mecc alte

POWER FROM WITHIN

BTB200 CONTROLLER

SMARTECH
A DIVISION OF MECC ALTE

TECHNICAL MANUAL

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Revision	Date	Notes
00	29/11/2017	First version of the manual for the version 01:00 of the controller.
01	10/09/2021	Valid for controller version 1.07 5.5.7, 7.3.5
02	04/10/2022	Valid for controller version 1.08 5.12.4
02	26/10/2023	Valid for controller version 1.10 5.4, 5.4.4, 5.4.5, 5.5.6, 5.5.7, 5.6.5, 5.7.3, 5.9.3, 6.4.4, 6.5.2, 6.5.3.12, 6.5.3.13, 6.5.3.2, 8.7.16-211, 8.7.20-900, 9.1, 9.6

1 Introduction

1.1 References

[1] Mecc Alte EAAM0597xx BTB200 Parameters Chart.

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

[3] Mecc Alte EAAS0341xx Serial communication and SMS protocol.

[4] Mecc Alte EAAS0598xx BTB200 Modbus Registers.

[5] Mecc Alte EAAM0136xx – J1939 Interface Manual.

[6] CANopen – Cabling and Connector Pin Assignment – CiA Draft Recommendation DR-303-1

[7] BOSCH CAN Specification – Version 2.0 – 1991, Robert Bosch Gmbh.

[8] Mecc Alte EAAP0457xx USB driver Installation Guide

[9] EAAM0410xx – SIMONE User Manual

[10] Mecc Alte EAAM0199xx - DST4602/GC500/GC400/GC600 Parallel functions manual.

[11] Mecc Alte EAAM0432xx – PLC Editor Manual

[12] Mecc Alte EAAM0412xx – PLC Description for Mecc Alte devices

1.2 Introduction and prerequisites

For the appropriate use of this manual it is required knowledge of the use and of the installation of generator groups.

⚠WARNING!!!

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

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

Do not disconnect for any reason the terminals of the current transformers (CT)

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

Please read this manual carefully before using the device.

The device uses a large number of 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 programming parameters: to this purpose, see documents [1]; these documents are to be considered as part of this manual.

The devices are supplied with a generic "default" configuration; is at the installer's care 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 device.

1.3 Notes on the parameters configuration of the device

Although most of the parameters and features can be accessed and configured by directly operating on the device, **some particular features or configurations, due to their nature, can only be set or changed 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 device and its use is strongly suggested. It also allows you to save the current configuration of the device on a file and to reuse it on other identical devices,

The program also allows the configuration, saving or loading of the characteristic curves of non-standard analogue sensors with resistive or live output.

BoardPrg4 can be used on all Mecc Alte devices; the connection to the PC can be direct via serial RS232 or USB, or by remote via modem, serial RS845 or Ethernet. For the use of the program, refer to the document [2].

1.4 Definitions

In this document, the word "**ALARM**" is used to indicate a fault that makes it impossible the normal plant management and forces the automatic opening of the BTB circuit breaker.

The word "**WARNING**" is used to indicate a fault that requires an operator action but doesn't require the automatic opening of the BTB circuit breaker.

1.4.1 Acronyms

AIF It identifies a function for the configuration of the analogue inputs ("Analogue Input Function"). The number that follows the caption "AIF" is the code to set in the parameter that configures the function of the desired analogue input.

AOF It identifies a function for the configuration of the analogue outputs ("Analogue Output Function"). The number that follows the wording "AOF." is the code to be set in the parameter that configures the function of the desired analogue output.

DIF It identifies a function for the configuration of the digital inputs ("Digital Input Function"). The number that follows the caption "DIF" is the code to set in the parameter that configures the function of the desired digital input.

DOF It identifies a function for the configuration with the digital outputs ("Digital Output Function"). The number that follows the caption "DOF" is the code to set in the parameter that configures the function of the desired digital output.

BTB ("Bus Tie Breaker") It identifies the circuit breaker managed by BTB200.

BUSA It identifies the genset and mains controllers connected on one side (A) of BTB circuit breaker.

BUSB It identifies the genset and mains controllers connected on the other side (B) of BTB circuit breaker.

1.5 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.

1.6 Revisions of the software

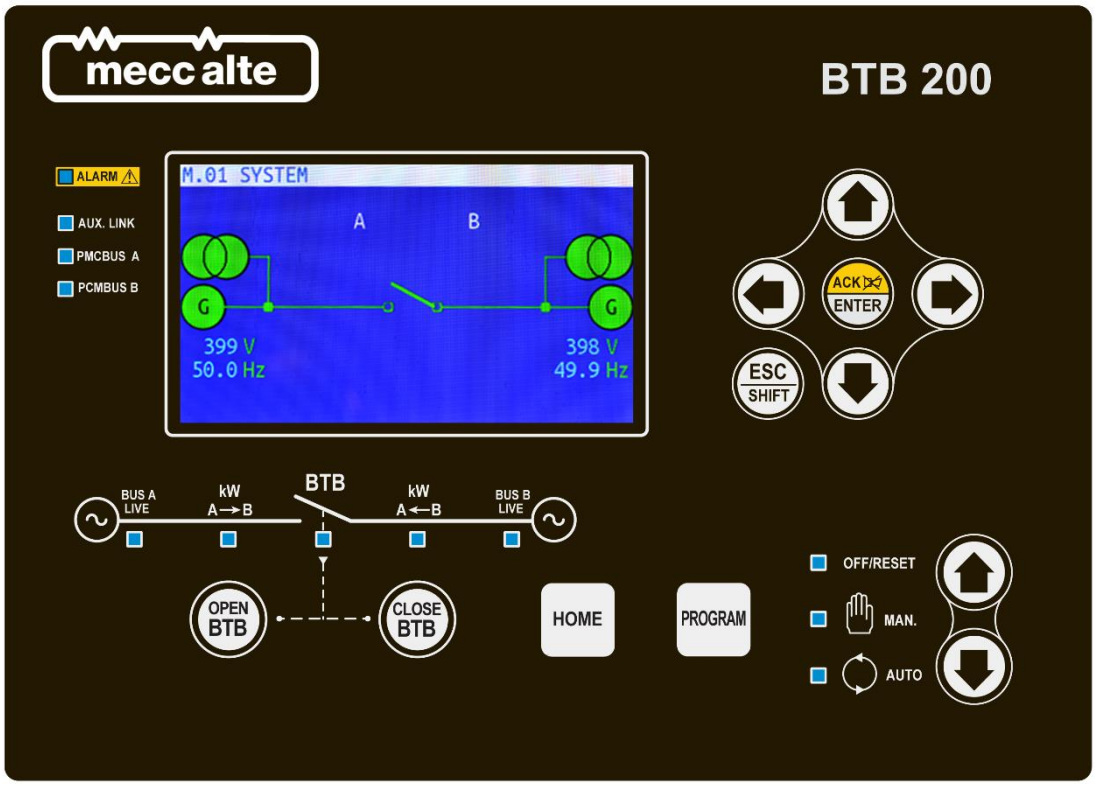
Several parts of this manual refer to the controller's software revisions. These revisions are marked with the assigned Mecc Alte code (shown on the rear panel of the controller). The format of the code is: EB0250272XXYY, where “XX” is the main version and “YY” is the minor version. Thus, the code EB02502720100 refers to the controller software release "1.00". The software revision is also displayed on page “S.03” of the TFT display.

BTB200 is a “dual processor” device and uses two different firmwares:

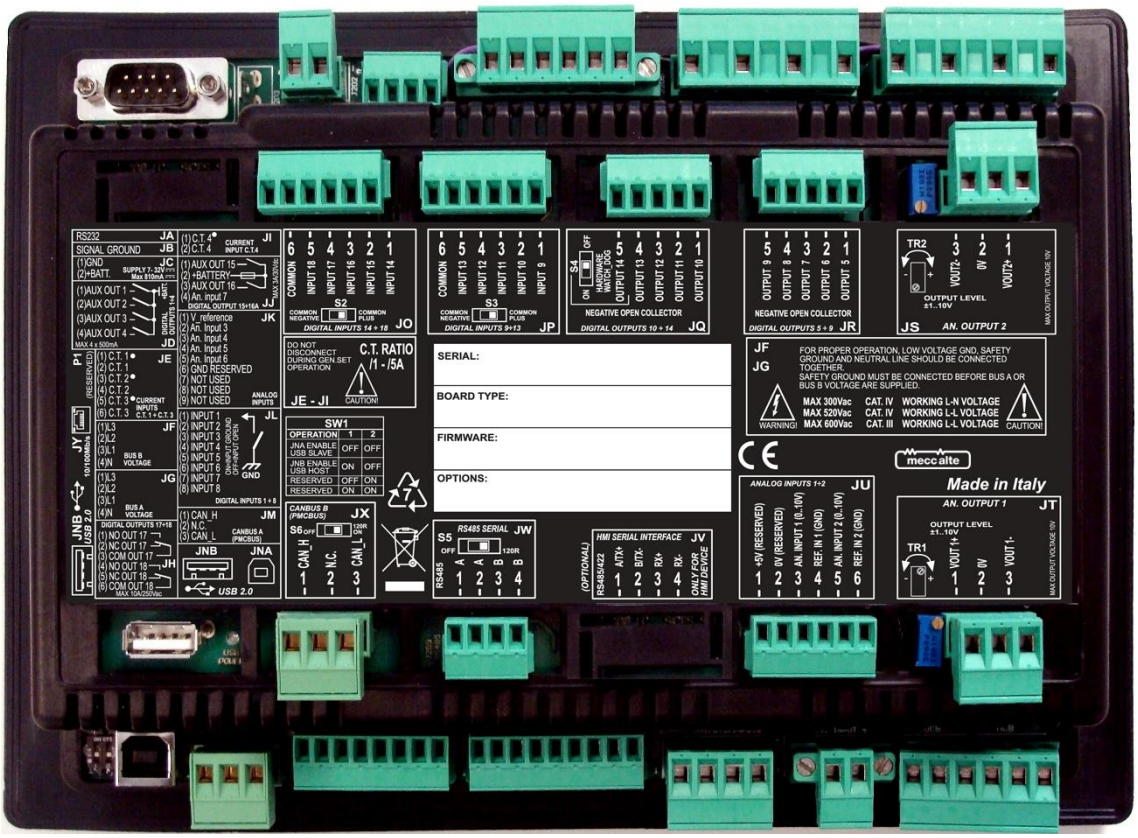
- EB0250272XXYY: for the main processor that deals with the operation management and the user interface (System controller).
- EB0250252XXYY: for the minor processor that deals with the electrical measurements and the related protections (Measure Engine).

2 Views of the device

BTB200 Front view



BTB200 Rear view



BTB200 Upper view

BTB200 Lower view

3 Technical features

INFORMATION! GND is referred to the potential of the terminal JC-1

Supply power voltage +VBATT:	
Operation	From 7 to 32Vdc with continuous operation. The device identifies the plant operation at 12 or 24V to manage its alarms when powered up and whenever OFF/RESET mode is selected. Protection against polarity reversal with built-in self-resetting fuse. Resolution of the measurement of the battery voltage to 12 bits.
Starting minimum voltage	The operation is guaranteed during the engine start up to Vbatt=5VDC for a undefined time.
Power consumption in stand-by:	Display minimum brightness: 350mA @ 13.5 Vdc 200mA @ 27 Vdc Display maximum brightness: 420mA @ 13.5 Vdc 225mA @ 27 Vdc
Maximum power consumption during operation (relays, horn, digital inputs activated; static outputs not activated)	Display minimum brightness: Max. 670mA @ 7 Vdc 375mA @ 13.5 Vdc 235mA @ 27 Vdc Display maximum brightness: Max. 810mA @ 7 Vdc 440mA @ 13.5 Vdc 260mA @ 27 Vdc
BUS A and BUS B voltage inputs	
	Measurement of the L-N and L-L phases voltages Measurements of the neutrall voltages referred to the device supply negative.
frequency	10Khz
Scale	It can be adjusted through the device parameters between 100V and 400V.
Type of measurement	True RMS measurements (TRMS).
Input impedance	> 0,8 MΩ L-N > 1,3 MΩ L-N > 0.8 MΩ L-GND > 0.5 MΩ N-GND
Maximum voltages applicable	MAX 300Vac in CAT.IV for measurements L-N MAX 520Vac in CAT.IV for measurements L-L MAX 600Vac in CAT.III for measurements L-L
Maximum voltages measurable with scale HV	Max 448 Vac for measures L-N (with voltage N-GND = 0 Vrms)
Maximum voltages measurable with scale HV	Max 147 Vac for measures L-N (with voltage N-GND = 0 Vrms)

<table>
<tr><td>Max tension in Common-Mode from GND with HV scale</td><td>Max 100 Vrms</td></tr>
<tr><td>Max tension in Common-Mode from GND with HV scale</td><td>Max 80 Vrms</td></tr>
<tr><td>Connection mode</td><td>3 phases 4 cables
3 phases 3 cables
Single phase 2 cables
Aron insertion with 2 voltage transformers</td></tr>
<tr><td>Measurement resolution</td><td>12 bit</td></tr>
<tr><td>Measurement accuracy</td><td><0,5% F.S.</td></tr>
<tr><td colspan="2">Current measurement inputs</td></tr>
<tr><td></td><td>3 inputs with internal CT and common CTs ratio
1 independent auxiliary current with internal CT that can be used as current measurement for Neutral.
Internal amplifier with automatic change of scale for currents lower than 1,2Aac and higher than 1,5Aac.
It is required the use of current transformers with a secondary current from 1A to 5A.
Required use of amperometric transformers with secondary 1A to 5 °
The external TA must guarantee at least one BASIC isolation for the use of the device in the Overvoltage Cat. IV</td></tr>
<tr><td>Scale</td><td>1Aac or 5Aac (automatically selected from the device).</td></tr>
<tr><td>Measurement range</td><td>Up to 7Aac</td></tr>
<tr><td>Type of measurement</td><td>True RMS measurements (TRMS).</td></tr>
<tr><td>Auto-consumption</td><td>< 1VA</td></tr>
<tr><td>Maximum currents allowed:</td><td>+ 40% of the rated current..
Possible sinusoidal transient voltage surges up to 20 Aac with progressive loss of the measurement accuracy depending on the amplitude of the surge.</td></tr>
<tr><td>Measurement resolution</td><td>12 bit</td></tr>
<tr><td>Measurement accuracy</td><td><0,2% F.S.</td></tr>
<tr><td colspan="2">Frequency measurements</td></tr>
<tr><td></td><td>50 or 60Hz nominal frequencies measured by L1-L2 phase voltages, for both the BUS A and the BUS B.
In case of single-phase systems, the detection of the frequency is carried out on the L1 voltage with respect to N (connected in place of L2).</td></tr>
<tr><td>Frequency minimum sensitivity on BUS A voltage input</td><td>
<table>
<tr><td>Rated voltage 100Vac</td><td>Rated voltage 400Vac</td></tr>
<tr><td>8 Vrms L1-N @ 50Hz</td><td>24 Vrms L1-N @ 50Hz</td></tr>
<tr><td>14 Vrms L1-L2 @ 50Hz</td><td>41 Vrms L1-L2 @ 50Hz</td></tr>
<tr><td></td><td></td></tr>
<tr><td>8 Vrms L1-N @ 60Hz</td><td>8 Vrms L1-N @ 60Hz</td></tr>
<tr><td>16 Vrms L1-L2 @ 60Hz</td><td>43 Vrms L1-L2 @ 60Hz</td></tr>
</table>
</td></tr>
</table>

<table>
<tr><td>Frequency minimum sensitivity on BUS B voltage input</td><td>
<table>
<tr><td>Rated voltage 100Vac</td><td>Rated voltage 400Vac</td></tr>
<tr><td>1 Vrms L1-N @ 10Hz</td><td>1,2Vrms L1-N @ 10Hz</td></tr>
<tr><td>1.7 Vrms L1-L2 @ 10Hz</td><td>2 Vrms L1-L2 @ 10Hz</td></tr>
<tr><td></td><td></td></tr>
<tr><td>5 Vrms L1-N @ 50Hz</td><td>13 Vrms L1-N @ 50Hz</td></tr>
<tr><td>9 Vrms L1-L2 @ 50Hz</td><td>22 Vrms L1-L2 @ 50Hz</td></tr>
<tr><td></td><td></td></tr>
<tr><td>6 Vrms L1-L2 @ 50Hz</td><td>18 Vrms L1-N @ 60Hz</td></tr>
<tr><td>10 Vrms L1-L2 @ 60Hz</td><td>31 Vrms L1-L2 @ 60Hz</td></tr>
</table>

The sensitivity decreases with the increase of the frequency for the acknowledgement of the engine running and for a higher rejection of the disturbances.
</td></tr>
<tr><td>Measurement resolution</td><td>0.1Hz ± 50ppm, 35ppm/C typical</td></tr>
<tr><td colspan="2">Digital inputs 01-08</td></tr>
<tr><td></td><td>8 opto-insulated digital inputs with same supply, internal supply terminal connected to the device positive JC (2) +Vbatt.
They are active when the input is connected to the supply negative GND. When they are open, the inputs terminals voltage is like Vbatt.</td></tr>
<tr><td>Activation/deactivation threshold</td><td>2,5VDC</td></tr>
<tr><td>Typical current with closed contact</td><td>5,3mA @ +Vbatt= 13.5Vdc
11,5mA @ +Vbatt= 27Vdc</td></tr>
<tr><td>Input signal delay</td><td>It can be adjusted by the related parameter for each input</td></tr>
<tr><td colspan="2">Digital inputs 09-18</td></tr>
<tr><td></td><td>Further two groups of 5 opto-insulated inputs with two separated common supplies, which can be connected to GND (active inputs to +Vbatt) or to +Vbatt (active inputs to GND).
Two selectors (S2 and S3) must be set to configure two groups of inputs as Common Plus or as Common Negative.</td></tr>
<tr><td>Activation/deactivation threshold</td><td>2,5VDC</td></tr>
<tr><td>Typical current with closed contact</td><td>5,3mA @ Vbatt= 13.5Vdc
11,5mA @ Vbatt= 27Vdc</td></tr>
<tr><td>Input signal delay</td><td>It can be adjusted by the related parameter for each input</td></tr>
<tr><td colspan="2">Digital outputs 01-04</td></tr>
<tr><td>Type of output</td><td>4 independent static outputs to battery positive.
The output current is supplied by the positive supply terminal of the device JC (2) +Vbatt.
All relay outputs are adjustable by parameter.</td></tr>
<tr><td>Rated supply</td><td>500mAdc @ 32Vdc for each output</td></tr>
<tr><td>Output resistor status ON</td><td>Max 350mΩ</td></tr>
</table>

Leakage current status OFF	Max 5uA@32Vdc
Protections	Internal current limited to about 4A max. on transients >150us Thermal protection, short circuit, overvoltage and inverted polarity.
Digital outputs 05-13	
Type of output	9 independent static outputs to battery negative. The output current is supplied by the negative supply terminal of the device JC (1) GND. All relay outputs are adjustable by parameter.
Rated supply	Max. 280mAdc @ 32Vdc for each output Total maximum current for all activated outputs 2A @ 50°c.
Output resistor status ON	Max 500mΩ
Leakage current status OFF	Max 1uA@32Vdc
Protections	Internal current limited to 2,2A Typ. Thermal protection, short circuit, overvoltage with Auto Restart Inverted protection polarity.
Digital outputs 14 - Output Hardware Watch_Dog	
Type of output	1 static outputs to battery negative. The output current is supplied by the negative supply terminal of the device JC (1) GND. If it is enabled through the selector S4, the output can be used as output connected to a watch-dog system hardware-independent. If the watch-dog is enabled (S4=ON) and the device works correctly, the output is running. If the device is blocked and/or does not refresh the watch-dog circuit for a time higher than 5 seconds, the output fails. If the device is turned off, the output immediately fails. If the watch-dog is disabled (S4=OFF) the status of the output depends on its configuration.
Rated supply	Max. 280mAdc @ 32Vdc for each output Total maximum current for all activated outputs 2A @ 50°c.
Output resistor status ON	Max 500mΩ
Leakage current status OFF	Max 1uA@32Vdc
Protections	Internal current limited to 2,2A Typ. Thermal protection, short circuit, overvoltage with Auto Restart Inverted protection polarity.
Digital outputs 15 and 16	
Type of output	2 relays with NO contacts and one positive common terminal. The positive common terminal has the function of input for the emergency stop. The measurement of the voltage on the common input is displayed at page S.15 of the display (EM-S). All relay outputs are adjustable by parameter.
Rated supply	Max. 3A @ 30Vdc for each output
Protections	Self-restoring fuse and integrated opening power-surge protection diodes.

Digital outputs 17 and 18 – Tie breaker command	
Type of output	2 relays with dry contacts for the contactors switch command All relay outputs are adjustable by parameter.
Rated supply	Max. 10A @250Vac.
Analogue inputs 01-02	
Type of input	2 differential analogue inputs 0...10Vdc Both inputs offer the possibility of differential measurement to compensate the differences of negative measurement with respect to GND. There's a 5Vdc (JU-1) regulated and protected output and an internal GND terminal (JU-2) that can be used as reference for external potentiometers on the two analogue inputs.
Measurement range	0 - 10Vdc
Compensation range	From -10Vdc to +6Vdc
Input impedance	> 470kΩ
Frequency	10kHz
Resolution	12 bit
Measurement accuracy	<0,4% F.S.
Analogue inputs 03-07	
Type of input	5 adjustable analogue inputs. Adjustable as voltage, current (with external resistor) and digital inputs.
Voltage inputs	Measurement range 0 – 10Vdc with error < 0,2% Input impedance: >470kΩ
Current inputs.	Measurement range 0 - 20mA with 500Ω external resistor
Frequency	10kHz
Resolution	12 bit
Digital outputs 01-02	
Type of output	2 galvanically insulated ±10Vdc voltage outputs They can be used for the AVR and speed analogue regulation. Each output has an integrated trimmer to reduce the maximum output voltage, preserving in this way signal resolution.
Regulation range	From -1Vdc to +10Vdc
Resolution	16 bit
Minimum load impedance	>10 kΩ
Insulation rated voltage	Max operating 560Vdc 3KVdc on transient < 60s.
Insulation resistor	>1000MΩ @ 500Vdc
RS232 Communication interface	
Type of interface	1 RS232 serial port standard TIA/EIA, not insulated on DB connector 9 poles male CANON
Electrical signals	TX. RX, DTR, DSR, RTS, GND

Settings	Baud rate selectable by parameter: 300, 600, 1200, 2400, 4800, **9600***, 19200, 38400, 57600, 115200 bps Parity: **None***, Even, Odd Stop bit: **1***,2 * **Default Setting**
Type of transmission	**Modbus RTU Slave***, Modem AT * **Default Setting**
RS485 Communication interface	
Type of interface	1 RS485 serial port standard TIA/EIA, with galvanic insulation. Terminal resistor connectible with S5 switch.
Electrical signals	DATA+ (A), DATA– (B)
Settings	Baud rate selectable by parameter: 300, 600, 1200, 2400, 4800, **9600***, 19200, 38400, 57600, 115200 bps Parity: **None***, Even, Odd Stop bit: **1***,2 * **Default Setting**
Type of transmission	**Modbus RTU Slave***, Modbus RTU Master (for connection to ECU CUMMINS) * **Default Setting**
Insulation voltage	Max operating 560Vdc 1KVdc on transient < 60s.
USB 2.0 Communication interface	
Type of interface	1 USB2.0 serial port not insulated, which can be used in Function or Host mode. Selection of the operating mode through SW5 dipswitch. **The USB port cannot be used as Function and Host simultaneously.**
Function Mode	Connection to PC by Sices Driver USB Connector type B. Type of transmission Modbus RTU Slave
Host Mode	Pen Driver Management USB Connector type A. Max current supplied 350mA@5Vdc with overcharge automatic protection. **Host function is not supported so far**
Maximum distance	6m (20 feet)
CANBUS Communication interface	
Type of interface	2 CANBUS serial ports with galvanic insulation. Terminal resistor connectible with S1 and S6 switch.
CanBus0	CanBus connection with protocol Mecc Alte PMCBus for the communication with other devices (BUS A).

CanBus1	CanBus connection with protocol Mecc Alte PMCBus for the communication with other devices (BUS B).
Rated impedance	120Ω
Insulation voltage	Max operating 560Vdc 1KVdc on transient < 60s.
Ethernet Communication interface	
Type of interface	1 Ethernet interface 10/100Mbps full-duplex 10T/100Tx Auto HP Auto-Mdix support Compliant IEE802.3/802.3u(Fast ethernet) Compliant ISO802-3/IEEE802.3 (10BASE-T)
Insulation voltage	1500VRMS
HMI Communication interface (Optional)	
Type of interface	1 RS485/422 serial port not insulated for the connection between the SCM (System Control Module) device and the HMI (Human Machine Interface) panel.
Rated impedance	120Ω
Display	
Type of display	TFT 4.3” colour display with white leds backlight
Resolution	480 x 272
Pixel Size	0,066 x 0,198 mm
Visual area dimensions	95 x 54 mm
Environmental conditions	
Operating temperature	From -25°C to +60°C
Stock temperature	From -30°C to +80°C
moisture	IEC 60068-2-30 Db Damp Heat Cyclic 20/55°C @ 95% RH 48 Hours IEC 60068-2-78 Cab Damp Heat steady state 40°C @ 93% RH 48 Hours
Box	
Material	Nylon66 + 30% fibreglass
Size	244(W) x 178(H) x 83(D) mm
Weight	1100g

Protection degree	IP55 with gasket for the front panel IP20 for the panel interior

3.1 Measurement resolution

BUS A and BUS B voltage	1Vrms
Current	Min. 0.1A (it depends on the CT ratio)
BUS A and BUS B frequency	0.1Hz ± 50ppm, 35ppm/C typical
Power	Min. 0.1 kW/kVA/kvar (it depends on the CT ratio)
Power Factor	0.01
Energy	1 kWh/kvarh

4 Installation

4.1 Mounting

The device has to be mounted permanently on a panel. The rear panel of the device 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 mounting dimensions for the installation are 218x159mm. The mounting is carried out by four 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 earthing through permanent connections.

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

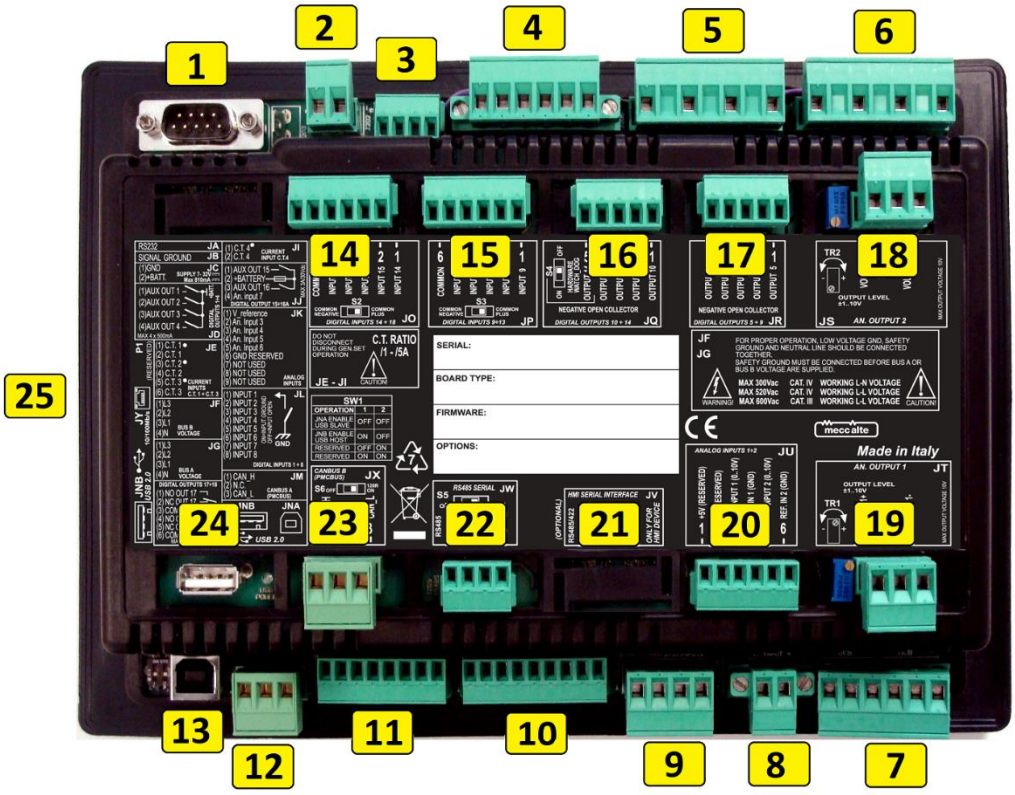
The section of the protective earthing conductor should be at least equal to the section of cables used to wire BUS A or BUS B voltage to the control panel. In addition, it must comply with the limit value of the overcurrent protection used.

For CAT.IV applications, the maximum phase-to-neutral voltage allowed is 300Vac, while the phase-to-phase voltage is 520Vac. The maximum voltage related to the protective earthing is 300 Vac.

For CAT.III applications, the maximum phase-to-neutral voltage allowed is 345Vac, while the phase-to-phase voltage is 600Vac. The maximum voltage related to the protective earthing is 600 Vac.

The device can operate in CAT.IV or CAT.III only if the supply negative terminal of the device and the neutral terminal are connected to the protective earthing.

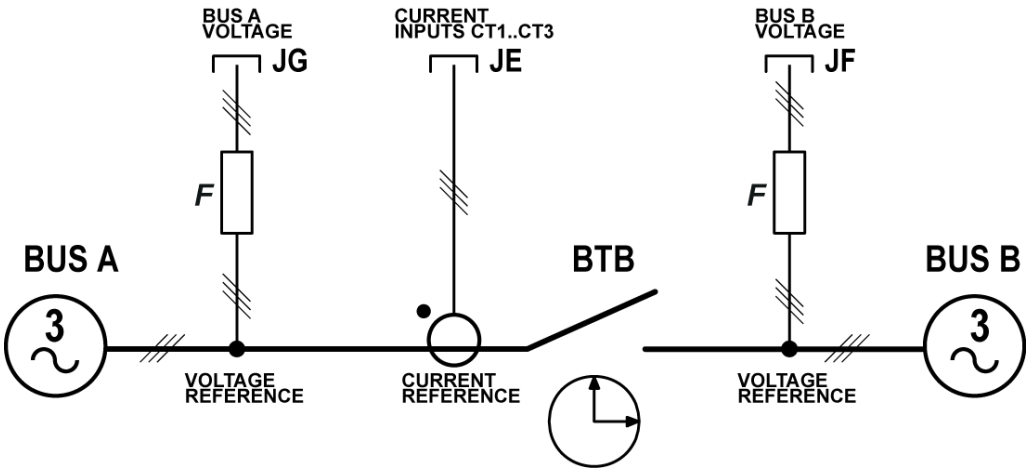
5 IN/OUT connections and configuration



N.	NAME	DESCRIPTION	CONNECTOR
1	JA	Communication interface RS232	9 Poles Male Canon
2	JC+JB	Supply + Functional earth	2 poles x 2,5mm² Screw terminal + faston
3	JD	Digital outputs 1-4	4 poles x 1,5mm² Screw terminal
4	JE	Currents inputs 1-3	6 poles x 2,5mm² Screw terminal
5	JF	BUS B voltages	4 poles x 2,5mm² Screw terminal
6	JG	BUS A voltages	4 poles x 2,5mm² Screw terminal
7	JH	Digital outputs 17 and 18 Tie Breaker command	6 poles x 2,5mm² Screw terminal
8	JI	Auxiliary Current Input	2 poles x 2,5mm² Screw terminal
9	JJ	Digital outputs 15 and 16 Analogue input 7	4 poles x 2,5mm² Screw terminal
10	JK	Analogue inputs 3-6	9 poles x 1,5mm² Screw terminal
11	JL	Digital inputs 1-8	8 poles x 1,5mm² Screw terminal

12	**JM**	BUS B - PCMBUS Interface	3 poles x 2,5mm² Screw terminal
13	**JNA**	USB 2.0 Function Interface	USB - B
14	**JO**	Digital inputs 14-18	6 poles x 1,5mm² Screw terminal
15	**JP**	Digital inputs 9-13	6 poles x 1,5mm² Screw terminal
16	**JQ**	Digital outputs 10-14	5 poles x 1,5mm² Screw terminal
17	**JR**	Digital outputs 5-9	5 poles x 1,5mm² Screw terminal
18	**JS**	Analogue output 2 (Voltage regulator)	3 poles x 2,5mm² Screw terminal
19	**JT**	Analogue output 1 (Speed regulator)	3 poles x 2,5mm² Screw terminal
20	**JU**	Analogue inputs 1-2	6 poles x 1,5mm² Screw terminal
21	**JV**	HMI Communication interface (Optional)	4 poles x 1,5mm² Screw terminal
22	**JW**	RS485 Communication interface	4 poles x 1,5mm² Screw terminal
23	**JX**	BUS A - PCMBUS Interface	3 poles x 2,5mm² Screw terminal
24	**JNB**	USB 2.0 Host Interface	USB - A
25	**JT**	Ethernet Interface	RJ45

5.1 Basic diagram

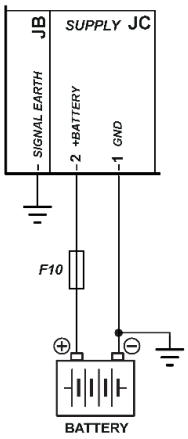


5.2 Functional earth (JB)

The connection to the functional earth **JB** is mandatory to guarantee the proper operation of the device and the compliance with the EU Electromagnetic Compatibility Regulation.

The connection is functional and not protective; therefore, the cross-section of the wire can be smaller. Connect the other end of the wire to a metal screw of the electrical panel (which must be grounded) next to the **JB** or to a grounding line, using the shortest cable possible.

5.3 Device supply (JC)



The **JC** connector is the supply connector: connect an DC supply (usually the engine starter battery) to the **1-GND** terminal (negative) and to the **2-+BATT** terminal (positive).

The minus terminal **1-GND** is the reference and the common return of the digital inputs, outputs and current and voltage measurements. **It must be connected to the ground protection.** The systems that require insulation between the battery negative and the ground protection can be used but can generate operating problems and may require particular care, as the use of insulation current transformers for the voltage measurements of BUS A and BUS B.

Although the device is protected by a built-in self-resetting fuse, it is recommended to use a fuse for the protection of the positive line **2-+BATT**. **The power supplied by the JD static outputs flows through the 2 +BATT positive input, so you must pay attention to the fuse dimension.**

The device automatically acknowledges when it is powered if the battery nominal voltage is 12 or 24V for managing the related logics and alarms. Also, the acknowledgement is carried out every time you switch to the **OFF/RESET** mode.

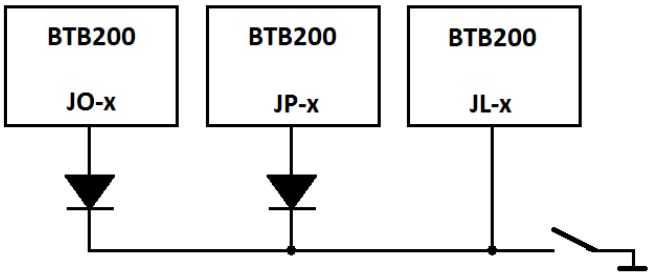
NOTE: when installing, connect the battery positive only after opening all fuses available in the panel.

5.4 Digital inputs 1-18 (JL, JO, JP)

The controller is equipped with a series of 18 opto-insulated digital inputs, which are fully configurable.

Besides these 18 inputs, it is possible to use the analogue inputs **JK** and **JU** as digital inputs, if not used as measurement inputs (see par.), 5.6and with different modes the **JJ-4** terminal too (D+ signal, see par.). 5.6.3In fact, every digital input can have an AND/OR logic associated, which determines its status.

