DIVISIONE ELETTRONICA E SISTEMI

IFX4L

DIGITAL OVERCURRENT AND EARTH FAULT MULTIFUNCTION RELAY

USER MANUAL

P522D831 **July 2019**

INDEX

Note: This User Manual refers to firmware version **01.07** of the protection relay.

1 INFORMATION AND PRECAUTIONS

This document describes technical characteristics of the protection relay IFX4L and it explains in detailed mode its functions, the mounting instructions, settings of operating parameters and commissioning.

The content of this document was carefully revised; however, since it is not possible to exclude the presence of inaccuracies in the description, no liability is accepted for any errors or omissions.

If the user of the document detects an error, he is invited to report it to SEB, who will make appropriate corrections.

Before performing any operation on the protection relay IFX4L, please read this user manual carefully.

The IFX4L protection relay must be used by specially trained personnel.

For proper operation of the protection relay IFX4L, you must follow these guidelines:

- The protection relay IFX4L is intended for use by qualified personnel with knowledge of physical phenomena and risks related to electricity. Training and instruction of personnel assigned to use the protection relay is the responsibility of the company that buys the product.
- The protection relay should be used only when it appears in good condition, i.e. there are no signs of damage. Its use must be made in accordance with security rules of the specific workplace and application.
- Safety conditions and criteria are guaranteed in the conditions of use described in this manual. Improper use of the protection relay or the included accessories may cause injury to person, damage to the device or to the equipments connected to it.
- The manufacturer is not responsible for any damage caused by improper use of the protection relay. The user assumes all responsibility and risks.
- This user manual must always be available where the protection relay IFX4L is used.
- Before using the protection relay IFX4L, the personnel in charge is required to read this user manual. This also applies to all personnel who occasionally work with the protection relay IFX4L.
- Any modification to the case, or to any part of the equipment, could compromise its correct functioning.
- Do not use the protection relay IFX4L in extremely humid environments and/or if there is risk of condensation inside the device. To avoid the risk of electric shock, do not plunge the equipment or the supplied accessories in water or other liquids.
- Do not use the protection relay IFX4L in presence of open flames.
- Do not use the protection relay IFX4L in environments where there are flammable gases or vapors.
- Avoid moving the equipment when it is in use, to avoid accidental disconnection of wires that may create a dangerous situation for the user.
- For your safety, avoid using non-compliant wires, damaged or worn.
- Before powering up the device, make sure that the protective earth is properly connected.

- The earth connection must be made using the special bolt on the back side of the metal casing. Failure to connect the protective earth could cause a safety risk.
- To avoid damage to the protection relay IFX4L, do not apply voltages or currents exceeding the maximum allowable values.

2 GENERAL CHARACTERISTICS

The IFX4L protection relay mainly performs the functions of phase overcurrent and earth fault overcurrent relay.

The following table indicates the different cases in which the IFX4L protection relay can be used:

Functions	ANSI Code	Measured currents
Two-phase overcurrent	50 51	IA, IB
Three-phase overcurrent	50 51	IA, IB, IC
Two-phase overcurrent + earth fault	50 51 50N 51N	IA, IB, Io
Three-phase overcurrent + earth fault	50 51 50N 51N	IA, IB, IC, Io
Earth fault (non directional)	50N 51N	Io
Stator earth fault (95%)	64S	Io
Transformer case earth fault	64T	Io

The IFX4L protection relay is compliant with Italian document Norm CEI 0-16 (2019-04), Addendum C, in reference to *general protections* relay, and it is equipped with internal data recording (aka *Logger*).

To increase the versatility of use of the protection relay, there are also some additional features that can be used for special needs:

- 2^{nd} harmonic restraint
- Cold Load Pickup
- Breaker Failure
- Remote trip
- Circuit breaker monitoring
- Digital inputs signals filtering (or delay)
- Operating mode for output relays (latch, drop-out delay)
- Direct command of output relays (by digital inputs or with special commands via RS-485 serial interface)

These features will be explained in detail in chapter 3.

All the programmable parameters and the information acquired by the protection relay can be viewed using the front panel display and can be transmitted using the RS-485 serial interface located on the back of the equipment.

THRESHOLDS – the protection relay IFX4L manages the following independent thresholds:

- 3 phase overcurrent thresholds I> , I>> , I>>>
- 3 residual overcurrent (or earth fault) thresholds Io>, Io>>, Io>>>

The available settings for each threshold are listed in Table A.

TRIP DELAYS – a programmable trip delay (TI) is available for each phase overcurrent and residual overcurrent threshold; it can be programmed as definite time or dependent time[1] in compliance with IEC 60255-151 standard.

For each threshold programmed as definite time delay, an additional time delay (TADD) is available; the additional time delay is added to time delay TI. The TADD delay is enabled by the status of digital inputs specifically programmed for this purpose and allows the use of the protection relay in systems with logical selectivity.

Trip delays settings are listed in Table A.

Trip delays related to other functions of the protection relay IFX4L are only definite time.

OUTPUT RELAYS – the protection relay IFX4L has 3 output relays (named RL1, RL2 and RL3); these relays can be programmed to be activated on START or TRIP conditions of the protection thresholds or additional features of the equipment.

START	instantaneous activation of the output relay when at least one of the measured currents exceeds the programmed threshold value.
TRIP	activation of the output relay when the programmed time delay (TI or TI+TADD) related to a threshold expires.

The quiescent status of each single relay RL1, RL2 and RL3 can be programmed as normally energized or normally de-energized.

A fourth relay, RL4 (normally energized), is used by the self-diagnosis routines to signal fault conditions.

DIGITAL INPUTS – the protection relay IFX4L has 3 digital inputs, galvanically isolated from each other and with respect to the rest of the equipment, which can be used to activate the following functions (when enabled by the user):

- block thresholds, both single threshold and logical groupings of thresholds[2]
- enable additional time delay, both single threshold and logical groupings of thresholds
- acquisition of the status of the auxiliary contacts of the circuit breaker
- trip circuit supervisor[3]
- remote trip command
- output relay reset (RESET LATCH)
- event recording
- logger recording
- direct control of output relays
- pilot wire fault monitoring (only for digital input DIG2).

To control the digital inputs, use a voltage signal (not a *clean contact*); the voltage applied must be within the range of the auxiliary voltage of the specific protection relay model.

[1] The use of time-dependent delay is available only for the thresholds I> and Io>.
[2] The *lock* of a threshold inhibits the trip; the start of the threshold is not affected by this predisposition.
[3] Only for circuit-breakers fitted with a current release coil.

The physical status that activates the associated function can be configured for each digital input.

AUXILIARY POWER SUPPLY – it is possible to use a DC voltage source or an AC voltage source[4] for the power supply of the equipment.

There are 2 versions of the IFX4L protection relay, which are different for the voltage range that can be used as auxiliary power supply and for the control of digital inputs.

Model[5]	DC voltage	AC voltage
IFX4L /#L	24 ÷ 90 Vdc	24 ÷ 80 Vac
IFX4L /#H	90 ÷ 250 Vdc	80 ÷ 230 Vac

Note: The choice of version must be indicated in the order.

DISPLAY OF MEASURES - the user can select the continuous display of a measured current (both in relative units and in engineering units, related to primary values). All measurements can be viewed on the appropriate menu (chap. 7.13). All measurements can be transmitted to an external controller using the RS-485 interface.

COMMAND OF OUTPUT RELAYS BY DIGITAL INPUT – two different control modes of the output relays via digital input are available:

REMOTE TRIP — this mode uses a signal from other protection relays and/or system equipment to control the output relays, after a time delay set by the user (*T Remote Trip*, ref. C29 and C313, chap. 7.8). The command must be present at least for the time *T Remote Trip*; the function is not operational in the case of commands lasting less than *T Remote Trip*. As for the other protection functions, it is possible to configure more than one output relay for the REMOTE TRIP function (ref. C319, chap. 7.10).

DIRECT COMMAND — in this mode a digital input can control only one output relay. It is necessary to enable the output relays to allow direct control (ref. C320, chap. 7.10).

If the same function is assigned to several digital inputs, the resulting signal is their logical OR.

EVENTS RECORDING - the information of the last 10 interventions (TRIPS) of the protection functions or activation of the event recording by the equipment's digital inputs are recorded and stored in a non-volatile memory.

The information recorded includes the identifier and the setting values of the threshold, the activated relays, the trip delay, the values of measured currents, the logical status of digital inputs, the date and time when the event occurred.

[4] In the case of auxiliary power supply by an AC voltage source, its frequency must be between 47 Hz and 63 Hz.

[5] The symbol # refers to the letter used to indicate the way of mounting (flush mounting, letter F, or inside a rack, supplied by Seb, letter R)

CONTROL AND RECORDING SYSTEM - LOGGER – this feature can be activated by the user. Information related to the last 200 *significant events* is recorded and stored in a non-volatile memory.

S*ignificant events* are:

- power on the protection relay[6]
- power off the protection relay[7]
- start (pickup) of a threshold
- trip (operation) of a threshold
- direct command of an output relay
- block and unblock of a threshold (from digital input or from internal logical signal)
- modification of the main parameters of the protection functions (via keyboard or RS-485 serial interface)
- incongruence of the circuit breaker position monitoring inputs (if enabled)
- loss of continuity of the circuit breaker trip circuit (if enabled)
- activation of digital inputs (if enabled)

The information recorded includes the significant event detected and the date and time at which this occurred. If a threshold related parameter is changed, the new set value is stored. To display this last information it is necessary to connect with the protection relay using the dedicated configuration program.

SELF-DIAGNOSIS - The firmware of the protection relay includes a diagnostic module that continuously checks the proper operation of all the functional components of the protection relay.

If an abnormal condition is detected, even temporary, this is signaled in various ways, such as:

- diagnostic message on the display
- activation of red LED *FAIL* on front panel
- RL4 relay drop-off for alarm signaling

The fault signaling remains active as long as the anomaly condition persists and is deactivated upon fault termination.

Fault conditions are divided into two categories:

- Minor fault, which does not affect the protection relay activities, signaled by the intermittent flashing of the LED *FAIL* and a proper message on the display.
- Serious fault, in which the protection functions (activation of the output relays) are suspended in order to avoid unsuitable trips, signaled by the continuous lighting of the LED *FAIL*, a proper message on the display and RL4 relay drop-off.

EVENT RECORDING BY DIGITAL INPUT – when the Event Recording function is activated by one of the digital input (when programmed) the protection relay stores a set of

[6] This event is always recorded, even if the logger has been disabled
[7] This event is always recorded, even if the logger has been disabled

information in a similar way to what happens to the EVENTS for the tripping of a protection threshold (see chap. 7.14).

The recorded information allows an analysis of trip causes in co-operative protection relays systems.

PILOT WIRE FAULT MONITORING - this function uses the digital input DIG2 to monitor the integrity of the pilot wire and it is enabled by programming the DIG2 input as *PILOT WIRE MONITORING* (see chap. 7.9).

The function checks that the physical status of DIG2 input is always complementary to what is acquired by the DIG1 input, signaling the presence of not complementary signals (for pilot wire interruption, etc.).

The non-complementarity of signals on DIG1 and DIG2 inputs for a time greater than 100 ms is a fault condition.

The PILOT WIRE MONITORING anomaly is a “minor fault”.

CIRCUIT BREAKER POSITION MONITORING FUNCTION - if enabled, the function uses two digital inputs to monitor the auxiliary contacts of the circuit breaker that indicate its position; the function checks that the digital inputs configured for this functionality always have complementary signals.

If not complementary signals are detected for a time greater than *T CB Mon Pos* (programmable), the circuit breaker position is considered incongruent and “Circuit Breaker Incongruent” information is recorded in the logger.

TRIP CIRCUIT SUPERVISOR - if enabled, the function uses a digital input to monitor the continuity of the trip circuit.

This function can be used if the circuit breaker controlled by the protection relay is equipped with a shunt trip coil, and is able to detect the following conditions:

- loss of continuity of the trip coil circuit (interruption of the coil)
- loss of supply voltage in trip coil circuit

If one of the previous conditions is detected, a "Trip TCS" information is recorded in the logger.

CIRCUIT BREAKER FAULT FUNCTION – the combination (OR) of the Circuit Breaker Position Monitoring and Trip Circuit Supervisor signals can be used to control an output relay associated with the Circuit Breaker Fault function. The function is automatically enabled when one or more of the above indicated functions is enabled.

LOGGER RECORDING FUNCTION – setting one or more digital inputs to this function, there is a recording in the logger when there is a transition from the LOW logical status to the HIGH logical status of one of the digital inputs programmed for this function.

This function can be used to allow recording in the logger of signals from other protection relays and/or plant equipment.

LOCAL USER INTERFACE - the IFX4L protection relay has a local user interface, consisting of an alphanumeric display with 2 lines of 16 characters each (16x2), backlit, a keyboard and 8 signaling LEDs; all these elements are placed in the front side of the protection relay.

It is possible to perform the full setup of the protection relay using only the local user interface. In the next chapters of the document there are detailed instructions on how to operate in this regard (see chap. 4, 6 and 7).

The user interface is multilingual; at the date of writing of this document it is possible to select the language of the user interface between English and Italian.

REMOTE COMMUNICATION - the IFX4L protection relay has an RS-485 serial interface, galvanically isolated, located on the rear side of the device; this interface can be connected to a personal computer or to a remote control system equipped with the same interface or through RS-232/RS-485 or USB/RS-485 converters usually available on the market.

Using the RS-485 serial interface it is possible to setup all the functions of the protection relay or to read the information (measurements or status) or parameters (thresholds configuration data, etc.) stored in it.

Using the RS-485 serial interface it is also possible to perform a number of activities such as: resetting the events, resetting the partial counters, releasing the relays for which the LATCH function has been activated, individually controlling the output relays, etc.

The communication protocol used for data exchange is MODBUS® RTU, in which the IFX4L protection relay operates as SLAVE.

The following communication parameters can be programmed:

- device address
- baud rate (from 1200 baud to 57600 baud)
- parity (none, even, odd)
- number of stop bits (1 or 2)

When a communication session is in progress, this is shown by the display with a proper message. In this condition, all the parameters can be viewed using the local user interface, but the modification is not allowed (the ENTER key is disabled, see chap. 4).

If the IFX4L protection relay has to be integrated into a control or supervision system, it is possible to request to SEB a document with detailed information about the communication protocol and the data exchanged using the RS-485 serial interface.

DATE AND TIME – the IFX4L protection relay has a clock-calendar inside, equipped with a large capacitor, which ensures the regular operation of the clock for 48 hours even in the absence of auxiliary voltage.

Note: the protection relay must be powered continuously for at least 8 hours to fully charge the capacitor associated with the clock-calendar. Otherwise, in the absence of auxiliary voltage, the autonomy of the clock-calendar will be lower than the value indicated above.

If the absence of the auxiliary voltage causes the complete discharge of the capacitor associated with the clock-calendar, the correct time references are lost. This condition is reported as a "minor fault" by the self-diagnostic function.

The update of the date and time via local user interface or via RS-485 serial interface causes the reset of this fault condition.

TRIP COUNTERS - partial and total trip counters are available for each protection threshold and function.

DATA STORAGE – the configuration data of the protection relay, those relating to the event recording and the data logger, etc., are stored in a non-volatile memory (EEPROM), to keep the information even in the absence of auxiliary voltage.

FIRMWARE UPDATE – if necessary, the IFX4L protection relay can update the application firmware of the equipment directly in the field, via the RS-485 serial interface.

The instructions for updating the application firmware will be contained in a specific document that will be supplied with the software required to perform this activity.

During the application firmware update, the protection relay is not able to perform its protection functions.

It is responsibility of the user of the protection relay to put the plant in safety conditions before starting the firmware update procedure and until the relay has resumed its normal operation.

3 FEATURES

This chapter describes in detail the various features of the IFX4L protection relay.

Availability of the protection functions and auxiliary features is related to the INSERTION selected by the user (ref. B0 – chap. 7.4).

Unless otherwise indicated, the protection functions use the RMS value of the fundamental frequency.

3.1 Phase overcurrent thresholds

The IFX4L protection relay has 3 phase overcurrent thresholds (ANSI 50 - 51), which can operate in bipolar or three-polar mode, depending on the insertion selected by the user. If *Bipolar* (or *Bipolar + Io*) insertion is selected, these thresholds use only the IA and IB measurements (see chap. 8.3).

The 3 phase overcurrent thresholds are named:

- I> first phase overcurrent threshold
- I>> second phase overcurrent threshold
- I>>> third phase overcurrent threshold

Each threshold can be configured independently.

3.2 Residual overcurrent (or earth fault) thresholds

The IFX4L protection relay has 3 residual overcurrent (or earth fault) thresholds. According to the type of insertion selected by the user, they can assume a different ANSI code: 50N - 51N, or 64S, or 64T.

The 3 residual overcurrent (or earth fault) thresholds are named:

- Io> first residual overcurrent (or earth fault) threshold
- Io>> second residual overcurrent (or earth fault) threshold
- Io>>> third residual overcurrent (or earth fault) threshold

Each threshold can be configured independently.

3.3 2nd harmonic restraint

This function uses the phase currents measurement.

The function is active only if enabled by the user and if the amplitude of the phase currents is greater than the value of the *base current* (*IB*, programmable).

For each phase current the ratio between the amplitude of the 2nd harmonic component and that of the fundamental is evaluated; if this value exceeds the threshold value (programmable) even for a single phase, an internal logical signal is activated. The logical signal can be associated with an output relay and/or used to block overcurrent and earth fault thresholds.

For each overcurrent and earth fault threshold there is a configuration parameter that enables the block of the threshold if the 2nd harmonic restraint threshold is exceeded[8].

[8] The block of a threshold is relative to the emission of the trip command; the start signal is not blocked.

The block of the thresholds is active until the ratio between the amplitude of the 2nd harmonic component and that of the fundamental is greater than the threshold value, and can be extended for a further time (programmable) after the fallout of this signal.

This function can be used to avoid unsuitable trips of phase overcurrent and earth fault thresholds caused by the high magnetizing currents due to the transient energization of the transformers (inrush current), which, as is known, have a significant 2nd harmonic component.

The possibility of associating the logical signal of exceeding the 2nd harmonic restraint threshold to an output relay is useful for sending this information to other protection relays in the system that do not have this function.

3.4 Breaker Failure

This function uses the phase currents measurement.

If enabled, this function verifies that after a trip command by other thresholds, the phase currents fall below a threshold value (programmable) within a certain time (*T Breaker Failure*, also programmable), therefore the circuit breaker opened correctly.

If this does not occur, an internal logical signal which can be associated with an output relay for opening another circuit breaker (upstream of the fault) is activated.

3.5 Cold Load Pickup

The purpose of the function is to detect the switching of the circuit breaker from open to closed and modify, for a certain time interval (*T Cold Load Pickup*, programmable), the behavior of phase overcurrent and earth fault thresholds in order to avoid unsuitable trips.

The switching of the circuit breaker from open to closed can be detected in the following ways:

- by exceeding a dedicated phase overcurrent threshold (with a fixed trip value of 0.05 In)[9]
- using the digital inputs of the protection relay, programmed to acquire the status of the auxiliary contacts of the circuit breaker (*52a* and/or *52b*) (see chap. 7.9)
- using the logical OR of the two previous conditions

For each phase overcurrent and earth fault overcurrent threshold there is a configuration parameter that indicates how the relative threshold must behave in the case of cold load pickup. Available choices are:

- no change to the behavior
- block of the threshold[10]
- modification of the threshold value (according to a multiplicative coefficient *K*, programmable)

This function can be used if the circuit breaker closes in order to power loads with high inrush current, which could cause the intervention of protection thresholds although there are no fault conditions, and for which the method of the 2nd harmonic restraint cannot be used.

[9] This mode can be used only if the insertion make use of the phase currents measurement.
[10] The block of a threshold is relative to the emission of the trip command; the start signal is not blocked.

