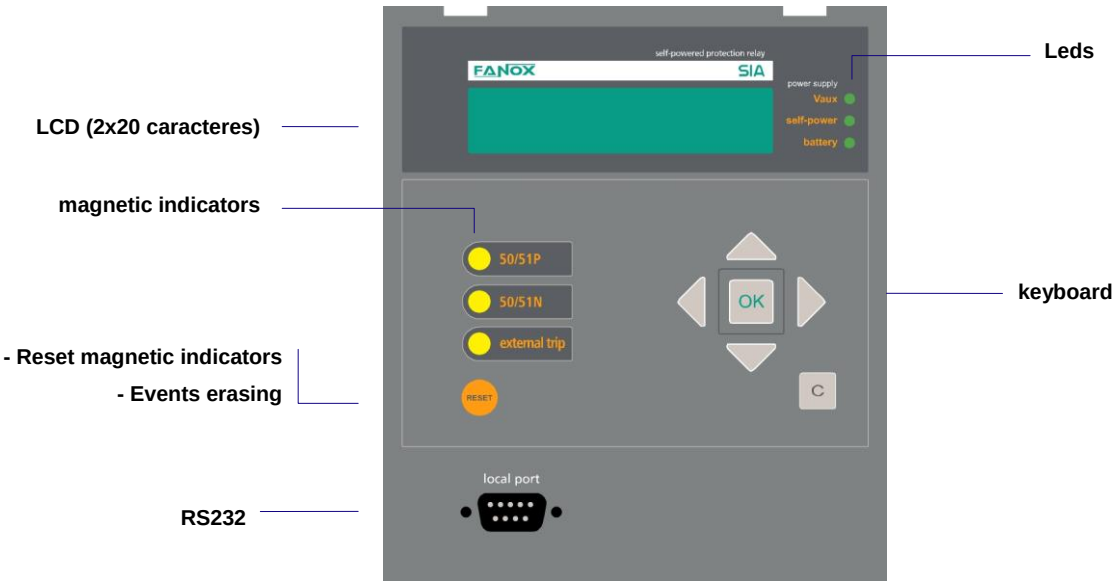
6.2. Standards

ELECTROMAGNETIC COMPATIBILITY TESTS									
Nº	Test Result	STANDARD		APPLICATION IN:					
				A.C. Power Supply	D.C. Power Supply	Signal Ports	Metallic Box	Applied	COMMENTS
			EMISSIONS						
10	√	**EN55022 (1998)** **+A1 (2000)** **+A2 (2003)**	RF Emissions				**Class B** 30-230MHz:<30uV/m 230-1000MHz:<37uV/m	√	
			IMMUNITY TO						
20	√	**IEC 61000-4-2 (1995)** **+A1 (2000)** **+A2 (2003)**	Electrostatic Discharges				**Level 3**: contact: ±6 kV air: ±8 kV	√	
21	√	**IEC 61000-4-3 (2006)** **ENV 50204 (1995)**	Radiated Radio-frequency Electro-magnetic Fields				**Level 3**: 10 V/m AM modulation; 80% 1KHz: 1) 80-1000MHz 2) 1000MHz-2000MHz	√	
							Level 3: 10 V/m PM modulation; 50% 200Hz: 1) 900-1890MHz	√	
22	√	**IEC 61000-4-4 (2005)**	Electrical Fast Transients (EFT)	**Level 4**: ±4 kV – 1) 15ms±20% at 5kHz 2) 0.75ms±20% at 100kHz		**Level 4**: ±2 kV 1) 15ms±20% at 5kHz 2) 0.75ms±20% at 100kHz		√	
23	√	**IEC 61000-4-5 (2007)** **+A1 (2000)**	Surges	**Level 4**, Class 5 ±2 kV Line-Line. Coupling:2Ω/18μF ±4 kV Line-Ground. Coupling: 12Ω/18μF		**Level 4**,Class 5 ±2 kV Line-Line. Coupling:42Ω/0.5μF ±4 kV Line-Ground. Coupling: 42Ω/0.5μF		√	

... ELECTROMAGNETIC COMPATIBILITY TESTS									
Nº	Test Result	STANDARD		APPLICATION IN:					
				A.C. Power Supply	D.C. Power Supply	Signal Ports	Metallic Box	Applied	COMMENTS
24	√	**IEC 61000-4-6 (2006)** **+A1 (2000)**	Conducted RF	**Level 3**: 0.15-80MHz : 140dB(µV)-10V				√	
25	√	**IEC 61000-4-8 (2001)**	Electro-magnetic Fields at Industrial Frequency				**Level 5**: Continuous: 100 A/m 2 seg.: 1000 A/m	√	
26	√	**IEC 61000-4-9 (1993)**	Pulsed Magnetic Fields				**Level 5**: 1000 A/m	√	
27	√	**IEC61000-4-10 (2001)**	Damped Oscillating Magnetic Fields				**Level 5**: 100 A/m	√	
29	√	**IEC 61000-4-12 (1995)**	"ring wave" (Damped RF oscillatory waves)	**Level 4**: ±4 kV Line-Ground ±2 kV Line-Line		**Level 4**: ±4 kV Line-Ground ±2 kV Line-Line		√	
			ISOLATION & SECURITY						
40	√	**IEC 60255-5 (2002)**	Dielectric Test	**Level 4**: Values in table 1		2 kVac Line-Ground 1 min.		√	
41	√	**IEC 60255-5 (2002)**	Isolation Resistance Test	500 Vdc Line-Ground				√	
42	√	**IEC 60255-5 (2002)**	Impulse Voltage Test	±1 kV Line-Line ±5 kV Line-Ground				√	

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

7. USER INTERFACE



7.1. Bistable magnetic indicators

The front panel is equipped with 3 bistable magnetic indicators which indicate the cause of the last trip. The indicators remain in position even when the equipment looses power, so that the maintenance service can see the cause of the trip even through the equipment is not powered.

Once they have been activated, it is necessary to manually reset them by pressing the "**RESET**" button.

The operation of the magnetic indicators can be checked from the test menu.

Magnetic indicator "50P/51P" activated	A trip has been caused by phase instantaneous overcurrent or phase inverse time overcurrent
Magnetic indicator "50/51N" activated	A trip has been caused by neutral instantaneous overcurrent or neutral inverse time overcurrent or neutral directional (according to model)
"External trip" magnetic indicator	A trip has been caused by the activation of the direct trip input

7.2. LED Indicators

The SIA-D front panel has three LED pilot lights to show the type of power being used: self-power, battery or auxiliary power. The LEDs are switched off when the power type that they represent is not active, and they blink when the power type that they represent is active.

Aside from showing the type of power that is being used by the equipment, one of the LEDs should be blinking under normal conditions. If they are all switched off, or some or all of them are permanently lit, this means that the equipment is not operational.

The following three LEDs are fitted:

Vaux LED	Activated (LED blinking) if it detects the auxiliary voltage
Battery LED	Activated (LED blinking) if it detects voltage from an external battery

More than one type of power can be used simultaneously, and more than one LED can be activated as a result.

The operation of the LED indicators can be checked from the test menu.

7.3. RS232 Communications port

The RS232 port can be found on the lower part of the front panel. The battery can be connected to this port through its kit, allowing the equipment to communicate with a local PC and to be powered at the same time.

PC communication through the RS232 allows all the information and the settings parameters to be accessed.

7.4. LCD and keypad

The front of the SIA-C relay is fitted with an alphanumeric LCD screen, measuring 2x20. 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 bistable magnetic indicators return to their initial position. The "**Reset**" key can also be used to delete all of the events in the "Events" menu.

7.5. SICom Communications program

The SIcom program, which works with the Windows® 2000/XP operating system is provided, and can be used to gain access to all of the equipment information, to modify the settings and to save events using a graphic user interface.

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

- Status reading
- Measurement reading
- Reading and changing settings
- Reading and deleting events
- Changing the user passwords
- Loading settings files
- Date-time synchronisation
- Checking the versions of the equipment

- Configuring the modbus address
- Reading and changing counters
- Processes for opening and closing the circuit breaker
- Configuration of the inputs
- Configuration of the outputs
- Configuration of the causes that start an oscillographic register

7.6. Setting-up the session: Password and access levels. Protected Settings

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

ACCESS LEVEL	Read-only permission: Status and measurements Settings Events	Permission to: Change settings Download and Delete the Events buffer	Permission to: Execute Commands	Permission to: Change Configuration	Permission to Change Protected Settings
1	YES	YES	NO	NO	YES
2	YES	YES	NO	NO	NO
3	YES	NO	YES	NO	NO
4	YES	YES	YES	NO	NO
5	YES	YES	YES	YES	NO

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

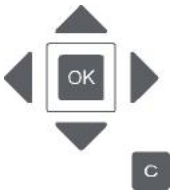
PASSWORD	ACCESS LEVEL
2222	2
3333	3
4444	4
5555	5

- No password is needed to perform the commands using the HMI.
- The SIA-D does not have protected settings.

7.7. MENUS

7.7.1. Standby mode screen

The standby mode screen displays the equipment model. The first line of menus can be accessed by pressing "OK": measurements, status, adjustments and events. If the HMI is left in any position, it returns automatically to its standby mode screen after five minutes if no key is pressed.



SIAD51520023S

FANOX

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

- PROTECTION ERROR
- MEASUREMENT ERROR
- EEPROM ERROR

7.7.2. 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.

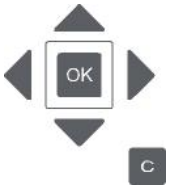
The keys ◄ and ► are used to navigate from one item to another within a parameter. The keys ▲ and ▼ are used to increase or decrease the value. If an invalid value is entered during the process, the "**C**" key can be used to delete it.