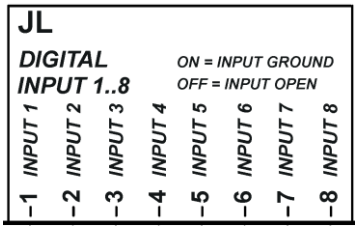
It is possible to share the same command signal of an input with different devices (for example, one signal for three BTB200). If you use the inputs of the JO and JP connectors (positive common), it's necessary to divide them with diodes, as in the figure below. This avoids the wrong activation of the input when one of the devices is turned off. If the JL connector inputs are used, the diode can be omitted as it is already provided internally.



There are also 16 “virtual” digital inputs, which do not really exist on the controller or on the expansion modules, but they are represented by the result of the logic combination of physical or virtual inputs, outputs, alarms or logical statuses, by means of the proper programming by BoardPrg4. The virtual inputs can be configured as functions and used as physical inputs; see par.5.4.4.

The status of the digital inputs and virtual inputs is displayed at pages S.11 (0=input not active, 1=input active).

5.4.1 JL - Digital inputs 1-8



They are a group of 8 opto-insulated digital inputs with common terminal internally connected to the positive supply terminal of the device +Vbatt. it is possible to activate the inputs by connecting them to the battery negative (GND). When it is left floating, the input brings itself to +Vbatt. Avoid situations where intermediate or undefined voltage levels can occur.

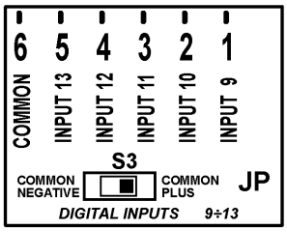
These inputs already have a series diode that allows to connect them directly among them.

The five inputs are wholly configurable (see par. 5.4.5).

By default, the functions of the JL input on the BTB200 controller are the following:

Terminal	Digital input (DI_CONTROLLER_)	Default function
JL-1	01	**DIF.3001 - “BTB status”**
JL-2	02	**DIF.4241 - “Overload”**
JL-3	03	**DIF.0000 - “Not used”**
JL-4	04	**DIF.1005 - “Request for BTB closure”**
JL-5	05	**DIF.1006 - “Request for BTB closure (A)”**
JL-6	06	**DIF.1007 - “Request for BTB closure (B)”**
JL-7	07	**DIF.0000 - “Not used”**
JL-8	08	**DIF.0000 - “Not used”**

5.4.2 JD - Digital inputs 9-13



They are a group of five opto-insulated digital inputs with common available on the terminal. It's possible to activate the inputs by connecting the terminal to the battery negative: in this way, the common terminal **JP-6** must be connected to the battery positive and the selector **S3** must be set on *common positive*.

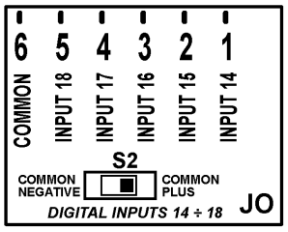
Alternatively, it's possible to activate the inputs by connecting them to the battery negative: in this case, the common terminal **JP-6** must be connected to the battery negative and the selector **S3** must be set on *common negative*.

The five inputs are wholly configurable (see par. In fact, every digital input can have an AND/OR logic associated, which determines its status (see par. 5.4.5).

By default, the functions of the JP input on the BTB200 controller are the following:

Terminal	Digital input (DI_CONTROLLER_)	Default function
JP-1	09	**DIF.0000 - "Not used"**
JP-2	10	**DIF.0000 - "Not used"**
JP-3	11	**DIF.0000 - "Not used"**
JP-4	12	**DIF.0000 - "Not used"**
JP-5	13	**DIF.0000 - "Not used"**
JP-6	-	Positive or negative common input terminal

5.4.3 JO - Digital inputs 14-18



They are a group of five opto-insulated digital inputs with common available on the terminal. It's possible to activate the inputs by connecting the terminal to the battery negative: in this way, the common terminal **JO-6** must be connected to the battery positive and the selector **S2** must be set on *common positive*.

Alternatively, it's possible to activate the inputs by connecting them to the battery negative: in this case, the common terminal **JO-6** must be connected to the battery negative and the selector **S2** must be set on *common negative*.

The five inputs are wholly configurable (see par.5.4.5).

By default, the functions of the JO inputs on the BTB200 controller are the following:

Terminal	Digital input (DI_CONTROLLER_)	Default function
JO-1	14	**DIF.0000 - "Not used"**

Terminal	Digital input (DI_CONTROLLER_)	Default function
JO-2	15	**DIF.0000 - "Not used"**
JO-3	16	**DIF.0000 - "Not used"**
JO-4	17	**DIF.0000 - "Not used"**
JO-5	18	**DIF.0000 - "Not used"**
JO-6	-	Positive or negative common input terminal

5.4.4 Virtual digital inputs (DI_VIRTUAL)

Besides 18 physical digital inputs, the controller manages 16 virtual digital inputs. They are managed by the controller exactly as they were physical inputs (without limitations), but the virtual inputs status is not acquired by the hardware, but determined via software. In fact, each virtual digital input can be associated to an AND/OR logic that determines the status (see par. 5.5.7) or to a logic used by the PLC program.

The status of the virtual inputs is displayed at pages S.11 (0=output not active, 1=output active).

Example of the use of an AND/OR logic. Let's suppose we would like to activate a warning if the BUS A exceeds the tolerance thresholds. Let us use the virtual digital input #1 (as example).

- Using the BoardPrg4 software we associate an AND/OR logic configured as AND to the #1 virtual digital input, with the following list of conditions:
  - ST.064 ("Status of the BTB")
  - ST.017 ("BUS A out of tolerance or absent").
- Therefore, the virtual digital input will be active when the BTB is closed and the BUS A is out of tolerance.
- Let us set the DIF.4001 function ("Generic warning") within the P.2151 parameter.
- Let us set the desired delay (for example 0.5 s) within the P.2152 parameter.
- Let us set the alarm message (for example "BUS A voltage warning") within the P.2153 parameter.

5.4.5 Digital inputs configuration

The digital inputs 9-18 (JO and JP) are by default configured as inputs with *common plus* and therefore with activation status equal to the digital inputs 1-8 (JL). It means that all the digital inputs are considered "active" only when the related terminal is connected to the supply negative of the controller; they are considered "not active" when the related terminal is left open.

The logic status of the input can be reversed with respect to the physical status by ticking the "Reversed polarity" box in the input configuration page on BoardPrg4.

The box is only visible if the function selected is other than DIF.0000 – "Not used".

It is also possible to reverse the logic status (always individually for each input), directly by the controller, using the parameters:

Parameter	Inputs
P.2000	01...16
P.2050	17...18
P.2100	Analogue inputs used as digital ones

Said parameters have a bit for each output:

- A bit set to zero means that the related input is “active” when it is connected to the negative supply of the controller.
- A bit set to one means that the related input is considered “active” when it is not connected to anything (it will become “not active” if it is disconnected to the supply negative terminal of the controller).

By default, all bits are set to zero.

Each input (both physical and virtual) has three parameters associated:

- One parameter which configures its function (P.2001 for input 1).
- A parameter that configures the delay time (P.2002 for the input 1).
- A parameter that configures a message to show on the display (P.2003 for the input 1).

See documents [1] for the parameters list.

The management of the physical and virtual inputs is the same, except that the virtual inputs cannot be inverted.

The status of the digital inputs and virtual inputs is displayed at pages S.11 (0=output not active, 1=output active).

The parameters that configure the delay and the message for an input are used by the controller only for certain features of the inputs. The following table highlights when they are used:

NOTE: in BoardPrg4, the boxes for the delay and the message are always displayed, even if they are not used by the controller.

The input functions that start with 3xxx are related to the functioning status; those that start with 4xxx activate alarms (alarms or warning).

The following function, not directly linked to the operation sequences of the controller, are selectable for any digital output:

- DIF.0101 - “Used by PLC”. It is possible to use the digital inputs of the controller only for the PLC logics, without the controller normal operation sequence using them. In these cases, it is possible to leave the inputs configured with the function DIF.0000 (“Not used”). Therefore, there’s the risk to reuse the input for other purposes, as it seems to be available: for this reason, there is the DIF.0101 function (to indicate the input used, even if not directly by the controller).

Input function xx.	Name	Delay	Message	Description
DIF.0000	Not used			Input not used.
DIF.0101	Used by PLC			Input used by the internal PLC logic
DIF.1001	Request for BTB manual closure			It only acts in MAN, used to control the manual closing of the BTB circuit breaker. The controller automatically selects the best BUS, based on the number of generators and their load. If there is no input configured with the function DIF.1004, this input works in reality as toggle: it commands the closure of the breaker when the same is open and commands the opening when the same is closed.

Input function xx.	Name	Delay	Message	Description
DIF.1002	Request for BTB manual closure (A)			It only acts in MAN, used to control the manual closing of the BTB circuit breaker to BUS A. The commands are sent to the BUSA (unless it is not parallel to a mains). If there is no input configured with the function DIF.1004, this input works in reality as toggle: it commands the closure of the breaker when the same is open and commands the opening when the same is closed.
DIF.1003	Request for BTB manual closure (B)			It only acts in MAN, used to control the manual closing of the BTB circuit breaker to BUS B. The commands are sent to the BUSB (unless it is not parallel to a mains). If there is no input configured with the function DIF.1004, this input works in reality as toggle: it commands the closure of the breaker when the same is open and commands the opening when the same is closed.
DIF.1004	Request for BTB manual opening			It only acts in MAN, used to control the manual opening of the BTB circuit breaker. It works only if at least another input is configured with the function DIF.1001 or DIF.1002 or DIF.1003.
DIF.1005	Request for BTB closure			It only acts in AUTO, used to control the automatic closing of the BTB circuit breaker. The controller automatically selects the best BUS, based on the number of generators and their load.
DIF.1006	Request for BTB closure (A)			It only acts in AUTO, used to control the automatic closing of the BTB circuit breaker to BUS A. The commands are sent to the BUSA (unless it is not parallel to a mains).
DIF.1007	Request for BTB closure (B)			It only acts in AUTO, used to control the automatic closing of the BTB circuit breaker to BUS B. The commands are sent to the BUSA (unless it is not parallel to a mains).
DIF.1008	BTB controlled externally			it indicates to the controller that the circuit breaker will be temporarily controlled by external logics: the controller will acknowledge it without activating faults.
DIF.2001	Command for resetting alarms			When the input becomes “active”, the controller carries out a reset of all faults. That is equivalent to change the controller mode to OFF/RESET and back again to the desired mode.
DIF.2002	Command for alarm acknowledgment			When the input becomes “active”, the controller silences the horn and recognises the faults as the ACK button was kept pressed on the device display.
DIF.2151	Select configuration 1.			When the input becomes “active”, the parameter of the alternative configuration 1 are copied into the work parameters
DIF.2152	Select configuration 2.			When the input becomes “active”, the parameter of the alternative configuration 2 are copied into the work parameters
DIF.2153	Select configuration 3.			When the input becomes “active”, the parameter of the alternative configuration 3 are copied into the work parameters
DIF.2154	Select configuration 4.			When the input becomes “active”, the parameter of the alternative configuration are copied into the work parameters
DIF.2271	Remote OFF			When this input is active, the operating mode of the controller is forced to OFF-RESET, and it is not possible to use the pushbuttons on the front panel to change it. **Note: when this deactivates, if no inputs are configured with the functions DIF.2272 and DIF.2273, the operating mode is forced to the one set before the input activation.**

Input function xx.	Name	Delay	Message	Description
DIF.2272	Remote MAN			When this input is active, the operating mode of the controller is forced into MAN and you cannot use the buttons on the panel to change it.
DIF.2273	Remote AUTO			When this input is active, the operating mode of the controller is forced into AUTO and you cannot use the buttons on the panel to change it.
DIF.2704	Disables protections on 4th current			When this input is “active”, the auxiliary current protection (normally used for differential protection) is disabled.
DIF.2705	Disables protections on analogue measures			When this input “activates”, the thresholds set on the analogue measures with bit14 ON, in the third or sixth configuration parameter (see par. 0) don’t cause the intervention of the relative protections.
DIF.2706	Enables serial ports commands			If this input is not “active”, the commands sent by means of Modbus registers HOLDING REGISTER 101 and 102 are not accepted.
DIF.3001	Status of BTB circuit breaker	Yes		It acquires the circuit breaker status which connects the BUS A to the BUS B. An input configured in this way is used to activate early warnings in the event of a discrepancy between the controls to the switch given by the board and the status of the same switch.
DIF.3101	Absence of voltage on BUSA			Used in plants, where the controller cannot directly measure the voltage on the BUS A. The active input indicates that there is no voltage on the BUS A.
DIF.3102	Absence of voltage on BUSB			Used in plants, where the controller cannot directly measure the voltage on the BUS B. The active input indicates that there is no voltage on the BUS B.
DIF.3201	Generic status (page 1)		Yes	When this input is “active”, the controller displays the text set in the parameters associated to the input on page S. 08.
DIF.3202	Important status (page 1)		Yes	When this input is “active”, the controller displays the text set in the parameters associated to the input on page S. 08, which is immediately shown.
DIF.3203	Generic status (page 2)		Yes	When this input is “active”, the controller displays the text set in the parameters associated to the input on page S. 09.
DIF.3204	Important status (page 2)		Yes	When this input is “active”, the controller displays the text set in the parameters associated to the input on page S. 09, which is immediately shown.
DIF.3205	Generic status (page 3)		Yes	When this input is “active”, the controller displays the text set in the parameters associated to the input on page S. 10.
DIF.3206	Important status (page 3)		Yes	When this input is “active”, the controller displays the text set in the parameters associated to the input on page S. 10, which is immediately shown.
DIF.4001	Generic warning	Yes	Yes	When the input is active, a warning is issued: the message shown is the one set in the parameters associated to the input
DIF.4004	Generic alarm	Yes	Yes	When the input is active, an alarm is issued: the message shown is the one set by means the related “text” parameter
DIF.4011	Warning (when BTB is open)	Yes	Yes	When the input is “active”, if the BTB command is not active, a warning is issued: the message shown is the one set in the parameters associated to the input
DIF.4014	Alarm (when BTB is open)	Yes	Yes	When the input is “active”, if the BTB command is not active, an alarm is issued: the message shown is the one set in the parameters associated to the input
DIF.4021	Warning (when BTB is closed)	Yes	Yes	When the input is “active”, if the BTB command is active, a warning is issued: the message shown is the one set in the parameters associated to the input

Input function xx.	Name	Delay	Message	Description
DIF.4024	Alarm (when BTB is closed)	Yes	Yes	When the input is “active”, if the BTB command is active, an alarm is issued: the message shown is the one set in the parameters associated to the input
DIF.4241	Over load	Yes		Normally, the “tripped” contact of the machine protection breaker is connected to this input. When the input is active, a block is activated with a fix description (based on the language).

5.5 Digital outputs 1-18 (JJ, JH, JD, JQ, JR)

The controller has 18 digital outputs: 4 relay outputs (**JJ** and **JH**), 4 positive static outputs (**JD**) and 10 negative static outputs (**JQ** and JR).

5.5.1 JJ - Digital outputs 15-16

The outputs of the **JJ** connector are free (not configured) as default, and can be freely configured by means the parameter of the controller.

The status of these outputs is displayed at pages S.12 (0=output not active, 1=active output).

The default functions of the JJ outputs are:

Terminal	Digital output	Type	Default function
JJ-1	15	Normally open contact, of the relay 15.	**DOF.0000 – “Not used”.**
JJ-2	-	Terminal positive common input	
JJ-3	16	Normally open contact, of the relay 16.	**DOF.0000 – “Not used”.**
JJ-4	-	-	

In detail:

5.5.1.1 JJ-2 COMMON PLUS Common positive

Positive input common for outputs 15 and 16, internally protected by self-reset fuse: it is therefore suggested to protect it with a correct range external fuse. It must be connected to the positive of the power supply by means of a contact of the emergency button: that is, this connection must be interrupted by keeping the emergency button pressed. Several emergency buttons may be used by series connecting them to each other.

Without voltage on that input (that is, pressing the emergency button,), in operational modes (MAN, AUTO, etc.) the device generates the alarm AL.048 “A048 Emergency Stop”. It is not possible to configure the controller to deactivate the alarm for emergency stop.

The voltage at terminal JJ-2 is measured for the management of the relative alarm and is displayed on page S.13 at EM-S

Attention: do not use the terminal as common negative for the two relays outputs. Inside, in effect, are damper diodes for the opening over voltages that would enter in conduction and could be immediately damaged.

5.5.1.2 JJ-1 Digital output 15

Positive relay output, with maximum capacity of 3A @30VDC. Integrated internal diode for damping opening over voltages. This terminal shows the battery voltage present on connector **JJ-2**; although one is already present inside, with particularly inductive loads (remote control switches, electromagnets, etc.) it is advisable to use a damper diode for opening over voltages.

Attention: for currents over the nominal one use an external restart relay.

The output can be freely configured by means of parameter P.3015, see paragraph 5.5.6 and document [1] for the parameters list.

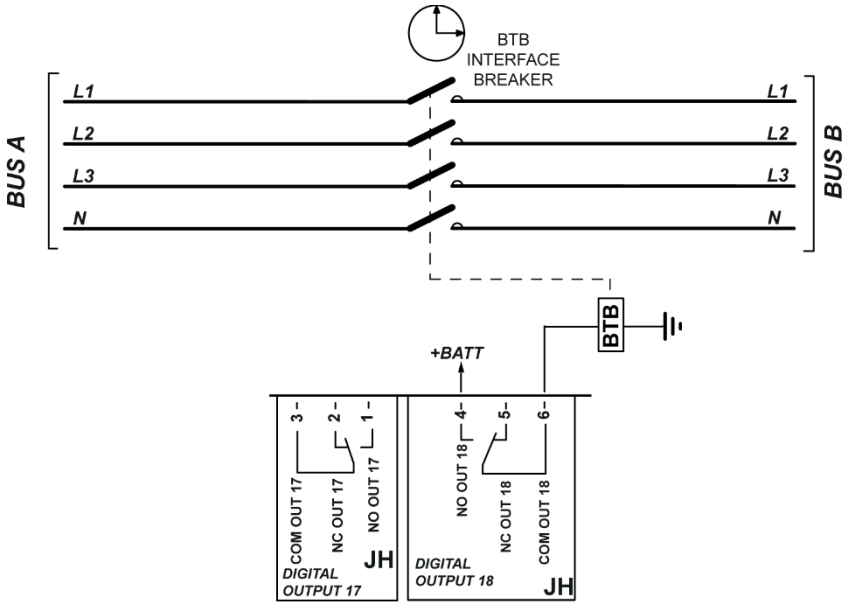
5.5.1.3 JJ-3 Digital output 16

Positive relay output, with maximum capacity of 3A @30VDC. Integrated internal diode for damping opening over voltages. This terminal shows the battery voltage present on connector **JJ-2**; although one is already present inside, with particularly inductive loads (remote control switches, electromagnets, etc.) it is advisable to use a damper diode for opening over voltages.

Attention: for currents over the nominal one use an external restart relay.

The output can be freely configured by means of parameter P.3016, see paragraph 5.5.6 and document [1] for the parameters list.

5.5.2 JH - Digital outputs 17-18: Outputs for the BTB circuit breaker

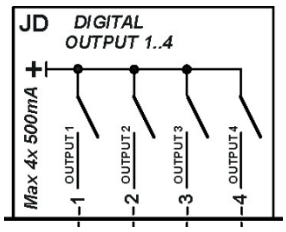


The controller uses two 10A@250Vac relays in clean contact for the circuit breaker command. On JH connector, a clean contact in exchange for each of the two relays.

The default functions of the outputs on the controller are:

Terminal	Digital output (DO_controller_)	Type of output	Default function
JH-1	17	Normally open contact, of the relay.	**DOF.2032 - "BTB steady opening command"**
JH-2		Normally closed contact, of the relay.	
JH-3		Common contact of the relay.	
JH-4	18	Normally open contact, of the relay.	**DOF.2033 - "BTB steady opening command"**
JH-5		Normally closed contact, of the relay.	
JH-6		Common contact of the relay.	

5.5.3 JD - Digital inputs 1-4



They are four digital outputs, wholly programmable. When activated, they bring themselves to the positive supply voltage which is on the **JC-2** supply terminal. The nominal capacity of each single output is 500mA: the total current is therefore 2A. **Do never overpass these values at full speed.**

The outputs are independent and individually protected from overloads, short circuits, polar inversion and overheating. The protection of overload intervenes limiting the current peak at an instantaneous value of 4A, to allow the activation of loads which need a higher transitory current than the nominal. When this condition is lasting, after 150us the gradual intervention of the thermal protection begins, up to the turning off of the output.

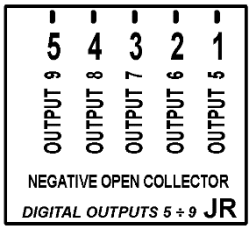
With inductive loads (power relays, electro-magnetic actuators), although already internally present, it is advisable to use damping diodes of the opening over voltages.

All the current supplied by the outputs must be kept available by means of **JC-2 +BATT;** ensure that the eventual protection fuse on the supply positive have adequate capacity and intervention time to protect both the outputs and the device in any usage condition.

The default functions of the JJ outputs are:

Terminal	Digital output (DO_CONTROLLER_)	Type of output	Default function
JD-1	01	Static output at battery positive	**DOF.0000 - "Not used"**
JD-2	02		**DOF.0000 - "Not used"**
JD-3	03		**DOF.0000 - "Not used"**
JD-4	04		**DOF.0000 - "Not used"**

5.5.4 JO - Digital inputs 5-9



They are four digital outputs, wholly programmable. When activated, they bring themselves to the negative supply voltage which is on the **JC-1 GND** supply terminal. Through this terminal, all current supplied by the active outputs flows. The nominal capacity of each output is of 280mA, while the total current with all active outputs of JR and JQ (Outputs 5-14) must be maintained below 2A. **Do never overpass these values at full speed.**

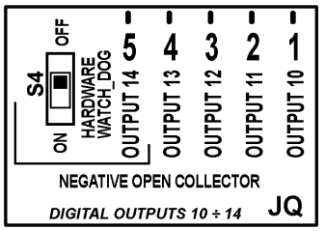
The outputs are independent and individually protected from overloads, short circuits, polar inversion and overheating. The overload protection intervenes limiting the current peak at a instantaneous value of 2.2A. When this condition is lasting, the intervention of the thermal protection starts, which gradually reduces the current to keep te temperature of the output driver within its maximum limit.

With inductive loads (power relays, electro-magnetic actuators), although already internally present, it is advisable to use damping diodes of the opening over voltages.

The default functions of the outputs are:

Terminal	Digital output (DO_CONTROLLER_)	Type of output	Default function
JR-1	05	static output to battery negative.	**DOF.0000 - "Not used"**
JR-2	06		**DOF.0000 - "Not used"**
JR-3	07		**DOF.0000 - "Not used"**
JR-4	08		**DOF.0000 - "Not used"**
JR-5	09		**DOF.0000 - "Not used"**

5.5.5 JQ - Digital outputs 10-14



They are four digital outputs, totally programmable. When activated, they bring themselves to the negative supply voltage which is on the **JC-1 GND** supply terminal.
Through this terminal, all current supplied by the active outputs flows. The nominal capacity of each output is of 280mA, while the total current with all active outputs of JR and JQ (Outputs 5-14) must be maintained below 2A. **Do never overpass these values at full speed.**

The JQ-5 terminal can be used, alternatively to the function of output 14 as independent hardware watch-dog output.
The activation happens through the S4 selector which, if set on ON, connects the output to the internal watch-dog circuit. If the device works properly and the output always remains in operation (output connected to battery negative).
If the device is blocked and/or does not refresh the watch-dog circuit for a time higher than 5 seconds, the output automatically fails.
If the device is turned off, the output immediately falls without waiting the 5 seconds time-out.
The output is on after about 1 sec, from the controller starting.

If the watch-dog is disabled (S4=OFF) the status of the output 14 on JQ-5 terminal depends on its configuration.
In case the output 14 is programmed with a specific function and the selector S4 is anyway set on ON (watch-dog output active), the output remains connected to the watch-dog circuit and it will never be activated by the chosen function.
Using the output as watch-dog the functionality of output 14 is lost.

All outputs are independent and individually protected from overloads, short circuits, polar inversion and overheating. The overload protection intervenes limiting the current peak at a instantaneous value of 2.2A. When this condition is lasting, the intervention of the thermal protection starts, which gradually reduces the current to keep te temperature of the output driver within its maximum limit.

With inductive loads (power relays, electro-magnetic actuators), although already internally present, it is advisable to use damping diodes of the opening over voltages.

The default functions of the outputs are:

Terminal	Digital output (DO_CONTROLLER_)	Type of output	Default function
JQ-1	05	Static outputs to battery negative.	**DOF.0000 - "Not used"**
JQ-2	06		**DOF.0000 - "Not used"**
JQ-3	07		**DOF.0000 - "Not used"**
JQ-4	08		**DOF.0000 - "Not used"**
JQ-5	09		**DOF.0000 - "Not used"**

5.5.6 Digital outputs configuration

All digital output of the controller (JD, JR and JQ) are individually totally programmable.

The status of the virtual outputs is displayed at pages S.12 (0=output not active, 1=output active).

All outputs activate when required by the relative function (e.g. The external horn output operates when the horn has to be activated).

Using BoardPrg4 it is possible to invert the activation by simply selecting the box "Inverted polarity", on the top of the configuration page of each output.

However, operating directly on the controller it is possible to invert the outputs logics (still individually for each outputs) using the parameters:

Parameter	Outputs
P.3000	01...16
P.3020	17...18

A bit to zero means that the output is normally at rest. It operates when it is required by the associated function.

A bit to zero means that the output is normally at rest. It operates when it is required by the associated function.

The map of the outputs on the controller is:

BIT	Exadecimal value	Digital output (DO_CONTROLLER_)	Terminal
1	0001	Output 01	JD-1
2	0002	Output 02	JD-2
3	0004	Output 03	JD-3
4	0008	Output 04	JD-4
5	0010	Output 05	JR-1
6	0020	Output 06	JR-2
7	0040	Output 07	JR-3
8	0080	Output 08	JR-4
9	0100	Output 09	JR-5
10	0200	Output 10	JQ-1
11	0400	Output 11	JQ-2
12	0800	Output 12	JQ-3
13	1000	Output 13	JQ-4
14	2000	Output 14	JQ-5
15	4000	Output 15	JJ-1

BIT	Exadecimal value	Digital output (DO_CONTROLLER_)	Terminal
16	8000	Output 16	JJ-3

Bit	Exadecimal value	Digital output (DO_controller_)	Terminal
1	0001	Output 17	JH-1..3
2	0002	Output 18	JH-4..6

Basically, if you want to invert the logic of an output it is necessary to add in the relative parameter its corresponding value: e.g. If you want to invert the oututs 3 and 4 on the controller, it is necessary to set P.3000 = 000C (cioè 0004+0008).

By default, all bits are set to zero.

The digital outputs can be used directly as command for external devices of the controller or as warning of particular operation conditions.

The following three function, not directly linked to the operation sequences of the controller, are selectable for any digital output:

- DOF.0101 - “Used by PLC”. This function matches the digital output to the PLC program inside the device; in this way, it is the PLC logic which commands the output, and not the normal operation logics of the controller. Note: if the PLC program uses some outputs, but those are not configured with function DOF.0101, the outputs will not be commanded (but the controller signals this situation with a warning).
- DOF.0102 - “Commanded by the serial ports”. The controller does not command the output with own internal logics, but with the commands received by means of the serial ports.
- DOF.0103 - “Logics AND/OR”. See 5.5.7.

Following the configurable functions on digital outputs.

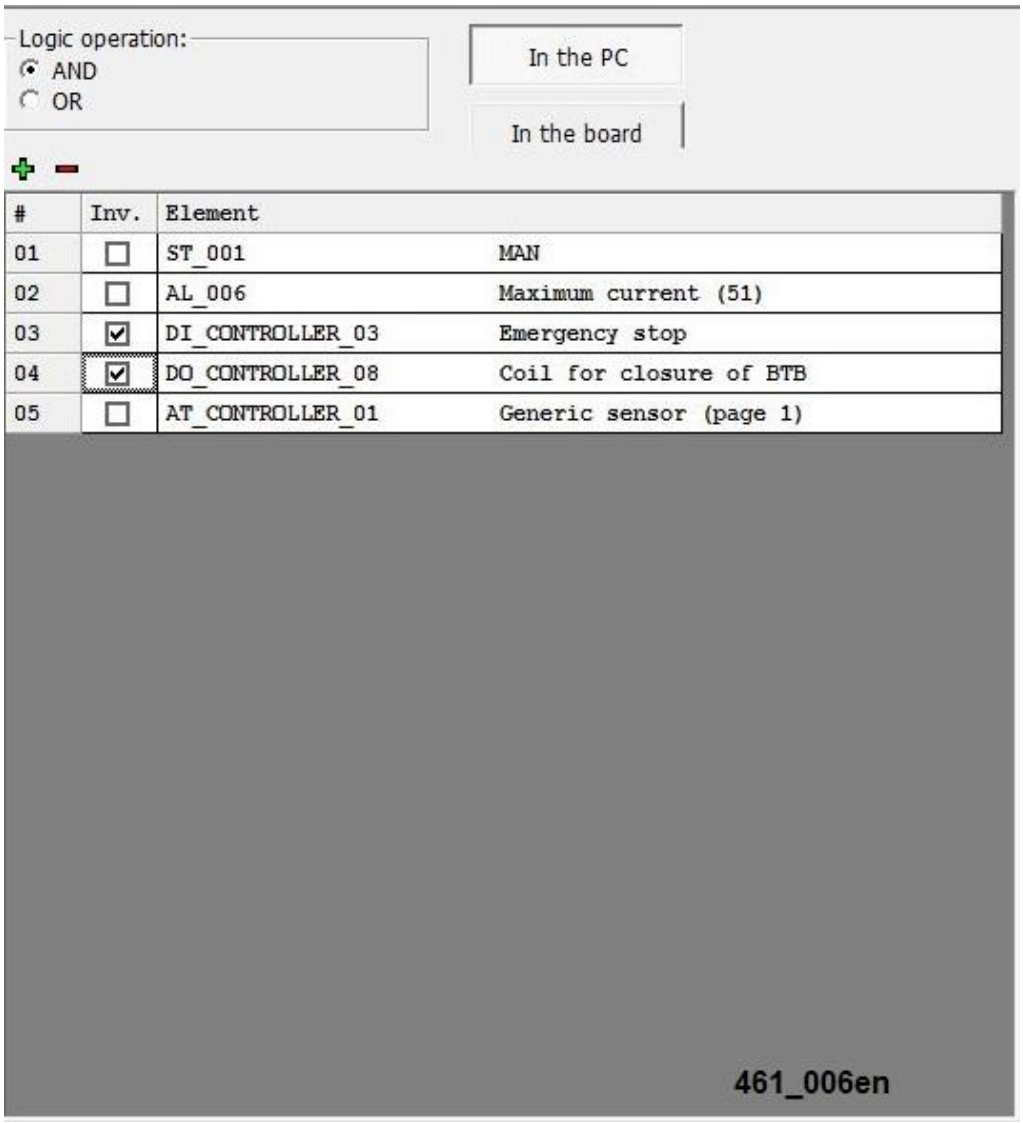
Output function xx.	Name	Description
DOF.0000	Not used	Output not used
DOF.0101	Used by PLC	Input used by the internal PLC logic
DOF.0102	Managed by serial ports	The controller does not command the output with own internal logics, but with the commands received by means of the serial ports.
DOF.0103	AND/OR logics	The output status is the result of the combination of the logics AND/OR, see par. 5.5.7
DOF.2031	Minimum voltage coil for BTB (NC)	See par. 7.3
DOF.2032	Coil for opening of BTB	See par. 7.3
DOF.2033	Coil for closure of BTB	See par. 7.3
DOF.2034	Stable closing command for BTB	See par. 7.3
DOF.3001	Off/reset	It activates when the controller is in OFF/RESET mode.
DOF.3002	Manual	It activates when the controller is in MANUAL mode.
DOF.3003	Automatic	It activates when the controller is in AUTOMATIC mode.
DOF.3011	Not in Off/reset	It activates when the controller is in MAN or AUTO mode.
DOF.3031	Voltage on BUS A	It activates when there is voltage on the BUS A.
DOF.3032	Voltage on BUS B	It activates when there is voltage on the BUS B.
DOF.3033	BUS A in tolerance	It activates when the BUS A parameters are in the window of normal operation.
DOF.3034	BUS B in tolerance	It activates when the BUS B parameters are in the window of normal operation.
DOF.3091	Synchronization for BUS A	It activates during the synchronisation for the closure of the BTB switch to BUS A.
DOF.3092	Synchronization for BUS B	It activates during the synchronisation for the closure of the BTB switch to BUS B.

Output function xx.	Name	Description
DOF.3093	Synchronization in progress	It activates during the synchronisation for the closure of the BTB switch.
DOF.3094	Synchronized	It activates during the synchronisation for the closure of the BTB switch, when the BUS A is synchronous with the BUS B or viceversa.
DOF.3151	Reset of the anomalies	The board activates this output for one second when the internal sequence for the cancellation of anomalies is carried out.
DOF.3152	External horn	It activates together with the internal siren.
DOF.3153	Lamp test	It activates in OFF/RESET mode, pressing STP button; it can be used to turn on eventual internal control lights of the controller, and there is one only procedure to test the control lights.
DOF.3154	Acknowledge of the anomalies	The board activates this output for one second when the internal sequence for the identification of anomalies is carried out.
DOF.4001	Warnings	It activates when there are warnings
DOF.4004	Alarms	It activates when there are alarms

5.5.7 AND/OR logics

The and/OR logics are basically a list of boolean conditions (true/false - on/off - 1/10), configurable by the operator (programming), evaluated by the controller and the result of which can be assigned to a digital output or to a virtual digital input (see par. 5.5.6 and par.5.4.5). To use the AND/OR logics with one digital output, use function DOF.0103.

Note: the configuration of the AND/OR logics cannot be carried out directly from the controller display, but it has to be carried out by PC with the BoardPrg4 software.



First of all, the operator must decide whether the conditions list has to be evaluated as AND (they have to be all checked) or as OR (at least one condition checked). **It is not possible to have mixed AND/OR logics (it is possible to do it using virtual digital inputs, see below).**

Up to 30 conditions can be added. Each condition can be individually denied: in the previous picture, for example, the controller will check the digital input 3 and the digital output 8 to be both **not active**. The following conditions can be added:

- DI_XXX: logic statuses of all digital inputs (physical and virtual).
- DO_XXX: logic statuses of all digital outputs.
- AL_XXX: presence of warning/alarms.
- ST_XXX: internal statuses of the controller.
- AT_XXX: statuses connected to the thresholds on analogue measures (see par. 0In fact, every digital input can have an AND/OR logic associated, which determines its statuses.

