mecc alte

POWER FROM WITHIN

MP250 CONTROLLER

SMARTECH

TECHNICAL MANUAL

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Revision	Date	Notes
00	13/03/2019	First version of the manual for the version 01.00 of the controller.
01	17/06/2019	Valid for the version 1.02 of the controller. 6.4.7.3…6.4.7.7, 6.4.8.3, 6.4.8.4, 8.6.1, 8.7.1, 8.7.2, 8.7.3, 8.7.7, 8.8

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1 Introduction

1.1 References

[1] Mecc Alte EAAM0659xx - MP250 parameters table.

[2] Mecc Alte EAAM0458xx - BoardPRG3.xx Manual.

[3] Mecc Alte EAAP0457xx - USB driver Installation Guide.

1.2 Information on safety

Many accidents are caused by insufficient knowledge and not-applied safety rules during operation and/or maintenance operations.

To prevent accidents, before carrying out any operation and/or maintenance, read, understand and follow the precautions and warnings contained in this manual.

This manual contains the following indications:

WARNING! This indication is used in the safety messages of the manual when there are possible danger situations that may cause injuries or death.

This safety messages describe the normal precautions needed to avoid the danger. Ignoring these precautions can cause serious damage to property and/or injury to persons.

ATTENTION! This indication is used in the safety messages for dangers that may cause injuries, damages or malfunctions.

The message can be also used only for few dangers that may cause damages to things and/or people.

INFORMATION! This term indicates that the message includes useful information for the current operation or procedures clarifications.

1.3 Introduction and prerequisites

WARNING!

Every intervention must be carried out by skilled personnel. There are dangerous voltages on the terminals of the controller; before carrying out any operation on them, make sure to open the grid and generator circuit breakers or to open the related fuses.

Do not remove or change any connection when the system is running.

Wrong operations on the connections can cause the disconnection of the loads from the mains or the generator.

Please read this manual carefully before using the controller.

The controller uses many configurable parameters and it is therefore impossible to describe all their possible combinations and effects.

In this document, there isn't a detailed description of all the programmable parameters: to this purpose, see documents [1]; this document is to be considered as part of this manual.

The controller is supplied with a generic "default" configuration; it is a task of the installer to adjust the operating parameters to the specific application.

Mecc Alte carries out a great effort to improve and update its products; therefore, they are subject to both hardware and software modifications without notice. Some of the features described in this manual may therefore differ from those present in your controller.

1.4 Notes on the controller's parameters' configuration

Although most configurable parameters are accessible from the front panel, **some particular features or configurations, due to their nature, can only be set or edited through the Mecc Alte Board Programmer4 PC Software** (hereinafter called "BoardPrg4"), which can be downloaded for free from the Mecc Alte website www.meccalte.com

It simplifies a lot the configuration of the controller and its use is strongly suggested. It also allows you to save the current configuration of the controller on a file and to reuse it on other identical controllers.

BoardPrg3 is usable on all Mecc Alte controllers; for MP250 the connection to the PC is only possible via USB serial port; by connecting the controller to the USB port to the PC, the controller automatically turns on and it is therefore possible to modify the parameters without other supply sources. For the use of the program, refer to the document [2].

1.5 Definitions

The codes that identify functions for digital inputs and output, for status or other functions are preceded by the following acronyms:

DIF ("Digital Input Function"): the following is a code for the configuration of the digital inputs.

DOF ("Digital Output Function"): the following is a code for the configuration of the digital outputs.

EVT ("Event"): the following is an event code.

ST ("Status"): the following code identifies an internal status of the controller, or one of its internal functions.

AL ("Alarm"): the following is an anomaly code.

1.6 Conventions

In this manual, the modifications, with respect to the previous version, are signalled by a vertical bar on the right of the paragraphs. The modifications on the fields of a table are highlighted with a grey background.

1.7 Software revisions

Several parts of this manual refer to the controller's software revisions. These revisions are marked with the assigned Mecc Alte code (shown on the rear panel of the controller). The format of the code is: EB0250279XXYY, where “XX” is the main version and “YY” is the minor version. Thus, the code EB02502790100 refers to the controller software release "1.00". The software revision is also displayed on page “S.04” of the LCD display.

The software code available at the release date is:

- EB0250269xxyy **MP250**.

2 Views of the device

MP250 Front view

Back MP250

3 Technical features

Supply voltage Vbatt:	7...32 VDC with continuous operation, protections intervention at 60 VDC. Protection against the polarity inversion. Integrated self-restoring fuse. The controller identifies the plant operation at 12 or 24 VDC (to manage its protections) when powered up and each time the RESET button is pressed.
Power consumption:	No digital inputs active: 40 mA @ Vbatt = 13.5 VDC display lamp on. 26 mA @ Vbatt = 13.5 VDC display lamp off. 25 mA @ Vbatt = 27 VDC display lamp on. 16 mA @ Vbatt = 27 VDC display lamp off.
Maximum power consumption in operating conditions (internal horn and LCD lamp activated, digital inputs activated, static outputs not activated).	230 mA @ 7 VDC. 110 mA @ 27 VDC. 132 mA @ 13.5 VDC.
AC voltage measurements:	Analogue/digital conversion at 12bits; sampling frequency 20kHz. TRMS measurements. Available measurements: L-N phase voltages. L-L concatenated voltages. Neutral voltage referred to the negative pole of the power supply of the controller. Input impedance of the voltage measurements: > 280 kOhm L-N. > 560 kOhm L-L. >1600 kOhm L-GND. >1450 kOhm N-GND.
Maximum AC voltages allowed:	Maximum 300 VAC in CAT.III for measures L-N. Maximum 520 VAC in CAT.III for measures L-L.
Minimum AC voltage measurable:	Matching with the minimum voltages required for the frequency measurement, see below.
Frequency measurement:	Rated frequency 50 or 60Hz, measurement from 3 to 99.9Hz. Measurements obtained by the voltage of the L1 phase. Minimum sensibility for the measurement: 24 VRMS L-N @ 50/60 Hz.

Digital inputs:	Four digital inputs that provide GND on terminals when activated. The inversion of the activation logic is possible from parameter. When open, the voltage on the input terminals is 4.1 VDC for the input T.16 and 4.6 VDC for the other three inputs. Threshold of activation/deactivation: 1.55 VDC. Typical current at closed contact 4 mA for T.16 and 4.6 mA for the other three inputs. Maximum voltage applicable: 60 VDC. Minimum voltage applicable: -24 VDC.
Statics outputs:	Six independent static outputs, that provide +BATT on terminals when activated. The outgoing current is supplied through the positive supply terminal (T.02, +BATT) of the controller. The inversion of the activation logic is possible from parameter. Outputs T.03 and T.04: Maximum 5 A resistive continuous (each) at 32VDC. Maximum 10 A resistive (each) at 32VDC for 10 seconds. Integrated thermal protection, over current, short circuit and inverse polarity. Outputs T.05, T.06, T.07 and T.08: Maximum 500 mA continuous (each). Internal limitation to approximately 4 A total on transients <150 us, then thermal protection intervention. Integrated protection against overload, short-circuit, voltage surge and reverse polarity. **If the static outputs are connected to external relay coils, use external diodes to damp the opening over voltages, especially in case of inductive loads.**
USB connection:	USB 2.0 for non-permanent connection to PC (maximum 6 meters) only for parameters configuration with the Mecc Alte PC program BoardPrg4. The controller can be directly supplied by the USB port when connected to a PC, with maximum consumption of 250mA from USB port.
Display:	Graphic transflective LCD, size 65 x 33 mm, resolution 128x64 pixels. Self-regulating contrast with the temperature and with possibility of manual correction.
Operating conditions:	From -30°C to +70°C, 95% not condensing humidity (see chapter 4.1).
Stock conditions:	From -35°C to +80°C.
Size:	141(L) x 113(H) x 39(P) mm.
Weight:	191g only the controller. 250g with connectors and fixing.

Dimensions of the mounting place.	118 x 92 mm.
Protection degree.	IP 65 external with mounted seal, IP20 internal.

3.1 Measurement resolution

AC voltages	Resolution: 1 VRMS. Accuracy <1% F.S.
Frequency	0.01Hz ± 50ppm, 35ppm/C typical.

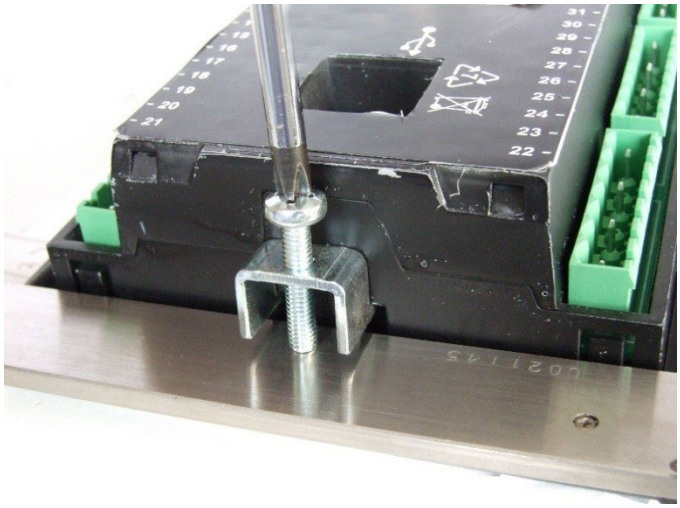
4 Installation

4.1 Mounting

The controller must be permanently mounted on a panel. The rear panel of the panel must be accessible only by keys or tools and only by authorized personnel for maintenance operations. It must be impossible to remove the controller without tools. The electric control panel must guarantee an adequate protection against bad weather.

WARNING! The operating temperature within the panel may vary between -30°C and +70°C; the outdoor operating temperature (ambient) can vary between -30°C and +60°C.

The mounting dimensions for the installation are 118 x 92 mm. The mounting is carried out by two hooks with screws: once the device is positioned, insert the hooks in the holes on the sides and tighten the screws. Pay attention not to tighten excessively the screws in order not to damage the hook on the device.



4.2 Wiring

Due to the high voltages connected to the measurement circuits of the controller, all conductive parts of the electrical panel should be connected to the protective earth through permanent connections.

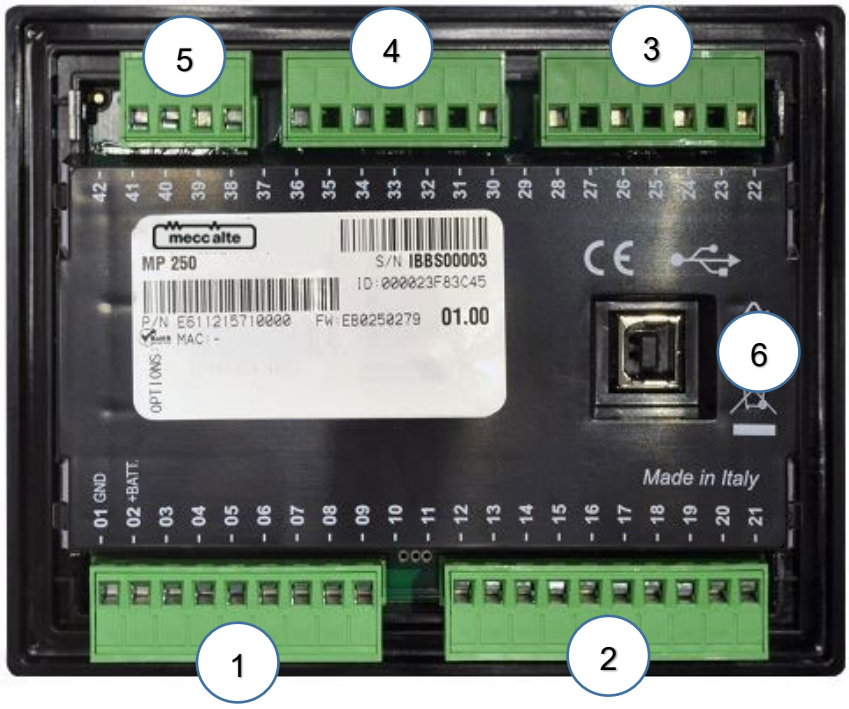
The installation of an overcurrent protection device is required for each phase of the AC voltage inputs. You can use 1 A fuses.

The section of the protective earth conductor should be at least equal to the section of cables used to wire the AC voltages to the panel. In addition, it must comply with the limit value of the overcurrent protection used.

For CAT.III applications, the maximum allowed phase-to-neutral voltage is 300 VAC, while the phase-to-phase voltage is 520 VAC. The maximum voltage related to the protective earth is 300 VAC.

The device can operate in CAT.III only if the negative pole of the power supply of the controller and the neutral terminal of the grid are both connected to the protective earth.

5 IN/OUT connections and configuration



N.	NAME	TERMINAL	FUNCTION	DESCRIPTION	CONNECTOR
1	JA	T.01	GND	Device supply	9 poles x 2.5 mm² Screw terminals
		T.02	+BATT		
		T.03	Digital output	Configurable digital output	
		T.04	Digital output	Configurable digital output	
		T.05	Digital output	Configurable digital output	
		T.06	Digital output	Configurable digital output	
		T.07	Digital output	Configurable digital output	
		T.08	Digital output	Configurable digital output	
		T.09	**NOT USED**		
2	JB	T.12	**NOT USED**		10 poles x 2.5 mm² Screw terminals
		T.13			
		T.14			
		T.15			
		T.16	Digital input	Configurable digital input	
		T.17	Digital input	Configurable digital input	
		T.18	Digital input	Configurable digital input	
		T.19	Digital input	Configurable digital input	
		T.20	**NOT USED**		
		T.21			
3	JC	T.22	L3	Mains AC voltages	4 poles x 2.5 mm² Screw terminals
		T.24	L2		
		T.26	L1		
		T.28	N		
4	JD	T.30	**NOT USED**		4 poles x 2.5 mm² Screw terminals
		T.32			
		T.34			
		T.36			

5	JE	T.38 T.39 T.40 T.41	**NOT USED**		4 poles x 2.5 mm^2 Screw terminals
6	JX		USB	USB communication port	USB type B

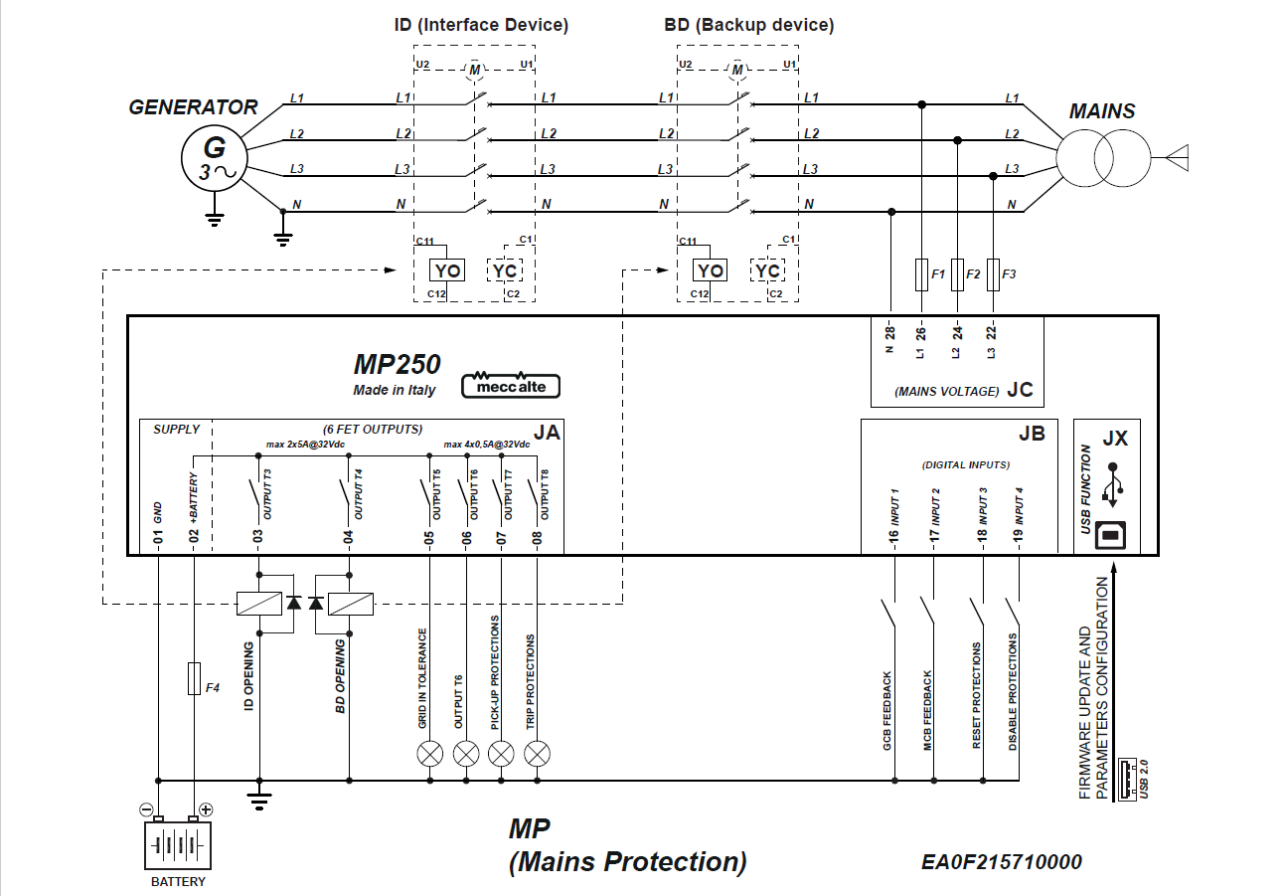
5.1 Correspondence input/output and their logic functions

In this document, we will always refer to the digital inputs and outputs through the name of the respective terminal T.XX; by the way, each terminal corresponds to a logic function depending on its configuration and its usage. It can be useful, in some cases (e.g. in the definition of AND/OR logic functions (see par. 0) or using the program BoardPrg3) to refer to the corresponding logic function.