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

7.7.3. Date-time menu

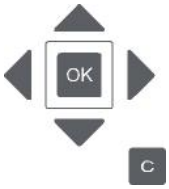
The date-time menu can be accessed by pressing the "►" key from the standby mode screen. From here, press the "OK" key to access the date-time modification screen. Use the "►" and "◄" keys to position the cursor over the digit that you want to change, and assign a value to this digit using the "▲" and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



<<DATE AND TIME >>
01/01/2000 00:54:51

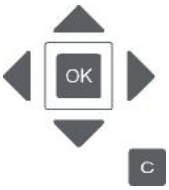
The date and time can be changed by pressing "**OK**"



01/01/2000 00:54

7.7.4. Versions

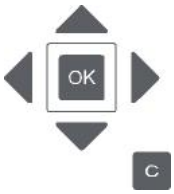
The equipment versions menu can be accessed from the standby mode screen by sequentially pressing the keys "◄", "▼", "►", and "▲". This displays the software versions of the relay processors. Press the "C" key to return to the standby mode screen.



Vers: COM DSP PIC
1.13 1.19 0.16

7.7.5. Communication parameters

The communications parameters can be viewed holding down the "▲" key from the standby mode screen.



COM Settings:
1 19200-8-N-1

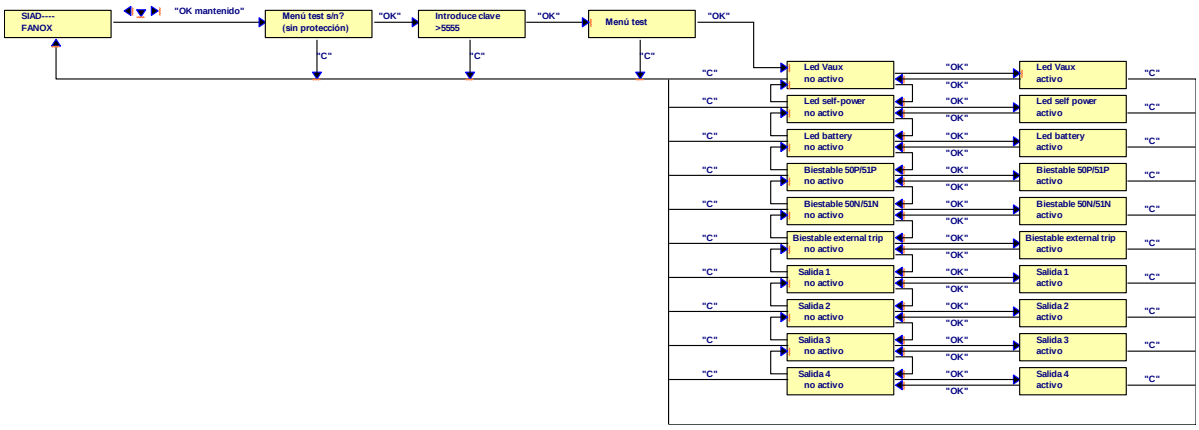
- Modbus address
- Communication speed
- Number of data bits
- Parity
- Number of stop bits

7.7.6. Fault report

From the "sleep" mode screen, press the “◄” key to access the fault report. Using the “▲” and “▼” keys we find the fault report that we are looking for and pressing “OK” we can read the data of this fault report.

7.7.7. Test Menu

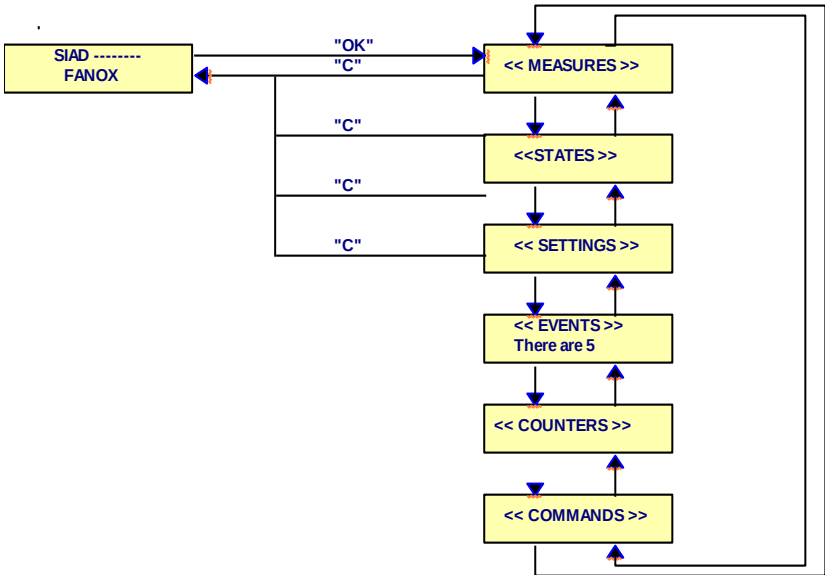
The “Test menu” is accessed from the standby mode screen by sequentially pressing the “◄”, “▼” and “►” keys, and then holding down the “OK” key. From here, press “OK” to access the components that can be tested.



7.7.8. Functions Menu

The SIA-D relay menu is split up into 6 main parts:

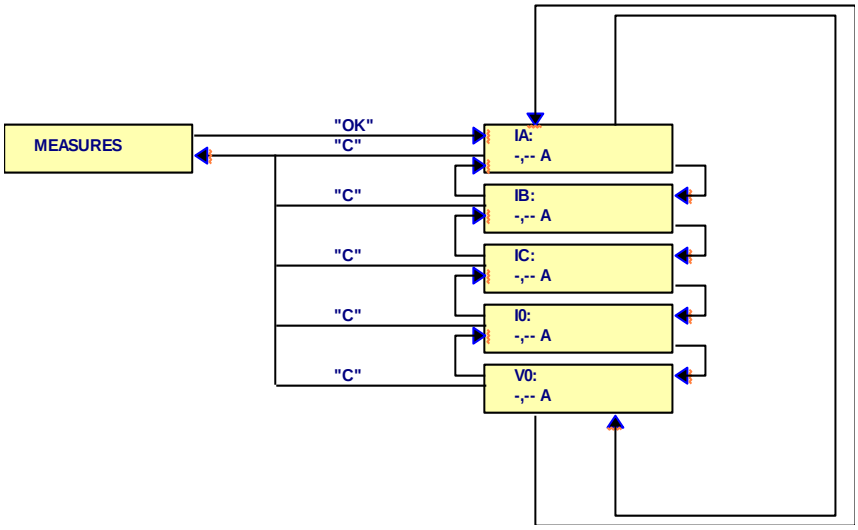
- Measurements.
- Status.
- Settings.
- Events.
- Counters
- Commands



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.

7.7.9. Measurements Menu

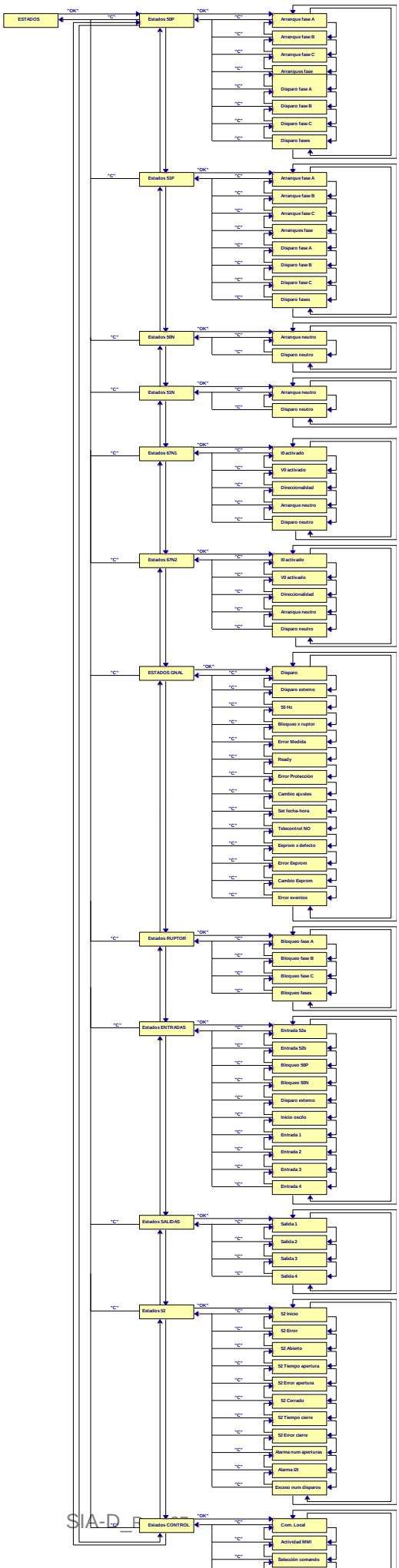
From the standby mode screen, press the "OK" key to access the first line of menus. Use the "▲" and "▼" keys to position the cursor over the "MEASUREMENTS" screen and press "OK". Use the "▲" and "▼" keys to position the cursor over the measurement and to see its value.



7.7.10. Status 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 or not each status is active. The message ">Activations present" 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.


