mecc alte

POWER FROM WITHIN

GC600 CONTROLLER

SMARTECH

TECHNICAL MANUAL

211

Revision	Date	Notes
00	03/05/2016	First version of the manual for the version 01:00 of the controller.
01	15/06/2017	Technical specifications update paragraph 3. Update paragraph 5.14
02	06/11/2017	Update paragraphs 5.6.7, 6.4.6, 6.5.1.3, 6.5.7.2, 9.2.1, 9.8 Added paragraph 9.2.5
03	04/07/2018	Update paragraphs 5.8.4, 5.8.5, 6.5.4.14, 6.5.5.4, 6.5.5.5, 6.5.5.6, 6.5.5.7, 6.5.5.8, 6.5.5.9, 7.6.4, 7.6.9.2, 8
04	24/07/2018	6.5.5.13, 6.5.5.14
05	04/03/2019	Update paragraphs 5.5.5, 5.6.6, 5.15.4.1, 5.6.7, 7.6.9, 8.8.1, 8.8.3, 8.8.56, 8.8.58, 9.2.1
06	22/03/2019	Added paragraph 5.15.4.2, 6.5.3.19 Update paragraphs 5.5.5
07	14/05/2019	Update to version 1.20 6.5.5.13, 6.5.5.14, 9.8
08	20/06/2019	Update technical specifications paragraph 3 Added paragraph 3.1
09	09/07/2019	Update to version 1.21 5.6.6, 5.6.7, 6.5.4.7, 6.5.4.8, 6.5.5.3, 6.5.5.9, 8.8.1, 8.8.2, 8.8.3, 8.8.4, 8.8.6, 8.8.9, 8.8.13, 8.8.40, 8.8.42, 8.8.45, 8.8.46, 8.8.48, 8.8.49, 8.8.51, 8.8.52, 8.8.53, 8.8.54, 8.8.60, 8.8.62, 8.8.79
10	16/01/2020	Update to version 1.24 5.5.5, 5.6.7, 5.15.4.1, 7.1, 7.2, 7.3.3, 7.8.5
11	21/07/2020	Update to version 1.26 5.15.4, 5.15.4.1
12	20/04/2021	Update to version 1.31 5.6.7, 9.2.6
13	09/06/2021	Update to version 1.32. 1.1, 1.3, 5.5, 5.5.4, 5.5.5, 5.6.6, 5.6.7, 5.8.4, 5.8.5, 5.8.6, 5.10, 5.15.1, 5.15.3, 5.15.4, 5.15.4.3, 5.16.1, 6.3, 6.5.1.3, 6.5.3.2, 6.5.3.3, 6.5.3.7, 6.5.4.15, 6.5.4.16, 6.5.5.3…6.5.5.12, 6.5.7, 6.5.7.1, 6.5.7.2, 6.5.7.3, 6.5.7.6, 6.6, 7.7.13, 7.7.13.1, 7.8.2.5, 8.8.20, 8.8.55, 8.8.58, 8.8.59, 8.8.81, 8.8.89, 9.1, 9.2.5, 9.8, 9.12
14	08/09/2021	Updated to version 1.33. 5.5.5, 5.6.6, 5.6.7, 5.7.1, 5.8.4, 5.8.5, 6.5.3.18, 6.5.4.12, 6.5.7.2, 7.5.6, 8.8.58
15	12/01/2022	Updated to version 1.38. 5.5.5, 5.6.6, 5.6.7, 5.8.5, 6.5.4.1, 6.5.4.5, 6.5.4.6, 6.5.4.12, 6.5.5.10, 6.5.5.12, 6.5.5.13, 6.5.6.2, 6.5.6.3, 6.5.7.2, 6.5.7.3, 7.7.5, 7.7.14, 8.8.58
16	01/06/2022	Updated to version 1.39. 5.5.5, 5.6.7, 5.8.5, 6.5.5.9…6.5.5.14, 7,7,14

Revision	Date	Notes
17	08/09/2022	Updated to version 1.42. 9.8, 9.12.2
18	08/11/2022	Updated to version 1.45. 6.2, 7.7.6.7, 7.7.8.1, 7.7.9, 8.8.7
19	02/03/2023	Updated to version 1.48. 6.2, 6.4.1, 6.5.6.4, 7.1
20	26/10/2023	Updated to version 1.52. 5.6.7, 6.5.3.2, 6.5.3.20, 6.5.3.21, 8.8.87

Table of Contents

1 Introduction

1.1 References

[1] Mecc Alte EAAM0555xx GC600 Parameters Chart.

[2] Mecc Alte EAAM0458xx - BoardPRG Manual.

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

[4] Mecc Alte EAAS0556xx GC600 Modbus Registers.

[5] Mecc Alte EAAM0136xx – J1939 Interface Manual.

[6] CAN open – 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 many configurable parameters and it is therefore impossible to describe all their possible combinations and effects.

In this document, there isn't a detailed description of all the 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 parameter's 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 the genset operation impossible and causes the automatic and immediate stop of the engine with emergency procedure (without cooling period).

The word **DEACTIVATION** is used to indicate a fault that makes the genset operation impossible and causes the automatic and immediate stop of the engine with standard procedure (with cooling period). The controller immediately opens the GCB circuit breaker when this kind of fault arises.

The word "**UNLOAD**" is used to indicate a fault that makes the genset operation impossible and causes the automatic and stop of the engine with standard procedure (with cooling period). If it is possible, the GC600 controller gradually reduces to zero the power supplied by the genset before opening the GCB circuit breaker.

The word "**WARNING**" is used to indicate a fault that requires an operator action but doesn't require the automatic shut-down of the genset.

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.

DTC It indicates a diagnostic code received from the engine control unit (ECU) via CAN-BUS ("Diagnostic Trouble Code").

ECU It indicates the engine electronic control unit ("Engine Control Unit").

EVT It identifies an event stored within the historical records. The number that follows the caption "EVT" is the numeric code of the event.

GCB This term identifies the circuit breaker that connects the genset to the load (or the parallel bars in case of plants with more gensets) (“Genset Circuit Breaker”)

MCB This term identifies the circuit breaker which connects the mains to the load (*“Mains Circuit Breaker”*)

MGCB It indicates the circuit breaker that connects the parallel bars of the genset to the load (“Master Genset Circuit Breaker”).

MPM See the description of the type of plant in [10].

MPtM See the description of the type of plant in [10].

MPtM + MSB See the description of the type of plant in [10].

MSB See the description of the type of plant in [10].

MSB + MSTP See the description of the type of plant in [10].

PMCB It identifies the communication bus (by Mecc Alte) that allows all devices exchange information to manage the parallel functions described in the document [10] (“Power Management Communication Bus”).

SPM See the description of the type of plant in [10].

SPtM See the description of the type of plant in [10].

SPtM + SSB See the description of the type of plant in [10].

SSB See the description of the type of plant in [10].

SSB + SSTP See the description of the types of plant in [10]

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

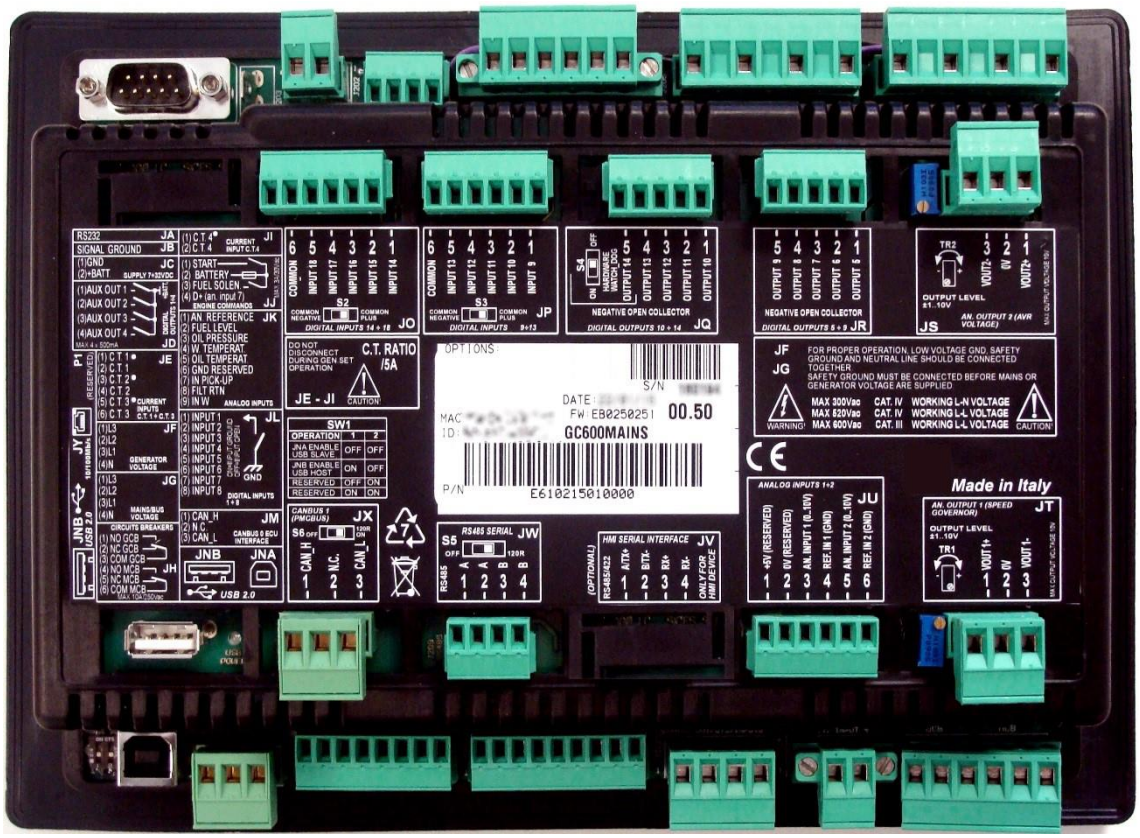
Several parts of this manual refer to the controller's software revisions. These revisions are marked with the assigned Mecc Alte code (shown on the rear panel of the controller). The format of the code is: EB0250251XXYY, where “XX” is the main version and “YY” is the minor version. Thus, the code EB02502510100 refers to the controller software release "1.00". The software revision is also displayed on page “S.03” of the TFT display.

GC600 is a “dual processor” device and uses two different firmwares:

- EB0250251XXYY: 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

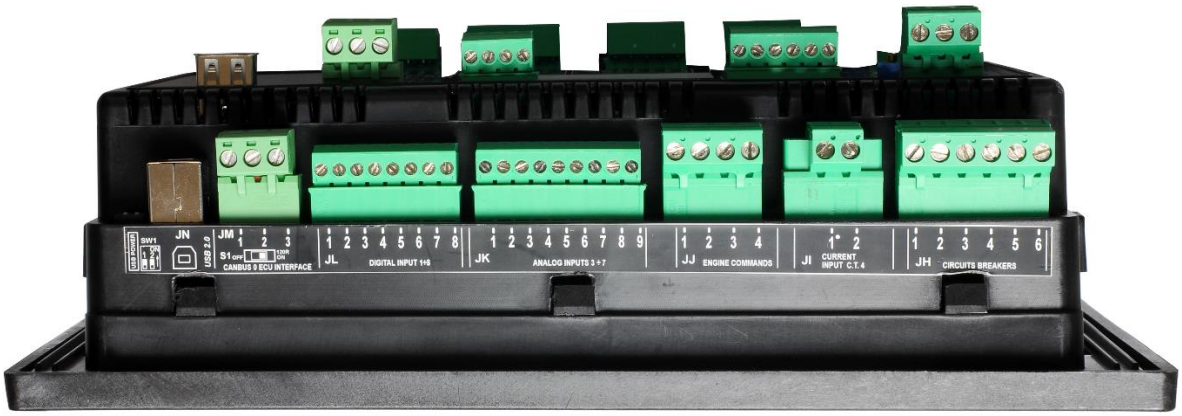
GC600^{Mains} Front view



GC600 - GC600 Mains Rear view

GC600 - GC600 Mains Upper view

GC600 - GC600^{Mains} Lower view



3 Technical features

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

Supply power voltage +VBATT:	
Nominal power supply (Vn)	12Vdc or 24 Vdc
Power supply range (Vn variation)	From 8 to 32Vdc 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.
Maximum time of interruption of the supply voltage without resetting the device	0 Vdc for min. 20 ms from a nominal voltage of 12 Vdc (voltage drop)
Starting minimum voltage	The operation is guaranteed during the engine start up to Vbatt=>5Vdc for indefinite time
Sampling rate	10kHz
Resolution	12 bit
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
Mains/Bus and Genset voltage inputs	
	Measurement of the L-N and L-L phases voltages Measurements of the neutral voltages referred to the device supply negative External fuse max. 2A slow-blow
Nominal Voltage (Vn)	400Vac L-L (230Vac L-N) 100Vac L-L (58Vac L-N)
Scale	400V (HV - High Voltage range) 100V (LV - Low Voltage range) Selectable from the device parameter
Sampling rate	10Khz
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 LV	Max 147 Vac for measures L-N (with voltage N-GND = 0 Vrms)
Max tension in Common-Mode from GND with HV scale	Max 100 Vrms
Max tension in Common-Mode from GND with LV scale	Max 80 Vrms
Connection mode	3 phases 4 cables 3 phases 3 cables Single phase 2 cables Aron insertion with 2 voltage transformers
Measurement resolution	12 bit
Measurement accuracy	<0,5% @ Vn
Current measurement inputs	
	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, differential protection or mains power. It is required the use of current transformers with a secondary current from 1A to 5A. **The external TA must guarantee at least one BASIC isolation for the use of the device in the Overvoltage Cat. IV.**
Nominal Current (In)	1Aac or 5Aac
Scale	1Aac nominal (Low Current range) 5Aac nominal (High Current range) Internal amplifier with automatic change of scale for currents lower than 1,2Aac and higher than 1,5Aac.
Sampling rate	10 KHz
Max. measurement range	Up to 7Aac
Type of measurement	True RMS measurements (TRMS).
Burden per phase (Auto-consumption)	< 1VA
Overload capacity	+40% of the nominal current
Overload peak	Possible sinusoidal transient voltage surges up to 20 Aac with progressive loss of the measurement accuracy depending on the amplitude of the surge.
Measurement resolution	12 bit
Measurement accuracy	<0,2% @ In
Frequency measurements	

<table>
<tr><td></td><td>Frequencies measured by L1-L2 phase voltages, for both the mains/bus and the genset.
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>Nominal Frequency (Fn)</td><td>50Hz or 60Hz</td></tr>
<tr><td>Measurement range</td><td>5 to 80 Hz</td></tr>
<tr><td>Measurement accuracy</td><td>± 50 mHz</td></tr>
<tr><td>Frequency minimum sensitivity for Mains/bus 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>
<tr><td>Frequency minimum sensitivity for Genset 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>
</table>

	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.
Activation/deactivation threshold	2,5VDC
Typical current with closed contact	5,3mA @ Vbatt= 13.5Vdc 11,5mA @ Vbatt= 27Vdc
Input signal delay	It can be adjusted by the related parameter for each input
Digital outputs 01-04	
Type of output	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.
Rated supply	500mAdc @ 32Vdc for each output
Output resistor status ON	Max 350mΩ
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. **Use suppression diodes on all relays and other inductive loads**
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. **Use suppression diodes on all relays and other inductive loads.**
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. **Use suppression diodes on all relays and other inductive loads.**
Digital outputs 15 and 16 - Engine commands	
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). They can be used as starter motor (START) and fuel solenoid valve (FUEL). 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 - Switch 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.
Output D+ and analogue input 07	
Type of output	Current output with value automatically switched according to the supply voltage Vbatt. If it is not used for the excitation of the battery charger alternator, it is possible to configure the D+ terminal as analogue input to acquire voltage measurements from 0 to 32Vdc or as additional digital input with +Vbatt activation. The voltage measurement acquired is displayed in the page S.15 of the display.
Excitation current	200mA @ 13.5 Vdc 100mA @ 27 Vdc
Sampling rate	10kHz
Resolution	12 bit

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
Sampling rate	10kHz
Resolution	12 bit
Measurement accuracy	<0,4% F.S.
Analogue inputs 03-06 and Vref	
Type of input	4 adjustable analogue inputs, which can be used as engine equipment. Adjustable as resistive, voltage, current (with external resistor) and digital inputs. For the resistive sensors, there's an input for the measurement and compensation of the reference potential with respect to the sensor common negative (Vref).
Resistive inputs	Measurement range 0 – 500Ω with error < 0,2% 0 – 2kΩ with error < 1% Injected current: 25mA max. Compensation range (Vref): from -2,7Vdc to 6Vdc
Voltage inputs	Measurement range 0 – 10Vdc with error < 0,2% Input impedance: >470kΩ
Current inputs.	Measurement range 0 - 20mA with 500Ω external resistor
Sampling rate	10kHz
Resolution	12 bit
Pick-up input for the measurement of the engine speed	
	Filtered for DC currents blocking.
Minimum voltage	1,3Vac @ 3kHz
Maximum voltage	60Vac
Frequency range	1Hz – 10000Hz
"W" inputs for the measurement of the engine speed	
	It uses a pick-up input with internal anti-interference filter to insert by connecting the JM connector pin 7 and 8 to each other.
Digital outputs 01-02	
Type of output	2 galvanically insulated ±10Vdc voltage outputs They can be used for the AVR and engine 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**
Maximum distance	Maximum Cable length depends cable capacitance, inductance and screening. 15m (50ft) @ 9600bps 10m (33ft) @ 19200bps 7,5m (25ft) @ 38400bps 5,0m (16ft) @ 57600bps 2.5m (8ft) @ 115200bps
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 Mecc Alte 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 SAE J1939 and MTU for ECU engine control.
CanBus1	Canbus connection with protocol Mecc Alte PMCBus for the communication with other devices.
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
Humidity	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
Operating altitude	Up to 2000 m (6561 ft.)
Box	
Material	Nylon66 + 30% fibreglass
Size	247(L) x 187(H) x 70(D) mm

Weight	1100g
Protection degree	IP55 with gasket for the front panel IP20 for the panel interior

3.1 Protection Elements Accuracy

3.1.1 Terms and definitions

G
The measured value of the characteristic quantity.

t_d
The theorical operation time (in seconds)

k, c, α
The constants characterizing the selected curve

Start (or Pickup) value
G_s
The reference value used for the definition of the theoretical curve of time vs. characteristic quantity.

Start (or Pickup) time
Duration of the time interval between the instant when the characteristic quantity of the measuring relay in reset condition is changed, under specified conditions, and the instant when the start (or pickup) signal asserts.

Operate (or trip) time
t_G
Duration of the time interval between the instant when the characteristic quantity of a measuring relay in reset condition is changed, under specified conditions, and the instant when the relay operates.

Disengaging time
Duration of the time interval between the instant a specified change is made in the value of the input energizing quantity which will cause the relay to disengage and the instant it disengages.

Reset time
Duration of the time interval between the instant when the characteristic quantity of a measuring relay in operate condition is changed, under specified conditions, and the instant when the relay resets.

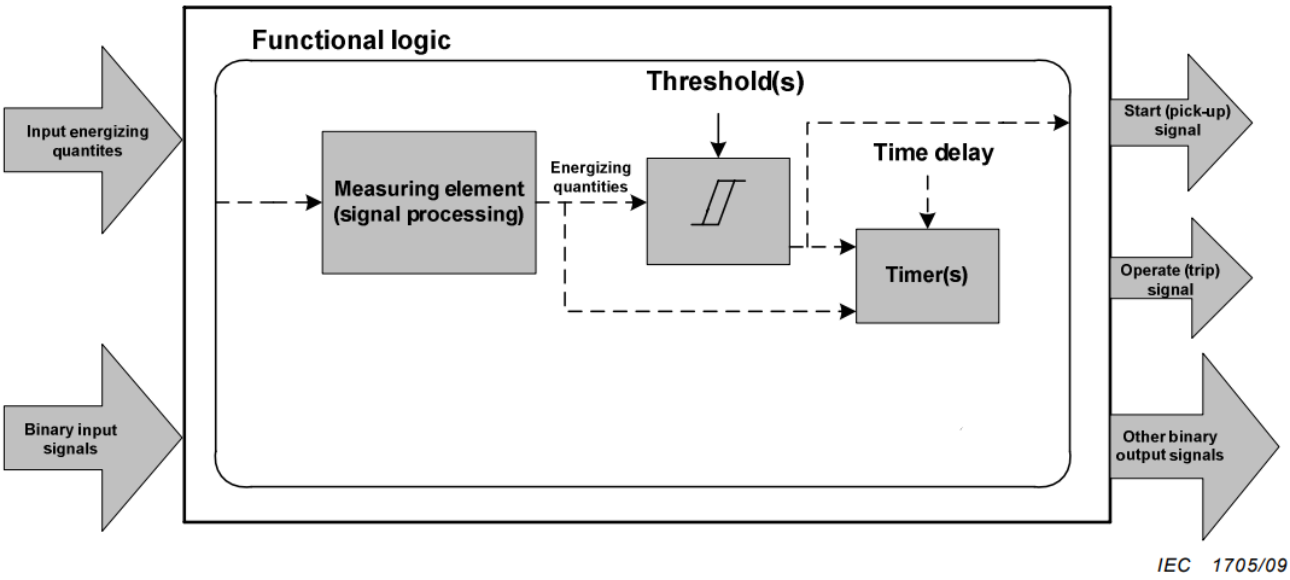
Overshoot time
The difference between the operate time of the relay at the specified value of the input energising quantity and the maximum duration of the value of input energising quantity which, when suddenly reduced (for the overvoltage relay) or increased (for the undervoltage relay) to a specified value below (for the overvoltage relay) or above (for the undervoltage relay) the setting value, is insufficient to cause operation.

Reset ratio
Ratio between the point where the relay just ceases to start (start signal change from ON to OFF) and the actual start value of the element.

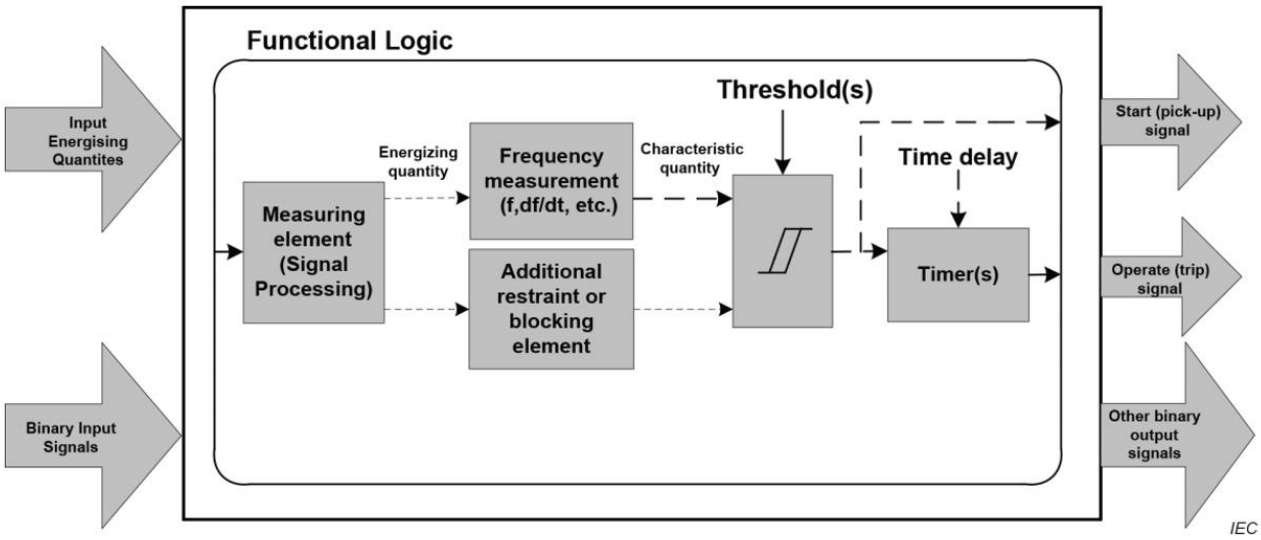
Threshold of independent time operation
The value of the characteristic quantity at which the relay operated time changes from dependent time operation to independent time operation.