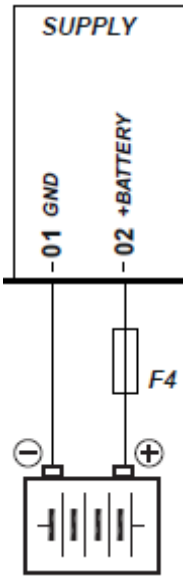
The following chart indicates the correspondences between the terminals, their respective logic functions and their default configurations.

Terminal	**Logic function**	**Default configuration**
DIGITAL OUTPUTS		
T.03	DO_CONTROLLER_T03	Opening command for interface circuit breaker.
T.04	DO_CONTROLLER_T04	Opening command for backup circuit breaker.
T.05	DO_CONTROLLER_T05	Grid in tolerance.
T.06	DO_CONTROLLER_T06	Not used.
T.07	DO_CONTROLLER_T07	Pick-up of grid protections.
T.08	DO_CONTROLLER_T08	Trip of grid protections.
DIGITAL INPUTS		
T.16	DI_CONTROLLER_T16	GCB feedback.
T.17	DI_CONTROLLER_T17	MCB feedback.
T.18	DI_CONTROLLER_T18	Grid protections reset command.
T.19	DI_CONTROLLER_T19	Grid protections disable command.

5.2 Principle connection diagram



5.3 Power supply (T.01, T.02)



ATTENTION! To respect the safety rules, an isolation of the power supply from the public grid must be always guarantee and must be lower than the one of a safety transformer compliant with norm IEC61558-2-6 or equivalent.

Connect a continuous power source to the terminals **T.01 GND** (negative) and **T.02 +BATT** (positive).

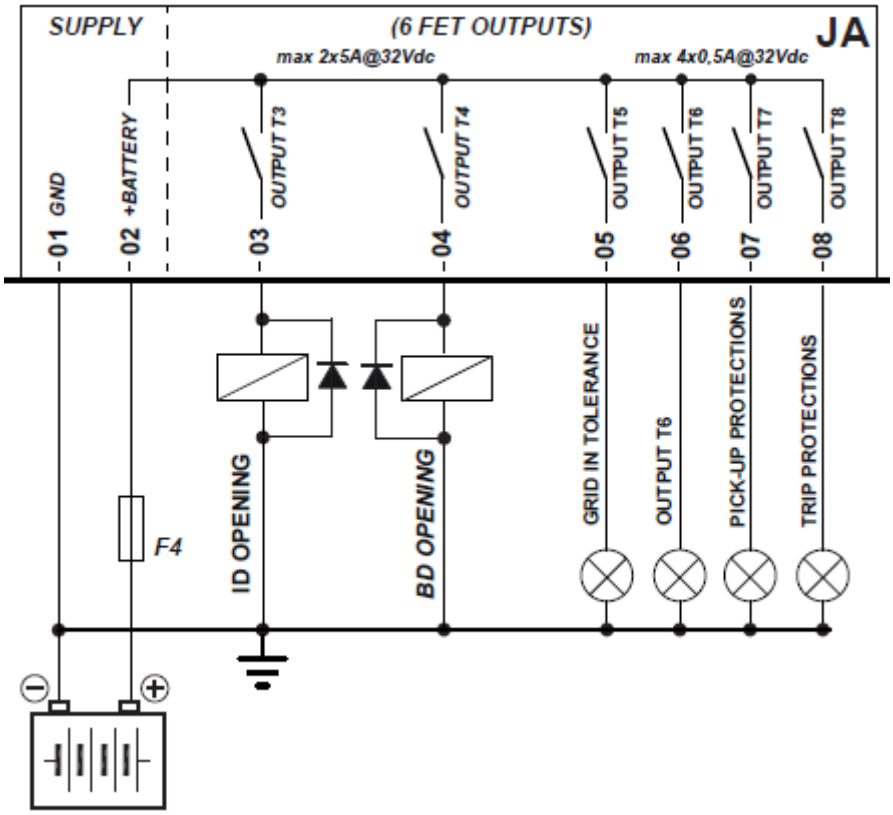
The negative terminal **T.01-GND** is the reference and the common return of the digital inputs, outputs and AC voltage measurement. **It must be connected to the protective earth.** Systems that require insulation between the negative power supply line and the protective earth can be used but can generate operating problems and may require care, as the use of insulation transformers for the AC voltage measurements.

Although the device is protected by a self-restoring internal fuse, the use of an external fuse to protect the positive power supply line **T.02 +BATT** is still necessary (F4 in the diagram). **All the current supplied by the six static outputs T.03...08 flows through the positive terminal T.02 +BATT, and it is therefore necessary to pay attention to the fuse dimensioning.**

The controller automatically recognizes the power supply rated voltage (12 or 24 VDC) for managing the related logics and anomalies. The recognition is done every time it is powered and every time the **RESET** button is pressed.

WARNING! During installation, connect the power supply positive line only after opening all fuses available in the panel.

5.4 Digital outputs (T.03, T.04, T.05, T.06, T.07, T.08)



The device manages six digital outputs, fully configurable. When activated, they bring their terminals to the positive power supply voltage (terminal **T.02**); **make sure that any safety fuse on the power supply positive line has a capacity and response time suitable to power and protect both the outputs and the controller under any condition of use.**

If the static outputs are connected to external relay coils, even if already provided internally, external diodes to damp the opening over voltages must be used, especially in case of inductive loads.

- Outputs T.03 and T.04: the rated capacity of each output is 5A resistive continuous at 32 VDC. They resist maximum 10A resistive (each) at 32 VDC for 10 seconds. Thermal, overcurrent, short-circuit and reverse polarity protections are integrated.

- Outputs T.03, T.04, T.05 and T.06: the rated capacity of each output is 500mA resistive; the total current is, therefore, of 2A. **In working conditions, do never overpass these values**. The outputs are independent and protected individually from overloads, short circuits, polarity reversal and overheating. The overload protection cuts in to limit the current spikes to an instantaneous value of 4A, to allow the activation of loads that require a transient inrush current greater than the rated. If this condition persists, after 150us the thermal protection cuts in progressively, until the output is turned off.

For each output, it is possible to select the associated function and possibly to invert the activation logic.

The outputs functions configured by default are the following:

Terminal	Function
T.03	DOF.3040 – Opening command for interface breaker.
T.04	DOF.3041 – Opening command for backup breaker.

Terminal	Function
T.05	DOF.3034 – Grid in tolerance.
T.06	DOF.0000 – Not used.
T.07	DOF.3038 – Pick-up of grid protections.
T.08	DOF.3039 – Trip of grid protections.

5.4.1 Digital outputs configuration

Each of the six digital outputs of the controller is singularly completely configurable.

The status of the digital outputs is shown on display page S.06 (0=output inactive, 1=output active).

By default, each output is activated when the related function requires it (for example the “grid in tolerance” output starts operating when the grid is “in tolerance”). Using the BoardPrg3 it’s possible to reverse the activation by simply ticking the “Reverse polarity” box on the top of the configuration page of every single output. It is also possible to reverse the logic of the outputs directly operating on the controller (still singularly for each output), using the parameter P.3000 (6 bits in total):

- A zero-bit means that the output is normally deactivated and starts operating when the related feature requires it.
- A one-bit means that the output is normally activated and stops operating when the related function requires it.

The mapping of the outputs on the controller is:

Bit	Value	Hexadecimal value	Output
0	1	01	T.03
1	2	02	T.04
2	4	04	T.05
3	8	08	T.06
4	16	10	T.07
5	32	20	T.08

Basically, if you want to reverse the logic of an output, it is necessary to add, in the P.3000 parameter, the corresponding value: e.g. if you want to reverse the outputs T.05 and T.06, it is necessary to set P.3000 =12 (that is 4+8) (“0C” in hexadecimal). By default, all bits are set to zero.

The digital outputs can be used directly as command for devices outside the controller, or for reporting certain operating conditions.

Functions configurable on the digital outputs

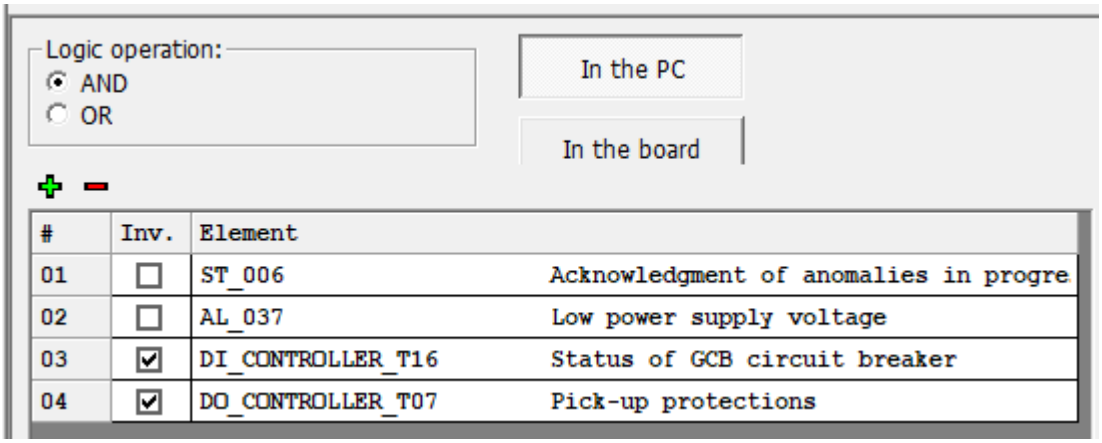
Code	Description.	Notes
DOF.0000	Not used.	
DOF.0102	Managed by the communication ports.	The controller never manages the output with its own logics, but with commands received from the USB port.
DOF.0103	AND/OR logics.	The status of the output is the result of the combination of the AND/OR logics. See par. 0
DOF.3034	Grid in tolerance.	It is activated when no grid protection is tripped.
DOF.3038	Grid protections pick-up.	Useful during the TEST of the grid protections, it activates whenever a measurement goes “out of threshold” (instantaneously, with no regards on the configured delay).
DOF.3039	Grid protections trip.	Useful during the TEST of the grid protections, it activates whenever a protection trips (even if the grid is disconnected from the plant).

DOF.3040	Opening command for the interface breaker.	The controller activates this output when a grid protection trips if the MCB and GCB circuit breakers are both closed.
DOF.3041	Opening command for the backup breaker.	The controller activates this output if the interface breaker does not open within P.9501 seconds from the trip of a grid protection.
DOF.3151	Reset of the anomalies.	It is activated when the controller performs a RESET of the anomalies.
DOF.3152	External horn.	It is activated together with the internal horn.
DOF.3153	Lamp test	It is activated by pressing the RESET button: it can be used to turn on possible external led to the controller and have one only procedure to test the TRIP lamps.
DOF.4001	Warnings	It is activated in presence of warnings
DOF.4004	Alarms.	It is activated in presence of alarms

5.4.2 AND/OR logics

The AND/OR logics are, basically, a list of boolean conditions (true/false, on/off, 1/0), which can be configured by the operator (programming), evaluated by the controller: the result can be assigned to a digital output (see par.5.4.1). For using the AND/OR logics with a digital output, use the DOF.0103 function.

INFORMATION! The configuration of the AND/OR logics cannot be carried out directly from the controller, but it must be carried out by a PC with the BoardPrg3 software.



It is necessary to decide whether the list of conditions must be evaluated as AND (they must be all verified) or as OR (it is enough that at least one condition is verified). **It is not possible to have mixed logics AND/OR (it is possible using the virtual digital inputs, see afterwards).**

You can add up to 30 conditions. Each condition can be negated individually: in the previous picture, for instance, the controller will check that the digital input T.16 and the digital output T.07 are both **inactive**. The following conditions can be added:

- DI_XXX: logic statuses of all digital inputs.
- DO_XXX: logic statuses of all digital outputs.
- AL_XXX: presence of anomalies.
- ST_XXX: internal statuses of the controller.

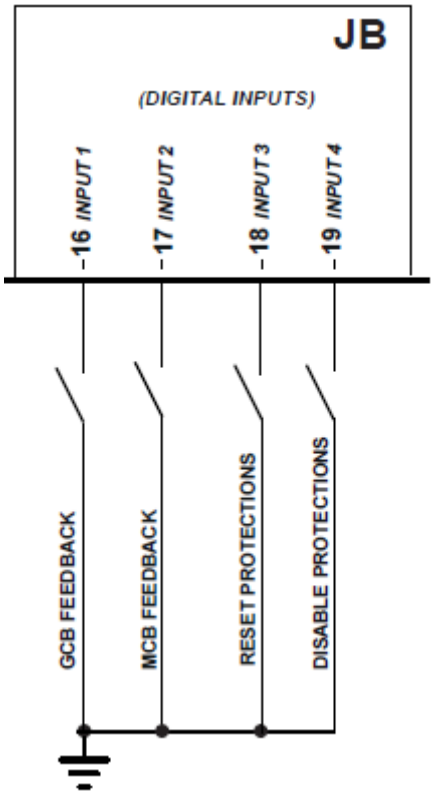
The following table shows the list of the internal statuses available for the AND/OR logics.

Status	Description

ST_006	Acknowledgment of anomalies in progress.
ST_007	Reset of anomalies in progress.
ST_008	Warnings.
ST_011	Alarms.
ST_012	Not recognized warnings.
ST_015	Not recognized alarms.
ST_016	Protection 27_1 tripped.
ST_017	Protection 27_2 tripped.
ST_018	Protection 27_3 tripped.
ST_019	Protection 27_4 tripped.
ST_020	Protection 27_5 tripped.
ST_021	Protection 59_1 tripped.
ST_022	Protection 59_2 tripped.
ST_023	Protection 59_3 tripped.
ST_024	Protection 59_4 tripped.
ST_025	Protection 59_5 tripped.
ST_026	Protection 59_AVG tripped.
ST_027	Protection V0 tripped.
ST_028	Protection V+ tripped.
ST_029	Protection V- tripped.
ST_030	Protection V_UNB tripped.
ST_031	Protection SEQ tripped.
ST_032	Protection 81U_1 tripped.
ST_033	Protection 81U_2 tripped.
ST_034	Protection 81O_1 tripped.
ST_035	Protection 81O_2 tripped.
ST_036	Protection 81R-1 tripped.
ST_037	Protection 81R-2 tripped.
ST_038	Protection 81R-3 tripped.
ST_039	Protection VS tripped.
ST_040	Protection EXT tripped.
ST_064	GCB status.
ST_065	MCB status.
ST_112	Sync per second.
ST_113	Sync per minute.
ST_114	Sync per hour.
ST_127	Daylight Save Time.
ST_224	Calendar 1.
ST_225	Calendar 2.
ST_226	Calendar 3.
ST_227	Calendar 4.
ST_228	Calendar 5.
ST_229	Calendar 6.
ST_230	Calendar 7.
ST_231	Calendar 8.
ST_232	Calendar 9.
ST_233	Calendar 10.
ST_234	Calendar 11.
ST_235	Calendar 12.
ST_236	Calendar 13.
ST_237	Calendar 14.
ST_238	Calendar 15.
ST_239	Calendar 16.

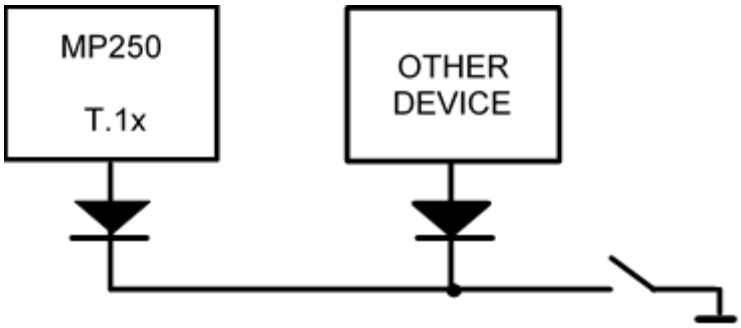
ST_240	Timer 1.
ST_241	Timer 2.
ST_242	Timer 3.
ST_243	Timer 4.
ST_310	Button UP.
ST_311	Button DOWN.
ST_314	Button ENTER.
ST_315	Button ESC/SHIFT.
ST_318	Button RESET.
ST_998	Always ON.
ST_999	Always OFF.