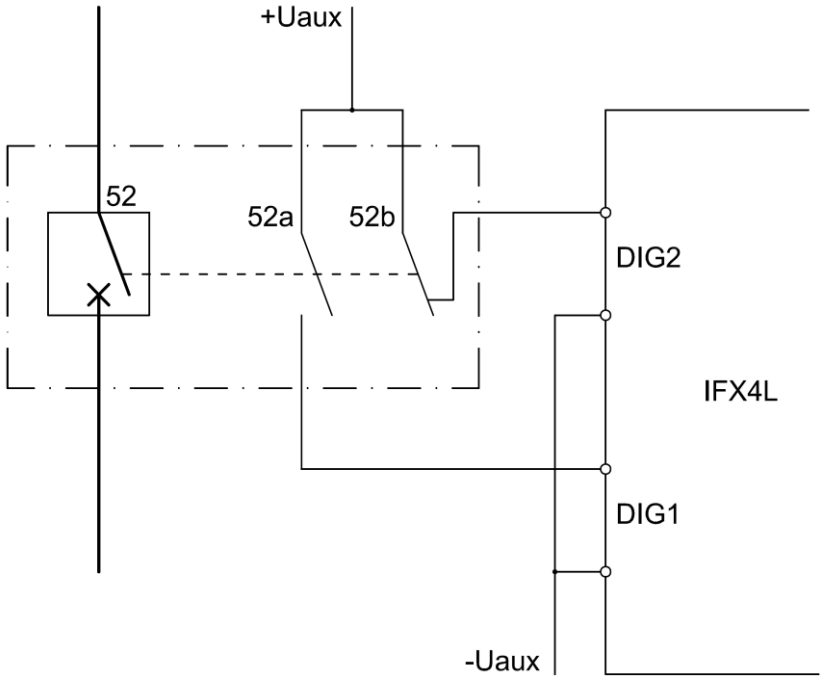
3.6 Circuit breaker position monitoring

The function uses two digital inputs to monitor the auxiliary contacts of the circuit breaker that indicate its position.

To use this function, in addition to enabling it, you have to program two digital inputs with function *52a* and *52b* respectively (see chap. 7.9).

The auxiliary contacts of the circuit breaker must be connected to these digital inputs: the status of the contact identified as *52a* corresponds to the position of the circuit breaker (52a open = circuit breaker open), while the status of the contact identified as *52b* corresponds to the opposite of the position of the circuit breaker (52b open = circuit breaker closed).

The following schematic diagram shows the connections in the hypothesis of using the DIG1 and DIG2 digital inputs for the circuit breaker position monitoring function.



With reference to the previous example diagram, for the correct operation of the circuit breaker position monitoring function, the digital inputs must be programmed as follows:

Digital input	Active status	Function
DIG1	HIGH	52a
DIG2	HIGH	52b

With reference to the example diagram above, according to the status of the digital inputs programmed as *52a* and *52b*, you can have the following combinations:

Logical status *52a*	Logical status *52b*	Circuit breaker position
HIGH	LOW	CLOSED
HIGH	HIGH	INCONGRUENT
LOW	HIGH	OPEN
LOW	LOW	INCONGRUENT

If a concordant signal is detected for a time greater than *T CB Pos Monit* (programmable), the circuit breaker position is diagnosed as *incongruent* and “Circuit Breaker Incongruent” information is recorded in the logger.

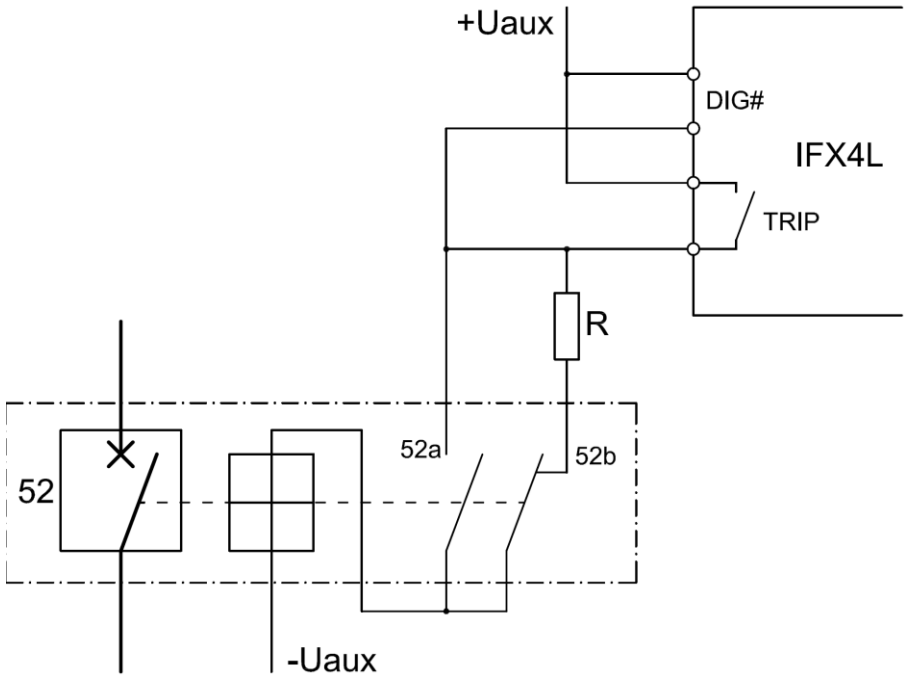
The circuit breaker position can be viewed on the display of the protection relay (see chap. 7.13).

The condition of *incongruent circuit breaker* activates the logical signal of "Circuit Breaker Fault".

3.7 Trip Circuit Supervisor - TCS

This function is used to monitor the continuity of the tripping circuit if the IFX4L protection relay controls a circuit breaker fitted with a shunt trip coil.

To use the TCS function, refer to the schematic diagram shown in the following figure. The digital input used for monitoring the continuity of the tripping circuit is connected in parallel to the contacts of the relay used for opening of the circuit breaker and an auxiliary contact of the circuit breaker (52b) is connected in series to a resistor.



In the example, the digital input used for the TCS function must be programmed with active status LOW.

The signaling of the intervention of the TCS function is issued after a time delay (*T Trip Circ Sup*, programmable) from when the anomaly condition is detected[11] on the circuit

[11] The anomaly condition corresponds to the deactivation of the digital input, i.e. the physical status LOW.

breaker tripping circuit, while the reset occurs after half of the aforementioned delay from when the condition of normality is detected.

To calculate the value of the resistor R, both the following conditions must be satisfied:

- the circuit breaker opening coil must not be energized when the circuit breaker is open
- the digital input must be in the physical status HIGH when the contacts of the relay that control the circuit breaker (named TRIP in the example diagram) are open.

With the circuit breaker open, to prevent the coil from being energized, the value of the resistor R must be greater than a minimum value expressed by the equation:

$$R\min = Rb * \frac{(Uaux - Ub\min)}{Ub\min}$$

where:

Ubmin	minimum excitation voltage of the opening coil
Uaux	auxiliary supply voltage for the control circuit
Rb	opening coil resistance

For the calculation of R to satisfy the digital input activation condition, the condition of open TRIP relay contacts and open circuit breaker must be considered. To be sure that the digital input is in HIGH status, the value of the resistor R must be lower than a maximum value expressed by the equation:

$$R\max = \left(\frac{Uaux - Udig}{Idig} \right) - Rb$$

where:

Udig	minimum voltage for the acquisition of the HIGH status by the digital input (15 V for the model /#L, 50 V for the model /#H)
Uaux	auxiliary supply voltage for the control circuit
Rb	opening coil resistance
Idig	operating current of the digital input (0.003 A)

The value of R that satisfies the previous conditions must be between *Rmin* and *Rmax* calculated according to the equations reported above; for simplicity we can consider the average value.

$$R = \frac{R\min + R\max}{2}$$

The maximum power dissipated by the resistor R is expressed by the following equation:

$$P = R * I^2 = R * \left(\frac{Uaux}{R + Rb} \right)^2$$

Example of calculation (assuming the use of the model IFX4L /#H):

Uaux = 110 Vcc (auxiliary voltage of the relay and of the control circuit)

Pb = 50 W (power of the opening coil)

Rb = $Uaux^2$ / Pb = 242 Ω (opening coil resistance)

Ubmin = 77 V (minimum excitation voltage of the opening coil = 70% Uaux)

Udig = 50 V (minimum activation voltage of the digital input)

Idig = 0.003 A (operating current of the digital input)

$$R\min = Rb * \frac{(Uaux - Ub\min)}{Ub\min} = 242 * \frac{(110-77)}{77} = 103.7\,\Omega$$

$$R\max = \left(\frac{Uaux - Udig}{Idig}\right) - Rb = \left(\frac{110-50}{0.003}\right) - 242 = 19758\,\Omega$$

$$R = \frac{R\min + R\max}{2} = \frac{103.7 + 19758}{2} = 9931\,\Omega\ (rounded\,10000\,\Omega)$$

$$P = R * I^2 = R * \left(\frac{Uaux}{R + Rb}\right)^2 = 10000 * \left(\frac{110}{10000 + 242}\right)^2 = 1.15\,\mathrm{W}$$

The tripping of the TCS function activates the logical signal of "Circuit Breaker Fault".

3.8 Digital Inputs

The IFX4L protection relay has 3 digital inputs, galvanically isolated from each other and with respect to the other circuits of the equipment.

Two variables are associated with each digital input, one that indicates its *physical status* and one that indicates its *logical status*.

For each digital input the physical status (HIGH or LOW) which activates the function assigned to the input can be selected.

The complete list of the various functions that can be assigned to the digital inputs is shown in chapter 7.9.

When a digital input is in the physical status that corresponds to the physical status programmed for the activation of the associated function, the variable indicating its logical status has a TRUE value[12], or HIGH; otherwise, this variable has the value FALSE, or LOW.

For the correct operation of digital inputs, they must be controlled by an external voltage, either DC or AC, in the range required for the auxiliary voltage of the specific protection model.

The following table defines the voltage values of the physical status:

[12] Intended as a binary value, which contrasts with the FALSE or LOW value.

Physical status	IFX4L /#L	IFX4L /#H
LOW	0 ÷ 10 V	0 ÷ 30 V
HIGH	> 15 V	> 50 V

For each digital input two separate timers are available (T FILTER 01 and T FILTER 10, programmable), that can be used as a filter (or delay) respectively for the transition from logical status 0 (FALSE) to 1 (TRUE) (i.e. *delayed activation*) and for the transition from logical status 1 to 0 (i.e. *delayed deactivation*) of the function associated with the digital input (ref. C314, C315 – chap. 7.9).

With no filtering (values of T FILTER = 0) the status of the digital input is acquired when it remains HIGH or LOW for at least 30 ms.

Both the physical status and the logical status of each of the digital inputs can be viewed on the display of the protection relay (ref. D27 - chap. 7.13).

In the event recording, the logical status of digital inputs when the recording took place is stored (ref. E27, E28, E29 - chap. 7.14).

3.9 Output relays

The IFX4L protection relay has 3 output relays (named RL1, RL2 and RL3), programmable according to the specific needs of the user.

The output relays can be programmed to be activated by START or by TRIP of one or more thresholds or by activating logical signals inside the protection relay.

The activation of multiple conditions on the same relay works with an OR logic.

For each of the output relays RL1, RL2 and RL3 it is possible to program the operating mode, so that they operate as normally de-energized or normally energized.

For each of the output relays RL1, RL2 and RL3 the *minimum activation time* of the relay can be programmed, regardless of the time duration of the signal that activated it. This functionality is useful for having a command of sufficient duration to the circuit breakers control circuits, therefore it is advisable to program this function for the relays activated by the TRIP of the thresholds.

For each of the output relays RL1, RL2 and RL3 the *drop-out delay* of the relay can be programmed, which allows the relay to be maintained in the activation condition for a certain time (programmable) after the reset of the cause that activated the relay.

For each of the output relays RL1, RL2 and RL3 the relay *LATCH* function can be activated.

The activation of an output relay with *LATCH* function enabled keeps the relay in the activation condition until a *RESET LATCH* command is given by the front panel (by pressing the RESET key), or by digital input or by special message sent via the RS-485 interface.

The *LATCH* function has priority over the minimum activation time and the drop-out delay functions.

To facilitate the commissioning operations, or for diagnostic purposes, it is possible to manually force the switching of the output relays RL1, RL2 and RL3 (TEST RELAY, chap. 6.4).

4 FRONT PANEL KEYS FUNCTION

The function of the keys on the front panel of protection relay is different depending on whether you are in *data display mode* or in *data modification mode*.

The function relating to the data display mode is indicated in the top line of the following table, while the one relating to data modification mode is indicated in the bottom line.

	Move to the previous item in the current menu. If the first item of the current menu is reached, it has no effect.
	Increase by one unit the digit highlighted by the cursor (in case of numeric variable) or select the previous element in the list of possible choices (enumerative variable).
	Move to the next item in the current menu. If the last item in the current menu is reached, it has no effect.
	Decrease by one unit the digit highlighted by the cursor (in case of numeric variable) or select the next element in the list of possible choices (enumerative variable).
	Go to the lower menu level than the current one. If the last menu level is reached, it has no effect.
	Move the cursor to the rightmost digit of the currently selected one (in case of a numeric variable) If you are already on the rightmost digit, it has no effect
	Go to the upper menu level than the current one. If the first level of the menu is reached (main menu), it has no effect
	Move the cursor to the leftmost digit of the currently selected one (in case of a numeric variable). If you are already on the leftmost digit, it has no effect.
	It has no effect.
	Move to the next editable variable in the current screen (in circular mode). If there is only one editable variable, it has no effect.
	Display the default screen.
	Discard the data editing session on the current screen, restoring data previously present.
	If there are modifiable data in the current screen, it starts an editing session, otherwise it has no effect.
	The data modification session in the current screen ends, confirming the new values set.

RESET	Display the default screen, turn off the stored LED signals and put the relays on which the LATCH function was active in the quiescent status.
	In addition to performing all the operations listed in the case of data visualization, abort any parameter modification session in progress and not yet confirmed.

Pressing any key, even though it may not have an impact on the display, turns on the display backlight and restarts the backlight on timer.

The display backlight turns off after 5 minutes since the last keystroke.

PARAMETER DISPLAY

- the various screens that allow the display of the parameters are arranged in a hierarchical order, on various levels; the use of the four arrow keys allows access to ALL the possible screens.
- the content and structure of the screens is shown in figures from 1 to 7.
- the structure of the parameters display screens depends on the active and/or available functions; to simplify the configuration of the equipment, the display of screens whose content is not relevant in the operating context of the protection relay is inhibited.

MODIFICATION OF PARAMETERS

- to modify the configuration parameters of the protection relay, it is necessary to move to the screens in which there are the data to be modified and then make the changes using the keys ENTER, the four arrow keys and also TAB if there are several parameters that can be modified on the same screen.

5 FRONT PANEL LED SIGNALINGS

On the front panel of the IFX4L protection relay there are 8 signaling LEDs, with the following functions:

POWER (green)	⊕	auxiliary supply available
FAIL (red)	⊕	fault condition detected by SELF-DIAGNOSIS module or by PILOT WIRE FAULT MONITORING function
START (yellow)	⊕	aggregate signaling of *START* condition of thresholds
TRIP (red)	⊕	aggregate signaling of TRIP condition of thresholds (stored)
I> (red)	⊕	trip condition of I> threshold (stored)
I>> I>>> (red)	⊕	trip condition of I>> and I>>> thresholds (stored)
Io (red)	⊕	trip condition of Io>, Io>>, Io>>> thresholds (stored)
EXT (red)	⊕	intervention of the *Remote Trip* function (stored)

The trip of a threshold, in addition to the activation of the LEDs as indicated above, also causes the display backlight to turn on, as with a keystroke, and to display a suitable screen that shows the identifier of the threshold and the time reference of the trip.

More detailed information about trip condition of thresholds and/or functions is stored in the EVENTS (chap. 7.14).

6 PROGRAMMING AND TEST

The IFX4L protection relay is easily programmable following the instructions in the next paragraphs:

- HOW TO PROGRAM THE PROTECTION RELAY
- HOW TO MODIFY A VISUALIZED PARAMETER

The user is responsible for the consistency and correctness of the configuration parameters set on the protection relay.

SEB is not responsible for incorrect programming of the protection relay.

6.1 How to program the protection relay

The parameters can be programmed in the following references of the figures from 1 to 7:

A12 – A13	date and time settings
B0	insertion of the protection relay
C20 ÷ C22	rated values of phase CT and earth CT and frequency
C23 ÷ C25	enabling and threshold values of the protection functions
C30 ÷ C37	other parameters related to the protection functions
C26 – C38	circuit breaker position monitoring function
C27 – C39	trip circuit supervision
C28 – C310 ÷ C312	cold load pickup
C29 – C313	remote trip function
C210	logger
C211 - C314 – C315	digital inputs
C212 - C316 ÷ C320 C410 - C411	output relays
C321 ÷ C324	Modbus protocol configuration data
C325 ÷ C327	user interface
G11 ÷ G15	various actions (default data, counter reset, etc.)

The programming sequence is the following:

1) **SELECT** with the arrow keys the screen where the parameter to be modified is located.

2) **ACTIVATE** the PARAMETER MODIFICATION session pressing the **[ENTER]** key and modify the parameter(s).

3) **END** the parameter editing session by pressing **[ENTER]** key again.

4) **REPEAT** the same procedure as in points 1, 2, 3 for all the screens where the parameters you want to modify are located, to obtain the new protection relay set-up.

5) **CONFIRM** the new protection relay set-up in the screen "STORE NEW DATA?" (ref. C17 - fig. 3) within 5 minutes, by pressing the **[ENTER]** key, and ⇧ or ⇩ until you see **YES** and again **[ENTER]** to confirm.

Note: The protection relay continues to operate using the previous set-up until the new set-up is confirmed as at point 5) above; the visualization of the modified parameters before the new set-up confirmation is only temporary to allow an easy definition of the new protection relay set-up.

If the new set-up is not confirmed within 5 minutes from the last keystroke, the changes made are lost, and the protection relay displays again the previous set-up (the parameters set-up that the protection relay is still using).

6.2 How to modify a parameter

When the parameter to be modified is visualized on front panel display do the following sequence:

1) **PRESS [ENTER]** to activate the parameter modification session

If one or more parameters in the screen is editable, a blinking cursor is displayed on the first of these.

If none of the parameters can be changed, no cursor will be displayed when the **[ENTER]** key is pressed.

2) **MODIFY THE PARAMETER** using the four arrow keys and the key TAB, according to the following indications:

⇧ Increase by one unit the digit highlighted by the cursor (in case of numeric variable) or select the previous element in the list of possible choices (enumerative variable).

⇩ Decrease by one unit the digit highlighted by the cursor (in case of numeric variable) or select the next element in the list of possible choices (enumerative variable).

⇨ Move the cursor to the rightmost digit of the currently selected one (in case of a numeric variable).
If you are already on the rightmost digit, it has no effect

⇦ Move the cursor to the leftmost digit of the currently selected one (in case of a numeric variable).
If you are already on the leftmost digit, it has no effect (to select the possible sign, use the key TAB).

TAB Move to the next editable variable in the current screen, in circular mode (the selected parameter is highlighted by a blinking cursor).

Note: the possible presence of the sign (+ or -) preceding a numerical value is considered as a separate variable with respect to the numerical value itself.

3) **PUSH [ENTER]** key to end the editing session.

This ends the session to change the parameters of the current screen and the blinking cursor turns off.

Note: if a numerical value is set outside the limits indicated in Table A, when the **[ENTER]** key is pressed the following message is displayed for a few seconds:

```
ERROR IN DATA
```

and the wrong parameter is shown again with the value it had before the change; the blinking cursor is positioned on the wrong parameter.

6.3 Reset

When the **[RESET]** key is pressed, the protection relays returns to the standard condition:

- all LED signals are switched off (stored or not)
- the output relays go into the quiescent status (even those for which the LATCH function was activated)
- any programming session in progress but not yet confirmed is aborted (the protection relay shows the parameters with which it is operating)
- the display shows the basic (or default) screen (ref. A0 - chap. 7.1).

6.4 Test of output relays

For functional checks on the electrical plant, it is possible to test the output relays (one at a time) using the appropriate screens (fig. 7, ref. G20, G21 e G22).

"Test" means the switching of the relays with respect to their current status.

The sequence of operations is as follows:

1) **SELECT THE SCREEN** of the output relay to be tested.

```
TEST RELAY RL1
NO
```

2) **PRESS [ENTER]** key to activate the test session; the message NO will start to blink.

3) **PRESS** ⇧ or ⇩; the message on the display will change as:

```
TEST RELAY RL1
YES
```

4) **PRESS [ENTER]** key to change the status of the output relay; the relay status change is immediate.

The relay will stay in test condition until:

- you leave the current screen
- the **[ENTER]** key is pressed and the sequence at points 3 and 4 is repeated (setting NO)

- 5 minutes elapse without any key being pressed.

The same procedure is used for RL2 and RL3 relays.