3.1.2 Simplified protection functional block diagram

Voltage/current protections



Frequency protections



3.1.3 Protection elements accuracy

3.1.3.1 Generator protection

Generator – Undervoltage protection (IEEE/ANSI C37.2 - Function Number 27)				
Parameter settings		**Value (range)**		
Pickup range (G_s) (2 stages)		25% … 100% x V_n		Step 0,1
Definite time delay (t_d) (2 stages)		0,1…300 sec		Step 0,1
Characteristic		**Value**		
Pickup accuracy	Depending on the frequency of the voltage measured: F_n ±2Hz	±0,5% of the set value or ±0,002 × V_n		
Pickup time 1)	V_{Fault} = 0,8 × set Pickup value	Minimum	Average	Maximum
		22 ms	36 ms	75 ms
Reset time		< 100 ms		
Reset ratio		Depends on the set Relative hysteresis		
Trip time accuracy in definite time mode (independent time characteristic)		±1% of the delay time value or ± 65 ms 1)		
Overshoot time accuracy		±10 ms 1)		
Equation operation time		$t_G = t_d$ when $G < Gs$		
1) Includes the delay of the signal output contact				

Generator – Overvoltage protection (IEEE/ANSI C37.2 - Function Number 59)				
Parameter settings		**Value (range)**		
Pickup value (G_s) (2 stages)		100% … 200% x V_n		Step 0,1
Definite time delay (t_d) (2 stages)		0,1…300 sec		Step 0,1
Characteristic		**Value**		
Pickup accuracy	Depending on the frequency of the voltage measured: F_n ±2Hz	±0,5% of the set value or ±0,002 × V_n		
Pickup time 1)	V_{Fault} = 1,2 × set Pickup value	Minimum	Average	Maximum
		10 ms	30 ms	60 ms
Reset time		< 100 ms		
Reset ratio		Depends on the set Relative hysteresis		
Trip time accuracy in definite time mode (independent time characteristic)		±1% of the delay time value or ± 50 ms 1)		
Equation operation time		$t_G = t_d$ when $G > Gs$		
1) Includes the delay of the signal output contact				

Generator - Underfrequency / Over frequency protection (IEEE/ANSI C37.2 - Function Number 81U/81O)				
Parameter settings		**Value (range)**		
Pickup value (G_s) (2 stages)		70% … 130% x F_n		Step 0,1
Definite time delay (t_d) (2 stages)		0,1…300 sec		Step 0,1
Characteristic		**Value**		
Pickup accuracy		±50 mHz		
Pickup time 1)		Minimum	Average	Maximum
		9 ms	25 ms	55 ms
Reset time		< 160 ms		
Trip time accuracy		±0,1% of the delay time value or ±40 ms 1)		
Equation operation time underfrequency	underfrequency	$t_G = t_d$ when $G < Gs$		
	over frequency	$t_G = t_d$ when $G > Gs$		

1) Includes the delay of the signal output contact

Generator - Instantaneous overcurrent protection (IEEE/ANSI C37.2 - Function Number 50)					
Parameter settings			**Value (range)**		
Pickup value (G_s)			5% … 500% x I_n		Step 1
Definite time delay (t_d)			0,1…300 sec		Step 0,1
Characteristic			**Value**		
Pickup accuracy	Depending on the frequency of the voltage measured: F_n ±2Hz	At currents in the range of 5…200% × I_n	±1,0% of the set value or ±0,002 × I_n		
		At currents in the range of 200…500% × I_n	±2,0% of the set value or ±0,004 × I_n		
Pickup time 1)			Minimum	Typical	Maximum
	Current before fault in the range 0… 25% × I_n		24 ms	73 ms	120 ms
	Current before fault in the range 25…500% × I_n		27 ms	45 ms	50 ms
Reset time			< 100 ms		
Reset ratio			Typical 0,96 %		
Disengaging time			Typical 76 ms		
Trip time accuracy in definite time mode (independent time characteristic)			±1,5% of the delay time value or ±100 ms 1)		
Equation operation time			$t_G = t_d \text{ when } G > Gs$		
1) Includes the delay of the signal output contact					

Generator - Time delayed overcurrent protection (IEEE/ANSI C37.2 - Function Number 51)				
Parameter settings		**Value (range)**		
Pickup value (G_s)		50% … 130% x I_n		Step 1
Definite time delay (t_d)		1…60 sec		Step 0,1
Characteristic		**Value**		
Pickup accuracy	Depending on the frequency of the voltage measured: F_n ±2Hz	±1,0% of the set value or ±0,002 × I_n		
Pickup time 1)		Minimum	Typical	Maximum
	Current before fault in the range 0… 25% × I_n	24 ms	73 ms	120 ms
	Current before fault in the range 25…130% × I_n	20 ms	23 ms	45 ms
Reset time		< 100 ms		
Reset ratio		Typical 0,96 %		
Disengaging time		Typical 75 ms		
Trip time accuracy in inverse time mode (dependent time characteristic)		±1,5% of the delay time value or ±80 ms 1)		
Equation operation time (Mecc Alte - Extremely inverse curve)	Definite time delay (t_d) Pickup value (G_s) c=0, k=1, α=2	$t_g = t_d \frac{k}{\left(\frac{G}{G_s}\right)^{\alpha} - 1} + c$		
1) Includes the delay of the signal output contact				

Generator - Voltage-dependent overcurrent protection (IEEE/ANSI C37.2 - Function Number 51V)				
Parameter settings		**Value (range)**		
Pickup value (G_s)		50% … 130% x I_n		Step 1
Definite time delay (t_d)		1…60 sec		Step 0,1
Characteristic		**Value**		
Pickup accuracy	Depending on the frequency of the voltage measured: F_n ±2Hz	±1,0% of the set value or ±0,002 × I_n		
Pickup time 1)		Minimum	Typical	Maximum
	Current before fault in the range 0… 25% × I_n	24 ms	73 ms	120 ms
	Current before fault in the range 25…130% × I_n	20 ms	23 ms	45 ms
Reset time		< 100 ms		
Reset ratio		Typical 0,96 %		
Disengaging time		Typical 75 ms		
Trip time accuracy in inverse time mode (dependent time characteristic)		±1,5% of the delay time value or ±80 ms 1)		

Equation operation time (Mecc Alte - Extremely inverse curve)	Definite time delay (t_d) Pickup value (G_s) c=0, k=1, α=2	$t_g = t_d \frac{k}{\left(\frac{G}{G_s}\right)^{\alpha} - 1} + c$
Constant values for Voltage retrained characteristics		k_1=20% k_2=20% k_3=80% k_4=100%
1) Includes the delay of the signal output contact		

Generator - Negative sequence time overcurrent protection (IEEE/ANSI C37.2 - Function Number 46)				
Parameter settings		**Value (range)**		
Pickup value (G_s)		5% … 100% x I_n	Step 0,1	
Definite time delay (t_d)		1…300 sec	Step 0,1	
Characteristic		**Value**		
Pickup accuracy	Depending on the frequency of the voltage measured: F_n ±2Hz	±1,5% of the set value or ±0,002 × I_n		
Pickup time 1)		Minimum	Typical	Maximum
	Current before fault in the range 0… 25% × I_n	25 ms	63 ms	115 ms
	Current before fault in the range 25…100% × I_n	25 ms	40 ms	55 ms
Reset time		< 100 ms		
Reset ratio		Typical 0,96 %		
Disengaging time		Typical 75 ms		
Trip time accuracy in definite time mode (independent time characteristic)		±1,0% of the set value or ±100 ms 1)		
Equation operation time		$t_G = t_d$ when $G > Gs$		
1) Includes the delay of the signal output contact				

Generator - Current Unbalance protection (IEEE/ANSI C37.2 - Function Number 60)				
Parameter settings		**Value (range)**		
Pickup value (G_s)		5% … 100% x I_n	Step 0,1	
Definite time delay (t_d)		1…300 sec	Step 0,1	
Characteristic		**Value**		
Pickup accuracy	Depending on the frequency of the voltage measured: F_n ±2Hz	±1,5% of the set value or ±0,002 × I_n		
Pickup time 1)		Minimum	Typical	Maximum
	Current before fault in the range 0… 25% × I_n	25 ms	63 ms	115 ms
	Current before fault in the range 25…100% × I_n	25 ms	40 ms	55 ms
Reset time		< 100 ms		
Reset ratio		Typical 0,96 %		
Disengaging time		Typical 75 ms		
Trip time accuracy in definite time mode (independent time characteristic)		±1,0% of the set value or ±100 ms 1)		
Equation operation time		$t_G = t_d$ when $G > Gs$		
1) Includes the delay of the signal output contact				

Generator - Voltage Unbalance protection (IEEE/ANSI C37.2 - Function Number 60)				
Parameter settings		**Value (range)**		
Pickup value (G_s)		1% … 100% x V_n	Step 0,1	
Definite time delay (t_d)		1…300 sec	Step 0,1	
Characteristic		**Value**		
Pickup accuracy	Depending on the frequency of the voltage measured: F_n ±2Hz	±0,5% of the set value or ±0,002 × V_n		
Pickup time 1)		Minimum	Typical	Maximum
		10 ms	30 ms	60 ms

Reset time	< 100 ms
Reset ratio	Depends on the set Relative hysteresis
Disengaging time	Typical 75 ms
Trip time accuracy in definite time mode (independent time characteristic)	±1% of the delay time value ± 65 ms 1)
Equation operation time	$t_G = t_d$ when $G > Gs$
1) Includes the delay of the signal output contact	

3.1.3.2 Grid protection

Mains – Undervoltage protection (IEEE/ANSI C37.2 - Function Number 27)				
Parameter settings		**Value (range)**		
Pickup value (G_s) (2 stages)		25% … 100% x V_n		Step 0,1
Definite time delay (t_d)	Stage 1	0,04…300 sec		Step 0,1
	Stage 2	0,1…300 sec		Step 0,01
Characteristic		**Value**		
Pickup accuracy		Depending on the frequency of the voltage measured: f_n ±2Hz		
		±0,5% of the set value or ±0.002 × V_n		
Pickup time 1)	V_{Fault} = 0,8 × set Pickup value	Minimum	Average	Maximum
		22 ms	36 ms	55 ms
Reset time		< 800 ms		
Reset ratio		Depends on the set Relative hysteresis		
Trip time accuracy in definite time mode (independent time characteristic)		±1% of the delay time value or± 35 ms 1)		
Overshoot time accuracy		±20 ms 1)		
Equation operation time		$t_G = t_d$ when $G < Gs$		
1) Includes the delay of the signal output contact				

Mains – Overvoltage protection (IEEE/ANSI C37.2 - Function Number 59)				
Parameter settings		**Value (range)**		
Pickup value (G_s) (2 stages)		60% … 150% x V_n		Step 0,1
Definite time delay (t_d)	Stage 1	0,04…300 sec		Step 0,01
	Stage 2	0,1…300 sec		Step 0,1
Characteristic		**Value**		
Pickup accuracy		Depending on the frequency of the voltage measured: f_n ±2Hz		
		±0,5% of the set value or ±0,002 × V_n		
Pickup time 1)	V_{Fault} = 1,2 × set Pickup value	Minimum	Average	Maximum
		10 ms	30 ms	50 ms
Reset time		< 800 ms		
Reset ratio		Depends on the set Relative hysteresis		
Trip time accuracy in definite time mode (independent time characteristic)		±1% of the delay time value or ± 30 ms 1)		
Equation operation time		$t_G = t_d$ when $G > Gs$		
1) Includes the delay of the signal output contact				

Mains - Underfrequency / Over frequency protection (IEEE/ANSI C37.2 - Function Number 81U/81O)				
Parameter settings		**Value (range)**		
Pickup value (G_s) (2 stages)		80% … 120% x F_n		Step 0,01
Definite time delay (t_d)	Stage 1	0,04…60 sec		Step 0,01
	Stage 2	0,1…60 sec		Step 0,1
Characteristic		**Value**		
Pickup accuracy		±50 mHz		
Pickup time 1)		Minimum	Average	Maximum
		10 ms	23 ms	45 ms
Reset time		< 160 ms		
Reset ratio		Depends on the set Relative hysteresis		
Trip time accuracy		±0,1% of the delay time value or ±35 ms 1)		
Equation operation time	underfrequency	$t_G = t_d$ when $G < Gs$		
	over frequency	$t_G = t_d$ when $G > Gs$		
1) Includes the delay of the signal output contact				

3.2 Measurement resolution

Mains and Genset voltage	1Vrms
Current	Min, 0,1A (it depends on the CT ratio)
Mains and Genset 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
Engine speed	1 rpm
Oil pressure	0,1bar (below 10bar)
Cooling liquid temperature	0,1°C
Oil temperature	0,1°C
Fuel level	0,1%

4 Installation

4.1 Mounting

The device must 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 mains and generator voltage inputs. You can use 1A fuses.

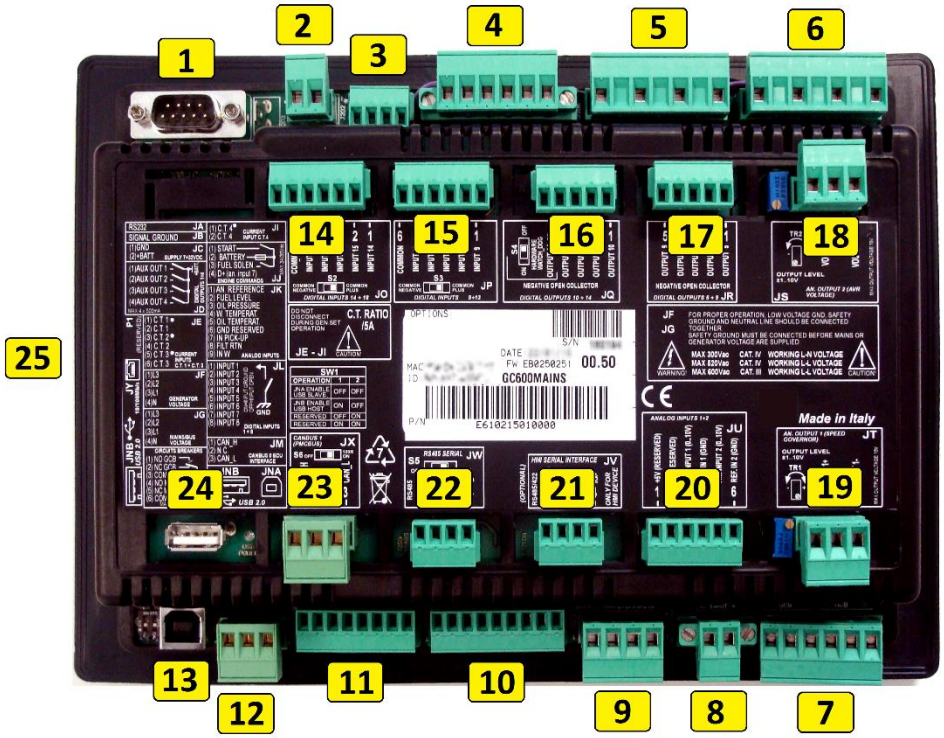
The section of the protective earthing conductor should be at least equal to the section of cables used to wire mains or generator voltage to the control panel. In addition, it must comply with the limit value of the overcurrent protection used.

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 of the genset are connected to the protective earthing.

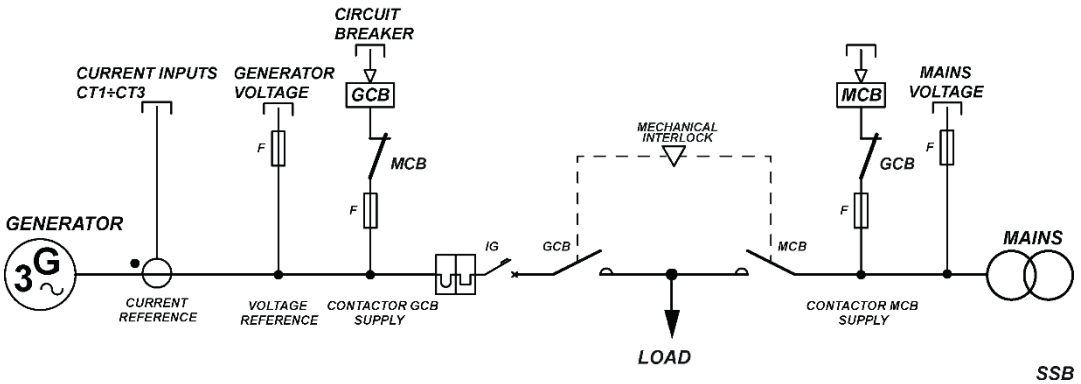
5 IN/OUT connections and configuration



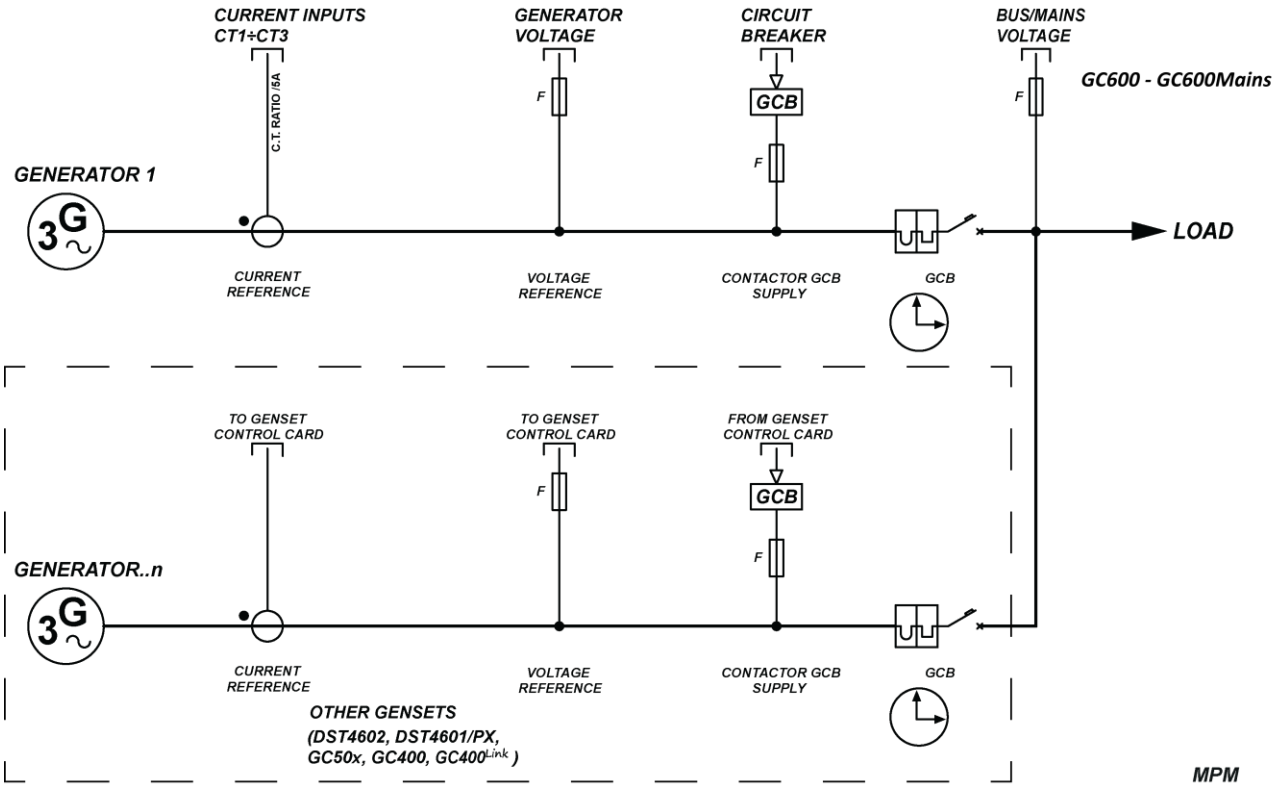
N.	NAME	DESCRIPTION	CONNECTOR
1	JA	Communication interface RS232	9 Poles Male Canon
2	JC+JB	Supply + Functional earth	2 poles x 2,5mm² Screw terminal + faston
3	JD	Digital outputs 1-4	4 poles x 1,5mm² Screw terminal
4	JE	Currents inputs 1-3	6 poles x 2,5mm² Screw terminal
5	JF	Genset voltages	4 poles x 2,5mm² Screw terminal
6	JG	Mains voltages	4 poles x 2,5mm² Screw terminal
7	JH	Digital outputs 17 and -18 - Switch 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 - Engine commands	4 poles x 2,5mm² Screw terminal
		Analogue input 7 (D+)	
10	JK	Pick-Up / W	9 poles x 1,5mm² Screw terminal
		Analogue inputs 3-6 (Engine Equipment)	

11	**JL**	Digital inputs 1-8	8 poles x 1,5mm² Screw terminal
12	**JM**	ECU Can-bus J1939	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 (Round regulator)	3 poles x 2,5mm² Screw terminal
19	**JT**	Analogue output 1 (Round 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**	PCMBUS Interface for parallel functions	3 poles x 2,5mm² Screw terminal
24	**JNB**	USB 2.0 Host Interface	USB - A
25	**JY**	Ethernet Interface	RJ45

5.1 Basic diagram (SSB or SSB+SSTP plants)



5.2 Basic diagram (MPM plant)

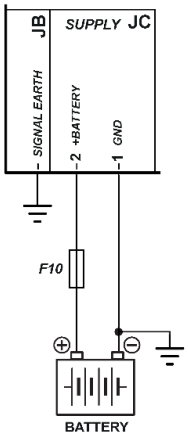


5.3 Functional earth (JB)

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.

5.4 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 care, as the use of insulation current transformers for the voltage measurements of Mains and Genset.

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 genset 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.

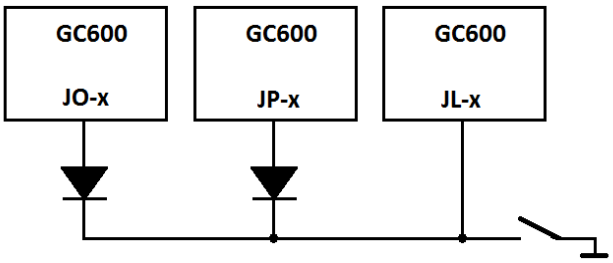
NOTE: when installing, connect the battery positive only after opening all fuses available in the panel.

5.5 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.), 5.8and with different modes the **JJ-4** terminal too (D+ signal, see par.). 5.8.3In 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 GC600). 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.

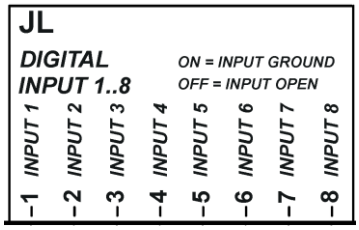


It's also possible to increase the number of digital inputs by adding up to four optional DITEL 16 IN modules (connected by CAN-BUS) for a total of 64 digital inputs (see par.5.10).

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.5.5.4.

The status of the digital inputs, virtual inputs and inputs available through DITEL modules is displayed at pages S.11 and S.12 (0=output not active, 1=output active).

5.5.1 JL - Digital inputs 1-8 (DI_01-DI_08)



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.

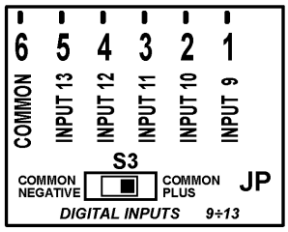
These inputs already have a series diode that allows to connect them directly among them.

The five inputs are wholly configurable (see par. 5.5.5).

By default, the functions of the JL input on the GC600 controller are the following:

Terminal	Digital input (DI_CONTROLLER_)	Default function
JL-1	01	**DIF.3001 - "GCB status"**
JL-2	02	**DIF.2702 – "Enable load function"**
JL-3	03	**DIF.0000 - "Not used"**
JL-4	04	**DIF.0000 - "Not used"**
JL-5	05	**DIF.4232 – "Maximum coolant temperature"**
JL-6	06	**DIF.4221 – "Minimum oil pressure"**
JL-7	07	**DIF.4212 – "Low fuel level"**
JL-8	08	**DIF.2501 – "Genset start inhibition"**

5.5.2 JP - Digital inputs 9-13 (DI_09-DI_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*.

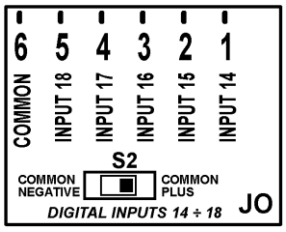
Alternatively, it's possible to activate the inputs by connecting them to the battery negative: in this case, the common terminal **JP-6** must be connected to the battery negative and the selector **S3** must be set on *common negative*.

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. 5.5.5).

By default, the functions of the JP input on the GC600 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

5.5.3 JO - Digital inputs 14-18 (DI_14-DI_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.5.5.5).

By default, the functions of the JO inputs on the GC600 controller are the following:

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

Terminal	Digital input (DI_CONTROLLER_)	Default function
JO-6	-	Positive or negative common input terminal

5.5.4 Virtual digital inputs (DI_VIRTUAL)

Besides 18 physical digital inputs and 64 available with the DITEL modules, 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 inputs can be associated to an AND/OR logic that determines the status (see par. 5.6.7) 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 mains/busbar 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 GCB")
  - ST.017 ("Mains/Busbar out of tolerance or absent").
- Therefore, the virtual digital input will be active when the GCB is closed and the mains/busbar 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 "mains voltage warning") within the P.2153 parameter.

5.5.5 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
P.2200	DITEL #01
P.2250	DITEL #02
P.2300	DITEL #03
P.2350	DITEL #04

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, virtual inputs and inputs available through DITEL modules is displayed at pages S.11 and S.12 (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 (alarm, deactivation, 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	GCB closing command			It only acts in MAN and TEST modes, used to control the manual closing of the GCB circuit breaker. If there is no input configured with the function DIF.1002, this input works as toggle: it commands the closure of the breaker when the same is open and commands the opening when the same is closed.
DIF.1002	GCB opening command.			It only acts in MAN and TEST modes, used to control the manual opening of the GCB circuit breaker.
DIF.1003	GCB 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.1004	GCB synchronization command.			It is used when GCB is controlled by external devices: the external device activates this input if it wants the controller to carry out the synchronization and supply the “synchronized” contact.

Input function xx.	Name	Delay	Message	Description
DIF.1031	MCB closing command.			Only acts in MAN and in TEST, used to control the manual closure of the MCB breaker. If there is no input configured with the function DIF.1032, this input works as toggle: it commands the closure of the breaker when the same is open and commands the opening when the same is closed.
DIF.1032	MCB opening command.			Only acts in MAN and in TEST, used to control the manual opening of the MCB breaker.
DIF.1033	MCB 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.1034	MCB synchronization command.			It is used when MCB is controlled by external devices: the external device activates this input if it wants the controller to carry out the synchronization and supply the "synchronized" contact (or if it wants the controller to get the analogue signal provided by the external synchronizer).
DIF.2001	Alarm reset command.			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	Alarm acknowledgement command.			When the input becomes active, the controller carries out an acknowledgement of all faults and silence the acoustic horn. This operation is equivalent to press the ACK key on the controller
DIF.2029	Request for the test mode without load (impulse).			When the input becomes "active" with the controller in AUTO, the controller carries out a test start of the engine without load, not depending from the value set in parameter P.0222 "Enable generator supply on TEST". The test has a configured duration with parameter P.0420: if set to zero, this test is never performed. If there is a second activation of the input during the test, the test is immediately stopped.
DIF.2030	Request for the test mode with load (impulse).			When the input becomes "active" with the controller in AUTO, the controller carries out a test start of the engine with load, not depending from the value set in parameter P.0222 "Enable generator supply on TEST". The test has a configured duration with parameter P.0420: if set to zero, this test is never performed. If there is a second activation of the input during the test, the test is immediately stopped.
DIF.2031	TEST mode command.			When the input is "active", the mode of the controller switches from AUTO to TEST (the input does nothing if the controller is not in AUTO or if the automatic intervention of the genset is required). When it becomes inactive, the status changes back to AUTO. The test will be performed "with load" or "without load" based on how configured with parameter P.0222.
DIF.2032	REMOTE START command.	Yes		If the input is "active", the controller operating mode changes from AUTO to REMOTE START (the input does nothing if the controller is in OFF/RESET or MAN mode). When it becomes inactive, the status changes back to AUTO.
DIF.2033	Manual start request.			When the input "activates" (only in MAN mode), the controller tries to start (only once) in the same way of an automatic start, that is commanding the motor up to the start success or failure.
DIF.2034	Manual stop request.			When the input activates (in MAN mode), the controller commands the stop of the engine. It equals to pressing the STOP button.