5.5 Digital inputs



The controller has 4 digital inputs, which can be activated by connecting them to GND. When left unconnected, the terminals go to around 4.5 VDC (around 4.15 VDC for input T.16). Avoid situations where intermediate or undefined voltage levels can occur.

If you are going to use the same signal shared among different devices beside MP250, it is recommendable the use of series diodes at the inputs as per the following figure:



For each input it is possible to select the associated function and to invert the activation logic.

By default, the functions of the inputs are the following:

Terminal	Function
T.16	DIF.3001 – GCB feedback.
T.17	DIF.3002 – MCB feedback.
T.18	DIF.2719 – Grid protections reset command.
T.19	DIF.2710 – Grid protections disable command.

5.5.1 Virtual digital inputs

The controller, in addition to the four physical digital inputs, also manages eight virtual digital inputs. They are managed by the controller exactly as if they were physical inputs (without any limitation), but their statuses are not acquired by the hardware but determined by software. For each virtual digital input, in fact, it is possible to associate an AND/OR logic that determines its status (see section 5.4.2).

Practical example of use. Suppose we want to reset the grid protections when the ENTER button is pressed and protection 27 - level 1 is not active. We use the virtual digital input # 1 (as an example).

Using the BoardPrg3 software, we associate the virtual digital input # 1 with an AND/OR logic configured as AND, with the following list of conditions:

- ST.314 (“Button ENTER”).
- ST.016 (“Protection 27_1 tripped”). This condition must have the "INV" column ticked (negated).

The virtual digital input will then be active when the ENTER button is pressed and the protection 27_1 is not active.

Set the DIF.2719 function ("Grid protection reset command") in parameter P.2151.

5.5.2 Digital inputs configuration

By default, all the digital inputs are considered “active” when the related terminal is connected to the negative pole of the controller’s power supply voltage; they are considered “not active” when the related terminal is left unconnected. **The logical status of the input can be inverted with respect of the physical status by selecting the box “Reverse polarity” in the input configuration page on BoardPrg3.** The box is only visible if the function selected is other than DIF.0000 – “Not used”. It is also possible to invert the logical status (for each single input), operating directly on the controller, using the parameters P.3000. This parameter has a bit for each input:

- A bit set to zero means that the related input is “active” when it is connected to the negative pole of the controller’s power supply voltage.
- A bit set to one means that the related input is considered “active” when it is left unconnected (it will become “not active” if it is connected to the negative pole of the controller’s power supply voltage).

By default, all bits are set to zero.

Two parameters are associated to each input:

- A parameter that configures the function of it (P.2001 for the input **T.16,** the consecutive parameters for the other inputs).
- A parameter that configures an activation delay of the function (P.2002 for the input **T.16,** the consecutive parameters for the other inputs). **Now, the delay parameter is never used, it is for future implementations.**

See documents [1] for the parameters list.

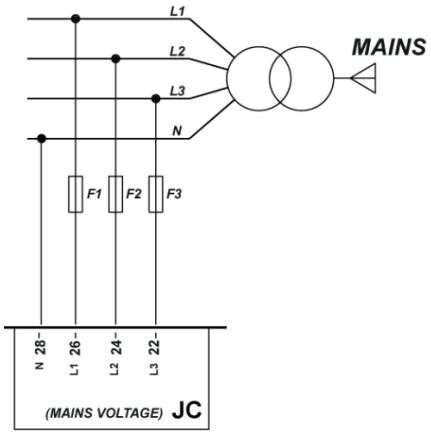
The parameter that configures the delay for an input is used by the controller only for some input functions. The following chart highlights when it is used:

Following are the configurable functions on the digital inputs:

Code	Description.	Notes
DIF.0000	Not used.	Input not used.

Code	Description.	Notes
DIF.2001	Command for resetting anomalies.	When the input becomes active, the controller executes a reset of all anomalies. That is equivalent to press the RESET button.
DIF.2002	Command for acknowledging anomalies.	When the input becomes active, the controller executes an acknowledge of all anomalies. That is equivalent to press the ENTER button twice.
DIF.2151	Select the configuration 1.	When the input becomes "active", parameters of the alternative configuration set #1 are copied in the working configuration.
DIF.2152	Select the configuration 2.	When the input becomes "active", parameters of the alternative configuration set #2 are copied in the working configuration.
DIF.2710	Grid protections disable command.	When the input is active, all the grid protections are disabled.
DIF.2711	Grid protections disable command #1.	When the input is active, the grid protections selected by parameter P.9511 are disabled.
DIF.2712	Grid protections disable command #2.	When the input is active, the grid protections selected by parameter P.9512 are disabled.
DIF.2713	Grid protections disable command #3.	When the input is active, the grid protections selected by parameter P.9513 are disabled.
DIF.2714	Grid protections disable command #4.	When the input is active, the grid protections selected by parameter P.9514 are disabled.
DIF.2715	Grid protections disable command #5.	When the input is active, the grid protections selected by parameter P.9515 are disabled.
DIF.2716	Grid protections disable command #6.	When the input is active, the grid protections selected by parameter P.9516 are disabled.
DIF.2717	Grid protections disable command #7.	When the input is active, the grid protections selected by parameter P.9517 are disabled.
DIF.2718	Grid protections disable command #8.	When the input is active, the grid protections selected by parameter P.9518 are disabled.
DIF.2719	Grid protections reset command.	When the input becomes "active", the controller performs a complete reset of all the grid protections.
DIF.3001	GCB feedback.	This input is used to get the status of the GCB circuit breaker, to know if the grid is connected to the system.
DIF.3002	MCB feedback.	This input is used to get the status of the MCB circuit breaker, to know if the grid is connected to the system.
DIF.3101	External sensor for grid.	When the input **is inactive**, the controller activates the related grid protection.

5.6 Connection to the grid (T.22…T.28)



The terminals **T.22, T.24, T.26, T.28** allow the connection to the public grid**,** using protection fuses (suggested 1A).

Three-phases connection:

- Connect the neutral (N) (if any) to the terminal **T.28.**
- Connect the phase L1 (or R) to the terminal **T.26.**
- Connect the phase L2 (or S) to the terminal **T.24.**
- Connect the phase L3 (or T) to the terminal **T.22.**

Single-phase connection:

- Connect the neutral (N) to the terminal **T.28.**
- Connect the phase L to the terminal **T.26.**

Parameters P.0119 allows to select the three-phases/single-phase mode.

For the usage in CAT.III, the maximum working voltage is 300 VAC (phase-neutral) and 520 VAC (phase-phase). Maximum voltage to ground is 300 VAC.

The controller uses phase L1 (terminal **T.26**) to measure the frequency.

5.6.1 Measurement of the neutral

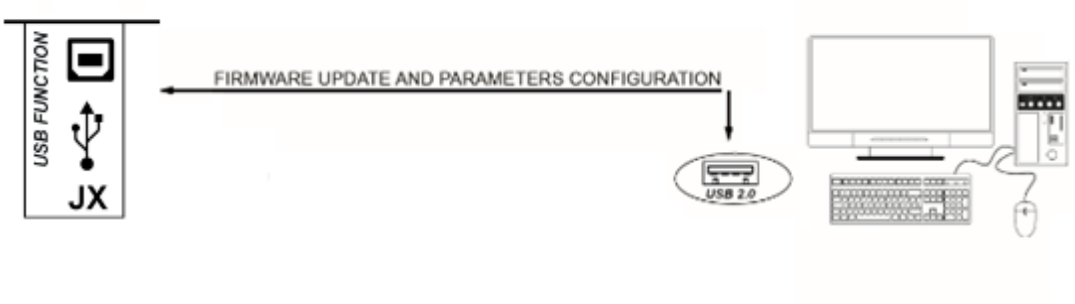
The controller, in three-phases connection, can work both with the neutral connection and without it; the selection is performed through the P.0129 parameter.

If the system is configured with the neutral connection, the neutral voltage is measured in relation with GND.

The measurements of the V1-N, V2-N and V3-N phase voltages, and the VN voltage of the neutral in relation to GND are displayed on page M.02.

If the device is configured not to measure the neutral voltage, then page M.02 will not be displayed.

5.7 USB Connection



MP250 has a USB port with B-type connector for a temporary connection with a PC for the parameter's configuration or for the reading of history logs.

The USB protocol specifications do not allow it to be used permanently in the industrial sector due to limited length of the cable and to the relatively elevated sensitivity to electrical disturbances including on the PC side. For this reason, the USB connection cable must only be plugged when it is necessary to operate on the controller and it must be removed from the connector when the operation is finished.

INFORMATION! The controller is directly supplied by the PC through the USB cable and it turns on as soon as it is connected, so to let the parameters programming be as easy as possible and without external power supply. Make sure that the PC can provide at least 300mA through the USB port used.

INFORMATION! When supplied by USB, the back-light if the LCD display can be reduced compared to the normal operation; this is normal, and it is not to be considered a device fault.

WARNING! When the device is supplied by the sole USB port, it is not to be considered operative and must not be used to manage the plant.

On PC side, the driver "CDC_Sices_Win.inf" (supplied by Mecc Alte) must be installed; for driver installation refer to document [3]. Once the driver has been installed, the PC will detect the controller as a new serial port, to be used just as if it was a standard RS232 serial port.

The USB connection to a PC is used for three purposes:

- Parameters programming.
- Reading the history logs.
- Upgrading the firmware of the controller.

The parameters programming is carried out through the BoardPrg4 program (Mecc Alte), which also allows to modify the counters, allows the synchronisation of the internal clock of the controller with the one of the PC and allows to save the configuration on file. For the use of the program, refer to the document [2].

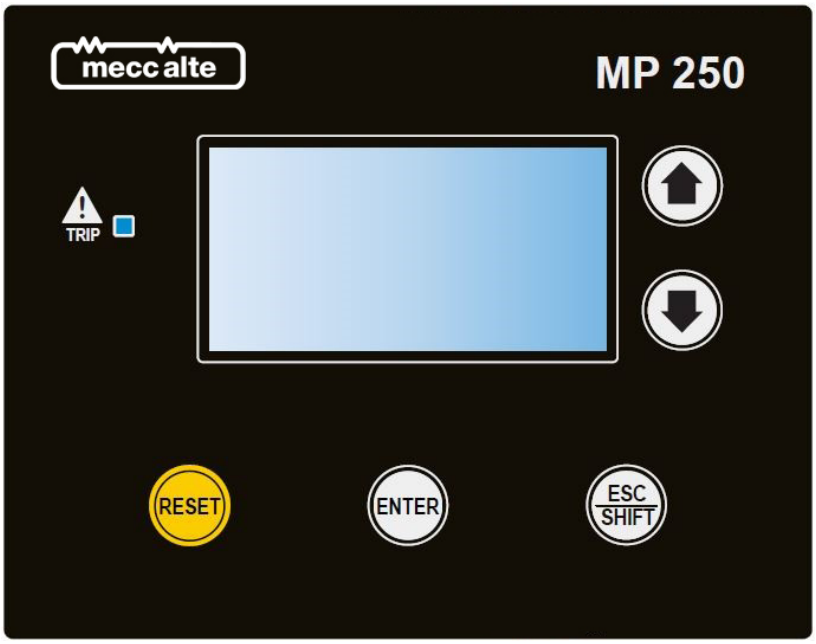
The reading of the history logs can be realised by means of special software tools.

The firmware upgrade of the controller is a specific operation of Mecc Alte; in addition to the new firmware to be loaded, it requires a procedure and specific programs; normally this procedure must

not be carried out by non- Mecc Alte person, except in specific situations previously agreed on with Mecc Alte.

6 Command and indications

6.1 MP250 Front panel



6.2 Push-buttons

Push-button		Function
	**UP**	It selects the previous page of the current menu; pressed for more than one second, it selects the previous menu. Together with the **SHIFT** button, it increases the display contrast. It increases the value of the selected setpoint during programming.
	**DOWN**	It selects the next page of the current menu; pressed for more than one second, it selects the next menu. Together with the **SHIFT** button, it decreases the display contrast. It decreases the value of the selected setpoint during programming.
	**RESET**	It performs a manual reset of all grid protections (if the auto-reset mode is not selected). It also resets all anomalies. It carries out the LAMP TEST of the TRIP led (while it is pressed). In programming, it allows to select the next digit during the editing process. **It forces a data / parameter saving into non-volatile memory: press this button and wait a few seconds before removing power supply.**
	**ENTER**	It silences the internal buzzer. It also recognizes all anomalies. It allows to entry into a submenu. In programming it starts and confirms the modification of a setpoint. Pressed together with the **EXIT** button: • When the controller is powered, it allows access to special functions.

		• During operation, it allows resetting the counters, clearing of the historical logs and reloading the defaults for the setpoints.
	**ESC / SHIFT**	It allows the exit from a submenu. In programming, it cancels the modification of a setpoint. Pressed together with the **ENTER** button: see above.

6.3 Indicators

LED OFF	LED steady ON	LED flashing
☐	▣	⧈

	Signalling		**Function**
	**TRIP**	▣	It indicates that at least one grid protection is tripped.
		⧈	It indicates that at least one anomaly is active.
		☐	No anomalies are present, and no grid protections are tripped.

6.4 Multifunctional display

6.4.1 LCD lighting

The back-light lamp is managed by the controller, which switches it off after a programmable delay (P.0492) without pressing any button. To turn it on again, simply press any button. This function can be disabled by setting parameter P.492 to 0.

6.4.2 Brightness adjustment

Depending on the environmental temperature conditions, it could be required a manual adjustment of the brightness to view the display correctly. Press in sequence the buttons **SHIFT** + **DOWN** to decrease it (lighten), press the buttons **SHIFT** + **UP** to increase it (darken).

6.4.3 Mode (menu) navigation

The display has different visualization modes, each composed by different pages:

Menu	
PROGRAM.	P.XX
STATUS	S.XX
MEASURES	M.XX
HISTORY	H.XX

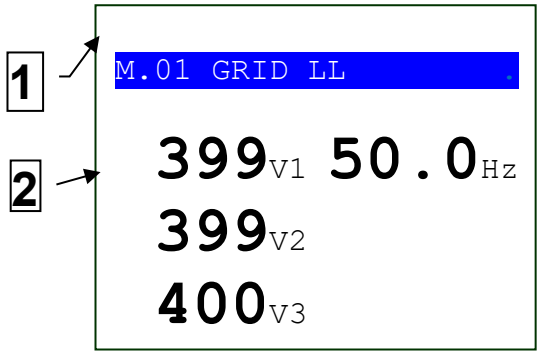
Multifunction display			
Press 1 sec	P.01	P.02	P.XX
	S.01	S.02	S.XX
	M.01	M.02	M.XX
	H.01	H.02	H.XX
			Press 1 sec

You can switch modes by holding down the **UP** or **DOWN** buttons for more than one second. Pressing them for less than a second, on the other hand, selects the pages within the current mode.

6.4.4 Structure of display areas

KEY:

1 Status bar
2 Data area

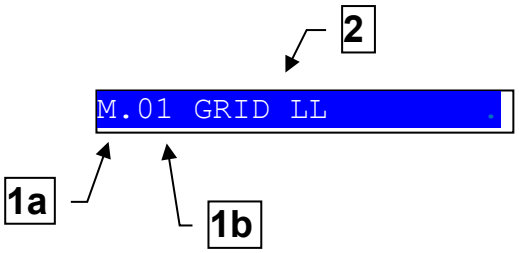


6.4.5 Top status bar

The top status bar contains information on navigation, times and/or some status information.

KEY:

1a Mode identifier
1b Page identifier
2 Title (description



The mode identifier (1a), and the page identifier (1b) identify and refer to the page so there is no chance of error. The title (description) is displayed in the current language.

The controller shows a special symbol (@) in the last character to the right of the top status bar when it is storing data / setpoints in the non-volatile memory: do not remove the power supply to the card at this stage.

6.4.6 Status information (S.XX)

This mode provides information on the system status. You can scroll through the different pages using the UP and DOWN navigation buttons.

6.4.6.1 S.01 STATUS

This page displays system status information. It contains:

- The global status of the grid (indicates if no grid protection has been triggered).
- The feedback of the GCB circuit breaker.
- The feedback of the MCB circuit breaker.

6.4.6.2 S.02 ANOMALIES

This page is automatically displayed if there is a new anomaly. For each anomaly it is shown:

- A char that identifies the type:
  - "A": alarm.
  - "W": warning.
- A three-digits numerical code that uniquely identifies the anomaly. This code flashes if the anomaly has not yet been acknowledged with the ENTER button.
- A description in the selected language.

Each anomaly uses one or two lines of the LCD display. The anomaly shown above is the most recent in chronological order. If the space available is not enough to display all the anomalies, only the most recent ones are shown. To see the others:

- Press the ENTER button.
- Use the UP and DOWN button s to move among all the anomalies.
- At the end press ENTER.

6.4.6.3 S.03 USB

This page displays the status of the communication via the USB port (in progress, at rest).