ESTADOS
Estados 50P
Arranque fase A
Arranque fase B
Arranque fase C
Arranques fase
Disparo fase A
Disparo fase B
Disparo fase C
Disparo fases
Estados 51P
Arranque fase A
Arranque fase B
Arranque fase C
Arranques fase
Disparo fase A
Disparo fase B
Disparo fase C
Disparo fases
Estados 50N
Arranque neutro
Disparo neutro
Estados 51N
Arranque neutro
Disparo neutro
Estados 67N1
I0 activado
V0 activado
Direccionalidad
Arranque neutro
Disparo neutro
Estados 67N2
I0 activado
V0 activado
Direccionalidad
Arranque neutro
Disparo neutro
ESTADOS GNAL
Disparo
Disparo externo
50 Hz
Bloqueo x ruptor
Error Medida
Ready
Error Protección
Cambio ajustes
Set fecha-hora
Telecontrol NO
Eeprom x defecto
Error Eeprom
Cambio Eeprom
Error eventos
Estados RUPTOR
Bloqueo fase A
Bloqueo fase B
Bloqueo fase C
Bloqueo fases
Estados ENTRADAS
Entrada S2a
Entrada S2b
Bloqueo 50P
Bloqueo 50N
Disparo externo
Inicio oscilo
Entrada 1
Entrada 2
Entrada 3
Entrada 4
Estados SALIDAS
Salida 1
Salida 2
Salida 3
Salida 4
Estados S2
S2 Inicio
S2 Error
S2 Abierto
S2 Tiempo apertura
S2 Error apertura
S2 Cerrado
S2 Tiempo cierre
S2 Error cierre
Alarma num aperturas
Alarma I2t
Exceso num disparos
Estados CONTROL
Com. Local
Actividad MMI
Selección comando
"OK"
"C"

7.7.11. 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.

Press the “◄” key to access the general settings from the "SETTINGS" screen.

The general setting "Equipment name" can be viewed from the HMI, but it can only be modified by using the SICom program.

The value of the "TI Phase ratio” and “TI 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.

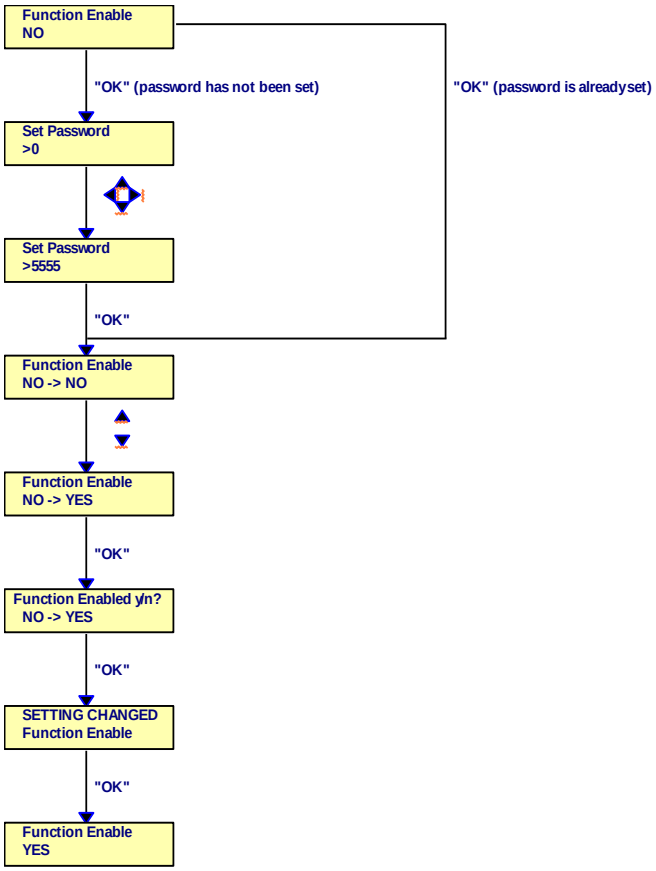
The frequency is selected for each model. The value is read only.

It is necessary to enter a password to change a setting for the first time. The settings can be changed after entering the password, until returning either manually or automatically to the standby mode screen. The system returns automatically to the standby mode screen if no key is pressed for five minutes.

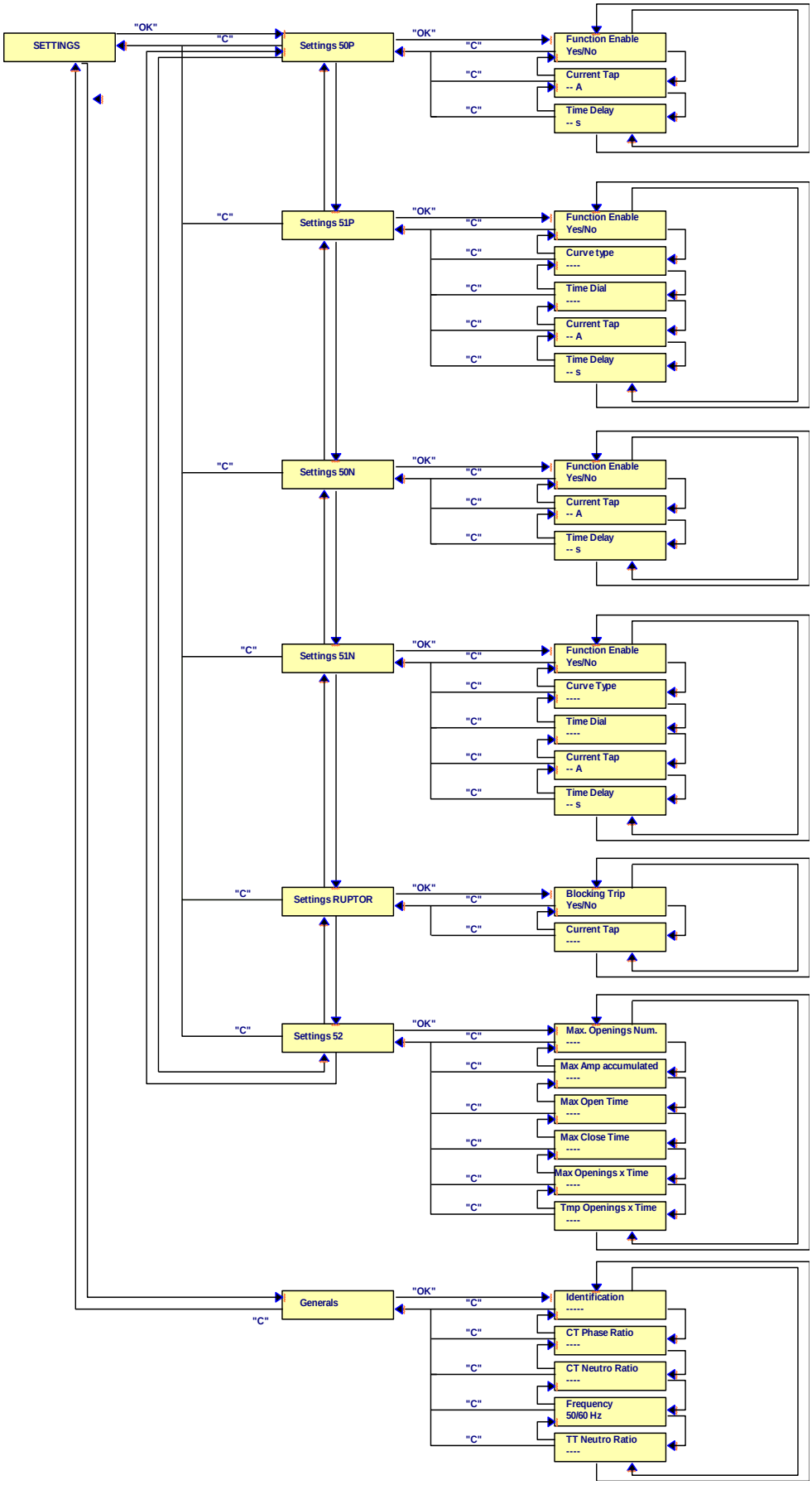
The factory setting password for the equipment is 5555. This password can be changed using the SICom program.

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.

Shown below is the sequence of steps to follow to change a setting:

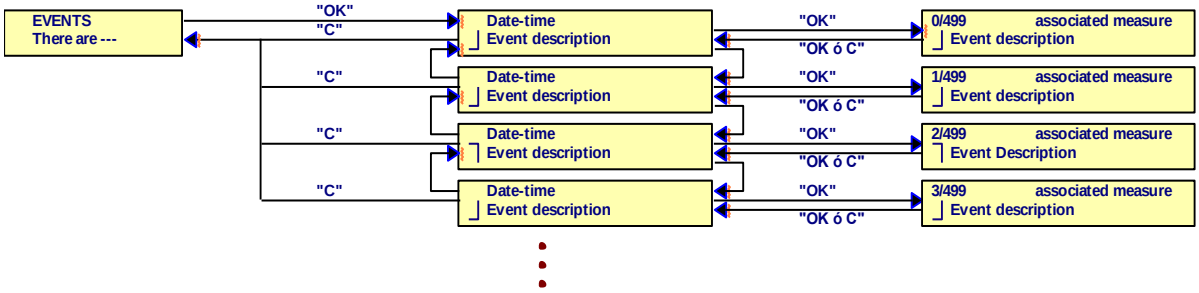


The method for navigating through the settings menu is shown graphically below.



7.7.12. 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.