Input function xx.	Name	Delay	Message	Description
DIF.2061	Low speed request.			When the input is “active”, the controller commands the engine a reduced rotation by means of a digital output (for some CAN-BUS engines, the command is sent directly to the CAN-BUS line). When this input is “active”, the controller disables the minimum frequency and minimum voltage protections of the genset because it assumes that the engine is running at a speed lower than the usual. The controller also impedes the GCB closing.
DIF.2062	Engine protections override			When the input is “active”, all the protections for the engine, which normally act as alarm, unload or deactivation elements, become mere warnings
DIF.2063	Complete protections override.			When the input activates, all protections (except some, see [1]) that cause alarms, unloads or deactivations become warnings.
DIF.2064	Genset protections override			When the input is “active”, all the protections for the genset, which normally act as alarm, unload or deactivation, become mere warnings
DIF.2071	Inhibit DPF regeneration.			When the input is "active", the controller "prevents" the regeneration of the particulate filter to the engine ECU. See par. **Error! Reference source not found.**.
DIF.2072	Force DPF regeneration.			When the input is "active", the controller requires the regeneration of the particulate filter to the engine ECU. See par. **Error! Reference source not found.**.
DIF.2073	Consent for DPF regeneration.			If this input exists, the controller authorizes the regeneration of the particulate filter only when the input is active. If it does not exist, the controller authorizes regeneration when GCB is open.
DIF.2091	Select DROOP mode for AVR			When the input is active, the controller activates the DROOP mode for the control of the round and voltage regulators.
DIF.2092	Second power set-point			When the input is active, the power setpoint during the parallel with the mains is the parameter P.0902 instead of the parameter P.0884.
DIF.2093	Select the import-export mode.			When the input is active, the controller switches to the “import/export” mode during the parallel with the mains, whatever is the mode configured in P.0880.
DIF.2094	Select the DROOP mode.			When the input is active, the controller activates the DROPP mode for the control of the round and voltage regulators.
DIF.2095	It disables the kW control.			When the input is active, the controller disables all the regulators for the management of the active and reactive power.
DIF.2096	Transfer to the gensets.			When the input is active, the controller transfers the load from the mains to the genset, then it opens the MCB circuit breaker.
DIF.2097	Limitation of set-point of active power 1			When the input is active, the power setpoint during the parallel with the mains is the parameter P.0902 instead of the parameter P.0954.
DIF.2098	Limitation of power setpoint active 2.			When the input is active, the power setpoint during the parallel with the mains is the parameter P.0902 instead of the parameter P.0955.
DIF.2099	Local BASE LOAD.			When the input is active, the controller operates in BASE LOAD mode, even if the parameter P.0880 has been selected in SYSTEM BASE LOAD mode. If the gensets are supplying a load (not in parallel with the mains), this input excludes the genset from the active and reactive power share and makes it work with fix power.
DIF.2121	Select the master genset.			Used in the “load management”. See document [10].
DIF.2151	Select configuration 1.			When the input becomes “active”, the parameters of the alternative configuration 1 are copied into the work parameters

Input function xx.	Name	Delay	Message	Description
DIF.2152	Select configuration 2.			When the input becomes “active”, the parameters of the alternative configuration 2 are copied into the work parameters
DIF.2153	Select configuration 3.			When the input becomes “active”, the parameters of the alternative configuration 3 are copied into the work parameters
DIF.2154	Select configuration 4.			When the input becomes “active”, the parameters of the alternative configuration are copied into the work parameters
DIF.2161	Selects the application SPM.			When the input becomes “active”, if the parameters P.0802 is set to “10”, the relevant SPM plant type is selected.
DIF.2162	Selects the application SSB.			
DIF.2163	Selects the application SSB+SSTP.			
DIF.2164	Selects the application SPTM.			
DIF.2165	Selects the application SPTM+SSB.			
DIF.2166	Selects the application MPM.			
DIF.2167	Selects the application MSB.			
DIF.2168	Selects the application MSB+MSTP.			
DIF.2169	Selects the application MPTM.			
DIF.2170	Selects the application MPTM+MSB.			
DIF.2181	Immediate supply.			It is used in plants composed by more gensets: if the input is active, the switch of the users between mains and gensets is carried out after the closing of the GCB circuit breaker.
DIF.2211	Load sharing enabled.			It is used if the sharing of the active power is managed by an external device: the controller uses the signal coming from that device only if this input is active.
DIF.2241	Fuel pump in MAN-OFF mode.			When the input is active, the fuel pump mode is forced in “MAN-OFF”.
DIF.2242	Fuel pump in MAN-ON mode.			When the input is active, the fuel pump mode is forced in “MAN-ON”.
DIF.2243	Fuel pump in AUTO mode.			When the input is active, the fuel pump mode is forced in “AUTO”.
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.**
DIF.2272	MAN, by remote control.			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	AUTO by remote control.			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.2330	Select no power reserve for the load function			Used in the “load management”. See document [10].
DIF.2331	Select the power reserve #1 for the load function.			Used in the “load management”. See document [10].
DIF.2332	Select the power reserve #2 for the load function.			Used in the “load management”. See document [10].
DIF.2333	Select the power reserve #3 for the load function.			Used in the “load management”. See document [10].
DIF.2401	Input for pulse counter #1			The controller increments the pulse counter #1 when this input **becomes** active.
DIF.2402	Input for pulse counter #2			The controller increments the pulse counter #2 when this input **becomes** active.

Input function xx.	Name	Delay	Message	Description
DIF.2403	Input for pulse counter #3			The controller increments the pulse counter #3 when this input **becomes** active.
DIF.2404	Input for pulse counter #4			The controller increments the pulse counter #4 when this input **becomes** active.
DIF.2405	Input for pulse counter #5			The controller increments the pulse counter #5 when this input **becomes** active.
DIF.2406	Input for pulse counter #6			The controller increments the pulse counter #6 when this input **becomes** active.
DIF.2407	Input for pulse counter #7			The controller increments the pulse counter #7 when this input **becomes** active.
DIF.2408	Input for pulse counter #8			The controller increments the pulse counter #8 when this input **becomes** active.
DIF.2417	Reset for pulse counter #1			The controller clears the pulse counter #1 when this input **is** active.
DIF.2418	Reset for pulse counter #2			The controller clears the pulse counter #2 when this input **is** active.
DIF.2419	Reset for pulse counter #3			The controller clears the pulse counter #3 when this input **is** active.
DIF.2420	Reset for pulse counter #4			The controller clears the pulse counter #4 when this input **is** active.
DIF.2421	Reset for pulse counter #5			The controller clears the pulse counter #5 when this input **is** active.
DIF.2422	Reset for pulse counter #6			The controller clears the pulse counter #6 when this input **is** active.
DIF.2423	Reset for pulse counter #7			The controller clears the pulse counter #7 when this input **is** active.
DIF.2424	Reset for pulse counter #8			The controller clears the pulse counter #8 when this input **is** active.
DIF.2501	Genset operation inhibit.			When the input is “active”, the automatic start of the engine is inhibited. "TEST" and "REMOTE START" modes are not affected by this function
DIF.2502	Inhibition to taking of load			In automatic mode, when the input is "active", the board opens GCB switch (and, where applicable, closes MCB switch).
DIF.2503	MCB closure inhibition			If this input is active, the controller keeps the MCB circuit breaker open (in automatic modes).
DIF.2701	Enable REMOTE START request.			If this function is defined for one input, “REMOTE START” function is inhibited if the input is not active.
DIF.2702	It enables the load function.			Used in the "load management". See document [10].
DIF.2703	Enable the load thresholds.			If the input is not active, the management of load thresholds (described in 9.6) is disabled
DIF.2704	Disable the protections on the 4th current.			When this input is “active” the auxiliary current protection (normally used for differential protection) is disabled.
DIF.2705	Disable the protections on the analogue measures.			When this input is “activated”, the thresholds set on analogue measures having bit 13 ON in the third configuration parameter (see par. **Error! Reference source not found.**) do not trigger the relevant protections.
DIF.2706	It enables controls from serial ports.			If this input is not active, the controls sent via Modbus HOLDING REGISTER 101 and 102 are not accepted.
DIF.2707	It enables fast parallel.			It enables CBE function. See document [10].
DIF.2708	It enables the restrictive thresholds ("1") for PPR.			If this input exists but is not active, the protections for the parallel with the mains configured with P.0922 and P.0924 parameters are disabled. See document [10].

Input function xx.	Name	Delay	Message	Description
DIF.2709	Consent to starting			In case of a request for automatic starting, the board activates its internal sequence to start the engine, but it does not activate any actual control until this input (if it exists) is activated (it can be used, for example, to manage pre-ventilation).
DIF.2710	It enables the acquisition of the setpoint for the BASE LOAD from analogue input			If this input exists and is active, the power setpoints for the parallel with the mains is acquired by a suitably configured analogue input. If it exists and is not active, the setpoint is P.0884 parameter.
DIF.2711	It enables the acquisition of the speed reference from analogue input			If this input exists and is active, the speed offset is acquired from an analogue input properly configured. If it exists and it is not active, the setpoint is the P.0840 parameter.
DIF.2712	Enables the function 27T			If this input exists and is not active, the function which disables the generator and interface protections 27 for low mains voltage is disabled.
DIF.2715	It enables the load function in DROOP mode.			If this input exists and is active, the load function works on the controllers in DROOP, instead of on those in ISOCHRONOUS.
DIF.2716	It enables the load function in system BASE LOAD mode.			If this input exists and is active, the load function works on the controllers in SYSTEM, BASE, LOAD, instead of on those in ISOCHRONOUS.
DIF.2723	Enables the limitation of the active power setpoint for high grid voltage			It is combined with the function which, in parallel with the mains, reduces the active power supplied if the mains voltage rises above a configured threshold. If there is no input configured with this code, the power reduction is always enabled. If there is an input configured with this code, the power reduction is enabled if the input is active.
DIF.3001	GCB breaker status.	Yes		It acquires the circuit breaker status which connects the genset to the parallel bars or to the loads. An input configured in this way is used to activate 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.3002	MCB breaker status.	Yes		It acquires the circuit breaker status which connects the mains to the users. An input configured in this way is used to activate warnings in the event of a discrepancy between the controls to the switch given by the board and the status of the same switch. Warning can be also issued in this case or, even, depending on the configuration, the gen-set can be started in case of MCB closure failure. It is also used to detect the status of the circuit breaker when it is commanded by external devices.
DIF.3003	MGCB breaker status.			It acquires the general circuit breaker status, which connects the genset parallel bars to the users. It is used for the parallel logics and to disable the “load management” if the loads are not connected to the gensets.
DIF.3004	Other gensets GCB status			Use this input if the genset must work in parallel with other gensets controlled by “non-Mecc Alte” controllers: indicate GC600 that at least another genset has got its own GCB closed.
DIF.3005	Status of the neutral earthing remote-control switch (NECB).	Yes		It acquires the contactors status for earthing the neutral of the genset. An input configured in this way is used to activate warnings in the event of a discrepancy between the controls to the switch given by the board and the status of the switch itself.
DIF.3101	External mains sensor.			When the input is “active”, the mains is considered “in tolerance”

Input function xx.	Name	Delay	Message	Description
DIF.3102	Absence of voltage on the parallel bars.			Used in parallel plants, where the controller cannot directly measure the voltage on the parallel bars. The active input indicates that there is no voltage on the bars.
DIF.3103	External protections for parallel with the mains			Connect the external device, which manages the protections of parallel with the mains, to this input. The input must be active when no protection has triggered.
DIF.3201	General 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 general 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	General 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 general 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	General 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 general 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.3301	Fuel level for pump start			When the input is “active” the fuel pump is started (see par. 9.1).
DIF.3302	Level for fuel pump stop			When the input is “active” the fuel pump is stopped (see par. 9.1)
DIF.3311	Level for starting AdBlue pump			See 7.7.14
DIF.3312	Level for stopping AdBlue pump			See 7.7.14
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.4002	Generic unload	Yes	Yes	When the input is active, a warning is issued: the message shown is the one set by means the related “text” parameter.
DIF.4003	Generic deactivation	Yes	Yes	When the input is active, a warning is issued: the message shown is the one set by means the related “text” parameter.
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	Yes	Yes	When the input is “active”, if the configured time with parameter P.0216has passed from the engine start, a warning is issued: the message displayed is the one set in the parameters associated to the input
DIF.4012	Warning (after oil delay)	Yes	Yes	When the input is “active”, if the configured time with parameter P.0216has passed from the engine start, an unload is issued: the message displayed is the one set in the parameters associated to the input.
DIF.4013	Deactivation (after oil delay)	Yes	Yes	When the input is “active”, if the configured time with parameter P.0216has passed from the engine start, a deactivation is commanded: the message displayed is the one set in the parameters associated to the input.
DIF.4014	Alarm (after oil delay)	Yes	Yes	When the input is “active”, if the configured time with parameter P.0216has passed from the engine start, an alarm is issued: the message displayed is the one set in the parameters associated to the input.
DIF.4021	Warning (if GBC closed)	Yes	Yes	When the input is “active”, if the GCB command is active, a warning is issued: the message shown is the one set in the parameters associated to the input
DIF.4022	Unload (if GBC closed)	Yes	Yes	If the input is active, an unload is issued: the message shown is the one set in the parameters associated to the input.

Input function xx.	Name	Delay	Message	Description
DIF.4023	Deactivation (if GBC closed)	Yes	Yes	When the input is active, if the GCB command is active, a deactivation is issued: the message shown is the one set in the parameters associated to the input.
DIF.4024	Alarm (if GBC closed)	Yes	Yes	When the input is “active”, if the GCB command is active, a warning is issued: the message shown is the one set in the parameters associated to the input
DIF.4031	Warning (if fuel activated)	Yes	Yes	When the input is “active”, if the fuel electro valve command (DOF.1003) is active, a warning is issued: the message shown is the one set in the parameters associated to the input
DIF.4032	Unload (if fuel activated)	Yes	Yes	When the input is “active”, if the fuel solenoid valve command (DOF.1003) is active, an unload is issued: the message shown is the one set in the parameters associated to the input
DIF.4033	Deactivation (if fuel activated)	Yes	Yes	When the input is “active”, if the fuel electro valve command (DOF.1003) is active, a deactivation is issued: the message shown is the one set in the parameters associated to the input
DIF.4034	Alarm (if fuel activated)	Yes	Yes	When the input is “active”, if the fuel electro valve command (DOF.1003) is active, an alarm is issued: the message shown is the one set in the parameters associated to the input
DIF.4041	Warning (if GAS activated)	Yes	Yes	When the input is “active”, if the output command set as DOF.1004 - gas valve is active too, a warning is issued: the message shown is the one set in the parameters associated to the input
DIF.4042	Unload (if fuel activated)	Yes	Yes	When the input is “active”, if the output command set as DOF.1004 - gas valve is active too, an unload is issued: the message shown is the one set in the parameters associated to the input
DIF.4043	Deactivation (if GAS activated)	Yes	Yes	When the input is “active”, if the output command set as DOF.1004 - gas valve is active too, a deactivation is issued: the message shown is the one set in the parameters associated to the input
DIF.4044	Alarm (if GAS activated)	Yes	Yes	When the input is “active”, if the output command set as DOF.1004 - gas valve is active too, an alarm is issued: the message shown is the one set in the parameters associated to the input
DIF.4051	Warning (fuel pump off)	Yes	Yes	If the input is active, a warning is issued: the message shown is the one set by means the related “text” parameter. The controller stops the fuel pump until when this input is “active”
DIF.4052	Unload (fuel pump off)	Yes	Yes	If the input is active, an unload is issued: the message shown is the one set by means the related “text” parameter. The controller stops the fuel pump until when this input is “active”
DIF.4053	Deactivation (fuel pump off)	Yes	Yes	If the input is active, a deactivation is issued: the message shown is the one set by means the related “text” parameter. The controller stops the fuel pump until when this input is “active”
DIF.4054	Alarm (fuel pump off)	Yes	Yes	If the input is active, an alarm is issued: the message shown is the one set by means the related “text” parameter. The controller stops the fuel pump until when this input is “active”
DIF.4062	Unload (subject to override)	Yes	Yes	When the input is “active”, an unload is normally activated. If the Override function of the engine protections is activated, a warning activates. The message shown is the one set on the parameters associated to the input.

Input function xx.	Name	Delay	Message	Description
DIF.4063	Deactivation (subject to override)	Yes	Yes	When the input is “active”, a deactivation is normally activated. If the Override function of the engine protections is activated, a warning activates. The message shown is the one set on the parameters associated to the input.
DIF.4064	Alarm (subject to override)	Yes	Yes	When the input is “active”, an alarm is normally activated. If the Override function of the engine protections is activated, a warning activates. The message shown is the one set by means of the related parameters.
DIF.4211	Fuel minimum level	Yes		When the input is active, an alarm is activated with a fix description (based on the language). This contact can be used for the management of the fuel pump (see par.). 9.1).
DIF.4212	Low fuel level	Yes		When the input is active, a warning is activated with a fix description (based on the language). This contact can be used for the management of the fuel pump (see par.). 9.1).
DIF.4213	High fuel level	Yes		When the input is active, a warning is activated with a fix description (based on the language). This contact can be used for the management of the fuel pump (see par. 9.1).
DIF.4221	Minimum oil pressure	Yes		When the input is “active”, if the configured time with parameter P.0216has passed from the engine start, an alarm is issued with a fix description (based on the language)
DIF.4222	Low oil pressure	Yes		When the input is “active”, if the configured time with parameter P.0216has passed from the engine start, a warning is issued with a fix description (based on the language)
DIF.4231	High cooling air temperature	Yes		When the input is “active”, if the configured time with parameter P.0216has passed from the engine start, a warning is issued with a fix description (based on the language)
DIF.4232	(L3)	Yes		When the input is “active”, if the configured time with parameter P.0216has passed from the engine start, an alarm is issued with a fix description (based on the languages)
DIF.4241	Overload	Yes		Normally, the “tripped” contact of the machine protection breaker is connected to this input. When the input is active, an alarm is activated with a fix description (based on the language).
DIF.4251	Overspeed	Yes		When the input is active, an alarm is activated with a fix description (based on the language).
DIF.4261	Production line open	Yes		When the input is “active”, the controller realises to be no more in parallel with the mains and stops the genset with an alarm.

5.6 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). It is possible to add 4 DITEL modules16 JN, each of which manages up to 2 DITEL 8 OUT relay modules, for a total of 64 additional outputs, in addition to the one on the controller.

5.6.1 JJ - Digital outputs 15-16: Engine commands outputs (DO_15-DO_16)

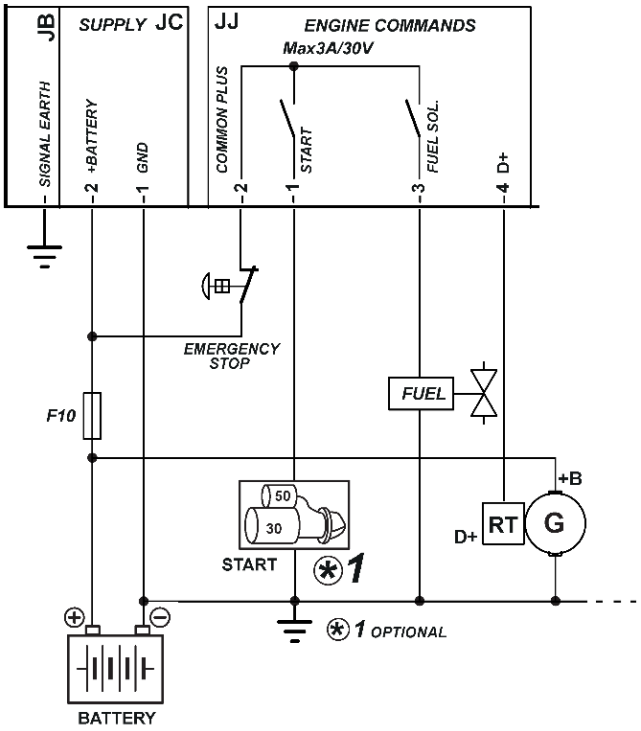


Diagram for de-energized stop

The **JJ** connector is configured for the connection of starter motor (**START**) and fuel electro-valve (**FUEL, SOLENOID)**; Also, there is (but not configured as a default), the output to check the battery charger generator on the engine (**+D**) If not used to control the engine (e.g., with CAN-BUS engines), the two outputs are re-configurable from parameter for other purposes, and the +D terminal can be used as digital input or of additional voltage measure.

The status of the START and FUEL outputs is displayed at pages S.13 (0=output not active, 1=output active).

The default functions of the JJ outputs are:

Terminal	Digital output (DO_CONTROLLER_)	Type	Default function
JJ-1	15 - START	Normally open contact, of the START relay.	**DOF.1005 – "Engine start command"**
JJ-2	-	Terminal positive common input	
JJ-3	16 - MCB	Normally open contact, of the FUEL relay.	**DOF.1003 – "FUEL valve"**
JJ-4	-	D+ Output	

In detail:

5.6.1.1 JJ-2 COMMON PLUS Common positive

Positive input common to outputs START and FUEL, 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 starting battery by means of a contact of the emergency button: that is, this connection must be interrupted by keeping the emergency button pressed (Attention: this is not valid for systems with stop in excitation). Several emergency buttons may be used by series connecting them to each other.
Voltage free (that is, pressing the emergency button,) in operational mode (MAN, AUTO, TEST, 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.15 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 overvoltage which would enter in conduction and could be immediately damaged.

5.6.1.2 JJ-1 START Command for the starter motor (Digital output 15)

Positive relay output, with maximum capacity of 3A @30VDC. Integrated internal diode for damping opening overvoltage. 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 overvoltage.

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

The controller activates this command when motor start is required and deactivates it automatically within 200-300ms from the instant when it recognizes the motor started state.

If this commands not necessary (e.g., In engines with CAN-BUS interface), the output can be configured for other purposes by means of parameter P.3015, see paragraph 5.6.6 and documents [1] for the parameters list.

5.6.1.3 JJ-3 FUEL SOLENOID Fuel solenoid valve command (Digital output 16)

Positive relay output, with a capacity of 3A @30VDC. Integrated internal diode for damping opening overvoltage. 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 overvoltage.

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

The default output is configured to command the interception solenoid valve of the fuel with stop systems of de-excitation (see below); if not used for this purpose (e.g. In engines with CAN-BUS interface), it can be reconfigured for other purposes with parameter P.3016, see paragraph 5.6.6 and documents [1] for the parameters list.

The controller allows two different stop modes of the engine:

Drop-down stop system

With this system (default configuration of the device), the engine is started giving voltage to the solenoid valve which opens/closes the fuel flow and stopped taking voltage off.

The controller activates, therefore, the JJ-3 FUEL SOLENOID output, before starting the engine (at least 200ms guarantee between the activation of this command and the activation of the command for the starter motor). It deactivates it when the motor must be turned off. If the engine is stopped by other means, it is possible to delay the deactivation of this command through parameter P.0234.

Pick-up stop system

This system is used when the engine requires an explicit command to stop. It is mostly used for security reasons: with the stop in de-energize, in effect, if a cabled wire on **JJ-3** terminal accidentally detaches, the engine stops. Instead, in case of shut-off while energizing, the engine does not stop until it receives the explicit arrest command.

By default, the positive auxiliary output **JD-1** is configured for the stop command during energizing. It is possible to configure any other output or the same output **JJ-3 FUEL SOLENOID** (but observing the following warning) to give the stop command setting the relative parameters (see par. 5.9.3 And documents [1] for the parameters list.

WARNING: The connection of the emergency button with the terminal JJ-2 DOES NOT WORK WITH SYSTEMS OF STOP IN EXCITATION, as the opposite effect of cutting the voltage to the stop valve would result, even though the controller activates the AL.048 "**A048 Emergency Stop" and the configured output as a stop command.** For these systems, in case the functionality of the emergency push button is to be guaranteed, it must have a double contact: one NC connected in series to JJ-3, as already seen to cut the supply off the starter motor and one NO between positive of

battery and stop valve/command without intermediate fuse which, when activated, supplies positive voltage to the stop valve bypassing the controller command.

5.6.1.4 JJ-4 D+ Excitation and check operation recharge generator

NOTE: To configure JJ-4 for the connection D+ to the recharge generator excitation it is necessary to configure the parameter P.4123 with the value AIF.1300 – "Signal D+". Tu use JJ-4 for other functions correlated to D+ see par. 5.6.6 and correlated. The output is configured as AIF.0000 – "Not Used".

When the controller starts the engine, the terminal **JJ-4** supplies the necessary current for the excitation of the battery recharge generator. The supply of the circuit is got from the **JC-2 +VBATT** controller supply terminal.

When engine and generator are stopped, the D+ terminal of the generator is practically a short circuit towards the battery negative and the voltage at its edges is close to 0V. During or immediately after the engine start, and in normal operation conditions, with the rotation of the recharge generator, the D+ voltage goes up to the value of the battery voltage. When the engine stops, or even if only the recharge generator would stop for the break of the belt that drags it, the D+ voltage goes back to be 0V. The same thing happens in case of malfunction of the alternator.

The current supplied with generator stopped is internally limited and is 200mA for 12V systems and 100mA for 24V systems, by means of an automatic threshold on the battery voltage value. The passage point between the two current levels happens at about Vbatt=19VDC.

The excitation command is activated in function of the engine start command.

During the engine starting cycle, up to when the engine is recognised as started, through any method (voltage, frequency, rpm, D+ voltage, oil pressure), the command is kept active for 30 continuing sec. and then it is deactivated/activated every 5s (5s ON followed by 5s OFF) up to the end of the starting sequence. When the engine is recognised as started, the command is kept active for further 5s and then released.

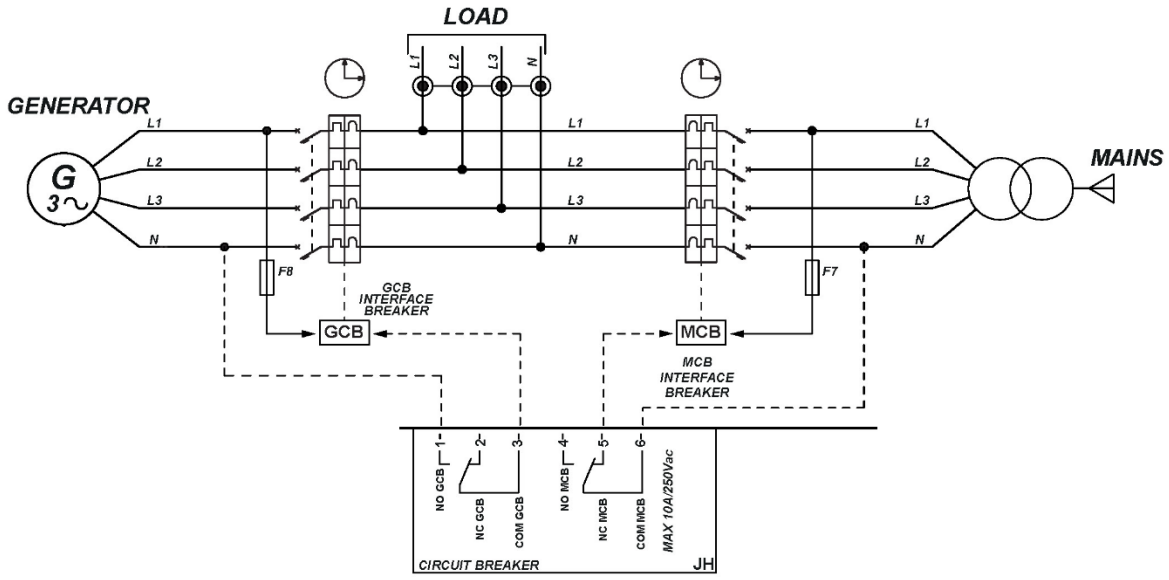
Still by means of JJ-4, the controller measures the D+ voltage of the recharge generator, both during the starting of the engine and when it is in operation. It is displayed on menu S.15 at D+

The voltage measure can be used for two purposes:

- Engine running/stop detection
- Usually, the recharge alternator is driven by the drive shaft through a drive belt. Normally, the drive belt also drives other mechanical components of the engine, for example the cooling fan of the radiator. If during the engine operation the D+ voltage of the recharge generator falls to 0V or does not raise after the starting, once the time P.0349 has passed, it is supposed that the belt broke or that there is a fault. The device activates the anomaly AL.005 ("A005 – Belt broken") configurable with parameter P.0357 (as warning, unload, deactivation or alarm) to protect the engine from the dysfunction of the mechanic parts dragged by the belt.

Using parameters P.0230 and P.0231 it is possible to activate/deactivate the recognition of the engine started by signal D+; using parameter P.0349 it is possible to deactivate the anomaly AL.005 ("A005 - belt broken) (see documents [1] for the parameters list).

5.6.2 JH - Digital outputs 17-18 Outputs for the command on the loads switching (DO_17-DO_18)



The controller uses two 10A@250Vac relays in clean contact for the switching commands of the loads. 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 - GCB	Normally open contact, of the GCB relay.	**DOF.2034 - "MCB steady opening command"**
JH-2		Normally closed contact, of the GCB relay.	
JH-3		Common contact of the GCB relay.	
JH-4	18 - MCB	Normally open contact, of the MCB relay.	**DOF.2004 - "MCB steady opening command"**
JH-5		Normally closed contact, of the MCB relay.	
JH-6		Common contact of the MCB relay.	