6.4.6.4 S.04 DEVICE

This page displays the specific information of the controller:

- Date and time.
- ID Code.
- Firmware version.
- Power supply voltage.

It also allows you to select the language for the display:

- Press the ENTER button.
- Select the language using the UP and DOWN buttons.

- Confirm with ENTER.

By default, the controller only contains the English language. Using BoardPrg3 you can download additional languages to your device.

6.4.6.5 S.05 DIGITAL INPUTS

This page displays the status of the digital inputs of the controller, both physical and virtual.

By pressing the ENTER button, it is possible to alternate the display mode of the inputs:

- **LOGICAL STATUS**: the controller shows the logical levels of the inputs (active or inactive) used in the management of the operating sequence.
- **PHYSICAL STATUS**: the controller shows the electrical levels (active or inactive, or high or low) present on the inputs; they can be opposite to the corresponding logical states. They are shown in negative.

6.4.6.6 S.06 DIGITAL OUTPUTS

This page shows the status of the digital outputs of the controller.

By pressing the ENTER button, it is possible to alternate the display mode of the outputs:

- **LOGICAL STATUS**: the controller shows the logical levels of the outputs (active or inactive) used in the management of the operating sequence.
- **PHYSICAL STATUS**: the controller shows the real commands (active or inactive) of the outputs; they can be opposite to the corresponding logical states. They are shown in negative.

6.4.7 Electrical measures (M.XX)

In this mode, the measurements made by the controller on the grid are displayed. Furthermore, the status of all the grid protections is displayed. You can scroll through the different pages using the **UP** and **DOWN** navigation buttons.

6.4.7.1 M.01 GRID LL

This page is only displayed for three-phases systems.

It shows the line-to-line voltages, the frequency and the phases' sequence (clockwise or counter clockwise) of the grid.

6.4.7.2 M.02 GRID LN

This page is shown for three-phases systems only, if the system is configured to use the neutral connection (see section 5.6.1). It is always displayed for single-phase systems.

It shows the line-to-neutral voltages and the voltage between the neutral and the negative pole of the power supply. For single-phase systems it also displays the frequency (page M.01 is hidden in this case).

6.4.7.3 M.03 GRID LL 10 min

This page is only displayed for three-phases systems.

It shows the 10 minutes rolling averages of the line-to-line voltages of the grid.

6.4.7.4 M.04 GRID LN 10 min

This page is shown for three-phases systems only, if the system is configured to use the neutral connection (see section 5.6.1). It is always displayed for single-phase systems.

It shows the 10 minutes rolling averages of the line-to-neutral voltages of the grid.

6.4.7.5 M.05 GRID V+/-/0

This page is only displayed for three-phases systems.

It shows the following voltages:

- Positive sequence (V+).
- Negative sequence (V-).
- Zero sequence (V0).

The controller can manage some protections on these measures.

6.4.7.6 M.06 GRID PROTECTIONS

This page shows the codes of the enabled grid protections (only those enabled):

- 27_1
- 27_2
- 27_3
- 27_4

- 27_5
- 59_1
- 59_2
- 59_3
- 59_4
- 59_5
- 59_AVG
- V0
- V+
- V-
- V_UNB
- SEQ
- 81U_1
- 81U_2
- 81O_1
- 81O_2
- 81R-1
- 81R-2
- 81R-3
- VS
- EXT

The previous codes are shown in reverse if the relative protections are tripped.

6.4.7.7 M.07 M.08 M.09 M.10 PROTECTION COUNTERS

These pages show the counters of the trips of the grid protections enabled (only those enabled). A row is used for each protection: on the left the protection code is shown (see previous paragraph) and on the right the number of activations. Each page shows up to 7 counters, the number of pages depends on the number of enabled protections.

It is possible to reset all the counters of the trips of the grid protections (**all together**) by pressing the **ENTER** and **ESC** buttons for 5 seconds.

It is also possible to reset them using a Modbus command via USB. The commands can be protected by a password (P.0004) which must be sent before any command and can be deactivated through a digital input (DIF.2706). To send the command, it is necessary to write in sequence (within 5 seconds):

- HOLDING REGISTER 101: write the password configured with the parameter P.0004.
- HOLDING REGISTER 102: write value “72”.

6.4.8 History archives (H.XX)

During the operation, the controller makes periodical or on event recordings, partially configurable with the programming parameters. It also records the minimum and maximum values of the main electrical measurements.

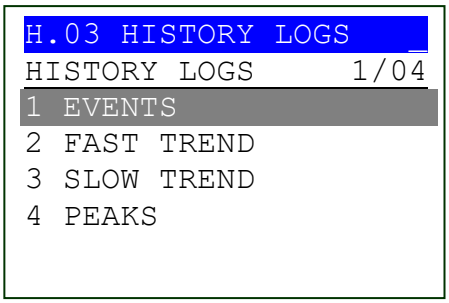
The historical archives can be downloaded via PC through the USB connection.

Four types of archives are managed:

#	Description	Log capacity
1	Events	63
2	Fast analogue	63
3	Slow analogue	63
4	Peaks	13

The pages in this mode are organized differently from the M.XX and S.XX pages. They have a menu organization. From the main page H.01, press the **ENTER** button to access the archive selection page.

6.4.8.1 Selection of the archive



The second row, on the right side, shows the number of available archives (4) and the index of the selected one (1 in the example). The following rows show the selectable archives. The selected item is highlighted in reverse

Using the **UP** and **DOWN** buttons select the archives in cyclic mode (i.e. by pressing **UP** from the first item you switch to the last and vice versa).

6.4.8.2 Entry into an archive

Press the **ENTER** button to view the recordings of the selected archive.

6.4.8.3 Pages for events and analogues

This description is common to the first three archives (events, fast analogue, slow analogue).

The controller adds a record to the event archive at the time an event occurs (previously configured with parameter P.0441). The capacity of this archive is 63 records.

The following table shows the values available for parameter P.0441: it must be set with the sum (hexadecimal) of the requested functions.

Ver.	Bit	Value	Hexadecimal	Description
01.00	0	1	01	Circuit breakers feedbacks.
01.00	1	2	02	-
01.00	2	4	04	-
01.00	3	8	08	-
01.00	4	16	10	-
01.00	5	32	20	-

01.00	6	64	40	-
01.00	7	128	80	-

The trip and reset of the grid protections are always recorded (they cannot be disabled). Also, the activation of any anomalies is always recorded (it can't be disabled). The default value of the parameter P.0441 is "01" (hexadecimal).

The controller adds a recording in the fast analogue archive every P.0442 seconds. The capacity of this archive is 63 records: with the default value of P.0442 (60 seconds) the archive fills up in something more than an hour.

The controller adds a recording in the slow analogue archive every P.0443 minutes. The capacity of this archive is 63 records: with the default value of P.0443 (30 seconds) the archive fills up in around a day and a half.

If an archive is full, with each new event the oldest one is overwritten (the last 63 records are always kept).

The recorded information is the same for all archives:

- Date/time.
- Numeric code.

Code	Description
EVT_0	Periodical recording of analogue measures.
EVT_1032	GCB closed.
EVT_1033	GCB open.
EVT_1037	MCB closed.
EVT_1038	MCB open.
EVT_1074	Auto reset of the controller.
EVT_1075	Real time clock not valid.
EVT_1076	Real time clock updated.
EVT_1077	New power on of the controller.
EVT_1078	Parameters have been reloaded with their default values.
EVT_1086	Daylight Save Time activated.
EVT_1087	Daylight Save Time deactivated.
EVT_1101	protection 27_1 tripped.
EVT_1102	protection 27_1 restored.
EVT_1103	protection 27_2 tripped.
EVT_1104	protection 27_2 restored.
EVT_1105	protection 27_3 tripped.
EVT_1106	protection 27_3 restored.
EVT_1107	protection 27_4 tripped.
EVT_1108	protection 27_4 restored.
EVT_1109	protection 27_5 tripped.
EVT_1110	protection 27_5 restored.
EVT_1121	protection 59_1 tripped.
EVT_1122	protection 59_1 restored.
EVT_1123	protection 59_2 tripped.

EVT_1124	protection 59_2 restored.
EVT_1125	protection 59_3 tripped.
EVT_1126	protection 59_3 restored.
EVT_1127	protection 59_4 tripped.
EVT_1128	protection 59_4 restored.
EVT_1129	protection 59_5 tripped.
EVT_1130	protection 59_5 restored.
EVT_1131	protection 59_AVG tripped.
EVT_1132	protection 59_AVG restored.
EVT_1141	protection 59_V0 tripped.
EVT_1142	protection 59_V0 restored.
EVT_1143	protection 59_V- tripped.
EVT_1144	protection 59_V- restored.
EVT_1145	protection 27_V+ tripped.
EVT_1146	protection 27_V+ restored.
EVT_1147	protection voltage unbalance tripped.
EVT_1148	protection voltage unbalance restored.
EVT_1149	protection phases sequence tripped.
EVT_1150	protection phases sequence restored.
EVT_1161	protection 81U_1 tripped.
EVT_1162	protection 81U_1 restored.
EVT_1163	protection 81U_2 tripped.
EVT_1164	protection 81U_2 restored.
EVT_1181	protection 81O_1 tripped.
EVT_1182	protection 81O_1 restored.
EVT_1183	protection 81O_2 tripped.
EVT_1184	protection 81O_2 restored.
EVT_1201	protection ROCOF_1 tripped.
EVT_1202	protection ROCOF_1 restored.
EVT_1203	protection ROCOF_2 tripped.
EVT_1204	protection ROCOF_2 restored.
EVT_1205	protection ROCOF_3 tripped.
EVT_1206	protection ROCOF_3 restored.
EVT_1221	protection vector jump tripped.
EVT_1222	protection vector jump restored.
EVT_1231	external protection tripped.
EVT_1232	external protection restored.
EVT_2000 + xxx:	warning xxx activated.
EVT_5000 + xxx:	alarm xxx activated.

- GCB and MCB feedbacks.
- Status of the digital inputs (physical and virtual) of the controller.
- Status of the digital outputs of the controller.

- Numerical codes of up to four active anomalies (0 if there are no active anomalies).
- Grid frequency.
- Line-to-line grid voltages (last 10 minutes average for event EVT_1131).
- Line-to-neutral grid voltages (last 10 minutes average for event EVT_1131).
- Neutral-to-GND grid voltage.
- Grid phases' sequence.
- Positive/negative/zero sequence grid voltage.
- Rate of variation of the grid frequency (Δf / Δt) (only for EVT.1201, EVT.1203 and EVT.1205 events).
- Vector jump measurement (only for EVT.1221 event).

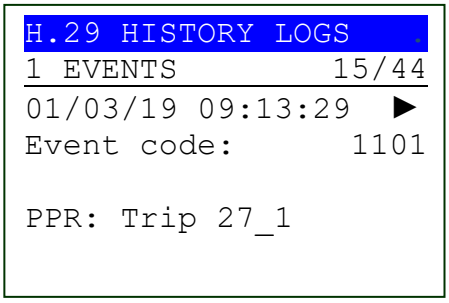
The anomalies are also stored as events. They are registered with their own code added to:

- **EVT.2000**: in case of warnings.
- **EVT.5000**: in case of alarms.

When displayed, the value 2000 or 5000 is subtracted and replaced with the char "W" or "A" before the anomaly code. For example, in case of a "low supply voltage" event, we will obtain a display of this type in the archive page: "0037: W037 Low supply voltage". The same event, read via USB, will be identified with the code 2037, where the number of thousands will identify the type (2 = warning), followed by the code (037 = low supply voltage).

For a complete list of fault codes see [1].

For showing each record, the controller uses eight display pages. The main page has the following format (the example is for the event archive):



The second row of all pages shows which recording is currently displayed and the total number of recordings. In the example, event 15 of 44 is displayed (out of a total of 63). The most recent event is the one associated with the highest number. Using the **UP** and **DOWN** buttons, all the recordings are cyclically scanned.

The recording date/time is displayed in the fourth row of all pages; on the right it also shows two arrows that indicate the availability of other pages on the right and on the left of the current page (for the current record). Pressing the **ENTER** button moves to the next page (cyclically). By pressing the **SHIFT** + **ENTER** buttons you go to the previous page (cyclically).

The rows from the fifth to the eighth show different information based on the selected page.

1) This page (shown only for the event archive) shows the numeric code of the event ("1101" in the example) and a description in the selected language ("PPR: Trip 27_1").

2) Shows the code of any anomalies that were active when the registration was made.

3) Shows the feedbacks of the MCB and GCB circuit breakers at the time of recording.

4) Shows the status of the digital inputs and outputs at the time of recording.

5) Shows the "phase-to-neutral" and "neutral-to-GND " voltages at the time of recording. Also shows the grid phases' sequence.

6) Shows the "phase-to-phase" voltages and the frequency at the time of recording.

7) Shows the positive, negative and zero sequence voltages at the time of recording.

8) For the events EVT.1201, EVT.1203 and EVT.1205 it shows the rate of variation of the frequency (Δf / Δt) (for the other events it shows dashes). For the event EVT.1221 shows the measured vector jump (for the other events it shows dashes).

Note on electrical measurements: as a rule, the controller stores the averaged values of voltages and frequency. In the recording of events, however**, it stores the instantaneous value of the measurement that caused the recording**. For example, if a low-frequency grid protection (81U) trips, the instantaneous frequency (but the averaged voltages) will be stored in the related recording in the event archive.

6.4.8.4 Pages for minimum and maximum peaks.

For the main electrical measurements, the controller stores the minimum and maximum values detected over time, together with the related date/time. The monitored measurements are:

1) L1-N voltage.

2) L2-N voltage.

3) L3-N voltage.

4) L1-L2 voltage.

5) L2-L3 voltage.

6) L3-L1 voltage.

7) L1-N average voltage (last 10 minutes).

8) L2-N average voltage (last 10 minutes).

9) L3-N average voltage (last 10 minutes).

10) L1-L2 average voltage (last 10 minutes).

11) L2-L3 average voltage (last 10 minutes).

12) L3-L1 average voltage (last 10 minutes).

13) V0 zero sequence voltage.

14) V+ positive sequence voltage.

15) V- negative sequence voltage.

16) Frequency.

17) Variation of frequency over time (Δf/ Δt).

18) Vector jump.

The archive is in fact made up of 13 registrations. You can move through the recordings with the **UP** and **DOWN** buttons.

For showing each recording, the controller uses only one page of the display.

```
H.29 HISTORY LOGS    |
4 PEAKS.         13/13
--------------------
VL1-N (Vac)
01/03/19 13:30:05
 Min.value:     230.71
01/03/19 13:30:25
 Max.value:     231.40
```

The second row shows which recording is currently displayed compared to the total number of recordings (the recordings are always 13).

The fourth row shows the description of the recorded measurement.

The fifth and sixth rows show the minimum value and the related registration date.

The seventh and the eighth rows show the maximum value and the related registration date.

6.4.8.5 Exit from the archive view

To exit the archives visualization, press the **ESC** button several times until you reach the H.01 page, from where it will be possible to change the mode.

6.4.8.6 Clearing the archives

To reset an archive, first show it and then hold down the **ENTER** and **ESC** buttons for 5 seconds, until the controller shows a message that the archive has been reset.

It is also possible to reset the archives using a Modbus command via USB. The commands can be protected by a password (P.0004) which must be sent before any command and can be deactivated through a digital input (DIF.2706). To send the command, it is necessary to write in sequence (within 5 seconds):

- HOLDING REGISTER 101: write the password configured with the parameter P.0004.
- HOLDING REGISTER 102: write value:
  - “62” to clear the “events” archive.
  - “63” to clear the “fast trends” archive.
  - “64” to clear the “slow trends” archive.
  - “71” to clear the “peaks” archive.

7 Parameters programming

WARNING! Assigning an incorrect value to one or more parameters can cause malfunctions, damage to things or injury to people. The parameters must only be changed by qualified personnel. Parameters can be password protected (refer to par. 7.5).

INFORMATION! The controller manages a high number of parameters that allow the manufacturer, the installer or the final user to adapt it to specific system requirements. This document does not contain the parameters list (even though many of them are quoted in the description of the controller functions); the list is available in the documents [1] where they're described in detail.

ATTENTION! Some functions or configurations can be changed only through the PC program Mecc Alte Board Programmer4. The use of BoardPrg3 is recommended as it simplify a lot the programming operations.

This paragraph describes the general programming structure and the operating procedure that allows reading and/or modifying parameters, using the controller's front panel.

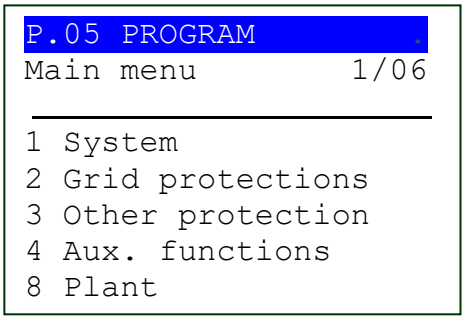
INFORMATION! The modification of some parameters can be password protected (see par. 7.5)

7.1 Access to programming menu

To access programming, press **ENTER** for 1 second (repeatedly if necessary), until the display shows the page P.02 (if you are viewing the historical archives, press the **ESC** button repeatedly until the page H.01 appears, then do the procedure described above).