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

Status	Description
ST.000	OFF_RESET
ST.001	MAN
ST.002	AUTO
ST.006	Identification ongoing anomalies
ST.007	Reset ongoing anomalies
ST.008	Warning total
ST.011	Blocks total
ST.012	Unacknowledged warnings total
ST.015	Unacknowledged blocks total
ST.016	Presence of BUS A voltage/frequency
ST.017	BUS A out of tolerance or off
ST.018	Delay for BUS A in tolerance
ST.019	BUS A in tolerance
ST.020	Delay for BUS A out of tolerance or off
ST.024	BUS B voltage/frequency present
ST.025	BUS B out of tolerance or absent
ST.026	Delay for BUS B within tolerance.
ST.027	BUS B in tolerance
ST.028	Delay for BUS B out of tolerance or absent
ST.064	BTB status
ST.068	BTB steady closing command
ST.070	BTB under voltage coil
ST.071	BTB pulse open command
ST.072	BTB pulse steady closing command
ST.096	Synchronization
ST.097	BUS A synchronization in progress
ST.098	BUS B synchronization in progress
ST.099	Synchronized
ST.112	Synchronization every second
ST.113	Synchronization every minute
ST.114	Synchronization every 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.256	CAN 0 BUS-OFF
ST.257	CAN 0 ERR-PASSIVE
ST.258	CAN 0 ERR-ACTIVE
ST.259	No communication on CAN 0

Status	Description
ST.260	CAN 1 BUS-OFF
ST.261	CAN 1 ERR-PASSIVE
ST.262	CAN 1 ERR-ACTIVE
ST.263	No communication on CAN 1
ST.264	CAN 2 BUS-OFF
ST.265	CAN 2 ERR-PASSIVE
ST.266	CAN 2 ERR-ACTIVE
ST.267	No communication on CAN 2
ST.304	PROGRAM button
ST.305	HOME button
ST.306	BTB CLOSE button
ST.307	BTB OPEN button
ST.308	MODE UP button
ST.309	MODE DOWN button
ST.310	UP button
ST.311	DOWN button
ST.312	LEFT button
ST.313	RIGHT button
ST.314	ENTER button
ST.315	EXIT button
ST.316	SHIFT button
ST.317	ACK button
ST_384	Generator 01 active on PMCB
ST_385	Generator 02 active on PMCB
ST_386	Generator 03 active on PMCB
ST_387	Generator 04 active on PMCB
ST_388	Generator 05 active on PMCB
ST_389	Generator 06 active on PMCB
ST_390	Generator 07 active on PMCB
ST_391	Generator 08 active on PMCB
ST_392	Generator 09 active on PMCB
ST_393	Generator 10 active on PMCB
ST_394	Generator 11 active on PMCB
ST_395	Generator 12 active on PMCB
ST_396	Generator 13 active on PMCB
ST_397	Generator 14 active on PMCB
ST_398	Generator 15 active on PMCB
ST_399	Generator 16 active on PMCB
ST_400	Generator 17 active on PMCB
ST_401	Generator 18 active on PMCB
ST_402	Generator 19 active on PMCB
ST_403	Generator 20 active on PMCB
ST_404	Generator 21 active on PMCB
ST_405	Generator 22 active on PMCB
ST_406	Generator 23 active on PMCB
ST_407	Generator 24 active on PMCB
ST_408	Generator 25 active on PMCB
ST_409	Generator 26 active on PMCB
ST_410	Generator 27 active on PMCB
ST_411	Generator 28 active on PMCB
ST_412	Generator 29 active on PMCB
ST_413	Generator 30 active on PMCB
ST_414	Generator 31 active on PMCB
ST_416	MC 01 active on PMCB
ST_417	MC 02 active on PMCB
ST_418	MC 03 active on PMCB
ST_419	MC 04 active on PMCB

Status	Description
ST_420	MC 05 active on PMCB
ST_421	MC 06 active on PMCB
ST_422	MC 07 active on PMCB
ST_423	MC 08 active on PMCB
ST_424	MC 09 active on PMCB
ST_425	MC 10 active on PMCB
ST_426	MC 11 active on PMCB
ST_427	MC 12 active on PMCB
ST_428	MC 13 active on PMCB
ST_429	MC 14 active on PMCB
ST_430	MC 15 active on PMCB
ST_431	MC 16 active on PMCB
ST_432	BTB 01 active on PMCB
ST_433	BTB 02 active on PMCB
ST_434	BTB 03 active on PMCB
ST_435	BTB 04 active on PMCB
ST_436	BTB 05 active on PMCB
ST_437	BTB 06 active on PMCB
ST_438	BTB 07 active on PMCB
ST_439	BTB 08 active on PMCB
ST_448	RN 01 active on PMCB
ST_449	RN 02 active on PMCB
ST_450	RN 03 active on PMCB
ST_451	RN 04 active on PMCB
ST_452	RN 05 active on PMCB
ST_453	RN 06 active on PMCB
ST_454	RN 07 active on PMCB
ST_455	RN 08 active on PMCB
ST_464	Validity of shared digital input 1
…	…
ST_719	Validity of shared digital input 256
ST_720	Validity of shared analogue input
…	…
ST_751	Validity of shared analogue input32
ST.997	First PLC scan
ST.998	Always active
ST.999	Always not active

Using the virtual digital inputs, it is possible to create mixes AND/OR logics (composed by AND or OR together). Let's suppose we want to activate the digital output #1 when the digital inputs #1 and #2 are active, or if the digital input #3 is active.

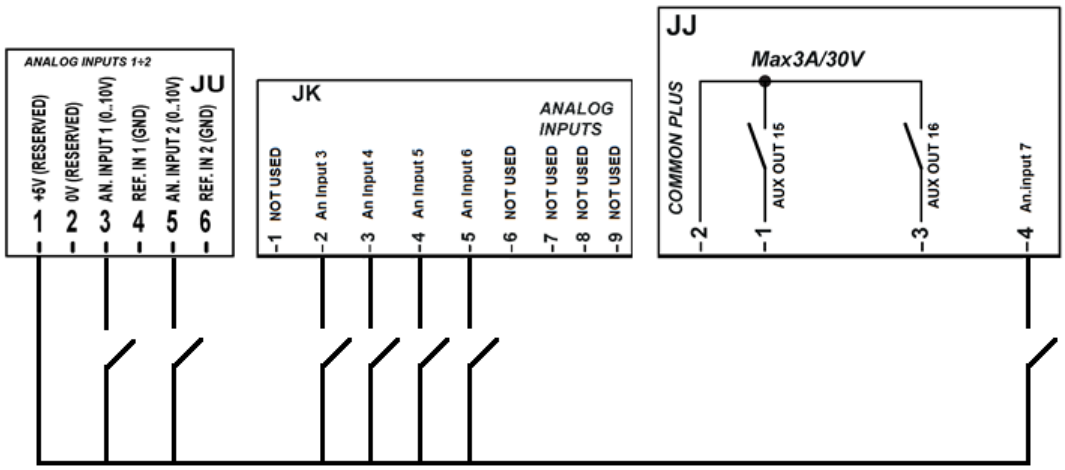
Fist of all we have to associate to the virtual digital input #1 e.g. an AND/OR logic configured as AND, which checks that the first two inputs are both active. Then we have to associate to the digital output #1 an AND/OR logic configured as OR, which checks that the virtual digital input #1, or the digital input #3 are active. Basically, we have to use the virtual digital input #1 as "support" for the AND condition. In this case, it is not necessary to associate any function to the virtual digital input.

5.6 Analogue inputs 1-7 (JU, JK, JJ)

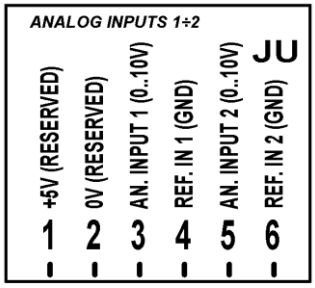
The device is equipped by two differential 0...10V voltage analogue inputs available on terminal **JU**, four inputs in voltage available on terminal **JK** and one in voltage available on terminal **JJ-4**.

All these inputs can also be configured individually as digital inputs (function AIF.0100 in parameter P.4001 or equivalent). In this case, the analogue inputs from 1 to 7 will be additional digital inputs from 19 to 25. The status of the virtual inputs is displayed at page S.11 (0=output not active, 1=output active). The inputs not configured as digital will be displayed with a dash. If set as digital (function

AIF.0100 in parameter P.4001 or equivalent), the inputs are considered active when the measured voltage is higher than 4.0Vdc; they are considered not active when the measured voltage is lower than 3.5Vdc. They cannot therefore be activated as the other inputs by connecting it to the mass:



5.6.1 JU - Analogue inputs 1-2



The are two inputs for the measure of voltage signals for 0...10Vdc signals.

The two ANALOGUEUE inputs. INPUT 1 and INPUT 2 are not galvanically isolated, but it is possible to measure the signal in differential, so that they can compensate eventual differences of measure negatives compared to the negative of GND controller. The compensation range is -10 /+6Vdc.

The terminals REF.IN1 (**JU-4**) and REF.IN2 (**JU-6**) are internally connected to GND by means of 1KΩ resistors; this allows to avoid their connection with the masses of the sources of voltage signals for connections which are short and inside the control panel.

On the same connector **JU** there are also one regulated +5Vdc output (**JU-1**) and one output connected to the mass inside the device (**JU-2**). This voltage is specific for the use of potentiometers. The total minimum resistance applicable between **JU-1** and **JU-2** is 10KΩ.

If set as digital (function AIF.0100 in parameter P.4001 or equivalent), the input is considered active when the measured voltage is higher than 4.0VDC; it is considered not active when the measured voltage is lower than 3.5VDC. It cannot therefore be activated as the other inputs by connecting it to the mass.

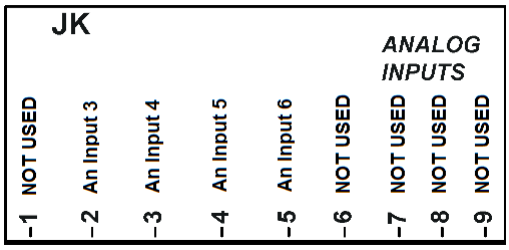
For configuration and uses of analogue inputs see par.0

The default functions of the inputs are:

Terminal	Analogue input (AI_controller_)	Type of input	Default function

JU-1	-	-	+5Vdc output only reserved to the only connection of trimmer/potentiometers for analogue inputs 1 and 2.
JU-2	-	-	GND output only reserved to the only connection of trimmer/potentiometers for analogue inputs 1 and 2.
JU-3	Analogue input 1	0...10Vdc voltage measure input	**AIF.0000 - "Not used"**
JU-4		JU-3 mass input	
JU-5	Analogue input 2	0...10Vdc voltage measure input	**AIF.0000 - "Not used"**
JU-6		JU-5 mass input	

5.6.2 JK - Analogue inputs 3-6

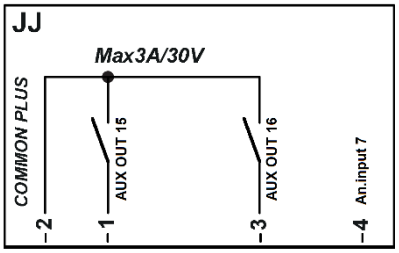


The device is equipped with four programmable inputs (0...10Vdc) **JK-2, JK-3, JK-4, JK-5**. The voltages are measured respect the negative power supply **JC-1 GND**. The four voltage values measured on the terminals are displayed on page S.13.

The default functions of the outputs are:

Terminal	Analogue input (AI_controller_)	Type of input	Default function
JK-2	Analogue input 3	Voltage analogue input 1	**AIF.0000 - "Not used"**
JK-3	Analogue input 4		**AIF.0000 - "Not used"**
JK-4	Analogue input 5		**AIF.0000 - "Not used"**
JK-5	Analogue input 6		**AIF.0000 - "Not used"**

5.6.3 JJ-4 Analogue input 07



This input acquires a voltage with measurement range from 0 to 32Vdc compared to the supply negative of the controller (GND). Page S.13 shows the measured voltage.

5.6.4 Configuration of digital inputs

The analogue inputs can be used for the acquisition of several predefined values or to acquire generic sensors (therefore user-adjustable). Some values can be only acquired by some inputs (see following chat in this paragraph).

For all these values it is possible to choose sensors of a standard type with more common resistance values directly by the configuration parameters of the single sensor acting on the controller, or by means of the BoardPrg4 program it is possible to define the generic curves, knowing at least two couples of resistance/values points of the value to be measured, see par.5.6.6.

It is possible to apply to all physical analogue inputs (JU, JK and JJ) a conversion curve (not to the virtual analogue inputs).

To each analogue input (JU, JK, JJ and virtual) a set of 8 parameters is associated, to define the function type, an alternative denomination and a series of generic thresholds and configurations usable for different functions.

Following are listed, as examples, those relative to the JK-2 input. For parameters of other inputs, refer to document [1] or to configuration page I/O of BoardPrg4.

NOTE: On BoardPrg4 the parameters are all displayed only when the input is really configured as analogue, and not as digital. The analogue inputs of the expansion modules are only displayed if the module is configured.

You will have:

- One parameter which configures its function (P.4017 for input **JK-2**).
- A parameter that configures a message to show on display (P.4018 for input **JK-2**).
- Two thresholds consisting of three parameters each:
    - A parameter which configure the threshold value (P.4019 and P.4022 for input **JK-2**).
    - A parameter which configure the delay to manage the “out of threshold” (P.4020 and P.4023 for input **JK-2**).
    - A parameter which configure the checking options and the actions in case of “out of threshold” (P.4021 e P.4024 for the input **JK-2**).

The parameter which contains a message for a given analogue input (in the example parameter P.4018) , it is displayed by the controller each time that the the thresholds are used to activate alarms and/or warnings ()see after).

It is also used for the following functions of the analogue inputs AIF.2001, AIF.2003 e AIF.2005. In this case, the measurement acquired will be displayed on pages M10, M11 e M12, preceded by the configured message. **NOTE: it is also possible to use function AIF.2051 instead of the three preceding ones. In this case, the measurement acquired will be not displayed; it can be used with the thresholds to manage digital outputs and activate warnings/blocks.**

The two thresholds are completely independent on each other. The third parameter of each threshold is a “bit” parameter that allows you to associate to each threshold the following options:

- Bit 1. If this bit is “OFF”, the controller checks if the measurement is higher than the threshold. If this bit is “ON”, the controller checks if the measurement is lower than the threshold.
- Bit 2. If this bit is “OFF”, the controller sets to OFF the internal status related to this analogue measurement, if the measurement is out of threshold. If this bit is “ON”, the controller sets

to ON the internal status related to this analogue measurement, if the measurement is out of threshold.

- Bit 3 and Bit 4 currently not used.
- Bit 5. If this bit is “ON”, the controller activates a warning if the measurements is out of threshold.
- Bit 8. If this bit is “ON”, the controller activates a block if the measurements is out of threshold.
- Bit 9. If this bit is “ON”, the controller checks that BTB is close to activate eventual warnings/blocks configured with the preceding bits.
- Bit 10. If this bit is “ON”, the controller checks that BTB is open to activate eventual warnings/blocks configured with the preceding bits.
- Bit 14. If this bit is “ON”, to activate eventual warnings/blocks configured with the preceding bits, the controller checks the status of eventual digital inputs configured with function “DIF.2705 – “Disable the protections on analogue measurements. The warnings/blocks will be activated if no digital input is configured like that, or if they are all OFF.

It is possible to set any combination of these bits.

Using together the two thresholds and the AND/OR logics, it is possible to activate a digital output related to the value of an analogue measurement, with hysteresis. Let’s assume to activate a digital output if the frequency goes over 50.5 Hz. It is first of all necessary to manage a minimum hysteresis on the threshold. Otherwise when the frequency is next to the threshold, the output would keep on activating and deactivating for minimum variation of the frequency itself. Let’s assume to activate the output if the frequency goes over 50.5 Hz and turn off the output if the frequency is lower than 50.3 Hz. To do so, we use for example the virtual analogue input #1 (see par.5.6.5) which has been configured to contain the BUS A frequency.

Let’s set the parameters as follows:

- P.4051 (function #1): 4001 (AIF.4001).
- P.4052 (message #1): “”.
- P.4053 (threshold #1): 50.5 Hz
- P.4054 (delay #1): 0.5 sec
- P.4055 (configuration #1): 0002 (bit 1 OFF, bit 2 ON)
- P.4056 (threshold #2): 50.3 Hz
- P.4057 (delay #2): 0.5 sec
- P.4058 (configuration #2): 0001 (bit 1 ON, bit 2 OFF)

The first threshold is used to activate the internal status associated to the analogue input. Having a look to the configuration parameter, we can see that:

- Bit 1 OFF (checks that the measurement is higher than the threshold).
- Bit 2 ON (activates the internal status in “out of Threshold”) condition.

The second threshold is used to deactivate the internal status associated to the analogue input. Having a look to the configuration parameter, we can see that:

- Bit 1 ON (checks that the measurement is lower than the threshold).
- Bit 2 OFF (deactivates the internal status in “out of Threshold”) condition.

With the previous program, therefore, the controller will activate the internal status related to the analogue input when the measurement is higher than 50.5 Hz per 0,5 seconds; it will deactivate the internal status when the measurement is lower than 50.5 Hz per 0,5 seconds.

Using AND/OR logics (see par. 5.5.7), it is possible to “copy” the internal status on a physical output.

The following chart shows the list of functions matchable with the the analogue inputs of the controller.

Analogue Input function xx.	**Name**	**Message**	**Thresholds**	**From AI_01 to AI_07 (JU, JK, JJ)**
AIF.0000	Not used			X
AIF.0100	Used as digital input			X
AIF.2001	General sensor (page 1).	X	X	X
AIF.2003	General sensor (page 2).	X	X	X
AIF.2005	General sensor (page 3).	X	X	X
AIF.2051	Generic sensor	X	X	X
AIF.2101	Speed offset.	X	X	X
AIF.2201	Voltage offset	X	X	X

All AIF.XXXX odd functions require the use of program BoardPrg4 for the definition or the load of the characteristic curve of the sensor (see par. 5.6.6).

5.6.5 Virtual digital inputs (AI_VIRTUAL)

The controller, besides the physical analogue inputs, also manages 8 virtual analogue inputs. They are managed by the controller exactly as they were physical inputs (without limitations), but the virtual inputs status is not acquired by the hardware, but determined via software.

The purpose of the virtual analogue inputs is multiple:

- To allow the activation of warnings/blocks related to the internal available measurements.
- To activate digital outputs based on the value of the internal available measurements.
- To check some functions of the controller through PLC.

It is possible to operate in the following way to assign a value to the virtual analogue inputs:

- Using the internal PLC. In this case, it is necessary to assign a standard function to the virtual analogue input (function minor than AIF.4001).

  For example, we can use the PLC program to modify the power setpoint for the parallel with the mains based on a temperature acquired from an external sensor. It is necessary:

  - To set parameter P.4051 (function for virtual analogue input #1) to value 2301 (AIF.2301 – Setpoint for local BASE LOAD). The controller will therefore use the value of virtual analogue input #1 as power setpoint for the parallel with the mains.
  - Using the internal PLC, create a logic which writes in the virtual analogue input #1 the power setpoint corresponding to the external temperature acquired.

- Assigning a value which is major or equal to 4001 (AIF.4001) to the parameter “function” of the virtual analogue input. In this case, the controller copies the value identified from the

previous parameter in the virtual analogue input: on this measurement, it is then possible to manage the thresholds to activate digital outputs and anomalies.

The following chart shows the list of functions matchable with the analogue inputs of the controller.

Virtual Analogue Input function xx.	Name	Message	Thresholds
AIF.0000	Not used		
AIF.2001	General sensor (page 1).	X	X
AIF.2003	General sensor (page 2).	X	X
AIF.2005	General sensor (page 3).	X	X
AIF.2051	Generic sensor	X	X
AIF.2101	Speed offset.	X	
AIF.2201	Voltage offset	X	
AIF.4001	BUS A frequency	X	X
AIF.4006	BUS A voltage L1-L2	X	X
AIF.4007	BUS A voltage L2-L3	X	X
AIF.4008	BUS A voltage L3-L1	X	X
AIF.4009	BUS A Voltage L-L average	X	X
AIF.4012	BUS B frequency	X	X
AIF.4017	BUS B voltage L1-L2	X	X
AIF.4018	BUS B voltage L2-L3	X	X
AIF.4019	BUS B voltage L3-L1	X	X
AIF.4020	BUS B Voltage L-L average	X	X
AIF.4023	Current L1	X	X
AIF.4024	Current L2	X	X
AIF.4025	Current L3	X	X
AIF.4026	Auxiliary current (or neutral current)	X	X
AIF.4031	Active power L1	X	X
AIF.4032	Active power L2	X	X
AIF.4033	Active power L3	X	X
AIF.4034	Total active power	X	X
AIF.4041	Total apparent power	X	X
AIF.4047	Total reactive power	X	X
AIF.4058	Total power factor (calculated from kW and kVA)	X	X
AIF.4059	Total Cosfi (calculated from kW and kvar)	X	X
AIF.4062	Active energy total A->B	X	X
AIF.4063	Active energy partial A->B	X	X
AIF.4064	Reactive energy total A->B	X	X
AIF.4065	Reactive energy partial A->B	X	X
AIF.4068	Active energy total B->A	X	X
AIF.4069	Active energy partial B->A	X	X
AIF.4070	Reactive energy total B->A	X	X
AIF.4071	Reactive energy partial B->A	X	X
AIF.4105	Battery voltage	X	X

It is not possible to use functions major than 4000 for the configuration of physical analogue inputs.

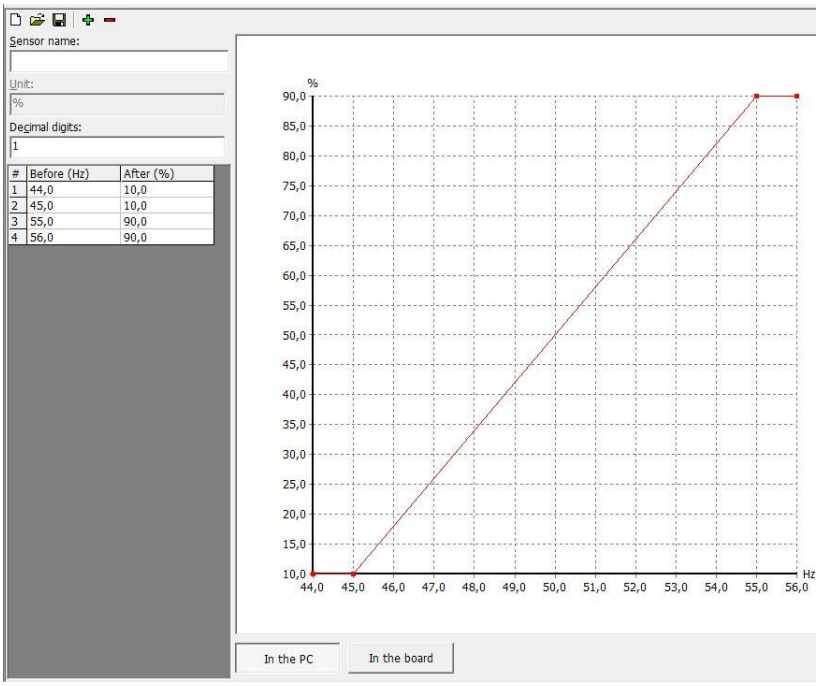
5.6.6 Conversion curves

The conversion curves are a tool which allows to convert a numeric value in another numeric value. They can be used for two purposes, for analogue inputs and for the analogue outputs:

- To convert the acquired value from an analogue input (physical) which is on the controller from electric value to real unit of measure of the sensor.
- To convert an internal measurement of the controller to a percentage value before writing it on an analogue output.

Note: the configuration of the AND/OR logics cannot be carried out directly from the controller display, but it has to be carried out by PC with the BoardPrg4 software.

The curves, once created, can be saved on a file to use them later even on other controllers.



The figure above shows a conversion curve associated to an analogue output. The analogue input has been configured with function AOF.3101 (" Frequency of the BUS A"). With this configuration, the output will be 10% for a frequency lower than or equal to 45 Hz, 90% for a frequency higher than or equal to 55 Hz; for frequency values included between 45 Hz and 55 Hz, the output will take a value between 10% and 90%.

You can add up to 32 points in the graph, thus creating also not linear curves. Note, in the example, that the configured curve has two horizontal segments at the beginning and at the end, obtained inserting two equal values in column "after", corresponding to two different values in column "first". This is not obligatory, but it allows you to set a saturation limit on one end or on both ends of the curve. In fact, the controller board extends to infinity the first and last segments of the curve. Being horizontal, whatever value the measure "to convert" assumes, you will obtain the same value of the "converted" measure. In the previous example, for any frequency measure lower than 45 Hz, the analogue output will be set at 10%. If from the example above you removed the first point (44 Hz 10%), the horizontal segment would not be at the beginning of the curve: in this case, if the frequency should drop below 45 Hz, the analogue output would drop below the 10%.

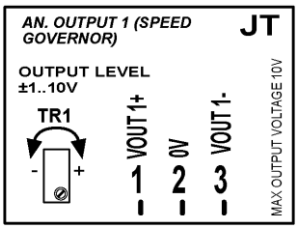
Important: the points inserted must be ordered in increasing way in column "first", otherwise the conversion required will not be obtained.

The BoardPrg4 software allows you (by means of the first buttons on top left) to save the curve on file to be able to use it again in other applications. It is therefore possible to make an archive of the conversions associated to the sensors used.

In case the curve is associated to a phisical analogue input configured with functions AIF.2001, AIF.2003 e AIF.2005 ("generic sensor"), the measurement converted will be displayed on pages M10, M11 e M12: in this case it is also possible to specify (through the conversion curve) how many decimal digits the displayed value and its unit of measure must have.

5.7 Digital outputs 1-2 (JT, JS)

5.7.1 JT - Analogue output 1



Analogue output addressed to external devices interfacing equipped with analogue input in voltage or current.

The output voltage can be controlled through TR1 potentiometer, between a minimum of ±1VDC and a maximum of ±10VDC. Potentiometer TR1 therefore defines the maximum of the analogue output.

The output can be positive or negative (symmetrical type) if connected VOUT1+ and VOUT1-, or only positive (asymmetrical type) if connected between VOUT1+ and 0V.

The output is galvanic isolated (floating voltage source).

The minimum load impedance is 10 kOhm

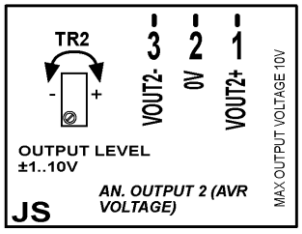
This output is not used by default. If the output is configured with other available functions, it is necessary to add the specific conversion curves to the output configuration (see 5.6.6).

To know the available functions to be assigned to the other parameters regarding this analogue output, refer to doc. [1].

The default functions of the outputs on the controller are:

Terminal	Digital output (AO_CONTROLLER_)	Type of output	Default function
JT-1	01	**VOUT1+:** Analogue signal in voltage with positive polarity.	**AOF.0000 – "Not used"**
JT-2		**0V**: Internal GND reference of the isolated output.	
JT-3		**VOUT1-:** Analogue signal in voltage with negative polarity.	

5.7.2 JS - Analogue output 2



Analogue output addressed to external devices interfacing equipped with analogue input in voltage or current.

The output voltage can be controlled through TR2 potentiometer, between a minimum of ±1VDC and a maximum of ±10VDC. Potentiometer TR2 therefore defines the maximum of the analogue output.

The output can be positive or negative (symmetrical type) if connected VOUT2+ and VOUT2- or only positive (asymmetrical type) if connected between VOUT2+ and 0V.

The output is galvanic isolated (floating voltage source).

The minimum load impedance is 10 kOhm

This output is not used by default. If the output is configured with other available functions, it is necessary to add the specific conversion curves to the output configuration (see 5.6.6).

To know the available functions to be assigned to the other parameters regarding this analogue output, refer to doc. [1].

The default functions of the outputs on the controller are:

Terminal	Digital output (AO_CONTROLLER_)	Type of output	Default function
JS-1	02	**VOUT1+:** Analogue signal in voltage with positive polarity.	**AOF.0000 – "Not used"**
JS-2		**0V:** Internal GND reference of the isolated output.	
JS-3		**VOUT2-:** Analogue signal in voltage with negative polarity.	

5.7.3 Configuration of the analogue outputs

Both analogue outputs are completely configurable. To each output a parameter is associated (e.g. P.6001 for output 1), which configure the function (see doc.[1]).

To all analogue outputs is possible to apply a conversion curve.

The following functions is not directly linked to the operation sequences of the controller. It is selectable for any analog output:

- AOF.0101 - "Used by PLC". This function matches the digital output to the PLC program inside the device; in this way, it is the PLC logic which commands the output, and not the normal operation logics of the controller. Note: if the PLC program uses some outputs, but those are not configured with function AOF.0101, the outputs will not be commanded (but the controller signals this situation with a warning).
- AOF.0102 - "Commanded by the serial ports". The controller does not command the output with own internal logics, but with the commands received by means of the serial ports.

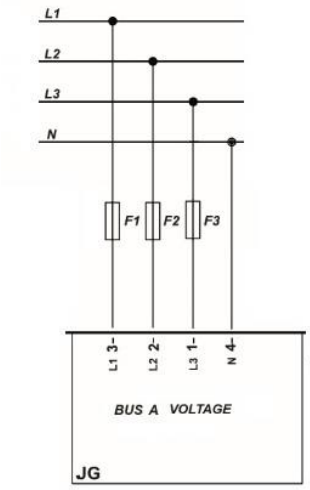
The following chart shows the list of functions matchable with the the analogue ouputs of the controller.

Analogue output function xx.	Name
AOF.0000	Not used
AOF.0101	Used by PLC
AOF.0102	Managed by the serial ports
AOF.1000	Speed regulator
AOF.1001	Speed regulator (with curve)
AOF.1002	Speed regulator BUS A (with curve)
AOF.1003	Speed regulator BUS B (with curve)
AOF.1010	Voltage regulator
AOF.1011	Voltage regulator (with curve)
AOF.1012	Voltage regulator BUS A (with curve)
AOF.1013	Voltage regulator BUS B (with curve)
AOF.3101	Frequency of the BUS A
AOF.3111	Voltage of the BUS A
AOF.3121	Active power
AOF.3201	Frequency of the BUS B

AOF.3211	Voltage of the BUS B

When functions AOF.3001 and following are used, the proportion between the selected unit of measure (voltage, frequency, etc.) and the % value compared to the scale bottom of the output by means of the conversion curves (see par. In fact, every digital input can have an AND/OR logic associated, which determines its status (see par. 5.6.6).

5.8 JG – Voltage measure input BUS A



The connection to the BUS A lines happens though the **JG** connector of the controller.

Three phase connection:

- Connect phase L1 (or R) to terminal 3 of **JG** connector.
- Connect phase L2 (or S) to terminal 2 of **JG** connector.
- Connect phase L3 (or T) to terminal 1 of **JG** connector.
- Connect the neutral (if present) (N) to terminal 4 of **JG** connector

One phase connection:

- Connect phase (L) to terminal 3 of **JG** connector.
- Connect neutral (N) to terminal 2 and 4 of **JG** connector.

The three-phase/one-phase selection is done through parameter P.0101.

The controller uses phase L1 (terminal **JG-3**) and L2 (terminal **JG-2**) to measure the frequency.

For CAT.III use, the maximum working voltage is 300Vac (phase-neutral) and 520Vac (phase to phase). The maximum voltage compared to the protection earth is 300Vac.

If working voltages are greater than these values, step-down transformer must be used in order to respect the specified limits. The nominal voltages on the primary and secondary of the VT are configurable with parameters P.0103 and P.0104. It is suggested to use Voltage transformers having a nominal voltage of 400V on the secondary (this solution can preserve the best available measurement precision of the board).

In alternative, it is possible to use VT, with secondary sides by 100V. In this case, it is necessary to configure parameter P.0151 for the operation at 100V. The controller will adapt the internal gain to optimize the voltage measurement on the nominal value set in parameter P.0151.

It is also possible to use the Aron insertion of the VTs, which uses only two transformers, instead of three. It is necessary to set P.0120 not to use the neutral connection.

Attention! Do not connect JG measurement input to TA with 400V secondary sides or directly to the BUS A at 400V when the device is configured to read at 100V nominal voltage (parameter P.0151 is set to 1). The device could be damaged.

5.8.1 BUS A neutral measurement

The device, in three-phase connection, can work with both the neutral connection and without; the selection is made through parameter P.0120.

If the system is configured with neutral connection, the neutral voltage is measured in function to GND (battery negative).

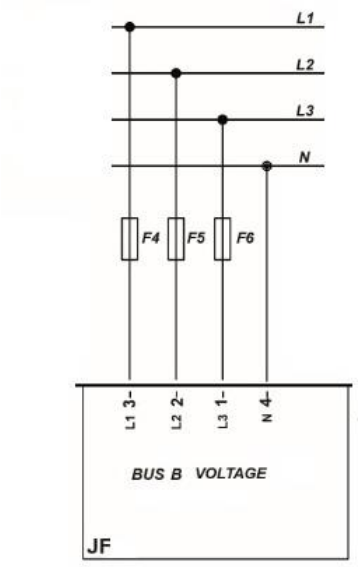
The values of the three phase voltages and of the neutral voltage compared to GND are displayed on page M.02.

By pressing ENTER button it is possible to change the view mode of these BUS A measures in two different ways:

- Measure of the L1-L2, L2-L3, L3-L1 linked voltages and of the Neutral voltage compared to the N-B battery negative.
- Measure of the L1-N, L2-N, L3-N phase voltages and of the Neutral voltage compared to the N-B battery negative.

If the device is configured not to measure the neutral voltage, on page M.02 will be shown the L1-L2, L2-L3, L3-L1 linked voltages measures only, without the Neutral voltage compared to the battery negative N-B. It will not be possible to display L-N voltages.

5.9 JF – BUS B voltage measure input



The connection to the BUS B lines happens through JF connector of the controller

Three phase connection:

- Connect phase L1 (or R) to terminal 3 of **JF** connector.

- Connect phase L2 (or S) to terminal 2 of **JF** connector.
- Connect phase L3 (or T) to terminal 1 of **JF** connector.
- Connect the neutral (if present) (N) to terminal 4 of **JF** connector

One phase connection:

- Connect phase (L) to terminal 3 of **JF** connector.
- Connect neutral (N) to terminal 2 and 4 of **JF** connector.

The three-phase/one-phase selection is done through parameter P.0201.

The controller uses phase L1 (terminal **JF-3**) and L2 (terminal **JF-2**) to measure the frequency.

For CAT.III use, the maximum working voltage is 300Vac (phase-neutral) and 520Vac (phase to phase). The maximum voltage compared to the protection earth is 300Vac.

If working voltages are greater than these values, step-down transformer must be used in order to respect the specified limits. The nominal voltages on the primary and secondary of the VT are configurable with parameters P.0203 and P.0204. Voltage transformers having a nominal voltage of 400V on the secondary side are the solution that preserves the best available measurement precision of the board.

In alternative, it is possible to use VT, with secondary sides by 100V. In this case, it is necessary to configure parameter P.0251 for the operation at 100V. The controller will adapt the internal gain to optimize the voltage measurement on the nominal value set in parameter P.0251.

It is also possible to use the Aron insertion of the VTs, which uses only two transformers, instead of three. It is necessary to set P.0220 not to use the neutral connection.

Attention! Do not connect JF measurement input to VT with 400V secondary sides or directly to the BUS B at 400V when the device is configured to read at 100V nominal voltage (parameter P.0251 set to 1). The device could be damaged.

5.9.1 BUS B neutral measurement

The device, in three-phase connection, can work with both the neutral connection and without; the selection is made through parameter P.0220.

If the system is configured with neutral connection, the neutral voltage is measured in function to GND (battery negative).

The values of the three phase voltages and of the neutral voltage compared to GND are displayed on page M.03.

By pressing ENTER button it is possible to change the view mode of these BUS B measures in two different ways:

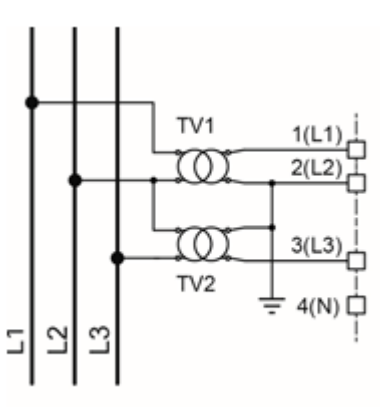
- Measure of the L1-L2, L2-L3, L3-L1 linked voltages and of the Neutral voltage compared to the N-B battery negative.
- Measure of the L1-N, L2-N, L3-N phase voltages and of the Neutral voltage compared to the N-B battery negative.

If the device is configured not to measure the neutral voltage, on page M.03 will be shown the L1-L2, L2-L3, L3-L1 linked voltages measures only, without the Neutral voltage compared to the battery negative N-B. It will not be possible to display L-N voltages.

5.10 Aron insertion of Voltmetric transformers

Both for the BUS A voltage and for the BUS B voltage measurement inputs, it is possible to use the Aron insertion of the voltmetric transformers instead of three. The connection is possible both with the measurement inputs set to 100Vac and with 400Vac nominal voltage.