Following an example of use of the two commands for those plants that don't go in parallel with the mains or with other gensets.

The command GBG is necessary to (as default) connect the loads to the generator. The command GBG is necessary to (as default) connect the loads to the generator. Both the relays can be used for other functions.

It is necessary to use the contact, normally used of MCB and normally open of GCB; in this way, even with deactivated controller, however the loads remain connected to the electric mains.

Three different systems can be used to change-over the loads:

- SWITCH (SIRCOVER): with only one command the loads are changed-over to the mains or to the generator. Use the terminals JH1 and JH3 to control the SIRCOVER: in this way, when the controller is unpowered, the loads are automatically changed-over to the mains. The MCB output (terminals 4... 6 of JH) is not used, it can be therefore associated to a different function. Configure P.0220 parameter with the time spent by the SIRCOVER for the switching: in this way the controller avoids reversing the command before the switching ends (operation that risks getting the SIRCOVER itself stuck). Instead, P.0219 to be set to zero because the pause between mains and genset and vice-versa is ensured by SIRCOVER.
- Two separated switches (if the parallel with the mains is not provided, it is suggested to interlock them mechanically and electrically). The command for the switch that connects the two loads to the genset (GCB) must be taken from the

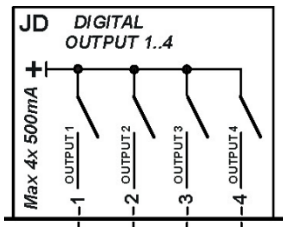
terminals 1 and 3 of the JH connector. In this way, with controller deactivated, the contact opens, and the GCB switch separates the genset from the loads. The command for the switch that connects the two loads to the mains (MCB) must be taken from the terminals 5 and 6 of the JH connector. In this way, with controller deactivated, the contact closes and the MCB switch will connect the loads to the electric mains. Set parameter P.0220 to zero (the command can always be immediately inverted) and set the pause time required during the switching on parameter P.0219 The controller uses logics that avoid the simultaneous not synchronized closure of GCB and MCB; in any case, it is necessary that an external wired logic is used to this purpose.

- One breaker (for manual gen-sets where the mains is missing). Use the terminals JH1 and JH3 for the command of the switch: in this way, when the controller is deactivated, the loads are separated from the generator. Configure both parameter P.0220 and P.0219 to zero.

  For the switching management see par. 7.7.13

  If there is only one switch, the MCB output (terminals 4... 6 of JH) is not used, it can be therefore associated to a different function (see par. 5.6.6).

5.6.3 JD - Digital output 1-4 (DO_01-DO_04)



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. **Never exceed these maximum current values.**

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 deactivate the output.

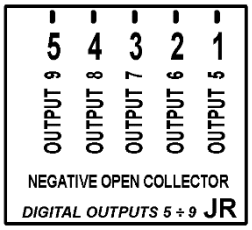
With inductive loads (power relays, electro-magnetic actuators), although already internally present, it is advisable to use damping diodes of the opening over voltages. **Use of opening overvoltage damping diodes is necessary**, especially for highly inductive loads.

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.1006 – "Command for stopping in excitation)**
JD-2	02		**DOF.3152 – "External acoustic signal"**
JD-3	03		**DOF.0000 - "Not used"**
JD-4	04		**DOF.0000 - "Not used"**

5.6.4 JR - Digital output 5-9 (DO_05-DO_09)



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. **Never exceed these maximum current values.**

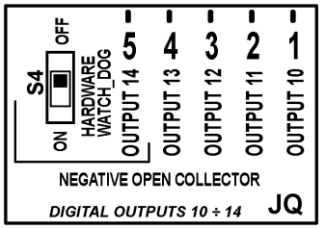
The outputs are independent and individually protected from overloads, short circuits, polar inversion and overheating. The overload protection intervenes limiting the current peak at an instantaneous value of 2.2A. When this condition is lasting, the intervention of the thermal protection starts, which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

With inductive loads (power relays, electro-magnetic actuators), although already internally present but the **use of opening overvoltage damping diodes is necessary**, especially for highly inductive loads.

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"**

5.6.5 JQ - Digital output 10-14 (DO_10-DO_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. **Never exceed these maximum current values.**

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 to 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 to 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.

Some engines have a PWM output to adjust the speed. The outputs 12 and 13 (JQ-3 and JQ-4) can be used (if configured with function DOF.2231) to generate a PWM signal with 500Hz frequency and duty-cycle proportional to the engine speed required.

All outputs are independent and individually protected from overloads, short circuits, polar inversion and overheating. The overload protection intervenes limiting the current peak at an instantaneous value of 2.2A. When this condition is lasting, the intervention of the thermal protection starts, which gradually reduces the current to keep the temperature of the output driver within its maximum limit. **Use of opening overvoltage damping diodes is necessary**, especially for highly inductive loads.

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"**

5.6.6 Digital outputs configuration

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

The status of the virtual outputs is displayed at pages S.13 and S14 (0=output not active, 1=output active).

All outputs activate when required by the relative function (e.g., The fuel pump output operates when the pump must 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 output) using the parameters:

Parameter	Outputs
P.3000	01...16
P.3020	17...18
P.3200	DITEL #01
P.3250	DITEL #02
P.3300	DITEL #03
P.3350	DITEL #04

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	Hexadecimal 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
16	8000	Output 16	JJ-3

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

While the map for the outputs on the four DITEL 8 OUT modules is:

Bit	Hexadecimal value	Digital output (DO_ CONTROLLER _)
1	0001	Output 01
2	0002	Output 02
3	0004	Output 03
4	0008	Output 04
5	0010	Output 05
6	0020	Output 06
7	0040	Output 07
8	0080	Output 08
9	0100	Output 0 9
10	0200	Output 10
11	0400	Output 11
12	0800	Output 12
13	1000	Output 13
14	2000	Output 14
15	4000	Output 15
16	8000	Output 16

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 outputs 3 and 4 on the controller, it is necessary to set P.3000 = 000C (thus 0004+0008); if you want to invert the outputs 5 and10 of the DITEL (16 IN + 16 OUT) second group, it is necessary to set P.3250 = 0210 (thus 0010+0200).

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 specific operation conditions.

The following three functions, 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 5.6.7.

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 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	AND/OR logics. X	The output status is the result of the combination of the logics AND/OR, see par. 5.6.7
DOF.1001	Glow plugs preheating.	Command for glow plugs preheating for diesel engines, see par. 7.7.6
DOF.1002	Activation engine junction box	Command to activate the ECU of the engine; see par. 7.7.6
DOF.1003	Fuel valve	Command for fuel shut off valve; see par. 7.7.6
DOF.1004	Gas valve	Command for the gas valve activation (for gas engines); see par. 7.7.6
DOF.1005	Engine start command	Command for the starter motor; see par. 7.7.6
DOF.1006	Command of stop	Command of stop for engines with stop in excitation; see par. 5.6.1.3 and par. 7.7.6
DOF.1007	Command of reduced speed	Some engines have an output to reduce the rotation speed; see par. 7.7.6
DOF.1008	Select battery 1	Select battery 1 for the engine starting; see par. 7.7.6.4.
DOF.1009	Select battery 2	Select battery 2 for the engine starting; see par. 7.7.6.4.
DOF.1031	Pre-heating cooling liquid	Command for pre-heating cooling liquid; see 7.7.6.4.
DOF.1032	Fuel pump	Command for fuel pump activation
DOF.1033	Command for pre-lubricating	Command to activate the pre-lubricating pumps before the engine start; see par. 7.7.6
DOF.1034	Solenoid valve for the fuel pump.	Command to activate the fuel shut off valve as done for fuel pump, see par. 9.1
DOF.1035	Inhibit DPF regeneration.	Command to inhibit the regeneration of the particulate filter; see par. 6.5.5.11.
DOF.1036	Force DPF regeneration.	Command to force the regeneration of the particulate filter; see par. 6.5.5.11.
DOF.1037	AdBlue pump.	See 7.7.14
DOF.1038	Solenoid for AdBlue pump.	See 7.7.14
DOF.2001	MCB (NC) Under voltage coil	See par. 7.7.14
DOF.2002	MCB opening coil	See par. 7.7.14
DOF.2003	MCB closing coil.	See par. 7.7.14
DOF.2004	MCB open command	See par. 7.7.14
DOF.2031	GCB under voltage coil.	See par. 7.7.14
DOF.2032	DOF.2032 - “GCB opening coil”.	See par. 7.7.14

Output function xx.	Name	Description
DOF.2033	Impulse closing command for GCB	See par. 7.7.14
DOF.2034	GCB close command	See par. 7.7.14
DOF.2061	Status of the neutral earthing remote-control switch (NECB).	Status of the neutral earthing remote-control switch (NECB). Used on parallel plants with mains or among gensets.
DOF.2091	GTS close command	It commands the opening and closing of the GTS switch (together with the MTS switch command, they allow to manage and external switching even in case of parallel among several gensets).
DOF.2092	MTS open command	It commands the opening and closing of the MTS switch (together with the GTS switch command, they allow to manage and external switching even in case of parallel among several gensets).
DOF.2121	Magnetization of the asynchronous genset	It commands the contactor connecting/disconnecting the magnetization resistors: the controller activates the output when it wants to insert the resistors.
DOF.2122	Power-factor capacitors	It commands the contactor connecting/disconnecting the power-factor capacitors: the controller activates the output when it wants to insert the resistors.
DOF.2211	Voltage increase pulse	It provides a pulse command to the voltage regulator to increase the genset voltage. The minimum and maximum duration of the pulse are set in % by parameters P.0998 e P.0999.
DOF.2212	Voltage decrease pulse	It provides a pulse command to the voltage regulator to decrease the genset voltage. The minimum and maximum duration of the pulse are set in % by parameters P.0998 e P.0999.
DOF.2213	Voltage reset pulse	It provides a pulse command to the voltage regulator to restore the voltage to the nominal value (if managed by the voltage regulator).
DOF.2221	Speed increase pulse	It provides a pulse command to the voltage regulator to increase the engine speed. The minimum and maximum duration of the pulse are set in % by parameters P.0994 e P.0995.
DOF.2222	Speed decrease pulse	It provides a pulse command to the voltage regulator to decrease the engine speed. The minimum and maximum duration of the pulse are set in % by parameters P.0994 e P.0995.
DOF.2223	Speed reset pulse	It provides a pulse command to the voltage regulator to restore the speed to the nominal value (if managed by the voltage regulator).
DOF.2231	PWM 500Hz	Some engines have a PWM output to adjust the speed. This function configures the output as a signal in PWM and 500Hz frequency and duty-cycle proportional to the required engine speed. It can be set only on digital outputs 12 and 13.
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.3004	Test	It activates when the controller is in TEST mode.
DOF.3005	REMOTE START	It activates when the controller is in REMOTE START mode.
DOF.3011	Not in Off/reset	It activates when the controller is in MAN or AUTO mode.
DOF.3012	One of the automatic modes	It activates when a controller is in an automatic operation mode, that is AUTO, TEST, or REMOTE START.
DOF.3031	Voltage on bars	It activates when there is voltage on the parallel bars.
DOF.3032	Generator in tolerance	It activates when the genset parameters are in the window of normal operation
DOF.3033	Mains in tolerance	It activates when the mains parameters are inside the window “mains live”
DOF.3034	PPR ok	This output deactivates when an anomaly is diagnosed on the mains voltage which requires the interruption of the parallel with the mains itself.
DOF.3035	First command for 27Q	It is the first command of the 27Q protection for the parallel with the mains.
DOF.3036	Second command for 27Q	It is the second command of the 27Q protection for the parallel with the mains.
DOF.3037	Mains parallel closure consent	This output activates when the mains status allows the GCB switch closure and the parallel with the mains itself.
DOF.3061	Engine running.	It is active after noticing the condition of engine running, even if started manually.
DOF.3062	Ready to supply	It activates if the engine is running and if the “delay before supply” has been done (P.0218)
DOF.3091	Synchronisation for GCB	It activates during the synchronisation for the closure of the GCB switch.
DOF.3092	Synchronisation for MCB	It activates during the synchronisation for the closure of the MCB or MGCB switches.

Output function xx.	Name	Description
DOF.3093	Synchronization in progress.	It activates during the synchronisation for the closure of the GCB, MCB or MGCB switches.
DOF.3094	Synchronized	It activates during the synchronisation for the closure of the GCB or MCB switches, when the genset is synchronous with the mains or with the parallel bars.
DOF.3095	In parallel with other gensets	It activates when the genset is supplying in parallel with other gensets (but not with the mains).
DOF.3096	In parallel with the mains	It activates when the genset is supplying in parallel with the mains.
DOF.3121	Load thresholds	It activates to signal, according to the configuration, a condition of high or low load. See par. 9.6
DOF.3151	Reset 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 horn.
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.3180	No power reserve for the load function	Used for the load management, see [10].
DOF.3181	Selected the power reserve #1 for the load function.	Used for the load management, see [10].
DOF.3182	Selected the power reserve #2 for the load function.	Used for the load management, see [10].
DOF.3183	Selected the power reserve #3 for the load function.	Used for the load management, see [10].
DOF.3184	Enough power reserve for the load function	Used for the load management, see [10].
DOF.3190	Generator protections out of thresholds	It is activated as soon as the controller recognizes any "out of threshold" condition in the generator protections (including also the maximum active power protection), ignoring the delay. It is used during the TEST procedure, to check the accuracy of the controller on the measurement. For the sole purpose of activating this output, any protection masking conditions are ignored.
DOF.3191	Generator protections tripped	It is activated when the controller recognizes any "out of threshold" condition in the generator protections (including also the maximum active protection), consecutively for the configured delay. It is used during the TEST procedure to check the accuracy of the controller on the delay. For the sole purpose of activating this output, any protection masking conditions are ignored.
DOF.3192	Grid protections out of thresholds	It is activated as soon as the controller recognizes any "out of threshold" condition in the “parallel to the grid” protections, ignoring the delay. It is used during the TEST procedure, to check the accuracy of the controller on the measurement. For the sole purpose of activating this output, any protection masking conditions are ignored.
DOF.3193	Grid protections tripped	It is activated when the controller recognizes any "out of threshold" condition in the “parallel to the grid” protections (including also the maximum active protection), consecutively for the configured delay. It is used during the TEST procedure to check the accuracy of the controller on the delay. For the sole purpose of activating this output, any protection masking conditions are ignored.
DOF.4001	Warnings	It activates when there are warnings
DOF.4002	Unloads	It activates when there are unloads
DOF.4003	Deactivations	It activates when there are deactivations
DOF.4004	Alarms	It activates when there are alarms
DOF.4005	Alarms, deactivations and unloads	It activates when there are alarms. Deactivations and unloads
DOF.4031	Genset anomalies	It activates when there are anomalies regarding the genset, that is: 001 Genset minimum voltage 002 Genset maximum voltage 003 Minimum generator frequency

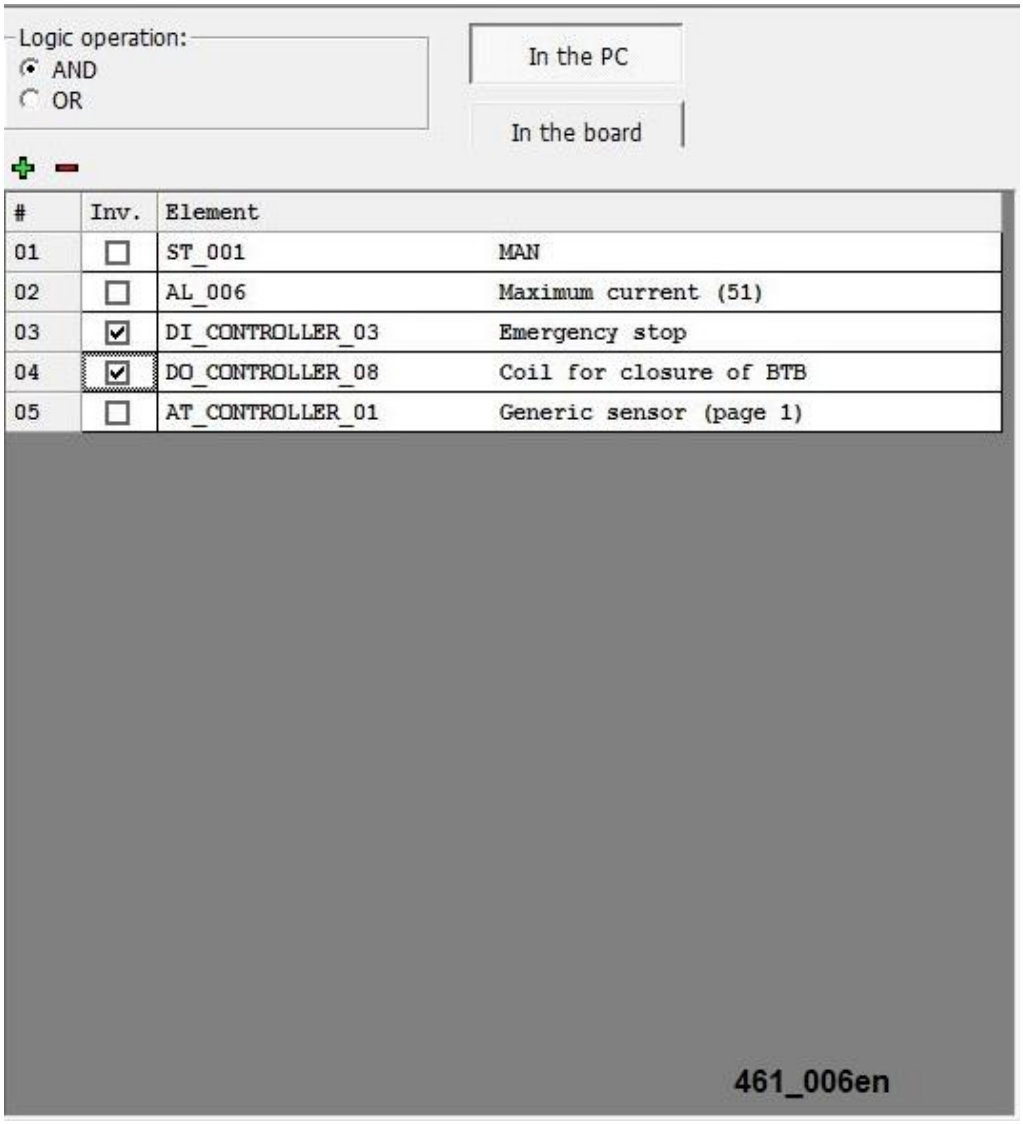
Output function xx.	Name	Description
		004 Maximum generator frequency 006 Maximum current 008 Full speed conditions not reached. 015 Overload (from contact) 016 Short circuit. 052 Disequilibrium on the voltages 053 Disequilibrium on the currents. 055 Phases wrong sequence 056 Genset low voltage. 058 Genset low frequency. 059 Genset high voltage. 060 Genset high frequency. 061 Lost Excitation 099 Minimum speed for asynchronous gensets
DOF.4032	Engine anomalies	It activates when there are anomalies regarding the engine, that is: 005: Belt break (fault generator battery charger). 021: Engine not stopped. 022: Over crank 031: High temperature cooling liquid (from contact). 032: High coolant temperature (from analogue sensor) 033: Maximum coolant temperature (from contact) 034: Maximum coolant temperature (from analogue sensor) 035: Maximum oil temperature (from analogue sensor) 037: Starter battery voltage, low 038: Starter battery voltage, high 039: Maintenance required 1 040: Maintenance required 2 041: Minimum oil pressure (from contact) 042: Minimum oil pressure (from analogue sensor) 043: Low oil pressure (from contact) 044: Low oil pressure (from analogue sensor) 049: High power 050: Maintenance required (from days counter) 054: High oil temperature (from analogue sensor) 062: Fault on Can-bus connection 065: Low coolant temperature (from analogue sensor) 096: Magnetic pickup failure

Output function xx.	Name	Description
		098: Communication lost with engine 105: Belt broken from Can-Bus 132: High temperature cooling liquid (from Can-Bus). 134: Maximum temperature cooling liquid (from Can-Bus). 135: Minimum temperature cooling liquid (from Can-Bus). 136: Low temperature cooling liquid (from Can-Bus). 137: Low battery voltage from Can-Bus 142: Minimum oil pressure from Can-Bus 144: Low oil pressure from Can-Bus 158: High oil temperature from Can-Bus 159: Maximum oil temperature from Can-Bus 198: Cumulative of warnings from Can-Bus 199: Cumulative of alarms from Can-Bus
DOF.4033	Anomalies speed regulator	It activates when there are anomalies with the engine rotation, that is: 003: Minimum generator frequency 004: Maximum generator frequency 011: Power inversion 018: Overspeed (from pick-up) 019: Overspeed (from frequency) 058: Genset low frequency. 060: Genset high frequency. 099: Minimum speed for asynchronous gensets 118: Overspeed (from can-Bus)
DOF.4034	Anomalies on fuel	It activates when there are anomalies regarding the fuel level, that is: 025: Minimum fuel level (from contact) 026: Minimum fuel level (from analogue sensor) 027: Low fuel level (from contact). 028: Low fuel level (from analogue sensor) 029: High fuel level (from contact) 030: High fuel level (from analogue sensor) 160: Water in fuel from CAN BUS
DOF.4035	Anomalies on circuit breakers	It activates when there are anomalies on the GCB and MCB circuit breakers, that is: 013: Mains circuit breaker not closed 014: Genset circuit breaker not closed 023: Mains circuit breaker not open 024: Genset circuit breaker not open

5.6.7 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. 5.6.6 and par.5.5.5). 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 must be carried out by PC with the BoardPrg4 software.



First, the operator must decide whether the conditions list must be evaluated as AND (they must be checked) or as OR (at least one condition checked). **It is 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. 5.8.4). In 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.003	TEST
ST.004	REMOTE START
ST.006	Identification ongoing anomalies
ST.007	Reset ongoing anomalies
ST.008	Warnings cumulative
ST.009	Unloads cumulative
ST.010	Deactivations cumulative
ST.011	Alarms cumulative
ST.012	Not recognised warnings total
ST.013	Not recognised unloads cumulative
ST.014	Not recognised deactivations cumulative
ST.015	Not recognised alarms cumulative
ST.016	Presence of mains voltage/frequency
ST.017	Mains out of tolerance or off
ST.018	Delay for mains in tolerance
ST.019	Mains in tolerance
ST.020	Delay for mains out of tolerance or off
ST.024	Generator voltage/frequency present
ST.025	Generator out of tolerance or absent
ST.026	Delay for generator within tolerance.
ST.027	Generator in tolerance
ST.028	Delay for generator out of tolerance or absent
ST.032	Engine started
ST.033	Oil protections enabled
ST.035	Engine sequence: standby
ST.036	Engine sequence: starting
ST.037	Engine sequence: low speed
ST.038	Engine sequence: delay before power delivery
ST.039	Engine sequence: ready to deliver
ST.040	Engine sequence: cooling
ST.041	Engine sequence: arrest
ST.048	Presence of bar voltages
ST.051	Protection 27Q active
ST.052	Mains parallel protections active (mains off)
ST.053	Protection 27 active (U<<, 1st threshold)
ST.054	Protection 59 active (U>>, 1st threshold)
ST.055	Protection 81 active (f<<, 1st threshold)
ST.056	Protection 81 active (f>>, 1st threshold)
ST.057	Protection ROCOF active
ST.058	Protection VECTOR JUMP active
ST.059	Protection 27 active (U<, 2nd threshold)
ST.060	Protection 59 active (U>, 2nd threshold)
ST.061	Protection 81<active (f<, 2nd threshold)
ST.062	Protection 81>active (f>, 2nd threshold)
ST.064	GCB status
ST.065	MCB status
ST.066	MGCB status
ST.068	GCB steady closing command
ST.069	MCB steady closing command
ST.070	GCB under voltage coil

Status	Description
ST.071	GCB pulse open command
ST.072	GCB pulse steady closing command
ST.073	MCB Minimum voltage coil command
ST.074	MCB pulse open command
ST.075	MCB pulse steady closing command
ST.080	Contact start inhibition
ST.081	Clock/Calendar start inhibition
ST.082	Starting inhibition from load function
ST.083	Start inhibition because it is not possible to supply in island mode or in case of mains failure
ST.084	Starting inhibition because another generator has GCB not open
ST.086	Start inhibited by MC controller
ST.088	Inhibition of the GCB closing from contact
ST.089	Inhibition of the GCB closing from serial port
ST.090	GCB closing inhibition from seal port
ST.091	GCB closing inhibition because another generator has GCB not open
ST.092	GCB closing inhibition because a returning synchronization is ongoing
ST.093	GCB closing inhibition from MC100 board
ST.096	Ready to supply
ST.097	Input synchronization
ST.098	Returning synchronization
ST.099	Synchronized
ST.100	Loading phase.
ST.101	Unloading ramp
ST.102	Supply in parallel with the mains
ST.103	Supply in parallel among gensets
ST.104	Supply
ST.108	Emergency plant
ST.109	Plant of parallel with the mains
ST.110	Parallel plant with other generators
ST.111	No MC100 on PMCB bus
ST.112	Synchronization every second
ST.113	Synchronization every minute
ST.114	Synchronization every hour
ST.127	Daylight Save Time
ST.128	Glow plug pre-heating command
ST.129	Engine activation command
ST.130	Fuel solenoid valve command
ST.131	Gas valve command
ST.132	Starter motor command
ST.133	Stop in excitation command
ST.134	Low speed command (IDLE)
ST.135	Pre-heating cooling liquid
ST.136	Pre- lubricating command
ST.137	Inhibit DPF regeneration
ST.138	Force DPF regeneration
ST.139	AdBlue pump command
ST.140	AdBlue solenoid command
ST.144	GCB closed on genset 01
ST.145	GCB closed on genset 02
ST.146	GCB closed on genset 03
ST.147	GCB closed on genset 04
ST.148	GCB closed on genset 05
ST.149	GCB closed on genset 06
ST.150	GCB closed on genset 07
ST.151	GCB closed on genset 08
ST.152	GCB closed on genset 09

Status	Description
ST.153	GCB closed on genset 10
ST.154	GCB closed on genset 11
ST.155	GCB closed on genset 12
ST.156	GCB closed on genset 13
ST.157	GCB closed on genset 14
ST.158	GCB closed on genset 15
ST.159	GCB closed on genset 16
ST.176	Master genset
ST.192	Unload ramp on generator 01
ST.193	Unload ramp on generator 02
ST.194	Unload ramp on generator 03
ST.195	Unload ramp on generator 04
ST.196	Unload ramp on generator 05
ST.197	Unload ramp on generator 06
ST.198	Unload ramp on generator 07
ST.199	Unload ramp on generator 08
ST.200	Unload ramp on generator 09
ST.201	Unload ramp on generator 10
ST.202	Unload ramp on generator 11
ST.203	Unload ramp on generator 12
ST.204	Unload ramp on generator 13
ST.205	Unload ramp on generator 14
ST.206	Unload ramp on generator 15
ST.207	Unload ramp on generator 16
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.256	CAN 0 BUS-OFF
ST.240	Timer 1
ST.241	Timer 2
ST.242	Timer 3
ST.243	Timer 4
ST.257	CAN 0 ERR-PASSIVE
ST.258	CAN 0 ERR-ACTIVE
ST.259	No communication on CAN 0
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	START button

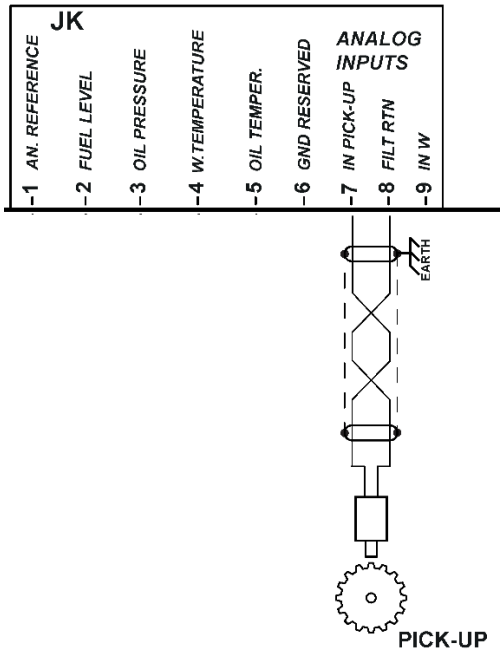
Status	Description
ST.305	STOP button
ST.306	GCB button
ST.307	MCB button
ST.308	MODE UP button
ST.309	MODE DOWN button
ST.310	UP button
ST.311	DOWN button
ST.312	LEFT button
ST.313	RIGHT button
ST.314	ENTER button
ST.315	EXIT button
ST.316	SHIFT button
ST.317	ACK button
ST.320	Status #01 from engine management by file
ST.321	Status #02 from engine management by file
ST.322	Status #03 from engine management by file
ST.323	Status #04 from engine management by file
ST.324	Status #05 from engine management by file
ST.325	Status #06 from engine management by file
ST.326	Status #07 from engine management by file
ST.327	Status #08 from engine management by file
ST.328	Status #09 from engine management by file
ST.329	Status #00 from engine management by file
ST.330	Status #11 from engine management by file
ST.331	Status #12 from engine management by file
ST.332	Status #13 from engine management by file
ST.333	Status #14 from engine management by file
ST.334	Status #15 from engine management by file
ST.335	Status #16 from engine management by file
ST.336	Application type: SPM
ST.337	Application type: SSB
ST.338	Application type: SSB+SSTP
ST.339	Application type: SPTM
ST.340	Application type: SPTM+SSB
ST.341	Application type: MPM
ST.342	Application type: MSB
ST.343	Application type: MSB+MSTP
ST.344	Application type: MPTM
ST.345	Application type: MPTM+MSB
ST.352	Maximum deliverable power limited for low mains frequency
ST.353	Delivered active power limited for high mains frequency
ST.354	Delivered active power limited for high mains voltage
ST.355	Delivered active power limited by external command
ST.367	Enable protections 27 for low mains voltage
ST.368	Active regeneration status: not active (spn3700=0)
ST.369	Active regeneration status: active (spn3700=1)
ST.370	Active regeneration status: will start soon (spn3700=2)
ST.371	DPF status: regeneration not required (spn3701=0)
ST.372	DPF status: regeneration needed - lowest level (spn3701=1)
ST.373	DPF status: regeneration needed - moderate level (spn3701=2)
ST.374	DPF status: regeneration needed - highest level (spn3701=3)
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

Status	Description
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_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
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 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.