To exit the programming menus and return to the normal pages, press the **ESC** button repeatedly until you return to page P.02.

At the start of the procedure the main menu is always shown:



- **1 (SYSTEM)**: it allows first to indicate how the controller is connected to the public grid, including the rated voltage and frequency values. It is essential to correctly set these parameters, because almost all the thresholds for the protections are expressed as a percentage of them. It also allows the configuration of digital inputs and outputs.
- **2 (GRID PROTECTIONS)**: allows you to fully configure the grid protections (thresholds, delays, measurement modes, any disabling etc.).
- **3 (OTHER PROTECTIONS)**: allows to configure the other protections of the controller, not related to the grid.

- **4 (AUXILIARY FUNCTIONS)**: it allows to configure the historical archives and to customize the use of the keyboard and of the display of the controller. It also allows you to adjust the real time clock/calendar, and to use the configurable calendars and timers.
- **8 (PLANT)**: allows you to assign a name to the plant.

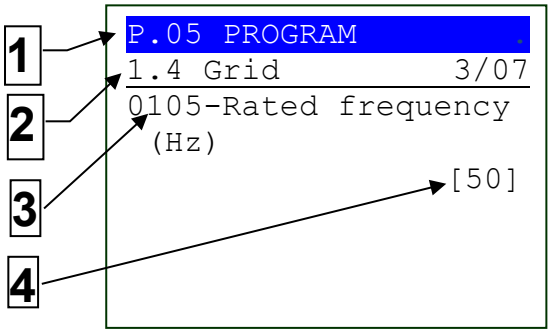
7.1.1 Menu selection

The second row always shows the name of the current menu, followed by the indication of the selected menu item and the number of items in the menu. The following rows of the display are used to display the menu items, i.e. the submenus. The selected item is highlighted in REVERSE. Using the **UP** and **DOWN** buttons scroll the menus to the lower and upper index items respectively, cyclically (i.e. by pressing **UP** from the first item you switch to the last and vice versa).

Pressing the **ENTER** button, you enter the selected submenu (the highlighted one), pressing the **ESC** button exits the menu (returning to the previous menu or exiting the programming to the main page if you were already in the main menu).

7.2 Parameter organization

LEGEND:
1 – Status bar
2 – Current menu
3 – Current parameter
4 – Parameter's value



The second row always shows the name of the current menu (for example the "1.4 Grid" menu), followed by the numerical indication of the selected menu item and the number of items in the menu. The following rows of the display are all used to display a single parameter. In particular:

- The fourth and fifth rows show the unique code of the parameter (four digits) followed by the description in the current language.
- The sixth row shows, aligned to the right, the value of the parameter, enclosed in square brackets or between the "<>" symbols.
- For some parameter, the eighth row shows a value that is in some way related to the current value of the parameter. For example, in the case of the minimum frequency threshold (%), the frequency in Hz corresponding to the actual value of the parameter is shown. Often this additional measure is displayed when the parameter is expressed as a percentage with respect to some other value, to show its absolute value.

Using the **UP** and **DOWN** buttons scroll the menu to the upper and lower index items respectively, cyclically (i.e. by pressing **UP** from the first item you switch to the last and vice versa). By pressing the **ENTER** button, the parameter modification procedure is activated (see the following paragraph), by pressing the **ESC** button, you exit the menu (returning to the previous menu).

7.2.1 Modify a parameter

A parameter can only be changed if it is shown in square brackets ([]); if enclosed in "<>", it cannot be changed. In this case it may be necessary to set an appropriate password.

If the displayed parameter can be modified, pressing the **ENTER** button will start flashing the square brackets that enclose the value, indicating that the modification phase is in progress. To confirm the new value, press the **ENTER** button; to abort the change and return to the original value, just press the **ESC** button.

The following types of parameters exist:

- **Numeric**: the value can be changed using the **UP** and **DOWN** buttons, respectively to increase or decrease the value of a unit (if these buttons are pressed together with **SHIFT**, the value will be increased or decreased by ten units at a time). The change is cyclical: trying to increase the value when it is already at maximum, it goes to the minimum and vice versa.
- **Numbers with selection from a predefined list** (for example the number of phases of the grid): the same applies for the numerical parameters, considering that the **UP** and **DOWN** buttons allow to move to the next/previous value in the predefined list (pressed together with the button **SHIFT** goes to the value following/precedes by ten positions the current one).
- **Numeric with selection from a list of pairs of string numbers** (for example the rated phases' sequence): the same applies to the previous point.
- **Times**: the same applies for the numeric parameters, with the exception that the controller manages the increase/decrease maintaining valid values (for example, increasing from "00.59" to "01.00" and not to "00.60").
- **Texts** (for example the name of the plant): in this case the display highlights (in reverse) the currently selected character in the string. The **UP** and **DOWN** buttons act on the selected character (moving to the next/previous in the ASCII table or to the one that follows it/precedes by ten positions if also pressed **SHIFT**), while the **RESET** button allows to select the character to be modified (cyclically).
- **Bits**: Some parameters are managed by bit. Each bit to 1 enables a function and each bit to 0 disables a function. A value is assigned to each bit. The parameter must be set with the result of adding the values associated with the functions to be enabled. N bits can be used. In the description of these parameters you will have a table like the following:

Bit	Value	Hexadecimal	Description
0	1	01	It enables the function 1
1	2	02	It enables the function 2
2	4	04	It enables the function 3
3	8	08	It enables the function 4
4	16	10	It enables the function 5
5	32	20	It enables the function 6
6	64	40	It enables the function 7
7	128	80	It enables the function 8

If the operator wants:

- Disable all functions: must set 0 in the relevant parameter.
- Enable all functions: the value to be set is given by the sum 1 + 2 + 4 + 8 + 16 + 32 + 64 + 128 = 255.
- For example, enable functions 3, 4, 6 and 8: the value to be set is given by the sum 4 + 8 + 32 + 128 = 172 (where 4 is the value associated to function 3, 8 to function 4, 32 to the function 6 and 128 to function 8).

Attention: the value must be set with the hexadecimal notation:

- 255 → FF
- 0 → 00
- 172 → AC

7.2.2 Set up limits

The operator does not have to worry about verifying that the set value is acceptable for the controller because it is not possible to set unacceptable values.

This applies to the single parameter; it is however possible to set two or more parameters in an inconsistent or even incompatible way. It is up to the operator to verify that this does not happen.

7.3 Exit from programming

To exit programming, press the **ESC** button several times to go back to the main menu and then press it again to exit programming. The next main access to the programming will be shown.

7.4 Loading default values

WARNING! This procedure permanently reloads all factory parameters according to access rights.

In certain situations, it may be convenient to reload the factory defaults for the parameters. To do this, you must first enter the programming mode, then press and hold the **ENTER** and **ESC** buttons simultaneously and consecutively for five seconds. A message on the display will indicate that the factory values have been reloaded. The default values are only reloaded for the parameters for which access rights are granted**.**

7.5 Protection password

Access to parameter programming can be influenced by three different password levels, listed in order of priority:

- Manufacturer password.
- Installer password.
- User password.

Each parameter of the controller is associated with a protection level (in document [1] this association is indicated in the column "ACC" with a letter "C" for the manufacturer, "I" for the installer and "U" for the final user).

A parameter associated with the manufacturer level can only be changed by entering the manufacturer password. A parameter associated with the installer level can be modified by the manufacturer and the installer. A parameter associated with the user level can be modified by the manufacturer, installer and user.

The operator who wants to modify a parameter must first be recognized by the controller as "manufacturer", "installer" or "user" by typing the appropriate password in parameter P.0000 (menu "1 System → 1.1 Sa Security → 1.1.1 Authentication"). After this operation he can change the parameters, limited to those to which he has access based on his password level. The code entered will remain stored in P.0000 for a period of about 10 minutes from the end of programming. After this time will be automatically reset and must be reset to access the programming again.

Passwords can be customized using parameters P.0001 (manufacturer), P.0002 (installer) and P.0003 (user), available in the menu "1 System → 1.1 Security → 1.1.2 Password". The value "0" for these parameters indicates password not set.

If you lose a password, you can reconfigure it by accessing the higher-level password. For this reason, it is advisable to set at least the "manufacturer" password (P.0001): if someone sets it or a lower password (even if only by mistake) without communicating it, it will no longer be possible to change any parameters. By knowing the "manufacturer" password instead, it will be possible in any case to cancel or modify the other passwords. In case of loss of the "manufacturer" password it is necessary to contact Mecc Alte assistance.

The following examples show all combinations of password assignments.

Example 1: P.0001 =0 P.0002 =0 P.0003 =0

Any operator is seen as a "manufacturer", with no need of setting anything in P.0000. Therefore, all parameters can be changed by anyone (this is the default mode).

Example 2: P.0001 =0 P.0002 =0 P.0003 =UUU

No parameter is modifiable. When the operator enters the "UUU" code in P.0000, he would be considered "user", but as no password is associated to the "installer" and the "manufacturer", the controller considers him as "manufacturer". After entering this code, all parameters can be modified.

Example 3: P.0001=0 P.0002 =III P.0003 =UUU

No parameter is modifiable. When the operator enters "UUU" in P.0000, he is considered "user" and can modify only the parameters associated to "user". If the operator enters "iii" the controller considers it "manufacturer" because there is no password for "manufacturer". After entering this code, all parameters can be modified.

Example 4: P.0001=CCC P.0002 =III P.0003 =UUU

No parameter is modifiable. When the operator enters "UUU" in P.0000, he is considered "user" and can modify only the parameters associated to "user". If the operator enters "III", he can modify all parameters associated to "installer" and "user". When entering "CCC", the operator is identified as "manufacturer" and is therefore allowed to modify any parameter of the controller.

Example 5: P.0001=CCC P.0002 =0 P.0003 =0

No passwords are associated to the user and the installer. The parameters associated to user and installer are free programmable, without entering any code in P.0000. To modify manufacturer associated parameters the operator has to enter "CCC" in P.0000.

Example 6: P.0001=0 P.0002 =III P.0003 =0

As no password is associated to the user, the parameters associated are freely programmable, without entering any code in P.0000. When the operator enters "III" in P.0000, he can modify all parameters because there is no password for "manufacturer". After entering this code, all parameters can be modified.

Example 7: P.0001=CCC P.0002 =III P.0003 =0

As no password is associated to the user, the parameters associated are freely programmable, without entering any code in P.0000. When the operator enters "III" in P.0000, he can modify all parameters associated to "installer" and "end user". When entering "III" in P.0000, the operator is identified as "manufacturer" and can modify all parameters.

Example 8: P.0001=CCC P.0002 =0 P.0003 =UUU

No parameter is modifiable. When the operator enters the “UUU” code in P.0000, the controller considers him “user”, but as no password is associated to “installer”, it considers him “installer”. He can modify all parameters associated to the end user and the installer. When entering “III” in P.0000, the operator is identified as “manufacturer” and can modify all parameters.

The value of a parameter is always readable, but modification is only possible if P.0000 contains an appropriate password. The exceptions are the parameters P.0001, P.0002 and P.0003: they are not displayed if P.0000 does not contain an adequate password.

7.5.1 Password for commands from serial port (USB)

There is a further password managed by parameter P.0004, which is designed to prevent commands from being sent to the controller via USB communication trough the Modbus protocol. To send commands via Modbus to the controller, each command must be preceded by the password contained in P.0004. By default, the password is "123".

8 Operation sequence

The field of application of the controller are the plants with one or more generators operating in parallel to the public grid. The main purpose of the device is to monitor the grid, to detect any faults and isolate the generators from the grid.

To detect a fault on the grid (while the generators are in parallel with it), the controller manages some protections that keep under control:

- The voltages.
- The frequency.
- The rate of change of frequency over time.
- The possible phase change that occurs in case of a big step in load (this last technique is deprecated today).

The device complies with the G59 standard. It is supplied by default with a configuration suitable for low voltage systems (400 VAC).

8.1 Preliminary operations

8.1.1 Connections

For the electrical connection to the public grid, see paragraph 5.6:

Type	Terminals	P.0119	P.0129
Single phase	T.28 (N), T.26 (L)	1	1 - Yes
Three phases without neutral	T.26 (L1) T.24 (L2) T.22 (L3)	3	0 – No
Three phases with neutral	T.28 (N), T.26 (L1) T.24 (L2) T.22 (L3)	3	1 - Yes

The voltmetric inputs of the controller are suitable up to 300 VAC phase-neutral. For medium voltage systems, it is necessary to use external voltage transformers; configure the transformation ratio with parameters P.0117 and P.0118.

8.1.2 Rated values

The following parameters must be set very carefully, all protections refer to them:

Parameter	Function	Default
P.0105	Rated frequency.	50 Hz
P.0116	Rated voltage.	400 VAC
P.0920	Rated phases sequence	-

8.2 How to disable a protection

All grid protections can be disabled permanently by acting on the parameters that configure them. However, it is possible to temporarily disable them using the controller's digital inputs. The following table indicates the functions for the configuration of the digital inputs usable for disabling protection:

Function	Description
DIF.2710	When the input is active (logical state), all grid protections are disabled.
DIF.2711	When the input is active (logical state), all the grid protections selected by parameter P.9511 are disabled.
DIF.2712	When the input is active (logical state), all the grid protections selected by parameter P.9512 are disabled.
DIF.2713	When the input is active (logical state), all the grid protections selected by parameter P.9513 are disabled.

DIF.2714	When the input is active (logical state), all the grid protections selected by parameter P.9514 are disabled.
DIF.2715	When the input is active (logical state), all the grid protections selected by parameter P.9515 are disabled.
DIF.2716	When the input is active (logical state), all the grid protections selected by parameter P.9516 are disabled.
DIF.2717	When the input is active (logical state), all the grid protections selected by parameter P.9517 are disabled.
DIF.2718	When the input is active (logical state), all the grid protections selected by parameter P.9518 are disabled.

The parameters from P.9511 to P.9518 are “bit parameters” that allow you to select one or more protections:

Bit	Value	Hexadecimal	Description
00	1	0000001	27_1
01	2	0000002	27_2
02	4	0000004	27_3
03	8	0000008	27_4
04	16	0000010	27_5
05	32	0000020	59_1
06	64	0000040	59_2
07	128	0000080	59_3
08	256	0000100	59_4
09	512	0000200	59_5
10	1024	0000400	59_AVG
11	2048	0000800	V0
12	4096	0001000	V+
13	8192	0002000	V-
14	16384	0004000	V_UNB
15	32768	0008000	SEQ
16	65536	0010000	81U_1
17	131072	0020000	81U_2
18	262144	0040000	81O_1
19	524288	0080000	81O_2
20	1048576	0100000	81R-1
21	2097152	0200000	81R-2
22	4194304	0400000	81R-3
23	8388608	0800000	VS
24	16777216	1000000	EXT

If, for example, you want to disable all the “stage 1” protections with a digital input, you should set the parameter P.9511 to the value 1 (27_1) + 32 (59_1) + 65536 (81U_1) + 262144 (81O_1) + 1048576 (81R_1) → 1376289, which in hexadecimal becomes 150021.

Then simply associate the DIF.2711 function with a digital input: when the input is active, the “stage 1” protections are disabled.

The DIF.2710 function is by default associated with the digital input T.19. The other functions are not used by default.

8.3 Circuit breakers

The purpose of the controller is to isolate the generators from the grid if there is a fault on the grid itself. It therefore provides commands that must be used to open one or more circuit breakers.

Two circuit breakers are defined:

- **Interface device**. The controller opens this circuit breaker as soon as a grid protection trips, if the system is connected to the grid.
- **Backup device**. If the interface device does not open within the time configured with parameter P.9501, the controller opens this second circuit breaker as well.

Note: the controller only provides stable opening commands: it is the system's task to manage the circuit breaker closing, when the opening commands are no longer present. Once the opening of a circuit breaker has been commanded, the opening command remains active until all the protections have been restored.

To operate on these circuit breakers, the controller uses its digital outputs, configured with the functions:

- DOF.3040 – Opening command for interface device (output T.03 as default).
- DOF.3041 – Opening command for backup device (output T.04 as default).

As mentioned, the controller must open one or more circuit breakers only if the generators are connected to the grid. To obtain this information, the acquisition of the feedbacks of two circuit breakers (called MCB and GCB) is provided, through digital inputs configured with the functions:

- DIF.3001 – Feedback of GCB circuit breaker (input T.16 as default).
- DIF.3002 – Feedback of MCB circuit breaker (input T.17 as default).

Note: the controller always evaluates these inputs. If only one circuit breaker is available in the plant, connect the second input directly to negative (GND), simulating the circuit breaker always closed.

If MCB and/or GCB are open when a protection is activated, the interface device will never be opened. The generators, however, must not be able to be reconnected to the grid until all the protections have been restored. For this purpose, the controller manages a third output:

- DOF.3034 – Grid in tolerance (output T.05 as default).