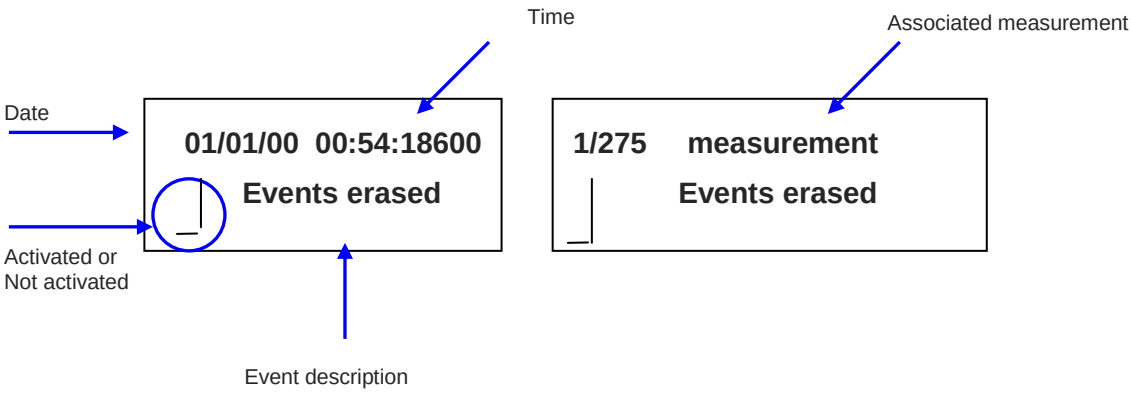


The “┘” and “┐” shows the event has been caused by the activation or reset of the associated status.

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)



7.7.13. Counters Menu

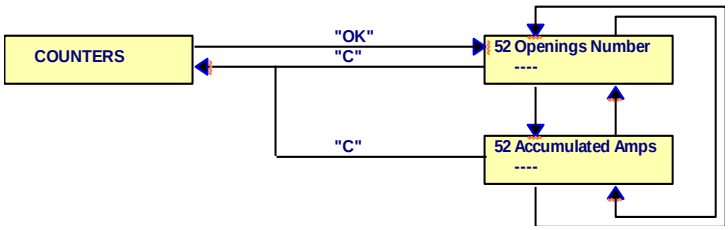
The first line of menus can be accessed from the standby mode screen by pressing the “OK” key. Use the “▲” and “▼” keys to move the cursor through the different screens until it is positioned over the "COUNTERS" screen. Press "OK" and use the “▲” and “▼” keys to view the different counters. The information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

The password must be entered before attempting to change a counter for the first time. Meter 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.

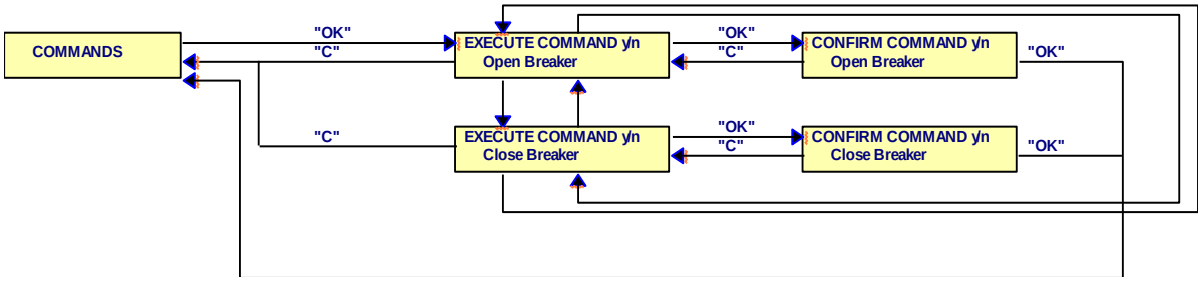
The factory setting password for the equipment is 5555. The password can be changed using the SICom program.

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.



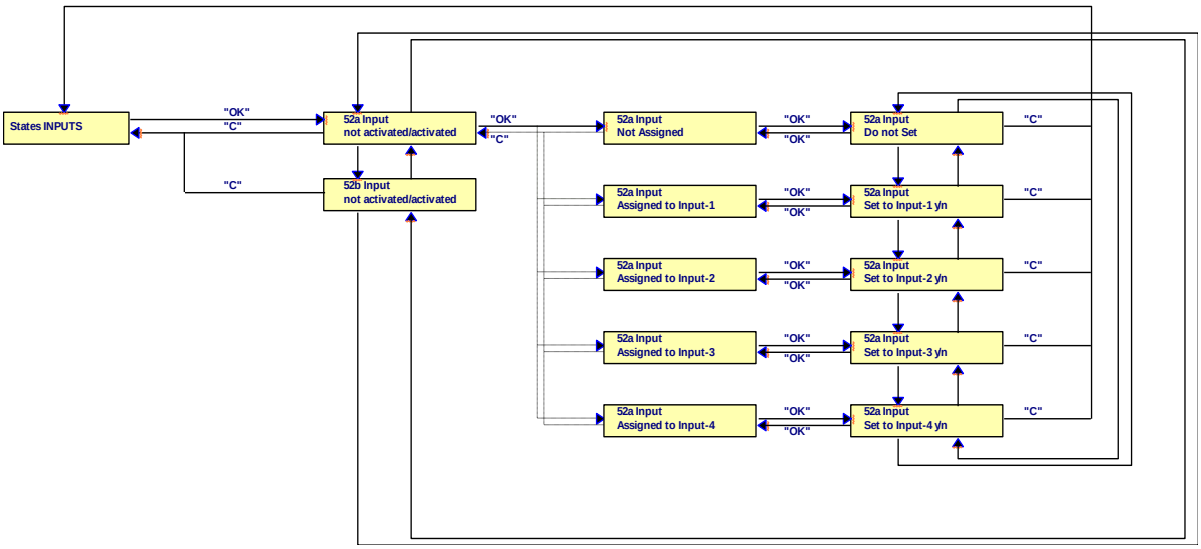
7.7.14. Commands Menu

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 commands. Press the "OK" key to perform a command, and press the "OK" key again to confirm the command.



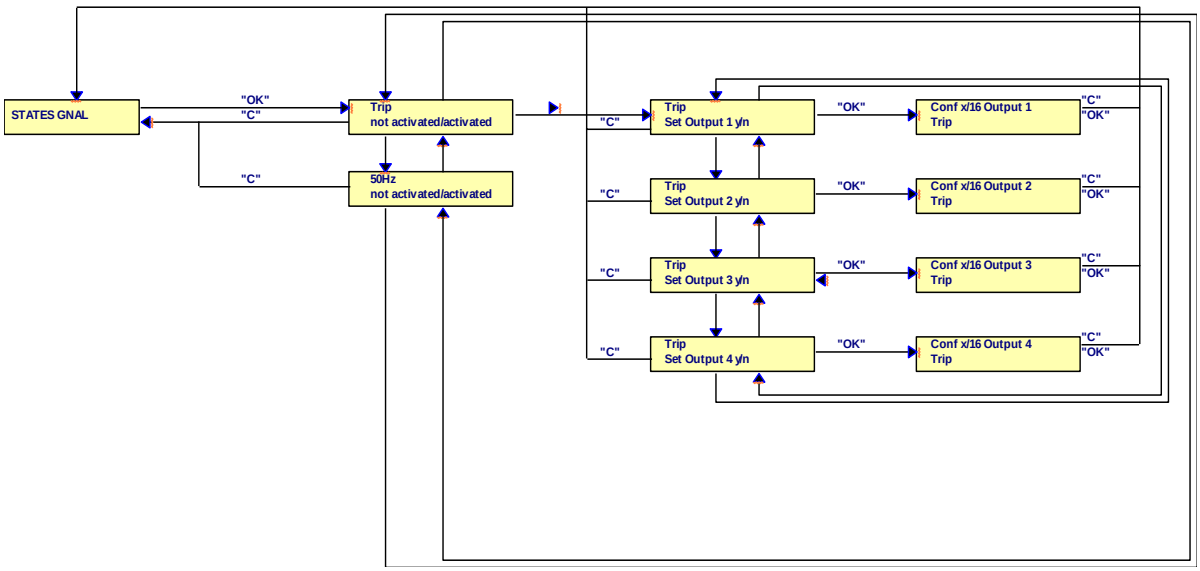
7.7.15. Input Configuration menu

To assign a logical input to a physical input, go to the “INPUT STATUS” menu. If “OK” is pressed from the screen that displays the input’s status (activated or deactivated), the current status of the logical input will disappear and the physical input that it is associated with will be displayed. To change the associated logical input, press “OK” and use the “▲” and “▼” keys to find the desired physical input. Confirm the choice by pressing “OK”. Go up through the menu levels by pressing the "C" key.

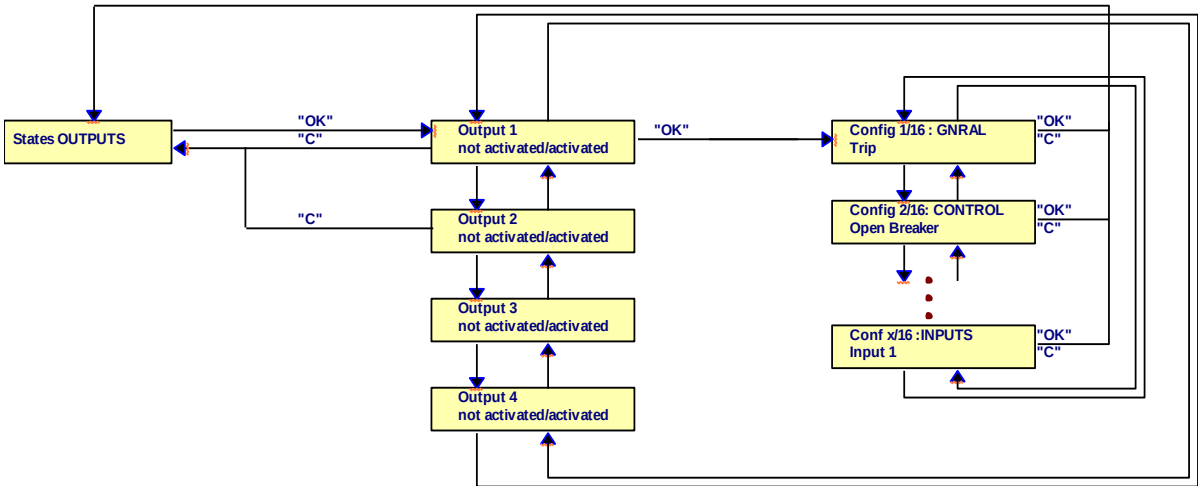


7.7.16. Output Configuration menu

To assign an instantaneous status to a physical output, browse through the STATUS menu to find the desired instantaneous status. When the status appears, press ► to enter the output configuration menu. Use the “▲” and “▼” keys in this menu to find the desired physical output and confirm the choice by pressing “OK”. After the confirmation is displayed on the screen, the index of 1 to 16 associated to the instantaneous status within the physical output configuration is displayed. Go up through the menu levels by pressing the "C" key.