First, we must 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 must 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 must 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.

5.7 Measure of engine rotation speed (PICK-UP or W) JK-7, JK-8 and JK-9



To measure the engine rotational speed, you can use a magnetic pick-up placed on the fly-wheel or use the W speed signal on the battery recharge alternator. The connection must be made with a shielded cable, with grounded shield.

In the case of engines equipped with digital control unit the rotational speed is measured directly via CAN-BUS.

If there is no acquisition system, the controller can still calculate and show rotation capacity from the genset speed as well.

5.7.1 Magnetic pick-up

You can use either two ground insulated wires pick-up, or a one-wire pick-up with the thread screwed onto the grounded engine (GND), which is the return connection for the signal; the two-wire isolated pick-up is however recommended.

The signal is sine wave; the frequency depends on the engine rotation speed and on the numbers of rotations of the fly-wheel.

The input minimum voltage with engine at full speed is about 3Vac; in case the voltage is lower, the signal can be increased screwing the pick-up so to get it close to the cogged wheel, paying much attention not to hit it during the rotation of the fly-wheel.

Connections:

JK-7 pick-up signal positive input

JK-8 pick-up signal negative input

With pick-up with only one thread, connect only **JK-7.**

It is normally possible to use only one pick-up connected both to the controller and to another device, e.g. a governor speed, paying therefore attention to observe the polarity of the connections. Check also that the signal amplitude is sufficient.

The number of teeth of the flywheel must be set in the P.0110 parameters; by entering 0, the pick-up measurement is disabled.

If the measurement is enabled, the controller signals any sensor failure with the anomaly AL.096.

5.7.2 W signal

Some battery charger alternators make available a "W" terminal that has an alternate voltage with a frequency proportional to the rotation speed of the battery charger. The W signal is generated inside the engine start battery recharge alternator. It is a squared wave of width, between 0 and Vbatt and frequency that is proportional to the rotation capacity of the engine but depends on how the generator is built and on the ratio between the diameters of the pulleys where the belt which pulls it moves.

To use the W signal, it is required:

- Connect the W signal of the battery charger alternator to the terminal **JK-9**.
- Connect terminal **JK-7** to terminal **JK-8**.

As said, the frequency of the signal W is proportional to the rotation capacity of the battery charger generator, not to the rotation capacity of the engine: between them there is, in effect, a belt. It is therefore necessary to set a ratio (parameter P.0111) which allows the controller to convert the frequency of the signal W (rotation per second of the battery charger generator) in rotations per minute of the engine. Such a ratio depends on different factors and it is not easily obtainable. If a frequency meter is available, simply start the engine (it will run at is rated and known speed, i.e., 1500 rpm) and measure the W signal frequency, and then calculate the ratio. If a frequency meter is not available, the following method can be used:

- Set a random value for P.0111 (e.g., 15).
- Start the engine and, when at operating speed, note the rpm value shown by the controller.
- Calculate the ratio between the displayed speed and the actual engine speed (displayed/actual).
- Multiply the value previously set in P.0111 for such ratio and set the new value.

Restarting the engine, the speed measure should be close to the actual speed. It is then possible to proceed by manually adapting the P.0111value up to obtain the correct view, keeping in mind that at equal real speed, the more P.001 increases, the more the values displayed by the controller decreases.

Leave P.0111 to 0 if W signal is not used.

NOTE: if W signal is used, set P.0110 to zero.

5.7.3 Revolutions measurement from frequency

If pick-up, W and can-bus are not available, it is possible to calculate the engine speed from the frequency of the generator. These two measures, in fact, are related by a fixed ratio, depending only by the number of poles of the alternator. On normal 4 poles generators, the rotation capacity is 30 times the generator frequency. To use this feature, the following settings are needed:

- Set P.0110 to 0 (disables pick-up).
- Set P.0111 to 0 (disables W).
- Set P.0127 to the right ratio.

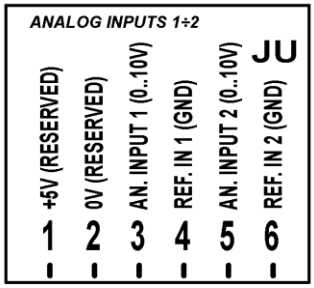
5.8 Analogue inputs 1-7 (JU, JK, JJ)

The device is equipped by two differential 0...10V voltage analogue inputs, available on terminal JU, four inputs fitted for sensor connection of a resistive/voltage type, available on terminal JK and one in voltage available on terminal JJ-4 (as an alternative od the use as signal +D).

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 AI_1 to AI_7 will be additional digital inputs from DI_19 to DI_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.

It is also possible to use 5 DIVIT expansion modules and 10 DIGRIN or DITHERM optional expansion modules, connected via CAN-BUS to acquire further 20 signals of voltage/current and up to 30 temperatures.

5.8.1 JU - Analogue inputs 1-2 (AI_01-AI_02)



They 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 4.0 VDC; 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.

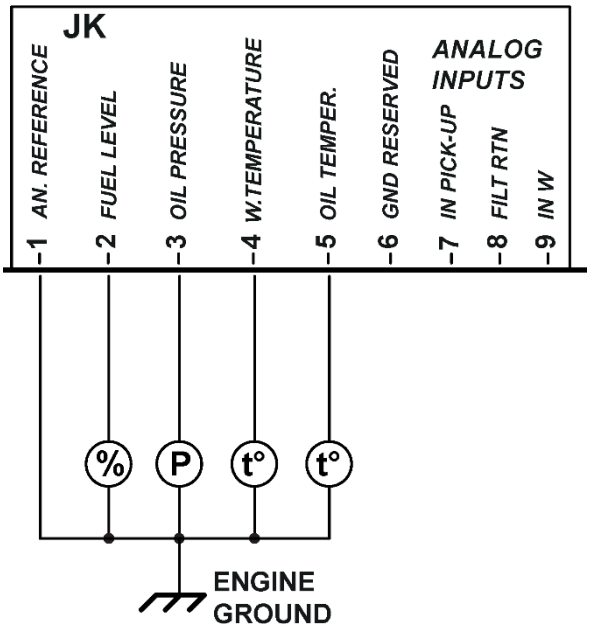
For configuration and uses of analogue inputs see par.5.8.4

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	

5.8.2 JK - Analogue inputs 3-6 (AI_03-AI_06)



The device is equipped with four programmable inputs and usable for measures of engine tools with sensors of a resistive type **JK-2, JK-3, JK-4, JK-5**. There is also a measure input of their common potential of mass **JK-1**.

The five voltage values measured on the terminals, and their corresponding sensor resistance value, are displayed on page S. 15.

It is possible to individually configure the four inputs **JK-2, JK-3, JK4 and JK-5** as further digital inputs or as (0...10Vdc) inputs in voltage.

If set as digital (function AIF.0100 in parameter P.4001 or equivalent), to activate the input it is necessary to connect it to the mass, to deactivate it just to release it. These inputs will appear therefore on the configuration menu of the digital inputs (DI_21, DI_22, DI_23 and DI_24) and will be manageable exactly as the other inputs; see par. 5.5.5.

The inputs not configured as digital will be displayed with a dash.

The default functions of the outputs are:

Terminal	Analogue input (AI_CONTROLLER_)	Type of input	Default function
JK-1	-	Voltage analogue input 1	Analogue input, REF; measure of the voltage of the analogue inputs from 3 to 6 (JK-2, JK-3, JK-4 e JK-5)
JK-2	Analogue input 3		**AIF.0000 - "Not used"**

JK-3	Analogue input 4	Resistive/Voltage analogue input 1	**AIF.0000 - "Not used"**
JK-4	Analogue input 5		**AIF.0000 - "Not used"**
JK-5	Analogue input 6		**AIF.0000 - "Not used"**

5.8.2.1 Input JK-1 Analogue reference (Analogue Reference)

It is not a real measure input: it is used together with the three inputs for resistive sensors and it has no effect on **JJ-4**. Its purpose is to compensate for the lack of equipotentiality between electric earthing of the device (GND terminal) and of the electric panel and electric earthing of the gen-set, usually generated by the voltage drop on the connection cables; particularly, this happens when the connections between electric panel and engine are long and when there is a power flow in the battery minus and earthing connections, for example due to the presence of the battery recharge device inside the electric panel.

The system can efficiently compensate for both positive and negative potentials, ranging between -2.7VDC and +2.6VDC, with sensors resistor values of 100 ohm. The range of compensation increases for lower resistor values and decreases for higher values of resistor, being optimized for the resistor values of the sensors in normal operating conditions of the system.

The voltage measure compared to the GND terminal is displayed on page S.15 at JK-1; the measure range of the system is therefore the indicated value can be higher than the one useful for the compensation, above mentioned.

The input measures the potential of the common ground point (negative) of the resistive sensors, which for the sensors mounted on the engine is represented directly by the engine itself or the chassis of the gen-set; JK-1 can therefore be connected to a grounding system or to a bolt on the engine.

If the minus of one or several sensors is isolated from the engine or the gen-set chassis, for example in the case of floats for fuel level measurement mounted on the plastic tanks or electrically separated from the gen-set, you need to connect the JK-1 to the return of the sensor and also to the negative electric mass of the engine or to the negative limit of the starting battery.

Note: this connection should be made using a dedicated wire having the shortest possible length. Avoid making the wire lies near high power and high voltage cable.

5.8.2.2 Analogue input 3 (AI_03) JK-2 (FL Fuel Level)

It can be configured by means of suitable parameter as analogue input in voltage or as digital input. If configured as digital, its status is displayed on page S.11 (0=not active input, 1= active input) as digital input number 21.

The input has a useful measure and resistance field between 0 and 1500Ω; in this range it is guaranteed an error level lower than 1% with voltage at **JM-1** terminal, compared to GND, which is 0. It can be measured higher resistance values, but with progressively decreasing precision.

Even though its natural function is the fuel measurement, it can be also used to acquire also many values.

5.8.2.3 Analogue input 4 (AI_04) JK-3 (OP Oil Pressure)

It can be configured by means of suitable parameter as analogue input in voltage or as digital input. If configured as digital, its status is displayed on page S.11 (0=not active input, 1= active input) as digital input number.

The input has a useful measure and resistance field between 0 and 2000Ω; in this range it is guaranteed an error level lower than 1% with voltage at **JM-1** terminal, compared to GND, which is 0. It can be measured higher resistance values, but with progressively decreasing precision.

Even though its natural function is the oil measurement, it can be also used to acquire also many values.

5.8.2.4 Analogue input 5 (AI_05) JK-4 (CT Coolant Temperature)

It can be configured by means of suitable parameter as analogue input in voltage or as digital input. If configured as digital, its status is displayed on page S.11 (0=not active input, 1= active input) as digital input number 23.

The input has a useful measure and resistance field between 0 and 1700Ω; in this range it is guaranteed an error level lower than 1% with voltage at **JM-1** terminal, compared to GND, which is 0. It can be measured higher resistance values, but with progressively decreasing precision.

Even though its natural function is the coolant temperature measurement, it can be also used to acquire also many values.

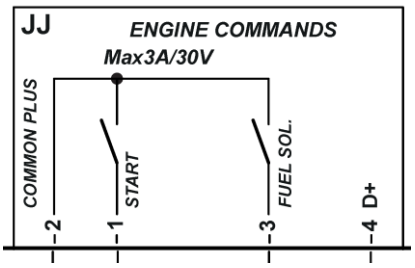
5.8.2.5 Analogue input 6 (AI_06) JK-5 (OT Oil Temperature)

It can be configured by means of suitable parameter as analogue input in voltage or as digital input. If configured as digital, its status is displayed on page S.11 (0=not active input, 1= active input) as digital input number 24.

The input has a useful measure and resistance field between 0 and 1700Ω; in this range it is guaranteed an error level lower than 1% with voltage at **JM-1** terminal, compared to GND, which is 0. It can be measured higher resistance values, but with progressively decreasing precision.

Even though its natural function is the coolant temperature measurement, it can be also used to acquire also many values.

5.8.3 JJ-4 Analogue input 07 (AI_07) JJ-4 (D+)



If the battery charger generator does not require the excitation connection, it is possible to configure the analogue input 7available on terminal **JJ-4** ad analogue input in auxiliary voltage, with measurement range from 0 to 32Vdc compared to the supply negative of the controller (GND), associating to it one of the available functions through parameter P.4123.

It can be used to acquire many values.

It is possible to configure **JJ-4** input as further digital input (function AIF.0100 in parameter P.4001 or equivalent). It is considered active when the measured voltage is higher than 4.0VDC, it is considered not active when it is lower than 3.5VDC. It cannot therefore be activated as the other inputs by connecting it to the mass.

If configured as digital, its status is displayed on page S.11 (0=not active input, 1= active input) as digital input number 25.

5.8.4 Configuration of digital inputs (AI_CONTROLLER)

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).

As for the values regarding the engine (pressure, temperature), with engines equipped with digital starter motor, they are normally data directly acquired via CAN-BUS; it can be necessary to use and configure the resistive level sensor sometimes.

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.5.8.6.

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

To each analogue input (JU, JK, JJ, DIGRIN, DITHERM, DIVIT 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.

The analogue inputs from AI_3 to AI_6) (JK-2, JK-3, JK-4, JK-5) have an additional parameter which allows to define if the analogue input is used as resistive input or as voltage input. As default, when the analogue input is enables, it is configured as resistive analogue input.

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.
NOTA:

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 which configures if the analogue input must be resistive or in voltage (P.0136 for input **JK-2**, P.0137 for input **JK_3**, P.0138 for input **JK_4** e P.0149 for input **JK_5**). This parameter is available only for the analogue inputs of **JK-2**, **JK-3**, **JK4** and **JK-5**.
- A parameter that configures a message to show on display (P.4018 for the input **JK-2**).
- Two thresholds consisting of three parameters each:
- A parameter which configures the threshold value (P.4019 and P.4022 for input **JK-2**).
- A parameter which configures the delay to manage the “out of threshold” (P.4020 and P.4023 for input **JK-2**).
- A parameter which configures the checking options and the actions in case of “out of threshold” (P.4021 e P.4024 for the input **JK-2**).

NOTE: the thresholds here defined are independent from those eventually set on the menus “Protections”: it is possible for example for the coolant temperature sensor to set a threshold of high temperature by means of parameter P.0337 to stop the engine and a couple of independent temperature thresholds through the above-described parameters, used to create other alarms, signalling or different logics.

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 thresholds are used to activate alarms and/or warnings).

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 E12, E13 e E14, 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/alarms.**

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 7. If this bit is “ON”, the controller commands a deactivation if the measurements is out of threshold.
- Bit 8. If this bit is “ON”, the controller activates an alarm if the measurements is out of threshold.
- Bit 11. If this bit is “ON”, the controller checks that GBC is close to activate eventual warnings/alarms configured with the preceding bits.
- Bit 12. If this bit is “ON”, the controller activates an anomaly only if the fuel valve is active.
- Bit 13. If this bit is “ON”, the controller activates an anomaly only if the gas valve is active.
- Bit 14. If this bit is “ON”, to activate eventual warnings/alarms 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/alarms will be activated if no digital input is configured like that, or if they are all OFF.
- Bit 15. If this bit is “ON”, the anomaly makes the fuel pump stop.
- Bit 16. If this bit is “ON”, the anomaly is subject to override of the engine protections (see par.8.5).

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 mains frequency goes over 50.5 Hz. It is first necessary to manage a minimum hysteresis on the threshold. Otherwise, when the mains 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.5.8.5) which has been configured to contain the mains 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. 5.6.7), it is possible to “copy” the internal status on a physical output.

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

Analogue Input function xx.	Name	Message	Thresholds	From AI_01 to AI_02 (JU)	From AI_03 to AI_06 (JK)	AI_07 (JJ-4)	DIVIT	DIGRIN / DITHERM
AIF.0000	Not used			X	X	X	X	X
AIF.0100	Used as digital input			X	X	X		
AIF.1000	Oil pressure (VDO)	X	X		X			
AIF.1001	Oil pressure (general)	X	X	X	X	X	X	
AIF.1100	Oil temperature (VDO)	X	X		X			
AIF.1101	Oil temperature (general)	X	X	X	X	X	X	X
AIF.1110	Coolant temperature (VDO)	X	X		X			
AIF.1111	Coolant temperature (general)	X	X	X	X	X	X	X
AIF.1200	Oil level (VDO)	X	X		X			
AIF.1201	Oil level (general)	X	X	X	X	X	X	
AIF.1210	Coolant level (VDO)	X	X		X			
AIF.1211	Coolant level (general)	X	X	X	X	X	X	
AIF.1220	Fuel level (VDO)	X	X		X			
AIF.1221	Fuel level (general)	X	X	X	X	X	X	
AIF.1231	Fuel level in litres (general)	X	X	X	X	X	X	
AIF.1300	D+ Signal	X	X			X		
AIF.1601	Air temperature in the intake pipe	X	X	X	X	X	X	X
AIF.1603	Exhaust gas temperature (left bank)	X	X	X	X	X	X	X
AIF.1605	Exhaust gas temperature (right bank)	X	X	X	X	X	X	X
AIF.1641	Turbo pressure	X	X	X	X	X	X	
AIF.2001	General sensor (page 1).	X	X	X	X	X	X	X
AIF.2003	General sensor (page 2).	X	X	X	X	X	X	X
AIF.2005	General sensor (page 3).	X	X	X	X	X	X	X
AIF.2051	Generic sensor	X	X	X	X	X	X	X
AIF.2101	Speed offset.			X	X	X	X	
AIF.2103	External synchronizer			X	X	X	X	
AIF.2105	External MCB synchronizer			X	X	X	X	
AIF.2107	External GCB synchronizer			X	X	X	X	
AIF.2109	External load sharing			X	X	X	X	
AIF.2111	Setpoint for the frequency			X	X	X	X	
AIF.2201	Voltage offset			X	X	X	X	
AIF.2211	Setpoint for the voltage			X	X	X	X	
AIF.2301	Local BASE LOAD Setpoint			X	X	X	X	
AIF.2303	Mains power			X	X	X	X	
AIF.2305	DROOP Setpoint (Hz)			X	X	X	X	
AIF.2307	System BASE LOAD Setpoint			X	X	X	X	
AIF.2321	Limitation of the active power (curve)			X	X	X	X	
AIF.2401	Local power factor setpoint			X	X	X	X	
AIF.2403	DROOP Setpoint (V)			X	X	X	X	

Analogue Input function xx.	Name	Message	Thresholds	From AI_01 to AI_02 (JU)	From AI_03 to AI_06 (JK)	AI_07 (JJ-4)	DIVIT	DIGRIN / DITHERM
AIF.2405	System power factor setpoint			X	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. 5.8.6). The measures acquired from DITHERM/DIGRIN modules that are already expressed in °C and don't need any conversion are exceptions.

Functions AIF.1000, AIF.1100, AIF.1110, AIF.1200, AIF.1200, AIF.1210, AIF.1220 use instead conversion curves suitable to the most common VDO sensors.

VDO Oil temperature sensor (AF.1100)	
0 °C	3240 Ohm
50 °C	322 Ohm
100 °C	62 Ohm
150 °C	19 Ohm

VDO Water temperature sensor (AF.1110)	
0 °C	1800 Ohm
50 °C	195 Ohm
100 °C	38 Ohm
120 °C	22 Ohm

VDO Oil pressure sensor (AF.1000)	
0 bar	10 Ohm
4 bar	86 Ohm
10 bar	180 Ohm

Level sensor VDO (AIF.1200, AIF.1200, AIF.1210, AIF.1220)	
0 %	180 Ohm
100 %	10 Ohm

5.8.5 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/alarms 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 two ways 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.1001	Oil pressure (general)	X	X
AIF.1101	Oil temperature (general)	X	X
AIF.1111	Coolant temperature (general)	X	X
AIF.1201	Oil level (general)	X	X
AIF.1211	Coolant level (general)	X	X
AIF.1221	Fuel level (general)	X	X
AIF.1231	Fuel level in litres (general)	X	X
AIF.1601	Air temperature in the intake pipe	X	X
AIF.1603	Exhaust gas temperature (left bank)	X	X
AIF.1605	Exhaust gas temperature (right bank)	X	X
AIF.1641	Turbo pressure	X	X
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.		
AIF.2103	External synchronizer		
AIF.2105	External MCB synchronizer		
AIF.2107	External GCB synchronizer		
AIF.2109	External load sharing		
AIF.2111	Setpoint for the frequency		
AIF.2201	Voltage offset		
AIF.2211	Setpoint for the voltage		
AIF.2301	Local BASE LOAD Setpoint		
AIF.2303	Mains power		
AIF.2305	DROOP Setpoint (Hz)		
AIF.2307	System BASE LOAD Setpoint		
AIF.2321	Limitation of the active power (curve)		

Virtual Analogue Input function xx.	Name	Message	Thresholds
AIF.2401	Local power factor setpoint		
AIF.2403	DROOP Setpoint (V)		
AIF.2405	System power factor setpoint		
AVF.4001	Generator frequency	X	X
AVF.4006	L1-L2 Generator voltage	X	X
AVF.4007	L2-L3 Generator voltage	X	X
AVF.4008	L3-L1 Generator voltage	X	X
AVF.4009	L-L Generator medium voltage	X	X
AVF.4012	Mains frequency	X	X
AVF.4017	L1-L2 mains voltage	X	X
AVF.4018	L2-L3 mains voltage	X	X
AVF.4019	L3-L1 mains voltage	X	X
AVF.4020	L-L mains medium voltage	X	X
AVF.4023	Current phase L1	X	X
AVF.4024	Current phase L2	X	X
AVF.4025	Current phase L3	X	X
AVF.4026	Auxiliary current (including N)	X	X
AVF.4031	Active power L1	X	X
AVF.4032	Active power L2	X	X
AVF.4033	Active power L3	X	X
AVF.4034	Total active power	X	X
AVF.4041	Total apparent power	X	X
AVF.4047	Total reactive power	X	X
AVF.4058	Total power factor	X	X
AVF.4059	Total cos phi	X	X
AVF.4063	Partial active energy of the generator	X	X
AVF.4065	Partial reactive energy of the generator	X	X
AVF.4069	Partial mains active power	X	X
AVF.4071	Partial mains reactive power	X	X
AVF.4075	Active power on loads	X	X
AVF.4088	Speed	X	X
AVF.4091	Oil level	X	X
AVF.4092	Coolant level	X	X
AVF.4093	Fuel level	X	X
AVF.4094	Fuel level in litres	X	X
AVF.4096	Instantaneous consumption	X	X
AVF.4097	Average consumption	X	X
AVF.4105	Battery voltage measured by the controller	X	X
AVF.4108	Engine start number	X	X
AVF.4111	Engine operating hours (ECU)	X	X
AVF.4112	Engine operating hours	X	X
AVF.4114	Engine partial operating hours with GCB closed (partially)	X	X
AVF.4116	Engine operation remaining hours before maintenance 1 (partial)	X	X
AVF.4118	Engine operation remaining hours before maintenance 2 (partial)	X	X
AVF.4119	Remaining days before maintenance (partial)	X	X
AVF.4121	Oil pressure	X	X
AVF.4122	Coolant pressure	X	X
AVF.4123	Fuel Delivery Pressure	X	X
AVF.4126	Air pressure in the intake pipe	X	X
AVF.4134	Room temperature	X	X
AVF.4136	Oil temperature	X	X
AVF.4137	Coolant temperature	X	X
AVF.4138	Fuel Temperature	X	X

Virtual Analogue Input function xx.	Name	Message	Thresholds
AVF.4139	Air temperature in the intake pipe	X	X
AVF.4140	Temperature of the turbocharger	X	X
AVF.4141	Exhaust gas temperature (left bank)	X	X
AVF.4142	Exhaust gas temperature (right bank)	X	X
AVF.4143	Intercooler temperature	X	X
AVF.4153	Soot level	X	X
AVF.4154	Ash level	X	X
AVF.4156	DEF level (AdBlue)	X	X

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

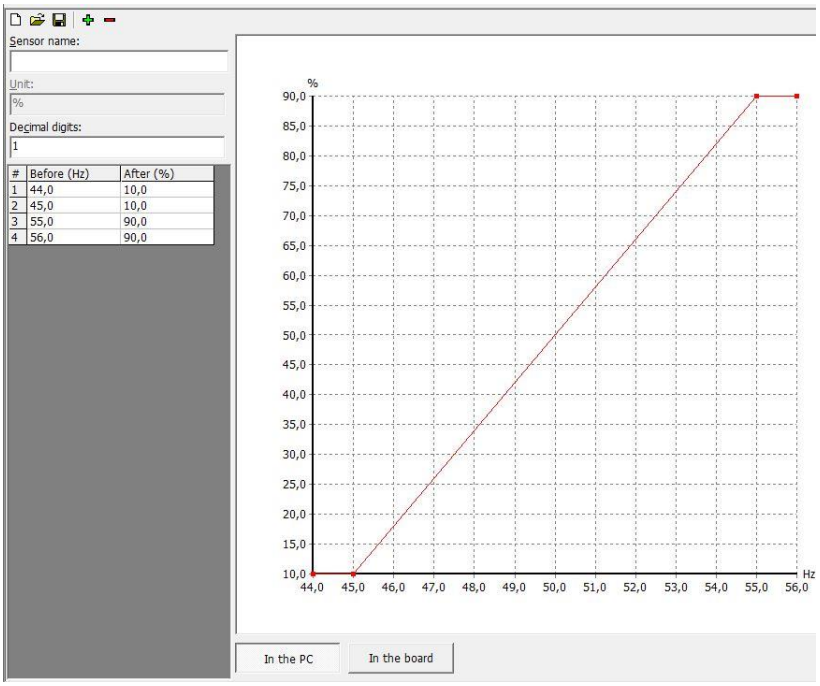
5.8.6 Conversion curves

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 or on the optional expansion modules 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 must 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 (“Genset frequency”). With this configuration, the output will be 10% for a generator 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 non-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%.