7 DISPLAY AND PROGRAMMING

The contents and the structure of the displayed screens are shown in figures from 1 to 7; the references A0, B0, C0, etc. identify specific displayed screen in the figures.

The data display is organized in a hierarchical order, through a main menu and various submenus.

This rule is used in the screen naming:

- each item of the main menu is identified with a letter, in progressive order, followed by the number 0
- each item of a first level submenu is identified with the letter of the main menu to which it belongs, followed by the number 1 and then a progressive number, starting from 0
- each item of a second level submenu is identified with the letter of the main menu to which it belongs, followed by the number 2 and then a progressive number, starting from 0

and so on.

The data is displayed using an alphanumeric display with 2 lines of 16 characters each, backlit, located on the front of the protection relay.

Since this manual is written in English, screens in English are used; the structure of the screens remains the same for other languages (the wordings reported in the various screens will be different).

The following conventions are generally used to indicate data and parameters, which identify the type of data displayed, regardless of whether it can be modified or not (the number of characters used refers approximately to the size used by the variable on the display):

- **eeee** enumerative value (the selection is made by a list of available choices)
- **dddd** numerical value (integer)
- **xx.xx** numerical value (with decimals)
- **dd/mm/yy** date, shown as "day/month/year"
- **hh:mm:ss** time of day, shown as "hour:minutes:seconds"

Any different notations from those indicated above are clarified in the specific context in which they are used.

7.1 Default screen

A0 – DEFAULT SCREEN - (fig. 1)

It is the basic display of the protection relay when there is no operator intervention (no key pressed for at least 5 minutes) or after pressing the [RESET] key. The information is displayed according to the protection relay status.

NORMAL OPERATION

In this status the following information can be displayed according to the programming by the user (ref. C325):

Protection identifier, with date and time - the protection displays its own code, including identifiers related to the rated values of the currents, and the date and time. See the following example screen:

```
   IFX4L STxy
dd/mm/yyyy hh:mm
```

Where **x** and **y** indicate the secondary rated values of phase CTs (In) and of earth CT (Ion), respectively. They can assume the following values: 1, 5, or 0, in case the selected insertion (ref. B0) does not require the use of these measurement inputs.

Protection functions (ANSI codes) - the protection displays the ANSI codes of the protection functions that can be activated (ref. B0 - INSERTION). See the following example screen:

```
      ANSI
 50 51 50N 51N
```

Current measurements - the protection displays the instantaneous value of one of the measured currents, according to the selection made by the user.

The current is displayed in relative values and in primary Amps; if the selection of the current to be visualized refers to a current not measured (depending on INSERTION), no value is presented. See the following example screen:

```
IA 01.150 In
      345 A
```

ON TRIP CONDITION

When a trip condition occurs, the protection relay visualizes the TRIP message that includes the threshold identifier and the time reference when the trip occurred (day/month - hour:minutes:seconds), as in the examples below:

```
TRIP I>
30/09 – 08:50:30
```

```
TRIP Io>>
02/10 – 15:30:21
```

```
REMOTE TRIP
15/10 – 22:30:01
```

The information of the trip, as well as the lighting of the corresponding LEDs (see chap. 5), is displayed until the [RESET] key is pressed.

If a new trip condition occurs, the displayed information will be updated; information related to previous trips is recorded in EVENTS memory (see chap. 7.14).

FAULT CONDITION

When a permanent or temporary fault condition is detected by the self-diagnosis module, a specific message is displayed, in different formats, depending on the fault detected, such as:

```
INTERNAL FAULT
Code hhhh
```

```
FAULT
PILOT WIRE
```

Depending on the type of anomaly, the behavior of the protection relay changes and the operator must act accordingly, following the instructions below:

INTERNAL FAULT: internal protection relay fault (CPU, measurement acquisition, etc.); it is considered a serious anomaly, therefore, in order to avoid unsuitable tripping, the protection functions are inhibited.

Corrective action - replace the protection relay and contact SEB post sales service.

An alphanumeric code (**hhhh**) identifies the type of fault.

FAULT PILOT WIRE: fault condition on pilot wire; the function related to DIG1 digital input is disabled. Other functions stay operational.

Corrective action - verify pilot wire (short circuit or broken wire)

DATE & TIME OUT OF SYNC: anomaly related to the internal time reference of the protection relay (the protection relay was not powered for a long time and the capacitor that ensures the functioning of the internal clock has discharged).

Corrective action – set date and time.

7.2 Structure of visualizations

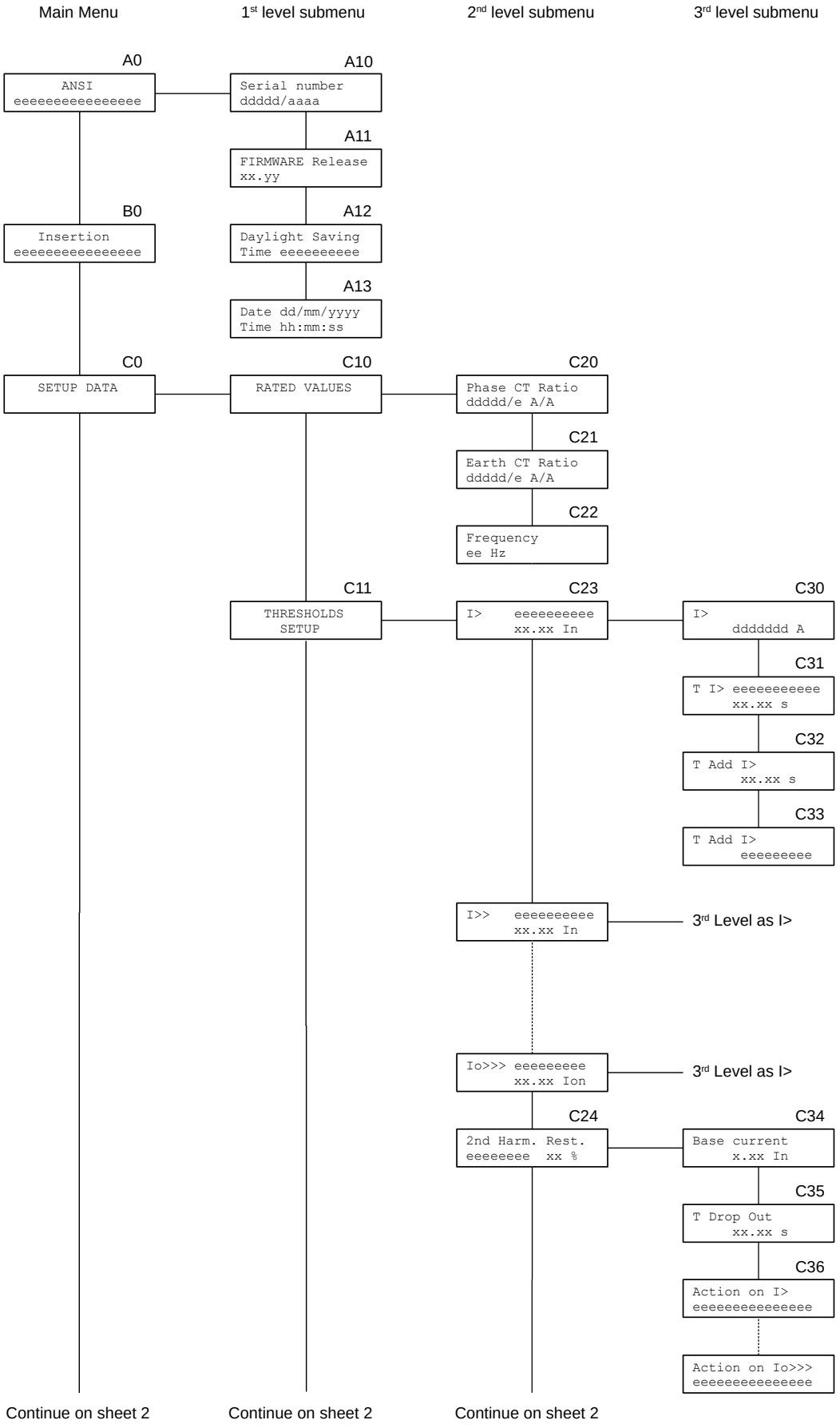


Figure 1

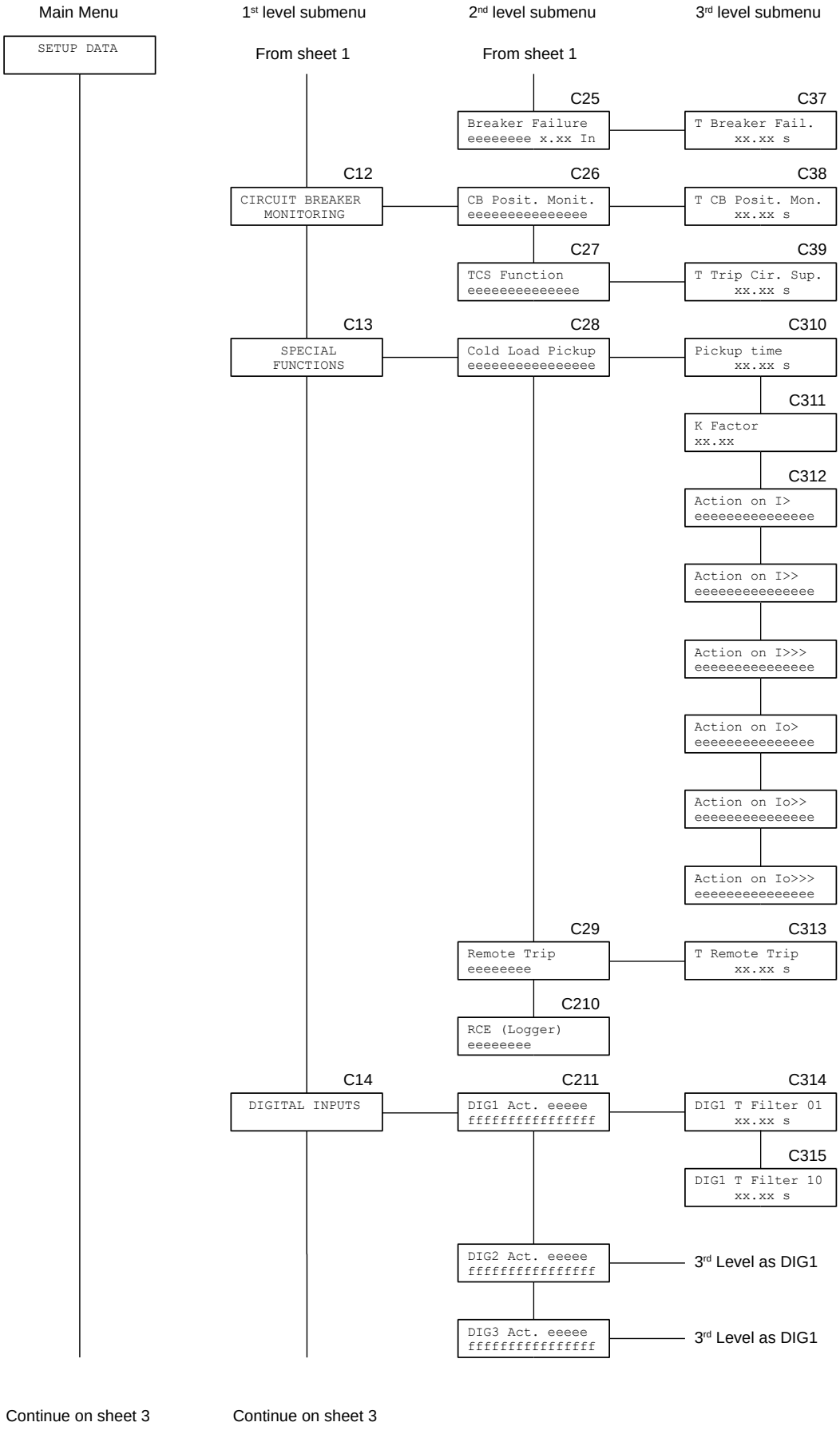

Main Menu
1st level submenu
2nd level submenu
3rd level submenu
SETUP DATA
From sheet 1
From sheet 1
C25
Breaker Failure
eeeeeeee x.xx In
C37
T Breaker Fail.
xx.xx s
C12
CIRCUIT BREAKER
MONITORING
C26
CB Posit. Monit.
eeeeeeeeeeeeeee
C38
T CB Posit. Mon.
xx.xx s
C27
TCS Function
eeeeeeeeeeeee
C39
T Trip Cir. Sup.
xx.xx s
C13
SPECIAL
FUNCTIONS
C28
Cold Load Pickup
eeeeeeeeeeeeeee
C310
Pickup time
xx.xx s
C311
K Factor
xx.xx
C312
Action on I>
eeeeeeeeeeeeee
Action on I>>
eeeeeeeeeeeeee
Action on I>>>
eeeeeeeeeeeeee
Action on Io>
eeeeeeeeeeeeee
Action on Io>>
eeeeeeeeeeeeee
Action on Io>>>
eeeeeeeeeeeeee
C29
Remote Trip
eeeeeeee
C313
T Remote Trip
xx.xx s
C210
RCE (Logger)
eeeeeeee
C14
DIGITAL INPUTS
C211
DIG1 Act. eeeee
fffffffffffffff
C314
DIG1 T Filter 01
xx.xx s
C315
DIG1 T Filter 10
xx.xx s
DIG2 Act. eeeee
fffffffffffffff
3rd Level as DIG1
DIG3 Act. eeeee
fffffffffffffff
3rd Level as DIG1
Continue on sheet 3
Continue on sheet 3

Figure 2

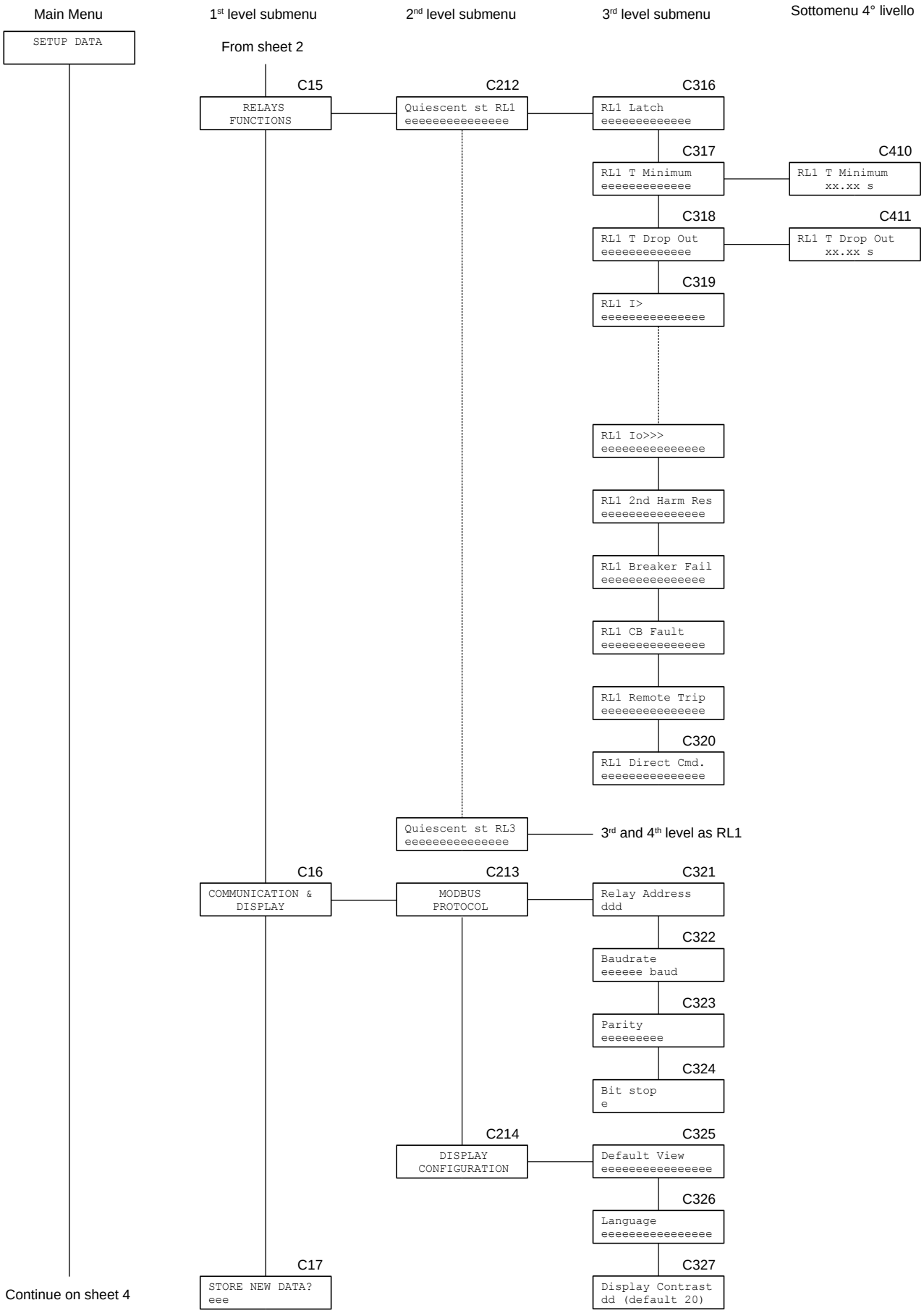

Main Menu
1st level submenu
2nd level submenu
3rd level submenu
Sottomenu 4° livello
SETUP DATA
From sheet 2
C15
RELAYS FUNCTIONS
C212
Quiescent st RL1 eeeeeeeeeeeeee
C316
RL1 Latch eeeeeeeeeeee
C317
RL1 T Minimum eeeeeeeeeeee
C410
RL1 T Minimum xx.xx s
C318
RL1 T Drop Out eeeeeeeeeeee
C411
RL1 T Drop Out xx.xx s
C319
RL1 I> eeeeeeeeeeeeee
RL1 Io>>> eeeeeeeeeeeeee
RL1 2nd Harm Res eeeeeeeeeeeeee
RL1 Breaker Fail eeeeeeeeeeeeee
RL1 CB Fault eeeeeeeeeeeeee
RL1 Remote Trip eeeeeeeeeeeeee
C320
RL1 Direct Cmd. eeeeeeeeeeeeee
Quiescent st RL3 eeeeeeeeeeeeee
3rd and 4th level as RL1
C16
COMMUNICATION & DISPLAY
C213
MODBUS PROTOCOL
C321
Relay Address ddd
C322
Baudrate eeeeee baud
C323
Parity eeeeeeeee
C324
Bit stop e
C214
DISPLAY CONFIGURATION
C325
Default View eeeeeeeeeeeeeee
C326
Language eeeeeeeeeeeeeee
C17
STORE NEW DATA? eee
C327
Display Contrast dd (default 20)
Continue on sheet 4