To view or remove the instantaneous statuses assigned to a physical output, go to the “OUTPUT STATUS" menu. When the output current status (activated or deactivated) is displayed, press the "OK” key to replace this current status reading with the first instantaneous status that is associated with the output, along with its index number from 1 to 16. The “▲” and “▼” keys can be used in this menu to browse all of the statuses (up to 16) that are associated with a physical output. Press and hold the “RESET” key while viewing any of the instantaneous statuses associated with the output and its index number from 1 to 16 to remove the association with the physical output.



8. COMMISSIONING

8.1. Checklist for Commissioning

The commissioning sheets that are needed to register the commissioning process and the specific settings for each installed piece of equipment are found in the Appendix.

8.2. Inspection

It is important to pay attention to the following aspects during the installation.

8.3. Electrostatic discharge

Before handling any of the equipment electronic components, make sure that you have read the section of the user manual related to electrostatic discharges.

8.4. Visual Inspection

Make sure that the cabling has been installed as per the external connection diagrams.

8.5. Earthing

It is very important for the equipment to be earthed correctly. To check this, make sure that the equipment earth connection, located on the reverse side of the relay, is correctly connected to the facility local earth connection.

8.6. Current transformers

The high voltage that is generated in the secondary circuits of current transformers can cause death and could damage the facility. Therefore, the secondary circuits of current transformers should never be opened.

8.7. Auxiliary power

If an SIA-D relay with auxiliary power is required, this must be specified on the order reference. The amount of auxiliary power required for the SIA-D relay should be checked: 110-230 Vac 50/60 Hz or 90-300 Vdc or 24-48 Vdc.

8.8. RS232 Front communications port

To perform this test, connect a PC with the SICom software program to the SIA-D relay, and check that there are no communication errors.

If a laptop computer is used, the connector will probably be a USB. It is important to check the assigned communications port.

8.9. Commissioning

It is recommended that the following safety measures are taken before starting up the facility for the first time, or after a trip event:

- FANOX recommends the use of the KitCom accessory with a battery in the front port. This additional energy source allows the relay to be monitored and the trip to function without the need for self power in any breakdown situation.
- Once all of the connections have been made, we recommend a check to make sure that they are correct, safe and well attached.
- The "complete test" menu procedure should be applied. **NOTE! See 5.12.**
- It is important to check that the measurements are correct once the facility has been powered up.

Maintenance: FANOX recommends a minimum of one facility inspection per year, to at least go through the test menu and check the values of the measurements.

9. PROTOCOL

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

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

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

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

- Reading function 3.
- Writing function 16.

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

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

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

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

If the equipment is fitted with two switched ports, one front and one rear, the following features can be configured: speed (1200, 2400, 4800, 9600 or 19200), parity (even, odd or no parity), the stop bits (1 or 2) and the address (1 to 247).

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

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

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

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

9.1. Modbus packaged format

CUSTOMER ADDRESS	1 byte	Each device on a communication bus must have a unique address, otherwise two different units could reply simultaneously to the same request. All ports of the relay will use this address which can be set a value between 1 and 247. When the master transmits a frame with the slave address to 0 indicates a Broadcast. All the slaves in the communications bus will carry out the requested action, but no one will reply to the master. The Broadcast will only be accepted to write, as it makes no sense to make a read request in the Broadcast, as no one will reply this request.
FUNCTION CODE	1 byte	This is one of the function codes supported by the equipment. In this case, the only function codes supported are 3 to read and 16 to write. When the slave has to reply with an exception one of these frames, it is indicated by putting 1 in the most important bit of the correspondent function. Thus, an exception for the function 3, will be indicated with a 83 as a function code; and an exception for the function code 16 or 0x10 in hexadecimal, will be indicated with an 0x90.
DATA	N bytes	This part consists of a variable number of bytes, depending on the function code. It may include: addresses, data lengths, settings, commands or exception codes sent by the user.
CRC	2 bytes	Control code of two bytes. The ModBus/RTU includes a 16 bit CRC in each frame, to detect errors. If the slave detects an erroneous frame, based on a CRC that is not correct, it won't take any action, nor will reply anything to the master. The management of the CRC is LSB-MSB.
DEAD TIME	Necessary time to transmit 3,5 Bytes	A frame is terminated when nothing is received for a period of 3,5 bytes. It means: 15 ms at 2400 bps 2 ms at 19200 bps ...etc.

9.2. Function codes

HEX DEC CODE	MODBUS NAME	DEFINITION	COMMENT
0x03 3	Read Holding Registers	Reading of Any Value	This function allows the master to read 1 or more consecutive addresses of a relay. The registers always are of 16 bits, with the most important byte at first. The maximum number of registers to be read in a package are 60.
0x10 16	Preset Multiple Registers	Script	This function allows to write one or more registers that represent one or more settings. The registers are values of 2 bytes of length, transmitted with the most important byte at first. The maximum number of register to be written in a package is 60.

9.3. Exemptions and error answers

The error codes defined by the ModBus protocol are as follows:

01	ILLEGAL FUNCTION	The slave does not support any function with the function code received in this message.
02	ILLEGAL DATA ADDRESS	The master is trying to do an operation in a wrong address.
03	ILLEGAL DATA VALUE	The slave has detected that the value sent by the master is not valid.
04	SLAVE DEVICE FAILURE	Indicates an error occurred in the slave while trying to execute the request of the master.
05	ACKNOWLEDGE	Generic recognition.
06	SLAVE DEVICE BUSY	The slave is busy and unable to perform the required operation.
07	NEGATIVE ACKNOWLEDGE	Generic non-recognition.

9.4. Data type

TYPE	LENGTH	DESCRIPTION
UCHAR	1/2	Integer without sign of 1 byte
BYTE	1/2	Integer with sign of 1 byte
BIT16	1	Gathered bits type, groups of 16. E. g.: 0x1A41 = 0001101001000001b
BIT32	2	Gathered bits type, groups of 32.
ENUM	1	Integer without sign of 16 bits. Each of the values that the integer can be will have a correspondence in the auxiliar list of the database. I this list is the correspondence chain which must be shown for each of the values. Memory will only receive an integer value. E. g.: 0, 1 Correspondence to “CLOSED”, “OPEN”
DENUM	2	Integer without sign of 32 bits
UINT	1	Integer without sign of 2 bytes
INT	1	Integer with sign of 2 bytes
LONG	2	Integer without sign of 4 bytes
DWORD	2	Integer with sign of 4 bytes
FLOAT	2	Number in floating decimal point “Float” of 4 bytes
ASCIIxx	xx/2	String: In length variable character chain. Final of String marked with ‘\0’. E. g.: “ABC” 0x41x42x43x00....
MILIS	3	*Minutes*(passed since 00:00 of 1/1/2000)(LONG).*milliseconds*(UINT)
FH	5	*Year*(UINT).*month*(UCHAR).*day*(UCHAR).*hour*(UCHAR).*minutes*(UCHAR).*seconds*(UCHAR).*hundredth*(UCHAR).*thousandth*(UINT)
CONT	13	Directory(UINT).Value(DWORD).Description(ASCII20)
EVENT	9	Criteria Directory(UINT).Event Identifier(UINT).Value(UINT).Associated Measure(UINT).Date and Time(FH)
EVENTO	10	Antiquity(UINT).Event(EVENT)
CCRIT	6	Criteria Number(UINT).Criteria Directory(UINT).Descriptive text(ASCII8)

TYPE	LENGTH	DESCRIPTION
PEST	61	Number of States(UINT).Protection State-1(BIT16). … Protection State-60(BIT16)
PCRIT	61	Number of Criteria(UINT).Index of Criteria-1(UINT). … Index of Criteria-60(UINT).
CMED	8	Number of Meassure(UINT).Descriptive text(ASCII7).Unit(ASCII3).Primary Unit(ASCII5).Number of decimals(UCHAR)
GAJU	61	Number of Groups(UINT).Index of the Criteria-1(UINT).Index of the first setting of the Criteria-1(UINT). … Index of the Criterion-30(UINT).Index of the first setting of the Criteria-30(UINT).