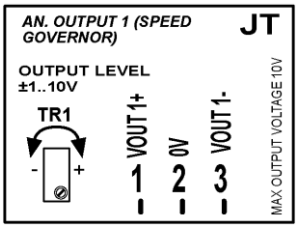
Important: the points inserted must be ordered in increasing way in column “first”, otherwise the conversion required will not be obtained.

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 physical analogue input configured with functions AIF.2001, AIF.2003 e AIF.2005 (“generic sensor”), the measurement converted will be displayed on pages E11, E12 e E13: 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.

5.9 Analogue outputs 1-2 (JT, JS)

5.9.1 JT - Analogue output 1 (AO_01) (Speed governor)



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

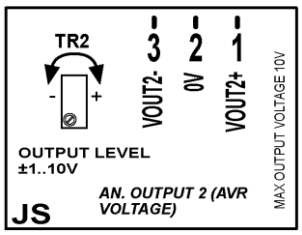
This output is used, by default, to supply a DC signal to the rpm regulator. If the output is configured with other available functions, it is necessary to add the specific conversion curves to the output configuration (see 5.8.6).

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.1000 – “Speed governor”**
JT-2		**0V**: Internal GND reference of the isolated output.	
JT-3		**VOUT1-:** Analogue signal in voltage with negative polarity.	

5.9.2 JS - Analogue output 2 (AO_01) (Speed governor)



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 used, by default, to supply a DC signal in continuous voltage to the voltage regulator. If the output is configured with other available functions, it is necessary to add the specific conversion curves to the output configuration (see 5.8.6).

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.1002 – "Voltage Regulator"**
JS-2		**0V:** Internal GND reference of the isolated output.	
JS-3		**VOUT2-:** Analogue signal in voltage with negative polarity.	

5.9.3 Configuration of the analogue outputs

Each analogue output (the two of GC600 controller and the four of the DANOUT module) are all 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 it is possible to apply a conversion curve.

The following functions, not directly linked to the operation sequences of the controller, are selectable for any digital 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 analogue outputs 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 governor
AOF.1001	Speed governor (generic)
AOF.1002	Voltage Regulator
AOF.1003	Voltage regulator (generic)
AOF.3001	Engine speed
AOF.3011	Oil pressure
AOF.3013	Oil temperature
AOF.3015	Oil level
AOF.3023	Coolant temperature
AOF.3025	Coolant level
AOF.3035	Fuel level
AOF.3101	Genset frequency
AOF.3111	Genset voltage
AOF.3121	Genset active power
AOF.3201	Mains frequency
AOF.3211	Mains voltage
AOF.3221	Mains power

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. 5.8.6).

5.10 Optional additional modules

Using one of the two CAN-BUS connections (CAN-BUS-0 ECU Interface or CAN-BUS-1 PMCBus) it is possible to connect the following optional additional modules to the device:

- 10 DITHERM/DIGRIN modules:
  - DITHERM: 3 galvanically insulated thermocouples for the temperature measurement.
  - DIGRIN: 3 galvanically insulated Pt100 sensors for the temperature measurement.
- 5 DIVIT:4 modules galvanically insulated analogue inputs 0...5V/0...10V – 0...10mA/0...20mA
- 4 DANOUT modules: 4 galvanically insulated analogue outputs 0...5V/0...10V – 0...10mA/0...20mA
- 4 DITEL 16IN modules: 16 digital inputs opto-insulated (total 64 inputs). To each DITEL 16IN module it is possible to connect 2 DITEL modules 8 OUT relays for a total of 64 digital outputs. It is not possible to use the output modules without their relative input module.

For configurations to do on the modules, refer to the relative user manuals.

Below we use the name DITEMP to refer to a temperature measurement module (DITHERM or DIGRIN).
To use the modules on GC600 it is necessary to indicate to which CAN BUS interface the expansion modules are connected, except parameter P.0140:

- P.0140=0: the expansion modules are connected to the CAN-BUS 0 (JM) for the communication with the engine. This CAN BUS interface is standard and should always be used. **The only case in which it cannot be used is when this interface is connected to a MTU engine equipped with a MDEC junction box.**
- P.0140=1: the expansion modules are connected to the CAN-BUS 1 (JX) for the parallel functions. If CAN-BUS 1 has already been used with other Mecc Alte devices, to connect the modules to this CAN-BUS interface it is necessary to use a further device called CAN-BRIDGE. The duty of the CAN-BRIDGE is to avoid that the data sent by the expansion modules are received by all controllers connected to the CAN-BUS distribution line used for the parallel functions.

Then it is necessary to set the number of modules which are with the parameters.

- P.0141: number of modules DITEL 16 IN (with eventual modules OUT) (maximum 4).
- P.0142 the number of DITEMP modules (i.e., DITHERM or DIGRIN) (maximum 10).
- P.0143: the number of DIVIT modules (maximum 5).
- P.0144: the number of DANOUT modules (maximum 4).

Once configured the presence of the modules, they look like digital or analogue inputs or outputs and are managed as those present on the controller.
For the relative parameters see docs [1].
In program BoardPrg4, once the presence of a module is configured, it appears on menu I/O in the left column, with single inputs/outputs ready to be configured.

It is necessary, though, to clarify about DIVIT modules. They can measure any value: it is necessary to convert the measure done (Volt or mA) to the real unit of measure of the acquired value. Such a conversion can be done directly in the module (DIVIT), or on the GC600. Ensure you don't have a double conversion.

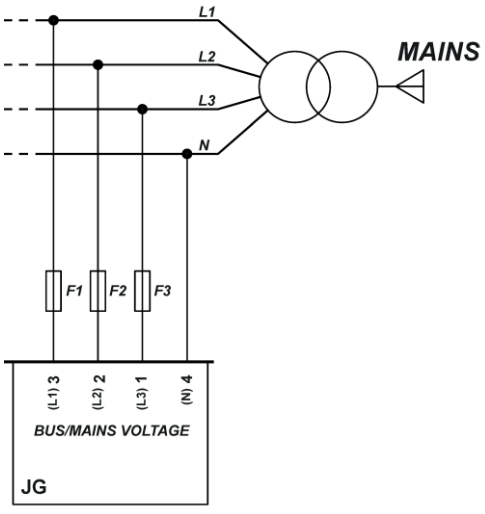
It is suggested to:

- Configure the module DIVIT to transmit a percentage value. In the example below, a channel configured to acquire a signal 0-10 mA, will transmit "0" at 0 mA and "100" at 10 mA.

ID	Description	U.M.	In the controller	In the PC
P.0101	Sensor 1 - Input Type	-		1-0/10 mA
I1_SO1	Input 1 - Input value 1 (mA/V)	mA/V		0,000
I1_DE1	Input 1 - Correspondent transmitted value 1	-		0,0
I1_SO2	Input 1 - Input value 2 (mA/V)	mA/V		10,000
I1_DE2	Input 1 - Correspondent transmitted value 2	-		100,0
I1_LDN	Input 1 - Lower threshold for sensor fault (0-10(	%		-1
I1_LUP	Input 1 - Upper threshold for sensor fault (20-12	%		-1

- On the GC600, use a conversion curve to convert from a % value to the real unit of measure.

5.11 JG – Voltage measure input Mains/Parallel bars



The connection to the public electric mains or to the parallel bars (Bus) happens though the **JG** connector of the controller. Normally, on those plants composed of more than one genset (P.0802 >=5), the **JG** connector is used for the connection to the parallel bars; for those plants composed of only one genset (P.0802 < 5) the **JG** connector is used for the connection to the public mains. Anyway, it is possible to use parameter P.0126 to indicate to the GC600 device what has been connected to JG:

- 0: parallel bars.
- 1: public mains.

Three phase connections:

- 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.0119.

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 to respect the specified limits. The nominal voltages on the primary and secondary of the VT are configurable with parameters P.0117 and P.0118. 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.0152 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.0152.

It is also possible to use the Aron insertion of the VTs, which uses only two transformers, instead of three (see par. 0). It is necessary to set P.0129 not to use the neutral connection.

Attention! Do not connect JG measurement input to TA with 400V secondary sides or directly to the mains/bus at 400V when the device is configured to read at 100V nominal voltage (parameter P0.152 set to 1). The device could be damaged.

5.11.1 Mains neutral measurement/Parallel bars

The device, in three-phase connection, can work with both the neutral connection and without; the selection is made through parameter P.0129.

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

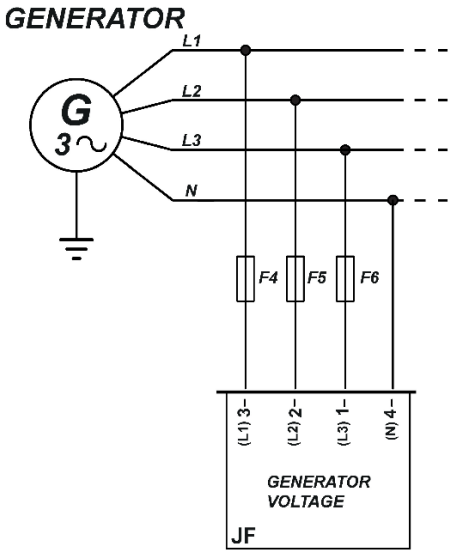
The values of the three phase voltages and of the neutral voltage compared to GND are displayed on page M.02.

By pressing ENTER button it is possible to change the view mode of these Bus/Mains 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.

5.12 JF - Genset voltage measure input



The connection to the genset happens through JF connector of the controller

Three phase connections:

- 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.0101.

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 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. 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.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 (see par. 0). It is necessary to set P.0128 not to use the neutral connection.

Attention! Do not connect JF measurement input to VT with 400V secondary sides or directly to the mains/bus at 400V when the device is configured to read at 100V nominal voltage (parameter P0.151 set to 1). The device could be damaged.

5.12.1 Genset neutral measurement

The device, in three-phase connection, can work with both the neutral connection and without; the selection is made through parameter P.0128.

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/Mains measures in two different ways:

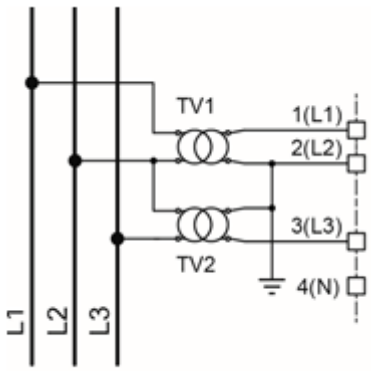
- Measure of the L1-L2, L2-L3, L3-L1 linked voltages and of the Neutral voltage compared to the N-B battery negative.
- Measure of the L1-N, L2-N, L3-N phase voltages and of the Neutral voltage compared to the N-B battery negative.

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.

5.13 Aron insertion of Voltmetric transformers

Both for the genset voltage and for the mains/bus-bars 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.

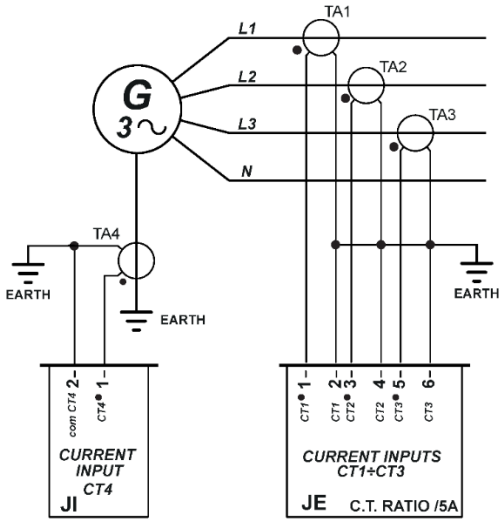
The diagram of the Aron connection is the following:



The diagram is the same both for the genset and for the mains/bars; it is necessary to set parameters P.0128 (for the genset) or P.0129 (for the mains/bars), or both to indicate to the controller that the neutral connection is not used.

5.14 (JE-JI) Currents measurement inputs.

5.14.1 JE - Currents measurement inputs 1-3



ATTENTION! The current measurement must happen 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.

External ammeter transformers can be connected to these terminals, 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 can measure (with progressively decreasing precision) up to 15Aac though, e.g., to measure over currents 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 genset 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.0107 and P.0139 allows to configure the transformation ratio of the external ammeter transformers. For example, if we use 50/5 ammeter transformers, set P.0107=50 and P.0139=5.

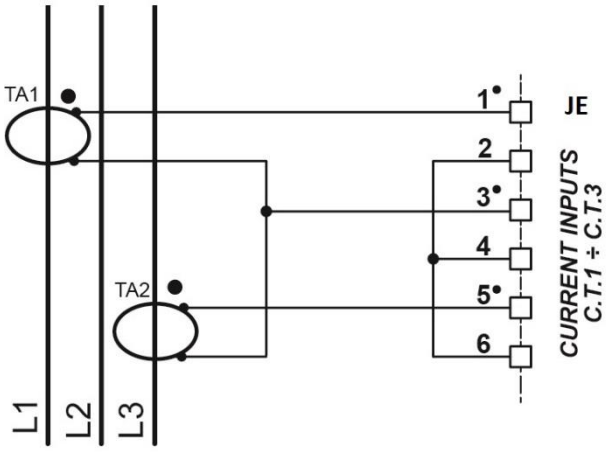
It is possible, through parameter P.0124 to define if CTs on the three phases are situated on the genset (as per drawing above) or on the load, so to measure also the absorbed power by the loads when supplied by the mains. This is only possible for the types of plant which does not do the parallel, though: for SSB plant only (“Single Stand By”, plant

composed of a single genset which is in emergency service with the electric mains and which does not do the parallel with the mains itself).

5.14.1.1 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:



5.14.2 JI - Currents measurement input 4

The device allows to acquire a fourth current measurement, usable e.g. For a differential protection. By default, the fourth measure is not used.

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

5.14.2.1 Controller without option E620215011000

Parameter P.0109 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.

External ammeter transformers can be connected to these terminals, 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 can measure (with progressively decreasing precision) up to 15Aac though, e.g., to measure over currents 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.0108 and P.0135 allows to configure the transformation ratio of the external ammeter transformers. For example, if we use 50/5 ammeter transformers, set P.0108=50 and P.0135=5.

5.14.2.2 Controller with option E620215011000

Parameter P.0109 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.0108 and P.0135 allows to configure the transformation ratio of the external toroid. For example, if we use 500/1 toroid, set P.0108=500 and P.0135=1.

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

5.14.2.3 Use of the fourth current

Parameter P.0130 allows to tell the controller where the transformer which acquires this current measurement is located.

- P.0130=0. The transformer is some way connected on the genset lines. It is the most common case: use this configuration, e.g. If you want to measure the current circulating on the neutral line, or to measure the current between neutral and earth.
- P.0130=1. The transformer is someway connected on the loads lines. It is not a frequent case, as only applicable to SSB plants (see note on previous par.). It could be used, e.g. To perform a differential protection (through toroid) on the loads line instead of on the genset line.
- P.0130=2. The transformer is some way connected on the loads lines. Use this configuration if you want, for example, that the controller can measure the power circulating on a mains phase.

The most important parameter to be configured is parameter P.0131 though, which allows to establish what type of current measurement you want to do:

- P.0131 = 0 ("Not used") The controller disables the measurement of the fourth current, which will not be shown on display.
- P.0131 = 1 (General use"). The controller displays the current measurement done on page M.09 with the lettering "Auxiliary current").
- P.0131 = 2 ("Genset neutral"). The controller displays the current measurement done on page M.04 identifying as "An". Moreover, if the measurement is acquired by an ammeter transformer **(not by a toroid)**, identical to those used to measure the phase current (same primary, same secondary and placed on the same source), the controller calculates also the immediate total of the four currents and displays it on page M.04 with the lettering "A∑".
- P.0131 = 3 ("Differential protection"). The controller interprets the measurement already as a differential current (already as the sum of the four genset currents). It displays it on page M.04 with the lettering "A∑".
- P.0131 = 4 ("Power measurement on the mains"). The controller interprets the measurement like the current circulating on L1 phase of the mains and shows it on page "M.09" with the lettering "Current on the mains". If its three-phase

sensor is configured to measure mains voltages, the controller also calculates the active power circulating on L1 phase of the mains (kW, negatives if the power is ceded to the mains). Finally, for three-phase systems, it multiplies the calculated power by three, assuming that the load is uniformly shared on the three phases. If it was not like this, it is possible to apply a correction factor (P.0132), which allows to increase the calculated power (if P.0132 > 1) or to decrease it (if P.0132 < 1), to let it the closest to real. This power measurement on the mains can be used to manage function "IMPORT/EXPORT" (see [10]).

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. Setting 2 allows the controller to calculate the genset differential current (as sum of the four currents).

Settings 2 and 3 allow to establish a threshold on the differential current (P.0377 e P.0378): when overpassing it, an alarm is given.

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.

5.14.2.4 Differential current

The genset differential current can be acquired in two ways:

- Setting P.0131 to "3-Differential protection" and connecting directly to the controller the differential current to be measured (typically through a toroid which embraces the phase and neutral lines).
- Setting P.0131 to "2-Genset neutral" and connecting the controller directly to the current of the neutral line. In this case, it is necessary that the CT used for the neutral line is identical to those used for the phases (same primary and secondary). Moreover, parameter P.0130 (which indicates on which lines the fourth CT is connected) is set to "0-On genset). In this case, the device calculates the differential current as immediate sum of the neutral phases current.

  The device allows to increase, through P.0377 e P.0378, a threshold for the differential maximum current protection. The activation of the protection generates an alarm.

5.15 Communication ports

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

Both models GC600 e GC600^{Mains} are provided with:

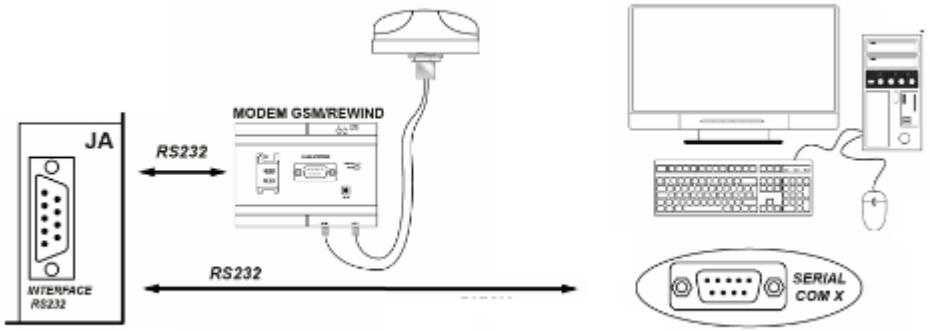
- 1 USB2.0 serial port not insulated, which can be used in Function or Host mode.
  - Function: (USB B connector): connection with PC for FW update and programming of device parameters.
  - Host (USB A connector): Pen Drive management **(up to today not available)**
- A RS232 serial port with DB9 male connector usable for the interfacing with an external device equipped with RS232 interface. The maximum length of the cable is 12 mt. See par. 5.15.1.
- 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. 5.15.2
- A CAN-BUS port with galvanic insulation for the communication with ECU engine and/or additional optional modules (DITEL, DITHERM, DIGRIN e DIVIT). 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). See par. 0

- A CAN-BUS port with galvanic insulation for the communication with other devices of genset control and/or additional optional modules (DITEL, DITHERM, DIGRIN e DIVIT). The 120ohm terminal resistor is integrated and can be inserted through S6 selector. The specific use of the shielded cable is required (e.g., HELUKABEL 800571). See par. 0
- 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].

5.15.1 JA - Serial port 1 RS232 (JA)



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].

5.15.1.1 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.**

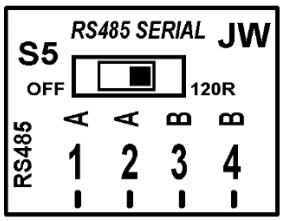
The SIM type to insert depends on the use of the modem.

- 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].

5.15.2 JW - Serial port 2 RS485 (JW)



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 4.2) with shielded filter connected to earth.

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

- P.0471: use of serial port 2
- 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].

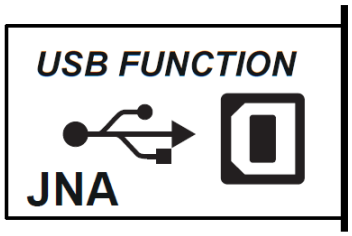
On serial port 2 cannot be connected a modem; for the rest, it is possible to use it for the same connections possible from RS232 serial port using RS485/RS232 adaptors or RS485/USB when necessary.

It is also possible to use this port to directly connect to the ECU electronic junction box of some CUMMINS engines which don't have the CANBUS communication. To do so, it is necessary to set:

- P.0471 = 2-Master Modbus
- P.0472 = 1
- P.0473 = 9600
- P.0474 = 3-8 bit, no parity, 2 stops
- P.0475 >= 0-LSWF
- P.0700
  - 184: for CUMMINS QSX15
  - 185: for CUMMINS QSK2323/45/60/78
  - 186: for CUMMINS QST30

Use the traditional commands for the start-up, the stop and the engine speed regulation.

5.15.3 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 must 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

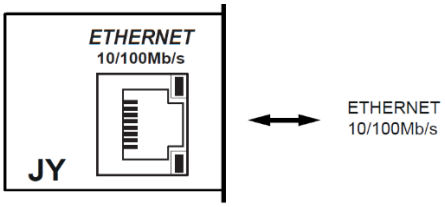
The insertion/substitution of the device firmware is a specific operation of Mecc Alte; besides the operation FW to be inserted, it requires a particular procedure and special programs. Also, it must not be done by the installer, except for specific cases previously agreed with Mecc Alte.

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

5.15.4 JY - Ethernet port 10 100Mbps (JY)



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 and the dispatch of data and events towards the SMARTCLOUD 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.0504	Web Server Port. Indicate the port to be used for the TCP/IP packages management for Web Server management.	80
P.0505	MODBUS registers order When 32 bits information is required, it establishes if the first 16 more significant bits must 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	255.255.255.255

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:

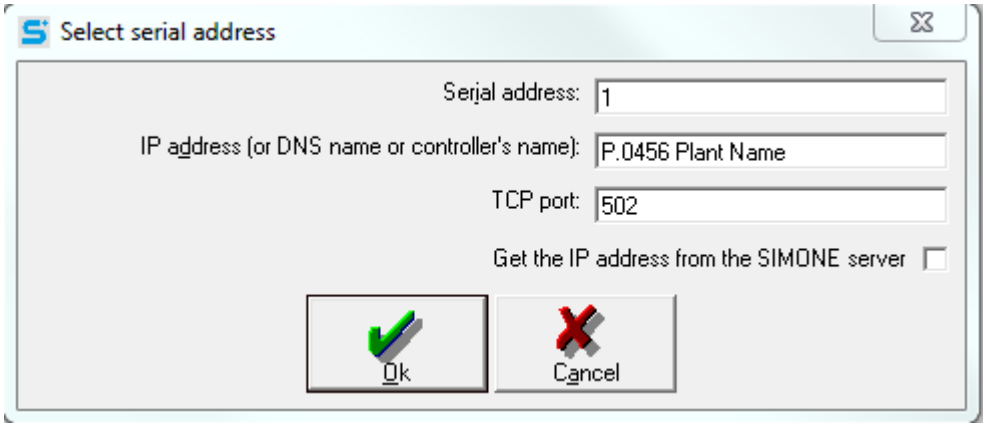
- It is possible to manually configure the three above mentioned parameters, with congruent values with the net to which we connect (the sub-net mask and the router/gateway are specific of each net, the IP address must be univocal in the net). To proceed this way, it is necessary that parameter P.0514 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 (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 function to convert the name of the server “SMARTCLOUD” 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.

5.15.4.1 Web Server

Starting from version 1.26, the Web Server on board the controller is available based on the HTTP protocol. It uses the port configured in parameter P.0504 and is intended for use in private networks. It is not recommended to expose the web interface to the public Internet.

The Web Server is designed to monitor the main measures, the states and the alarms of the controller through a Web browser. It is enough to set the IP address of the controller in the address bar of the browser (ex: http://192.168.1.220) to view the main web page of the controller. You will be asked for the controller access code (P.0469) prior to entering the web pages.

5.15.4.2 SNMP protocol

The SNMP protocol (Simple Network Management Protocol) is an international standard protocol for managing devices on IP networks. It uses the UDP protocol on ports 161 and 162; it allows to simplify the configuration, management and supervision (monitoring) of devices connected in a network.

The SNMP protocol has three fundamental components:

- **MANAGER**: is the management system (e.g., supervisory system or PC);
- **AGENT**: is the device that responds to SNMP queries (e.g., Mecc Alte controller);
- **MIB** (Management Information Base): is a fixed file used to provide the **MANAGER** with instructions to collect the information contained in the **AGENT**.

It is a request-response protocol; the **MANAGER** queries the **AGENT** by sending the request messages (GetRequest, SetRequest, GetNextRequest and GetBulkRequest) and the **AGENT** will reply with Response. Furthermore, when an "event" occurs, the **AGENT** sends spontaneous information through TRAP messages to a specified **MANAGER**.

The protocol provides the definition of the "Community String" to regulate the access to the data of the **AGENT** in reading and writing. Those currently used in the controller are:

- Read Community String: "public"
- Write Community String: "private".

Currently the controller supports the versions v1 and V2c of the SNMP protocol.