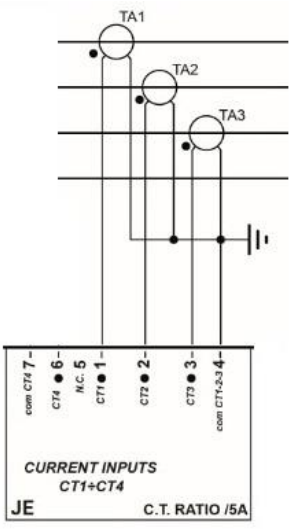
The diagram of the Aron connection is the following:



The diagram is the same both for the BUS A and for the BUS B; it is necessary to set parameters P.0120 (for the BUS A) or P.0220 (for the BUS B), or both to indicate to the controller that the neutral connection is not used.

5.11 (JE-JI) Currents measurement inputs.

5.11.1 JE - Currents measurement inputs 1-3



ATTENTION! Do not connect mains voltage conductors to JI and JE.

The currents measure must be carried out exclusively by means of external current transformers (CTs) featured by an insulation level coherent with the system in which the device is installed: at least one MAIN (BASIC) isolation for the use of the device in Cat. Overvoltage IV

The secondary side of the Current Transformers must be grounded near the CT of the measurement. Internally, the controller is equipped with additional current transformers for further galvanic isolation (ADDITIONAL).

The measurement happens through current transformers inside the device.

To these terminals, external ammeter transformers can be connected with a 5Aac or 1Aac secondary: Internally, the controller guarantees the same measurement precision with both types of transformer.

Each current measurement requires a power of about 1VA: however, 5VA CTs are suggested to compensate the losses along the connection cables.

The maximum current measurable directly from the device is 7Aac. Over this threshold, the measure circuit saturates. The controller is able to measure (with progressively decreasing precision) up to 15Aac though, e.g. to measure overcurrents or short circuit currents on the plant, using an algorithm of compensation of saturation of the circuits of measurement.

To acquire the currents of the three phases, the JE connector is used.

- Connect to **JE-1** terminal to hot pole of CT connected on phase L1.
- Connect to **JE-2** terminal to cold pole of CT connected on phase L1.
- Connect to **JE-3** terminal to hot pole of CT connected on phase L2.
- Connect to **JE-4** terminal to cold pole of CT connected on phase L2.
- Connect to **JE-5** terminal to hot pole of CT connected on phase L3.
- Connect to **JE-6** terminal to cold pole of CT connected on phase L3.

For one-phase connections, **JE-3, JE-4, JE-5, JE-6** terminals can be left free.

Parameters P.03121 and P.0313 allows to configure the transformation ratio of the external ammeter transformers. For example, if we use 50/5 ammeter transformers, set P.0312=50 and P.0313=5.

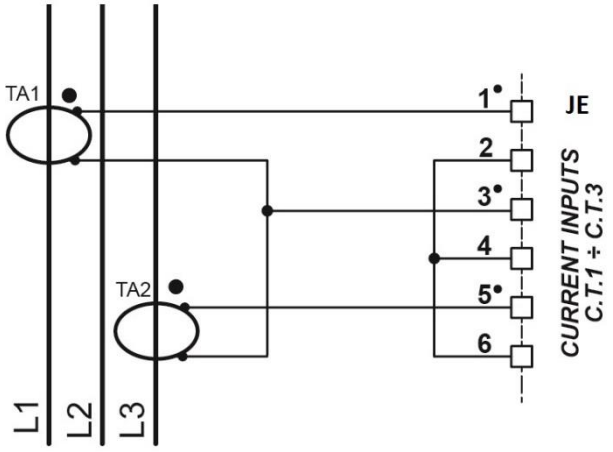
The C.T.s can be connected on both sides of the BTB circuit breaker (on the BUSA or BUSB lines). You must, however, indicate on which side they have been linked using the parameter P.0311.

If you do not use C.T.s, set parameters P.0312 and P.0313 to zero: in this way, the controller will hide (on the display) all measures related to currents and powers.

5.11.1.1 Aron insertion of Ammeter transformers

It is possible, independently from the connection of the voltmeter transformers, to connect ammeter transformers configured as Aron insertion. This allows to use only two ammeter transformers instead of three.

The diagram of the Aron connection is the following:



5.11.2 JI - Currents measurement input 4

The device allows to acquire a fourth current measurement. By default, the fourth measure is not used.

JI input type varies based on the fact that the controller has been ordered with or without the toroid option (code E620215011000). This option is only on demand.

5.11.2.1 Controller without option E620215011000

Parameter P.0319 must be set to "0".

The current measurement must happen only by means of external ammeter transformers (CT). **Do not connect mains voltage conductors to JI and JE.** The measurement happens through ammeter transformers inside the device.

To these terminals, external ammeter transformers can be connected with a 5Aac or 1Aac secondary: Internally, the controller guarantees the same measurement precision with both types of transformer.

The current measurement requires a power of about 1VA: however, 5VA CTs are suggested to compensate the losses along the connection cables.

The maximum current measurable directly from the device is 7Aac. Over this threshold, the measure circuit saturates. The controller is able to measure (with progressively decreasing precision) up to 15Aac though, e.g. to measure overcurrents or short circuit currents on the plant, using an algorithm of compensation of saturation of the circuits of measurement.

To acquire the current the connector JI is used:

- Connect to **JI-1** terminal the hot pole of external CT.
- Connect to **JI-2** terminal the cold pole of external CT.

Parameters P.0316 and P.0317 allows to configure the transformation ratio of the external ammeter transformers. For example, if we use 50/5 ammeter transformers, set P.0316=50 and P.0317=5.

5.11.2.2 Controller with option E620215011000

Parameter P.0319 must be set to "1".

The current measurement must happen only by means of an external toroid. **Do not connect mains voltage conductors to JI and JE.**

The maximum current measurable directly from the device is 0,1Aac. Over this threshold, the measure circuit saturates. Use one toroid with a transformation ratio which guarantees currents lower than this threshold on the secondary.

To acquire the current the connector JI is used:

- Connect to **JI-1** terminal the hot pole of external toroid.
- Connect to **JI-2** terminal the cold pole of external toroid.

Parameters P.0316 and P.0317 allows to configure the transformation ratio of the external toroid. For example, if we use 500/1 toroid, set P.0316=500 and P.0317=1.

The cold pole of the Toroid (JI-2) must also be connected to the supply negative of the controller.

5.11.2.3 Use of the fourth current

Parameter P.0315 allows to tell the controller where the transformer which acquires this current measurement is located.

- P.0315=0. The transformer is some way connected on the BUS A lines
- P.0315=1. The transformer is someway connected on the BUS B lines

The most important parameter to be configured is parameter P.0318 though, which allows to establish what type of current measurement you want to do:

- P.0318 = 0 (“Not used”) The controller disables the measurement of the fourth current, which will not be shown on display.
- P.0318 = 1 (General use”). The controller displays the current measurement done on page M.04 identifying as “Ax”.
- P.0318 = 2 (“Neutral”). The controller displays the current measurement done on page M.04 identifying as “An”.

Settings 1 and 2 allow to establish a threshold on the auxiliary current (P.0367 e P.0368) and to define what action to carry out at its overpassing (P.0369).

It is possible to configure a digital input with function DIF.2704 - “Disable the protections on the fourth current”. If the input is active, the thresholds, even if set, are ignored and do not create anomalies in case of overpassing.

5.12 Communication ports

The device is equipped with many communication ports for the connection to PC, modem, networks, etc:

- A USB2.0 serial port not insulated, which can be used in Function or Host mode.
    - Function: (USB B connector): connection with PC for FW update and programming of device parameters.
    - Host (USB A connector): PenDrive management **(up to today not available)**

- A RS232 serial port with DB9 male connector usable for the interfacing with an external device equipped with RS232 interface. The maximum length of the cable is 12 mt. See par. 5.12.1.

- A RS485 serial port with galvanic insulation; the maximum connection length in optimal conditions is 1200 mt. The 120ohm terminal resistor is integrated and can be inserted through S5 selector. The use of a shielded cable with 120ohm impedance is required (e.g. BELDEN 3105A Multi-conductor-EIA Industrial RS-485PLT/CM). See par. 5.12.2

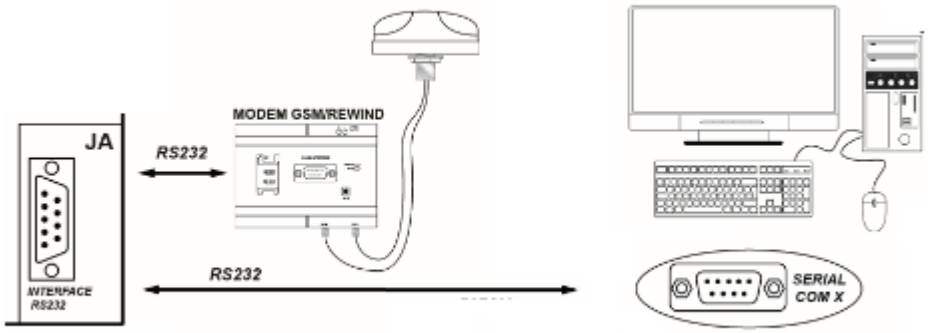
- Two CAN-BUS ports with galvanic insulation for the communication with all other Mecc Alte controllers (mains controllers, genset controllers, other BTB controllers) located on both sides of the BTB circuit breaker. The 120ohm terminal resistor is integrated and can be inserted through S1 selector. The specific use of the shielded cable is required (e.g. HELUKABEL 800571).

- An Ethernet port with RJ45 connector for 10/100 Mbps Ethernet nets connections.

For details related to the communications see specific paragraphs and document [3].

For CAN-BUS connections see documents [5], [6] e [7].

5.12.1 JA - Serial port 1 RS232



RS232 JA connector (serial port 1) can be used for the interfacing with an external device equipped with RS232 interface, e.g. A modem or a pc. The maximum distance of the connection is 12 mt.

The connection can be used for the device parameter programming through BoardPrg4 program or for the connection to a supervision program as Mecc Alte SS3.

For the functions and protocols implemented, refer to document [3]. Connector diagrams as follows:

- JA_01: not connected
- JA_02 RXD

- JA_03 TXD
- JA_04 DTR
- JA_05 GND
- JA_06 DSR
- JA_07 RTS
- JA_08: not connected
- JA_09: not connected

To configure the use of serial port 1 it is necessary to set the following parameters:

- P.0451: use of serial port 1
- P.0452: Modbus address serial port 1
- P.0453: Baud rate serial port 1
- P.0454: Setting serial port 1
- P.0470: Modbus register orders for serial port 1

The description of these parameters is on document [3].

5.12.1.1 GSM analogue Modem

The analogue/GSM modem must be connected to serial port 1 (JA connector). The modem must be selected among the types tested by Mecc Alte.

For the use of a GSM modem it is necessary that the operator inserts a SIM card of any phone operator. **It is important that on the SIM card the PIN code is disabled: insert the SIM into a phone and disable the PIN code before inserting it into the phone.**

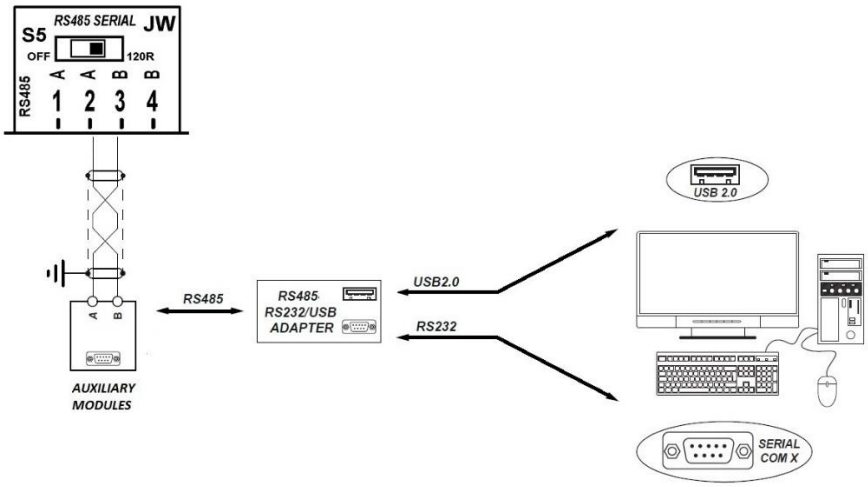
The SIM type to insert depends on the use of the modem.

- If you want to use only SMS messages, any SIM is suitable.
- If you want to use the data exchange with a pc through an analogue modem (classic modem 56k for example), it is necessary a SIM which allows that kind of data. The data exchange happens through the phone channel, but the operators can enable/disable the passage of the data on phone both on the calls done and on those received. Normally, the passage of the data on phone is available on SIM M2M (Machine To Machine), but it is better to check with your own operator anyway. **Attention: if you talk about data with your phone operator, he would mean the data on TCP/IP protocol (those of the Smartphone), but they are not the data needed, though.**

In any case, the connection of the GSM antenna is necessary.

For the use of SMS or data transmission through phone see document [3].

5.12.2 JW - Serial port 2 RS485



The device is equipped with a RS485 serial port (serial port 2) galvanically insulated and independent from serial port 1 (RS232), usable to connect via Modbus to a pc or other devices.

For details on RS485 connections, its usage and its parameter programming, refer to doc.[3].

Connections:

- **JW 1-2**: connection RS485 **A+**
- **JW 3-4**: connection RS485 **B-**

The RS485 connection needs a 120Ohm termination resistor on both ends of the cable. The device has integrated resistor; to insert it, it is necessary to act on selector S5.

The galvanic insulation guarantees the operation security of the connection also among distant devices and with different mass potentials compared with the controller.

The maximum connection length is 1200m: it is also function of the set transmission baud rate, though. The use of a special shielded cable is provided (see 0) with shielded filter connected to earth.

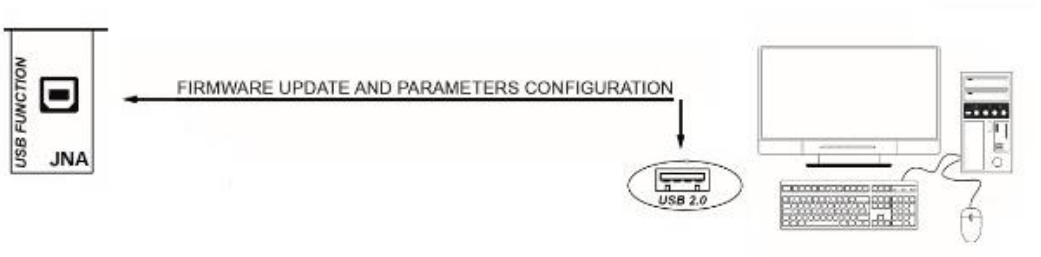
To configure the use of serial port 2 it is necessary to set the following parameters:

- P.0472: Modbus address serial port 2
- P.0473: Baud rate serial port 2
- P.0474: Setting serial port 2
- P.0475: Modbus register orders for serial port 2

The description of these parameters is on document [3].

On serial port 2 cannot be connected a modem; for the rest, it is possible to use it for the same connections possible from RS232 serial port using RS485/RS232 adaptors or RS485/USB when necessary.

5.12.3 USB Serial port (JNA): Function mode



The USB protocol specifications don't allow its use in the permanent industrial field due to the limited length of the cable and of the elevated sensibility to electric disturbs also on PC side. For this reason, **the USB connection cable has to be inserted only when it is necessary to operate on the device and can be removed from the JNA connector when the operation has finished.**

The USB connection with a PC is used for two purposes:

- Firmware insertion of the device
- Parameter programming

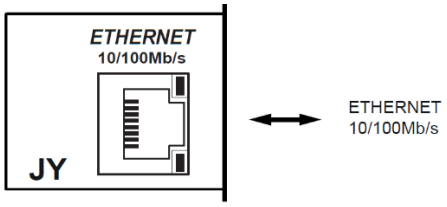
The insertion/substitution of the device firmware is a specific operation of Mecc Alte; besides the operation FW to be inserted, it requires a particular procedure and special programs. Also it must not be done by the installator, except for specific cases previously agreed with Mecc Alte.

The USB port can be used for the programming of parameters with BoardPrg4 program, in alternative to the RS232/RS485 serial connection or Ethernet.
It is necessary that on the PC to be connected the driver **CDC_Sices_Win.inf** supplied by Mecc Alte is installed; for the driver installation, refer to document [8].
Once installed the driver, the PC will detect the controller as a new serial port, to be used exactly as it was a RS232 serial port.

The configuration parameters are:

- P.0478: Modbus address USB serial port
- P.0479: Modbus registers order for USB serial port

5.12.4 JY - Ethernet port 10 100Mbps



The Ethernet port with RJ45 connector is provided for data connection via LAN. For details on net connection and protocol, refer to doc. [3].

It is possible to connect the device inside a LAN net or directly to a PC (point to point plant connection). The connection makes possible the use of Mecc Alte SS3 supervision SW, BoardPrg4 configuration and all available functionalities through the TCP/IP Modbus protocol.

The connection of the device inside a LAN net also allows to maintain updated the internal calendar with UTC. Server, besides the possibility to assign a public IP address (static or dynamic) directly to the device itself.

Parameters for the configuration.

Parameter	Name	Default
P.0500	IP address	192.168.0.1
P.0501	Subnet Mask	255.255.255.0
P.0502	Net gateway	0.0.0.0
P.0503	Modbus port Indicate the port to be used for the TCP Modbus communication.	502
P.0505	MODBUS registers order When 32 bit information is required, it establishes if the first 16 more significant bits have to be sent, or those less significant.	0-LSWF
P.0508	NTP Server port	123
P.0509	IP address NTP server	0.0.0.0
P.0510	IP address DNS primary server	0.0.0.0
P.0511	IP address DNS secondary server	0.0.0.0
P.0513	DHCP Server port	67
P.0514	IP address DHCP server	0.0.0.0

To reach the device inside a LAN net, it is necessary to configure at least parameters P.0500, P.0501 e P.0502. It is possible to proceed in two ways:

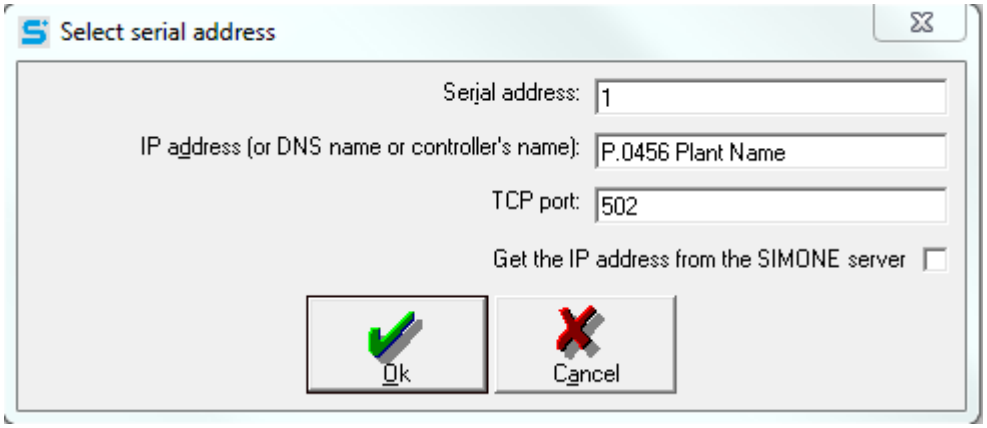
- It is possible to manually configure the three above mentioned parameters, with congruent values with the net to which we connect (the sub-net mask and the router/gateway are specific of each net, the IP address must be univocal in the net). To proceed this way, it is necessary that parameter P.0514 is set to 0.0.0.0 or that parameter P.0513 is set to zero.
- It is possible to dynamically acquire from the net the values for the three above mentioned parameters. To do so, it is necessary that the controller can connect to a DHCP server (Dynamic Host Configuration Protocol). To proceed this way, it is necessary that parameter P.0514 is set to 255.255.255.255 or that parameter P.0513 is set to 67 (67 is the TCP standard port for the DHCP server, if your server uses a different port, set it in P.0513). Also, parameter P.0456 must contain the name to which server DHCP will match the IP address (see after DNS description).

Once the controller has valid values for parameters P.0500, P.0501 and P.0502 (see page S.05), can be contacted through Modbus-TCP protocol on the assigned IP address and on TCP port configured with P.0503, for example with the supervision SW (Mecc Alte SS3) and of configuration (BoardPrg4).

The controller also supports the DNS protocol (Domain Name System). The DNS system is a system used for the conversion of the names of the net knots in IP addresses and vice-versa. The controller uses this functionto convert the name of the server “Si.Mo.Ne.” into an IP address, but also to register in the net with a name. The name must be configured through P.0456 and must be univocal in the net. To use the DNS system, it is required:

- If you don’t use a DHCP server (see above), it is necessary to set the IP address of the DNS server in P.0510 (it is possible to set the address of a secondary DNS server in P.0511).
- If you use a DHCP server (see above), the IP address of the DNS server is acquired by the controller directly from the DHCP server.

If the DNS server is reachable on the net, the controller provides to register its own name (P.0456) on the net and since that moment it will be reachable through the Modbus-TCP protocol both on IP address and on the configured name, on P.0503 port.



Parameters P.0508 and P.0509 allows to set the IP address and the server NTP port (Network Time Protocol) to be used to connect to a NTP server, in such way to keep synchronized and updated the internal calendar with date and time of the reference time zone (that is, of the UTC time). Setting one or both parameters to zero the function will be disabled. For more details refer to the document 9.2.1.

The real IP addresses (those configured manually or those obtained by DHCP server) are visible on page S.05.

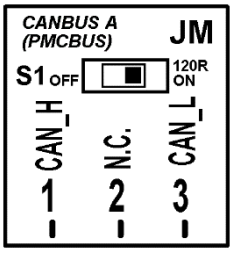
5.13 CAN-BUS Communication ports

BTB200 provides two CAN-BUS lines, insulated and self-powered. They are used for the connection to all other controllers (mains controllers, genset controllers, other BTB controllers) located on both sides of the BTB circuit breaker. BTB200 uses these CAN-BUS lines to:

- Collect information from all other controllers.
- Change the frequency and the voltages on one side of the BTB circuit breaker in order to synchronize BUSA and BUSB before closing BTB.
- When BTB is opened, BUSA and BUSB are completely separated. The controllers located on different buses, must not exchange information to each other, because that information will be “wrong”. Suppose that there is a genset supplying on BUSA and another one supplying on BUSB. If the controllers are connected to the same CAN-BUS line, they should think to be in parallel, but they are not, because BTB is opened. Thus, in this case, BTB100 does not connect internally the two CAN-BUS lines.
- When BTB is closed, BUSA and BUSB are electrically connected, so they can be managed as one. Thus, the controllers located on the two buses must exchange information to each other. So, in this case, BTB100 connects internally the two CAN-BUS lines.

For the connections below mentioned, use a cable suitable for CAN-BUS (see documents [6] [7]).

5.13.1 (JM) CAN-BUS A port



This CAN-BUS interface must be used only for BUS A line.

The CAN-BUS interface is galvanically insulated.

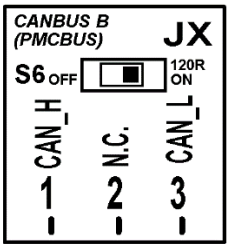
Connections:

- Connect terminal **JM-1** to terminal CAN_H of the other Mecc Alte controllers.
- Connect terminal **JM-3** to terminal CAN_L of the other Mecc Alte controllers.
- Connect the shielding mesh of the shielded cable to the protective earth or to signal on both sides make sure that interior, panel and the engine frame are kept at the same potential).

The CAN-BUS connection needs a 120Ohm termination resistor on both ends of the cable. It is therefore necessary to insert such resistance only on the first and on the last Mecc Alte controller. Note: the connection of the controllers can never be star but it has to be daisy chain.

The terminal resistor is integrated in our controller; to insert it, you need to act on switch S1.

5.13.2 (JX) CAN-BUS B port



This CAN-BUS interface must be used only for BUS B line.

The CAN-BUS interface is galvanically insulated.

Connections:

- Connect terminal **JX-1** to terminal CAN_H of the other Mecc Alte controllers.
- Connect terminal **JX-3** to terminal CAN_L of the other Mecc Alte controllers.
- Connect the shielding mesh of the shielded cable to the protective earth or to signal on both sides make sure that interior, panel and the engine frame are kept at the same potential).

The CAN-BUS connection needs a 120Ohm termination resistor on both ends of the cable. It is therefore necessary to insert such resistance only on the first and on the last Mecc Alte controller. Note: the connection of the controllers can never be star but it has to be daisy chain.

The terminal resistor is integrated in our controller; to insert it, you need to act on switch S6.

6 Main functions

6.1 Front panel

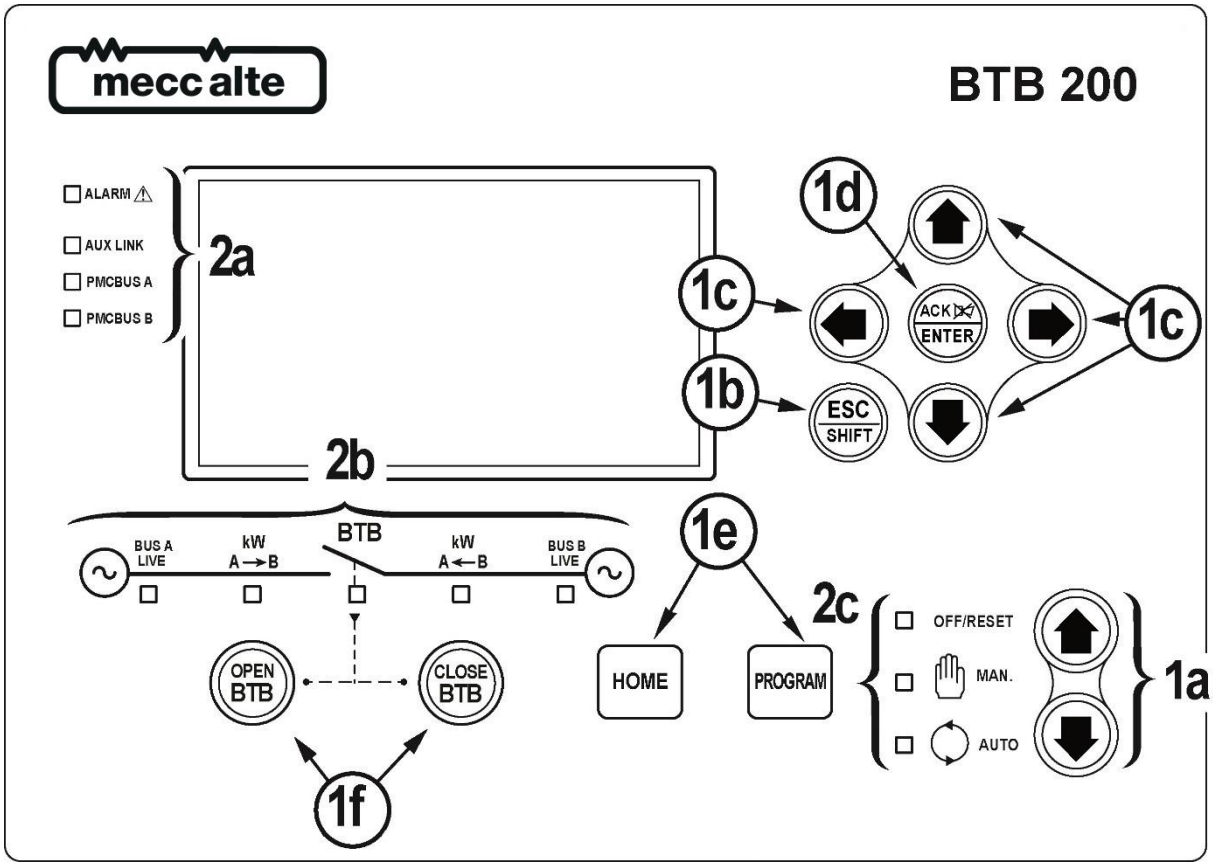


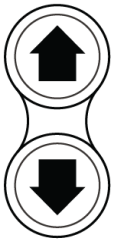
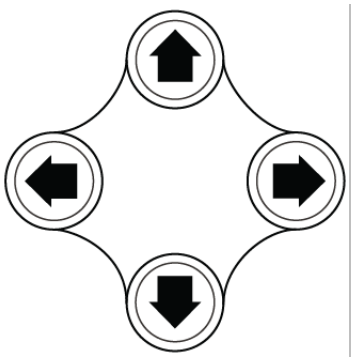
Fig. 1 - Front Panel

KEY
1 - Pushbuttons
2 - Indicators

The controls consist of 12 buttons (**1a, 1b, 1c, 1d, 1e, 1f**).

The front panel also has some luminous indicators (**2a, 2b, 2c**).

6.2 Buttons (ref. to fig. 1)

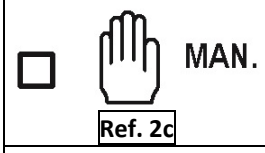
<table>
<tr><th colspan="2">Pushbutton</th><th>Function</th></tr>
<tr><td rowspan="3">MODE UP
 
MODE DOWN
Ref. 1a</td><td>OFF/RESET</td><td>All anomaly signals are disabled and you can program the parameters.</td></tr>
<tr><td>MAN (Manual)</td><td>The board is set for manual control.
Press the OPEN BTB  button for manual opening control of the tie breaker.
Press the CLOSE BTB  button for manual closing control of the tie breaker.</td></tr>
<tr><td>AUTO (Automatic)</td><td>The controller automatically manages the tie breaker operation, so it will be started if required by the operating conditions</td></tr>
<tr><td colspan="2"> 
Esc/SHIFT
Ref. 1b</td><td>In programming mode, it cancels the changes made to a variable value, brings up the previous menu level, or exits programming mode. If it is pressed for at least two seconds in any menu, you exit the programming mode retaining the current menu position for further programming access.
If it is pressed in any window, it displays the status information on the upper line (displaying them cyclically).
Depending on the selected page, if pressed together with the ENTER  button for at least 5 seconds while in OFF/RESET mode, it can reset counters to zero, reload default values of the programming parameters or cancel history logs, force exit from BUS OFF mode of the CAN-BUS). When used during the keyboard regulation function, it aborts the function.</td></tr>
<tr><td colspan="2"> 
Ref. 1c</td><td>Navigation buttons of the multifunction display. These buttons let you select the previous or next page on the display in all modes, except in the PROGRAM and HISTORY LOG mode.
Horizontal navigation buttons: in PROGRAM mode, they are used to position the cursor when entering the strings. Used in combination with the ESC/SHIFT  buttons, they allow to adjust the contrast.
ESC/SHIFT  + LEFT  : to decrease the contrast (lighten)
ESC/SHIFT  + LEFT  : to increase the contrast (darken)
Vertical navigation buttons: In PROGRAM and HISTORY LOG they allow to scroll the menus and the variables / registrations. You can increase/decrease the value of the variable to change the settings. Used in combination with ESC/SHIFT buttons  , they allow you to scroll through the menus ten entries at a time or increase/decrease the variables ten units at a time.</td></tr>
</table>

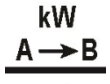
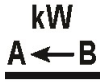
Pushbutton	Function
 **ENTER/ACK** **Ref. 1d**	In the PROGRAM menu, you can enter the programming mode and open a submenu, change a variable or parameter, and confirm the operation. In ARCHIVE menu, it allows to activate the **HISTORY LOG** menu and allows the entrance in the selected archive. It allows to “accept” eventual anomaly signalling on the memory while turning on. When there is a block alarm, by pressing the button you deactivate the siren. A further press of the button recognises the presence of an anomaly and resets any alarm signals if the operating conditions have returned to normal. Lockout signals can only be reset by activating the "OFF/RESET" mode.
 **OPEN BTB** **Ref. 1f**	The button is disabled in the “**OFF/RESET**” and “**AUTO**” modes. In “**MAN**” it is used to open the **BTB** tie breaker.
 **CLOSE BTB** **Ref. 1f**	The button is disabled in the “**OFF/RESET**” and “**AUTO**” modes. In “**MAN**” it is used to close the **BTB** tie breaker (with or without synchronization).
 **HOME** **Ref. 1e**	It forces the display to show the page “M.01”.
 **PROGRAM** **Ref. 1e**	It forces the PROGRAM mode, showing the last modified parameter. If pressed during the PROGRAM mode, it goes back to the page that was shown before entering the PROGRAM mode.

6.3 Indicators (ref. to fig. 1 and 2)

It is possible to modify the brightness of the light indicators (all together) using parameter **P.0496**: the higher the parameter value, the brighter the light indicators. The value can be set between 1 to 10 (default value = 5).

LED OFF	LED steady ON	LED flashing
□	▣	⧈

	Signalling		Function
 Ref. 2c	OFF/RESET	■	Indicates that the operation mode is OFF/RESET
		▣	Indicates that you are accessing the PROGRAMMING menu
		□	The controller is in another operating mode.
 Ref. 2c	MANUAL	■	Indicates that the operation mode is MANUAL
		□	The Gen-set control module is in another operating mode.
 Ref. 2c	AUTO	■	Indicates that the operation mode is AUTOMATIC
		▣	Flashing at 50% indicates that the operating mode is TEST
			Flashing at 90% indicates that the operating mode is REMOTE START.
		□	The control module is in another operating mode.
 Ref. 2a	ALARM	■	Signals at least one active alarm.
		▣	There is at least one active warning.
		□	No anomalies.
 Ref. 2a	AUX. LINK	■	At least one Modbus or Modbus/TCP communication is running over the serial ports, the USB port or the ETHERNET port.
		▣	No Modbus nor Modbus/TCP communications are running.
 Ref. 2a	PMCBUS A	■	Signals that the **CAN-BUS** interface is active and in **ERROR-ACTIVE** mode.
		▣	Flashing at 25% ON signals a COM error: the port is in **ERROR-PASSIVE** mode.
			Flashing at 75% ON signals a COM error: the port is in **BUS-OFF** mode.
		□	Indicates that the **CAN-BUS** is disabled, or that it is enabled and operating, but no messages from engine and/or expansion modules for at least 2 seconds are received.
 Ref. 2a	PMCBUS B	■	Signals that the **CAN-BUS** interface is active and in **ERROR-ACTIVE** mode.
		▣	Flashing at 25% ON signals a COM anomaly: the interface is in **ERROR-PASSIVE** mode.
			Flashing at 75% ON signals a COM anomaly: the interface is in **BUS-OFF** mode.
		□	Indicates that the **CAN-BUS** has been disabled.

	Signalling		Function
 Ref. 2b	BUS A LIVE	▣	BUS A voltage and frequency are present and stead within the tolerance range.
		☐	BUS A voltage and frequency are not present.
		▣	Flashes at 50% during transition between the previous two statuses.
			Flashing at 25% the BUS A voltage and frequency are under the tolerance threshold.
			Flashing at 75% the BUS A voltage and frequency are above the tolerance threshold.
 Ref. 2b	BUS B LIVE	▣	BUS B voltage and frequency are present and stead within the tolerance range.
		☐	BUS B voltage and frequency are not present.
		▣	Flashes at 50% during transition between the previous two statuses.
			Flashing at 25% the BUS B voltage and frequency are under the tolerance threshold.
			Flashing at 75% the BUS B voltage and frequency are above the tolerance threshold.
 Ref. 2b	BTB	☐	The BTB switch is opened.
		▣	The BTB switch is closed.
		▣	Flashes at 25% ON if open after a closing command.
			Flashing at 75% ON if closed after an opening command.
 Rif. 2b	A -> B	▣	Indicates that the active power is flowing from BUSA to BUSB through the BTB circuit breaker.
		☐	-
 Rif. 2b	A -> B	▣	Indicates that the active power is flowing from BUSB to BUSA through the BTB circuit breaker.
		☐	-

6.4 Multifunctional display

6.4.1 LCD lighting

The backlight lamp is managed by the controller, which switches off the back light after a programmable time (P.492) if no buttons are pressed in the meantime. Press any button to switch the lamp ON again, (we recommend using the Esc/SHIFT 

button as it has no function when used alone). This function can be disabled by setting parameter P.492 to 0.