9.5. Memory map of SIA-D

Function	Description	Start address	Number of registries	Format	
03	Read of Model and Version	100	44	ASCII88	
03	Read of Equipment State	160	2	BIT32	See general status map
03	Read of Access Level	162	4	UCHAR8	See Passwords and Access Levels
16	Write access code	168	2	UCHAR4	See Passwords and Access Levels
03	Read Date and Time	170	5	FH	
16	Write Date and Time	170	5	FH	
16	Write the Directory of Counters	175	1	UINT	See counters map
03	Read of Counters	176	13	CONT	See counters map
16	Write of Counters	176	13	CONT	See counters map
16	Selection of Command	200	1	UINT	See commands map
16	Confirmation of Command	201	1	UINT	See commands map
16	Write the Directory of Event	400	1	UINT	See commands map
03	Read an Event	401	10	EVENTO	See events list
03	Read and Delete the oldest Event	433	9	EVENT	See events list
16	Delete All Events	465	1	dummy	
16	Write the Directory of the Protection Criterion	500	1	UINT	See protection criteria map
03	Read of the Protection	501	61	PEST	See protection status

	States				map
Function	**Description**	**Start address**	**Number of registries**	**Format**	
03	Read of which protection criterion implements the equipment	561	61	PCRIT	See protection criteria map
03	Read the characteristics of a Protection Criterion	681	6	CCRIT	See protection criteria map
16	Write the Measure Directory	1000	1	UINT	See measures map
03	Read Secondary Measure	1001	2	FLOAT	See measures map
03	Read Primary Measure	1401	2	FLOAT	See measures map
03	Read the characteristics of a measure	1801	8	CMED	See measures map
16	Write the number of the Setting List	3000	1	UINT	
03	Read of a Setting	3001	2	See Settings map	
16	Write of a Setting	3001	2	See Settings map	
16	Write-Confirmation of a Setting	5001	2	See Settings map	
03	Read directory of first setting of each protection criterion	7001	61	GAJU	See Settings map

9.6. General Status Map

bit-0	Trip
bit-1	External Trip Input Active
bit-2	Auxiliary Supply
bit-3	Self-power
bit-4	9Vcc Supply
bit-5	Error No Trip Voltage
bit-6	Frequency 50 Hz
bit-7	RESERVED
bit-8	RESERVED
bit-9	RESERVED

bit-10	RESERVED
bit-11	RESERVED
bit-12	RESERVED
bit-13	48 Vdc power supply alarm
bit-14	RESERVED
bit-15	Measure Error
bit-16	Equipment Start
bit-17	Protection Error
bit-18	Settings Change
bit-19	RESERVED
bit-20	Date and Time Synchronized
bit-21	Local communication Active
bit-22	Error Default Settings
bit-23	E2prom Error
bit-24	RESERVED
bit-25	RESERVED
bit-26	RESERVED
bit-27	Change of values in E2prom
bit-28	Error registering Events
bit-29	RESERVED
bit-30	RESERVED
bit-31	There are New Events

9.7. Counters Map

1	Number of circuit breaker openings
2	Number of Amps Accumulated during the circuit breaker openings

9.8. Comands Map

1	Open Circuit breaker
2	Close circuit breaker

9.9. Measures Map

1	IA
2	IB
3	IC
4	IN
5	VN

9.10. Protection Criteria Map

Criteria Number	Criteria Directory	Criteria denomination
1	12805 =50*256+5	50P
2	13061 =51*256+5	51P
3	38405 =150*256+5	50N
4	38661 =151*256+5	51N
5	42753 = 167*256+1	67N1
6	42785 = 167*256+33	67N2
7	51202 =200*256+2	General
8	51713 = 202*256+1	Fuse + Switchgear
9	52225 = 204*256+1 52226 = 204*256+2	Tripping Bus: 50P, 51P, 50N, 51N Tripping Bus: 50P, 51P, 50N, 51N, 67N1 and 67N2
10	64770 = 253*256+2	Inputs

11	65027 = 254*256+3	Outputs
12	13313 = 52*256+1	52
13	63745 = 249*256+1	Local Communication ModBus

9.11. Protection Status Map

Designation of the criteria	Protection criteria status	
50P	bit-0	Phase A pick-up
	bit-1	Phase B pick-up
	bit-2	Phase C pick-up
	bit-3	Pick-up
	bit-4	RESERVED
	bit-5	RESERVED
	bit-6	RESERVED
	bit-7	RESERVED
	bit-8	Phase A trip
	bit-9	Phase B trip
	bit-10	Phase C trip
	bit-11	Trip
	bit-12	RESERVED
	bit-13	RESERVED
	bit-14	RESERVED
	bit-15	RESERVED

Designation of the criteria	Protection criteria status	
51P	bit-0	Phase A pick-up
	bit-1	Phase B pick-up
	bit-2	Phase C pick-up
	bit-3	Pick-up
	bit-4	RESERVED
	bit-5	RESERVED
	bit-6	RESERVED
	bit-7	RESERVED
	bit-8	Phase A trip
	bit-9	Phase B trip
	bit-10	Phase C trip
	bit-11	Trip
	bit-12	RESERVED
	bit-13	RESERVED
	bit-14	RESERVED
	bit-15	RESERVED

Designation of the criteria	Protection criteria status	
50N	bit-0	RESERVED
	bit-1	RESERVED
	bit-2	RESERVED
	bit-3	RESERVED
	bit-4	Pick-up
	bit-5	RESERVED
	bit-6	RESERVED
	bit-7	RESERVED
	bit-8	RESERVED
	bit-9	RESERVED
	bit-10	RESERVED
	bit-11	RESERVED
	bit-12	Trip
	bit-13	RESERVED
	bit-14	RESERVED
	bit-15	RESERVED

Designation of the criteria	Protection criteria status	
51N	bit-0	RESERVED
	bit-1	RESERVED
	bit-2	RESERVED
	bit-3	RESERVED
	bit-4	Start
	bit-5	RESERVED
	bit-6	RESERVED
	bit-7	RESERVED
	bit-8	RESERVED
	bit-9	RESERVED
	bit-10	RESERVED
	bit-11	RESERVED
	bit-12	Trip
	bit-13	RESERVED
	bit-14	RESERVED
	bit-15	RESERVED

Designation of the criteria	Protection criteria status	
67N1	bit-0	I0 Active
	bit-1	V0 Active
	bit-2	Directionality
	bit-3	RESERVED
	bit-4	Start up
	bit-5	RESERVED
	bit-6	RESERVED
	bit-7	RESERVED
	bit-8	RESERVED
	bit-9	RESERVED
	bit-10	RESERVED
	bit-11	RESERVED
	bit-12	Trip
	bit-13	RESERVED
	bit-14	RESERVED
	bit-15	RESERVED

Designation of the criteria	Protection criteria status	
67N2	bit-0	I0 Active
	bit-1	V0 Active
	bit-2	Directionality
	bit-3	RESERVED
	bit-4	Start up
	bit-5	RESERVED
	bit-6	RESERVED
	bit-7	RESERVED
	bit-8	RESERVED
	bit-9	RESERVED
	bit-10	RESERVED
	bit-11	RESERVED
	bit-12	Trip
	bit-13	RESERVED
	bit-14	RESERVED
	bit-15	RESERVED
Tripping Bus	bit-0	50P Block
	bit-1	51P Block
	bit-2	50N Block
	bit-3	51N Block
	bit-4	67N1 Block
	bit-5	67N2 Block
	bit-6	50P Block Signalling
	bit-7	51P Block Signalling
	bit-8	50N Block Signalling
	bit-9	51N Block Signalling

	bit-10 67N1 Block Signalling bit-11 67N2 Block Signalling bit-12 RESERVED bit-13 RESERVED bit-14 RESERVED bit-15 RESERVED

General	bit-0	Trip
	bit-1	External Trip input Active
	bit-2	Auxiliary Power
	bit-3	Self-Power
	bit-4	12Vdc Power
	bit-5	No Trip Voltage Error
	bit-6	50 Hz grid frequency
	bit-7	RESERVED
	bit-8	RESERVED
	bit-9	RESERVED
	bit-10	RESERVED
	bit-11	RESERVED
	bit-12	RESERVED
	bit-13	48 Vdc power supply alarm
	bit-14	RESERVED
	bit-15	Measurement error
	bit-16	Equipment Start
	bit-17	Protection Error
	bit-18	Change Settings
	bit-19	RESERVED
	bit-20	Date and Time Synchronised
	bit-21	Local communication active
	bit-22	Default Settings Error
	bit-23	E2prom Error
	bit-24	RESERVED
	bit-25	RESERVED
	bit-26	RESERVED
	bit-27	Changing E2prom values
	bit-28	Events records error
	bit-29	RESERVED
	bit-30	RESERVED
	bit-31	There are New Events

Designation of the criteria	Protection criteria status	
Breaker	bit-0	Phase A blocking
	bit-1	Phase B blocking
	bit-2	Phase C blocking
	bit-3	Blocking
	bit-4	RESERVED
	bit-5	RESERVED
	bit-6	RESERVED
	bit-7	RESERVED
	bit-8	RESERVED
	bit-9	RESERVED
	bit-10	RESERVED
	bit-11	RESERVED
	bit-12	RESERVED
	bit-13	RESERVED
	bit-14	RESERVED
	bit-15	RESERVED

Designation of the criteria	Protection criteria status	
Inputs	bit-0	Input 52a
	bit-1	Input 52b
	bit-2	Input Phase Blocking
	bit-3	Input Neutral Blocking
	bit-4	Input External Trip
	bit-5	Input Oscillography Start
	bit-6	RESERVED
	bit-7	RESERVED
	bit-8	RESERVED
	bit-9	RESERVED
	bit-10	RESERVED
	bit-11	RESERVED
	bit-12	RESERVED
	bit-13	RESERVED
	bit-14	RESERVED
	bit-15	RESERVED