This output is always commanded (even if the generators are already disconnected from the grid). It is activated when all grid protections have been restored; it is deactivated on the trip of a protection. It must not be possible to reconnect the generators to the grid if this output is not active.

Note: on MP250 there is no relationship between the interface/backup and GCB/MCB circuit breakers.

8.4 Checking the accuracy of the controller

During commissioning, it is often required to verify the accuracy (both in terms of threshold and delay) of the trip of the protections. Normally this is done by connecting an instrument that generates voltages and frequencies to MP250.

To avoid changing settings and wiring, the controller manages two additional functions for configuring the digital outputs, which are managed even if the system is disconnected from the grid:

- DOF.3038 – Pick-up protection (by default associated with output T.07). The controller activates this output in the instant in which one of the controlled measurements exceeds the relative threshold, without waiting for the configured delay. It becomes useful to verify the accuracy of the controller in assessing the exceeding of a threshold. The output is deactivated with a small hysteresis on the threshold.

- DOF.3039 – Trip protection (by default associated with output T.08). The controller activates this output when a protection trips (also considering the relative delay), **even if the system is already disconnected from the grid**. It becomes useful to check the accuracy of the controller in assessing the delay associated with a protection. The output is deactivated when the protection is restored.

8.5 Actions on trip

When a protection trips (so when the relative controlled measurements is outside the trip threshold for the configured delay), the controller performs the following actions:

- It activates the TRIP led.
- It adds a record in the “event” history log.
- It increases the trip counter of that protection.
- It forces the page M.04 on the display, highlighting the tripped protections by reverse writing its code.
- **It deactivates** the output configured with the function “DOF.3034 - Grid in tolerance”.
- **It activates** the output configured with the function “DOF.3039 – Trip protections”.
- If the generators are connected to the grid (thus both the input acquiring GCB and MCB feedbacks are active):
    - **It activates** the output configured with the function “DOF.3040 – Opening command for interface device”.
    - If, after the time configured in P.9501, the generators are still connected to the grid, it also **activates** the output configured with the “DOF.3041 – Opening command for backup device”.

8.6 Resetting a protection

The controller accepts to restore a protection only after the controlled measurements falls within the reset threshold (different from the trip threshold) for the configured delay (different from the trip delay). When all the protections are in the previous condition, the controller can manage an automatic reset (without operator intervention) or manual. See below the description of the two modes.

After recovery, the controller performs the following actions:

- **It deactivates** the output configured with the function e “DOF.3040 – Opening command for interface device”.
- **It deactivates** the output configured with the function “DOF.3041 – Opening command for backup device”.
- **It deactivates** the output configured with the function “DOF.3039 – Trip protections”.
- **It activates** the output configured with the function “DOF.3034 – Grid in tolerance”.
- It deactivates the TRIP led.
- It adds a record in the “event” history log for each protection restored.

8.6.1 Automatic reset

In the previous conditions, the controller automatically resets the protections after the delay set by parameter P.9503 (default 20 seconds). This behaviour occurs if parameter P.9502 is set to 0.

8.6.2 Manual reset

The manual reset is managed if parameter P.9502 is set to 1 (always in the conditions described above).

The operator can command the reset in three ways:

- Pressing the RESET button.
- Activating a digital input configured with the "DIF.2719 – Protections reset command" function (default associated with input T.18). Note: the reset is made on the activation of the input (it must pass from not active to active).
- Using a Modbus command via USB. The commands can be protected by a password (P.0004) which must be sent before any command and can be deactivated through a digital input (DIF.2706). To send the command, it is necessary to write in sequence (within 5 seconds):
    - HOLDING REGISTER 101: write the password configured with the parameter P.0004.
    - HOLDING REGISTER 102: write value “54”.

8.7 List of the protections

8.7.1 27 (minimum voltage)

The device implements five stages of this protection, all identical to each other, with specific thresholds and delays. The following table summarizes the five levels:

Level	1	2	3	4	5
Code	27_1	27_2	27_3	27_4	27_5
Trip threshold	P.9521	P.9525	P.9529	P.9533	P.9537
Trip delay	P.9522	P.9526	P.9530	P.9534	P.9538
Reset threshold	P.9523	P.9527	P.9531	P.9535	P.9539
Reset delay	P.9524	P.9528	P.9532	P.9536	P.9540
Event on trip	EVT.1101	EVT.1103	EVT.1105	EVT.1107	EVT.1109
Event on reset	EVT.1102	EVT.1104	EVT.1106	EVT.1108	EVT.1110
Internal status	ST.016	ST.017	ST.018	ST.019	ST.020

Voltage protections can work both on phase-neutral and phase-phase voltages:

- Single-phase systems (P.0119=1): they work on phase-neutral voltages, whatever the value of parameter P.9504.
- Three-phase systems without neutral (P.0119=3, P.0129=0): they work on phase-phase voltages, whatever the value of parameter P.9504.
- Three-phase systems with neutral (P.0119=3, P.0129=1): it depends on the parameter P.9504:
    - 1-LN: only on phase-neutral voltages.
    - 2-LL: only on phase-phase voltages.
    - 3-LN+LL: both on phase-neutral and phase-phase voltages.

The trip and reset thresholds are expressed as a percentage of the rated voltage:

- Single-phase systems: parameter P.0116 configures the rated phase-neutral voltage.
- Three-phase systems: parameter P.0116 configures the rated phase-phase voltage. The rated phase-neutral voltage is calculated as P.0116 / 1.732051.

The protection trips if **any** of the voltages remains **below** the trip threshold continuously for the trip delay.

The protection can be restored if **all** the voltages remain **above** the reset threshold continuously for the reset delay.

To disable protection, set the trip delay to zero.

The G59 standard requires the configuration of two levels:

Level	Trip threshold	Trip delay	Reset threshold	Reset delay
1	87.0 %	2.50 s	90.0 %	0.70 s
2	80.0 %	0.50 s	90.0 %	0.70 s

The G59 standard does not specify reset thresholds and delays.

8.7.2 59 (maximum voltage)

The device implements five stages of this protection, all identical to each other, with specific thresholds and delays. The following table summarizes the five levels:

Level	1	2	3	4	5
Code	59_1	59_2	59_3	59_4	59_5
Trip threshold	P.9551	P.9555	P.9559	P.9563	P.9567
Trip delay	P.9552	P.9556	P.9560	P.9564	P.9568
Reset threshold	P.9553	P.9557	P.9561	P.9565	P.9569
Reset delay	P.9554	P.9558	P.9562	P.9566	P.9560
Event on trip	EVT.1121	EVT.1123	EVT.1125	EVT.1127	EVT.1129
Event on reset	EVT.1122	EVT.1124	EVT.1126	EVT.1128	EVT.1130
Internal status	ST.021	ST.022	ST.023	ST.024	ST.025

Voltage protections can work both on phase-neutral and phase-phase voltages:

- Single-phase systems (P.0119=1): they work on phase-neutral voltages, whatever the value of parameter P.9504.
- Three-phase systems without neutral (P.0119=3, P.0129=0): they work on phase-phase voltages, whatever the value of parameter P.9504.
- Three-phase systems with neutral (P.0119=3, P.0129=1): it depends on the parameter P.9504:
    - 1-LN: only on phase-neutral voltages.
    - 2-LL: only on phase-phase voltages.
    - 3-LN+LL: both on phase-neutral and phase-phase voltages.

The trip and reset thresholds are expressed as a percentage of the rated voltage:

- Single-phase systems: parameter P.0116 configures the rated phase-neutral voltage.
- Three-phase systems: parameter P.0116 configures the rated phase-phase voltage. The rated phase-neutral voltage is calculated as P.0116 / 1.732051.

The protection trips if **any** of the voltages remains **above** the trip threshold continuously for the trip delay.

The protection can be restored if **all** the voltages remain **below** the reset threshold continuously for the reset delay.

To disable protection, set the trip delay to zero.

The G59 standard requires the configuration of two levels:

Level	Trip threshold	Trip delay	Reset threshold	Reset delay
1	114.0 %	1.00 s	110.0 %	0.70 s
2	119.0 %	0.50 s	110.0 %	0.70 s

The G59 standard does not specify reset thresholds and delays.

8.7.3 59_AVG (maximum average voltage - last 10 minute)

Code	59_AVG
Trip threshold	P.9581
Trip delay	P.9582
Reset threshold	P.9583
Reset delay	P.9584
Event on trip	EVT.1131
Event on reset	EVT.1132
Internal status	ST.026

The controller calculates the rolling averages (last 10 minutes) of the phase-neutral and phase-phase voltages, as specified by the IEC 61000-4-30 standard. A new value for these averages is available every 3 seconds. These average voltages are used for this protection. Note: the average voltages are not available in the first 10 minutes from the power supply of the controller, so in this period the protection is disabled.

This protection can work both on phase-neutral and phase-phase voltages:

- Single-phase systems (P.0119=1): they work on phase-neutral voltages, whatever the value of parameter P.9504.
- Three-phase systems without neutral (P.0119=3, P.0129=0): they work on phase-phase voltages, whatever the value of parameter P.9504.
- Three-phase systems with neutral (P.0119=3, P.0129=1): it depends on the parameter P.9504:
    - 1-LN: only on phase-neutral voltages.
    - 2-LL: only on phase-phase voltages.
    - 3-LN+LL: both on phase-neutral and phase-phase voltages.

The trip and reset thresholds are expressed as a percentage of the rated voltage:

- Single-phase systems: parameter P.0116 configures the rated phase-neutral voltage.
- Three-phase systems: parameter P.0116 configures the rated phase-phase voltage. The rated phase-neutral voltage is calculated as P.0116 / 1.732051.

The protection trips if **any** of the voltages remains **above** the trip threshold continuously for the trip delay.

The protection can be restored if **all** the voltages remain **below** the reset threshold continuously for the reset delay.

To disable protection, set the trip delay to zero.

The G59 standard does not require this protection.

8.7.4 V0 (maximum zero-sequence voltage)

This protection, by its nature, can only be used on three-phase systems (P.0119 = 3). The calculation of the zero-sequence voltage is made on the phase-neutral voltages (regardless of the value of the parameter P.9504), therefore the neutral must be connected to the controller (P.0129 = 1).

The zero-sequence voltage is conceptually the vector sum of the phase voltages. In a balanced system it tends to be equal to "0".

Code	V0
Trip threshold	P.9601
Trip delay	P.9602
Reset threshold	P.9603
Reset delay	P.9604
Event on trip	EVT.1141
Event on reset	EVT.1142
Internal status	ST.027

The trip and reset thresholds are expressed as a percentage of the rated phase-neutral voltage (P.0116 / 1.732051).

The protection trips if the zero-sequence voltage remains **above** the trip threshold continuously for the trip delay.

The protection can be restored if the zero-sequence voltage remains **below** the reset threshold continuously for the reset delay.

To disable protection, set the trip delay to zero.

The G59 standard does not require this protection.

8.7.5 V+ (minimum positive-sequence voltage)

This protection, by its nature, can only be used on three-phase systems (P.0119 = 3). The calculation of the positive-sequence voltage is made on the phase-neutral voltages (regardless of the value of the parameter P.9504), therefore the neutral must be connected to the controller (P.0129 = 1).

The positive sequence voltage is conceptually the vector sum of the phase voltages, with a 120° rotation of the vectors L2 and L3 in the direction of the vector L1. In a balanced system it tends to be equal to the nominal phase voltage.

Code	V+
Trip threshold	P.9605
Trip delay	P.9606
Reset threshold	P.9607
Reset delay	P.9608
Event on trip	EVT.1145
Event on reset	EVT.1146
Internal status	ST.028

The trip and reset thresholds are expressed as a percentage of the rated phase-neutral voltage (P.0116 / 1.732051).

The protection trips if the positive-sequence voltage remains **below** the trip threshold continuously for the trip delay.

The protection can be restored if the positive-sequence voltage remains **above** the reset threshold continuously for the reset delay.

To disable protection, set the trip delay to zero.

The G59 standard does not require this protection.

8.7.6 V- (maximum negative-sequence voltage)

This protection, by its nature, can only be used on three-phase systems (P.0119 = 3). The calculation of the negative-sequence voltage is made on the phase-neutral voltages (regardless of the value of the parameter P.9504), therefore the neutral must be connected to the controller (P.0129 = 1).

The negative-sequence voltage is conceptually the vector sum of the phase voltages, with a 120° rotation of the vectors L2 and L3 in the opposite direction to the vector L1. In a balanced system it tends to be equal to "0".

Code	V-
Trip threshold	P.9609
Trip delay	P.9610
Reset threshold	P.9611
Reset delay	P.9612
Event on trip	EVT.1143
Event on reset	EVT.1144
Internal status	ST.029

The trip and reset thresholds are expressed as a percentage of the rated phase-neutral voltage (P.0116 / 1.732051).

The protection trips if the negative-sequence voltage remains **above** the trip threshold continuously for the trip delay.

The protection can be restored if the negative-sequence voltage remains **below** the reset threshold continuously for the reset delay.

To disable protection, set the trip delay to zero.

The G59 standard does not require this protection.

8.7.7 V_UNB (voltages unbalance)

This protection, by its nature, can only be used on three-phase systems (P.0119 = 3).

Code	V_UNB
Trip threshold	P.9621
Trip delay	P.9622
Reset threshold	P.9623
Reset delay	P.9624
Event on trip	EVT.1147
Event on reset	EVT.1148
Internal status	ST.030

This protection can work both on phase-neutral and phase-phase voltages:

- Three-phase systems without neutral (P.0119=3, P.0129=0): they work on phase-phase voltages, whatever the value of parameter P.9504.
- Three-phase systems with neutral (P.0119=3, P.0129=1): it depends on the parameter P.9504:
    - 1-LN: only on phase-neutral voltages.
    - 2-LL: only on phase-phase voltages.
    - 3-LN+LL: both on phase-neutral and phase-phase voltages.

The trip and reset thresholds are expressed as a percentage of the rated voltage:

- Parameter P.0116 configures the rated phase-neutral voltage.
- The rated phase-neutral voltage is calculated as P.0116 / 1.732051.

The protection calculates the biggest difference between the individual phase-phase voltages and between the individual phase-neutral voltages.

The protection trips if the biggest difference remains **above** the trip threshold continuously for the trip delay.

The protection can be restored if the biggest difference remains **below** the reset threshold continuously for the reset delay.

To disable protection, set the trip delay to zero.

The G59 standard does not require this protection.

8.7.8 SEQ (phases sequence)

This protection, by its nature, can only be used on three-phase systems (P.0119 = 3).

Code	SEQ
Rated phases sequence	P.0920
Trip delay	P.9631
Event on trip	EVT.1149
Event on reset	EVT.1150
Internal status	ST.031

Parameter P.0920 allows to establish the desired phases sequence:

- 0: none (the protection is disabled)
- 1 (CW, clockwise).
- 1 (CCW, counter-clockwise).

The protection trips if the real phases sequence is different from the configured one, continuously for the trip delay.

The protection can be reset if the real phases sequence is the same as the configured one, for 0.7 seconds (fixed).

To disable protection, set the trip delay to zero.

The G59 standard does not require this protection.

8.7.9 81U (minimum frequency)

The device implements two stages of this protection, identical to each other, with specific thresholds and delays. The following table summarizes the two levels:

Level	**1**	**2**
Code	81U_1	81U_2
Trip threshold	P.9641	P.9645
Trip delay	P.9642	P.9646
Reset threshold	P.9643	P.9647
Reset delay	P.9644	P.9648
Event on trip	EVT.1161	EVT.1163
Event on reset	EVT.1162	EVT.1164
Internal status	ST.032	ST.033

The trip and reset thresholds are expressed as a percentage of the rated frequency (P.0105).

The protection trips if the frequency remains **below** the trip threshold continuously for the trip delay.

The protection can be reset if the frequency remains **above** the reset threshold continuously for the reset delay.

To disable protection, set the trip delay to zero.

The G59 standard requires the configuration of two levels:

Level	**Trip threshold**	**Trip delay**	**Reset threshold**	**Reset delay**
1	95.0 %	20.00 s	99.0 %	0.70 s
2	94.0 %	0.50 s	99.0 %	0.70 s

The G59 standard does not specify reset thresholds and delays.

8.7.10 81O (maximum frequency)

The device implements two stages of this protection, identical to each other, with specific thresholds and delays. The following table summarizes the two levels:

Level	**1**	**2**
Code	81O_1	81O_2
Trip threshold	P.9651	P.9655
Trip delay	P.9652	P.9656
Reset threshold	P.9653	P.9657
Reset delay	P.9654	P.9658
Event on trip	EVT.1181	EVT.1183
Event on reset	EVT.1182	EVT.1184
Internal status	ST.034	ST.035

The trip and reset thresholds are expressed as a percentage of the rated frequency (P.0105).

The protection trips if the frequency remains **above** the trip threshold continuously for the trip delay.

The protection can be reset if the frequency remains **below** the reset threshold continuously for the reset delay.

To disable protection, set the trip delay to zero.