6.4.2 Contrast adjustment

Depending on the environmental temperature conditions, the contrast may require adjustment in order to view the display correctly.

Press in sequence the Esc/SHIFT 

button + LEFT  to reduce the contrast (lighten), press the Esc/SHIFT 

button + RIGHT  to increase it (darken).

6.4.3 Colours scheme

As a default, the controller shows all information on the display using a colour with a blue background. It is possible to modify this logic, though, using parameter P.0499:

- P.0499 = 0: blue background.
- P.0499 = 1: black background.
- P.0499 = 2: white background.

The colour of the messages depends on the background colour and on the type of information displayed.

6.4.4 Mode navigation

The display has different visualization modes composed by different pages.

Mode	Description	Page identifier
PROGRAMMING	Programming	P.XX
PLC	Information on PLC program	L.XX
STATUS	Status information	S.XX
MEASURES	Electrical measurements	M.XX
PMCB	Pages related to parallel functions.	B.XX
HISTORY	History logs	H.XX

Generally, the navigation among the modes happens through UP **buttons** **Ref. 1c**

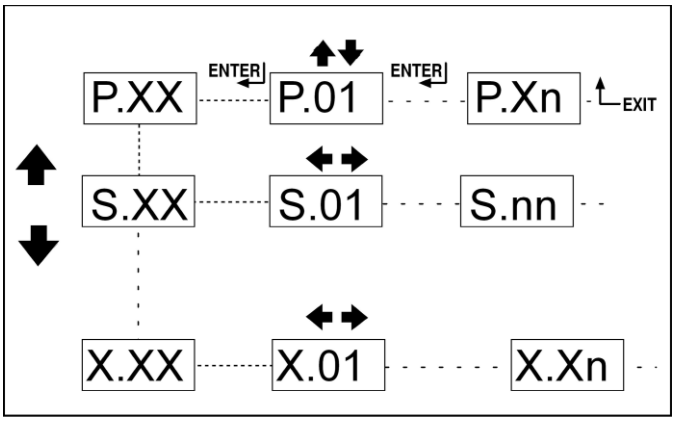


Fig. 3 - Mode navigation

and **DOWN** **Ref. 1c**.

To view the pages inside the mode use the buttons LEFT **Rif. 1c** e

DOWN **Ref. 1c**.

In some modes (e.g.: mode P.xx and mode H.xx) to view the pages, the **ENTER** button, and then the **UP** **Ref. 1c** and **DOWN** **Ref. 1c** buttons must be pressed to navigate between pages.

If the UP and DOWN buttons have to be used to manage the functions within the mode, the ENTER button must be pressed to activate the said functions, and the Esc/SHIFT button to deactivate them.

6.4.5 Display area layout (ref. to fig. 4)

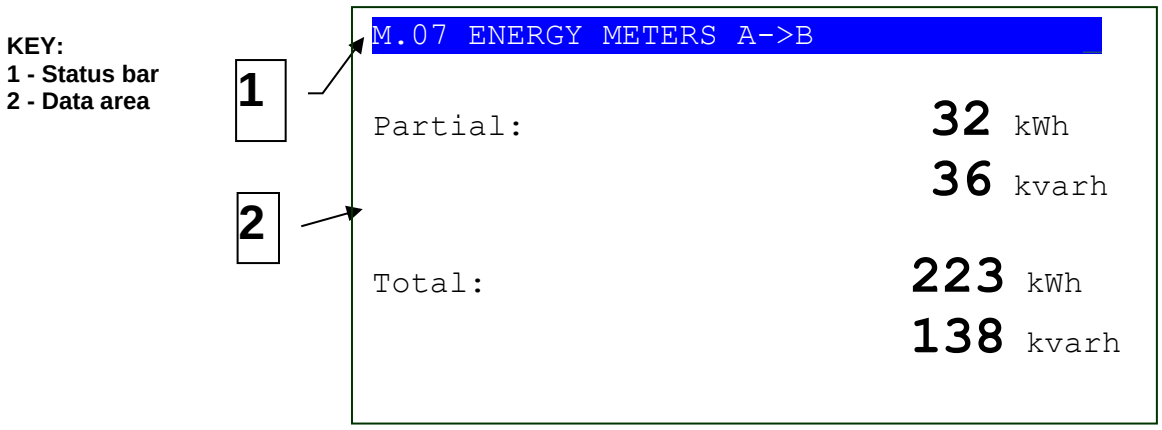


Fig. 4 - Display areas

6.4.6 Top status bar (ref. to fig. 5)

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

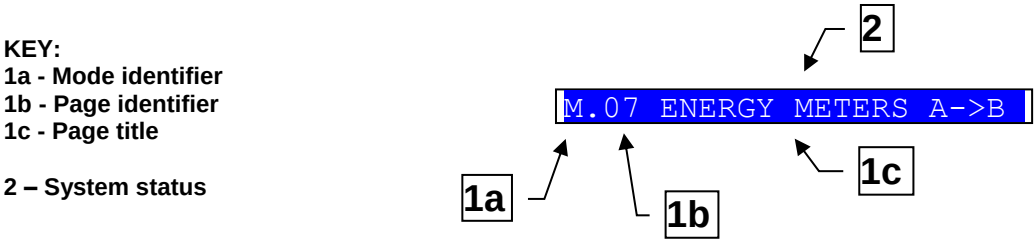


Fig. 5 - Top status bar

The current mode is shown in the relevant field of the top status bar (**1a**).

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

Pressing the **ESC/SHIFT** button, the controller replaces the title (while the button is held) with a status message. By double clicking the **ESC/SHIFT** button, the title is replaced with a status message so long as you remain on that page. If the bit 6 of parameter P.0495 is activated, the controller automatically replaces the title with a status message if there is at least one pending status message with a waiting time (countdown); if the operator selects a new page, the controller shows the title for two seconds, then it shows the status message again.

6.5 Display mode

6.5.1 Programming (P.xx)

The controller manages a relevant number of parameters, which allows the constructor, the installator and the final customer to configure it based on plant specific needs. This document does not contain the list of parameters (even if many of them are mentioned in the description of the different controller functions), but refer to documents [1], for a detailed description. Here is described the general structure of the programming and the operating procedure which allows to read and/or modify the parameters.

To access the parameter modification mode, place on page P.02 with **UP** and **DOWN** vertical scroll buttons. Program and activate it with **ACK/ENTER** button.

To exit the programming menu and go back to the main window, press button **ESC/SHIFT**.

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 may be password protected (see par. 6.5.1.2In fact, every digital input can have an AND/OR logic associated, which determines its status.

6.5.1.1 Organization

This mode allows the display and change of the programming parameters.

KEY:
1 - Status bar
2 - Current menu
3 - Current parameter
4 - Parameter value
5 – Access level

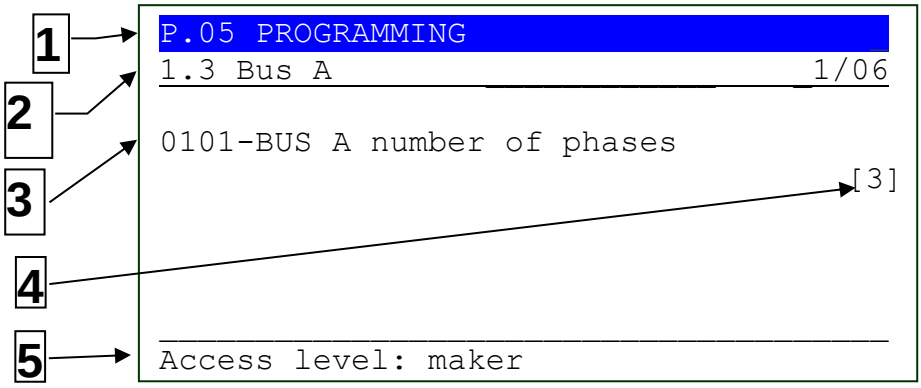


Fig. 6 - Display areas

Each programming parameter Ref. 3 has a 4-digit numeric code (e.g. P.0101) to identify the variables regardless of the language used. The current value of the parameter is displayed below the description Ref.4.

The first line under the top status bar identifies the current menu (2) with the menu number and the relevant text. A pair of numbers is displayed on the right of this line (1/06 in the example in fig. 6). The first indicates which entry of the menu is selected or which page is displayed, the second indicates how many entries or pages can be displayed in the present menu/submenu.

Pressing **ESC/SHIFT** button, the first line (1) is temporarily substituted with a status message.

6.5.1.2 Protection password

Access to the programming mode can be controlled by 4 different PASSWORD levels, which are listed in order of priority.

- Mecc Alte password
- MANUFACTURER password
- INSTALLER password
- USER password

Each parameter of the controller is associated to a protection level (in document [1] this association is indicated in column “ACC” with a letter “S” to indicate Mecc Alte level, “C” for constructor, “I” for installator and “U” for final user).

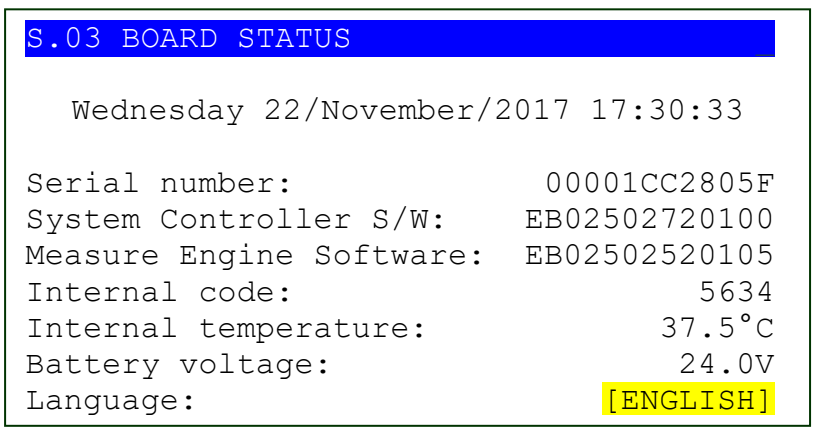
A parameter associated to Mecc Alte level is modifiable only setting Mecc Alte password. A parameter associated to the manufacturer level can be modified only by the manufacturer himself (or with the Mecc Alte password). A parameter associated to the installer level can be modified by the manufacturer and the installer (or with the Mecc Alte password). A parameter associated to the end user lever can be modified by the manufacturer, the installer, and the end user (or with the Mecc Alte password).

The general rule says that the parameters are modifiable only when the controller is in “OFF/RESET” mode. Some parameters are an exception and can be modified regardless of the status of the controller board, including with the engine running. Generally, if a parameter cannot be modified, its value will be between “<” and “>”, whilst if modifiable, it is between “[” and “]”: this is valid also for the password restrictions.

The operator who has to modify a parameter, must first of all let the controller recognise him as “Mecc Alte”, “constructor”, “installer” or “user”, dialling the right password in parameter P.0000 (menu !1.1.1 - authentication”, path “Programming\1 System\ 1.1 Security\ 1.1.1 Authentication”). After this operation, he will be able to modify the parameters. The set access code remains in P.0000 memory for about 10 minutes after programming has been completed. After this time, it will be automatically reset and it will have to be set again to enter a new programming.

It is possible to customise the password through parameters P.0001 (constructor), P.0002 (installer) and P.0003 (user), available on menu “1.1.2 Password configuration”, path “Programming\1 System\ 1.1 Security\ 1.1.2 Password”. The value “0” for these parameters indicates password not set. The Mecc Alte password instead, it is a special password, pre-assigned and supplied together with the controller. The password supplied with the controller is always valid. On demand, Mecc Alte can provide a second password, only valid for 2 hours operation, though. After this time, a new password must be asked to Mecc Alte.

To obtain the password, the operator will have to ask Mecc Alte, indicating the serial number (”Cod. ID”) of the controller, together with the “Internal Code” displayed on page S.03, as shown below:



If a password gets lost, it is possible to reconfigure it by logging in with the higher-level password. For this reason, we advise against not setting at least the "constructor" password (P.0001): is, in effect, someone else sets it or another lower password (even only for distraction) without communicate it, it will no longer be possible to modify any parameter. By knowing the "contructor" password, it will be possible to nullify or modify the other passwords. Contact our service centre if the "manufacturer" password is lost.

The following examples show all combinations of password assignment.

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

Any operator is considered "constructor", without setting anything in P.0000. Therefore all parameters, except for the special ones, 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 user 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, except for the special ones, can be modified.

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

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

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

No parameter is modifiable. When the user enters "UUU" in P.0000, he is considered "user" and can modify only the parameters associated to "user". If the user enters "III", he can modify all parameters associated to "installer" and "user". When entering "CCC" , the operator is identified as "manufacturer" and is allowed to modify all parameters, excluding the critical ones 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 you have 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 user enters "III" in P.0000, he can modify all parameters because there is no password for "manufacturer". After entering this code, all parameters, except for the special ones, 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 user 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 is allowed to modify all parameters, excluding critical ones.

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

No parameter is modifiable. When the user 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 is able to modify all parameters associated to the end user and the installer. When entering "III" in P.0000, the operator is identified as "manufacturer" and is allowed to modify all parameters, excluding critical ones.

The parameter value can be read, but the modification can be carried out only if P.0000 contains a proper password. Parameters P.0001, P.0002, P.0003 and P.0469 are excluded: actually, they are not displayed in case P.0000 does not contain a proper password.

Parameter P.0469 (password for serial ports) is viewable and/or modifiable only from operator panel and, at least, with installer rights.

6.5.1.3 Operating procedure

This procedure will describe the keyboard and display use.

```
P.05 PROGRAMMING

Main menu                          1/06

1 System
2 Sequence
3 Protections
4 Auxiliary functions
5 Communication

Access level: maker
```

- **1 (SYSTEM):** The menu 1-SYSTEM allows first of all to indicate how the controller is connected to the plant. It is most important to correctly set these parameters as nearly all thresholds for the protection activation are expressed in percentage compared to them.
- **2 (SEQUENCE):** Working sequence configuration can be modified through the menu 2-SEQUENCE. In this menu the threshold percentages can be set, the time of acquisition and enabling/disabling of the functions related to the operation sequences.
- **3 PROTECTIONS):** Protections management is accessible through the menu 3-PROTECTION. As to this, it is important to know that, in order to enable/disable a protection, you may simply modify the associated time, leaving the threshold unchanged: by setting the time to zero, the protection is disabled. However, this general rule provides some exceptions. Refer to the chapter dedicated to the anomalies, par. 0, which describes each disabling mode.
- **4 (AUXILIARY FUNCTIONS):** All that is not about the configuration of the system, the sequence and protections is configurable from menu 4-AUXILIARY FUNCTIONS. In this menu are other menus which configure auxiliary functions of the engine, calendars and the setting of the history log.
- **5 (COMMUNICATION):** In this menu are the communication settings on the first serial RS232, second RS232/RS485, Ethernet port TCP/IP, USB port and modem configuration.
- **8 (PARALLEL):** The menu 8-PARALLEL allows to configureall functions related to the parallel on the two sides of the circuit breaker.

6.5.1.3.1 Access to programming

The programming is accessable in any operation status of the controller, while the parameter modification is generally possibile only with the controller in OFF/RESET. By pressing **PROGRAM** key, you can open the last programming page displayed directly; or, to enter in programming mode, it is

required to act on ▲ and ▼ pushbuttons until the programming screen appear (P.02).

If you are in a mode which limitates the use of the vertical scroll pushbuttons, it might be necessary to press one or more times the ESC pushbutton (e.g. when viewing history logs or during particular operations as e.g. the setting of the uel pump command mode).

Then press **ENTER** to enter programming.

At the start of the procedure, the menu o the variable used at the last exit from programming is shown (at first entrance the main menu is shown). This is true if the programming procedure has been previously abandoned changing the operation mode of the controller in MAN or AUTO or after a maximum time of permanence without operating in programming or keeping ESC pressed for more than two seconds.

6.5.1.3.2 Menu selection

The name of the current menu (in the example the menu “1-SYSTEM”) is always shown in the first line, followed by the numeric Id of the selected item and the number of menu items. The further lines of the display are used to view the menu items, that is, the submenus. The item selected is highlighted by the fact to be viewed in REVERSE. Using ▲ and ▼ digits, the menu scrolls respectively towards the top or bottom index items, in a cyclical way (that is, pressing ▲ from the first item you pass to the last and vice-versa).

Pressing **ENTER** digit, you enter a selected submenu (the one highlighted), pressing **ESC** you leave the menu (going back to the previous menu or leaving the programming to the basic screen if you were already on the main menu).

6.5.1.3.3 Parameters selection

The name of the current menu (in the example the menu “1-SYSTEM”) is always shown in the first line, followed by the numeric Id of the selected item and the number of menu items. The next display lines are all used to view a single parameter. In particular:

- Fourth and fifth rows show the univocal parameter code (four decimal digits) followed by the description in the current language.
- The seventh line shows, aligned on the right, the value of the variable.
- For some parameters, on the ninth line, a value someway connected to the current value of the parameter is shown. For example, for parameter P.0321 (maximum current threshold, %), it is shown the equivalent current in Ampere, calculated from the nominal current (P.9502). Often, this additional measure is visualized when the parameter is expressed as percentage related to something else, to show its absolute value.
- The penultimate line of the display shows the protection level given to the operator (Mecc Alte, constructor, installer or user).

Using ▲ and ▼ digits, the menu scrolls respectively towards the top or bottom index items, in a cyclical way (that is, pressing ▲ from the first item you pass to the last and vice-versa). Pressing **ENTER** digit, the modification procedure of the parameter activates (see next paragraph), pressing **ESC** digit you leave the menu (going back to the previous menu).

6.5.1.3.4 Modification of a parameter

A parameter can be modified only if viewed between squared brackets ([ ]); if between “<>”, it cannot be modified. In this case, it could be necessary to set a suitable password or system status.

Once visualized a parameter, to start modifying it, it is necessary to press the ENTER pushbutton. To confirm the new value, it is necessary to press **ENTER**; to cancel the modification and go back to the original value just press **ESC**.

There are the following typed of parameters:

- **Bits:** Some parameters are managed in bit. Each bit at 1 enables a function and each bit at 0 disables a function. Up to 16 bit can be used. A hesadecimal value is attributed to each bit. The parameter must be set with the result of the sum of the hexadecimal values linked to the functions to be enabled. The setting happens as described for the strings, with the exception that it is possible to select only hexadecimal characters ((0...9, A....F).

  In the description of these parameters, there will be a chart like the following:

Bit	Value	Description
1	0001	Enable function 1
2	0002	Enable function 2
3	0004	Enable function 3
4	0008	Enable function 4
5	0010	Enable function 5
6	0020	Enable function 6
7	0040	Enable function 7
8	0080	Enable function 8
9	0100	Enable function 9
10	0200	Enable function 10
11	0400	Enable function 11
12	0800	Enable function 12
13	1000	Enable function 13
14	2000	Enable function 14
15	4000	Enable function 15
16	8000	Enable function 16

  If the operator wants to:

  - Disable all functions: you must set 0000 in the related parameter.
  - Enable the functions from 1 to 8: the value to set is given by the hexadecimal sum 0001+0002+0004+0008+0010+0020+0040+0080 = 00FF.
  - Enable e.g. Function 3, 4, 6 and 8: the value to set is given by the sum of 0004+0008+0020+0080 = 00AC.

- Numerics: the value is modifiable using ▲▼ digits, respectively to increase or decrease the value of one unit (if these digits are pressed together with SHIFT , the value will be increased or decreased of ten units at a time). The modification is cyclical: trying to increase the value when it is already at the maximum, it passes to the minimum, and vice-versa.
- **Numerical with selection among a default list** (e.g. The number of phases of the bus): it is valid what said for the numerical parameters, considering that the ▲▼ digits allows to pass to the following /previous value in the default list (**SHIFT** digit allows to pass to the value which follows/precedes the current one of ten positions).
- **Numerics selected in a number-string couples list** (e.g. the type of input function of a digital input): same as the previous point.

- **Time**: it is valid what said for the numeric parameter, except for the fact that the controller manages the increasing/decreasing keeping valid values (e.g. Increasing from 00.59” to “01.00” and not to "00.60").

- **Strings** (e.g. Phone numbers): in this case the visualizer highlights (in reverse) the character selected on the string. The ▲▼ pushbuttons work on the selected character (passing to next/previous character of the ASCII table or jumping by ten positions ahead/back if SHIFT is pressed too), whereas ◄► pushbuttons allow selecting the character to modify. **Characters ASCII from 32 (space) to 127 (escape) are settable. Characters ASCII (over 127) and those of control (from zero to 31) are not settable.**

- **Hexadecimal strings** (e.g. The bit polarity of the outputs): as for string parameters, but the selectable parameters are only “0-9” and “A-F” (these last in capital letters).

6.5.1.3.5 Set up limits

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

This is valid for each single parameter; it is possible, though, to set two or more parameters in contradictory or incompatible way. The operator is in charge of verifying that this does not happens.

6.5.1.3.6 Exit from programming

There are four ways to exit the programming:

- Press **ESC** n times to climb up again to the main menu and then press it again to exit the programming. Coming a next time into programming, it will be show main menu.

- Keep **ESC** pressed for two seconds from any position: you will exit immediately the programming and you will find yourself exactly at the same point at the next entrance.

- Press the **PROGRAM** key: the controller will go back to the page shown before entering programming mode; the next programming entry will be exactly in same point.

- Changing the controller mode to AUTO or MAN: next entry will be exactly in same point.

6.5.1.4 Loading default values

WARNING: This procedure reloads in a permanent way the default parameters in function of the access rights.

In certain situations it can be useful to reload the default parameters. To do so, it is necessary to select first of all the OFF/RESET mode, enter into programming, then keep the **ACK/ENTER** and **ESC/SHIFT**digits pressed at the same time and consecutively for five seconds. A message on the display will indicate to the operator the happened reloading of the default values. The default values are only reloaded for those parameters for which you have access rights.

6.5.2 PLC (L.XX)

Pages from L.01 to L.07 contain the information related to the PLC logic and are only displayed if on the controller is installed a valid PLC program. Refer to [12] for information on PLC.

6.5.2.1 L.01 PLC

```
L.01 PLC

PLC version:                        1.01
Editor compiler:                2.01
Editor version:                     2.04
Last modification    28-04-2016
13:45:00
Medium/max time     1.250ms 1.452ms
Title:                        New Project
Description:
```

This page contains information of identification of the PLC program installed in the device, as:

- The title and the description of the PLC program.
- The date of the last modification.
- The PLC firmware version of the compilator and of the editor.
- The medium/maximum time of execution. These times are reset automatically when the PLC program is sent to the controller, or it is possible to force the reset by pressing ACK/TEST + EXIT at the same time for five seconds.

6.5.2.2 L.02 PLC LOGIC

```
L.02 PLC LOGIC
PLC block:                        >AND-001
          |                          |
<out>     |DI_VIRTUAL_01     |       0
|
<in>      |DI_CONTROLLER_01  |       1
<in>      |DI_CONTROLLER_02  |       0
          |                          |
          |                          |
          |                          |
          |                          |
```

This page shows information about a single PLC block.

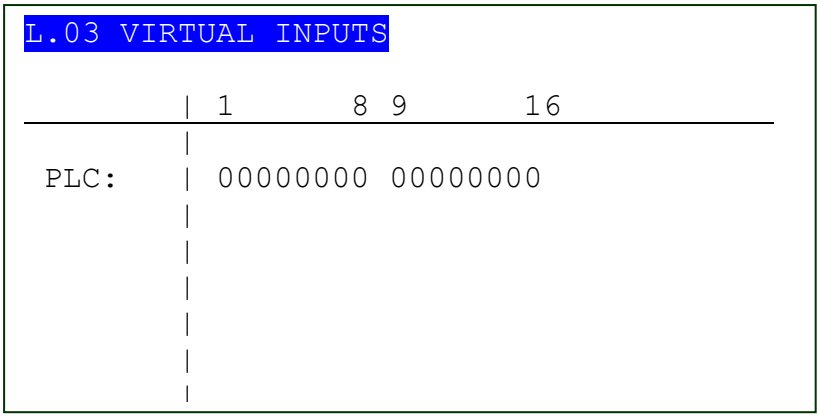
In the second line on the right the selected block is shown, with format “TYPE-NUMBER”. To select the PLC block, press **ENTER**, then use ▲▼ buttons to search for the PLC block wanted; confirm by pressing **ENTER** again.

All parameters of the PLC block selected are shown in the following lines (one line for each parameter).

- The first column identifies the type of parameter used (input/output).

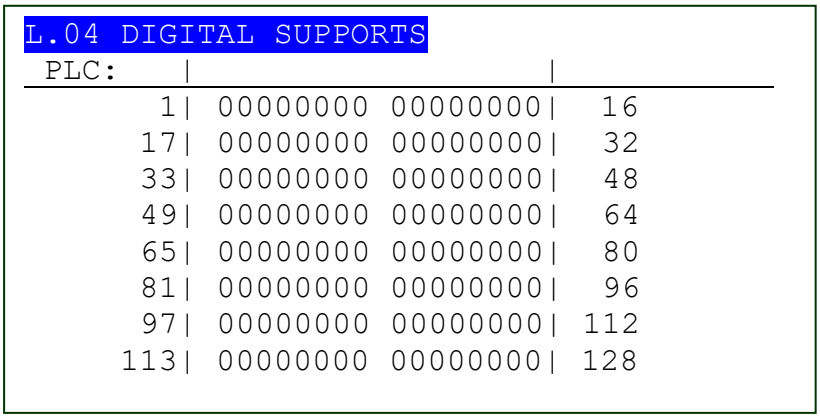
- The second column identifies the resource associated to the parameter. The resources are normally shown with Mecc Alte codification (e.g., The digital input 1 is identified as CONTROLLER 01). In the PLC program it is possible to associate symbols ("nicknames" to the resources. It is possible to view the symbols in the second column, in place of Mecc Alte codes: press **ENTER** (as to select a different PLC block) and press ◄►; confirm with **ENTER** button. See 12] for Mecc Alte codes description, to identify the PLC resources.
- The third column shows the current value of the resource. For the digital resources, if the viewed value is in REVERSE, it means that the relative parameter is denied.

6.5.2.3 L.03 VIRTUAL INPUTS



This page shows to status of all virtual digital inputs (that is, those inputs the status of which has not been acquired by the hardware but is determined by the PLC program).

6.5.2.4 L.04 DIGITAL SUPPORTS



This page shows the status of all temporary digital variables (DT_XXX) available for the PLC program. Many pages which alternate every 2 seconds are available to view all digital supports. Keeping **SHIFT** pressed, you can impede the rotation of the pages (keeping on the display the page currently viewed).

6.5.2.5 L.05 DIGITAL STATUSES

```
L.05 DIGITAL STATUS
 PLC:    |                    |
       1| 00000000 00000000|  16
      17| 00000000 00000110|  32
      33| 00110000 00000000|  48
      49| 00001000 00000000|  64
      65| 00000000 00000000|  80
      81| 00000000 00111000|  96
      97| 00100000 00000000| 112
     113| 00000000 00000000| 128
```

This page shows the value of all internal status of the controller (ST.XXX) available for the PLC program).

6.5.2.6 L.06 VIRTUAL ANALOGUEUES

```
L.06 VIRTUAL ANALOGS

 #1: --------.--
 #2: --------.--
 #3: --------.--
 #4: --------.--
 #5: --------.--
 #6: --------.--
 #7: --------.--
 #8: --------.--
```

This page shows to status of all virtual analogue inputs (that is, those inputs the heat of which has not been acquired by the hardware but is determined by the PLC program).

6.5.2.7 L.07 NUMERIC SUPPORTS

```
L.07 NUMERIC SUPPORTS

 #01:          0 #02:          0
 #03:          0 #04:          0
 #05:          0 #06:          0
 #07:          0 #08:          0
 #09:          0 #10:          0
 #11:          0 #12:          0
 #13:          0 #14:          0
 #15:          0 #16:          0
 #17:          0 #18:          0
```

This page shows the status of all temporary numeric variables (AT_XXX) available for the PLC program. Many pages which alternate every 2 seconds are available to view all numeric supports. Keeping **SHIFT** pressed, you can impede the rotation of the pages (keeping on the display the page currently viewed).

6.5.3 Status information (S.xx)

In this mode, the information on the system status are supplied. You can scroll through the various pages using the LEFT and RIGHTbuttons.

6.5.3.1 S.01 STATUS

Page **S.01 (STATUS)** shows system status information. Part of this information is displayed in the upper title bar if you press and hold the **SHIFT** button. It contains:

- Working mode of the controller (MAN, AUTO, etc.).
- The status of voltages/frequency on BUSA (absent, low, high etc.).
- The status of voltages/frequency on BUSB (absent, low, high etc.).
- The status of the internal sequence that manages the BTB circuit breaker.

Some information are shown alongside an elapsing time; for example, during automatic synchronization, the residual time is shown.

6.5.3.2 S.02 ANOMALIES

The page S.02 (ANOMALIES) is automatically displayed in case a new anomaly arises. For every anomaly, it is shown:

- The date/hour the anomaly activated.
- A letter identifying the type of it:
  - “A”: block.
  - “W”: Warning.
- A three digit numeric code that uniquely identify the anomaly. This code flashes if the anomaly has not been acknowledged yet with ACK.
- An alphanumeric description, based on the currently selected language and that in some cases can be customized through the controller parameters.

Each anomaly uses two lines of the LCD display. The anomaly shown on the top is the more recent in chronological order. If space is not sufficient to show all the pending anomalies, only the most recent ones are shown. To see also the other, you have to:

- Press the ENTER pushbutton.
- Use the ▲▼ pushbuttons to scroll the anomalies.
- Press EXIT to leave the mode.

Some anomalies can show additional diagnostic information. This information is automatically viewed if an anomaly is active: if there are many anomalies active, use the procedure described above to select the single anomalies and see the eventual additional diagnostic information regarding the selected anomaly. The anomalies with additional diagnostic information are:

- 211 ("PMCB: shared input written by multiple devices"). It shows an additional message that identifies the type, the number of the shared input and the PMCB address of the controller that is writing it. See document [9].

- 900 (“incoherent parameters on PLC”). It shows an additional message helping to understand the problem.

6.5.3.3 S.03 CONTROLLER STATUS

This page is dedicated to the information of the device and contains:

- The current date and hour in extended format (flashing is the clock is not valid, date in reverse if Daylight Save Time in progress).
- The serial number univocal for the controller (“ID Code”).
- The software codes currently uploaded on the controller (see par. 1.6).
- The internal code necessary to obtain a temporary Mecc Alte level password (see 6.5.1.2).
- The internal temperature of the controller.
- The power supply voltage.
- The language currently used by the device. It is also possible to select a different language: press ENTER digit, select the language with digits ▲ and ▼ and confirm with ENTER digit. **Note: Standard BTB200 is supplied only with ENGLISH, ITALIAN and PORTUGUESE languages. With BoardPrg4 program it is possible to transfer other languages to the controller.**

6.5.3.4 S.04 SERIAL COMMUNICATION

This page is dedicated to the status of the serial communication towards the two serial ports and through USB. In the case of operating errors, check the information in this page.

For each serial port (and for the USB too) the status (stand-by, communicating, etc.) and the counter of receiving errors are displayed. To reset an error counter, you have to:

- Press ENTER: the controller highlights the error counter of the serial port COM1.
- Use the vertical arrows to highlight the counter to be reset.
- Press ENTER+EXIT for 5 seconds: at the end, the controller resets the counter.
- Press EXIT.

If a modem is connected to the controller, is also shown:

- The modem model
- In case of a GSM modem:
  - The name of the telephone provider.
  - The GSM signal level

6.5.3.5 S.05 NETWORK

This page is dedicated to the status of the connection and communication via TCP/IP on the Ethernet interface.

The controller shows:

- The status of the connection.
  - “Stand by”: no ongoing communication and Ethernet cable disconnected.

- “Stand-by-connected”): no ongoing communication and cable connected to Ethernet network.
- “Ongoing communication” ongoing communication and cable connected to Ethernet network.

- MAC address of the physical net interface.
- The IP address of the controller, the address of the router/gateway, the Subnet-mask and the DNS server address. Those values can be the ones set with the parameters of the controller, or those dynamically acquired by server DHCP (see 5.12.4).

6.5.3.6 S.07 CAN-BUS

This page displays the status of the CAN-BUS interfaces of the controller. BTB200 has two interfaces. Each interface displays

- The communication status of the bus. There are three possible signalling:
  - - ERROR-ACTIVE: normal operation
  - - ERROR-PASSIVE: communication is working despite faults (errors).
  - - BUS-OFF: Gen-set has interrupted the connection to the bus due to too many errors.
- Communication error counters are displayed. The counters of the instantaneous transmission/reception errors and the maximum values reached are displayed. It is possible to reset the maximum values (and force the output status of BUS-OFF) by pressing for 5 seconds the buttons ENTER and Esc/SHIFT. Since two CAN interfaces are present, it is necessary to select the desired CAN interface first and then reset the counters: to select an interface press ENTER digit and use ▲ and ▼ digits.

6.5.3.7 S.08-09-10 GENERIC STATUS

These pages are dedicated to the view of the generical statuses acquired through the digital inputs, configured with functions DIF.3201 and DIF.3202 (page 1), DIF.3203 and DIF.3204 (page 2), DIF.3205 and DIF.3206 (page 3).

The page uses one line for each configured input. If more than 6 inputs are configured, the controller will display all of them in rotation (6 at a time) every 2 seconds: keeping SHIFT digit pressed you clock the rotation. If there are no configured inputs on a page, the page is not displayed.

On each line, the controller shows a configured text for the digital input and the logical status of it.

If you use functions DIF.3202, DIF.3204 and DIF.3206, when the input is activated, the controller forces the view of the relative page.

6.5.3.8 S.11 DIGITAL INPUTS

This page shows the status of:

- Digital inputs
- Analogue inputs used as digital (if they are not used as digital they are displayed with hyphens).
- Virtual digital inputs

Pressing **ACK/ENTER it is possible to view the rotating inputs in three different ways:**

- **LOGIC STATE:** The Controller shows the input's logic level (active or inactive) used in the management of the operating sequence.
- **PHISICAL STATE:** The Controller shows the electrical level (active or inactive, or high or low) really present on the input; this can be the opposite in comparison to the corresponding logic state. Displayed in negative.
- **FOR FUNCTION: the controller shows a list of functions really associated to the digital inputs, showing the logic status (1/0) relative to each function, independently from the input really associated to the functions.** If more than 8 inputs are configured, the controller will display all of them in rotation (8 at a time) every 2 seconds: keeping SHIFT digit pressed you clock the rotation.

6.5.3.9 S.12 DIGITAL OUTPUTS

This page displays the status of the controller's digital outputs. Pressing **ACK/ENTER it is possible to view the rotating inputs in three different ways:**

- **LOGIC STATE:** The Controller shows the output's logic level (active or inactive) used in the management of the operating sequence.
- **PHISICAL STATUS:** The Controller shows the Electrical level (active or inactive, or high or low) actually present on the output; this can be the opposite in comparison to the corresponding logic state. Displayed in negative.
- **FOR FUNCTION: the controller shows a list of functions really associated to the digital outputs, showing the logic status (1/0) relative to each function, independently from the output really associated to the functions.** If more than 8 outputs are configured, the controller will display all of them in rotation (8 at a time) every 2 seconds: keeping SHIFT digit pressed you clock the rotation.

6.5.3.10 S.13 ANALOGUE INPUTS

The page shows the value of the analogue inputs of the controller (connectors JU, JK and JJ) and of the emergency stop (EM-S). Pressing **ACK/ENTER it is possible to view the rotating inputs in two different ways:**

- **PHYSICAL STATE**: For each input a measure in Volt is displayed.
- **FOR FUNCTION: the controller shows a list of functions really associated to the digital inputs, showing the real acquired value, independently from the input really associated to the functions.** If more than 8 functions are used for the digital outputs, the controller will display all of them in rotation (8 at a time) every 2 seconds: keeping SHIFT digit pressed you clock the rotation.