Figure 3

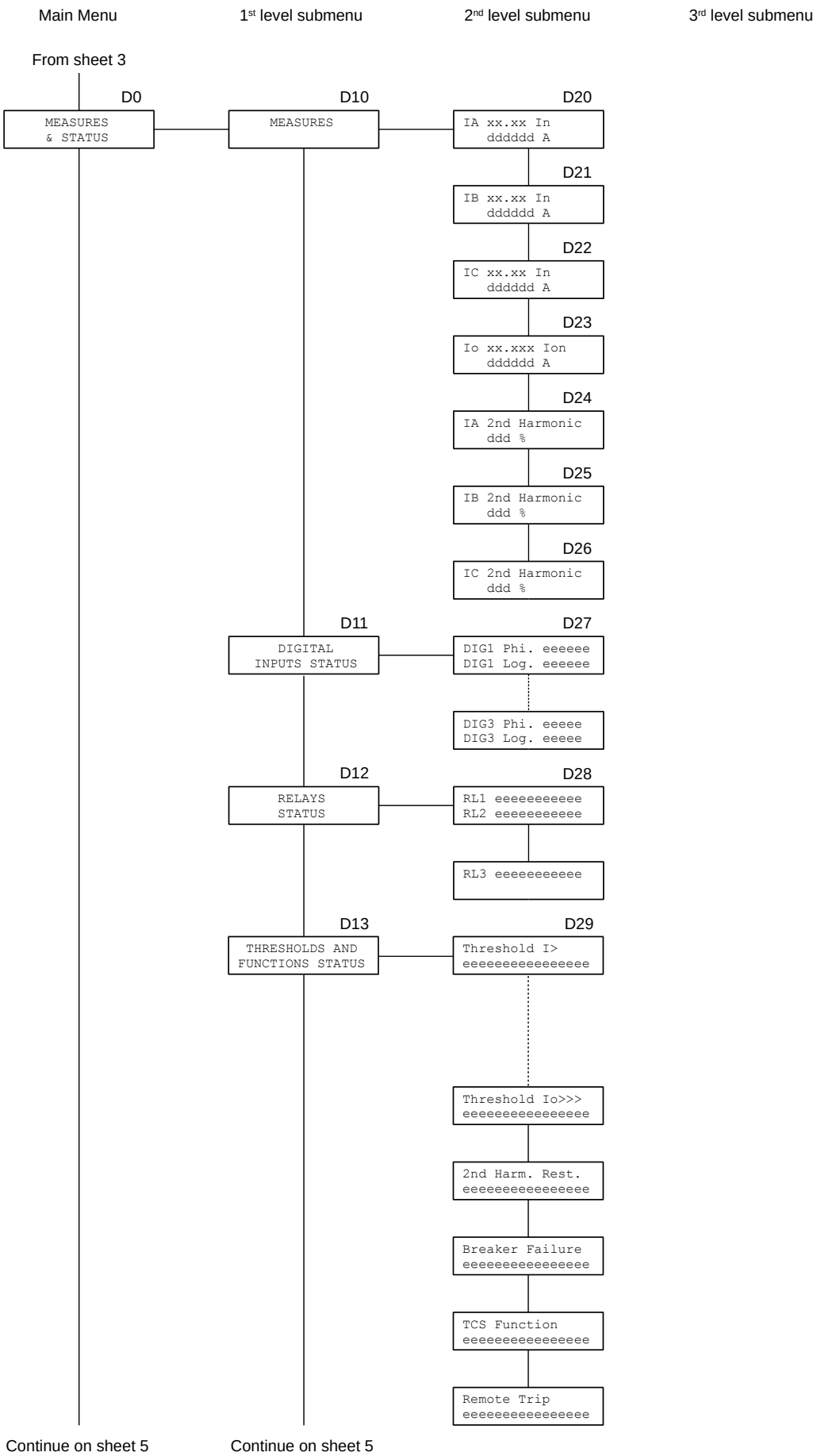

Main Menu
1st level submenu
2nd level submenu
3rd level submenu
From sheet 3
D0
MEASURES & STATUS
D10
MEASURES
D20
IA xx.xx In dddddd A
D21
IB xx.xx In dddddd A
D22
IC xx.xx In dddddd A
D23
Io xx.xxx Ion dddddd A
D24
IA 2nd Harmonic ddd %
D25
IB 2nd Harmonic ddd %
D26
IC 2nd Harmonic ddd %
D11
DIGITAL INPUTS STATUS
D27
DIG1 Phi. eeeeee DIG1 Log. eeeeee
DIG3 Phi. eeeee DIG3 Log. eeeee
D12
RELAYS STATUS
D28
RL1 eeeeeeeeeee RL2 eeeeeeeeeee
RL3 eeeeeeeeeee
D13
THRESHOLDS AND FUNCTIONS STATUS
D29
Threshold I> eeeeeeeeeeeeeee
Threshold Io>>> eeeeeeeeeeeeeee
2nd Harm. Rest. eeeeeeeeeeeeeee
Breaker Failure eeeeeeeeeeeeeee
TCS Function eeeeeeeeeeeeeee
Remote Trip eeeeeeeeeeeeeee
Continue on sheet 5
Continue on sheet 5

Figure 4

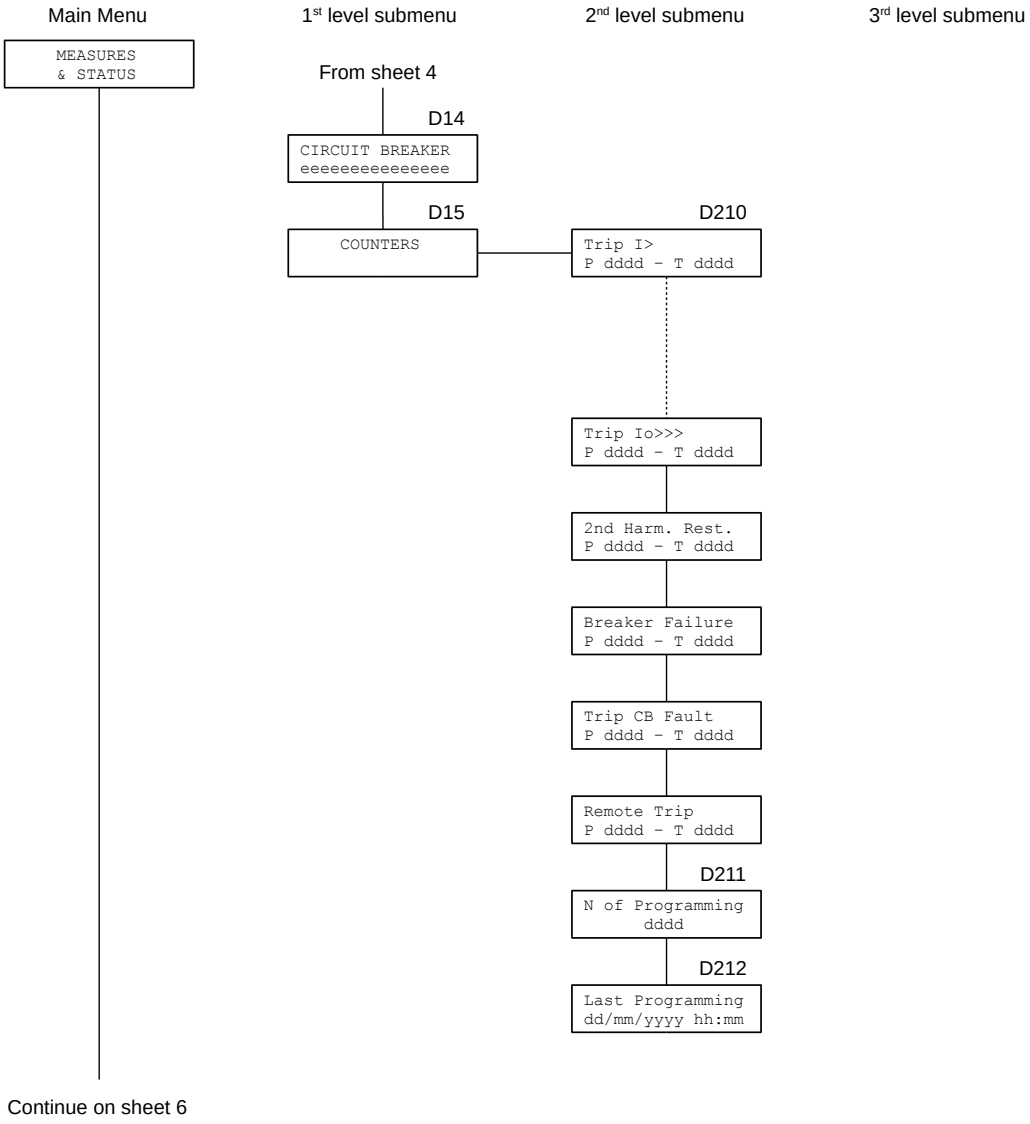

Main Menu
1st level submenu
2nd level submenu
3rd level submenu
MEASURES
& STATUS
From sheet 4
D14
CIRCUIT BREAKER
eeeeeeeeeeeeeee
D15
COUNTERS
D210
Trip I>
P dddd - T dddd
Trip Io>>>
P dddd - T dddd
2nd Harm. Rest.
P dddd - T dddd
Breaker Failure
P dddd - T dddd
Trip CB Fault
P dddd - T dddd
Remote Trip
P dddd - T dddd
D211
N of Programming
dddd
D212
Last Programming
dd/mm/yyyy hh:mm
Continue on sheet 6

Figure 5

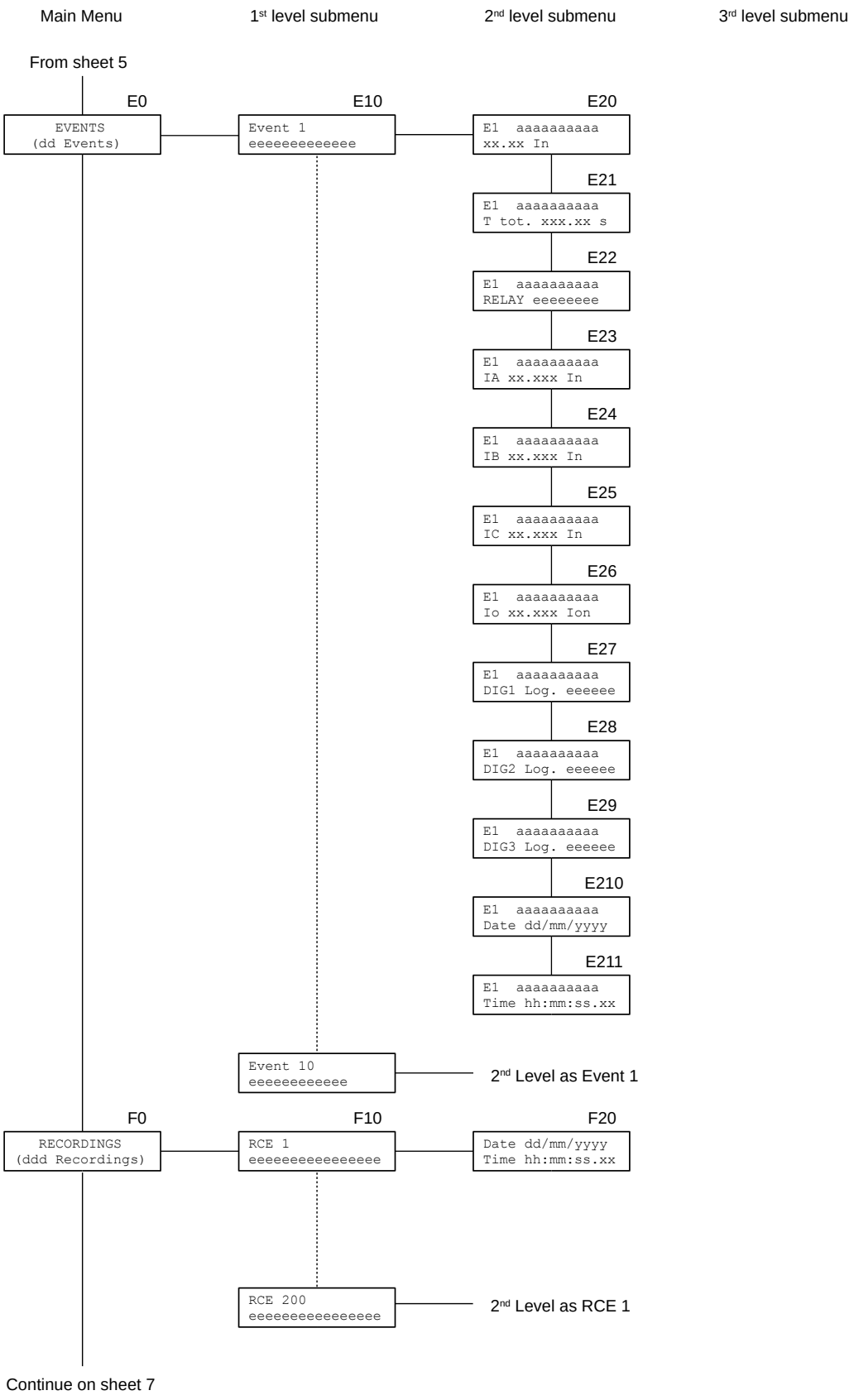

Main Menu
1st level submenu
2nd level submenu
3rd level submenu
From sheet 5
E0
EVENTS
(dd Events)
E10
Event 1
eeeeeeeeeeee
E20
E1 aaaaaaaaaa
xx.xx In
E21
E1 aaaaaaaaaa
T tot. xxx.xx s
E22
E1 aaaaaaaaaa
RELAY eeeeeeee
E23
E1 aaaaaaaaaa
IA xx.xxx In
E24
E1 aaaaaaaaaa
IB xx.xxx In
E25
E1 aaaaaaaaaa
IC xx.xxx In
E26
E1 aaaaaaaaaa
Io xx.xxx Ion
E27
E1 aaaaaaaaaa
DIG1 Log. eeeeee
E28
E1 aaaaaaaaaa
DIG2 Log. eeeeee
E29
E1 aaaaaaaaaa
DIG3 Log. eeeeee
E210
E1 aaaaaaaaaa
Date dd/mm/yyyy
E211
E1 aaaaaaaaaa
Time hh:mm:ss.xx
Event 10
eeeeeeeeeeee
2nd Level as Event 1
F0
RECORDINGS
(ddd Recordings)
F10
RCE 1
eeeeeeeeeeeeeeee
F20
Date dd/mm/yyyy
Time hh:mm:ss.xx
RCE 200
eeeeeeeeeeeeeeee
2nd Level as RCE 1
Continue on sheet 7

Figure 6

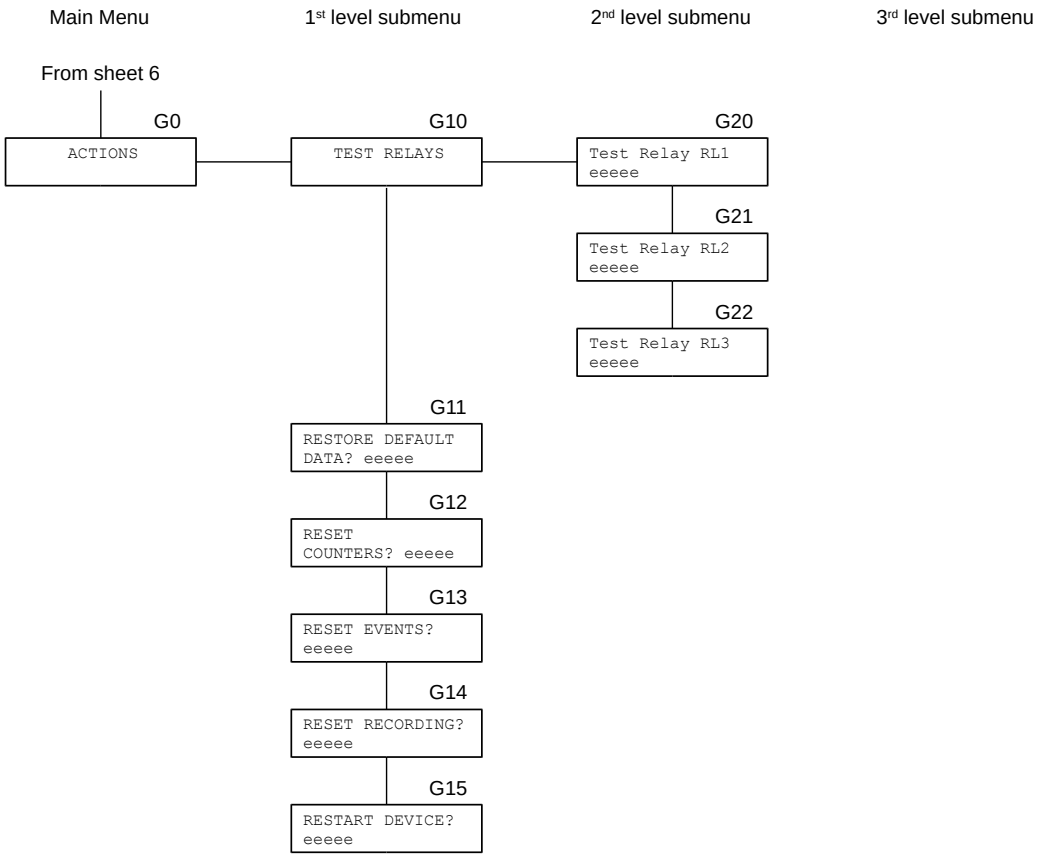

Main Menu
1st level submenu
2nd level submenu
3rd level submenu
From sheet 6
G0
ACTIONS
G10
TEST RELAYS
G20
Test Relay RL1
eeeee
G21
Test Relay RL2
eeeee
G22
Test Relay RL3
eeeee
G11
RESTORE DEFAULT
DATA? eeeee
G12
RESET
COUNTERS? eeeee
G13
RESET EVENTS?
eeeee
G14
RESET RECORDING?
eeeee
G15
RESTART DEVICE?
eeeee

Figure 7

7.3 Identification data and clock (fig. 1)

A10 – RELAY SERIAL NUMBER (not programmable)

```
Serial number
ddddd/aaaa
```

ddddd serial number (sequential)

aaaa year of construction of the protection relay

A11 – FIRMWARE VERSION (not programmable)

```
FIRMWARE Release
xx.yy
```

xx.yy identifies the application firmware of the protection relay

A12 – DAYLIGHT SAVING TIME (programmable)

```
Daylight Saving
Time eeeeeeeeee
```

eeeeeeeee	daylight saving time management	DISABLED
		AUTOMATIC

In the case of AUTOMATIC selection, the transition from standard time to daylight saving time and vice-versa takes place in accordance with the rules used in Italy (and in most European countries): last Sunday in March (from standard time to summer time) and last Sunday in October (from summer time to standard time).

Storing the daylight saving time configuration takes effect immediately (i.e. it is not necessary to confirm the storage of the setup – ref. C17).

If you change the configuration of daylight saving time, we also recommend setting the date and time (ref. A13).

A13 – DATE AND TIME (programmable)

```
Date dd/mm/yyyy
Time hh:mm:ss
```

The date and time are programmable and include leap year management and daylight saving time (if enabled).

Note: For the correct operation of the function that manages the transition from summer time to winter time, it is recommended not to update the date and time between 2.00 and 3.00 on the last Sunday of October.

It is recommended to configure the daylight saving time parameter first (ref. A12) and then set the date and time.

The date and time information is used by EVENTS and logger.

NOTE The clock is equipped with an energy storage system capable of ensuring the correct functioning of the clock for 48 hours. If the energy storage system is discharged, the clock is no longer correctly updated.

7.4 Insertion of the relay and protection functions (fig. 1)

B0 – INSERTION OF THE RELAY (programmable)

```
   Insertion
eeeeeeeeeeeeeeee
```

The insertion of the relay defines the ANSI code of the protection functions used and the thresholds that can be activated and implicitly also the current measurement inputs used.

FUNCTIONS	ANSI	INSERTION	AVAILABLE THRESH.
Two-phase overcurrent Three-phase overcurrent	50 - 51	**2 PHASES** **3 PHASES**	I>, I>>, I>>>
Two-phase overcur. + earth fault Three-phase overcur. + earth fault	50 - 51 50N - 51N	**2 PHASES + Io** **3 PHASES + Io**	I>, I>>, I>>>, Io>, Io>>, Io>>>
Earth fault (non-directional) Stator earth fault (95%) Transformer case earth-fault	51N 64S 64T	**EARTH CURRENT** **EARTH STATOR 95%** **CASE TRANSFORMER**	Io>, Io>>, Io>>>

Examples:

```
   Insertion
3 PHASES
```

```
   Insertion
EARTH CURRENT
```

```
   Insertion
3 PHASES+Io
```

For information about the current measurement inputs used according to the type of insertion selected, refer to chap. 2 and chap. 8.2.

7.5 Rated values (fig. 1)

This sub-menu (ref. C10) and the related sub-menu items are used to program the parameters of the current transformers (CTs) and the rated frequency of the electricity grid in which the protection relay is used.

When setting the parameters of CTs, only the screens relative to those actually used are shown, depending on the INSERTION (ref. B0).

C20 – PHASE CURRENT TRANSFORMER RATIO (programmable)

```
Phase CT Ratio
ddddd/e A/A
```

ddddd primary rated value (in Ampere) of phase CTs (1 ÷ 20000)

e secondary rated value (in Ampere) of phase CTs (1 or 5)

C21 – EARTH CURRENT TRANSFORMER RATIO (programmable)

```
Earth CT Ratio
ddddd/e A/A
```

ddddd primary rated value (in Ampere) of earth CT (1 ÷ 20000)

e secondary rated value (in Ampere) of earth CT (1 or 5)

Note: if *Holmgreen* insertion is used (see chap. 8.3), earth CT parameters must be the same of phase CTs.

C22 – FREQUENCY (programmable)

```
Frequency
ee Hz
```

ee electricity grid frequency, in Hertz, 50 or 60

7.6 Thresholds and time delays set-up (fig. 1 e 2)

In the programming screen hierarchy only the screens relative to the available thresholds are shown, according to the selected INSERTION (ref. B0).