Designation of the criteria	Protection criteria status	
Outputs	bit-0	Outputs 1
	bit-1	Outputs 2
	bit-2	Outputs 3
	bit-3	Outputs 4
	bit-4	RESERVED
	bit-5	RESERVED
	bit-6	RESERVED
	bit-7	RESERVED
	bit-8	RESERVED
	bit-9	RESERVED
	bit-10	RESERVED
	bit-11	RESERVED
	bit-12	RESERVED
	bit-13	RESERVED
	bit-14	RESERVED
	bit-15	RESERVED

Designation of the criteria	Protection criteria status	
Local Communication ModBus	bit-0	Local Communication
	bit-1	HMI Activity
	bit-2	RESERVED
	bit-3	RESERVED
	bit-4	RESERVED
	bit-5	RESERVED
	bit-6	RESERVED
	bit-7	RESERVED
	bit-8	RESERVED
	bit-9	RESERVED
	bit-10	RESERVED
	bit-11	RESERVED
	bit-12	RESERVED
	bit-13	RESERVED
	bit-14	RESERVED
	bit-15	RESERVED
	bit-16	Command selection
	bit-17	Open circuit breaker
	bit-18	Close circuit breaker

9.12. Events list

Criteria denomination	Criteria	Event identifier	
50P	12805	1	Phase A pick-up
		2	Phase B pick-up
		3	Phase C pick-up
		4	Pick-up
		5	Phase A trip
		6	Phase B trip
		7	Phase C trip
		8	Trip
51P	13061	1	Phase A pick-up
		2	Phase B pick-up
		3	Phase C pick-up
		4	Pick-up
		5	Phase A trip
		6	Phase B trip
		7	Phase C trip
		8	Trip
50N	38405	1	Pick-up
		2	Trip
51N	38661	1	Pick-up
		2	Trip
52	13313		Reset
			Error
			Open
			Opening
			Open Error
			Close
			Closing
			Close Error
			Too many open numbers
			Too may Amps accumulated
			Too many open numbers per time
			Contact 52-A activated

		Contact 52-B activated	
Criteria denomination	**Criteria**	**Event identifier**	
67N1	42753	1	Start up
		2	Trip
67N2	42785	1	Start up
		2	Trip
Tripping Bus		1	50P Block
		2	51P Block
		3	50N Block
		4	51N Block
		5	50P Block signalling
		6	51P Block signalling
		7	50N Block signalling
		8	51N Block signalling
		9	67N1 Block
		10	67N2 Block
		11	67N1 block signalling
		12	67N2 block signalling
General	51202	1	Trip
		17	Equipment Start
		18	Protection Error
		19	Settings Change
		21	Date and Time Synchronized
		22	Local communication Active
		23	Error Default Settings
		24	Error in E2prom
		28	Change of values in E2prom
		29	Error registering Events
		32	There are New Events
		33	Auxiliary Supply
		34	Self-power
		35	12Vdc Supply
		37	Error No Trip Voltage
		36	External Trip Input Active
		38	Measure error
		41	48Vdc power supply alarm
Inputs	64770		Input 52a

			Input 52b Input Phase Blocking Input Neutral Blocking Input External Trip Input Oscillography Start
Outputs	65027		Output 1 Output 2 Output 3 Output 4
Local Communication ModBus	63745	1 2 17 18 19	Local Communication HMI Activity Command selection Open circuit breaker Close circuit breaker

9.13. Settings Map

Start Address for Read and Write in ModBus	Start Address for Write-Confirmation in ModBus	Type	Category	Function	Minimum	Maximum	Step	Unit
3001	5001	ASCII20	Generals	Equipment identifier				-
3006	5006	DENUM 5060Hz	Generals	Phase CT Ratio	0	1	1	Hz
3007	5007	LONG	Generals	Neutral CT Ratio	1	2000	1	-
3008	5008	LONG	Generals	Frequency	1	2000	1	-
3009	5009	DENUM LANGUAGE	Generals	Language	0	3	1	-
3010	5010	LONG	Generals	Neutral TT Ratio	1	2000	1	-
3011	5011	DENUM NOSI	50P	Permission	0	1	1	-
3012	5012	FLOAT	50P	Tap	0,10	30,00	0,01	xIn
3013	5013	FLOAT	50P	Operating time	0,02	300,00	0,01	s
3014	5014	DENUM NOSI	50N	Permission	0	1	1	-
3015	5015	FLOAT	50N	Tap	0,10	30,00	0,01	xIn
3016	5016	FLOAT	50N	Operating time	0,02	300,00	0,01	S
3017	5017	DENUM NOSI	51P	Permission	0	1	1	-

3018	5018	DENUM	51P	Curve (1*)	0	3	1	-
3019	5019	FLOAT	51P	Dial	0,05	1,25	0,01	-
3020	5020	FLOAT	51P	Tap	0,10	7,00	0,01	xIn.
3021	5021	FLOAT	51P	Operating time	0.02	300,00	0,01	S
3022	5022	DENUM NOSI	51N	Permission	0	1	1	-
3023	5023	DENUM	51N	Curve (1*)	0	3	1	-
3024	5024	FLOAT	51N	Dial	0,05	1,25	0,01	-
3025	5025	FLOAT	51N	Tap	0,10	7,00	0,01	xIn.
3026	5026	FLOAT	51N	Operating time	0,02	300,00	0,01	S
3027	5027	DENUM NOSI	RUPTOR	Permission	0	1	1	-
3028	5028	FLOAT	RUPTOR	Tap	7,00	20,00	0,01	xIn
3029	5029	LONG	52	Excessive Number of Openings	1	10000	1	-
3030	5030	LONG	52	Maximum Accumulated Amps	1	10000	1	KA2
3031	5031	FLOAT	52	Opening Time	0,02	300,0	0,01	S
3032	5032	FLOAT	52	Closing Time	0,02	300,0	0,01	S
3033	5033	LONG	52	Excessive Repeated Openings	1	10000	1	-
3034	5034	FLOAT	52	Time of Excessive Repeated Openings	1,00	300,0	0,01	Min
Model with 67N x2								
3035	5035	DENUM NOSI	67N1	Permission	-	-	Si/No	-
3036	5036	FLOAT	67N1	Tap	0,10	30,00	0,01	Inominal
3037	5037	FLOAT	67N1	Operating time	0,02	300,0	0,01	S
3038	5038	DENUM NOSI	67N1	Direccionality	-	-	Si/No	-
3039	5039	FLOAT	67N1	Residual Voltage	4,00	110,00	0,1	V
3040	5040	LONG	67N1	Operating Angle	0	359	1	º
3041	5041	LONG	67N1	Half-cone Angle	0	170	1	º

3042	5042	DENUM NOSI	67N2	Permission	-	-	Si/No	-
3043	5043	FLOAT	67N2	Tap	0,10	30,00	0,01	Inominal
3044	5044	FLOAT	67N2	Operating time	0,02	300,0	0,01	s
3045	5045	DENUM NOSI	67N2	Direccionality	-	-	Si/No	-
3046	5046	FLOAT	67N2	Residual voltage	4,00	110,00	0,1	V
3047	5047	LONG	67N2	Operating Angle	0	359	1	º
3048	5048	LONG	67N2	Half-cone Angle	0	170	1	º
3049	5049	DENUM	Tripping Bus	Application (2*)	0	3	1	-
3050	5050	DENUM NOSI	Tripping Bus	50P blocking permission	0	1	1	-
3051	5051	DENUM NOSI	Tripping Bus	51P blocking permission	0	1	1	-
3052	5052	DENUM NOSI	Tripping Bus	50N blocking permission	0	1	1	-
3053	5053	DENUM NOSI	Tripping Bus	51N blocking permission	0	1	1	-
3054	5054	DENUM NOSI	Tripping Bus	67N1 blocking permission	0	1	1	-
3055	5055	DENUM NOSI	Tripping Bus	67N2 blocking permission	0	1	1	-
3056	5056	FLOAT	Tripping Bus	Phase blocking time	0	300,0	0,01	s
3057	5057	FLOAT	Tripping Bus	Neutral blocking time	0	300,0	0,01	s
3058	5058	FLOAT	Tripping Bus	Phase block signalling time	0	300,0	0,01	s
3059	5059	FLOAT	Tripping Bus	Neutral block signalling time	0	300,0	0,01	s
Model without 67N								
3035	5035	DENUM	Tripping Bus	Application (2*)	0	3	1	-
3036	5036	DENUM NOSI	Tripping Bus	50P blocking permission	0	1	1	-
3037	5037	DENUM NOSI	Tripping Bus	51P blocking permission	0	1	1	-

3038	5038	DENUM NOSI	Tripping Bus	50N blocking permission	0	1	1	-
3039	5039	DENUM NOSI	Tripping Bus	51N blocking permission	0	1	Si/1	-
3040	5040	FLOAT	Tripping Bus	Phase blocking time	0	300,0	0,01	s
3041	5041	FLOAT	Tripping Bus	Neutral blocking time	0	300,0	0,01	s
3042	5042	FLOAT	Tripping Bus	Phase block signalling time	0	300,0	0,01	s
3043	5043	FLOAT	Tripping Bus	Neutral block signalling time	0	300,0	0,01	s

(1*) Values of enum of Curve:

Value	Curve
0	IEC 244-4/BS-142 inverse
1	IEC 244-4/BS-142 very inverse
2	IEC 244-4/BS-142 extremely inverse
3	Definite Time

(2*) Values of enum of application setting on tripping bus:

Value	Application
0	Not activated
1	Feeder
2	Supply
3	Feeder and supply

9.14. Examples of ModBus frames

9.14.1. Writing the access password “5555” to equipment nº 1

Address	01
Function	10
H start address	00
L start address	A8
Number of H registers	00
Number of L registers	02
Number of Bytes	04
Password	35,35,35,35
checksum H	4A
checksum L	50

And the SIA will reply OK:

address	01
function	10
H start address	00
L start address	A8
Number of H registers	00
Number of L registers	02
Number of Bytes	04
checksum H	29
checksum L	93

9.14.2. Reading the 4 measurements from the primary winding to equipment nº 1

address	01
function	03
H start address	05
L start address	79
Number of H registers	00
Number of L registers	08
checksum H	95
checksum L	19

And the SIA will reply with the IA, IB, IC and I0 measurements in FLOAT format:

address	01
function	10
Number of Bytes	10
Measurement IA	00,00,00,00
Measurement IB	00,00,00,00
Measurement IC	00,00,00,00
Measurement IN	00,00,00,00
checksum H	E4
checksum L	59

9.14.3. Reading the protection status of equipment nº 1

address	01
function	03
H start address	01
L start address	F5
Number of H registers	00
Number of L registers	3D
checksum H	95
checksum L	D5

And the SIA will reply with:

address	01
function	03
Number of Bytes	7A
50PStatus	00,09
51PStatus	00,00
50NStatus	00,00
51NStatus	00,00
GeneralStatus	00,00,00,D2
Inputs Status	80,21
Outputs Status	00,00
COM Status	00,03

RESERVED	checksum H	checksum L
00,00,00,01,00,00,00,00,……,7C,B1,0A,AF,DD	3B	1D

10. APPENDIX

10.1. Identification

Date : .....

Manager : .....

Substation : .....

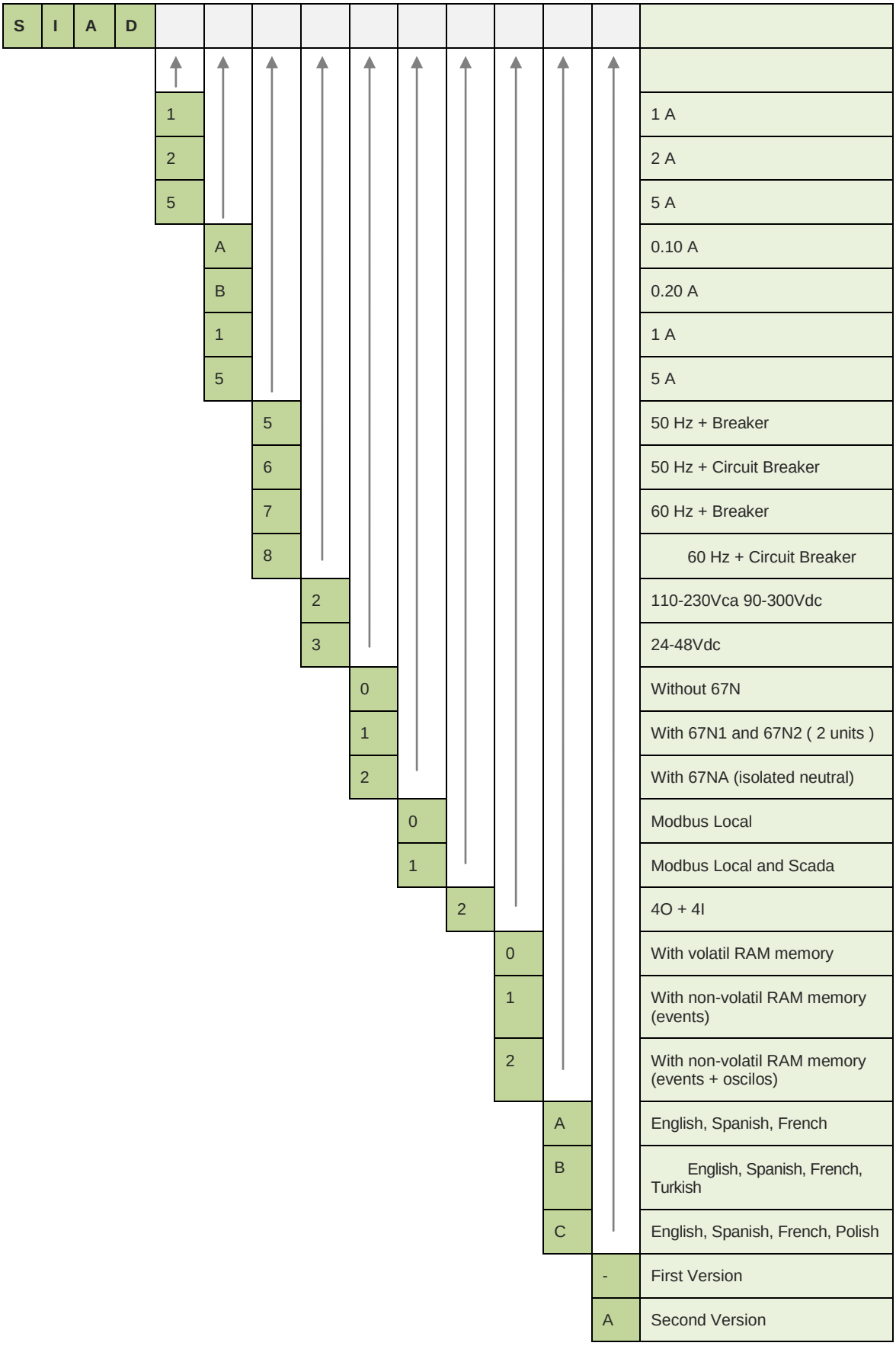
Circuit : .....

Model : .....

Serial no. : .....

Software Versions : .....

Model: .....


S I A D
1 A
2 A
5 A
0.10 A
0.20 A
1 A
5 A
50 Hz + Breaker
50 Hz + Circuit Breaker
60 Hz + Breaker
60 Hz + Circuit Breaker
110-230Vca 90-300Vdc
24-48Vdc
Without 67N
With 67N1 and 67N2 (2 units)
With 67NA (isolated neutral)
Modbus Local
Modbus Local and Scada
4O + 4I
With volatil RAM memory
With non-volatil RAM memory (events)
With non-volatil RAM memory (events + oscilos)
English, Spanish, French
English, Spanish, French, Turkish
English, Spanish, French, Polish
First Version
Second Version

10.2. Checks

Cabling check: ❒
Box earth: ❒
Vaux value: ❒

10.3. Test menu

Led Vaux:	❒	Bistable 50P/51P:	❒
Self-power LED:	❒	Bistable 50N/51N:	❒
Battery LED:	❒	External trip bistable:	❒
Output 1:	❒	Output 2:	❒
Output 3:	❒	Output 4:	❒

10.4. Register of commissioning settings

Password: ……

Identification: ……

10.4.1. CT Ratio:

Phase CT Ratio: ……

Neutral CT Ratio: ……

Neutral TT Ratio:……

10.4.2. 50P:

Permission ❒ Enabled ❒ Disabled

Tap.....…… xIn

Operating Time.....…….. ... s

10.4.3. 50N:

Permission ❒ Enabled ❒ Disabled

Tap.....…… xIn

Operating Time.....…….. ... s

10.4.4. 51P:

Permission ❒ Enabled ❒ Disabled

Tap.....…… xIn

Operating Time.....…….. ... s

IEC curve type ❒ Inverse ❒ Very Inverse ❒ Extrm. Inverse

Dial .....……

Operating Time …… s

10.4.5. 51N:

Permission ❒ Enabled ❒ Disabled

Tap.....…… xIn

IEC curve type ❒ Inverse ❒ Very Inverse ❒ Extrm. Inverse

Dial…….....……

Operating Time…..…..…… s

10.4.6. 67N1

Permission ❒ Enabled ❒ Disabled

Tap……..…… xIn

Operating Time …… s

Directional ❒ Yes ❒ No

Residual Voltage …….. V

Operating Angle …… º

Half-cone Angle …….. º

10.4.7. 67N2

Permission ❒ Enabled ❒ Disabled

Tap……xIn

Operating Time …… s

Directional ❒ Yes ❒ No

Residual Voltage …….. V

Operating Angle …… º

Half-cone Angle …….. º

10.4.8. Breaker:

Permission ❒ Enabled ❒ Disabled

Blocking level.....…… xIn

10.4.9. Circuit breaker

Excessive number of openings ……

Excessive accumulated amps……

Opening time……

Closing time……..

Excessive repeated openings ……..

Time of repeated openings ……

10.4.10. Tripping Bus

Application: ❒ not activated ❒ feeder ❒ supply ❒ feeder and supply

50P tripping bus permission: ❒ Yes ❒ No

51P tripping bus permission: ❒ Yes ❒ No

50N tripping bus permission: ❒ Yes ❒ No

51N tripping bus permission: ❒ Yes ❒ No

67N1 tripping bus permission: ❒ Yes ❒ No

67N2 tripping bus permission: ❒ Yes ❒ No

Phase blocking time: …… s

Neutral blocking time: …… s

Phase signalling time: …… s

Neutral signalling time: …… s

10.5. Input configuration

	Input 1	Input 2	Input 3	Input 4
No configuration				
52 a				
52 b				
Phase blocking				
Neutral blocking				
External trip				
Oscillograph start				

10.6. Output configuration

Output 1	Output 2	Output 3	Output 4	Nº de OR
				1
				2
				3
				4
				5
				6
				7
				8
				9
				10
				11
				12
				13
				14
				15
				16

10.7. Comments

…….....……..…

…….....……..…

…….....……..…

…….....……..…

…….....……..…

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

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

10.8. NOTES:

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