6.5.3.11 S.14 ANALOGUE OUTPUTS

This page shows the percentage value currently associated to the two analogue outputs of the controller.

Pressing ENTER you arrive to a view per function: the controller shows a list of the functions really associated to the analogue outputs, displaying the analogue value relative to each function, independently from the output really associated to the functions.

6.5.3.12 S.15 SHARED DIGITAL INPUTS

This page displays the status of the controller's shared digital inputs They are displayed in groups of 16 inputs and only those used (by the controller or received via PMCB). See document [9].

6.5.3.13 S.16 SHARED ANALOGUE INPUTS

This page displays the status of the controller's shared analogue inputs. Only those used (by the controller or received via PMCB) are displayed. See document [9].

6.5.4 Electrical measurements (M.xx)

In this mode, all the information on the measurements taken by the controller on the electric lines is shown. You can scroll through the various pages using the LEFT and RIGHT buttons.

6.5.4.1 M.01 SYSTEM

Page M.01 (SYSTEM) displays a wiring diagram of the system.

The BTB circuit breaker is shown at the center; if it is closed and if the current transformers have been correctly configured and wired (P.0312 and P.0313 different from zero), the controller shows also the active and the reactive powers, together with arrows that show the power flow direction.

NB: the power flow indicated by the controller may be wrong, depending on the wiring of the current transformers. If wrong, please change the value of the parameter P.0314 to get the right indication.

The symbol of the circuit breaker shows:

- The open/close status
- The discrepancy between the status and the circuit breaker command (in this case, the two circuit breaker's points of contacts flash).

The status of BUSA is shown on the left side, while the status of BUSB is shown on the right side. The following description applies to both.

The controller shows:

- A rectangle with the average voltage of the bus at the bottom. This is shown when BTB200 detects (by CAN-BUS link) that no generators are supplying on the bus and no MC boads are connecting the mains to the bus (MCB and MGCB both closed).
- The symbol of the generator. This is shown when BTB200 detects (by CAN-BUS link) that at least one generator is supplying on the bus. Alternatively, (or in addition), the controller shows the symbol of the mains (double circle) if it detects (by CAN-BUS link) that at least one MC board is connecting the mains to the bus (both MCB and MGCB closed).
- The background colour of the symbol indicated the status of the voltage on the bus:
  - White: voltage/frequency off.
  - Yellow: voltage/frequency on out of tolerance.
  - Green: voltage/frequency on and in tolerance.

With parameter P.0494 it is possible to customise the screen, hiding one or more of the previous information.

6.5.4.2 M.02 BUS A

In this page are displayed the voltages, the frequency and the rotation sense of BUS A. The information really displayed depends on the configuration.

- Three phase system (P.0101=3) with neutral connected to the controller (P.0120=1). The controller displays the three concatenated voltages, the frequency, the sense of rotation and the neutral-battery voltage. Pressing ENTER digit, in place of the concatenated voltages, the phase voltages are displayed (press ENTER again to go back to concatenates).
- Three-phase system (P.0101=3) without neutral (P.0120=0). The controller displays the three concatenated voltages, the frequency, the sense of rotation and the neutral-battery voltage.
- Single-phase system (P.0101=1). The controller displays the phase voltage, the frequency and the neutral-battery voltage.

Under each concatenated or phase voltage, the controller also displays a bar showing graphically the current voltage with respect to the nominal voltage: on the bar are also represented eventual thresholds. The colour with which the bar is filled is green if the voltage is in tolerance, yellow if it is out of tolerance.

On the right bottom an icon is shown which immediately permits to identify that the page is relative to the BUS A measurements.

6.5.4.3 M.03 BUS B

In this page are displayed the voltages, the frequency and the rotation sense of the BUS B. The information really displayed depends on the configuration.

- Three phase system (P.0201=3) with neutral connected to the controller (P.0220=1). The controller displays the three concatenated voltages, the frequency, the sense of rotation and the neutral-battery voltage. Pressing ENTER digit, in place of the concatenated voltages the phase voltages are displayed (press ENTER again to go back to the concatenated).
- Three-phase system (P.0201=3) without neutral (P.0220=0). The controller displays the three concatenated voltages, the frequency, the sense of rotation.
- Single-phase system (P.0201=1). The controller displays the phase voltage, the frequency and the neutral-battery voltage.

Under each concatenated or phase voltage, the controller also displays a bar showing graphically the current voltage with respect to the nominal voltage: on the bar are also represented eventual thresholds. The colour with which the bar is filled is green if the voltage is in tolerance, red if it is out of tolerance.

On the right bottom an icon is shown which immediately permits to identify that the page is relative to the BUS B measurements.

6.5.4.4 M.04 CURRENTS

In this page, phase currents are displayed (one or three) measured by the controller. At the bottom-right corner, the controller shows one symbol which immediately permits to identify the real source of the currents (BUS A or BUS B).

Under each concatenated or phase voltage, the controller also displays a bar showing graphically the current voltage with respect to the nominal voltage: on the bar are also represented eventual thresholds. The colour with which the bar is filled is green if the current is in tolerance, red if it is out of tolerance.

For three-phase systems also the negative sequence current is displayed.

If the fourth current is suitably configured, the controller will also display:

- **Ax**: auxiliary current (visible if P.0318=1).

- **An**: neutral current (visible if P.0318=2).

6.5.4.5 M.05 POWERS

The active powers and power factors are shown, total and phase by phase (for single-phase systems only the total values are shown).

At the bottom-right corner, the controller shows one symbol which immediately permits to identify the real source of the powers (BUS A or BUS B).

6.5.4.6 M.06 POWERS

The apparent and reactive powers are shown, total and phase by phase (for single-phase systems only the total values are shown).

At the bottom-right corner, the controller shows one symbol which immediately permits to identify the real source of the powers (BUS A or BUS B).

6.5.4.7 M.07 ENERGY COUNTERS A → B

In this page the active and reactive energy counters (partial and total) are shown, counted by the controller **when the related powers flow from BUS A to BUS B.**

On this page, you can reset to zero the partial counters individually. To do so, it is necessary to:

- Press ENTER digit: one of the counters will result highlighted.
- Use the vertical scrolling UP and DOWN digits to select the counter to be reset.
- Press ENTER and EXIT digits for 5 seconds.
- Press the EXIT pushbutton.

6.5.4.8 M.08 ENERGY COUNTERS B ← A

In this page the active and reactive energy counters (partial and total) are shown, counted by the controller **when the related powers flow from BUS B to BUS A.**

On this page, you can reset to zero the partial counters individually. To do so, it is necessary to:

- Press ENTER digit: one of the counters will result highlighted.
- Use the vertical scrolling UP and DOWN digits to select the counter to be reset.
- Press ENTER and EXIT digits for 5 seconds.
- Press the EXIT pushbutton.

6.5.4.9 M.09 SYNCHRONISATION

This page shows the necessary information for the synchronization.

On the right side, the controller displays a gauge which graphically shows a synchronoscope, indicating the current phase through a needle.

On the left side, the controller displays the current phase difference through a horizontal bat, which act as a synchronoscope. Usually it shows phase angles between -180° and +180°. When the phase error falls below 20°, the bar is reduced to show corners between -20° and +20° (in this case the bar is on black background). Under the bar 5 small rectangles are shown. The first three indicate if the voltage, frequency and phase differences allow the closure of the circuit breaker (if the rectangle is grey, the difference is too high and the circuit breaker cannot be closed, if it is green the difference is in tolerance). The fourth one indicates a possible mismatch of phase-rotation direction (also in this case the grey rectangle indicates that the switch cannot be closed). When all the first four rectangles

are entirely “green”, the status of the system is correct to close the switch: so, the fifth rectangle becomes green and the board controls the closing of the switch.

Still on the left side, the controller displays numerically the difference of phase, frequency, voltage and a blinking character (“A” o “B”) that indicates which bus is selected to receive frequency and voltage adjust commands.

On the bottom of the page there are stand-by values for the two regulators. If these values are related to an analogue input, it is possible to directly modify them from this page (see previous paragraph). In this way, it is possible to make a manual synchronization.

6.5.4.10 M.10-11-12 EXTERNAL MEASUREMENTS

These pages are dedicated to the displaying of the measurements acquired from the analogue inputs configured as "generic sensor". The operator has the option to acquire measures that are not in any way linked to the board, and to show them on the display. It can also group them (by any standard), and display them on one of the 3 available pages.

The division of the measures on the different pages is done via the function configured in the analogue inputs:

- AIF.2001: page M.10.
- AIF.2003: page M.11.
- AIF.2005: page M.12.

The controller shows one measurement per line: it shows the text configured for the analogue input (P.4002 for the analogue 1), followed by a measure. If more than 9 measurements are associated to one of these pages, the controller shows them all, rotating them every 2 seconds: keep SHIFT pressed to block the rotation on the current view.

6.5.5 CAN-BUS PMCB (B.XX)

6.5.5.1 B.01 CONTROLLERS ON PMCB BUS A

This page shows the list of the mains control boards (MC), of the genset control boards and of the tie control board (BTB) recognised on the Can-Bus PMCB connection of BUS A. It is useful for diagnostic purposes.

On the top the PMCB addresses of all BTB controllers are displayed. In the middle the PMCB addresses of all BTB controllers are displayed. On the bottom the PMCB addresses of all gensets controllers are displayed.

6.5.5.2 B.02 CONTROLLERS ON PMCB BUS B

This page shows the list of the mains control boards (MC), of the genset control boards and of the tie control board (BTB) recognised on the Can-Bus PMCB connection of BUS B. It is useful for diagnostic purposes.

On the top the PMCB addresses of all BTB controllers are displayed. In the middle the PMCB addresses of all BTB controllers are displayed. On the bottom the PMCB addresses of all gensets controllers are displayed.

6.5.6 History logs (H.xx)

During the operation, apart from the OFF/RESET mode, the controller makes periodic registration or on event, partially configured with the programming parameters.

The controller manages five types of archive:

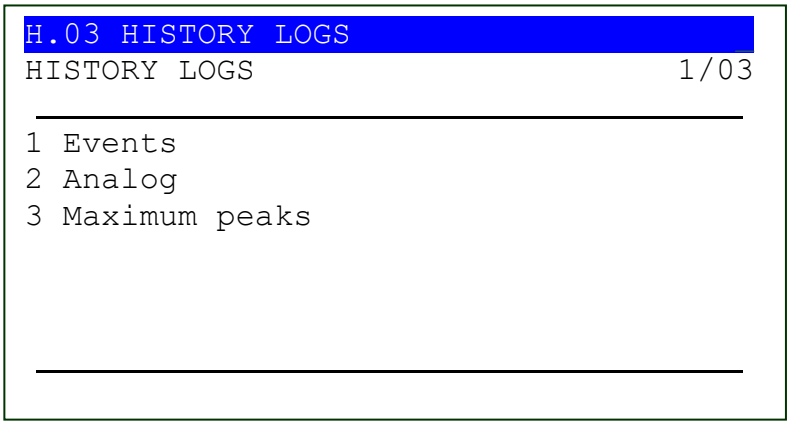
1. Events
2. Analogue
3. Maximum peaks

These archives can be accessed in any function mode and status of the controller. In order to select the function, use the buttons ▲ and ▼ under the display in order to show the HISTORY ARCHIVE (H.01) base page.

If you are in a mode which limits the use of vertical scrolling digits, it might be necessary to press ESC digit one or more times.

Then press ENTER to activate the mode (pass to page “H.03”).
At the starting of the procedure, the menu with the different archive function is shown.

6.5.6.1 Archive selection



The second line always shows the numeric indication of the function selected and the number of functions in the menu. The next lines on display are all used to view the selectable functions. The selected item is highlighted in negative (REVERSE).
Using ▲ and ▼ digits, the menu scrolls respectively towards the top or bottom index items, in a cyclical way (that is, pressing ▲ from the first item you pass to the last and vice-versa).

Pressing ENTER pushbutton the selected function activates (the one highlighted in negative), pressing ESC you go back to page “H.01”.

6.5.6.2 Pages for events

In the moment in which some events happen (previously configured), the controller adds a registration in this archive. The registration always contains date/hour, numeric code which identifies the event and the controller status. Through BoardPrg4 program, it is possible to select which other information must be registered at every event. It is possible to add 44 information maximum. The capacity of the archive depends on how many information are memorized at every event: with default configuration, by the way, the total capacity is 537 registrations. If the archive is full and a new event occurs, the less recent is overwritten.

Parameter P.0441 allows to select which events must be registered. It is a parameter configurable at bit:

Bit	Hexadecimal value	Firmware version	Description
1	01	01.00	Controller mode
2	02	01.00	BUS A statuses
3	04	01.00	BUS B statuses
4	08	01.00	BTB statuses.
5	10	01.00	BTB commands.
6	20	01.00	Diagnostics

A chart follows with the codes for all possible events.

Code	Version	Even if blocked.	Registration cause.
EVT.1001	01.00	Yes	OFF_RESET
EVT.1002	01.00	Yes	MAN
EVT.1003	01.00	Yes	AUTO
EVT.1010	01.00		BUS A off
EVT.1011	01.00		BUS A on
EVT.1012	01.00		BUS A in tolerance
EVT.1020	01.00		BUS B off
EVT.1021	01.00		BUS B on
EVT.1022	01.00		BUS B in tolerance
EVT.1030	01.00		BTB close command
EVT.1031	01.00		BTB open command
EVT.1032	01.00		BTB closed (from digital input)
EVT.1033	01.00		BTB open (from digital input)
EVT.1074	01.00	Yes	Reset
EVT.1075	01.00		Not valid clock (but used by some functions).
EVT.1076	01.00	Yes	Update clock/calendar
EVT.1077	01.00	Yes	New starting of controller
EVT.1078	01.00	Yes	Default values of parameters reloaded.
EVT.1086	01.00	Yes	Clock updated for daylight saving time.
EVT.1087	01.00	Yes	Clock updated for standard time.

The column “even if blocked” indicates which events are anyway recorded even if the records are blocked (see 6.5.6.4)

All the anomalies are recorded in the records of events. They are recorded with their own numerical code, added to:

- 2000: if the anomaly is an early warning.
- 5000: if the anomaly is a alarm.

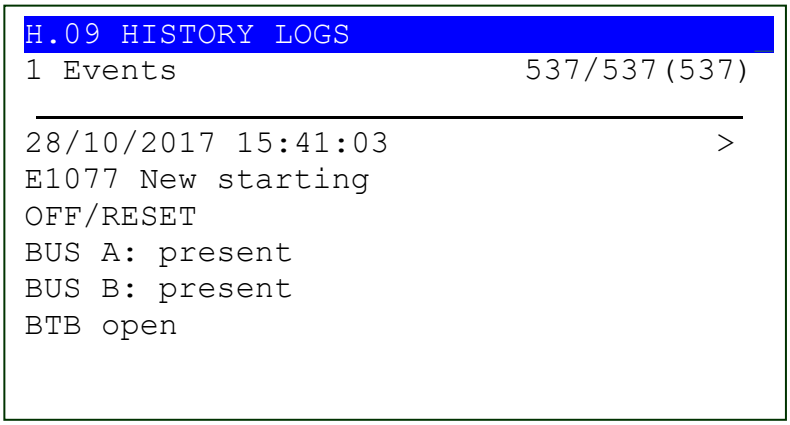
For example, anomaly 273 will be recorded as "2273" when it is activated as an early warning, as "5273" if it is activated as an alarm. By viewing the events from the board panel, the event code "2273" is automatically displayed as "W273", the code 5273 is displayed as "A273".

With the default configuration, each time that an event is recorded, the board also records the following info (this list can be modified by means of the BoardPrg4 program):

- Date/Time
- Operating mode of the controller.
- BUS A status.
- BUS B status.
- BTB circuit breakers status.
- BUS A phase-to-phase voltages and frequency.
- BUS B phase-to-phase voltages and frequency.
- The three phase currents.
- The total (apparent, active and reactive) powers and the total power factor.
- The battery voltage.

Using the ▲ and ▼ buttons to scroll cyclically trough all recordings. Each event has four information pages. Pressing the LEFT and RIGHT buttons allows you to scroll through the four pages related to the event.

The structure of the upper part of the pages is the same for all four. The following figure shows the first page.



The common part (above the dotted line) contains:

- The second line shows which event is currently displayed, the total number of recorded events and the maximum size of the archive. The most recent event is associated to the highest number.
- The next line shows the date/time of the recording.
- The next line shows the numeric code of the event and its description (variable depending on the selected language).

The content below the dashed line depends on the information configured for the record; with the default configuration, four pages are used:

Page 1 It shows the statutes of the system at the time when the event was recorded: board operation mode and statutes of BUS A, BUS B, and switches.

Page 2 It shows frequency and voltages of the BUS A. It shows the L1- L2 phase-to-phase frequency and voltage of the BUS B.

Page 3 It shows the L2- L3 and L3-L1 phase-to-phase voltage of the BUS B, phase currents and total power (kVA).

Page 4 It shows the total active power (kW), total reactive power (kvar), the total power factor and the battery voltage.

The information that were not available at the time of recording are displayed with dashes.

6.5.6.3 Pages for analogues

BTB200 records a series of analogue measurements and statuses at regular intervals. The recording interval is configurable, and different intervals for when the engine is running and when the engine is stopped can be configured:

- P.0442: interval (in seconds) for the recording into the archive of analogue measurements, used when the circuit breaker is closed.
- P.0443: interval (in seconds) for the recording into the archive of analogue measurements, used when the circuit breaker is opened.

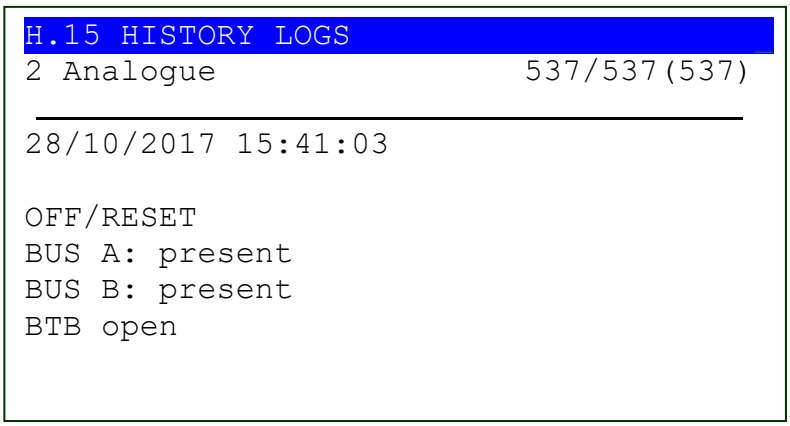
Each record always contains the date/time and the status of the controller. By means of the BoardPrg4 program, it is possible to select which information must be recorded. It is possible to add 44 information max. The capacity of the archive depends on the information recorded on event: however, with the default configuration the full capacity is 537 records. If the archive is full and a new event occurs, the oldest is overwritten.

With default configuration, the values recorded are:

- Date/Time
- Operating mode of the controller.
- BUS A status.
- BUS B status.
- BTB circuit breakers status.
- BUS A phase-to-phase voltages and frequency.
- BUS B phase-to-phase voltages and frequency.
- The three phase currents.
- The total (apparent, active and reactive) powers and the total power factor.
- The battery voltage.

Using the ▲ and ▼ buttons to scroll cyclically trough all recordings. Each record has a variable number of information pages (based on the configuration). By pressing LEFT and RIGHT keys it is possible to navigate on the four pages related to recording.

The structure of the upper part of the pages is the same for all four. The following figure shows the first page.



The common part (above the dotted line) contains:

- The second line shows which record is currently displayed, the total number of recorded registrations and the maximum size of the archive. The most recent record is associated to the highest number.
- The next line shows the date/time of the recording.

The content below the dashed line depends on the information configured for the record; with the default configuration, 5 pages are used:

Page 1 It shows the statutes of the system at the time when the event was recorded: board operation mode and statutes of BUS A, BUS B, and switches.

Page 2 It shows frequency and voltages of the BUS A. It shows the L1- L2 phase-to-phase frequency and voltage of the BUS B.

Page 3 It shows the L2- L3 and L3-L1 phase-to-phase voltage of the BUS B, phase currents and total power (kVA).

Page 4 It shows the total active power (kW), total reactive power (kvar), the total power factor and the battery voltage.

The information that were not available at the time of recording are displayed with dashes.

6.5.6.4 Locked recordings

The board does not perform recordings in the archive of analogues and in the archive of events if it is in OFF/RESET mode and when an alarm have been activated. Exceptions are some event codes (highlighted by the wording “Yes” in the column “even if blocked” of the table in 6.5.6.2) and all anomalies. Recordings are locked; all the windows of the History logs display an intermittent “Locked” message. To unlock the recordings, it is necessary cancel all anomalies and set the board in MAN or AUTO.

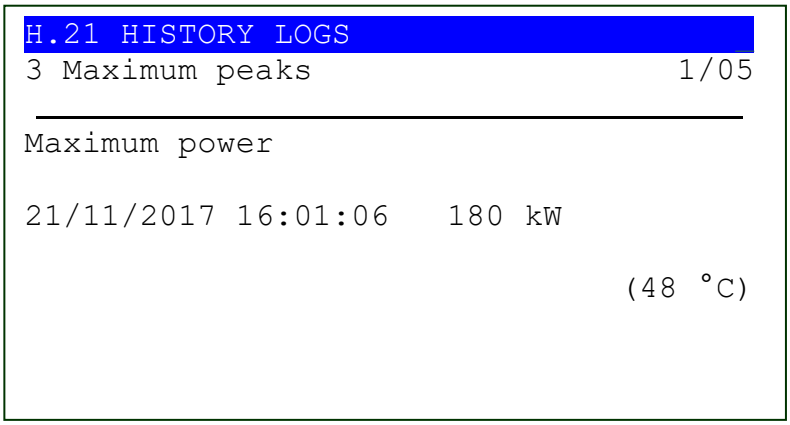
6.5.6.5 Pages for peaks

The controller makes a series of maximum and minimum peaks for some significant values.

- Total active power: the maximum peak is recorded, having the date/time and the measure of the engine coolant temperature (if available) associated.

- Currents: the maximum peaks of individual phases are recorded, having the date/time and power factor of that phase associated.
- Controller temperature: the minimum and the maximum peaks are recorded, with date/time associated.

To display all records, the controller uses only one page of the display.



The second line shows the record currently displayed, out of the total number of records (the maximum number of records is 6).

The fourth line shows a description of the peak record currently displayed.

- Maximum power
- Maximum current (L1)
- Maximum current (L2)
- Maximum current (L3)
- Minimum board temperature.
- Maximum board temperature.

The sixth line shows the date and the time of the record, the value of the record (power, current, etc.) On the eighth line a second value can be recorded together with the main value:

- The power factors on single phases are recorded together with the currents.

The information that were not available at the time of recording are displayed with dashes.

Using the ▲ and ▼ pushbuttons it is possible to scan all the records.

The buttons ◄ and ► are not used because the controller uses only one page of the display.

6.5.6.6 Exit from archives visualization

There are two ways to exit from archive visualization:

- Press ESC n times to go to page H.01
- Changing operating mode of the controller.

In both cases, it will be shown the page H.01, from which it is possible to pass to the status and measurements visualization with ▲ and ▼ pushbuttons.

6.5.6.7 Reset of archives

To reset an archive, it is first necessary to view it and then keep ENTER and EXIT pressed for 5 seconds up to when the controller shows a message of happened reset on the display. The archive of maximum peaks, actually, does not reset: when ENTER and EXIT are pressed for 5 seconds on this archive, the controller forces as maximum peak the current value of the measurements.

6.6 Language selection

The device allows to select the language to use for all writings displayed on the multifunctional viewer. Currently, 5languages are supported: Italian, English, Portuguese, French and Spanish (English as default). The directly available languages are only: English, Italian and Portuguese. The others can be transferred to the controller (one at a time) though BoardPrg4 software. See 6.5.3.3 for the language selection procedure.

7 Operation sequence

7.1 Operation mode

Three modes are available for the device management.

- **OFF/RESET**: BTB circuit breaker is opened, alarms/warnings are reset and it is possible to modify parameters in PROGRAM mode. The controller does not accept closure command for BTB.
- **MAN**: opening and closure of BTB are made by the operator (the board does not perform these operations automatically). However, since the protections are enabled, the board can open the BTB in case of alarms. It is allowed the access to programming but only few parameters can be changed.
- **AUTO**: opening and closure of BTB are made automatically by the controller as required by the plant status. Protections are enabled. It is allowed the access to programming but only few parameters can be changed.

The operation mode can be selected in three different ways:

- Using “MODE ▲” and “MODE ▼” buttons on the controller. The buttons must be pressed continuously for at least half a second to force the mode change. The buttons are disabled (on the first line of the display a flashing key shaped icon is shown) if at least one of the inputs described at the following point exists and is active.
- Using one or more configured inputs with the following functions:
  - DIF.2271 “OFF from remote”.
  - DIF.2272 “MAN from remote”.
  - DIF.2273 “AUTO from remote”.

  When one of these inputs is active, the controller mode is forced and it is no longer possible to use either the buttons on the panel or the commands from serial ports to modify it (on the first line of the display a flashing key shaped icon is shown).

  When none of these inputs is active, it becomes possible again to use the buttons and the commands from the serial ports to change the operation mode.

  If there are more active inputs at the same time, the priority is give to the input which forces OFF/RESET, followed by the one which forces MAN, and then the one which forces AUTO.

It is not mandatory to use all three inputs. For example, it is possible to use only one input to force the AUTO status; when the input is active, the controller is always in AUTO, when the input deactivates the controller remains in AUTO, but it is possible to use the buttons to pass to MAN or OFF/RESET.

If only one input is used to force OFF/RESET mode, the controller acts differently: when the input is active, the controller is always in OFF/RESET mode, and when the input goes back on standby, the controller goes back to the mode it was in prior to input activation.

- Sending Modbus commands through serial ports, the USB port, the ETHERNET port or through the modems. The commands are only managed if none of the above described inputs is active. The commands can be protected by a password (P.0004) which must be entered 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 the value:
    - "1" to require the OFF/RESET mode.
    - "2" to require the MAN mode.
    - "3" to require the AUTO mode.

The board records the following events if the working mode changes (if enabled with bit 1 of P.0441 parameter):

- EVT.1001: the new mode is "OFF/RESET".
- EVT.1002: the new mode is "MAN".
- EVT.1003: the new mode is "AUTO".

Some functions are available for the configuration of the digital outputs related to the operation mode of the board:

- DOF.3001 - "Off/reset". The board activates this output when in OFF/RESET mode.
- DOF.3002 - "Man". The board activates this output when in MAN mode.
- DOF.3003 - "Auto". The board activates this output when in AUTO mode.
- DOF.3011 - "Not in Off/reset". The board activates this output when in AUTO or MAN mode.

Also, the board operates with AND/OR logics through the following internal statuses:

- ST.000 - "OFF/RESET".
- ST.001 - "manual"
- ST.002 - "Automatic".

7.2 BUSA and BUSB voltage detection

BTB200 must acquire voltages and frequency of the two buses in order to decide whether using or not synchronization to close the BTB circuit breaker:

- If no voltages/frequency is detected on one or both buses, BTB can be closed without synchronization.

- If voltages/frequency are present on both buses, BTB can be closed only with synchronization.

If BTB200 must use synchronization, then frequencies and voltages are used to calculate adjust commands (for frequency and voltages) needed to reach the “synchronized” status.

Normally BTB200 uses its own three-phase sensors (JG and JF connectors) to measure frequencies and voltages of the two buses. If, for any reason, one or both sensors of the controller cannot be used, they must be disabled setting to 0 the parameter that configures the nominal voltage (P.0102 for BUSA and P.0202 for BUSB).

7.2.1 External sensor

Alternatively, (or in addition) to internal sensors, it is possible to use digital inputs configured as in the following:

- DIF.3101 – “Absence of voltage on BUSA”.
- DIF.3102 – “Absence of voltage on BUSB”.

Normally, it is possible to use a relay with an AC coil. Connect the coil between two phases of the bus: its normally closed contact can be used to connect the selected digital input to the ground.

If the digital input is used alternatively to internal sensor (internal sensor disabled), the management logic is:

- Input active: no voltages on the bus.
- Input not active: voltages on the bus.

If the digital input is used in addition to the internal sensor, the controller uses the digital input to signal presence of voltage even if the internal sensor does not detect voltages (OR logic). Even in this case, the voltage is present if the input is not active.

If you use digital inputs as “voltage sensors”, you may not be able to use synchronization to close the BTB (without voltages and frequencies the controller is not able to calculate commands to adjust frequency and voltages).

7.2.2 Internal sensor

The controller checks for both voltages and frequency to detect the status of a bus. Single checks can be disabled: if both are disabled, the bus is always considered “without voltage”.

7.2.2.1.1 Frequency check

BUS A	BUS A	Description	Default value	Frequency (Hz)
P.0301		Rated frequency	50 Hz	50.00
P.0108	P.0208	Low frequency threshold	90.0 %	45.00
P.0109	P.0209	High frequency threshold	110.0 %	55.00
P.0110	P.0210	Maximum hysteresis	2.5 %	1.25

To disable this check, one of the following conditions shall be true:

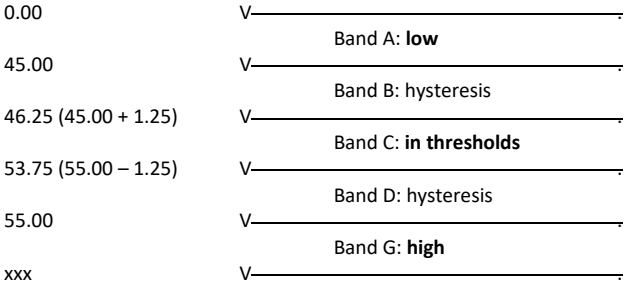
- P.0108 = 0%.
- P.0109 = 0%.
- P.0109 = 200%.

- P.0108 >= P.0109

The hysteresis applies to:

- Upwards towards minimum frequency threshold (i.e., with the default values of the parameters, between 45.00 Hz and 46.25 Hz).
- Downwards towards maximum frequency threshold (i.e., with the default values of the parameters, between 53.75 Hz and 55.00 Hz).

These values define the following bands:



If the frequency is within the bands “B” o “D”, previous status is maintained (hysteresis). For example, in case the voltage was within the “C” band and is now within the “D” band, it is anyway considered “In tolerance”. On the other hand, in case the frequency was within the “A” band, and now is within “B” band, it is considered “Low”. Frequency is considered “absent” only if it is 0 Hz.

7.2.2.1.2 Voltages check

BUS A	BUS B	Description	Default value	Voltage in Vac
P.0101	P.0201	Number of phases	3	-
P.0102	P.0202	Rated voltage	400 Vac	400
P.0106	P.0206	Voltage presence threshold	20.0 %	80
P.0111	P.0211	Low voltage threshold	80.0 %	320
P.0112	P.0212	HIgh voltage threshold	110.0 %	440
P.0110	P.0210	Maximum hysteresis	2.5 %	10

To disable this check, one of the following conditions shall be true:

- P.0111 = 0%.
- P.0112 = 0%.
- P.0112 = 200%.
- P.0111 >= P.0112

The hysteresis applies to:

- Downwards towards presence threshold (i.e., with the default values of the parameters, between 70 Vac and 80 Vac).
- Upward towards low voltage threshold (i.e., with the default values of the parameters, between 320 Vac and 330 Vac).

- Downwards towards high voltage threshold (i.e., with the default values of the parameters, between 430 Vac and 440 Vac).

These values define the following bands:

0 V
Band A: **absent**
70 (80-10) V
Band B: hysteresis
80 V
Band C: **low**
320 V
Band D: hysteresis
330 (320+10) V
Band E: **in thresholds**
430 (440-10) V
Band F: hysteresis
440 V
Band G: **high**
xxx V

If the voltage is in the “B”, “D” or “F” bands, previous status is maintained (hysteresis). For example, if the voltage was in the “E” band and now it is in “D” band, it is considered however “In tolerance”. On the contrary, if voltage was in the “C” band and now is in “D” band, it is considered “Low”.

These controls are managed at a single-phase level. In three-phase systems phase-to-phase voltages are used, phase voltage in single-phase systems.

Set parameter P.0121 (o P.0221) to “1”, the same checks are **also** made on the phase voltages (nominal voltage calculated by dividing the phase-to-phase nominal P.0102 (o P.0202) by 1.73 - squared root of 3).

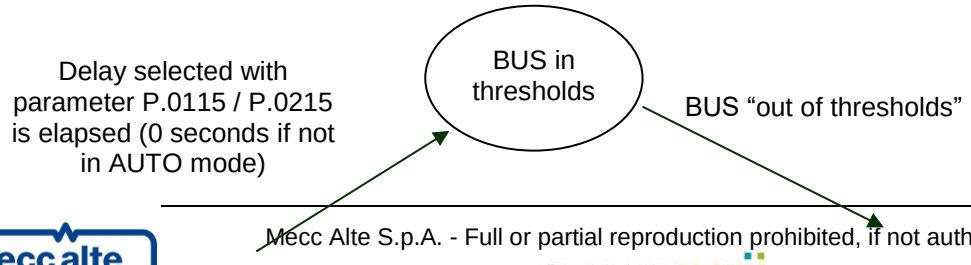
7.2.2.1.3 Internal sensor status

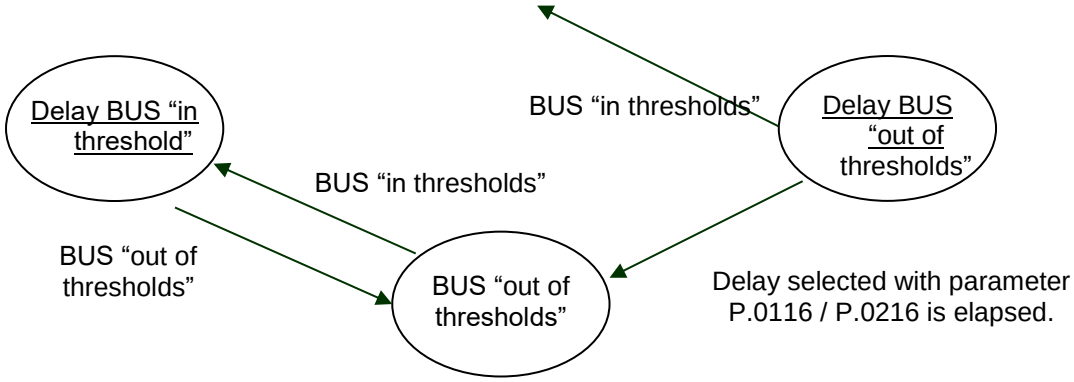
In order to diagnose the “global” status of the bus, the following algorithms are used, shown in their computing order:

- If all voltages and frequency are in a status of "Not present", also the global status is "Not present".
- If all voltages and frequency are in a status of "Within tolerance", also the global status is "Within tolerance".
- In case the status of at least one voltage or the frequency is “High”, also the global status is “High”.
- If all the previous conditions are not met, the global status is “Low”.

7.2.3 BUS global status

Whatever is the way used to detect the status, for the plant management logics the global status can be described with four steps:





7.2.4 Events and signallings

The controller stores all changes in BUSA and BUSB status in the EVENTS log, if enabled by means bit 1 and 2 of parameter P.0441:

- EVT.1010: No voltages on BUSA.
- EVT.1011: Voltages/frequency on BUSA, but "out of thresholds".
- EVT.1012: Voltages/frequency on BUSA, and "in thresholds".
- EVT.1020: No voltages on BUSB.
- EVT.1021: Voltages/frequency on BUSB, but "out of thresholds".
- EVT.1022: Voltages/frequency on BUSB, and "in thresholds".

The following functions are available for the configuration of the digital outputs, related to the status of BUSA and BUSB:

- DOF.3031 - "Voltages/frequency on BUSA". The controller activates this output when detects voltages or frequency on BUSA (even if "out of thresholds").
- DOF.3032 - "BUSA in thresholds". The controller activates this output when voltages and frequency on BUSA are "in thresholds" consecutively for the configured delay.
- DOF.3033 - "Voltages/frequency on BUSB". The controller activates this output when detects voltages or frequency on BUSB (even if "out of thresholds").
- DOF.3034 - "BUSB in thresholds". The controller activates this output when voltages and frequency on BUSB are "in thresholds" consecutively for the configured delay.