C23 - THRESHOLD LEVEL SET-UP (programmable)

The information and set-ups related to threshold I> in the following points (ref. C23, C30÷C33) are effective for all the thresholds I>>, I>>>, Io>, Io>>, Io>>> just taking into consideration the change of the threshold identifier and the limits indicated in table A.

```
I>     eeeeeeeeee
       xx.xx In
```

I> threshold identifier (I>, I>>, I>>>, Io>, Io>>, Io>>>)

eeeeeeeee ENABLED - enabled threshold

DISABLED - disabled threshold (available but not active)

xx.xx threshold level, in relative values

In (thresholds I>, I>>, I>>>)

Ion (thresholds Io>, Io>>, Io>>>)

Examples:

```
I>     ENABLED
       01.50 In
```

```
I>>>   DISABLED
       12.00 In
```

```
Io>>   ENABLED
       05.50 Ion
```

Note: If the threshold is *DISABLED*, the screens of the related submenu are not displayed.

C30 - THRESHOLD LEVEL IN PRIMARY VALUES (not programmable)

```
I>
     ddddddd A
```

The threshold level is displayed, in primary values; the value depends on the programmed CTs primary values at ref. C20 and C21 (chap. 7.5).

I> threshold identifier (I>, I>>, I>>>, Io>, Io>>, Io>>>)

ddddddd threshold level, in Amperes

C31 - TIME DELAY SET-UP (programmable)

```
T I>    eeeeeeee
        xx.xx s
```

Set-up of time-delay to the activation (TRIP) of the programmed output relays when the measured current exceeds the threshold level.

Parameter T I> eeeee: time delay characteristic

For **I>** and **Io>** thresholds, the time delay characteristic can be selected between one of the following:

DEFINITE	definite time delay
CURVE A	inverse time delay as curve A IEC 60255-151 (inverse time)
CURVE B	inverse time delay as curve B IEC 60255-151 (very inverse time)
CURVE C	inverse time delay as curve C IEC 60255-151 (extremely inverse time)

For other thresholds the time delay characteristic is fixed as DEFINITE (definite time delay).

Parameter xx.xx:

Definite time delay - value of the trip delay, in seconds (00.05 to 99.99).

Inverse time delay - value of the parameter *K* relative to the formula of the curves A, B, C, see chap. 10 (00.01 to 20.00)

```
T I>  CURVE B
  K = 02.50
```

```
T Io> CURVE A
  K = 10.00
```

```
T I>>>  DEFINITE
        03.25 s
```

Note: for thresholds where the time delay characteristic can be configured, the *K* or *s* indication is adjusted at the end of the screen data modification session.

C32 - ADDITIONAL TIME DELAY SET-UP (programmable)

The screen is displayed only when a definite time characteristic has been selected in the previous screen (C31).

```
T Add I>
      xx.xx s
```

The screen allows the programming of an additional delay, from 00.00 to 99.99 seconds, for the indicated threshold; to activate the additional delay, one of the digital inputs must be programmed for this function (ref. C211 - chap. 7.9).

The additional delay TADD is added to the definite time delay T to obtain an overall trip delay equal to T + TADD.

C33 – ADDITIONAL DELAY ACTIVATION (not programmable)

This screen is displayed only when a definite time characteristic has been selected in the screen C31.

```
T Add I>
      eeeeeeeeee
```

According to the settings (ref. C211 - chap. 7.9) and the status of the digital inputs, it indicates if the additional timer TADD of threshold I> is activated by one or more digital inputs programmed for this function.

The parameter **eeeeeeeee** can be one of the following values:

DISABLED no digital input is programmed to activate the additional delay TADD of the threshold I>

BLOCKED there are digital inputs programmed to activate the additional delay TADD of the threshold I>, but no digital input is in the status that activates the additional delay TADD of the threshold I>

ENABLED there are digital inputs programmed to activate the additional delay TADD of the threshold I>, and the status of the digital inputs activates the additional delay TADD of the threshold I>

C24 – 2nd HARMONIC RESTRAINT FUNCTION (programmable)

This screen and the relative lower level submenu are displayed only if the selected insertion (ref. B0) includes the measurement of phase currents.

```
2nd Harm. Rest.
eeeeeeeee dd %
```

eeeeeeeee ENABLED - enabled function

DISABLED - disabled function (available but not active)

dd threshold value, in % of the ratio between the 2nd harmonic and the fundamental (10 ÷ 50)

Example:

```
2nd Harm. Rest.
ENABLED   20 %
```

Note: If the function is *DISABLED*, the screens of the related submenu are not displayed.

C34 – BASE CURRENT FOR 2nd HARMONIC RESTRAINT (programmable)

```
Base current
     x.xx In
```

x.xx base current, programmable from 0.10 to 1.00 In; is the minimum value of phase current that enables the 2nd harmonic restraint function.

C35 – DROP-OUT DELAY FOR 2nd HARMONIC RESTRAINT (programmable)

```
T Drop Out
     xx.xx s
```

xx.xx drop-out delay, programmable from 00.00 to 99.99 s

C36 – ACTION OF 2nd HARMONIC RESTRAINT FUNCTION ON OVERCURRENT THRESHOLDS (programmable)

The following setting for I> threshold is also valid for the thresholds I>>, I>>>, Io>, Io>> and Io>>>, changing the identifier of the threshold.

```
Action on I>
eeeeeeeeeeeeeeee
```

eeeeeeeeee enumerative value which indicates how the I> threshold modifies its behavior when the 2nd harmonic restraint threshold is exceeded. Selectable between:

- NO ACTION — the threshold I> is not affected by 2nd harmonic restraint function.
- DISABLE THRESH. — the trip of the threshold I> is blocked until 2nd harmonic restraint function is in trip status (including the drop-out delay).

C25 – BREAKER FAILURE (programmable)

This screen and the relative lower level submenu are displayed only if the selected insertion (ref. B0) includes the measurement of phase currents.

```
Breaker Failure
eeeeeeee x.xx In
```

eeeeeeeee ENABLED - enabled function

DISABLED - disabled function (available but not active)

x.xx threshold value, in In

Example:

```
Breaker Failure
ENABLED  0.10 In
```

C37 – BREAKER FAILURE DELAY TIME (programmable)

```
T Breaker Fail.
     xx.xx s
```

xx.xx waiting time, counted starting from a trip command issued by one of the overcurrent phase or overcurrent earth fault thresholds, or external trip, within which the phase currents must be below the threshold value at ref. C25. This time is programmable from 00.05 to 99.99 s

7.7 Programming of circuit breaker monitoring functions (fig. 2)

C26 – CIRCUIT BREAKER POSITION MONITORING FUNCTION (programmable)

```
CB Posit. Monit.
eeeeeeee
```

eeeeeeeee ENABLED - enabled function

DISABLED - disabled function (available but not active)

C38 – CIRCUIT BREAKER POSITION MONITORING TIMER (programmable)

```
T CB Posit. Mon.
     xx.xx s
```

xx.xx indicates for how long the presence of coincident signals is allowed on the digital inputs programmed for the circuit breaker monitoring function (*52a* and *52b*) without this causing the recording of "CB incongruent" on the logger; see chap. 3.6.

Timer value is programmable from 00.00 to 99.99 s

C27 – TRIP CIRCUIT SUPERVISION FUNCTION (TCS) (programmable)

```
TCS Function
eeeeeeee
```

eeeeeeee ENABLED - enabled function

DISABLED - disabled function (available but not active)

C38 – TRIP CIRCUIT SUPERVISION TIMER (programmable)

```
T Trip Cir. Sup.
     xx.xx s
```

xx.xx delay time before the circuit-breaker tripping circuit fault signal is issued.

Timer value is programmable from 01.00 to 60.00 s

7.8 Programming of special functions (fig. 2)

C28 – COLD LOAD PICKUP FUNCTION (programmable)

The cold load pickup condition can be detected in different ways (or the function can be disabled).

```
Cold Load Pickup
eeeeeeeeeeee
```

eeeeeeeeeee	DISABLED	disabled function (available but not active).
	THRESH 0.05 In	the cold load pickup condition is detected when from a situation in which all the phase current measurements are below the indicated threshold, one or more of the phase currents exceeds the threshold.
	C.BREAK. CLOSING	the cold load pickup condition is detected by switching the circuit breaker from the *open* position to the *closed* position.
	THRESH+C.B.CLOSE	cold load pickup is detected using the OR of the conditions for exceeding the current threshold and closing the circuit breaker.

Note The item *THRESH 0.05 In* is displayed only if the selected insertion (ref. B0) uses the phase current measurement.

The item *C.BREAK. CLOSING* is displayed only if there is a digital input programmed to acquire the status of the auxiliary contacts of the circuit breaker (*52a* and/or *52b*) (ref. C211).

The item *THRESH+C.B.CLOSE* is displayed only if both items *THRESH 0.05 In* and *C.BREAK. CLOSING* are present.

We recommend configuring the digital inputs before proceeding to the settings for Cold Load Pickup function.

C310 – COLD LOAD PICKUP TIMER (programmable)

```
Pickup Time
    xxx.xx s
```

xxx.xx indicates the time interval that corresponds to the duration of the cold load pickup condition, during which the behavior of overcurrent protection thresholds is modified according to the settings indicated in ref. C312.

Timer value is programmable from 00.05 to 600.00 s

C311 – MULTIPLICATIVE FACTOR (programmable)

```
K Factor
xx.xx
```

xx.xx multiplicative factor that acts on thresholds value of overcurrent protections functions if the settings at ref. C312 have value *APPLY K FACTOR*.

K factor is programmable from 00.10 to 10.00

C312 – ACTION ON THRESHOLDS DURING COLD LOAD PICKUP (programmable)

The following setting for I> threshold is also valid for the thresholds I>>, I>>>, Io>, Io>> and Io>>>, changing the identifier of the threshold.

```
Action on I>
eeeeeeeeeeeeee
```

eeeeeeeeee enumerative value which indicates how the I> threshold modifies its behavior during cold load pickup. Selectable between:

NO ACTION	the threshold I> is not affected by cold load pickup function.
DISABLE THRESH.	the trip of the threshold I> is blocked for the entire duration of cold load pickup.
APPLY K FACTOR	the tripping value of the threshold I> is multiplied by the K factor (ref. C311) for the entire duration of cold load pickup.

C29 – REMOTE TRIP (programmable)

```
Remote Trip
eeeeeeee
```

eeeeeeee ENABLED - enabled function

DISABLED - disabled function (available but not active)

C313 – REMOTE TRIP TIMER (programmable)

```
T Remote Trip
     xx.xx s
```

xx.xx time delay before signaling the condition of "Remote trip". Since this function is correlated with the programming of one (or more) digital inputs for this purpose, note that any filtering time associated with the 0-1 transition programmed for the digital inputs (ref. C314) is added to the this delay.

Timer value is programmable from 00.00 to 99.99 s

C210 – RCE (LOGGER) ENABLING (programmable)

```
RCE (Logger)
eeeeeeee
```

eeeeeeee ENABLED - enabled function

DISABLED - disabled function (available but not active)

Enabling the logger is mandatory if the IFX4L protection is used in applications according to the Norm CEI 0-16 and is used to control a circuit-breaker fitted with a shunt trip coil. In this mode of use, the circuit breaker monitoring functions must be active (ref. C26 and C27) and the digital inputs should be programmed accordingly (ref. C211). Any error in programming the circuit breaker monitoring functions or digital inputs is detected when programming is confirmed (ref. C17).

An example of IFX4L protection relay configuration with the use of the logger is described in the chapter 9.1.

7.9 Programming of digital input functions (fig. 2)

One of the following functions can be activated for each individual digital input:

a) block of a specific threshold, of a group of thresholds or of all thresholds

b) activation of additional delay for a specific threshold, for a group of thresholds or for all thresholds

c) circuit breaker position monitoring[13]

d) trip circuit supervisor

e) remote trip

f) reset LATCH relays (chap. 1)

[13] For this function it is necessary to use two digital inputs, one for the auxiliary contact concordant with the circuit breaker position and one for the auxiliary contact discordant to the circuit breaker position.

g) event recording (chap. 1)

h) RCE (logger) recording (chap. 1)

i) direct command of output relays

j) pilot wire monitor function (only for digital input DIG2 - chap. 1)

If the functions of more than one digital input refer to the same threshold, remember that:

a) the BLOCK function (threshold trip disabling) is dominant on the TADD function (additional time delay)

b) the selection referred to a group of thresholds is dominant over the selections of the individual thresholds

C221 - DIGITAL INPUT FUNCTION (programmable)

What is described for digital input 1 (DIG1) is also valid for digital inputs 2 and 3 (changing the relative reference, DIG2 and DIG3).

For digital input 2 only, in addition to the functions indicated below, there is also the *PILOT WIRE MONITOR* item, which is added as the last item.

```
DIG1 Act eeeee
fffffffffffffff
```

Setting active status and function of digital input 1 (DIG1).

Parameter **eeeeee**: physical status of the digital input, selectable between HIGH and LOW, which activates the function selected with the parameter fffffffffffffff.

Parameter **fffffffffffff**: function assigned to the digital input, selectable according to the following list. The list lists all available functions, but only the set of functions related to insertion selected (ref. B0) will be shown to the operator.

NO ACTION	digital input with no assigned function
BLOCK PHASE THR.	block of phase overcurrent thresholds (I>, I>> and I>>>)
BLOCK I>	block threshold I>
BLOCK I>>	block threshold I>>
BLOCK I>>>	block threshold I>>>
BLOCK EARTH THR.	block of earth fault overcurrent threshold (Io>, Io>> and Io>>>)
BLOCK Io>	block threshold Io>
BLOCK Io>>	block threshold Io>>
BLOCK Io>>>	block threshold Io>>>
BLOCK BRK. FAIL.	Block Breaker Failure function
BLOCK ALL THRES.	block all thresholds
TADD PHASE THRES	additional delay for phase overcurrent thresholds (I>, I>> and I>>>)

TADD I>	additional delay for threshold I>
TADD I>>	additional delay for threshold I>>
TADD I>>>	additional delay for threshold I>>>
TADD EARTH THRES	additional delay for earth fault overcurrent thresholds (Io>, Io>> and Io>>>)
TADD Io>	additional delay for threshold Io>
TADD Io>>	additional delay for threshold Io>>
TADD Io>>>	additional delay for threshold Io>>>
TADD ALL THRESH.	additional delay for all thresholds
52a	signal concordant with circuit breaker position (52a)
52b	signal discordant with circuit breaker position (52b)
TCS FUNCTION	trip circuit supervision (TCS)
REMOTE TRIP	remote trip
COMMAND RL1	direct command of relay RL1
COMMAND RL2	direct command of relay RL2
COMMAND RL3	direct command of relay RL3
RESET LATCH RLY	reset LATCH relays
EVENT RECORDING	EVENT data recording (chap. 1)
RCE RECORDING	RCE (logger) data recording (chap. 1)

C314 – DIGITAL INPUT FILTERING TIME, TRANSITION FROM LOGICAL 0 TO LOGICAL 1 (programmable)

What is described for digital input 1 (DIG1) is also valid for digital inputs 2 and 3 (changing the relative reference, DIG2 and DIG3).

```
DIG1 T Filter 01
     xx.xx s
```

xx.xx time interval for which the digital input must continuously maintain a specific status so that it is recognized as valid; this time interval can be considered as a *delay in the activation* of the function assigned to the digital input.

Timer value is programmable from 00.00 to 99.99 s

To disable the filtering or delay function, set the time to 00.00 s.

C315 – DIGITAL INPUT FILTERING TIME, TRANSITION FROM LOGICAL 1 TO LOGICAL 0 (programmable)

What is described for digital input 1 (DIG1) is also valid for digital inputs 2 and 3 (changing the relative reference, DIG2 and DIG3).

```
DIG1 T Filter 10
     xx.xx s
```

xx.xx time interval for which the digital input must continuously maintain a specific status so that it is recognized as valid; this time interval can be considered as a *delay to the deactivation* of the function assigned to the digital input.

Timer value is programmable from 00.00 to 99.99 s

To disable the filtering or delay function, set the time to 00.00 s.

7.10 Output relay programming (fig. 3)

It allows to program the activation of the output relays RL1, RL2 and RL3 on the *START* or *TRIP* conditions of thresholds and functions.

Only the screens relative to the thresholds enabled according to what is set as INSERTION (ref. B0) are shown; for inactive thresholds the screens to which they refer are excluded.

What is described for the relay RL1 is also valid for the relays RL2 and RL3, changing the relay identification.

C212 - PROGRAMMING QUIESCENT STATUS OF OUTPUT RELAYS (programmable)

```
Quiescent st RL1
eeeeeeeeeeeeee
```

Programming of the quiescent status of the output relay, when not activated by START or TRIP conditions of thresholds.

DE-ENERGIZED: normally de-energized (energized status on activation)

ENERGIZED: normally energized (de-energized status on activation)

C316 - RELAY LATCH FUNCTION PROGRAMMING (programmable)

```
RL1 Latch
eeeeeeeeeeeeee
```

Programming of the LATCH condition of the relay (see chap. 3.9).

ENABLED: latch function is active

DISABLED: latch function is disabled

Note: switching off the equipment causes all output relays to de-energize, including those that were in the energized status due to the LATCH function.

C317 – ENABLING MINIMUM ACTIVATION TIME OF OUTPUT RELAY (programmable)

```
RL1 T Minimum
eeeeeeeeeee
```

Enabling the output relay for operation with minimum activation time duration.

ENABLED: minimum activation time duration is active

DISABLED: minimum activation time duration is disabled

We suggest to program the output relays used to control the circuit breaker with minimum activation time operation.

C410 – MINIMUM ACTIVATION TIME OF RELAY (programmable)

This screen is shown only if the enabling for minimum time operation (ref. C316) is active.

```
RL1 T Minimum
    xx.xx s
```

xx.xx minimum activation time of relay.

Timer value is programmable from 00.05 to 01.00 s

We suggest to set 0.15 s as minimum time, to provide a command of sufficient duration to allow the correct switching of the circuit breaker.

C318 – ENABLING DROP OUT DELAY TIME (programmable)

```
RL1 T Drop Out
eeeeeeeeeee
```

Enabling the output relay for drop out delay operation.

ENABLED: drop out delay is active

DISABLED: drop out delay is disabled

C411 – DROP OUT DELAY TIME (programmable)

This screen is shown only if the drop out delay enabling (ref. C317) is active.

```
RL1 T Drop Out
    xx.xx s
```

xx.xx drop out delay of the output relay (counted from the end of the conditions that caused the activation).

Timer value is programmable from 00.00 to 99.99 s

C319 - PROGRAMMING OF OUTPUT RELAY ACTIVATION FOR THRESHOLD I> (programmable)

What is indicated for I> threshold is also valid for thresholds I>>, I>>>, Io>, Io>>, Io>>> and for 2nd harmonic restraint, breaker failure, circuit breaker fault and remote trip functions, simply by changing the identifier of the threshold or function.

```
RL1 I>
eeeeeeeeeeeeeee
```

Programming the activation of the output relay on START or TRIP of threshold I>.

The parameter **eeeeeeeeeee** is selectable between:

NO ACTION	no activation related to threshold I>
START	activation of the relay when threshold I> is exceeded
TRIP	activation of the relay at the end of the delay set for threshold I>

The value TRIP is not available for 2nd harmonic restraint function.

The value START is not available for *Circuit Breaker Fault* and *Remote Trip* functions.

C320 – ENABLING DIRECT COMMAND OF OUTPUT RELAY (programmable)

To allow direct control of the output relay via digital inputs or commands received via RS-485 serial interface, it is necessary to enable this operating mode for the output relay, using this screen.

```
RL1 Direct Cmd.
eeeeeeeeeeeeeee
```

The parameter **eeeeeeeeeeee** is selectable between:

ENABLED: direct command is enabled

DISABLED: direct command is disabled

7.11 Communication and visualization (fig. 3)

COMMUNICATION

The setting of Modbus protocol parameters is done in the screens accessed from the specific submenu, see ref. C213.

C321 – RELAY ADDRESS (programmable)

```
Relay Address
ddd
```

ddd address used by the protection relay for communication with Modbus protocol.

The value is programmable from 1 to 247.

For the IFX4L protection relay the default address is 1.

If two or more devices are connected on the same communication bus, it is necessary to change the address value so that there are no devices on the bus with the same address.

C322 – BAUDRATE (programmable)

```
Baudrate
eeeee baud
```

eeeee communication speed (baudrate), selectable between the following values:

1200 – 2400 – 4800 – 9600 – 19200 – 38400 – 57600.