The G59 standard requires the configuration of two levels:

Level	**Trip threshold**	**Trip delay**	**Reset threshold**	**Reset delay**
1	103.0 %	90.00 s	101.0 %	0.70 s
2	104.0 %	0.50 s	101.0 %	0.70 s

The G59 standard does not specify reset thresholds and delays.

8.7.11 81R (maximum rate of change of frequency)

The device implements three stages of this protection, identical to each other, with specific thresholds and delays. The following table summarizes the three levels:

Level	**1**	**2**	**3**
Code	81R_1	81R_2	81R_3
Trip threshold	P.9661	P.9664	P.9667
Trip delay	P.9662	P.9665	P.9668
Trip direction	P.9663	P.9666	P.9669
Event on trip	EVT.1201	EVT.1203	EVT.1205
Event on reset	EVT.1202	EVT.1204	EVT.1206
Internal status	ST.036	ST.037	ST.038

The trip thresholds are expressed in Hz/s.

The protection trips if the rate of change of frequency remains **above** the trip threshold continuously for the trip delay.

The protection can be reset if the rate of change of frequency remains **below** the reset threshold continuously for the 0.7 seconds (fixed).

With the parameter that specifies the trip direction, it is possible to allow the trip only in case of an increase in frequency, only in case of a decrease, or in both cases.

The G59 standard requires a minimum trip delay of 0.5 seconds; if the configured delay is lower, the controller uses 0.5 seconds.

To disable protection, set the trip delay to zero.

The G59 standard requires the configuration of one level:

Level	**Trip threshold**	**Trip delay**	**Trip direction**
1	1.0 Hz/s	0.50 s	Increase/decrease

The G59 standard does not specify the reset delay.

8.7.12 VS (vector shift)

On generators, the relative position of the positive peak of one of the voltages (suppose L1) and of the rotor is not fixed. It varies depending on the load. If the load changes slowly, the angle between the generated voltage and the rotor will also change slowly. However, if the load suddenly changes, this angle will also suddenly change: therefore, a period (and only one) of the generated sinusoids will be longer or shorter than the previous and subsequent ones. The controller measures the periods, compares them with the previous ones and trips if the variation (compared to an angle) is greater than the trip threshold.

This protection is today deprecated by the G59 standard, because it is considered unreliable.

Code	81R_1
Trip threshold	P.9681
Trip direction	P.9682
Event on trip	EVT.1221
Event on reset	EVT.1222
Internal status	ST.039

The trip threshold is expressed in degrees.

The protection trips if a vector shift greater than the trip threshold is measured, without any delay.

The protection can be immediately reset after 0.5 seconds (fixed).

With the parameter that specifies the trip direction, it is possible to allow the trip only for positive, negative, or both phase shifts.

To disable protection, set the trip threshold to zero.

The G59 standard does not require this protection.

8.7.13 EXT (extern)

The controller is also able to acquire the trip command of an external protection (if any), connected to a digital input configured with the "DIF.3101 - external sensor for grid" function.

Code	EXT
Event on trip	EVT.1231
Event on reset	EVT.1232
Internal status	ST.040

The protection trips instantaneously on the activation of the input.

The protection can be reset after 0.7 seconds (fixed) by the input deactivation.

The G59 standard does not require this protection.

8.8 Status at power on

Normally, at power on, the controller considers all protections as "not tripped". Then, it evaluates voltages and frequency, and, in case, it trips the appropriate protections.

From version 1.02, it is possible to consider the protections "already tripped" at power on, by setting parameter P.9505 to "1". If the voltages and frequency are correct, it will be possible to reset the protections (manually or automatically, depending on P.9502).

9 Anomalies

This chapter describes all the anomalies managed by the controller.

When an anomaly activates, the controller performs the following:

- It activates the internal horn (and, if configured, also the external one: digital output configured with the function DOF.3152 – “external horn”).
- It forces the page S.02 on the multifunction display. This page shows the numeric codes and the descriptions of all active anomalies. The numeric code flashes to indicate that the anomaly hasn't been recognized by the operator yet.
- It activates the flashing of the “TRIP” led (but only if there are no grid protections tripped).

Three operations can be carried out on an anomaly:

- **Silence** the horn.
- **Acknowledge**: it means informing the controller that the operator has taken note of it.
- **Reset**: this tells the controller to act as if the anomaly was never activated.

9.1 Silencing the horn

The operator can silence the horn in two ways:

- By pressing the ENTER button.
- Using a Modbus command via USB. The commands can be protected by a password (P.0004) which must be sent before any command and can be deactivated through a digital input (DIF.2706). To send the command, it is necessary to write in sequence (within 5 seconds):
    - HOLDING REGISTER 101: write the password configured with the parameter P.0004.
    - HOLDING REGISTER 102: write value “51”.

Parameter P.0491 (Horn duration) influences the management of the controller's horn.

- If set to zero, the horn will be never activated.
- If set to 999, the horn will be activated when a new anomaly arises and will be deactivated with the above-mentioned procedure.
- If it is set to a value between 1 and 998, it will be activated when a new anomaly arises and deactivated through the described procedure above, or when the configured time has elapsed.

Silencing the horn is not the same as acknowledging the anomaly: in fact, it continues to flash on page S.02.

9.2 Acknowledging anomaly

The operator can “acknowledge” the anomaly in two ways:

- By pressing the ENTER button (when the horn has been silenced).
- Using a digital input configured with the function DIF.2002 - “Command for acknowledging anomalies”. When the input becomes active, the controller executes an acknowledge of all anomalies.
- Using a Modbus command via USB. The commands can be protected by a password (P.0004) which must be sent before any command and can be deactivated through a digital input (DIF.2706). To send the command, it is necessary to write in sequence (within 5 seconds):
    - HOLDING REGISTER 101: write the password configured with the parameter P.0004.

- HOLDING REGISTER 102: write value “52”. This command also silences the horn, if active.

When the anomaly has been acknowledged, it stops flashing on page S.02 ANOMALIES. Once acknowledged, if it is only a warning, it is automatically cancelled, if the cause that triggered it is no longer present.

Instead, if the cause disappears before the anomaly is acknowledged, the same will remain on the display.

9.3 Resetting anomaly

An anomaly can be reset only when the cause that activated it is no more present.

The controller automatically resets all the acknowledged warnings when their cause is no longer active.

On the contrary, to reset the anomalies, it is necessary to follow one of the below procedures:

- By pressing the RESET button.
- Using a digital input configured with the feature DIF.2001 - “Command for resetting anomalies”. When the input becomes active, the controller executes a reset of all anomalies.
- Using a Modbus command via USB. The commands can be protected by a password (P.0004) which must be sent before any command and can be deactivated through a digital input (DIF.2706). To send the command, it is necessary to write in sequence (within 5 seconds):
  - HOLDING REGISTER 101: write the password configured with the parameter P.0004.
  - HOLDING REGISTER 102: write value “53”.

9.4 Events and signalling related to the anomalies

All anomalies are being recorded (each with its own code) in the events log.

There are some functions available for configuring the digital outputs related to anomalies:

- DOF.3151 (“reset of anomalies”). The controller activates this output for one second when the internal reset sequence of the anomalies is carried out. With this procedure, it is also possible to reset externally managed anomalies.
- DOF.3152 (“external horn”). This output is activated and deactivated along with the internal horn. It can be used to control a more powerful horn and/or a lamp.
- DOF.4001 - (“Warnings”). The output is “active” if there is at least one warning.
- DOF.4004 – (“Alarms”). The output is “active” if there is at least one alarm.

In addition, the controller makes available the anomalies statuses for the AND/OR logics by means of the following internal statuses:

- ST.006 - "Acknowledgment of anomalies in progress"
- ST.007 - "Reset of anomalies in progress"
- ST.008 - "Warnings"
- ST.011 - "Alarms"
- ST.012 - "Not recognized warnings"
- ST.015 - "Not recognized alarms"

9.5 List of the anomalies

From this point on, the words **enabling** and **activation** will be used:

- Enabling an anomaly means having the minimum conditions necessary for the controller to observe the cause.
- Activation of an anomaly refers to the cause after enabling.

37 – Low power supply voltage

Type: **Warning**

Related parameters: **P.0362** Threshold for low power supply voltage (%)
P.0363 Delay for low power supply voltage

To disable: **P.0363=0**

It is always enabled. It activates if the power supply voltage is continuously lower than the P.0362 threshold for the P.0363 delay.

The threshold P.0362 is expressed as a percentage of the rated power supply voltage which is not configurable but is automatically selected by the controller between 12 e 24 Vdc. Selection is made when the controller is powered and every time the button RESET is pressed. If the controller detects a value lower than, or equal to, 17V, it considers to be powered by a 12V power source, otherwise it will consider a 24 V rated voltage.

38 – High power supply voltage

Type: **Warning**

Related parameters: **P.0364** Threshold for high power supply voltage **(%)**
P.0365 Delay for high power supply voltage

To disable: **P.0365=0**

It is always enabled. It activates if the power supply voltage is continuously higher than the P.0364 threshold for the P.0365 delay.

The threshold P.0364 is expressed as a percentage of the rated power supply voltage which is not configurable but is automatically selected by the controller between 12 e 24 Vdc. Selection is made when the controller is powered and every time the button RESET is pressed. If the controller detects a value lower than, or equal to, 17V, it considers to be powered by a 12V power source, otherwise it will consider a 24 V rated voltage.

10 Other functions

10.1 Alternative parameters configurations

You can use properly configured digital inputs to change the configuration of the system without changing the programming parameters. In fact, the controller manages internally two groups of alternative parameters that can be “copied” in the operating parameters on request (through a dedicated digital input).

Alternative configurations can be programmed only using the BoardPrg3xx. You cannot program or modify the configurations from the controller.

The parameters present in each alternative group are the following:

- P.0119: Number of phases.
- P.0129: Is the neutral connected to the controller?
- P.0105: Rated frequency.
- P.0116: Rated voltage.
- P.0117: Voltage transformers (primary side).
- P.0118: Voltage transformers (secondary side).
- P.0920: Rated phases sequence.

It is possible to change the configuration by means the following input digital functions:

- DIF.2151 – “Select configuration 1”. When the input becomes "active", parameters of alternative configuration set 1 are copied in the working configuration.
- DIF.2152 – “Select configuration 2”. When the input becomes "active", parameters of alternative configuration set 2 are copied in the working configuration.

Remark: copying an alternative set in working configuration causes the loss of the previous loaded parameters. The only way to restore them is to have them stored in another alternative configuration and recall it.

10.2 Clock

The controller is provided with a standard hardware clock. It is shown in detail in the page S.03 of the controller. It can be set through the programming menu “4.7.1 – Date/Time”, using the following parameters:

- P.0411: year.
- P.0412: month.
- P.0413: day of month.
- P.0415: hours.
- P.0416: minutes.
- P.0417: seconds.

You can set the clock manually, but also using the Modbus protocol through the USB port. The BoardPrg3 software, for example, allows the synchronization of the clock with the PC (it acts on the previous parameters).

The controller can also manage the daylight save time. This configuration can be done by means parameter P.0409 that allows the following values:

- "0 – No": manual management, the daylight save time is not active.
- "1 – Yes": manual management, the daylight save time is active.
- "2 – Automatic (Europe only)": automatic management, forced to use European calendars. In fact, the date/time for the activation/deactivation of the daylight save time are fixed:
    - The last Sunday of March, 02:00:00.
    - The last Sunday of October, 03:00:00.

  At the specified date/time, the controller automatically adds/subtracts the value specified by the parameter P.0408 to the current date/time.
- "3 – Automatic via calendar": automatic management. The date/time for the activation/deactivation of the daylight save time are configurable by means calendars 15 and 16 (see in the following10.2.1):
    - Use calendar 15 to specify date/time for the activation of the daylight save time.
    - Use calendar 16 to specify date/time for the deactivation of the daylight save time.

  Note: when parameter P.0409 is set to "3", calendars 15 and 16 cannot be used for other purposes.

  At the specified date/time, the controller automatically adds/subtracts the value specified by the parameter P.0408 to the current date/time.

  The parameter P.0408 allows to select (with a resolution of 15 minutes) which is the time difference when the daylight save time is activated (in Italy we have a difference of 1 hours, so this parameter must be set to 4 (15 min *4 = 1 hour)).

The clock is used for many functions:

- History logs recordings.
- Configurable calendars.

The clock is equipped with rechargeable backup battery and can stay up to date for several months, even if the controller remains unpowered. If the controller is not used (unpowered) for a long time, even if the clock reactivates immediately as soon as it is powered, it needs a few hours to ensure full recharge of the internal battery.

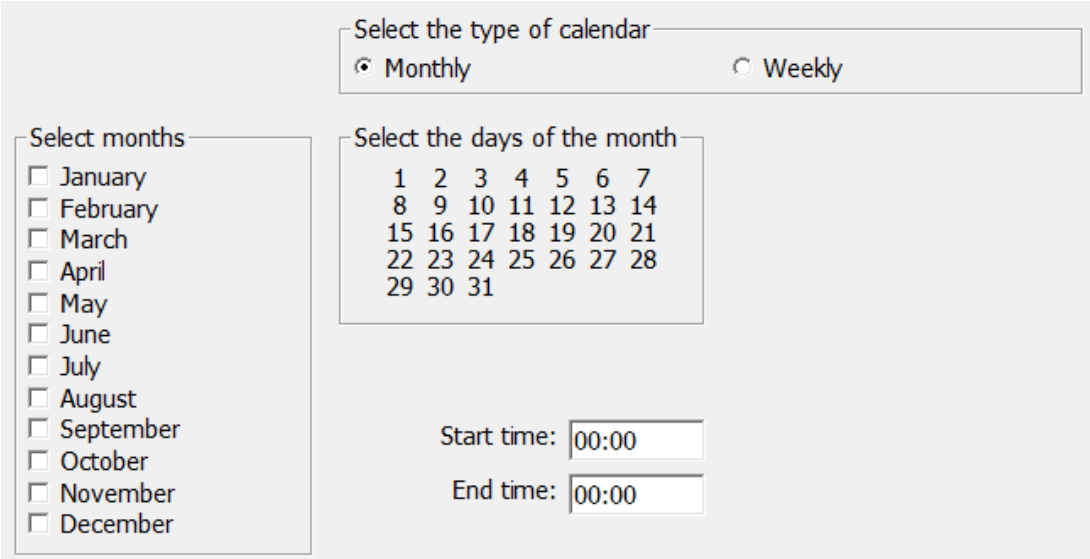
The controller stores the following event into the events log (they are related to the clock):

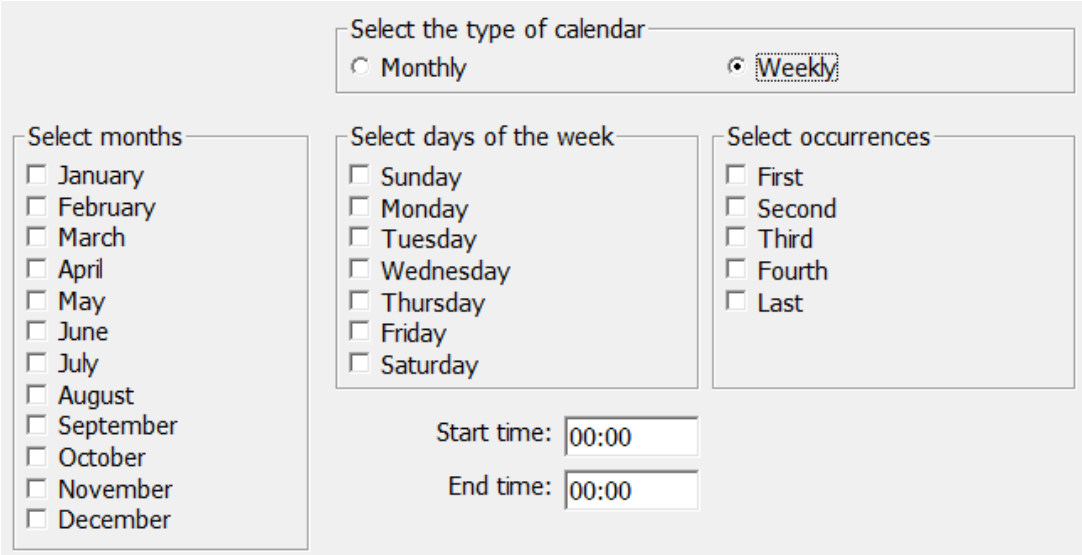
- EVT.1075: Real time clock not valid.
- EVT.1076: Real time clock updated.
- EVT.1086: Daylight Save Time activated.
- EVT.1087: Standard time activated.

10.2.1 Configurable calendars

The controller provides 16 calendars fully configurable. They allow to select days and time-slots, inside which the controller activates an internal bit. This bit could then be used by AND/OR logics to activate a digital output or to create more complex logics (ST.224…ST_239). All calendars are identical: calendars 15 and 16, however, can be used for the activation/deactivation of the daylight save time (if parameter P.0409 is set to "3").