The parameters used in the configuration are available in the menu 5.5 Ethernet:

Parameter	GC315	GC400	Name	Default
P.0524	01.49	02.10	Enable SNMP?	No
P.0525	01.49	02.10	SNMP Manager address	0.0.0.0
P.0526	01.49	02.10	SNMP Notification port (TRAP)	162
P.0527	01.49	02.10	SNMP Notification events (TRAP)	0

The parameter P.0527 configures in which cases the controller must spontaneously send notification events (TRAP) to the SNMP **MANAGER**:

Bit	Value (hex)	Description
0	0001	For alarms, warnings and deactivations
2	0004	For mains status
3	0008	For generator status
4	0010	For engine status
6	0040	For board operating mode

NOTE: the MIB file (Meccalte_GC600_v2B.mib) is available on Mecc Alte web site www.meccalte.com.

5.15.4.3 “SMARTCLOUD” system

“SMARTCLOUD” is a centralized system of data collection: such data are then consultable through a WEB interface. The GC600 controllers can communicate with “SMARTCLOUD” system through the Ethernet port. The following parameters must be conveniently configured:

Parameter	Name	Default
P.0530	Enabling of connection and dispatch packages to “SMARTCLOUD”	0-No
P.0531	IP address or name of “SMARTCLOUD” primary server	
P.0532	Secondary SMARTCLOUD server port.	0

P.0533	IP address or name of “SMARTCLOUD” secondary server	
P.0534	Secondary SMARTCLOUD server port.	0
P.0535	Time of data dispatch to engine enabled	900
P.0536	Time of data dispatch to engine enabled	3600
P.0537	Time for dispatch package “Keep Alive Network”	0
P.0539	Communication events	0000
P.0542	Type of genset voltage	0

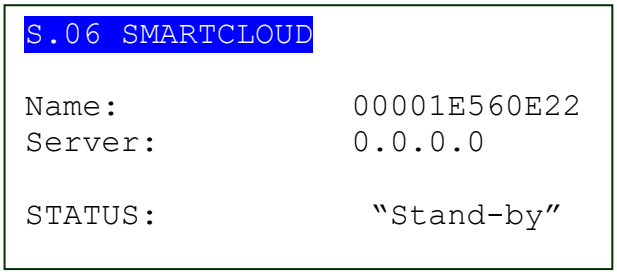
These parameters can be modified on the controller in the relative programming menus, with the BoardPrg4 and from the web service in the configuration page of the device. In detail:

- Parameter P.0530 set to value “1-Si” enables the data dispatch towards the server “SMARTCLOUD”.
- Parameter P.0531 configures the IP address or the name on the primary server “SMARTCLOUD”, while parameter P.0533 the one of the secondary server. It is possible to set the IP address in textual format or the name of the server in full (e.g., “smartcloud.meccalte.com”) which the controller will convert into IP address using DNS server (conveniently configured). It is possible to disable the connection towards the primary/secondary server setting the empty string.
- Parameter P.0532 configures the primary “SMARTCLOUD” server port, while parameter P.0534 the one of the secondary server. Setting the port address to zero, the connection towards the primary/secondary server is disabled. The default port is 53052 (check with Mecc Alte).
- Parameter P.0535 configures the interval of time to dispatch the periodic data towards the server when the genset is running.
- Parameter P.0536 configures the interval of time to dispatch the periodic data towards the server when the genset is stopped.
- Parameter P.0537 configures the interval of time in minutes to dispatch the special package “Keep Alive Network”, used to signal a minimum of activities to the server.
- Parameter P.0539 configures in which cases the device must perform the spontaneous dispatch of the communication events towards the server:

Bit	P.0539 Hexadecimal value	Description
1	0001	For alarms, unloads and deactivations.
2	0002	Warnings
3	0004	For mains status
4	0008	For generator status
5	0010	For engine status
6	0020	-
7	0040	For controller mode.

- Parameter P.0542 allows to choose whether to send the server the concatenated voltage measures or those of phase.

The parameter really used and the status information for the communication with “SMARTCLOUD” are visible on page S06. In detail:



- Name: it identifies the plant name (that should correspond to the one assigned on “SMARTCLOUD” to allow to easily identify the device on “SMARTCLOUD” web page).
- Server: it identifies the IP address of the server to which the data are sent.

- Status: is indicated the status, the date and time of the last connection (that is, of the last datum sent/received) and the remaining time before the next data dispatch. The status can be:

Status	**Description**
"Stand-by".	No ongoing connections
"Operating".	Ongoing connection to the server
Ok	Connection to server successful
Error	Connection to server failed
No answer	No answer from server (or device not registered on "SMARTCLOUD" device).

Keeping the digits ENTER+ESC pressed for at least 5 seconds, the data dispatch is forced. On display the writing "DATUM SENT" appears and via web the event "DATUM REQUIRED" appears.

Among the data sent to "SMARTCLOUD" system, the genset position is included (latitude/longitude): directly from "SMARTCLOUD" web interface it is possible to view the genset position on a map.
The controller is not equipped with a GPS receiver; it is possible to manually set the genset latitude (P.0581) and the longitude (P.0582), though.

For details regarding the communication with "SMARTCLOUD" server, see document [9].

5.15.4.4 Auxiliary data management

From revision 01.19 the new parameters P.1802 to P.1824 are available and dedicated to the configuration of three additional auxiliary data to be sent to the SMARTCLOUD

Auxiliary data	Parameter	Description
1	P.1802	Modbus Function of auxiliary data 1
1	P.1803	Modbus Register of auxiliary data 1
1	P.1804	Variable type of auxiliary data 1
2	P.1812	Modbus Function of auxiliary data 2
2	P.1813	Modbus Register of auxiliary data 2
3	P.1814	Variable type of auxiliary data 2
3	P.1822	Modbus Function of auxiliary data 3
3	P.1823	Modbus Register of auxiliary data 3
3	P.1824	Variable type of auxiliary data 3

In detail, for each auxiliary data:

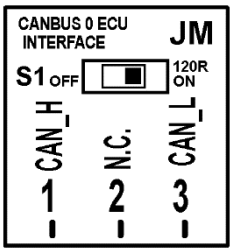
- parameters P.1802, P.1812, P.1822 define the type of Modbus function or whether to request the reading of an "INPUT REGISTER" or a "HOLDING REGISTER"
- parameters P.1803, P.1813, P.1823 define the number of the first Modbus register. If set equal to zero, the auxiliary data will not be sent.
- parameters P.1804, P.1814, P.1824 define the format of the auxiliary data (US_00, UL_00, SL_08, ...).

Refer to document [4] (GC600 Modbus Registers) for details on the number and format of each Modbus register to be read and sent as auxiliary data.

5.16 CAN-BUS Communication ports

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

5.16.1 CAN-BUS 0 port (JM)



Control interface for engine control units (ECU, with SAE J1939 and Canbus MTU interface) and automatic voltage regulators (AVR with SAE J1939 interface).

Using engine equipped with ECU (Electronic Control Unit) and CAN-BUS interface, most of the previous detailed connections are no more required. With a unique connection (CAN-BUS), the controller can command the starts and the stops of the engine, and to check its speed, acquire many measurements (e.g., Full speed, cooling temperature and oil pressure) and to show the diagnostic codes activated by the engine itself.

For the characteristics and the details for the use and configuration of the parameters regarding the CAN-BUS communication, refer to documents [5], [6] e [7].

The CAN-BUS interface is galvanically insulated.

CAN-BUS connection is carried out by means of connector JM.

The same bus can be also used for the connection to the optional modules DITHERM, DIGRIN, DIVIT, DITEL and DANOUT.

Connections:

- Connect terminal **JM-1** to terminal CAN_H of the engine's control unit.
- Connect terminal **JM-3** to terminal CAN_L of the engine's control unit.
- 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. Normally, the control units of the engine have the termination resistor built-in (if not, connect the resistor directly on the CAN_H and CAN_L terminals of the control unit).

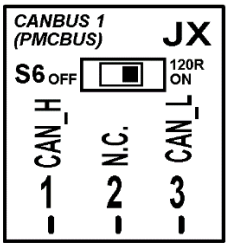
The terminal resistor is integrated in our controller; to insert it, you need to act on switch S1.

NOTE: the termination must always be inserted unless the connection carries on towards other devices and the controller is not one of the two extremes.

Use the parameters of menu 7.1 (in particular parameters P.0700 and P.0703) to indicate to the controller the type of engine with which it must interact, and the functions that must be managed. Similarly, use the parameters of menu 7.2 (in particular parameters P.1700 and P.1701) to indicate to the controller the type of voltage regulator with which it must interact, and the functions that must be managed.

For the configuration of the additional expansion modules, see par. 5.10.

5.16.2 CAN-BUS 1 port (JX)



This CAN-BUS interface must be used only for plants composed by more than one genset. It is useful to connect among themselves all Mecc Alte genset controllers (not necessarily only GC600): through this communication channel (PMCB – Power Management Communication Bus), the controllers exchange all necessary data to manage the parallel functions (see document[10]).

The CAN-BUS interface is galvanically insulated. **The same bus can be used also for the connection to optional modules DITHERM, DIGRIN, DIVIT, DITEL and DANOUT: in this case it is also required the use of a CAN-BRIDGE module, to avoid that the data of the expansion modules of a controller are sent also to other controllers connected to this CAN-BUS (see 5.10).**

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 must be daisy chain.

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

  Use the parameters of menu 8 for the parallel functions (parameter P.0800 enables/disables this CAN-BUS interface.

6 Main functions

6.1 Front panel

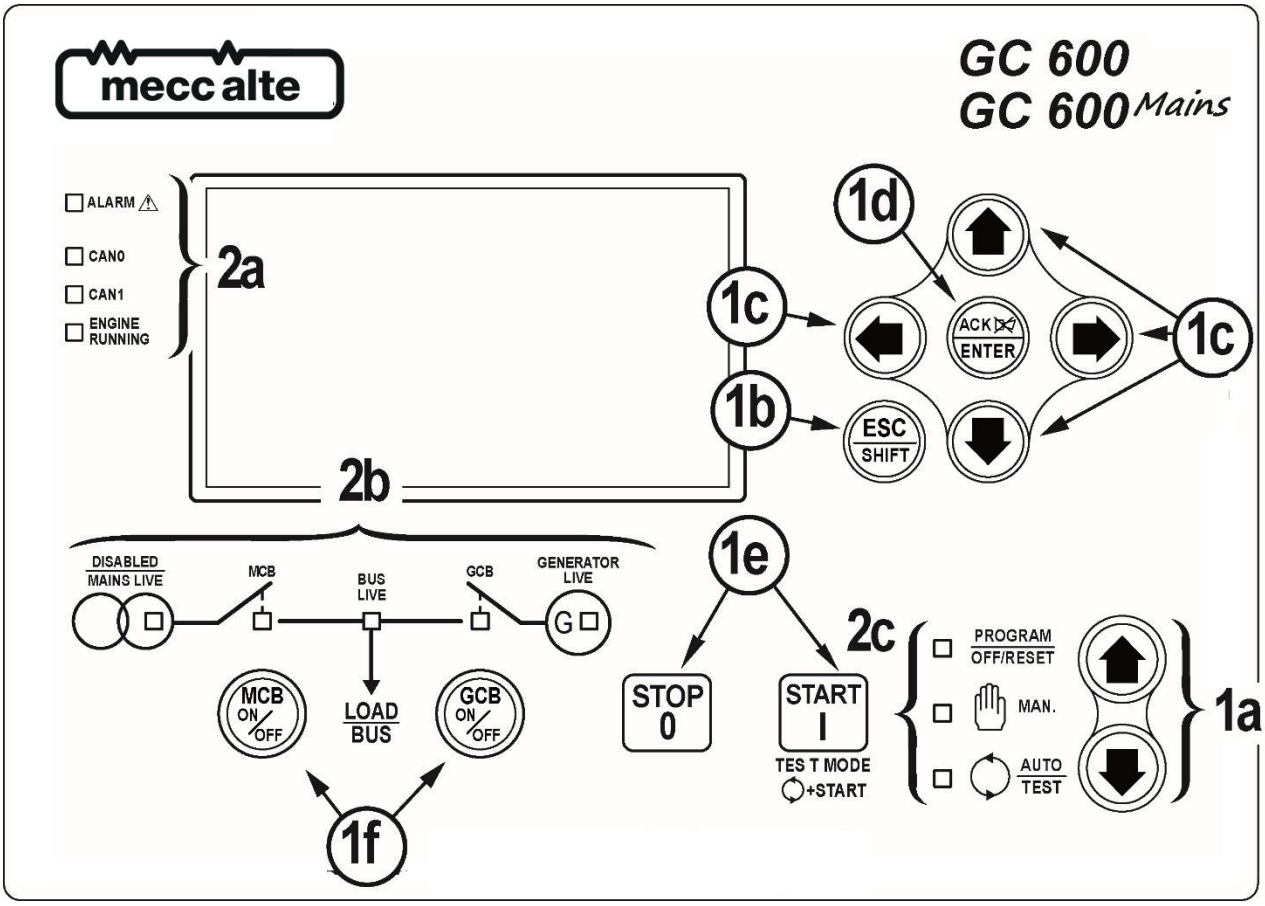


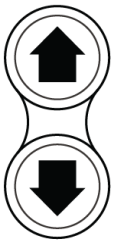
Fig. 1 - Front Panel

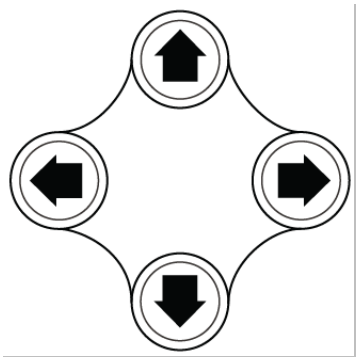
KEY
1 - Pushbuttons
2 - Indicators

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, and 2)

Pushbutton		Function
	OFF/RESET ***PROGRAM***	The genset is disabled; all anomaly signals are disabled. You can program the parameters.
MODE UP  **MODE DOWN**	**MAN (Manual)**	The Gen-set control module is set for manual gen-set control. Press the **START** (START / I) button to start the engine. Press the **STOP** (STOP / 0) button to stop the engine. With the engine running and up to speed: Press the **MCB** (MCB ON/OFF) button for manual opening/closing control of load contactors on the Mains (only GC600^{Mains}). Press the **GCB** (GCB ON/OFF) button for manual opening/closing control of load circuit breaker/contactors on genset.
Ref. 1a	**AUTO (Automatic)** ***TEST***	The controller automatically manages the genset operation, so it will be started if required by the operating conditions. By pressing the **START** (START / I) button it is possible to activate/deactivate the **TEST** mode. If not otherwise configured, it does not close the GCB circuit breaker (with eventual opening of MCB). This feature can be disabled using bit 1 of P.0495 The **STOP** (STOP / 0) button, if not otherwise configured, causes the stop of the genset and the activation of an alarm.
 **Esc/SHIFT** **Ref. 1b**		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 (ACK / 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.

Pushbutton	Function
 **Ref. 1c**	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** ESC/SHIFT buttons, they allow to adjust the contrast. **ESC/SHIFT** ESC/SHIFT + **LEFT** : to decrease the contrast (lighten) **ESC**/SHIFT 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 ESC/SHIFT, they allow you to scroll through the menus ten entries at a time or increase/decrease the variables ten units at a time.
ACK ENTER **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 an alarm, or a deactivation or an unload, 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. Alarm, deactivation and unload signals can only be reset by activating the "OFF/RESET" mode.
MCB ON/OFF **MCB** **Ref. 1f**	The button is disabled in the “**OFF/RESET**”, “**AUTO**” and “**TEST**” modes. In “**MAN**” it is used to open/close the MCB circuit breaker. To open the **Mains** switch **MCB**, with the engine idle, press and hold the “MCB” button for at least 5 seconds. This button is only available on GC600^{Mains}. On GC600 controller, use the combination SHIFT+GCB to command the MCB circuit breaker.
GCB ON/OFF **GCB** **Ref. 1f**	The button is disabled in the “**OFF/RESET**”, “**AUTO**” and “**TEST**” modes. In “**MAN**” it is used to open/close the GCB circuit breaker. The circuit breaker closure is only possible if the electric measurement of the genset are within the bands of tolerance.

Pushbutton	Function
START I **START** **Ref. 1e**	In MAN. mode it can be used to start the engine. The button can be configured in two ways: P.0252 = 0: fully manual (the starter motor is engaged all the time the button is pressed or until the engine running is detected). P.0252 > 0: fully automatic (simply press and release the "**START**" button to activate an automatic start sequence of maximum P.0252 tries). If the start is not successful, the fail to start anomaly will be activated. The "**START**" button must be pressed and released again to perform a new start attempt. In **AUTO** mode, it enables/disables the **TEST** status. This feature can be disabled using bit 1 of P.0495 When the Gen-set control module is activated, keeping it pressed at the same time as the **STOP** STOP 0 button allows access to the special functions.
STOP 0 **STOP** **Ref. 1e**	Used to control the stop of the engine in "MAN" mode. In **AUTO**, **TEST** or **REMOTE START**, the button can be configured in two ways (bit 0 of P.0495): Engine stop with activation of an alarm. No function. The button press is irrelevant. If pressed with the controller in OFF/RESET mode, it carries on the LAMP TEST of all the luminous indicators (in this phase, the controller activates any output configured with function DOF.3153, allowing the test of the lamps on the control panel as well. When the Gen-set control module is activated, keeping it pressed at the same time as the START START I button allows access to the special functions.

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

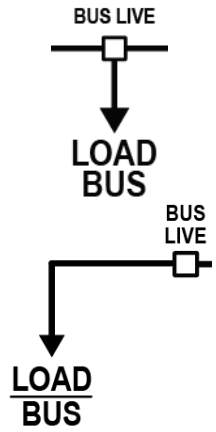
It is possible to modify the brightness of the light indicators (all together) using parameter **P.0496**: the higher the parameter value, the brighter the light indicators. The value can be set between 1 to 10 (default value = 5).

LED OFF	LED steady ON	LED flashing
□	▣	⧈

	Signalling		Function
□ PROGRAM / OFF/RESET **Ref. 2c**	**PROGRAM 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.
□ MAN. **Ref. 2c**	**MANUAL**	▣	Indicates that the operation mode is MANUAL
		□	The Gen-set control module is in another operating mode.
□ AUTO / TEST **Ref. 2c**	**AUTO TEST**	▣	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 Gen-set control module is in another operating mode.
□ ALARM ⚠ **Ref. 2a**	**ALARM**	▣	Indicates the presence of at least one alarm, or a deactivation or an unload.
		⧈	There is at least one active warning.
		□	No anomalies.
□ CAN0 **Ref. 2a**	**CAN0**	▣	Signals that the **CAN-BUS** interface is active and in **ERROR-ACTIVE** mode.
		⧈	Flashing (25% illuminated): it indicates that **CAN-BUS** interface is in **ERROR-PASSIVE** mode, and as a result there are communication problems.
			Flashing (75% illuminated): it indicates that **CAN-BUS** interface is in **BUS_OFF** mode, and as a result there are communication problems.
		□	It indicates that **CAN-BUS** interface is disabled, or that it is working and in **ERROR-ACTIVE** mode, but no external devices are transmitting data.
□ CAN1 **Ref. 2a**	**CAN1**	▣	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.

	Signalling		Function
		☐	Indicates that the **CAN-BUS** has been disabled.

	Signalling		Function
MAINS LIVE  DISABLED MAINS LIVE Ref. 2b	MAINS LIVE	▣	Mains power steadily within the tolerance range
		□	No mains power.
		⧈	Flashes at 50% during transition between the previous two statuses.
			Flashing at 25% ON - Mains power under tolerance values.
			Flashing at 75% ON - Mains power above tolerance values.
GENERATOR LIVE  Ref. 2b	GENERATOR LIVE	▣	Generator voltage and frequency are present and stead within the tolerance range.
		□	Generator voltage and frequency are not present, engine stopped.
		⧈	Flashes at 50% during transition between the previous two statuses.
			Flashing at 25% the Mains power and frequency are on but below the tolerance range, or they are off, but the engine is running.
			Flashing at 75%: Voltage and frequency are on but over the tolerance range.
MCB  Ref. 2b	MCB (only GC600^{Mains})	□	The MCB switch is opened.
		▣	The MCB switch is closed.
		⧈	Flashes at 25% ON if open after a closing command.
			Flashing at 75% ON if closed after an opening command.
			Flashing at 50%: during synchronization (flashes in alternation with a BUS LIVE).
GCB  Ref. 2b	GCB	□	The GCB switch is opened.
		▣	The GCB switch is closed.
		⧈	Flashes at 25% ON if open after a closing command.
			Flashing at 75% ON if closed after an opening command.
			Flashing at 50%: during synchronization (flashes in alternation with a BUS LIVE).
ENGINE RUNNING Rif. 2a	ENGINE RUNNING	▣	The engine is running
		⧈	Flashing (50% illuminated): the engine is running; the cooling cycle is in progress.
		□	The engine is OFF.

	Signalling		Function
 Ref. 2b	BUS LIVE	■	Signals BUS line ON.
		□	Signals BUS line OFF.
		▣	Flashing at 50% during the synchronization (it flashes in alternance with GCB during the entrance synchronization, flashes in alternance with MCB (GC600^{Mains}) or alone (GC600) during the back synchronization).

6.4 Multifunctional display

6.4.1 LCD lighting

The back-light 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.

During engine starting phase, the lamp is automatically turned-off to reduce the power consumption of the controller board, to ensure greater autonomy for the controller itself in the event of critical conditions of the starter battery. To keep the lamp switched on during cranks, set bit 4 of parameter P.0495. Using parameter P.0493 it is possible to force the lamp which is always on when the engine is started.

6.4.2 Contrast adjustment

Depending on the environmental temperature conditions, the contrast may require adjustment 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 Colour 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
ENGINE	Engine measurements	E.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** and **DOWN** **Ref. 1c**.

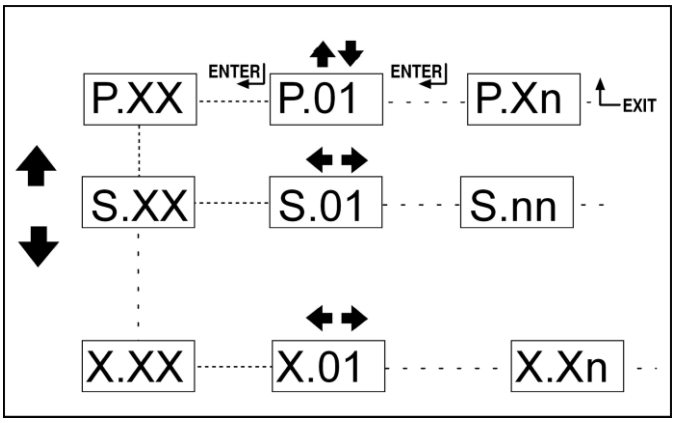


Fig. 3 - Mode navigation

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 must 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)

KEY:
1 - Status bar
2 - Data area

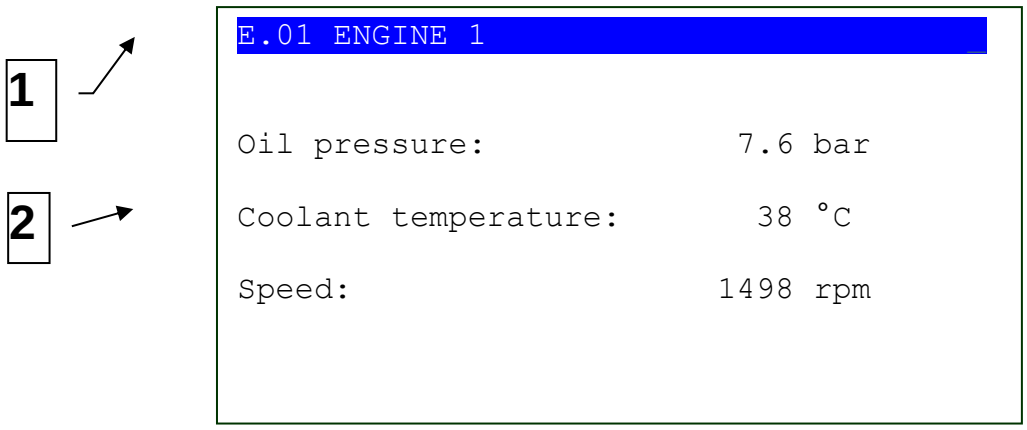


Fig. 4 - Display areas

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

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

KEY:
1a - Mode identifier
1b - Page identifier
1c - Page title

2 – System status

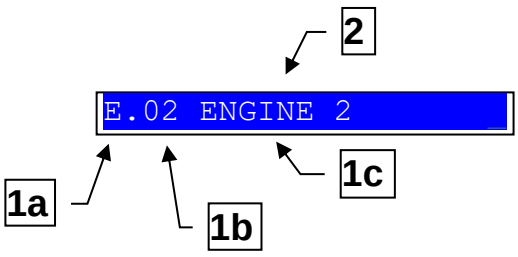


Fig. 5 - Top status bar

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 installer 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

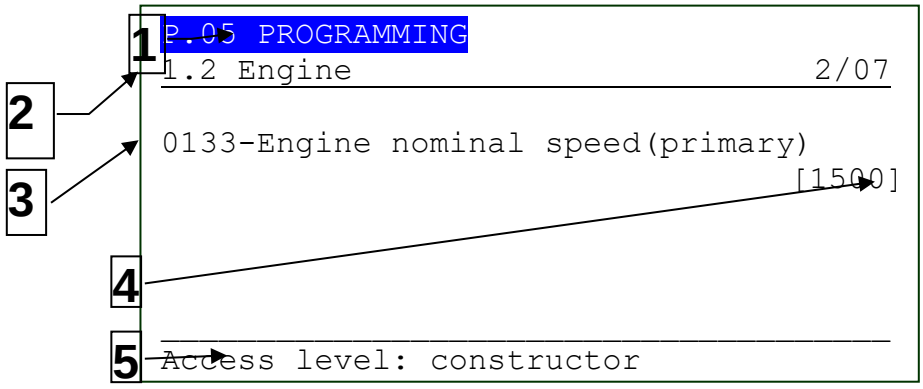


Fig. 6 - Display areas

Each programming parameter Ref. 3 has a 4-digit numeric code (e.g., P.0133) 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 (2/ 07 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 installer and “U” for final user).

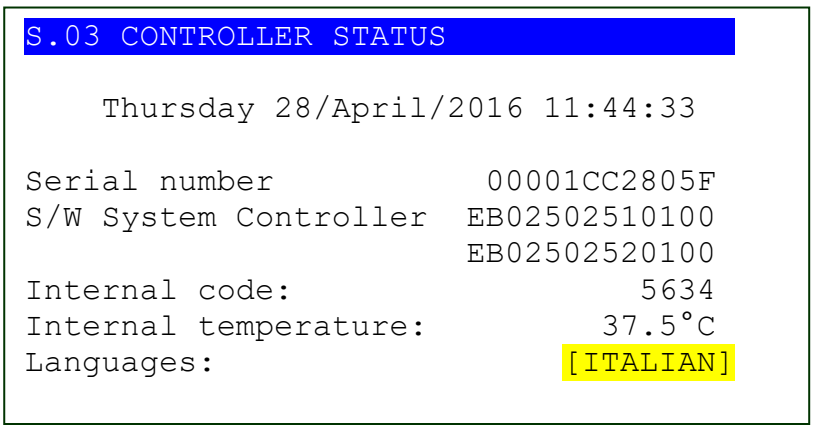
A parameter associated to Mecc Alte level is modifiable only setting Mecc Alte password. A parameter associated to the manufacturer level can be modified only by the manufacturer himself (or with the Mecc Alte password). A parameter associated to the installer level can be modified by the manufacturer 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 “maker” 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 can 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 can modify all parameters, excluding critical ones.