Moreover, the statuses of BUSA and BUSB are available for AND/OR logics by means the following internal statuses:

- ST.016 - "BUSA present (voltages/frequency)".
- ST.017 - "BUSA absent or out of thresholds".
- ST.018 - "Delay for BUSA in thresholds".
- ST.019 - "BUSA in thresholds".

- ST.020 - "Delay for BUSA absent or out of thresholds".
- ST.024 - "BUSB present (voltages/frequency)".
- ST.025 - "BUSB absent or out of thresholds".
- ST.026 - "Delay for BUSB in thresholds".
- ST.027 - "BUSB in thresholds".
- ST.028 - "Delay for BUSB absent or out of thresholds".

The following functions for the configuration of the analogue outputs are linked to the management of the BUS A and BUS B. The outputs are controlled according to the dimension of an analogue value. Use the "conversion curves" to adapt the single value to the output (0-100%):

- AOF.3101 ("frequency of the BUS A").
- AOF.3111 ("average voltage of the BUS A").
- AOF.3201 ("frequency of the BUS B").
- AOF.3211 ("average voltage of the BUS B").
- AOF.3121 ("active power").

7.3 Switches management

BTB200 can control BTB switch. Anyway, it accepts that this switch could be controlled by external logics (steadily or temporarily).

7.3.1 Digital outputs

It provides four different commands to manage the circuit breaker BTB:

- DOF.2031 - “Minimum voltage coil for BTB”. This function should be used to supply the minimum voltage coil of the circuit breaker (if present). The controller switches off this output to open the BTB. The controller switches on the output to enable the closure of the BTB: the real closure command will be activate at least after 0.5 seconds from the activation of this output. Note: if the circuit breaker is opened without the opening commands of the controller (trip of its protection), the controller waits the delay configured by parameter P.0308 before removing this command.
- DOF.2032 - “Coil for opening of BTB”. The controller activates this output to open the BTB: the output will be deactivated as soon as the BTB is opened (feedback) or when the opening time-out is elapsed.
- DOF.2033 - “Coil for closure of BTB”. The controller activates this output to close the BTB: the output will be deactivated as soon as the BTB is closed (feedback) or when the closure time-out is elapsed. The controller ensures that this output is activate at least after 0.5 seconds from the activation of DOF.2031.
- DOF.2034 - “Stable closing command for BTB”. The controller activates this output to close the BTB: the output is kept activated even when BTB is closed. The controller deactivates this output to open the BTB: the output is kept deactivated even when BTB is opened. The controller ensures that this output is activate at least 0.5 seconds after the activation of DOF.2031.

7.3.2 Digital inputs

The digital inputs of the board can be used for various purposes, within the scope of the management of the BTB switch.

7.3.2.1 Acquiring circuit breaker status

Just a function is available to get the feedback of the BTB switch:

- DIF.3001 - “Status of BTB circuit breaker”. Connect the feedback of the circuit breaker to this input. The controller uses this input for:
  - Activate alarms/warning for “circuit breaker not closed”, “circuit breaker not opened” and “no parallel”.
  - To internally connect/disconnect the two CAN-BUS lines.
  - For its own working sequence.
  - To know the status of the circuit breaker when it is configured as “externally managed”.

The delay configured for the input is used as opening/closure timeout.

The controller could work even without the feedback of the BTB. In this case, the controller assumes that the BTB is closed as soon as the closure command is activated; the same for the opening command. In real plants, it is always better to use the feedback.

7.3.2.2 Temporary override of the BTB commands

It is possible to use some digital inputs to communicate to the board that the BTB command is temporarily managed by an external device:

- DIF.1003 - “BTB controlled externally”.

Until the input is active, the board never tries either to open or close the switch: but, if the switch in motion (due to external controls), the board will adapt its own control to the new status of the switch, in order not to cause any unwanted opening/closure when the input is deactivated.

7.3.2.3 Manual controls for the switch

It is possible to connect some external keys to open/close the switch to the digital inputs of the board. The board will use these inputs (only in MAN) exactly in the same way as the OPEN BTB and CLOSE BTB keys present on the panel.

- DIF.1001 - “Manual request for BTB closure”.
- DIF.1002 - “Manual request for BTB closure (A)”.
- DIF.1003 - “Manual request for BTB closure (B)”.
- DIF.1004 - “Manual request for BTB opening”

7.3.3 Management logic

The BTB circuit breaker can be always closed, except when there are alarms or when the controller is in OFF/RESET.

The controller never closes the BTB circuit breaker without synchronization together with another mains/genset controller.

The controller automatically decides if BTB can be closed or not, based on BUSA and BUSB statuses (and also on the information collected from the CAN-BUS lines):

- BTB can be closed without synchronization. This is true when no voltages are detected on one or both buses; it also checks (information collected by CAN-BUS) that no genset are supplying on the bus “without voltage”, and also that no MC boards is connecting the mains to that bus.
- BTB can be closed with synchronization. This is true when voltages/frequency are present and “in thresholds” on both buses.
- BTB cannot be closed. This is true when:
  - Voltages/frequency are present on both buses, but at least one bus is “out of thresholds”.
  - No voltages are detected on one or both buses, but on the same bus it detects (information collected by CAN-BUS) one or more genset supplying, or one or more MC board connecting the mains to the bus. This condition happens only with wrong wirings.

Moreover, the controller can automatically select the better bus to which send the commands to adjust frequency and voltages, to synchronize the buses before closing BTB. The logic is:

- If both buses are connected to the mains (information collected by CAN-BUS), any choice is correct: BUSA is selected.
- If one bus is connected to the mains, and the other one is not connected (information collected by CAN-BUS), the second one is selected.
- If both buses are not connected to the mains (information collected by CAN-BUS):
  - If there are a different number of supplying gensets on the two buses, the bus with the lower number of supplying gensets is selected
  - If there are the same number of supplying gensets on the two buses, the bus with lower percent load is selected (the one with lower kW/nominal ratio).
  - If there are the same number of supplying gensets on the two buses with the same kW/nominal ratio, BUSA is selected.

However, it is possible to influence this logic both with manual and automatic closure commands (see in the following).

7.3.4 OFF/RESET management logic

The board always opens the BTB.

7.3.5 Management logic in MAN mode

The controller always opens the BTB if alarms are active.

The operator can request the opening/closure of the BTB in many ways.

- Using the keys of the controller.
  - Pressing “**OPEN BTB**” when BTB is closed, the operator requires the opening of the BTB.
  - Pressing “**CLOSE BTB”** when BTB is opened, the operator requires the closure of the BTB. If synchronization is needed, BTB200 decides to which BUS (A / B) to send the synchronization commands based on parameter P.0855:
    - “0-No selection” or “1-BUS A”: the frequency and voltage commands will be sent to the generators on BUS A (if possible).

- "2-BUS B": the frequency and voltage commands will be sent to the generators on BUS B (if possible).

- Pressing "**ESC/SHIFT + CLOSE BTB**" when BTB is opened, the operator requires the closure of the BTB. If synchronization is needed, BTB200 decides to which BUS (A / B) to send the synchronization commands based on parameter P.0855:

  - "0-No selection" or "2-BUS B": the frequency and voltage commands will be sent to the generators on BUS B (if possible).

  - "1-BUS B": the frequency and voltage commands will be sent to the generators on BUS A (if possible).

- Using the digital inputs of the controller. The following functions are provided:

  - DIF.1001 - "Manual request for BTB closure".

  - DIF.1002 - "Manual request for BTB closure (A)".

  - DIF.1003 - "Manual request for BTB closure (B)".

  The previous functions can be used to connect an external button to the controller, used to manually close the BTB. The difference between functions is the BUS selected for sending adjust commands if synchronization is required:

  - DIF.1001: the controller automatically selects the best BUS, based on the number of generators and their load.

  - DIF.1002: commands are sent to the BUSA (unless it is not parallel to a mains).

  - DIF.1003: commands are sent to the BUSB (unless it is not parallel to a mains).

  NB: if no digital input is configured with function DIF.1004 (see next paragraph), this input will work even as "opening command" (if activated while BTB is closed).

  - DIF.1004 - "Manual request for BTB opening". This function can be used to connect an external button to the controller, used to manually open the BTB. It works only if at least another input is configured with the function DIF.1001 or DIF.1002 or DIF.1003.

- Using commands from the serial ports. These commands must be enabled by a digital input configured as DIF.2706 - "Enable commands from the serial ports"; this input must be active. To send these commands through the serial ports, write the following data (in sequence, within 5 seconds):

  - HOLDING REGISTER 101: write the password set into parameter P.0004.

  - HOLDING REGISTER 102:

    - "31" to open the BTB.

    - "33" to close the BTB. BTB100 selects the best bus to send adjust commands for synchronization.

    - "34" to close the BTB. Adjust commands for synchronization will be sent to BUSA (if possible).

    - "35" to close the BTB. Adjust commands for synchronization will be sent to BUSB (if possible)

7.3.6 Management logic in AUTO mode

BTB200 always opens the BTB if alarms are active. Automatically, opens/closes the BTB, depending on the requests:

- Using the digital inputs of the controller. The following functions are provided:
  - DIF.1005 - “Automatic request for BTB closure”.
  - DIF.1006 - “Automatic request for BTB closure (A)”.
  - DIF.1007 - “Automatic request for BTB closure (B)”.

  Those functions are used only in AUTO mode. The logic is:
  - If all these inputs are not active, the controller opens the BTB.
  - If at least one input is active, the controller closes the BTB.

  The difference between functions is the BUS selected for sending adjust commands if synchronization is required:
  - DIF.1005: the controller automatically selects the best BUS, based on the number of generators and their load.
  - DIF.1006: commands are sent to the BUSA (unless it is not parallel to a mains).
  - DIF.1007: commands are sent to the BUSB (unless it is not parallel to a mains).

  NB: in AUTO mode, the controller does not manage those inputs if other digital inputs, configured with the following functions, are active:
  - **DIF.1008 - “BTB controlled externally" (see** Error! Reference source not found.**): the controller waits for external BTB closure/opening.**
  - **DIF.2706 (“Enable commands from the serial ports”): the controller waits for BTB closure/opening command through the serial port, and manage them. In any case, BTB is opened in case of alarms.**

- Using commands from the serial ports. These commands must be enabled by a digital input configured as DIF.2706 - “Enable commands from the serial ports”; this input must be active. To send these commands through the serial ports, write the following data (in sequence, within 5 seconds):
  - HOLDING REGISTER 101: write the password set into parameter P.0004.
  - HOLDING REGISTER 102:
    - “31” to open the BTB.
    - “33” to close the BTB. BTB100 selects the best bus to send adjust commands for synchronization.
    - “34” to close the BTB. Adjust commands for synchronization will be sent to BUSA (if possible).
    - “35” to close the BTB. Adjust commands for synchronization will be sent to BUSB (if possible)

7.3.7 Events and signallings

The controller stores all changes of BTB commands and status in the events log, if configured by means bit 4 and 5 of parameter P.0441:

- EVT.1030: BTB closure command.
- EVT.1031: BTB opening command.
- EVT.1032: BTB closed.
- EVT.1033: BTB opened.

Moreover, the status and the commands for BTB are available for the AND/OR logic through the following internal statuses:

- ST.064 - "BTB status".
- ST.068 - "BTB closure command (stable)".
- ST.070 - "BTB minimum voltage coil".
- ST.071 - "BTB opening pulse".
- ST.072 - "BTB closure pulse".

7.4 Synchronization

Synchronization is used when the circuit breaker must be closed and there are voltages on both sides of it. Synchronization can be divided into two separate functions:

- Check for differences in phase, frequency, voltages and phase sequence between the two buses, to allow a safe closure of the circuit breaker.
- Voltages and frequency regulations, to minimize differences in voltages, frequency and phase.

7.4.1 Synchro-check

Before closing a circuit breaker, this function checks the differences in voltages, frequency, phase and cycling sense between the two buses are within the thresholds configured; if yes, the circuit breaker can be closed in safety, otherwise it cannot be closed.

Obviously, synchronization will never start if one or both side of the circuit breaker are “dead” (without voltages).

The circuit breaker closure command (BTB) is issued only when the “synchronized” status is detected. The controller performs six different checks before allowing the circuit breaker closure: only when all checks are correct, the circuit breaker will be closed.

Voltages in tolerance check

Voltages (both BUS A and BUS B ones) must be inside configured thresholds. For example, if we have 200 V on both buses, but nominal voltages are 400 V, the circuit breaker will not be closed, even if voltage difference is zero. This check can be configured with:

- P.0111 / P.0211: low voltages threshold BUS A / BUS B (%).
- P.0112 / P.0212: high voltages threshold BUS A / BUS B (%).

These thresholds are displayed in percentage. These thresholds are percentage of P.0102 for BUS A voltages, and of P.0202 for BUS B voltages).

Each voltage measure is compared with these thresholds: if at least one of them is out of thresholds, the circuit breaker cannot be closed (this situation is shown on display page M.09 by an empty rectangle).

Voltage differences check

If all voltages are inside the configured thresholds, the controller calculates the differences between the two voltages and allows the closure of the circuit breaker only if the differences are below the threshold P.0841. This parameter allows to set the maximum voltage difference (%).

The controller analyses the differences between the voltages measured (BUS A phase L1 - BUS B phase L1, etc.) and it displays them in percentage with respect to the bus voltage. The circuit breaker can be closed only if all differences (%) are below the threshold configured by parameter P.0841 (with a fixed hysteresis of 1%). If at least one difference is higher than the threshold, the closing is not allowed. Obviously, in a single-phase system, the controller will consider the existing one only.

The controller can work also with different nominal voltages between the two buses (this happens when a transformer is placed between them). In this situation, both voltages (BUS A and BUS B) are converted into percentages of their own nominal, and the controller makes the comparison between those percentages: if the BUS A voltages are 95% of their nominal, also the BUS B voltages should be 95% of their nominal.

The result of this check (and of the one described above) is displayed in page M.09 by the rectangle that indicates the voltage difference:

- Empty rectangle: voltages or voltage differences are out of thresholds.
- Full rectangle: voltages and voltage differences are inside thresholds.

Frequency in tolerance check

Frequencies (both BUS A and BUS B ones) must be inside configured thresholds. For example, if we have 40 Hz on both buses, but nominal frequencies are 50 Hz, the circuit breaker will not be closed, even if frequency difference is zero. This check can be configured with:

- P.0108 / P.0208: BUS A / BUS B low frequency threshold (%).
- P.0109 / P.0209: BUS A / BUS B high frequency threshold (%).

These thresholds are percentage of P.03101.

BUS A and BUS B frequency are compared with these thresholds: if at least one of them is out of thresholds, the circuit breaker cannot be closed (this situation is shown on display page M.09 by an empty rectangle).

Frequency difference check

If all frequencies are in tolerance, the controller calculates the frequency differences between the two buses and it allows the closing only if lower than the threshold configured with the parameter P.0843. This parameter allows to set a max difference in Hz.

The controller analyses the differences between the frequencies measured, and it compares them with the threshold P.0843 (with a fixed 0,1Hz hysteresis): if the difference is higher than the threshold, the closing is not allowed.

The frequency status (the results of this check and of the previous one) is shown on the display page M.09, by the second small rectangle from the left (the one identified by the “Hz” label):

- Empty rectangle: frequencies or frequency differences are out of thresholds.
- Full rectangle: frequencies and frequency differences are inside thresholds.

Phase difference check

The controller must evaluate the phase difference between the two buses, and allow closing the circuit breaker only when this difference is below the threshold configured by parameter P.0842 (with a fixed hysteresis of 1 degree). P.0842 allows setting the maximum phase difference in degrees

The result of this check is shown on the display page M.09, by the third small rectangle from the left (the one identified by the “°” label):

- Empty rectangle: phase difference is out of thresholds.
- Full rectangle: phase difference is inside thresholds.

Sometimes, the plants do use transformers. These transformers can introduce a phase error in voltages. So, it is possible that synchronizing on their primary side, we have a phase error on the secondary side. If the controller regulates for 0° on secondary side, voltages on the circuit breaker may be not synchronized. Parameter P.0845 allows setting a fixed phase offset. If different from zero, the controller regulates for x° on the secondary side, to have 0° on primary side. The parameter P.0845 allows to set (with a sign) the compensation of the transformers phase error (+/-180°).

Phases sequence check.

Only for three-phase plants, the controller checks for the same phases sequence on BUS A and BUS B. The circuit breaker can be closed only if the same phases sequence is detected. No parameters are provided for this check.

The result of this check is shown on the display page M.09, by the forth small rectangle from the left (the one identified by two arrows):

- Empty rectangle: different phase sequences.
- Full rectangle: same phase sequences.

Circuit breaker closing enabled.

The controller detects a "synchronized" status only when all previous checks (or all the ones applicable) give correct results, consecutively for the time configured by parameter P.0844. When the controller removes its consent, it does not reactive it for at least one second.

The "closure enable" condition is shown on the display page M.09, by the fifth small rectangle from the left (the one identified by two arrows):

- Empty rectangle: closure not allowed.
- Full rectangle: closure allowed.

7.4.1.1 Signals

It's possible to configure an output to signal the synchronism condition externally. This output will be activated during synchronization only, when the controller activates the internal "closure enable" status. The output is configured with the function DOF.3094 ("Synchronized").

7.4.2 Voltages, frequency and phase regulations

To synchronize the two buses, it is needed to work on:

- On generator voltages, to make them equal to the buses.
- On generators frequency, to minimize differences on phase and frequency from the buses.

The controller can manage both voltage and frequency regulations on generators, by the CAN bus link. Thus, it can minimize differences in voltages, frequency and phase, to allow a safe closure of the circuit breaker.

Note: the gensets controllers always accept these commands, even if they are "not managed by MCxxx".

Note: these commands are transmitted on CAN bus only during the synchronization.

However, it is also possible to use the analogue outputs of the controller, using the functions:

- AOF.1001 – "Speed regulator". The output normally contains the value configured in P.0840. During synchronization, it contains the adjust command.
- AOF.1002 – "Speed regulator (A)". The output normally contains the value configured in P.0840. During synchronization, it contains the adjust command **only if commands are sent to BUSA**.

- AOF.1003 – “Speed regulator (B)”. The output normally contains the value configured in P.0840. During synchronization, it contains the adjust command **only if commands are sent to BUSB**.
- AOF.1011 – “Voltage regulator”. The output normally contains the value configured in P.0867. During synchronization, it contains the adjust command.
- AOF.1012 – “Voltage regulator (A)”. The output normally contains the value configured in P.0867. During synchronization, it contains the adjust command **only if commands are sent to BUSA**.
- AOF.1013 – “Voltage regulator (B)”. The output normally contains the value configured in P.0867. During synchronization, it contains the adjust command **only if commands are sent to BUSB**.

7.4.2.1 Using internal synchronizer

Phase/Frequency regulation

The controller regulates the gensets frequency to equalize the two frequencies and reset the phase difference between the two buses.

A PI regulator is used to manage the frequency and reset the phase error. It works on phase difference, and can be configured with the following parameters:

- P.0849 - “Gain for phase control loop”.
- P.0850 - “Integrative factor for phase control loop”.

These parameters must be adapted to get the best response from the system. They have the same functions of trimmers on analogue synchronizers.

Note: when you are setting these parameters, be sure the circuit breaker cannot be closed. Do that by opening fuses (if available) or by setting parameter P.0842 to zero.

Voltage regulation

The same concepts explained in the previous paragraph are valid also for voltage regulation. Parameters provided for the voltage PI regulator are:

- P.0868 - “Voltage matching gain”.
- P.0869 - “Voltage matching integrative factor”.

If both parameters are “0”, no voltage regulation is available during synchronization.

7.4.2.1.1 PI regulator

The controller uses two PI regulators internally to regulate the voltage and the speed of the gensets for the synchronization operations. All internal PI regulators can be configured with two parameters:

- The factor proportional to the current error (P) is also called “gain”.
- The factor related to the integral in the error delay (I) is also called “integrative factor”.

In the previous paragraph, there are the parameters associated to each PI regulator.

These two parameters for each PI regulator should be “adjusted” during the installation procedure. In fact, they depend on different factors: the type of engines, the alternator powers, the type of alternators; different parameters could be necessary for similar systems.

The definition of these parameters is not particularly critical if carried out with method. Unfortunately, the empirical adjustment (called Ziegler-Nichols) requires to measure the oscillation period of the measurement (frequency, voltage), which is not always possible (or simple) to do.

For this reason, besides the empirical method, we suggest a simplified method that should help carrying out in a valid way the parameters choice.

The PI regulator parameters can be modified even if the plant is working, by the user panel. It is suggested to carry out the modifications by using the BoardPrg4 program, which is available for free on our Mecc Alte website.

7.4.2.1.1.1 Complete method

1) Set “P” at an initial value (0,100) and “I” at 0,000.
2) Increase “P” until the adjusted measurement start to oscillate (for example, if you are adjusting the PI that manages the speed during the synchronization, increase “P” until it seems to hear that the engines accelerate / slow down). Decrease/increase the value “P” until an oscillation point is determined (a good estimate is sufficient).
3) Measure the oscillation period (the time between two consecutive peaks of speed).
4) Set “P” at a slight lower value than the one resulted by the division of the current value by 2.2.
5) Set “I” at the value calculated by dividing 1.2 for the period of oscillation measured before (in seconds). A lower value can be set at a lower value, decreasing its performance but increasing the stability range.
6) Further adjustments could be necessary. Check how the system reacts in case of low, medium or high load. In case there still is a system instability, reduce the “P” value again.

7.4.2.1.1.2 Simplified method

To avoid the problem of measuring the oscillation period, you can proceed by referring to what has been described before, up to the point 6 included, except for the point 3 and 5. At point 5, increase/decrease “I” (after having adjusted “P” at point 4) until getting the best performances.

7.4.2.1.1.3 General notes

The parameter “P” is not able to guarantee a good adjustment alone. To reduce the error, “P” should be increased, but over a set threshold, the systems becomes unstable. The value “P” defined with the described method usually is the best relation between stability and performance.

For a good adjustment, it is necessary to set the factor “I”. Even little values of the parameter “I” change the system performance. The value, obtained by the procedure described, usually supplies the best performances. Anyhow, it is not critical and it can be set in a greater range of values.

Consider that the factor “I” accumulates the adjustment errors: delay in the recovery of the error can cause over-shoots or under-shoots. Very high values of “I” bring to the oscillation of the system.

Once you found the value that supplies a good performance, try to decrease it until the performance decreases under the waited minimum. Then select an intermediate value in this range.

In some case, it would be necessary to start a procedure with a minimum value of “I” to guarantee a level of adjustment suitable with the operation of the system. A very low value of “I” (0.01) can be used with light effects on the procedure.

7.4.3 Digital outputs for synchronization

The controller allows configuring digital outputs with the following special functions related to synchronization:

- DOF.3091 – "Synchronization (BUSA)". The controller activates this output when a synchronization is in progress, and adjust commands are sent to BUSA. When synchronization ends, the output become “not active”.
- DOF.3092 – "Synchronization (BUSB)". The controller activates this output when a synchronization is in progress, and adjust commands are sent to BUSB. When synchronization ends, the output become “not active”.
- DOF.3093 – "Synchronization". The controller activates this output when a synchronization is in progress. When synchronization ends, the output become “not active”.
- DOF.3094 (“Synchronized”). The controller activates this output only during synchronization process, when detects the “synchronized” status between the buses. Outside synchronization process, or when the buses are not synchronized, this output is “not active”.
- DOF.3094 – “Synchronized”. The controller activates this output when a synchronization is in progress, if the “synchronized” condition is met.
- DOF.0103 (AND/OR logics) with the status:
  - ST.096: "Synchronization in progress".
  - ST.097: "Synchronization in progress (BUSA)”.
  - ST.098: "Synchronization in progress (BUSB)”.
  - ST.099: “Synchronized”.

7.4.4 Automatic synchronization

This description refers to the operation in AUTO. It also refers to the operation in MAN if the parameter P.0848 (“automatic synchronization in manual mode”) is set to “1”.

The controller allows configuring the maximum duration of synchronizations for the two circuit breakers:

- P.0852: Maximum time for BUS A synchronization.
- P.0853: Maximum time for BUS B synchronization.

The duration of the synchronization phase on a circuit breaker is managed only in automatic mode (not MAN) and if the related delay is different from zero; in this case an anomaly is activated:

- W271 – “BUS A synchronization failure”. It is always a warning.
- W272 – “BUS B synchronization failure”. It is always a warning.

7.4.5 Manual synchronisation

This description refers to the operation in MAN if the parameter P.0848 (“automatic synchronization in manual mode”) is set to “0”.

The user must manually regulate the gensets voltage and frequency until the “synchronized” status is detected (this check is always carried out by the controller).

The controller provides two parameters that allow voltages and frequency regulations on the generators:

- P.0867 - “Voltage offset”.
- P.0840 - “Speed offset”.

Both are expressed as percentage (between 0 and 100%). The first allows changing generators voltages of +/-20 Volt; the second allows changing generators frequency of +/- 4 Hz (the real voltages and frequency ranges depend on single genset controller settings). Setting both to 50%, generators work to their nominal voltages and frequency.

These parameters can be directly changed on display page M.09 (provided for synchronization). It is possible to simplify the procedure using two potentiometers instead of the parameters. The following is needed:

Voltage

- Configure an analogue input with the function AIF.2201 (“Voltage offset”) (parameter P.4001 for analogue input 1).
- Associate the input to a conversion curve, which converts the voltage of the analogue input into a voltage correction (%).

After these configurations, you can change the voltage offset between 0 and 100% by moving the potentiometer between 0 and 10 Vdc (the current voltage offset is shown on page M.12), and consequently you can change the gensets voltage. Note: once you have configured an analogue input with the function AIF.2201, the parameter P.0867 is no more used.

Frequency.

- Configure an analogue input with the function AIF.2101 (“Speed offset”) (parameter P.4001 for analogue input 1).
- Associate the input to a conversion curve, which converts the voltage of the analogue input into a speed correction (%).

After these configurations, you can change the speed offset between 0 and 100% by moving the potentiometer between 0 and 10 Vdc (the current speed offset is shown on page M.09), and consequently you can change the gensets frequency. Note: once you have configured an analogue input with the function AIF.2101, the parameter P.0840 is no more used.

Manual synchronization procedure is:

- Select the page M.09 on the display (this can be carried out also by giving a manual closing command of the circuit breaker – CLOSE BTB pushbutton or digital inputs configured for BTB).
- Use parameters P.0868 and P.0840 (or the related potentiometer, if configured) to synchronize the two buses. When the controller signals a synchronism status, send a new closing command (pushbutton or related digital input): the circuit breaker will be closed.

8 Anomalies

This chapter describes all the anomalies managed by the controller. Before describing them in detail, some definitions are required.

We define two typologies of anomaly:

- **Warnings**: they point out to situations that are not dangerous at the moment, but the operator must take some action because, if ignored, they could degenerate in one of the following categories.
- **Alarms**: these anomalies are dangerous and, for this reason, the controller opens immediately the BTB circuit breaker.

An alarm can be activated if no other alarms are already active (there are some exceptions, which will be listed below).

A warning can be activated if no other alarms are already active. Some other warnings can be active.

When an anomaly activates, the controller performs the following:

- It activates the internal horn and, if configured, also the external one. To this purpose, it is possible to configure an output of the controller with function DOF.3152 (”External horn”). The output is controlled together with the internal acoustic signalling; the aim is to use a more powerful signalling or a lamp.
- Prompts the page S.02 ANOMALIES on the multifunction display. This page shows the fault numeric code and the current language text related to the anomaly. The numeric code flashes to indicate that the anomaly hasn't been recognized by the operator yet.
- It will activate the flashing of the “WARNING” light, if the anomaly belongs to the early warning category, or the “ALARM” light. The light flashing indicates the presence of an anomaly, of the relevant category, not yet recognized.
- If the anomaly is an alarm it will open immediately the BTB circuit breaker.

The following operations can be carried out on an anomaly:

- **Silence** the horn.
- **Acknowledge** it: this informs the controller that the operator has acknowledged the event.
- **Reset:** this informs the controller that the anomaly is no longer active.

The multifunction display shows the anomaly until the operator “acknowledges” it, even if the relevant cause is no longer present (sequence ISA2C). The controller automatically resets all the acknowledged warnings when their cause is no longer active.

8.1 Silence the horn

The horn can be suppressed in three ways:

- Pressing the START pushbutton. This operation does not detect the anomaly, which continues to flash on the display.
- With a digital input configured with DIF.2002 function (”Alarm acknowledgement control”). The acoustic signalling is suppressed when the input passes from “not active” to “active”.

- Using a command from the serial port. The commands can be protected by a password (P.0004) which must be entered 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: enter the value “51”.

The management of the hooter is anyway linked to the value of P.0491 parameter (“duration of hooter control”).

- If set to zero, the horn will be never activated.
- If the hooter is set on 999, it will be activated when a new anomaly arises and deactivated through the above-described procedure.
- If the hooter is set on 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 span has elapsed.

Suppressing the hooter does not mean to acknowledge the anomaly: it remains, in effect, flashing on page S.02 ANOMALIES.

8.2 Acknowledge the anomaly

The anomaly (sequence ISA2C) can be identified in three ways:

- By pressing the ACK key on the board panel. If you push this key when the hooter is on, it stops the hooter: it should be pressed a second time to “recognize” the anomaly.
- With a digital input configured with DIF.2002 function (“Alarm acknowledgement control”). The are acknowledged when the input passes from “not active” to “active”.
- Using a command from the serial port. The commands can be protected by a password (P.0004) which must be entered 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: enter the value “52”. NB: this control also cancels the hooter, in case it is active.

When the anomaly has been acknowledged, it stops flashing on page S.02 ANOMALIES. After being identified, if it is a warning, it is automatically cancelled if the cause is no more present.

Otherwise, if the cause disappears before the anomaly has been acknowledged, it remains on the display.

8.3 Cancel the anomaly

An anomaly can be cancelled 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 cancel any alarms, it is necessary to follow one of the below procedures:

- By moving the key switch on OFF/RESET position.

- Using a digital input configured with the feature DIF.2001 - “Alarm reset command”. When the input becomes “active”, the controller carries out a reset of all faults.
- Using a command from the serial port. The commands can be protected by a password (P.0004) which must be entered 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: enter the value “53”.
- By using an “SMS” control (see document [3]).

8.4 Events and signalling

Every anomaly is registered (with own code) in the event log.

Some functions are available for the configuration of the digital outputs related to the anomalies:

- DOF.3151 (“reset of anomalies”). The board activates this output for one second when the internal sequence for the cancellation of 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 hooter. It can be used to control a more powerful hooter and/or a lamp.
- DOF.3154 (“faults acknowledgement”). The controller activates this output for one second when the internal sequence of faults acknowledgement is carried out. This procedure can be used to acknowledge also some possible faults managed by other devices externally.
- DOF.4001: the output will be activated if at least an early warning is active.
- DOF.4004: the output will be activated if at least an alarm is active.

The board makes controls and statuses of the switches available, for AND/OR logics, through the following internal statuses:

- ST.006: the output will be activated for a second after a command of faults acknowledgement.
- ST.007: The output will be activated for a second after a command of faults reset.
- ST.008: Warnings cumulative
- ST.011: Alarms cumulative
- ST.012: Non-identified early warnings cumulative
- ST.015: Non-identified alarms cumulative

8.5 Anomalies connected to digital inputs

The board manages a significant number of digital input. Every input can be used to activate anomalies. These anomalies are divided into two kinds:

- **Specific.** They are configured with functions DIF.4211 and following. The board knows the modes through which these anomalies should be managed, and already has some default error messages (that cannot be configured) connected to each anomaly.

- **Generic**. They are configured through DIF.4001 through DIF.4064functions. As to these anomalies, the operator should configure the message that will be shown on the display. Moreover, by using the appropriate functions, the board will be instructed regarding the way it will have to manage the anomaly.

Specific anomalies will be described in the following paragraphs: in the description the parameters relevant to the digital input #1 of DST4602 (P.2001, P.2002 e P.2003) will be always referred to. The document [1]has a table that shows the parameters to be used for every digital input.

What stated above is true also for generic anomalies. They will not be described in the following paragraphs, because they will be infinite repetitions of the same description for each input. On the contrary, they are described here, by indicating parameters for input #1 of the controller.

The board assigns numeric codes 701 through 742 to generic anomalies linked to digital inputs (the document [1]has a table that shows the code for each input). By utilizing the parameter that configures the function (P.2001), it is possible to select the type of anomaly (early warning or alarm) and also to define the conditions for the anomaly management. Warning: by setting the delay to “0”, the anomaly is disabled. In the list below, the functions for the configuration of digital inputs, used to manage generic anomalies, are indicated. They are grouped four by four: the four functions for each group define the type of anomaly (see document [1] for the list of functions).

- DIF.4001 e DIF.4004 . The board will activate this anomaly if the digital input is uninterruptedly active for the configured (P.2002) time span.
- DIF.4011 e DIF.4014 . The anomaly can be activated only if BTB switch is opened. The board will activate this anomaly if the digital input is uninterruptedly active for the configured (P.2002) time span.
- DIF.4021 e DIF.4024 . The anomaly can be activated only if BTB switch is closed. The board will activate this anomaly if the digital input is uninterruptedly active for the configured (P.2002) time span.

8.6 Anomalies connected to analogue inputs

For each analogue input, allows setting two thresholds on the acquired measure, and each threshold can activate an anomaly. These are generic anomalies, since the controller doesn't know how to manage them and hasn't default warning messages. They will not be described in the following paragraphs, because they will be infinite repetitions of the same description for each analogue input. On the contrary, they are described here, by indicating parameters for input 1.

The controller assigns numeric codes 301 through 554 to generic anomalies linked to analogue inputs (the document [1]has a table that shows the code of each input).

First of all the operator should configure the error message that will be shown on the board display when the anomaly is activated. It has to use P.4002 parameter, the only one for the two thresholds. The controller will add an initial wording to the configured message:

- “High value:” if the anomaly is activated when the measure is higher than the threshold.
- “Low value:” if the anomaly is activated when the measure is lower than the threshold.

For each analogue input, there are six parameters available for the management of thresholds, three for each threshold (P.4003, P.4004 and P.4005 for the first threshold of the first analogue input; P.4006, P.4007 and P.4008 for the second threshold of the first analogue input).

Besides the threshold value (P.4003 or P.4006) and the delay to be managed (P.4004 or P.4007), the operator has to configure the operations connected to the threshold (P.4005 o P.4008). The parameter

that configures the actions is managed through bits (every bit enables/disables a function connected to the threshold). For the description of these parameter, see 0.

⚠ **Warning: by setting the delay to "0", the anomaly isn't disabled.**

8.7 Faults list

NOTE: as it is not possible to define either which digital or analogue inputs (of the controller or on additional modules) will be used or which function they are going to perform, refer to the following list as an example of the first configurable input.

The presence of symbol **(*)** or the indication "or equivalent for the other inputs" aside a parameter indicates that it varies according to the particular configured input.

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

- Enabling an anomaly means that the minimum necessary conditions verify in order for the controller to observe the provoking cause.
- Activating an anomaly means the verification of the provoking cause, after the enabling has happened.

8.7.1 06 – Maximum current (51)

Type:	**Configurable**
Parameters connected:	**P.9502** Nominal current **P.0102** Number of phases of BUS A **P.0102** Nominal voltage of BUS A **P.0201** Number of phases of BUS B **P.0202** Nominal voltage of BUS B **P.0311** C.T. connection **P.0321** Maximum current threshold (time dependent) **P.0322** Maximum current delay (time dependent) **P.0325** Action on maximum current (51) **P.0326** Protections enabling 50V-51V
To disable:	**P.0322=0**
Enabled in:	**MAN, AUTO**

Current protection is time dependent (reaction time is faster when the overload increases). The used curve is named **EXTREMELY INVERSE**, and implements an **I2t** function.