Default value is 19200 baud.

C323 – PARITY BIT (programmable)

```
Parity
eeeeeeeeee
```

eeeeee parity bit, selectable between the following values: NONE, ODD, EVEN.

Default value is EVEN.

C324 – STOP BIT (programmable)

```
Stop Bit
e
```

e number of stop bits, selectable between the following values: 1 or 2.

Default value is 1.

DISPLAY CONFIGURATION

The setting of parameters related to the display is done using screens accessed from the specific submenu, see ref. C214.

C325 – DEFAULT VIEW (programmable)

```
Default View
eeeeeeeeeeeeee
```

Select the basic (or default) display on the protection display (ref. A0) when no intervention of protection functions has occurred or no fault has been detected by the self-diagnosis function. Available choices are:

DEVICE TYPE	Protection relay type, with date and time
ANSI CODE	ANSI code of active functions
CURRENT PHASE A	Current IA
CURRENT PHASE B	Current IB
CURRENT PHASE C	Current IC
EARTH CURRENT	Current Io

Only the choices consistent with the INSERTION (ref. B0) are shown; for example, in the case of *BIPOLAR* insertion, the possibility of selecting the values of phase C and earth current is not shown.

Examples:

```
Default View
ANSI CODE
```

```
Default View
CURRENT PHASE A
```

```
Default View
EARTH CURRENT
```

C326 - USER INTERFACE LANGUAGE SETTING (programmable)

```
Language
eeeeeeeeeeeeee
```

Select the language of the user interface. Available choices at the time of writing of this document are: ITALIANO - ENGLISH.

Other values can be added later.

The modification of this parameter has immediate effect on the display (i.e. the programming confirmation operation is not necessary to see the effects, ref. C17).

For the permanent storage of the parameter, the usual programming confirmation procedure is required (chap. 7.12).

C327 – DISPLAY CONTRAST (programmable)

```
Contrast
dd (Default 20)
```

The contrast value of the display (parameter **dd**) can be set from 10 to 30, so that it ensures good legibility of the text on the display. The effect is applied immediately, but for the permanent storage of the parameter the usual procedure for confirming the programming is required (chap. 7.12).

7.12 Programming confirmation (fig. 3)

The IFX4L protection relay operates with two different instances of the database containing the configuration data, one used for the operating functions of the equipment and one for parameter modification operations (using local user interface or via serial interface RS-485).

The data in the database used for programming does not become operative until the programming confirmation operation is performed.

If the programming confirmation operation is not executed within 5 minutes from the last operation performed by the user (i.e. pressing a key), the database used for modification operations is overwritten with the contents of the operative database and the changes made by the user and not confirmed are lost.

C17 – STORING CONFIGURATION DATA

```
STORE NEW DATA?
eee
```

The parameter **eee** can be selected between the following values:

- .. no action is taken (it is possible to continue the programming operations).
- YES the previously modified data become those with which the protection relay will operate (the operative database is overwritten with the contents of the database used for modification operations).
- NO no action is taken (it is possible to continue the programming operations).

When the operator selects the item YES, the protection relay performs a congruency check to make sure that programmed data are correct, before storing the data.

If any inconsistency in the programming data is detected, an error screen containing a numeric code that identifies the problem is displayed.

```
ERROR IN DATA
Code dddd
```

The numerical codes associated with the type of inconsistency are:

Numerical code	Inconsistency detected and operations to be performed
1	This signaling occurs if the "Circuit Breaker Position Monitoring" function (ref. C26) is enabled, but the programming of the functions assigned to the digital inputs is not correct according to the requirements of this function. It is necessary to program two digital inputs with function *52a* and *52b* respectively
2	This signaling occurs if the "TCS" function (ref. C27) is enabled, but the programming of the functions assigned to the digital inputs is not correct according to the requirements of this function. It is necessary to program a digital input with *TCS* function.
3	This signaling occurs if "Remote Trip" function (ref. C29) is enabled, but no digital input is programmed with this functionality. It is necessary to program a digital input with the REMOTE TRIP function.
4	This signal occurs if the "Cold Load Pickup" function detected on the position of the circuit breaker (ref. C29) is enabled, but the programming of the functions assigned to the digital inputs is not correct according to the requirements of this function. It is necessary to program a digital input with function *52a* or *52b*.
5	This signal occurs if the programming of the digital inputs has multiple instances of inputs configured for function *52a* or *52b*.

If data storage is successful, the display blinks showing an indication of data storage in progress, and then the default screen is displayed (ref. A0).

7.13 Measures and status (fig. 4 and 5)

The main menu item "Measures and status" (ref. D0) and the relative submenus are very useful during the commissioning and maintenance operations of the protection relay, as they provide indications regarding the interaction with the other equipments of the plant and on the status of the various thresholds and functions of the protection relay.

All information displayed in this section is read-only, except for partial counters, whose value can be changed.

D20 – D21 - D22 – D23 – D24- D25 – D26 - DISPLAY MEASUREMENTS

These screens show the instantaneous measurements acquired by the protection relay (measurements of the currents and of the ratio between the 2nd harmonic component and that of the fundamental); the display of unused measurements in relation to the type of insertion is omitted (ref. B0 - INSERTION).

The screens showing the currents measurement (D20, D21, D22 and D23) show the current identifier, the value expressed in relative units and the one in primary values, taking into account the parameters set as the primary value for phase and earth CTs (ref. C20 and C21, chap. 7.5).

The screens displaying the 2nd harmonic components (D24, D25 and D26) show the current identifier and the percentage ratio between the 2nd harmonic component and that of the fundamental.

Display examples:

IA xx.xxx In dddddd A	Io xx.xxx Ion dddddd A	IA 2nd Harmonic ddd %

D27 – DISPLAY OF DIGITAL INPUTS STATUS

These screens show the identification of the digital input (DIG1, DIG2, DIG3), the relative **physical status** (DIG# Phi.) and **logical status** (DIG# Log.). The values that identify the physical status are HIGH and LOW, while for the logical status they are TRUE and FALSE.

D28 - RELAY STATUS DISPLAY

These screens show the identifier of the relays (RL1, RL2, RL3) and the relative physical status (ENERGIZED / DE-ENERGIZED).

D29 - DISPLAY OF THRESHOLDS AND FUNCTIONS STATUS

This screen (and subsequent ones) shows the current status of thresholds and functions of the protection relay.

The screens of thresholds that cannot be activated according to the INSERTION (ref. B0), are not displayed.

Each screen shows the identification of the threshold or function and its status; the status can have the value:

DISABLED	threshold disabled (ref. C22 ÷ C29, chap. 7.6)
BLOCK by DIG.INP	threshold enabled, but blocked due to the current status of digital inputs (ref. C211)
BLOCK by LOGIC	threshold enabled, but blocked due to an internal logical signal (e.g. 2nd harmonic restraint, cold load pickup, etc.)
ENABLED	threshold enabled (ref. C22 ÷ C29, chap. 7.6), without intervention
START	threshold enabled, in start condition
TRIP	threshold enabled, in trip condition

Examples:

Threshold I>> ENABLED	Threshold Io> BLOCK by DIG.INP	TCS Function DISABLED

D14 – CIRCUIT BREAKER POSITION

This screen is shown only if the "Circuit breaker position monitoring" function (ref. C26) is active or there are digital inputs programmed to acquire the status of the auxiliary contacts of the circuit breaker, *52a* or *52b* (ref. C221).

It displays the position of the circuit breaker, using the information acquired by digital inputs.

The following values are used to indicate the position of the circuit breaker:

CLOSED	circuit breaker closed
OPEN	circuit breaker open

INCONGRUENT	indicates an abnormal condition, whose causes must be investigated

"Incongruent circuit breaker" status is detected when digital inputs programmed as *52a* and *52b* are in the same logical status.

D15 - COUNTERS

The items in this menu show the partial and total counters of the interventions (TRIPS) of thresholds and functions and also show the number of programming operations performed on the protection relay (with indication of the date and time of the last programming).

The total counters, the number of programming and the date and time of the last programming cannot be changed or reset; the information relating to the last programming can be used to detect unauthorized access to the programming of the protection relay.

The value of each partial counters can be reset or modified (from 0 to 9999) with the usual parameter modification procedure described in the paragraph 6.2; the counters are immediately modified in memory, without having to perform the programming confirmation procedure (ref. C17).

D210 – THRESHOLD TRIPS COUNTERS

```
Trip I>
P dddd – T dddd
```

Display the value of partial (P) and total (T) counters of TRIPs related to each threshold or function.

The counters are identified by the identifier of the threshold or function to which they refer (I>, Io>, etc.); for non-active thresholds, depending on what is programmed for INSERTION (ref. B0), the relative views are omitted.

When the value exceed 9999 the counter starts again from 0000.

D211 – D212 - TOTAL PROGRAMMING SESSIONS AND DATE/TIME OF THE LAST PROGRAMMING SESSION

```
N of Programming
      dddd
```

```
Last Programming
dd/mm/yyyy hh:mm
```

Display of the number of confirmed programming sessions (from the factory set-up) and the date and time of the last confirmed programming session.

7.14 Events (fig. 6)

This menu, referring to ref. E0, and the relative submenus display the information stored at TRIP of a protection threshold or activation of a digital input specifically programmed for this function (ref. C211).

Events are stored in a circular memory and are identified with a progressive number from 1 to 10; the most recent event has a lower number.

When this memory is full, the occurrence of a new event will overwrite the oldest event.

Screen E0 shows the number of stored events that can be viewed by accessing the submenus.

In the submenus (ref. E10) only the events actually stored are displayed.

If there are no recorded events, access to submenus is blocked.

E10 - EVENT NUMBER

```
Event 1
eeeeeeeeeee
```

Index 1, 2 ... 10 identifies the stored event.

The data **eeeeeeeeee** gives a general indication about the type of event stored and can have the value:

NO EVENT	no event recorded
TRIP I>	event on trip threshold I>
TRIP I>>	event on trip threshold I>>
TRIP I>>>	event on trip threshold I>>>
TRIP Io>	event on trip threshold Io>
TRIP Io>>	event on trip threshold Io>>
TRIP Io>>>	event on trip threshold Io>>>
REMOTE TRIP	event by Remote Trip function
BREAKER FAILURE	event by Breaker Failure function
CIRC. BRK. FAULT	event by Circuit Breaker Fault function
DIGITAL INPUT	event by digital input

For NO EVENT there is no subsequent display.

For other recorded events, there are successive screens with detailed information.

The number of the event and the abbreviation of the identifier of the cause that caused the recording are re-proposed also in the first line of the remaining screens showing detailed information regarding the event itself.

In the example screens, for convenience of representation, it is assumed that the event is caused by the TRIP of threshold I>.

E20 – TRIP THRESHOLD

```
E1  I>
xx.xxx In
```

Not present for event CIRC. BRK. FAULT and DIGITAL INPUT

It displays the threshold value (in relative units).

E21 - TOTAL TIME DELAY ON TRIP

```
E1  I>
T tot xxx.xx s
```

It displays the total time delay of output relays, starting from exceeding the threshold; in presence of additional delays, the change of status of the control signal during the timing can cause a total time delay different from the sum of the delays set as T and TADD.

If the event is recorded on the digital input command (DIGITAL INPUT) or due to the intervention of Circuit Breaker Fault function (CIRC. BRK. FAULT), the indication N/A (not applicable) is shown instead of the trip delay, like in the example below.

```
E1  DIG. INPUT
T tot  N/A
```

E22 - ACTIVATED OUTPUT RELAYS

```
E1  I>
RELAY nnnnnnn
```

Not present for event DIGITAL INPUT

It shows the output relay activated by the threshold trip; the relays are identified with their number.

Examples:

```
E1  I>
RELAY 1
```

```
E3  I>
RELAY 1,2
```

If no output relay has been activated (no relay programmed for TRIP of the threshold or function), a screen is shown as in the following example:

```
E1  I>>
NO RELAY
```

E23 ÷ E26 - REGISTRATION OF MEASURES

The values of the measured currents at the event are displayed; the values are in relative units, as in the following examples.

```
E1  I>
IA xx.xxx In
```

```
E1  I>
Io xx.xxx Ion
```

Only the currents measured by the protection relay at the event according to INSERTION (ref. B0) are displayed.

E27 ÷ E29 - DIGITAL INPUTS STATUS ON EVENT

The **logical status** of digital inputs (see chap. 3.8) at the event are displayed, as in the following examples.

```
E1  I>
DIG1 Log. eeeee
```

```
E1  I>
DIG3 Log. eeeee
```

The status **eeeeeee** can be TRUE or FALSE.

E210 – E211 - DATE AND TIME OF THE EVENT

```
E1  I>
Date dd/mm/yyyy
```

```
E1  I>
Time hh:mm:ss.xx
```

The date and time of the event are shown.

7.15 RCE (Logger) (fig. 6)

This menu, referring to ref. F0, and the relative submenus display the information memorized by the "Chronological Event Recording" function, i.e. the Logger.

Information are:

- switching the equipment on / off
- start of a threshold
- trip of a threshold
- block and unblock of a threshold
- direct command of output relays
- modification of the main configuration parameters of protection relay
- circuit breaker monitoring
- trip circuit supervision
- activation of digital inputs

The logger recordings are stored with a progressive number from 1 to 200; the most recent registration has a lower number.

The logger stores the recordings in a circular buffer; when this memory is full, the occurrence of a new registration will overwrite the oldest registration.

F10 – RECORDING NUMBER

```
RCE 1
eeeeeeeeeeeeee
```

The index RCE 1, RCE 2… RCE 200 identifies the number of the recording.

The value **eeeeeeeeeeeee** indicates the reason that caused the registration and can have the value:

None	no recording
Power OFF	switching off the protection relay
Power ON	switching on the protection relay
Start I>	start threshold I>
Trip I>	trip threshold I>
Start I>>	start threshold I>>
Trip I>>	trip threshold I>>
Start I>>>	start threshold I>>>
Trip I>>>	trip threshold I>>>
Start Io>	start threshold Io>
Trip Io>	trip threshold Io>
Start Io>>	start threshold Io>>
Trip Io>>	trip threshold Io>>
Start Io>>>	start threshold Io>>>
Trip Io>>>	trip threshold Io>>>

Start BrkFail	start Breaker Failure
Trip BrkFail	trip Breaker Failure
CB Incongruent	Circuit Breaker in Incongruent position
Trip TCS	trip TCS function
Remote Trip	Remote Trip
DIG1 Active	recording by digital input 1
DIG2 Active	recording by digital input 2
DIG3 Active	recording by digital input 3
Direct Command RL1	direct command output relay RL1
Direct Command RL2	direct command output relay RL2
Direct Command RL3	direct command output relay RL3
Modify INSERTION	modify insertion parameter (ref. B0)
Modify I>	modify status threshold I>
Modify I>>	modify status threshold I>>
Modify I>>>	modify status threshold I>>>
Modify Io>	modify status threshold Io>
Modify Io>>	modify status threshold Io>>
Modify Io>>>	modify status threshold Io>>>
Mod. Value I>	modify intervention value threshold I>
Mod. Value I>>	modify intervention value threshold I>>
Mod. Value I>>>	modify intervention value threshold I>>>
Mod. Value Io>	modify intervention value threshold Io>
Mod. Value Io>>	modify intervention value threshold Io>>
Mod. Value Io>>>	modify intervention value threshold Io>>>
Modify T I>	modify delay time threshold I>
Modify T I>>	modify delay time threshold I>>
Modify T I>>>	modify delay time threshold I>>>
Modify T Io>	modify delay time threshold Io>
Modify T Io>>	modify delay time threshold Io>>
Modify T Io>>>	modify delay time threshold Io>>>
Block I>	block of threshold I>
Block I>>	block of threshold I>>
Block I>>>	block of threshold I>>>
Block Io>	block of threshold Io>
Block Io>>	block of threshold Io>>
Block Io>>>	block of threshold Io>>>
Block BrkFail	block of Breaker Failure function
Unblock I>	unblock of threshold I>
Unblock I>>	unblock of threshold I>>
Unblock I>>>	unblock of threshold I>>>
Unblock Io>	unblock of threshold Io>
Unblock Io>>	unblock of threshold Io>>

Unblock Io>>>	unblock of threshold Io>>>
Unblock BrkFail	unblock of Breaker Failure function

F20 - DATE AND TIME OF RECORDING

```
Date dd/mm/yyyy
Time hh:mm:ss.xx
```

It shows the date and time of the recording. The time is inclusive of the hundredths of second (xx).

7.16 Actions (fig. 7)

This menu, referring to ref. G0, and the relative submenus allow to perform particular activities on the protection relay.

Some of the activities accessed from this menu can have a significant impact on the system in which the protection relay is used, therefore maximum attention is recommended when using them.

G20 – G21 – G22 - TEST RELAY

These screens allow you to control the output relays RL1, RL2 and RL3 in manual mode. This can be very useful during the commissioning of the equipment.

What is indicated for the RL1 relay also applies to RL2 and RL3.

```
TEST RELAY RL1
ee
```

For detailed information on Test Relay procedure, see chap. 6.4.

G11 – RESTORE DEFAULT DATA

```
RESTORE DEFAULT
DATA? eee
```

The parameter **eee** can be selected between the following values:

..	no action is taken
YES	the default configuration data is restored, as if the protection relay had just left the factory
NO	no action is taken

After restoring the default data, a complete reprogramming of the protection relay is required, according to the specific needs of the plant in which it is used. Therefore the default data recovery operation should be performed only in circumstances that do not create potentially dangerous situations for the plant in which the equipment is installed.

This action also causes the reset of all the counters, partial and total, and the cancellation of the data of Events and RCE (logger).

After restoring the default data, setting the date and time is recommended (ref. A12 and A13, chap. 7.3).

G12 – RESET COUNTERS

```
RESET
COUNTERS? eee
```

The parameter **eee** can be selected between the following values:

.. no action is taken

YES all partial counters are set to 0

NO no action is taken

G13 – RESET EVENTS

```
RESET EVENTS?
eee
```

The parameter **eee** can be selected between the following values:

.. no action is taken

YES the memory with the events is reset

NO no action is taken

G14 – RESET RECORDINGS

```
RESET RECORDING?
eee
```

The parameter **eee** can be selected between the following values:

.. no action is taken

YES the memory with RCE (Logger) is reset

NO no action is taken

Note: **this operation should NOT be performed if the protection relay is used as general protection (PG) according to the Norm CEI 0-16 and controls a circuit breaker with shunt trip coil**.

G15 – RESTART PROTECTION RELAY

```
RESTART DEVICE?
eee
```

The parameter **eee** can be selected between the following values:

.. no action is taken

YES the protection relay restarts, in a similar way to what happens at power on

NO no action is taken

This operation can be useful if you need to update the application firmware of the device.

At first the boot loader is executed and then, if no firmware update procedure is started, the application program of the protection relay is executed again.

Note: during the execution of the boot loader all the output relays are placed in the DE-ENERGIZED status.

8 INSTALLATION

8.1 Supplied kit

VERSION RH or RL - 19" rack installation (the proper rack is supplied by SEB)

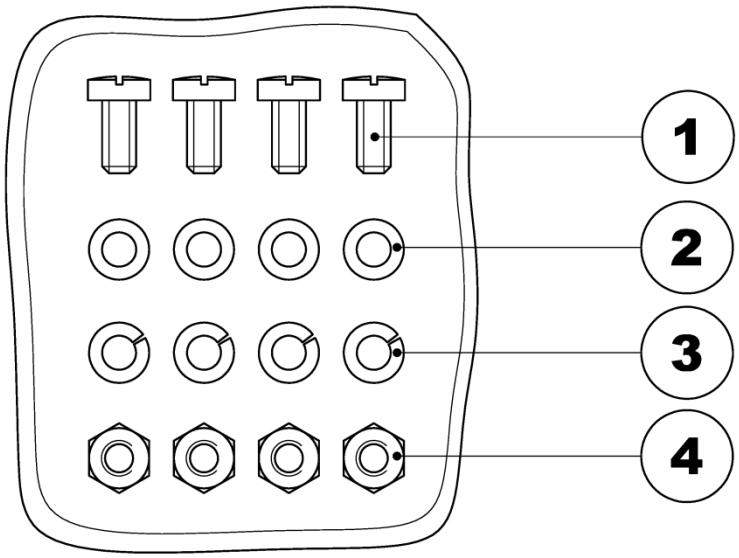
protection relay module IFX4L with removable connectors

rack 19” with cover panels

VERSION FH or FL - flush mounting installation

protection relay module IFX4L with removable connectors

blister with mounting accessories 1-2-3-4



1) n° 4 screws to fix the protection relay
2) n° 4 flat washers
3) n° 4 spring washers
4) n° 4 hexagonal nuts

8.2 Cabling

Current circuits

It is advisable to terminate the current wirings with pre-insulated fork terminals or eyelet terminals.