Each calendar can be individually selected as "monthly" or "weekly":





Using BoardPrg3 software, it is very easy to select whether a calendar is “weekly” or “monthly”. If you want to use the parameters of the controller, you must act on the parameter P.1900. It is a bit-field parameter; one bit is provided for each calendar:

BIT	Value	Hexadecimal	Calendar
0	1	0001	Calendar 1
1	2	0002	Calendar 2
2	4	0004	Calendar 3
3	8	0008	Calendar 4
4	16	0010	Calendar 5
5	32	0020	Calendar 6
6	64	0040	Calendar 7
7	128	0080	Calendar 8
8	256	0100	Calendar 9
9	512	0200	Calendar 10
10	1024	0400	Calendar 11
11	2048	0800	Calendar 12
12	4096	1000	Calendar 13

13	8192	2000	Calendar 14
14	16384	4000	Calendar 15
15	32768	8000	Calendar 16

The parameter must be set with the sum of the values for all the calendars that have to be selected as "weekly" (in hexadecimal notation). In fact, a bit set to "1" selects the "weekly" mode.

Both calendar types allow to select in which months the controller activates the internal bit (at least one month must be selected, it is even possible to select all months). Using the parameters of the controller, this selection is done by means parameter P.1901 (for the calendar 1 or equivalent for other calendars). This is also a bit-field parameter:

BIT	Value	Hexadecimal	Month
0	1	0001	January
1	2	0002	February
2	4	0004	March
3	8	0008	April
4	16	0010	May
5	32	0020	June
6	64	0040	July
7	128	0080	August
8	256	0100	September
9	512	0200	October
10	1024	0400	November
11	2048	0800	December

The parameter must be set with the sum of the values of the required months (in hexadecimal notation).

For "monthly" calendars, is then possible to select the days of the month for the activation of the internal bit (at least one day must be selected, it is even possible to select all days). Using the parameters of the controller, this selection is done by means parameter P.1902 (for the calendar 1 or equivalent for other calendars). This is also a bit-field parameter:

BIT	Value	Hexadecimal	Day of month
0	1	00000001	1
1	2	00000002	2
2	4	00000004	3
3	8	00000008	4
4	16	00000010	5
5	32	00000020	6
6	64	00000040	7
7	128	00000080	8
8	256	00000100	9
9	512	00000200	10
10	1024	00000400	11
11	2048	00000800	12
12	4096	00001000	13
13	8192	00002000	14
14	16384	00004000	15
15	32768	00008000	16

16	65536	000100000	17
17	131072	00020000	18
18	262144	00040000	19
19	524288	00080000	20
20	1048576	00100000	21
21	2097152	00200000	22
22	4194304	00400000	23
23	8388608	00800000	24
24	16777216	01000000	25
25	33554432	02000000	26
26	67108864	04000000	27
27	134217728	08000000	28
28	268435456	10000000	29
29	536870912	20000000	30
30	1073741824	40000000	31

The parameter must be set with the sum of the values of the required days (in hexadecimal notation).

For “weekly” calendars, is then possible to select the days of the week for the activation of the internal bit (at least one day must be selected, it is even possible to select all days). Using the parameters of the controller, this selection is done by means parameter P.1902 (for the calendar 1 or equivalent for other calendars). This is also a bit-field parameter:

BIT	Value	Hexadecimal	Day of week
16	65536	00010000	Sunday
17	131072	00020000	Monday
18	262144	00040000	Tuesday
19	524288	00080000	Wednesday
20	1048576	00100000	Thursday
21	2097152	00200000	Friday
22	4194304	00400000	Saturday

The parameter must be set with the sum of the values of the required days (in hexadecimal notation).

Selecting a day of the week (Sunday for example), it is then possible to select if all “Sundays” in the month must be used or only some of them. Using the parameters of the controller, this selection is done by means parameter P.1902 (for the calendar 1 or equivalent for other calendars). This is also a bit-field parameter:

BIT	Value	Hexadecimal	Occurrence
0	1	00000001	First occurrence
1	2	00000002	Second occurrence
2	4	00000004	Third occurrence
3	8	00000008	Forth occurrence
4	16	00000010	Last occurrence

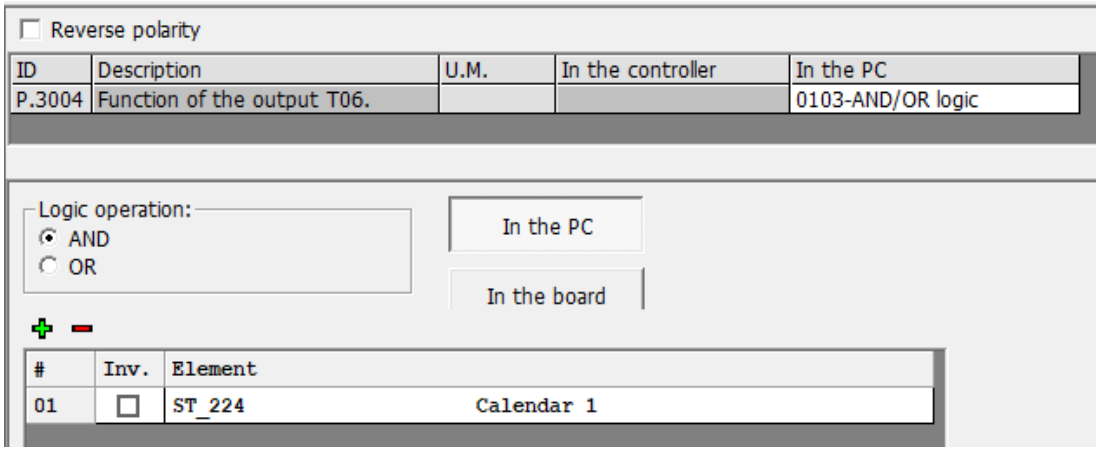
The parameter must be set with the sum of the values of the required occurrences (in hexadecimal notation). **Note: for “weekly” calendars, the days of week and their occurrences in the month are selected by the same parameter, using different bits.**

If the “occurrence” bits are all “0”, then the selected days of week will be managed in any week of the month; otherwise they will be managed for the selected occurrences only. The “last” option is useful because, depending on the month and on the year, a certain day of the week can be present 4 or 5

times in a month: using the “last” option you can do an action exactly in the last occurrence in the month. A typical example is the management of the daylight save time; in Italy, it is activated on the last Sunday of October, and deactivated on the last Sunday of March. Those Sundays can be the 4° or the 5° occurrence in the month, depending on the first day of the month. Using the “last” option, the problem is solved.

Finally, for both “weekly” and “monthly” calendars, it is possible to select a time-slot (valid for all selected days). The controller will activate the internal bit only inside the selected time-slot. Using the parameters of the controller, the time-slot can be selected by means P.1903 and P.1904 (for the calendar 1 or equivalent for other calendars). If those parameters are set with the same values, the full day is selected. If the start time is lower than the end time, the time-slot is not across midnight; otherwise, the internal bit is activated after the start time of the selected days, and it is deactivated after the end time of the day after the selected one.

Using the AND/OR logics, it is possible to activate a digital output into selected days and time-slot (selected using a calendar):



This is an example for the configuration of the daylight save time for Italy, using calendars 15 and 16:

- Calendar 15.
  - Select “weekly” (bit 15 of P.1900 = “1”).
  - Last Sunday of March:
    - Select “March” (P.1961 = “0004”).
    - Select “Sunday”, “Last” (P.1962 = “00010010”).
  - The activation should happen at 03:00:
    - Select “3:00” as start time (P.1963).
    - Select “3:01” as end time (P.1964).
- Calendar 16.
  - Select “weekly” (bit 14 of P.1900 = “1”).
  - Last Sunday of October:
    - Select “October” (P.1957 = “0200”).
    - Select “Sunday”, “Last” (P.1958 = “00010010”).

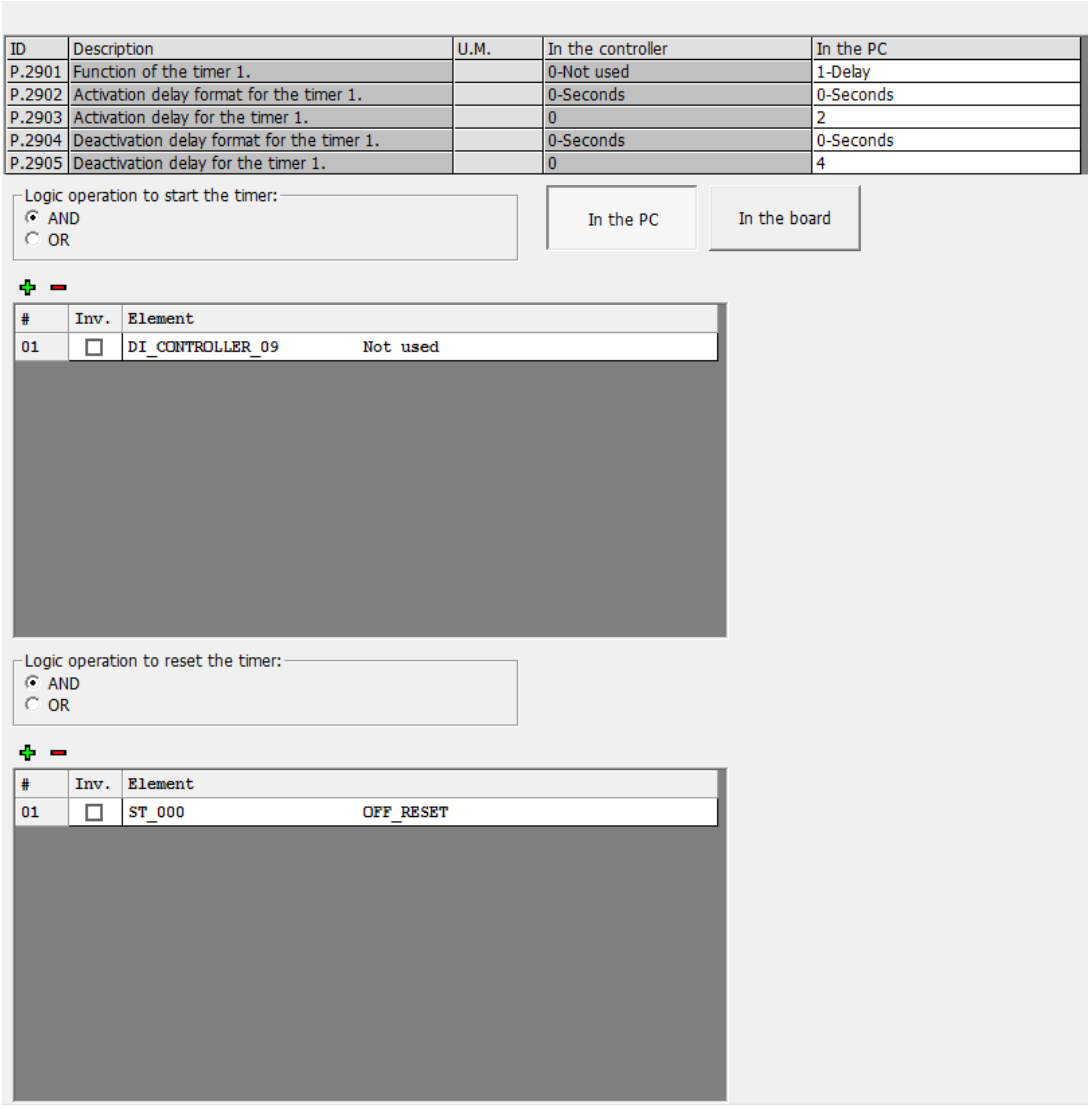
- The activation should happen at 02:00:
  - Select “2:00” as start time (P.1959).
  - Select “2:01” as end time (P.1960).

10.3 Configurable timers

The controller provides 4 generic timers fully configurable, that can be used inside the AND/OR logics to create complex sequential logics. Each timer, in fact, activates/deactivates an internal bit that can be used by the AND/OR logics (ST.240…ST_243).

The four timers are identical.

For each timer it is possible to select (by means an AND/OR logic) an “activation condition” that starts the timer. In the same way, it is possible (but not mandatory) to select (by means an AND/OR logic) a “reset condition” that resets the timer. When the “reset condition” is true, the internal bit of the timer is forced to “0”.



Moreover, each timer provides the following five parameters (the list refers to the timer 1):

- P.2901: function of the timer 1.

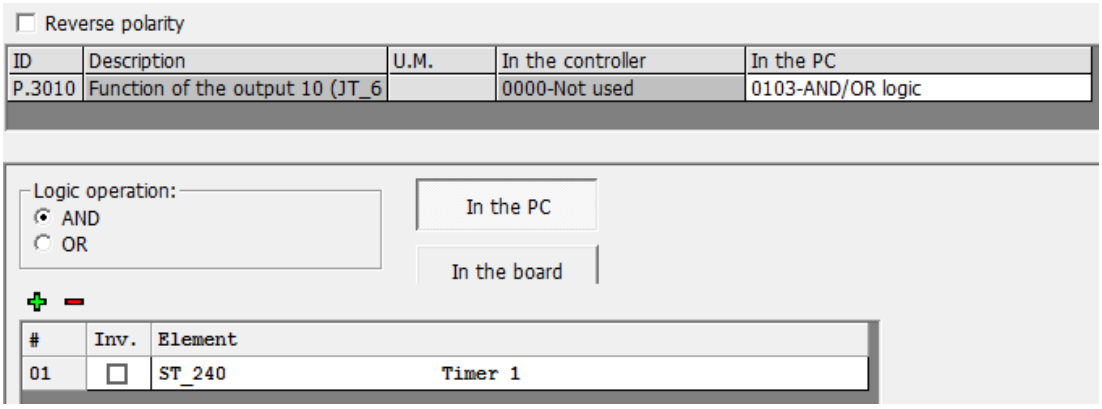
- P.2902: Activation delay format for the timer 1.
- P.2903: Activation delay for the timer 1.
- P.2904: Deactivation delay format for the timer 1.
- P.2905: Deactivation delay for the timer 1.

In addition to the function, two delays are configurable for any timer; for each of them it is possible to select the time base ("0 – Seconds", "1 – Minutes", "2 – Hours") and the delay value.

Each timer can work in four different modes, selectable by means parameter P.2901 (for the timer 1 or equivalent for the other timers):

- 0 – Not used. In this case the internal bit related to the timer is always reset.
- 1 – Delay.
    - The internal bit is reset while the "reset condition" is true.
    - The internal bit is set with the delay P.2902 – P.2903 from when the "activation condition" becomes true.
    - The internal bit is reset with the delay P.2904 – P.2905 from when the "activation condition" becomes false.
- 2 – Pulse.
    - The internal bit is reset while the "reset condition" is true.
    - The internal bit is set for the time configured with P.2902 – P.2903 each time the "activation condition" changes from false to true.
    - The internal bit is set for the time configured with P.2904 – P.2905 each time the "activation condition" changes from true to false.
- 3 – Free run
    - The internal bit is reset while the "reset condition" is true.
    - The internal bit is reset while the "activation condition" is false.
    - While the "activation condition" is true, the internal bit is managed as a square wave: it is set for the time configured with P.2902 – P.2903, then it is reset for the time configured with P.2904 – P.2905, and so on.
- 4 – Set/Reset
    - The internal bit is reset while the "reset condition" is true.
    - The internal bit is set if the "activation condition" is true and the "reset condition" is false.
    - The internal bit keeps its previous status if the "activation condition" is false and the "reset condition" is false.

The following example manages a digital output related to the internal bit of the timer 1:



10.4 Non-volatile memory

The controller has a non-volatile memory inside (which does not need any power supply), used to store various information such as parameters, counters etc. The memory is divided into different zones. When the controller is powered, it performs a check on the data stored in each area: if even just one area is incorrect, it displays an error message; this can happen after a FW update. Said message contains a numerical code (in hexadecimal form); each bit to 1 of said code corresponds to an area of the memory that is not valid. Here is a table listing the areas and their bit.

Area	Version	Bit	Value	Description
1	1.00	0	1 (0001)	Coefficients for the calibration of the measuring inputs of the controller.
2	1.00	1	2 (0002)	Mixed information (LCD display contrast).
3	1.00	2	4 (0004)	Trip counters for grid protections.
4	1.00	3	8 (0008)	Parameters alternative configurations.
5	1.00	4	16 (0010)	Peaks archive.
6	1.00	5	32 (0020)	Parameters.

If, for example, the value between brackets is “0004”, it means that only the “counters” area is not valid. If the value is “0022”, it means that the “parameters” areas (0020) and the “LCD contrast” areas (0002) are not valid.

If any zone is not valid, the normal operation sequences are not performed until the operator presses the buttons “ENTER + ESC”: it is in effect necessary that the situation has been acknowledged as it can cause dysfunctions (for example if the not valid area is the one of the parameters). Only when the operator presses “ENTER + ESC”, the controller reloads the defaults for the data saved in the not valid areas: this means that if the controller is unpowered without pressing “ENTER + ESC”, when you turn it on next you will get again the signalling of not valid memory.

10.5 Plant name

It is possible to assign a name to the plant, including it into parameter P.0456.

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