A maximum current threshold and the maximum time the circuit breaker can work with this current are defined. If the current is lower than the defined threshold, the protection does not activate. If the current rises above the threshold, the protection activates with a time inversely proportional to the overcurrent. In order to correctly set the thresholds, perform the following steps:

- Set the maximum current threshold with the parameter P.0321, as a percentage of the rated current.
- Set the action time in the parameter P.0322: the protection will be activated within time set if the current is constantly equal to the threshold P.0321 multiplied by $\sqrt{2}$.

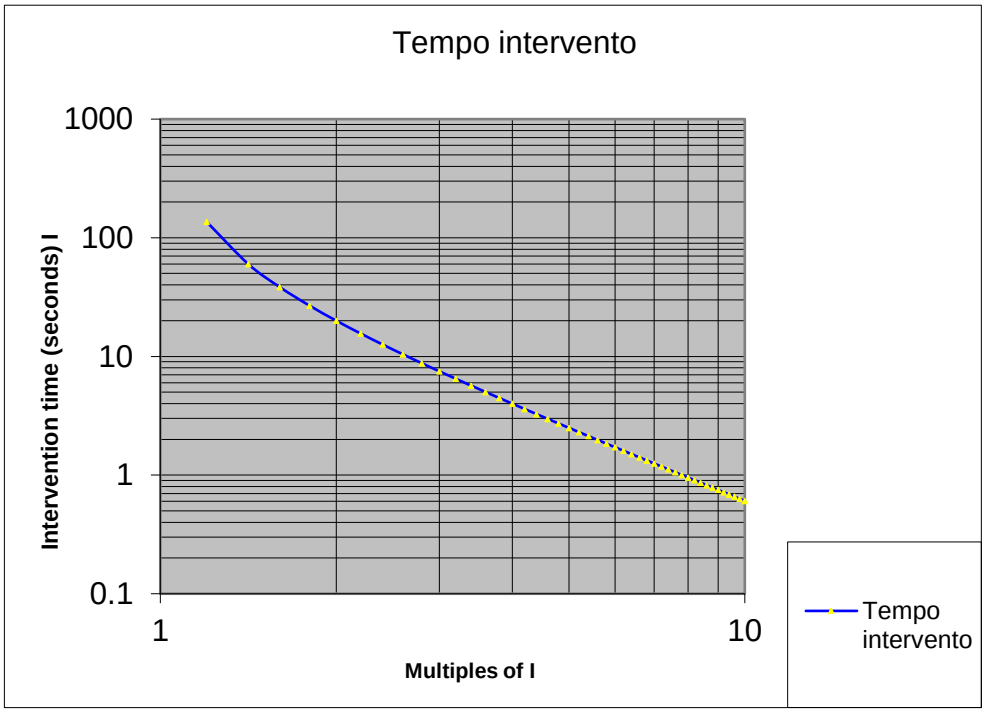
In order to calculate the intervention time for a preferred current, please use the following formula:

$$t_1 = \frac{P.0322}{\left(\frac{I}{P.0321}\right)^2 - 1}$$

Where I is the current in the circuit.

Please remember that the protection is performed by performing the integral of the current value during time; therefore, current values above the rated threshold all concur to define the intervention time, with their instant weight resulting from the above formula. Thus, only way to experimentally verify this formula is to switch instantaneously from a normal load situation to an overload situation.

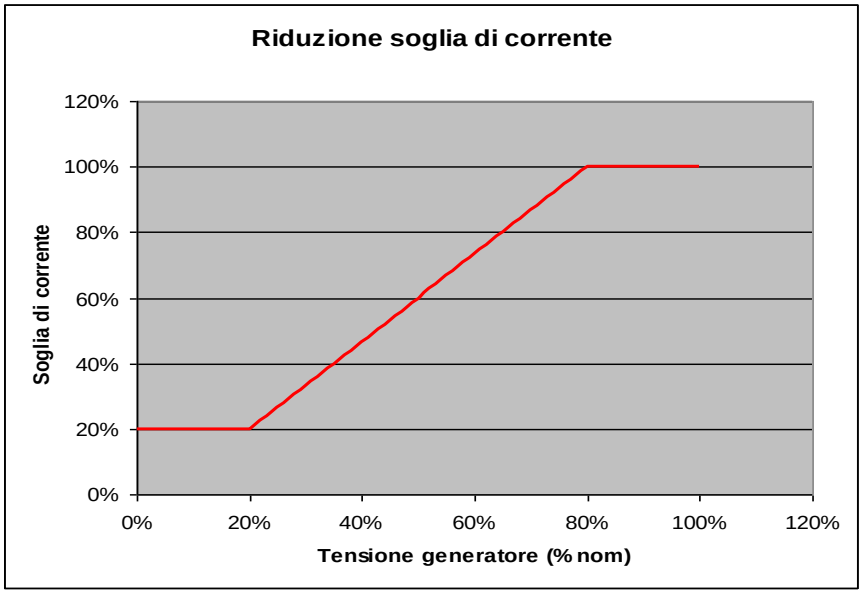
The following graph shows the curve used for enabling protection, with a value of P.0322 set to 60 seconds (I is the maximum current):



The type of anomaly can be configured through P.0323 parameter.

By utilizing P.0326 parameter, it is possible to convert this protection into 51V protection (values 2 or 3 in P.0326). The 51V protection differs from 51 “normal” protection for the fact that the threshold set with P.0321 is automatically reduced when the voltage decreases. In detail:

- If the bus voltage is higher than 80% the rated, the current threshold remains the one set.
- If the bus voltage is less or equal to 20% of the rated, the current threshold becomes 20% of the one set.
- If the bus voltage is between 20% and 80% of the rated, the current threshold is reduced in percentage.



8.7.2 14 – BTB circuit breaker not closed

Type: **Warning/Alarm**

Parameters connected: **P.2001** Feature of the input 1 or equivalent for the other inputs.
P.2002 Feature of the input 1 or equivalent for the other inputs.

To disable: **P.2002=0**

Enabled in: **MAN, AUTO**

The protection will be enabled if the board receives the feedback from BTB switch (DIF.3001 function in P.2001 parameter or equivalent) and if the delay associated to the input is different from 0 (P.2002 or equivalent).

The board activates the protection when it controls the closing of BTB switch, but it doesn't close within the time associated to the input (in AUTO, the board performs three closing attempts of the switch before activating the anomaly). In MAN, the board activates an early warning, in the other modes it activates an alarm.

Note: this anomaly can be activated also with an already active alarm.

8.7.3 15 – Maximum current (from contact)

Type: **Alarm**

Parameters connected: **P.2001** Feature of the input 1 or equivalent for the other inputs.
P.2002 Feature of the input 1 or equivalent for the other inputs.

To disable: **P.2002=0**

Enabled in: **MAN, AUTO**

The protection is always enabled. It will be activated if the input that receives the external contact (4241 function in P.2001 parameter or equivalent) remains active uninterruptedly for the configured time span (P.2002 or equivalent).

8.7.4 16 – Maximum current (50)

Type: **Alarm**

Parameters connected: **P.9502** Nominal current
P.0102 Number of phases of BUS A

P.0102 Nominal voltage of BUS A
P.0201 Number of phases of BUS B
P.0202 Nominal voltage of BUS B
P.0311 C.T. connection
P.0322 Instantaneous maximum current threshold
P.0312 Instantaneous maximum current delay
P.0323 Action on maximum current (50)
P.0324 Protections enabling 50V-51V

To disable: **P.0312=0**

Enabled in: **MAN, AUTO**

This protection intervenes as quickly as possible and it doesn't depend on timings of the curve represented for maximum current protection. The protection is configured by setting P.0323 threshold, indicated as percentage of the system nominal current P.9502.

It activates when the current on at least one phase exceeds threshold P.0323 continuously, for time P.0324.

The type of anomaly can be configured through P.0325 parameter.

By utilizing P.0326 parameter, it is possible to convert this protection into 50V protection (values 1 or 3 in P.0326). The 50V protection differs from 50 “normal” protection for the fact that the threshold set with P.0323 is automatically reduced when the voltage decreases.
In detail:

- If the bus voltage is higher than 80% the rated, the current threshold remains the one set.
- If the bus voltage is less or equal to 20% of the rated, the current threshold becomes 20% of the one set.
- If the bus voltage is between 20% and 80% of the rated, the current threshold is reduced in percentage.

Please see the graphic in the anomaly description “06 – Maximum current (51)”.

8.7.5 24 – BTB circuit breaker (GCB) not open

Type: **Warning**

Parameters connected: **P.2001** Feature of the input 1 or equivalent for the other inputs.
P.2002 Feature of the input 1 or equivalent for the other inputs.

To disable: **P.2002=0**

Enabled in: **MAN, AUTO**

The protection will be enabled if the board receives the feedback from BTB switch (DIF.3001 function in P.2001 parameter or equivalent) and if the delay associated to the input is different from 0 (P.2002 or equivalent).

The board activates the protection when it controls the opening of BTB switch, but it doesn't open within the time associated to the input (in AUTO, the board performs three attempts to open the switch before activating the anomaly). In MAN, the board activates an early warning, in the other modes it activates an alarm.

Note: this anomaly can be activated also with an already active alarm.

8.7.6 37 – Low battery voltage

Type: **Warning**

Parameters connected: **P.0362** Battery low voltage threshold (%)
P.0363 Delay for battery low voltage

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

Enabled in: **MAN, AUTO**

It activates if the battery voltage is continuously lower than the threshold P.0362 for time P.0363. The threshold is expressed as a percentage of the rated battery voltage which is not settable but is automatically selected by the controller between 12 e 24 Vdc. Selection is made when the controller is powered and every time the key is switched to OFF/RESET. If the controller previously sensed a value lower than, or equal to, 17V, it considers to be powered by a 12 V battery, otherwise it will consider a 24V rated voltage.

8.7.7 38 – High battery voltage

Type: **Warning**

Parameters connected: **P.0364** Battery high voltage threshold (%)
P.0365 Delay for battery high voltage

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

Enabled in: **MAN, AUTO**

It activates if the battery voltage is continuously above threshold P.0364 for time P.0365. The threshold is expressed as a percentage of the rated battery voltage which is not settable but is automatically selected by the controller between 12 e 24 Vdc. Selection is made when the controller is powered and every time the key is switched to OFF/RESET. If the controller previously sensed a value lower than, or equal to, 17V, it considers to be powered by a 12 V battery, otherwise it will consider a 24V rated voltage.

8.7.8 45 – Maximum auxiliary current

Type: **Alarm**

Parameters connected: **P.0319** Transformer type.
P.0315 Connection of transformer or toroid.
P.0316 Primary of transformer or of toroid.
P.0317 Secondary of transformer or of toroid.
P.0318 Auxiliary current use
P.0367 Threshold for auxiliary/neutral current
P.0368 Delay for auxiliary/neutral current

To disable: **P.0368=0**

Enabled in: **MAN, AUTO**

The protection will be enabled if a valid current measure is configured. In particular, both P.0316 and P.0317 should be different from zero, and P.0318 should be set to one or to two. Moreover, the protection can be disabled through a digital input configured through DIF.2704 function (“disable protections on the fourth current”): if the digital input exists and is activated, the protection will be disabled.

The protection will be activated if, according to the previous conditions, the measure of current stays above P.0367 threshold uninterruptedly for P.0368 time span.

8.7.9 48 – Emergency stop

Type: **Alarm**

Parameters connected: **P.0361 Emergency stop delay**

To disable: **-**

Enabled in: **MAN, AUTO**

The protection is always enabled.

It will be activated if, according to the previous conditions, the input dedicated to the emergency stop (JJ 2) remains idle, continuously for the configured time span (P.2002 or equivalent).

Note: this anomaly can be activated also with an already active alarm.

8.7.10 51 – High controller temperature

Type: **Warning**

Parameters connected: **P.0366** Controller high temperature threshold

To disable: **P.0366** = 255 (maximum value)

Enabled in: **MAN, AUTO**

The protection is always enabled.

It activates if the internal controller temperature is over the threshold P.0366, even for an instant.

8.7.11 57 – Clock not valid

Type: **Warning**

Parameters connected: **P.1901** Month of the calendar (1 …16)

To disable: -

Enabled in: **MAN, AUTO**

The protection is always enabled.

It is activated if the controller recognizes the clock status as not valid and the functions related to the clock, such as calendars (at least one month is set).

To deactivate it, you need to set the clock.

8.7.12 62 – Faulty CAN-BUS A (PMCBUS A) link

Type: **Warning**

Parameters connected: -

To disable: -

Enabled in: **MAN, AUTO**

It activates if the internal CAN controller switches to BUS-OFF status due to bus communication errors.

8.7.13 200 – Faulty CANBUS N (PMCBUS B) connection

Type: **Warning**

Parameters connected: -

To disable: -

Enabled in: **MAN, AUTO**

It activates if the internal CAN controller switches to BUS-OFF status due to bus communication errors.

8.7.14 201 – CAN-BUS B (PMCBUS B) addresses conflict

Type: **Warning**

Parameters connected: **P.0801** PMCB bus address

To disable: -
Enabled in: **MAN, AUTO**

It will be activated when two or more BTB control boards connected on PMCB have the same address (configured in P.0801).

8.7.15 203 – CAN-BUS A (PMCBUS A) addresses conflict

Type: **Warning**
Parameters connected: **P.0801** PMCB bus address
To disable: -
Enabled in: **MAN, AUTO**

It will be activated when two or more BTB control boards connected on PMCB have the same address (configured in P.0801).

8.7.16 211 – Shared input written by multiple devices CAN-BUS (PMCBUS A/B)

Type: **Warning**
Parameters connected: **P.0800** PMCB bus mode
To disable: **P.0800=0**
Enabled in: **MAN, AUTO, TEST, REMOTE START**

The protection is enabled if the PMCB CAN-BUS is activated (P.0800 different from zero).

It will be activated when one or more boards communicating on the PMCB CAN-BUS are using the same shared input. On page S.02, by selecting this warning, the board shows the type and the number of the shared input and the address of the controller that is writing it. See document [9].

8.7.17 271 – BUS A parallel failure

Type: **Warning**
Parameters connected: **P.0852** Synchronization Maximum Time for BUS A
To disable: -
Enabled in: **AUTO**

It activates when the BTB breaker does not close within the time set with P.0852 since synchronization start, when speed and voltage adjust commands are sent through BUS A. It is always a warning.

8.7.18 272 – BUS B parallel failure

Type: **Warning**
Parameters connected: **P.0853** Synchronization Maximum Time for BUS B
To disable: -
Enabled in: **AUTO**

It activates when the BTB breaker does not close within the time set with P.0853 since synchronization start, when speed and voltage adjust commands are sent through BUS B. It is always a warning.

8.7.19 277 – BTB cannot be closed.

Type: **Warning**
Related parameters: -
To disable: -
Enabled if: **MAN, AUTO.**

This warning is issued when the BTB circuit breaker has to be closed, but actually it cannot be closed due to an external non-consistent condition:

- Voltages are present on both BUSA and BUSB, but is not “in thresholds” on one (or both) of them.
- There are no voltages on one or both buses. On the bus without voltages, the controller detects (form information collected via CAN-BUS) that one generator is supplying or one mains is connected to the bus (wiring problems).

8.7.20 900 – Incoherent PLC Parameters

Type:	**Warning**
Parameters connected:	-
To disable:	-
Enabled in:	**MAN, AUTO, TEST, REMOTE START**

The protection is enabled only when a valid PLC program has been transferred to the board. It reports possible problems during the running of the PLC:

- The PLC program uses more FLASH memory than available.
- The PLC program uses more RAM memory than available.
- The PLC program has an invalid control check-sum.
- The PLC program is developed with a version not supported by this board.
- A digital or analogue output controlled by the PLC is not configured with DOF.0101 or AOF.0101 function (“used by the PLC”).
- The PLC program uses a resource (of any kind) not available on this board (for example, a digital input of a non-connected expansion module).
- An invalid parameter has been specified for one of PLC blocks.
- An invalid type of block has been specified.
- Calculation error during the running of the program.

On S.02 page, by selecting this warning, the board shows additional information to help solving the problem.

8.7.21 301...554 - Generic anomalies linked to digital inputs

See 8.5.

8.7.22 701...742 - Generic anomalies linked to analogue inputs

See 8.6.

8.7.23 901...964 - Anomalies connected to the PLC

The PLC program, through one of its blocks, can activate anomalies. 901 through 964A codes are connected to such anomalies. Anomalies triggered by the PLC can be alarms, deactivations, unloads or warnings.

9 Other functions

9.1 PLC logic

The GC600 controller is equipped with a PLC environment (acronym for “Programmable Logic Controller”) that carries out a sequence of functions previously stored in a proper Flash memory.

Use “Mecc Alte PlcEditor” software to create and fulfil the PLC program. Use the “BoardPrg4” software to transfer the compiled PLC program to the controller or to read it again from the controller [2].

The PLC program is run every 100ms. This time span could not be adequate to manage protections that have to intervene very quickly.

9.2 Clock

The board is provided with a hardware clock. It is shown in details on page S.03. It is possible to set the clock through 4.7.1 menu or serial ports. It is used for history logs recordings and calendars.

The clock is equipped with a rechargeable battery and can be updated for some months, even if the controller is not supplied. After a long time in which the controller is not used (no supply), even if the clock reactivats immediately when the supply comes back, a few hours are necessary to guarantee to full recharge of the internal battery.

9.2.1 Clock automatic update

In case the controller has an Ethernet connection, the clock can be automatically updated through the connection towards a NTP server (see par. In fact, every digital input can have an AND/OR logic associated, which determines its status (see par. 5.12.4). The controller registers the “EVT.1076 event - Date and hour modified” in the history log, only if the difference between the new time received and the current one is higher than one minute.

Server NTP

The server NTP (questioned by the controller every 5 minutes) gives the date and hour of the jet lag (that is UCT Universal Coordinated Time”) from which the controller can calculate and update the internal calendar considering its own jet lag and eventual summertime. To this purpose, the follow parameters are available:

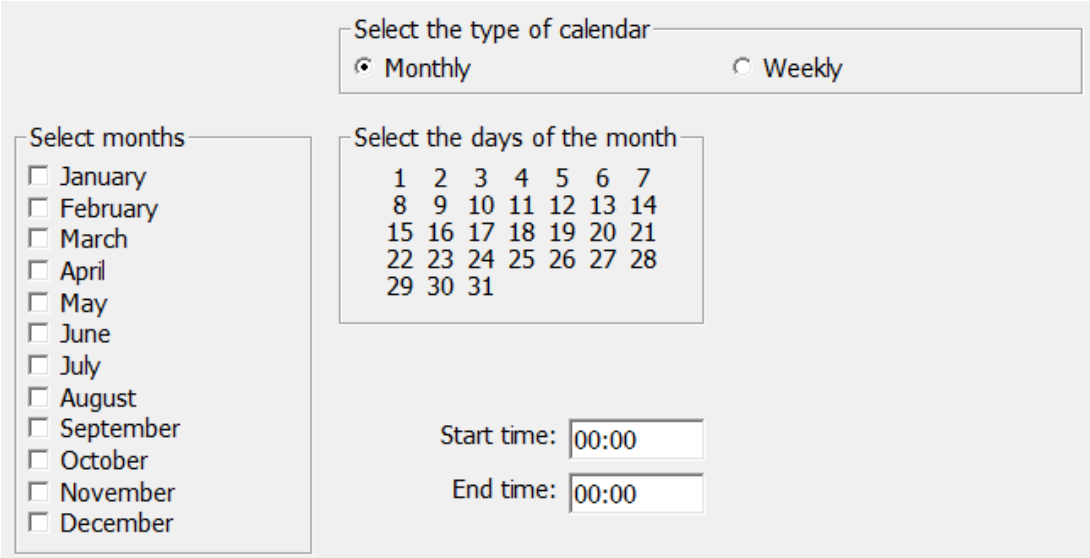
- P.0409: Legal time.
  - “0-No” jet lag not in use
  - “1-Yes” jet lag in use (it adds an hour to the one received).
  - “2-Automatic (only Europe)”: It is only valid for Europe, as since 2002 has been unified (it activates ate 01.00 of the last Sunday of March and deactivates at 01.00 of the last Sunday of October).
  - “3-Automatic (via calendar)”: the activation/deactivation of the daylight save time is configurable by calendars 15 and 16.
- P.0410: Jet lag (1=15 min.; 4=1 hour). The setting limits are from -47 to + 48 and allow to manage all time bands of the Earth by hour quarts.

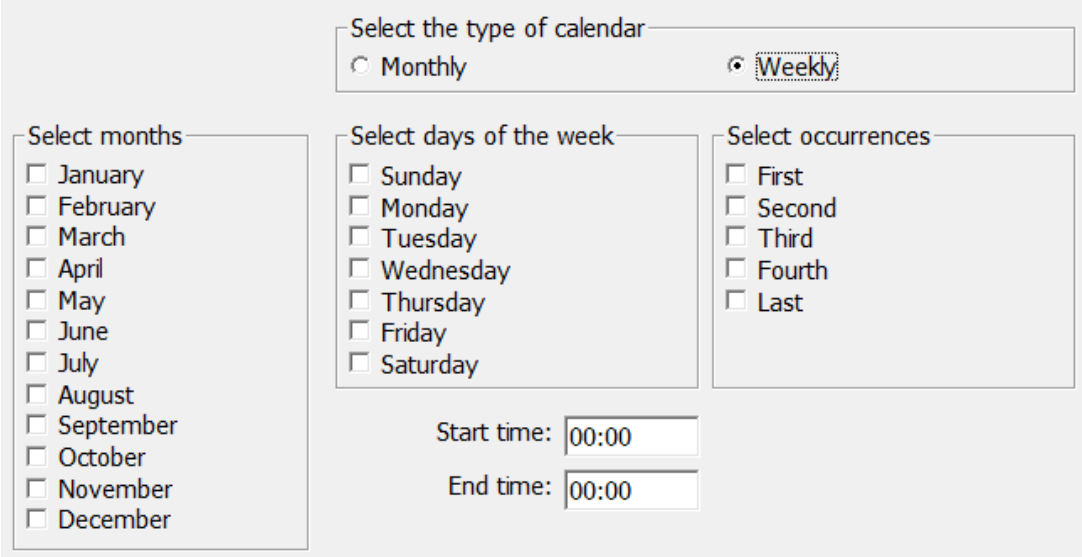
9.2.2 Configurable calendars

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. 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 BoardPrg4 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 must 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:

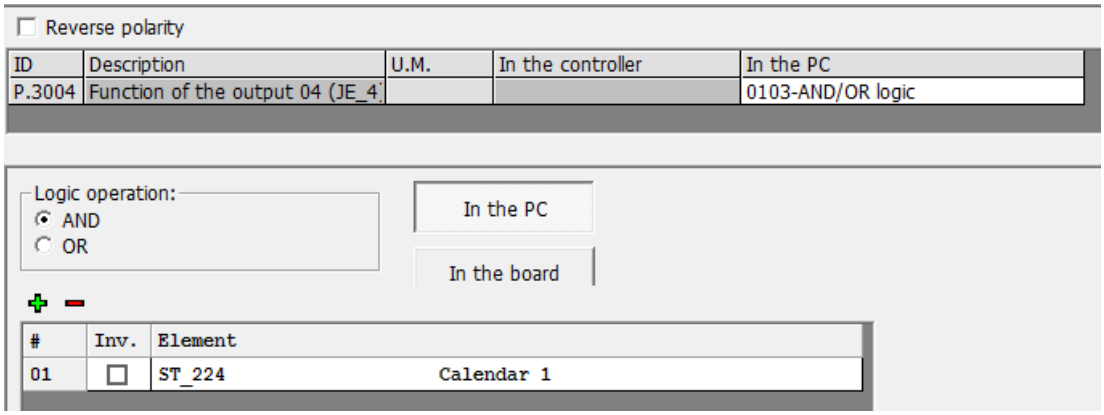
BIT	Value	Hexadecimal	Occurrence
0	1	00000001	First occurrence
1	2	00000002	Second occurrence
2	4	00000004	Third occurrence
3	8	00000008	Forth occurrence
4	16	00000010	Last occurrence

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 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).
- Calendar 16.
    - Select "weekly" (bit 15 of P.1900 = "1").

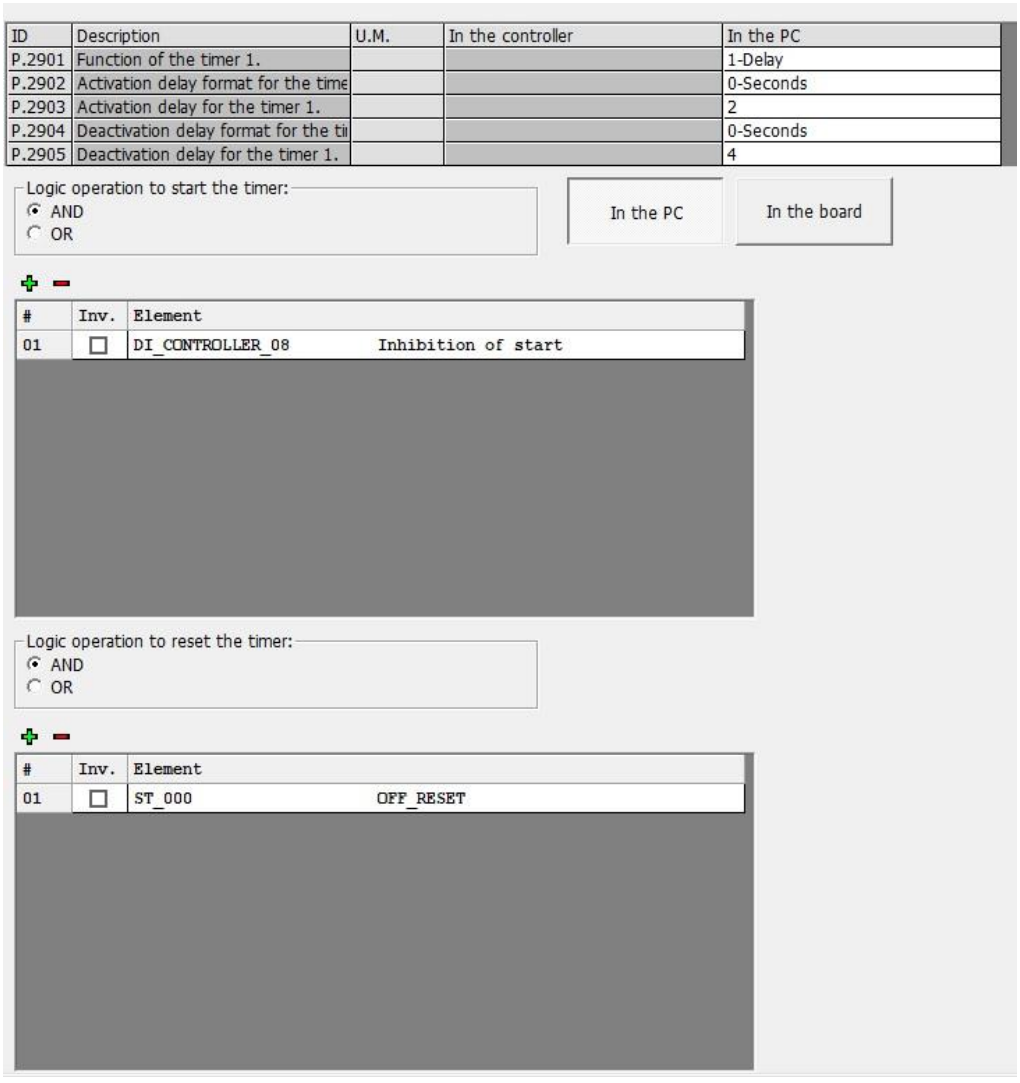
- Last Sunday of March:
  - Select “March” (P.1961 = “0004”).
  - Select “Sunday”, “Last” (P.1962 = “00010010”).
- The activation should happen at 03:00:
  - Select “3:00” as start time (P.1963).
  - Select “3:01” as end time (P.1964).

9.2.3 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.

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):

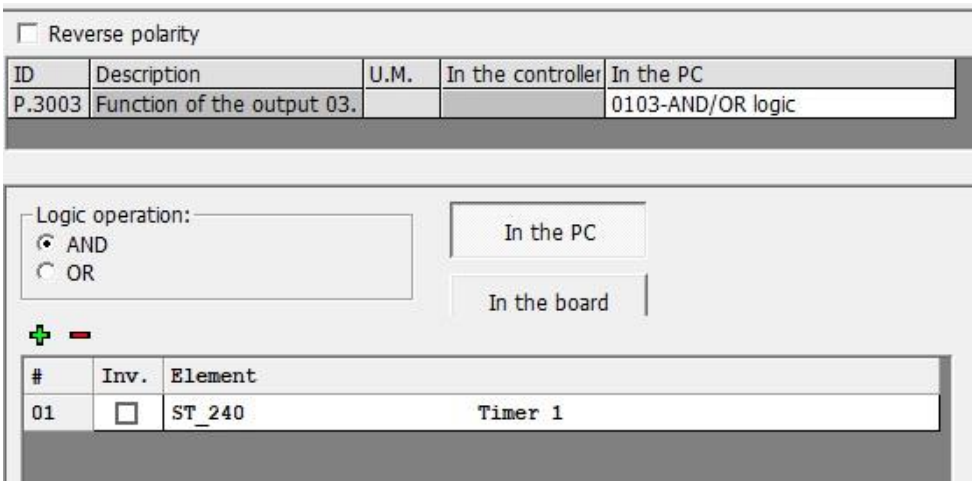
- P.2901: function of the timer 1.
- P.2902: Activation delay format for the timer 1.
- P.2903: Activation delay for the timer 1.
- P.2904: Deactivation delay format for the timer 1.
- P.2905: Deactivation delay for the timer 1.

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:



9.3 Thermometer

The controller is provided with a hardware thermometer, for measuring its internal temperature. The temperature is shown at page S.03, multifunction display, last line. It is used for many functions:

- At very low temperatures information display slows down. By utilizing the thermometer, when the temperature falls under a very low threshold, the board keeps always the backlighting lamp on, that contributes to heat the display and therefore to increase its efficiency.
- The electronic components inside the controller have an extended working temperature range. Despite this, it is possible in critical ambient conditions that temperature goes out of this range. The controller uses the thermometer to activate a warning if the ambient temperature goes over a threshold configurable with parameter P.0366. This serves to alert the operator, but it is also possible, by using AND/OR logics, to ensure that, when the early warning is active, also an output is activated, output that therefore can be used to start cooling the mechanisms.

9.4 Counters

The controller manages internally the following counters:

- Active power (kWh) (resettable to zero): it counts only when the active power flows through the circuit breaker from BUSA to BUSB.
- Active power (kWh) (total): it counts only when the active power flows through the circuit breaker from BUSA to BUSB.
- Reactive power (kvarh) (resettable to zero): it counts only when the reactive power flows through the circuit breaker from BUSA to BUSB.
- Reactive power (kvarh) (total): it counts only when the reactive power flows through the circuit breaker from BUSA to BUSB.
- Active power (kWh) (resettable to zero): it counts only when the active power flows through the circuit breaker from BUSB to BUSA.
- Active power (kWh) (total): it counts only when the active power flows through the circuit breaker from BUSB to BUSA.

- Reactive power (kvarh) (resettable to zero): it counts only when the reactive power flows through the circuit breaker from BUSB to BUSA.
- Reactive power (kvarh) (total): it counts only when the reactive power flows through the circuit breaker from BUSB to BUSA.

Almost all these counters and meters are displayed on the controller's front panel (only the total supply time counter is not displayed). However, all can be read via the serial port (with the ModBus protocol). Some of these counters can be reset by the operator following a proper procedure, or via the serial port (they are marked in the list with “resettable to zero”). All these counters are saved in a non-volatile memory; therefore they store their values also when the controller is powered off. Since non-volatile memories “consume” themselves writing in them, it is necessary to reduce at the minimum the number of writings. For this reason, a counter is not immediately saved as its value changes, and it is then important to know when values are saved and how to be sure that they are saved before removing supply from the board.

Counters are saved (all together and in the same time) in the following conditions:

- Each time the operating mode is switched to OFF_RESET.
- For each hour the controller is powered.

Furthermore, counters are saved when they are reset to zero (individually or globally) via front panel or serial port. Note that some counters have a decimal part (for example the minutes-counters associated to hours-counters), which is also saved in a non-volatile memory. Powering off the controller in an uncontrolled way can cause the loss of the decimal part. You will need to switch the key to OFF-RESET to force the controller to save data, before switching off the power.

9.4.1 Counters reset

The reset procedure is common to all counters, but it works only on some of them based on the page shown on the multifunctional viewer. See in par. **Error! Reference source not found.** The description of the displayed page containing the counter to be reset

9.5 Alternative parameters configurations.

You can use certain properly configured digital inputs to change the configuration of the system without changing the programming parameters. In fact, the controller manages internally four 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 BoardPrg4xx.

You cannot program or modify the configurations from the controller.

The parameters present in each alternative group are the following:

- P.0101: Number of phases of BUSA.
- P.0102: Nominal voltage of BUSA.
- P.0103: Voltage transformers for BUSA (primary side).
- P.0104: Voltage transformers for BUSA (secondary side).
- P.0120: Is the neutral of the BUS A connected to the controller?
- P.0151: Input type for BUSA voltages.

- P.0201: Number of phases of BUSB.
- P.0202: Nominal voltage of BUSB.
- P.0203: Voltage transformers for BUSB (primary side).
- P.0204: Voltage transformers for BUSB (secondary side).
- P.0220: Is the neutral of the BUS B connected to the controller?
- P.0251: Input type for BUSB voltages.
- P.0301: Nominal frequency.
- P.9502: Nominal current.
- P.0311: Connection of current transformers.
- P.0312: Current transformers (primary).
- P.0313: Current transformers (secondary).
- P.0314: Direction of current transformers.
- P.0315: Connection of current transformer for auxiliary current.
- P.0316: Current transformer for auxiliary current (primary).
- P.0317: Current transformer for auxiliary current (secondary).
- P.0318: Usage of auxiliary current.
- P.0319: Transformer type for auxiliary current.

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.
- DIF.2153 – “Select configuration 3”. When the input becomes "active", parameters of alternative configuration set 3 are copied in the working configuration.
- DIF.2154 – “Select configuration 4”. When the input becomes "active", parameters of alternative configuration set 4 are copied in the working configuration.

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

This function is usually used with multi-voltage and/or multi-frequency panel: cabling the cams in a panel selector on the inputs of the controller it is possible to switch manually voltages and frequency without using the parameter of the controller.

NB. The change of parameters happens only with the controller in OFF_RESET.

9.6 Non-volatile memory

The controller has a non-volatile memory inside (with no need to be supplied), used to store different information as parameters, counters or other. 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 message contains a numeric code (hexadecimal note); each bit if this code corresponds to a non valid memory zone. A chart follows with the zones and relative bits.

Area	Version	Bit	Value	Description
1	01.00	1	0001	Coefficients for the calibration of the measuring inputs of the controller.
2	01.00	2	0002	Different information (selected languages, lcd display contrast…)
3	01.00	3	0004	Counters
4	01.00	4	0008	History log of the maximum peaks.
5	01.00	5	0010	Parameters alternative configurations.
6	01.00	6	0020	Parameter:
7	01.10	7	0040	Setpoint for the PLC
8	01.00	8	0080	Parameters in text form (e.g. Configurable messages connected to inputs)

If for example the value between brackets was “0004”, this means that the only counter zone is not valid. If the value was “0021”, this means that the parameters zones (0020) and the calibration zones (0001) are not valid.

If a zone is not valid, the normal operation sequences are not performed until when the operator does not press “ENTER + EXIT”: it is , in effect, necessary that the situation is clear also because it might cause malfunctions (e.g. If the non valid zone was the one of the parameters). Only when the operator presses “ENTER + EXIT”,the controller recharges the default data for the data stored in non valid zones: this means that if you turn off the controller without pressing “ENTER + EXIT”, in a subsequent start there will be a signalling of not valid memory.

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