Minimum suggested wire cross section: 2.5 mm^2

Other circuits (digital inputs, output relays, etc.)

It is suggested to terminate the other circuits wiring using plug terminals.

Minimum suggested wire cross section (except RS-485 interface): 1.5 mm^2

The following table indicates the connection references.

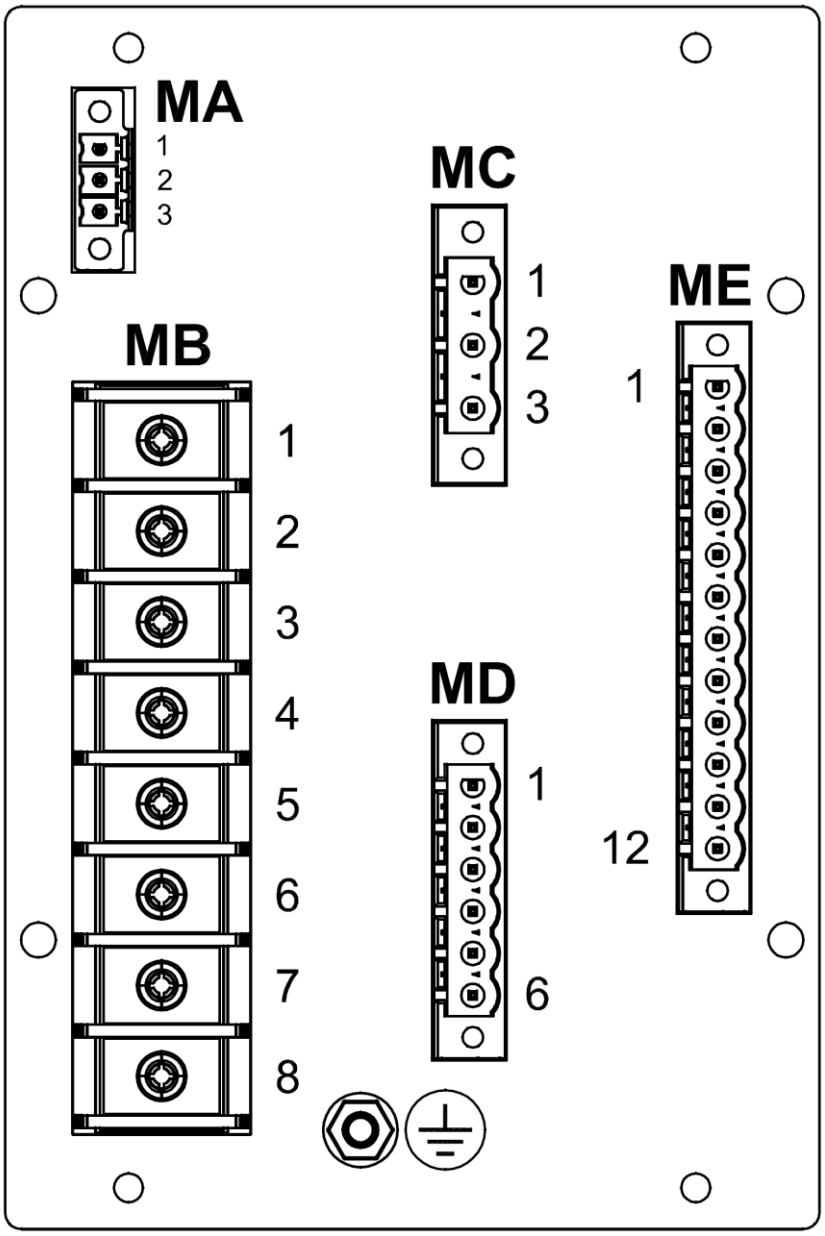
Terminal block	Terminals	Signal	Description
MA	MA-1	RS-485-A	RS-485 serial interface
	MA-2	RS-485-B	
	MA-3	RS-485-IsoGND	Shield for RS-485
MB	MB-1	IA1	Current input phase IA
	MB-2	IA2	
	MB-3	IB1	Current input phase IB
	MB-4	IB2	
	MB-5	IC1	Current input phase IC
	MB-6	IC2	
	MB-7	Io1	Earth current input Io
	MB-8	Io2	
MC	MC-1	Ground	Ground connection
	MC-2	Uaux1	Power supply inputs
	MC-3	Uaux2	
MD	MD-1	DIG1a	Digital input 1 (DIG1)
	MD-2	DIG1b	
	MD-3	DIG2a	Digital input 2 (DIG2)
	MD-4	DIG2b	
	MD-5	DIG3a	Digital input 3 (DIG3)
	MD-6	DIG3b	
ME	ME-1	RL1-NC	Relay RL1
	ME-2	RL1-COM	
	ME-3	RL1-NO	
	ME-4	RL2-NC	Relay RL2
	ME-5	RL2-COM	
	ME-6	RL2-NO	
	ME-7	RL3-NC	Relay RL3
	ME-8	RL3-COM	
	ME-9	RL3-NO	
	ME-10	RL FAIL-NC	Relay RL4 (FAIL)
	ME-11	RL FAIL-COM	
	ME-12	RL FAIL-NO	

In case of *2 PHASES* or *2 PHASES+Io* insertion, the current IC is not used.

For functions such as *earth fault overcurrent* (ANSI 50N-51N), *stator earth fault 95%* (ANSI 64S) and *transformer case earth fault* (ANSI 64T) only the current Io is used.

The terminals for Io measurement (MB-7 and MB-8) must be connected to a CT sensible to earth currents (64S - on star connection of the generator, 64T on the earth connection of the transformer case).

The following figure shows the position of the terminal blocks:



Connectors on the back of the protection relay.

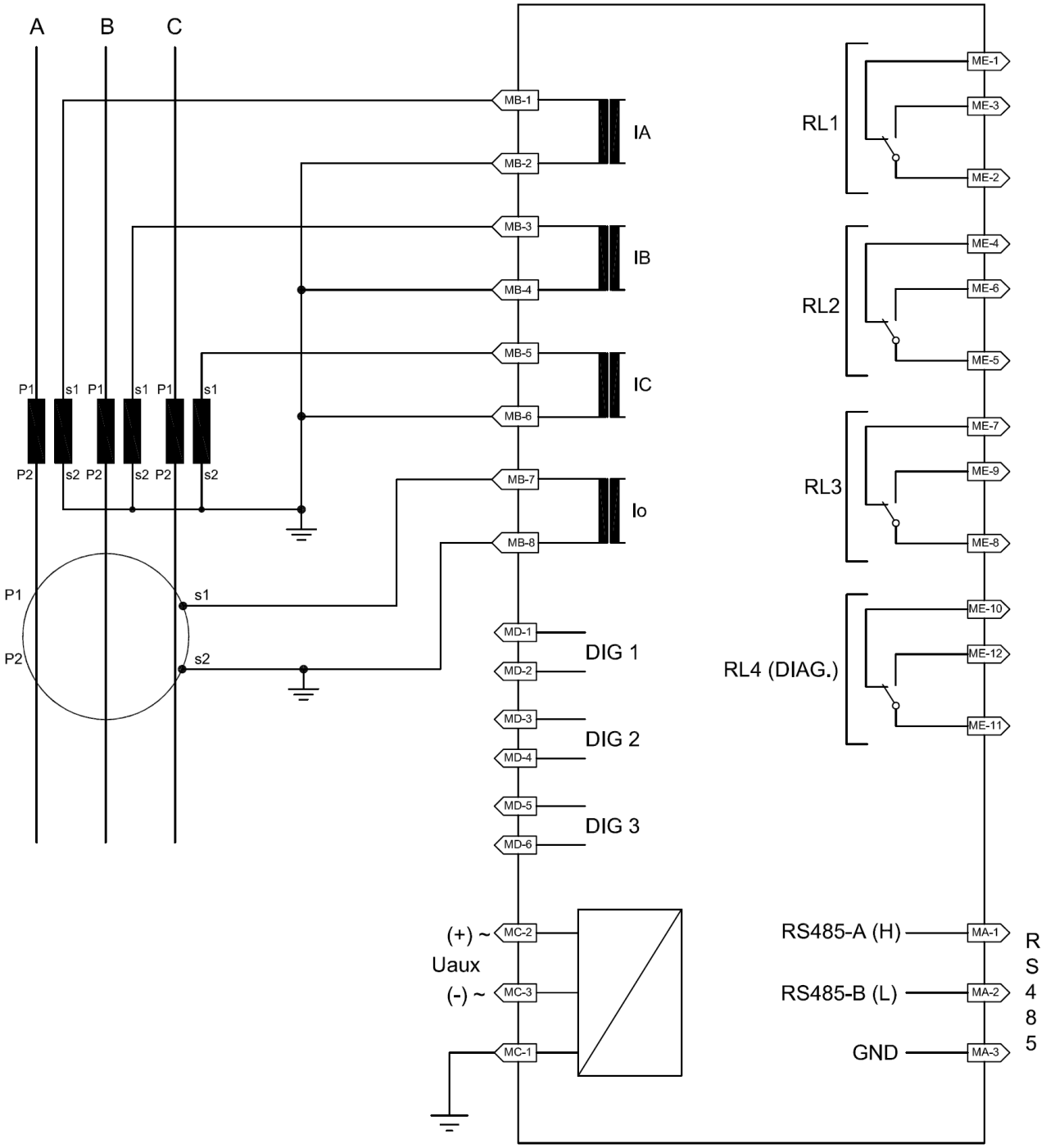
The MA, MC, MD and ME connectors have a removable female part, which is supplied. The figure also shows the screw and nut used for ground connection.

8.3 Insertion diagrams

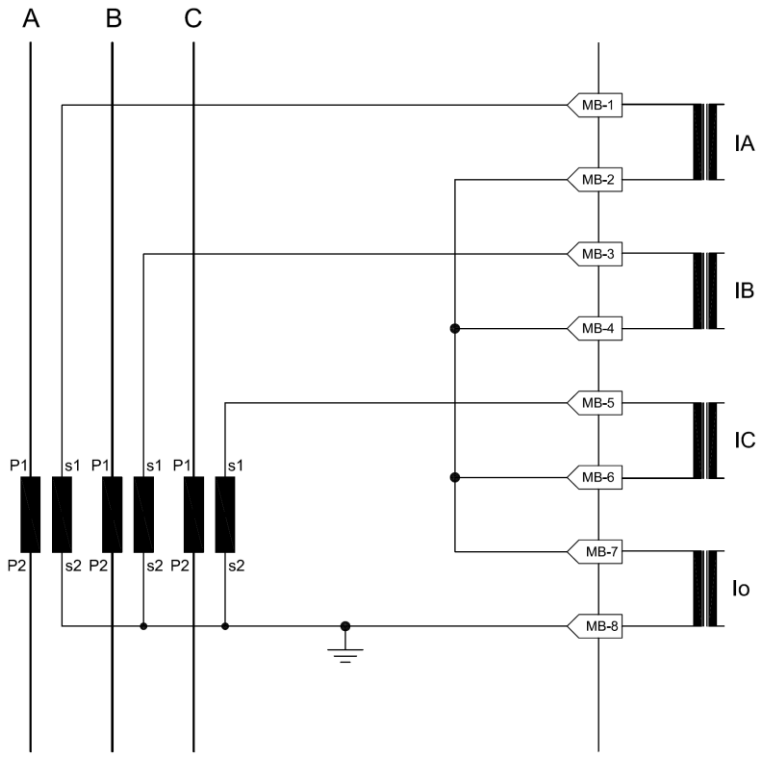
The following figures show some typical insertion diagrams.

The diagrams are only proposed as an example and should not be considered exhaustive for use in real cases.

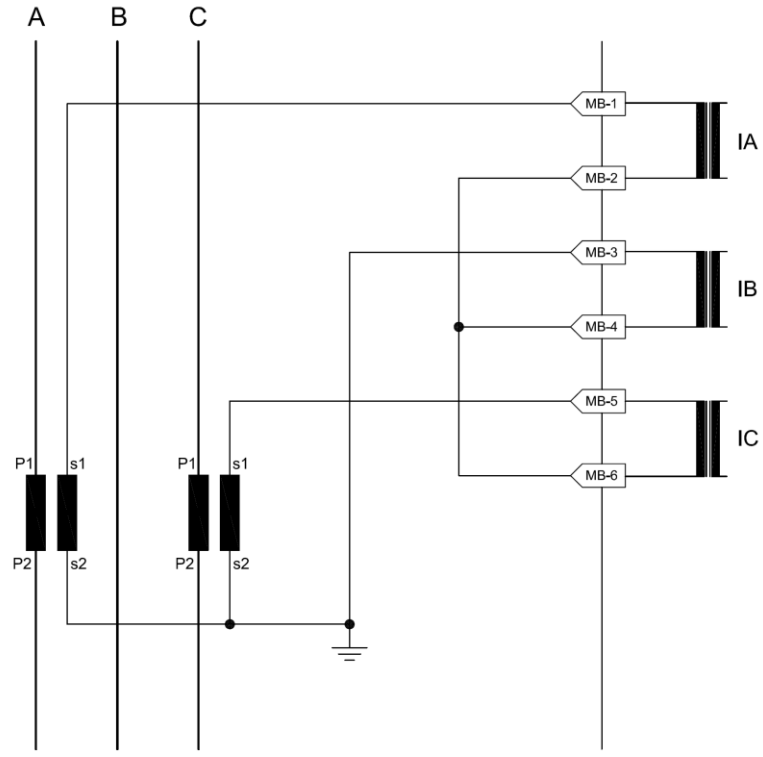
Note: as usual in the representation of the electrical and insertion diagrams, the contacts of the output relays are shown in the condition of equipment not powered.



Insertion diagram
(for general use as phase overcurrent and earth fault overcurrent protection relay)

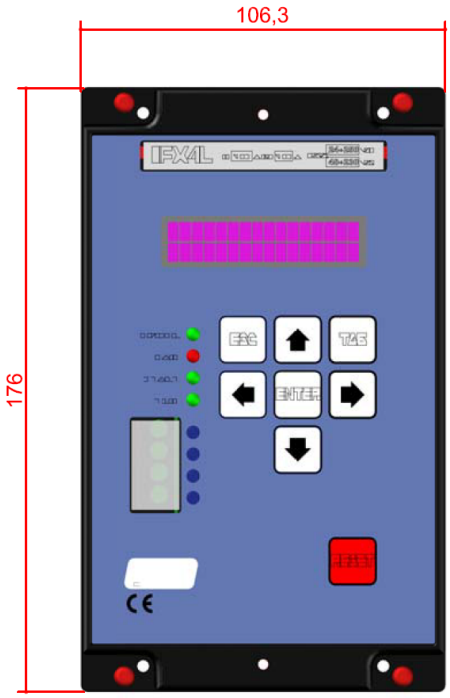


Holmgreen insertion (measurement of the residual current on the return wire of the phase CTs)

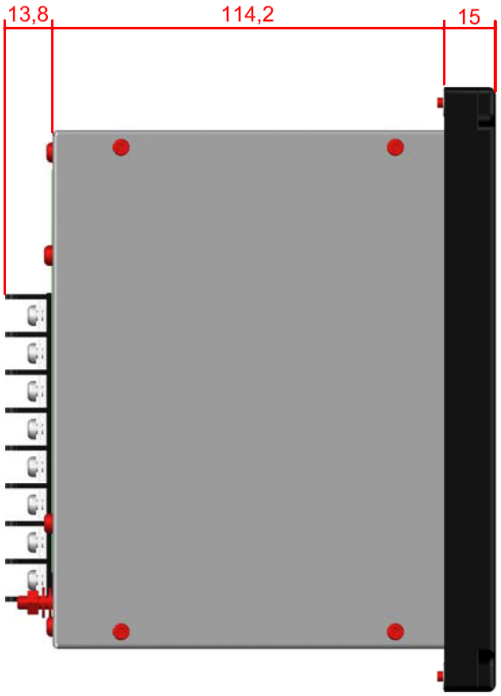


Tripolar measurement with only 2 phase CTs
With this connection select 3 PHASES insertion

8.4 Mechanical dimensions

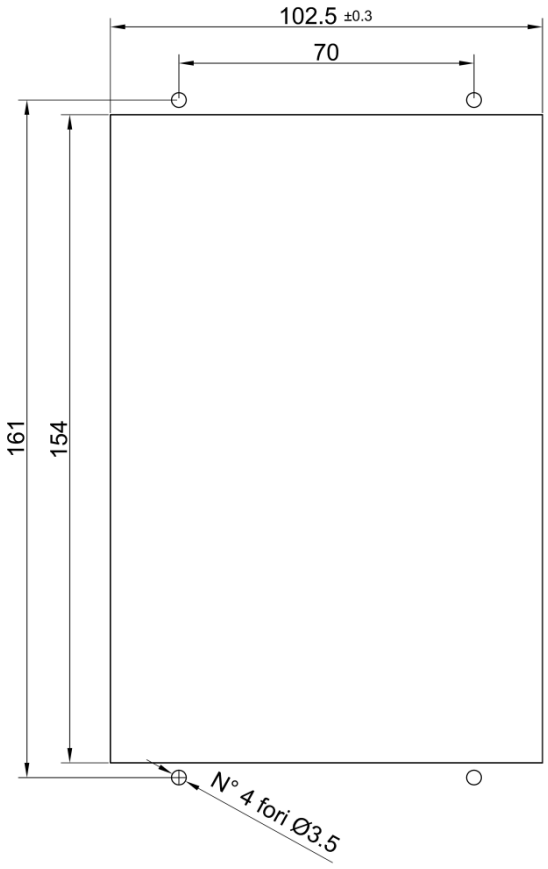


VISTA FRONTALE



VISTA LATERALE

Flush mounting cutout



Dimensions are in mm.

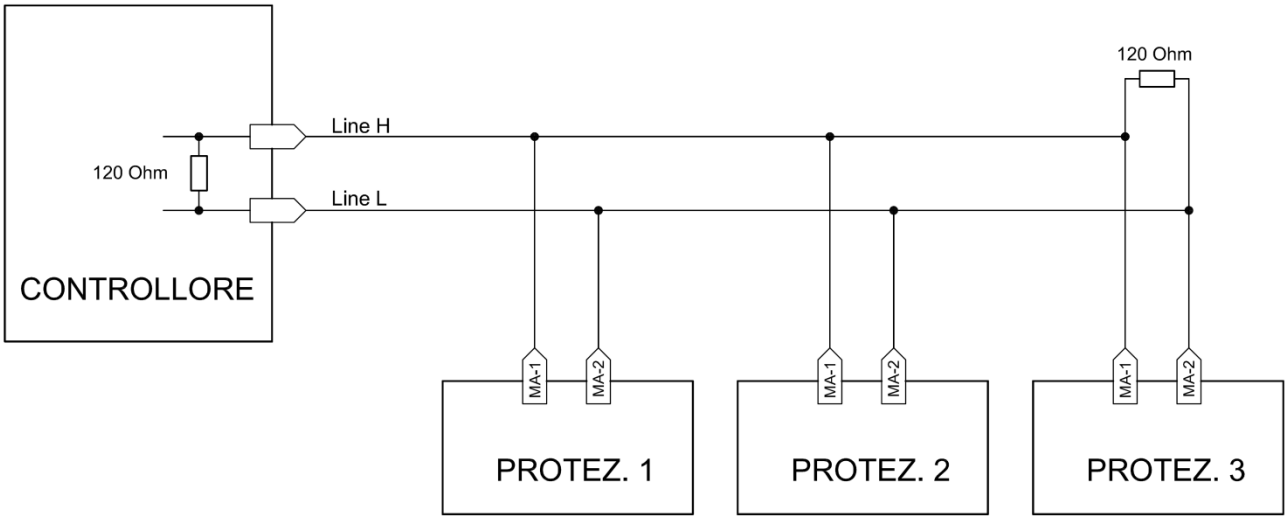
8.5 Serial interface

The IFX4L protection relay has a RS-485 serial interface, galvanically isolated from the rest of the equipment, which allows the multi-drop connection up to 31 protection units.

If you want to integrate the protection relay in control and supervision systems, you can ask SEB for documentation about protocol and mapping of the variables.

Protection relays can be connected to the controller (personal computer or control system) with point-to-point or multi-drop architecture.

For the serial interface wiring, we recommend using a shielded twisted pair AWG 22; terminal MA-3 can be used for shields connections.



We recommend terminating the interconnection bus with a resistor 120 Ω, 1/4 W.

9 EXAMPLES OF USE

The IFX4L protection relay can be used in various plant situations.

The use of the IFX4L protection relay as PG according to Norm CEI 0-16 requires a specific configuration.

An example of parameterization is provided, assuming that the protection relay controls a circuit breaker fitted with undervoltage trip (therefore the use of the logger function is not required). The reference insertion diagram is the first reported in the paragraph 8.3; it is assumed to connect the trip circuit to the output relay RL1.

Only the parameters relevant to protection functions and the configuration of the digital inputs and output relays are shown in the following table.

Insertion	2 PHASES+Io (also possible 3 PHASES+Io)
In (primary)	Depends on the phase CT used
In (secondary)	1 A / 5 A (depends on the phase CT used)
Ion (primary)	Depends on the earth CT used (most common case 100 A)
Ion (secondary)	1 A (most common case)
I>	ENABLED / DISABLED (it depends on the request of the distributor)
I>	If the threshold is ENABLED, the trip value is indicated by the distributor
TI I>	If the threshold is ENABLED, the delay time is indicated by the distributor[14]
I>>	ENABLED
I>>	The trip value is indicated by the distributor
TI I>>	The delay time is indicated by the distributor
I>>>	ENABLED
I>>>	The trip value is indicated by the distributor
TI I>>>	The delay time is indicated by the distributor
Io>	ENABLED
Io>	The trip value is indicated by the distributor
TI Io>	The delay time is indicated by the distributor
Io>>	ENABLED / DISABLED (it depends on the request of the distributor)
Io>>	If the threshold is ENABLED, the trip value is indicated by the distributor
TI Io>>	If the threshold is ENABLED, the delay time is indicated by the distributor
Io>>>	DISABLED
CB POSIT. MONIT.	DISABLED

[14] In plants according to the Norm CEI 0-16, if the I> threshold is required, usually for this threshold a timer with dependent time (normally inverse time) characteristic is used, which corresponds to the curve A (see ref. C31, par. 7.6), setting CURVE A.
For more details on time-dependent timers, refer to chap. 10

TRIP CIR. SUP.	DISABLED	
RCE	DISABLED	
DIG1	active status → HIGH	T Filter 01 00.00 s T Filter 10 00.00 s
	NO ACTION	
DIG2	active status → HIGH	T Filter 01 00.00 s T Filter 10 00.00 s
	NO ACTION	
DIG3	active status → HIGH	T Filter 01 00.00 s T Filter 10 00.00 s
	NO ACTION	
RL1	Quiescent st. ENERGIZED	Latch → DISABLED T Minimum → ENABLED, 0.15 s T Drop Out → DISABLED
	I> → TRIP I>> → TRIP I>>> → TRIP Io> → TRIP Io>> → TRIP	
RL2	Quiescent st. DE-ENERGIZED	Latch → DISABLED T Minimum → DISABLED T Drop Out → DISABLED
	Available	
RL3	Quiescent st. DE-ENERGIZED	Latch → DISABLED T Minimum → DISABLED T Drop Out → DISABLED
	Available	

9.1 Control and Registration Function (Logger)

If the IFX4L protection relay is used as a PG according to the Norm CEI 0-16 and the circuit breaker has a shunt trip coil, it is necessary to use the logger function.

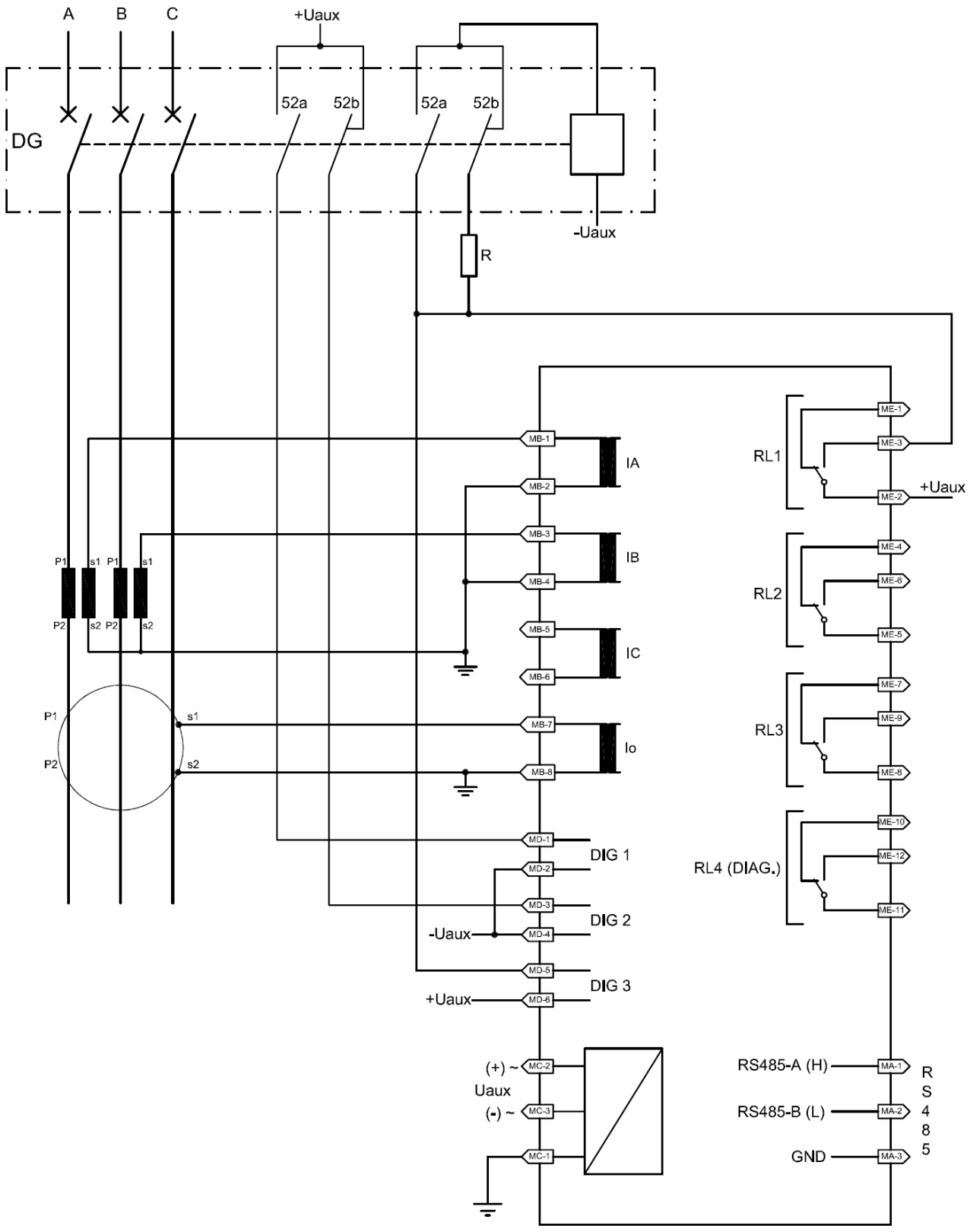
The control and recording function (logger) described in the Norm CEI 0-16 requires a series of features (see appendix C.3 of the Norm), to which what implemented on the IFX4L protection relay is fully compatible; in detail:

1	Presence of the connection between PG and logger	The logger is inside the PG
2	Presence of the logger power supply	The logger is inside the PG (see next point)
3	Presence of the protection relay power supply	The logger records both switching on and switching off of the protection relay (see chap. 7.15)
4	Presence and continuity of the control circuit	This feature is performed by enabling the Circuit Breaker Position Monitoring (ref. C26) and TCS (ref. C27) functions. The logger records the intervention of these functions

5	Adjustment thresholds set from installation	The logger records the modification of the threshold setting parameters and the related timers[15]
6	Events that caused the activation of the PG	The logger records the activation (or START) of each threshold
7	Events that caused the DG (circuit breaker) opening command to be issued	The logger records the intervention (TRIP) of each threshold. There is also a recording of the last 10 trips, complete with thresholds settings, fault current measurements, digital input status, etc. This information is available in the Event Registration (see chap. 7.14)

Compared to what is indicated in the previous configuration example, referring to the following insertion diagram,

[15] The protection relay has a counter of the total number of programming performed and the date and time of the last programming is available. This counter is incremented regardless of the modified parameter.



Insertion diagram for use with the Logger

the configuration of output relays, digital inputs and special functions must be changed as shown below:

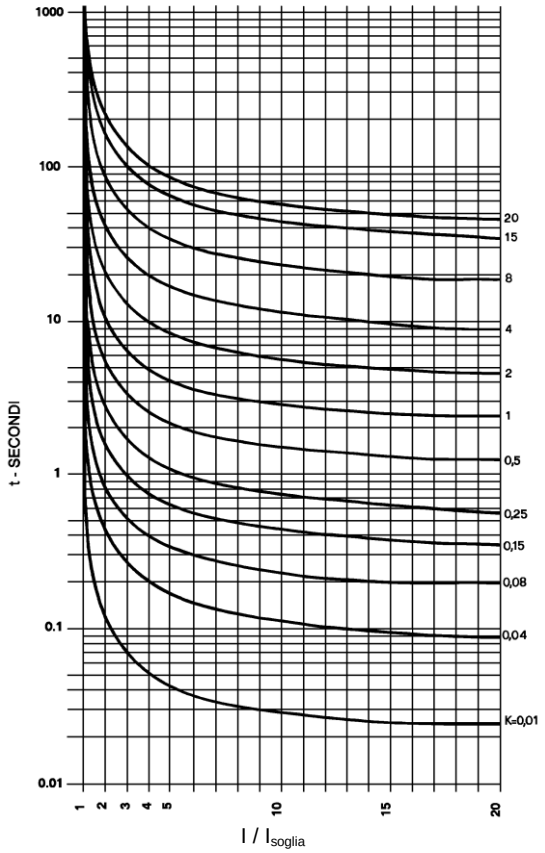
CB Posit. Monit.	ENABLED

T CB Pos. Mon.	0.5 s	
TRIP CIR. SUP.	ENABLED	
T Trip Cir. Sup.	20.00 s	
RCE (Logger)	ENABLED	
DIG1	active status → HIGH	T Filter 01 00.00 s T Filter 10 00.00 s
	52a	
DIG2	active status → HIGH	T Filter 01 00.00 s T Filter 10 00.00 s
	52b	
DIG3	active status → LOW	T Filter 01 00.00 s T Filter 10 00.00 s
	TCS	
RL1	Quiescent st. DE-ENERGIZED	Latch → DISABLED T Minimum → ENABLED, 0.15 s T Drop Out → DISABLED
	I> → TRIP I>> → TRIP I>>> → TRIP Io> → TRIP Io>> → TRIP	
RL2	Quiescent st. DE-ENERGIZED	Latch → DISABLED T Minimum → ENABLED, 0.15 s T Drop Out → DISABLED
	CB Fault → TRIP[16]	
RL3	Quiescent st. DE-ENERGIZED	Latch → DISABLED T Minimum → DISABLED T Drop Out → DISABLED
	Available	

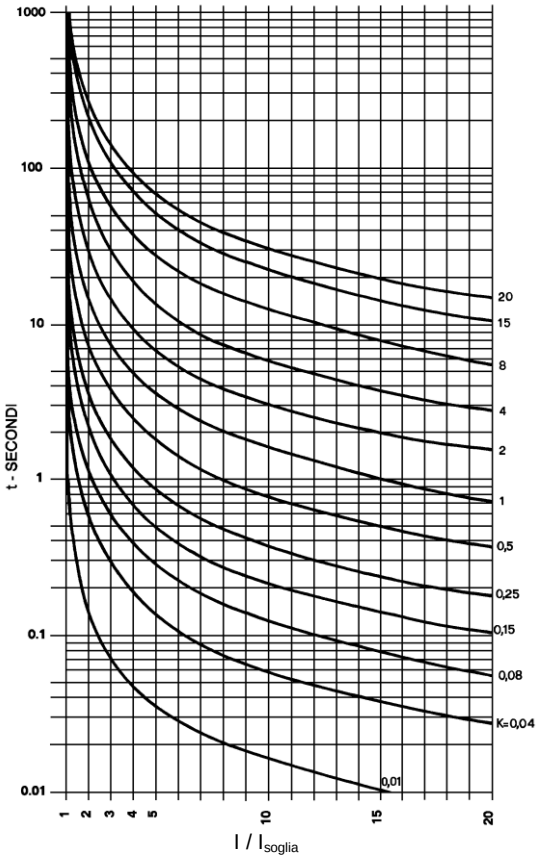
[16] The RL2 output relay is available to the user. The suggested configuration is only indicative; it can be used to monitor Circuit Breaker Failure information, but is not required by the Norm CEI 0-16.

10 TIME DEPENDENT CURVES

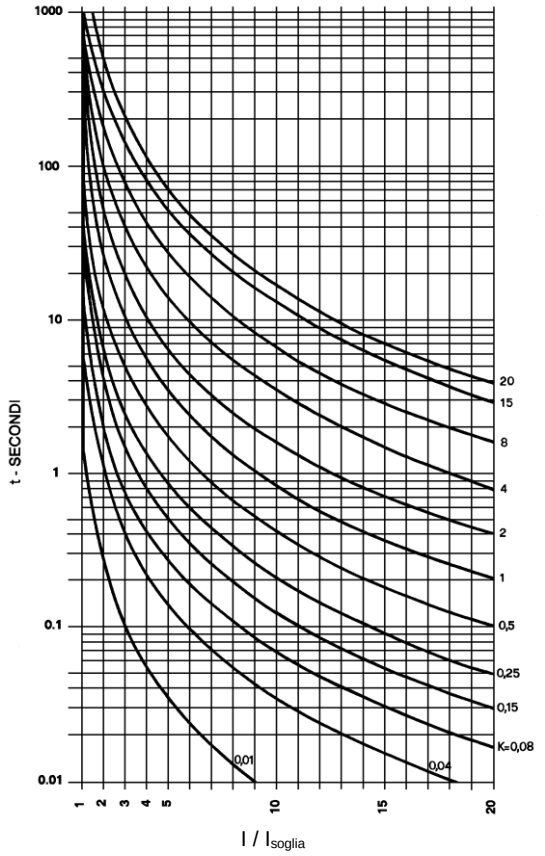
Curva - Curve A



Curva - Curve B



Curva - Curve C



Time dependent characteristics

$$t = \frac{Ki * K}{\left(\frac{I}{I_{thresh}}\right)^{\alpha} - 1} + 0.02s$$

Curve IEC 60255-151	A	B	C
Ki	0.14	13.5	80
α	0.02	1	2

K	Parameter 0.01 ÷ 20.00 s
I / I_{thresh}	Ratio between the greatest measured current and I_{thresh}

11 NOTES FOR USE

11.1 Maintenance

The IFX4L protection relay does not require any particular maintenance activity; all the circuits use high quality components and the electronic boards that compose it are subjected to functional checks before the assembly of the equipment.

After the assembly, the protection relay is subjected to a further test of all its functions by an automated procedure.

The self-diagnostic function in the firmware continuously checks the correct operation of the equipment. An appropriate output relay (RL4) can be used to monitor the presence of fault conditions.

Using the local user interface, or by connecting to the RS-485 interface, it is possible to read the value of electrical measurements performed by the equipment; in this way it is possible to compare the measurements detected by the protection relay with those performed by external instrumentation.

The absence of fault signaling (both current and historical) gives a reasonable certainty on the correct operation of the protection relay, so that, under normal conditions, it is not necessary to make further checks.

11.2 Repairs

There are no repairs carried out by the customer.

If the checks described in the previous paragraph confirm the presence of an anomaly or a fault, it is necessary to send the protection relay to the factory for repair.

11.3 Storage

Storage of the IFX4L protection relay must be done respecting the temperature limits for this operation; relative humidity must not cause the formation of condensation or ice.

It is recommended to keep the equipment in its original packaging.

Do not submit the equipment to sudden temperature changes that could cause the formation of condensation (cold-heat). If in doubt, wait until the equipment has gradually reached room temperature before power on.

In the case of storage for a long time, it is advisable to power the equipment for a few hours before proceeding with commissioning, so as to bring the electronic circuits inside the equipment to a steady status.

11.4 Warranty

The IFX4L protection relay has 2 (two) years warranty starting from the date of purchase against faults or manufacturing defects.

The warranty does not include accidental breakdowns (eg.: falling) and malfunctions due to improper use of the equipment or outside its operating limits.

12 TECHNICAL CHARACTERISTICS

Measuring inputs

Rated phase current (In)	1 A / 5 A programmable
Rated earth current (Ion)	1 A / 5 A programmable
Thermal withstand continuously	25 A
Thermal withstand for 1 s	250 A
Rated frequency	50 Hz / 60 Hz programmable
Primary CT's current	1 ÷ 20000 A
Measurement range	0.0025 ÷ 50 In / Ion

Output contacts ratings

Number of relays (note 1)	3 + 1
Rated current	5 A
Maximum instantaneous current	10 A
Rated voltage	250 V
Contact configuration	change over
Breaking capability (note 2)	
- tripping relays (RL1, RL2, RL3)	0.5 A
- signaling relays (RL4)	0.2 A
Mechanical endurance	> 10^6 operations
Electrical endurance (note 3)	> 50 * 10^3 operations

Digital inputs

Number of inputs	3
External control voltage	as Uaux
Typical current (sink)	3 mA

Communication interface

Physical level	RS-485, half duplex
Communication protocol	MODBUS® RTU
Transmission speed	from 1200 to 57600 baud, selectable
Parity	None, even, odd
Stop bit	1 or 2

Auxiliary supply

Power supply range version /#L	24 ÷ 90 Vdc ± 20% 24 ÷ 80 Vac ± 20%
Power supply range version /#H	90 ÷ 250 Vdc ± 20% 80 ÷ 230 Vac ± 20%
Frequency (Vca)	47 ÷ 63 Hz
Burdens (min/max)	3.5 / 6.5 W (DC power supply) 5 / 9 VA (AC power supply)

Environmental conditions

Operation	- 10 / +55 °C
Transport and storage	- 25 / +80 °C
Relative humidity (without condensation)	≤ 93%
Protection degree for flush mounting	IP 52
Weight	1.4 kg (3.09 lbs)

Note 1) The additional relay RL4 is controlled by self-test program

Note 2) Breaking capability at 110 Vdc, L/R = 40 ms, 100.000 operations.

Note 3) At rated load in AC1.

13 TABLES

Table A Settings

ANSI	Thresholds / functions		Settings	Resolut.
50 - 51	I>	Phase overcurrent	0.10 ÷ 5.00 In	0.01 In
	I>>		0.10 ÷ 40.00 In	0.01 In
	I>>>		0.10 ÷ 40.00 In	0.01 In
50N 51N 64S 64T	Io>	Earth overcurrent	0.01 ÷ 2.00 Ion	0.005 Ion
	Io>>		0.01 ÷ 10.00 Ion	0.01 Ion
	Io>>>		0.01 ÷ 10.00 Ion	0.01 Ion
50BF	Brk. Fail.	Breaker Failure	0.05 ÷ 1.00 In	0.01 In
	2^a Harmonic	2^{nd} Harmonic Restraint	10 ÷ 50 %	1 %
	Ibase		0.10 ÷ 1.00 In	0.01 In
Time delays			**Settings**	**Resolut.**
Definite time		All thresholds	0.05 ÷ 99.99 s	0.01 s
Dependent time (I>, Io>)		Characteristic curves (IEC 60255-151)	A, B, C	--
		Characteristic constant	0.01 ÷ 20.00 s	0.01 s
Definite time thresholds (I>, I>>, I>>>, Io>, Io>>, Io>>>)		Additional delay	0.00 ÷ 99.99 s	0.01 s

Table B Additional information

OTHER VALUES		
Burden (at rated value)	< 0.01 VA / phase (In = 1 A) < 0.2 VA / phase (In = 5 A)	< 0.01 VA (Ion = 1 A) < 0.2 VA (Ion = 5 A)
Drop-off ratio	≥ 0.95	
Overshoot time	≤ 30 ms	
Output relays (RL1, RL2, RL3)	Quiescent status: ENERGIZED or DE-ENERGIZED Programmable for each threshold or function as START / TRIP	

NOTES:

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