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

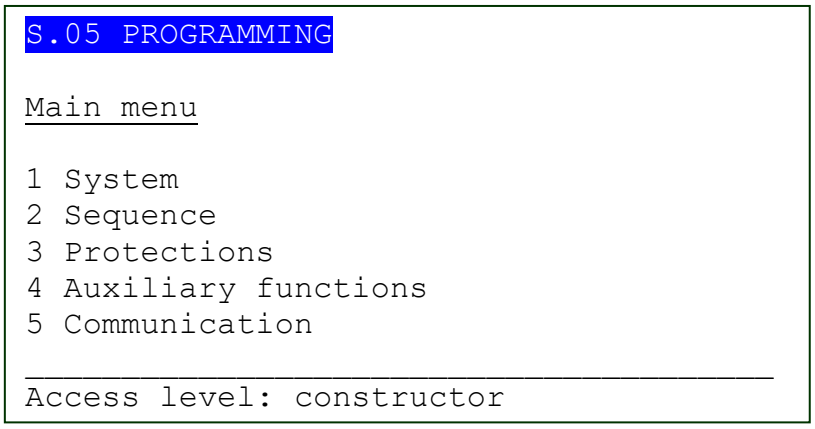
No parameter is modifiable. When the user enters the “UUU” code in P.0000, the controller considers him “user”, but as no password is associated to “installer”, it considers him “installer”. He can modify all parameters associated to the end user and the installer. When entering “III” in P.0000, the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



- **1 (SYSTEM):** The menu 1-SYSTEM allows first to indicate how the controller is connected to the engine and to the genset and the plant type. 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, 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. 8, 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.
- **7 (CANBUS):** this menu allows to configure how the controller should communicate on the bus to acquire the measurements from the electronic engine control unit or from the voltage regulator, and, if necessary, how to send commands.
- **8 (PARALLEL):** The menu 8-PARALLEL allows to configure all functions related to the parallel with the mains or with other gensets.

6.5.1.3.1 Access to programming

The programming is accessible in any operation status of the controller, while the parameter modification is generally possible only with the controller in OFF/RESET.
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 limits 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 fuel 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 Parameter's 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, in the case of the genset nominal power, the nominal current of the genset is shown, resulted by the genset nominal voltage (P.0102) and by the parameter itself (nominal power, P.0106). This additional modification is often displayed when the parameter is expressed as percentage compared to some other value to show the 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 to stop the genset.

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 bits can be used. A hexadecimal 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.
- **Numeric**: 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.
- **Numeric with selection among a default list** (e.g., the number of phases of the genset): 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).
- **Numeric selected in a number-string couples list** (e.g., the type of pressure sensor): 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 oversees verifying that this does not happens.

6.5.1.3.6 Exit from programming

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

6.5.1.4 Loading default values

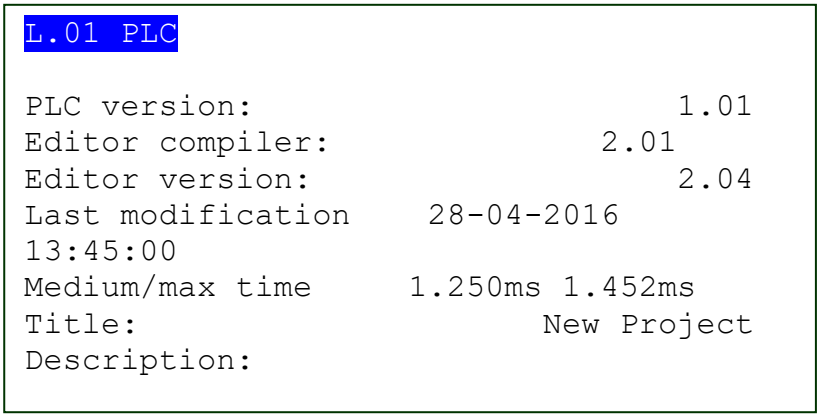
WARNING: This procedure reloads in a permanent way the default parameters in function of the access rights.

In certain situations, it can be useful to reload the default parameters. To do so, it is necessary to select first the OFF/RESET mode, enter 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.

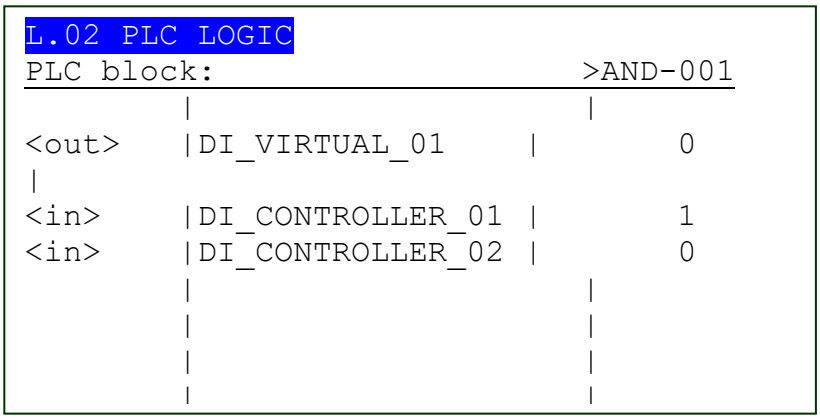
6.5.2.1 L.01 PLC



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



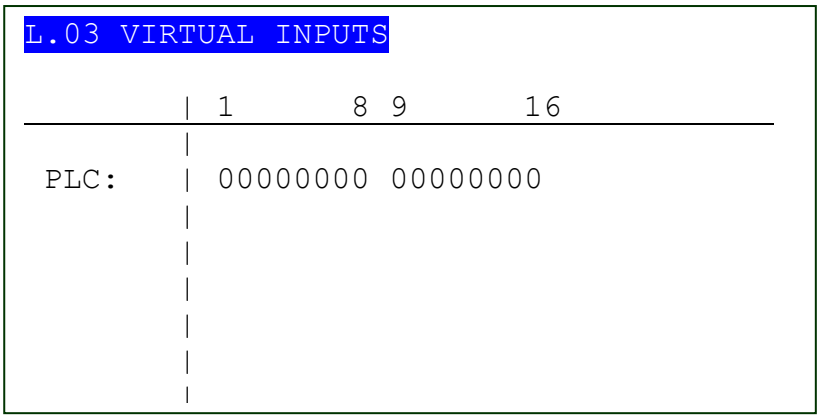
This page shows information about a single PLC block.

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).

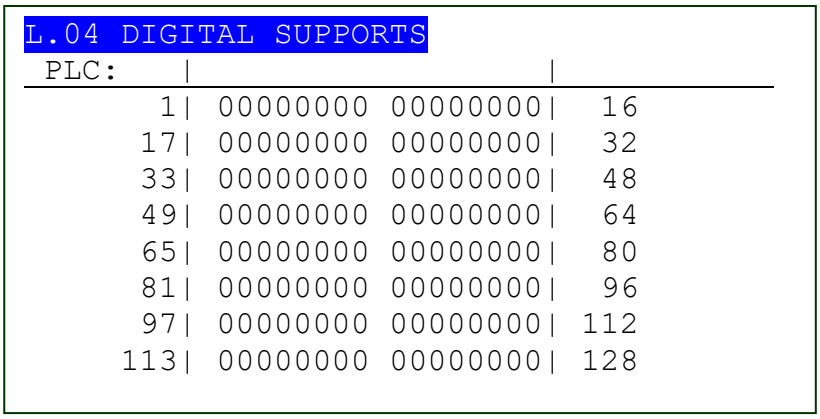
- The first column identifies the type of parameter used (input/output).
- The second column identifies the resource associated to the parameter. The resources are normally shown with Mecc Alte codification (e.g., The digital input 1 is identified as CONTROLLER 01). In the PLC program it is possible 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



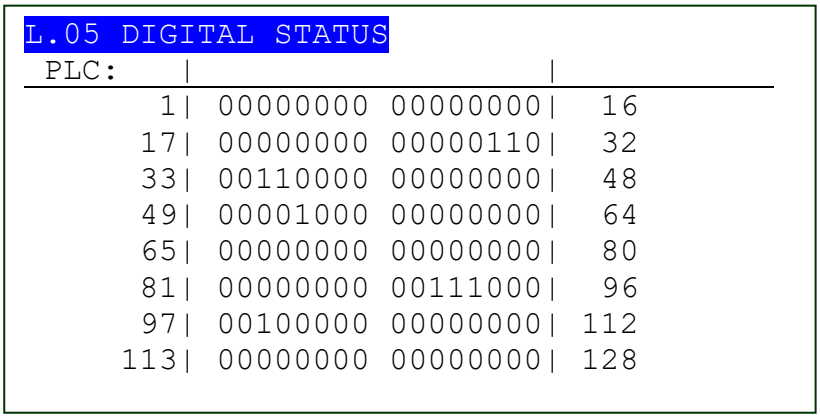
This page shows to status of all virtual digital inputs (that is, those inputs the status of which has not been acquired by the hardware but is determined by the PLC program).

6.5.2.4 L.04 DIGITAL SUPPORTS



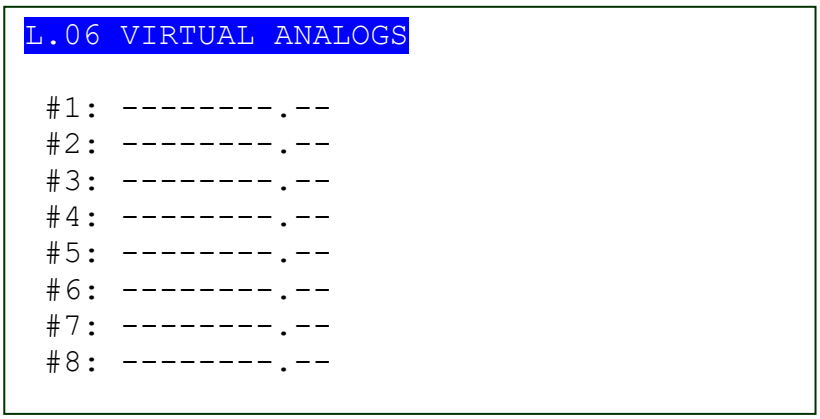
This page shows the status of all temporary digital variables (DT_XXX) available for the PLC program. Many pages which alternate every 2 seconds are available to view all digital supports. Keeping **SHIFT** pressed, you can impede the rotation of the pages (keeping on the display the page currently viewed).

6.5.2.5 L.05 DIGITAL STATUSES



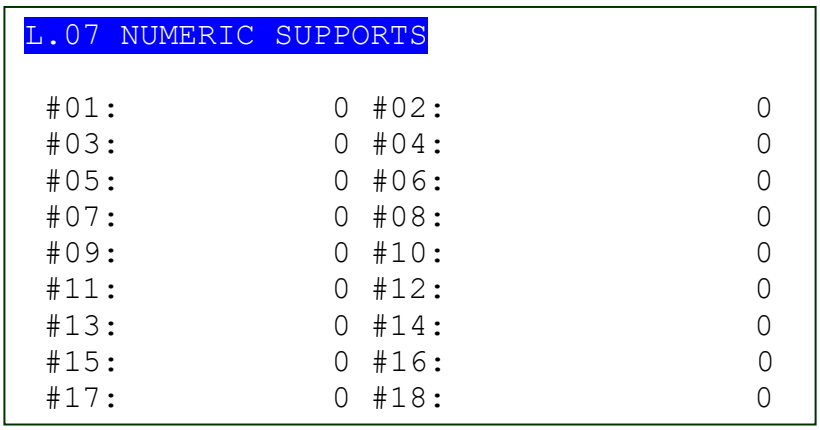
This page shows the value of all internal status of the controller (ST.XXX) available for the PLC program).

6.5.2.6 L.06 VIRTUAL ANALOGUEUES



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



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 RIGHT buttons.

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:

- The status of the operation sequence (stop, start, supplying, etc.).
- Working mode of the controller (MAN, AUTO, etc.).
- The electric Mains status (absent, low, high, etc.).
- The eventual presence of inhibition to genset start.
- The eventual presence of inhibition to users switching on genset.
- The eventual activation of protections override.
- The status of protections for the parallel with the mains.
- The presence of “power limitation” in parallel with the mains.
- The signalling of operation in DROOP mode.
- The signalling of operation “controlled by a MC100 controller”.
- The signalling of some genset in condition of “GCB not open”.
- The wait of the cooling of magnetization resistances for asynchronous gensets.
- The wait of another genset start before stopping this.
- The signalling of situations acquired by the engine junction boxes (power derating, excluding cylinders banks, etc.).

For many information a time is also shown; for example, during the engine cooling cycle the lasting time is shown at the end of that cycle.

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”: alarm.
  - “D”: deactivation.
  - “U”: unload.
  - “W”: warning.
- A three digits 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 must:

- 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 [10].
- 273 (“incoherent parameters”). It shows an additional message helping to understand the problem.
- 252 (“expansion module lacking”). It shows an additional message that identifies the configured expansion module, but that does not communicate with GC600.
- 253: (“analogue measure lacking”). It shows an additional message that identifies the acquisition channel and the expansion module from which we expect to receive a measure, which is lacking instead.
- 254 (“address doubled on EXBUS”). It shows an additional message that identifies the type and the address of the expansion module that is connected twice to GC600.
- 255 (“connection interrupted with a sensor”). It shows an additional message that identifies the channel of acquisition and the expansion module which is sending the information of “broken wire”.
- 900 (“incoherent parameters on PLC”). It shows an additional message helping to understand the problem.

- 198 and 199 ("yellow light" and "red light" from CAN-BUS). In this case the controllers shows also the diagnostic codes received from the extern electronic device (Engine Control Unit, Automatic Voltage Regulator). For each diagnostic code it is shown:

- The name of the external device who generated it (only since version 1.15).
- The SPN code (it is a code defined by the SAE J1939 standard, which identifies the mechanical component that is having the problem) (if available).
- The FMI code (it is a code defined by the SAE J1939 standard, which identifies the type of problem) (if available).
- How many times this diagnostic code has been activated (OC) (if available).
- The alarm code specific for the connected external device (DTC) (if available).
- An alphanumeric description (the same in English) of the problem (if available).

If one or more of the previous information are not available, they are replaced by dashes or not displayed. If there are more active diagnostic codes at the same time, they are cyclically alternated on the display every 2 seconds (hold ESC/SHIFT to stop the rotation). The diagnostic codes are stored (even if the external device deactivates them) until the operator acknowledges (with the “ACK/ENTER” button) the “yellow/red lamp from CAN-BUS” warnings.

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).
- The serial number univocal for the controller. ID”).
- The codes of the software 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 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 GC600 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 must:

- 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 5.15.4).

6.5.3.6 S.06 SMARTCLOUD

This page is only displayed if parameter P.0530 is at value 1. It shows the controller's name (useful to search it in "SMARTCLOUD" system) and the IP address of "SMARTCLOUD" server. Moreover, it displays the communication status with the server:

- "Stand-by".
- "Operating".
- "Error".
- "No answer".

6.5.3.7 S.07 CANBUS

This page displays the status of the CAN-BUS interfaces of the controller. GC600 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.

6.5.3.8 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.

6.5.3.9 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.

6.5.3.10 S.12 DIGITAL INPUTS

This page is only shown if some DITEL modules have been configured (see5.10). It displays the status of the digital inputs acquired from DITEL digital modules. If a DITEL module does not communicate correctly, the controller will display some dashes in place of the input's status. Pressing **ACK/ENTER it is possible to view the rotating inputs in two 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.

6.5.3.11 S.13 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) 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.

6.5.3.12 S.14 DIGITAL OUTPUTS

This page is only shown if some DITEL modules have been configured (see5.10). It displays the status of the DITEL digital outputs. If a DITEL module does not communicate correctly, the controller will display some dashes in place of the input's status. Pressing **ACK/ENTER it is possible to view the rotating outputs in two 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) present on the output; this can be the opposite in comparison to the corresponding logic state. Displayed in negative.

6.5.3.13 S.15 ANALOGUE INPUTS

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

- **PHYSICAL STATE**: Foe each input a measure in Volt is displayed, for terminals JK-2, JK-3, JK-4 and JK-5 also the measure in Ohm.
- **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.

6.5.3.14 S.16 ANALOGUE INPUTS

This page is only shown if some DITHERM or DIGRIN modules have been configured (see5.10).

On the left side, the type of module really connected is shown ((DIGRIN, DITHERM or "DITEMP", if the module does not communicate correctly). On the right side it shows the temperatures acquired by the modules. They can be replaced by:

- "------" if the expansion module does not transmit the measurement.
- "OPEN": if the module signals that the sensor is disconnected.
- "+OVER": if the module signals that the input signal has a too high value, symptom of a fault.
- "-OVER": if the module signals that the input signal has a too low value, symptom of a fault.

If more than 8 DIGRIN/DITHERM are used, the controller shows them on two pages, rotating them every two seconds (keep SHIFT presses to block the rotation).

6.5.3.15 S.17 ANALOGUE INPUTS

This page is only shown if some DIVIT modules have been configured (see 5.10).

On the right side, it shows the measures acquired by the modules (without any conversion). They can be replaced by:

- "------" if the expansion module does not transmit the measurement.
- "OPEN": if the module signals that the sensor is disconnected.
- "+OVER": if the module signals that the input signal has a too high value, symptom of a fault.
- "-OVER": if the module signals that the input signal has a too low value, symptom of a fault.

If more than 3 DIVIT are used, the controller shows them on two pages, rotating them every two seconds (keep SHIFT presses to block the rotation).

6.5.3.16 S.18 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. 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.

6.5.3.17 S.19 ANALOGUE OUTPUTS

This page is only shown if some DANOUT modules have been configured (see5.10).

It shows the percentage value currently associated to the four analogue outputs of each DANOUT module (the real corresponding electrical measure depends on the configuration done inside the module DANOUT). The values are shown in reverse if the DANOUT module is not communicating correctly.

If more than 3 DANOUT are used, the controller shows them on two pages, rotating them every two seconds (keep SHIFT presses to block the rotation).

6.5.3.18 S.20 PROTECTION MAINS

The page is displayed only if the type of plant considers the parallel with the mains.

It displays the status of all protections of parallel with the mains. The disabled protections are not displayed. For each protection enabled, the controller displays the initial (for example “27<<”: it is displayed in reverse if the protection has sprung (mains out of tolerance).

Possible codes are: “27<<”, “27<”, “27Q”, “59>”, “59>>”, “81<<”, “81<”, “81>”, “81>>”, “81R”, “VJ”, “MC” (by MC100), “DI” (by contact). See document [10].

6.5.3.19 S.23 PULSE COUNTERS

This page is displayed only if the controller is configured as pulse-counter. Starting from version 00.89, in fact, it is possible to count the activations / deactivations of the digital inputs, up to maximum 8 counters. The following functions for the configuration of the digital inputs have been added:

Counter	Function for the input to be counted	Function for the reset input
1	DIF.2401	DIF.2417
2	DIF.2402	DIF.2418
3	DIF.2403	DIF.2419
4	DIF.2404	DIF.2420
5	DIF.2405	DIF.2421
6	DIF.2406	DIF.2422
7	DIF.2407	DIF.2423
8	DIF.2408	DIF.2424

When an input configured with functions DIF.2401…DIF.2408 switches from “not active” to “active”, the controller increments by one the related counter. When the input configured with functions DIF.2417... DIF.2424 is active, the controller clears the related counter.

This page shows the values of the configured counters.

6.5.3.20 S.24 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 [10].

6.5.3.21 S.25 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 [10].

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, highlighting:

- The mains, the genset and the loads. The background colour of the symbol indicated the status of the voltage on the mains, on the genset or on the loads:
  - White: voltage/frequency off.
  - Yellow: voltage/frequency on out of tolerance.
  - Green: voltage/frequency on and in tolerance.
- The GBC, MCB and MGCB circuit breakers. 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 possibility to use the synchronization to close the circuit breaker (if the synchronization can be used, the two circuit breaker's points of contacts are empty squares, otherwise they are full).
- The power flows display as arrows in three branches of the plant. The arrow points to power direction. The arrow flashes (to indicate an anomaly) in case of energy inversion on genset and in case of negative power on the loads.
- The active power measurement and of the power factor in the different branches of the plant.
- The active/factor power setpoint for the operation in parallel with the mains.

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

If the operator activates bit 5 of parameter P.0495, the controller displays the active and apparent powers in percentages instead of in kW and in kVA.

6.5.4.2 M.02 MAINS/BARS

In this page are displayed the voltages, the frequency and the rotation sense of the mains/bus-bars phases. The information really displayed depends on the configuration.

- Three phases system (P.0119=3) with neutral connected to the controller (P.0129=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.0119=3) without neutral (P.0129=0). The controller displays the three concatenated voltages, the frequency, the sense of rotation and the neutral-battery voltage.
- Single-phase system (P.0119=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 MAINS/BARS measurements.

6.5.4.3 M.03 GENSET

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

- Three phases system (P.0101=3) with neutral connected to the controller (P.0128=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.0101=3) without neutral (P.0128=0). The controller displays the three concatenated voltages, the frequency, the sense of rotation.
- 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, 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 GENSET measurements.

6.5.4.4 M.04 CURRENTS

In this window phase currents are displayed (one or three) measured by the controller. **NB: normally, these currents are the ones delivered by the generator. If the measure CT are connected on load lines instead of on the genset lines, the displayed currents can be those absorbed by the mains. At the bottom right corner, the symbol of the generator or of the mains are displayed from time to time to identify the real source of the current.**

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.0131=1 or P.0131=4).
- **An**: neutral current (visible if P.0131=2).
- **A∑:** differential current (visible if P.0131=2 or P.0131=3).

If P.0131=2 (neutral current) is configured, the controller can calculate (and display) the differential current if:

- The CT of the auxiliary current has the same ration of the CT of the genset.
- The CT of the auxiliary current is connected to the same line of the CT of the genset.

6.5.4.5 M.05 POWERS

The active powers and power factors are shown, total and phase by phase (dashes only for phase 2 and 3 in single-phase mode).

Under the measure of the total active power, 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 active power is in tolerance, red if it is out of tolerance.

At the right bottom corner, the generator or mains icon is displayed, to indicate which powers you are looking at (see note in 6.5.4.4).

If the operator activates bit 5 of parameter P.0495, the controller displays the active and apparent powers in percentages instead of in kW and in kVA.

6.5.4.6 M.06 POWERS

In this page the reactive powers (kvar) and the apparent powers (kVA) on the single and total phases are shown (for single-phase systems, the information relative to phases 2 and 3 are replaced by dashes).

Under the measure of the total reactive power, 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 reactive power is in tolerance, red if it is out of tolerance.

At the right bottom corner, the generator or mains icon is displayed, to indicate which powers you are looking at (see note in 6.5.4.4).

If the operator activates bit 5 of parameter P.0495, the controller displays the active and apparent powers in percentages instead of in kW and in kVA.

6.5.4.7 M.07 ENERGY COUNTERS

In this page the active and reactive energy counters (partial and total) are shown, counted by the controller **when all loads are connected to the genset.**

The active power is counted only if positive (it is not counted in the event of reversed power). The reactive power is counted in module (the counter goes up both with capacitive loads and with inductive loads).

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.

From version 1.21, these counters are protected with the password configured by parameter P.0001 (protection level: user). If a password has been configured in P.0001, to be able to reset the counters, it must first be entered (login) in parameter P.0000 ("access code").

Use the EXIT button. At the bottom to the right, the display shows an icon which identifies the generator, to allow you to easily distinguish this page from the next, which has an identical structure.

6.5.4.8 M.08 ENERGY COUNTERS

In this page the active and reactive energy counters (partial and total) are shown, counted by the controller **when all loads are connected to the mains/bars.** This page is visible only if the controller has been configured to operate with the CT on the loads instead if on the genset (P.0124 = 1 – On loads).

The active power is counted only if positive (it is not counted in the event of reversed power). The reactive power is counted in module (the counter goes up both with capacitive loads and with inductive loads).

The reactive power is counted in module (the counter goes up both with capacitive loads and with inductive loads).

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.

From version 1.21, these counters are protected with the password configured by parameter P.0001 (protection level: user). If a password has been configured in P.0001, to be able to reset the counters, it must first be entered (login) in parameter P.0000 ("access code").

Use the EXIT button. At the bottom to the right, the display shows an icon which identifies the mains, to allow you to easily distinguish this page from the previous, which has an identical structure.

6.5.4.9 M.09 AUSILIARY MEASURES

This page displays the additional information on genset voltages and currents, used for the protection of the 27Q mains parallel. It is shown:

- The current measured through the fourth CT on the interchange point with the mains (if P.0131=4).
- The current of positive sequence (I+).
- The current of negative sequence (I-).
- The voltage of positive sequence (V+).
- The voltage of negative sequence (V-).
- The reactive power of positive sequence (kvar).

6.5.4.10 M.10 REGULATIONS

This page is not useful in the parallel applications. It displays genset and mains/bus voltages and frequencies at the same time. It is then possible to modify the commands for the speed governor and voltage regulator directly from this page. On the last two lines, in effect, there are stand-by values for the two regulators or, in alternative, the voltage and frequency setpoints (it depends on the controller configuration and on the status of the plant). In both cases, it is possible to manually modify these values:

- Press ENTER digit: one of the values is highlighted.
- Using ENTER digit or ◄► digits, you select the other value (cyclically).
- Using ▲ and ▼ digits, it is possible to modify the selected value (if pressed together with SHIFT the modification is quicker).
- Press EXIT digit to end the modification.

The modification is automatically interrupted if you don’t press any digits for 10 seconds.

Note: some of these setpoints can be acquired from the analogue inputs: in this case on this page they are shown, but it is not possible to modify them.

6.5.4.11 M.11 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 and voltage between genset and mains/bars, besides the engine rotation full speed.

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.

6.5.4.12 M.12 PARALLEL

This page shows useful information when the genset is in parallel with the mains or with other gensets. Active power, reactive power and power factor are shown. It also displays currents, medium voltage and genset frequency.

In the lower part of the window, the controller shows the active and reactive power reference value (if available when the generator is in parallel with the mains or with other generators). They are instantaneous values; the controller should act to ensure that the generator delivers exactly that active and reactive power. They are calculated from instant by instant, by applying any configured loading and unloading phases (P.0874, P.0875 and P.0876): for this reason, the controller also displays the final reference for the active power, which is what the generators will have to deliver at the end of loading and unloading phases.

If the operator activates bit 5 of parameter P.0495, the controller displays the active and apparent powers in percentages instead of in kW and in kVA.

6.5.4.13 M.13 SETPOINTS

This page shows and allows to modify (in just one point) all the applicable setpoints for the plant, relative to the speed governor and the voltage regulator. It is useful because on page M.01 are instead shown only the significant setpoints in a given moment. For example, if a plant can operate both in BASE LOAD mode and in DROOP mode, on page M.01 only the setpoints relative to the active operation mode will show, while on page M.13 they will all be shown: in this way, the operator can set the setpoints before changing the operation mode. The displayed and modifiable setpoints (if not acquired from analogue inputs) are:

- Offset of speed (P.0840) and voltage (P.0867).
- Empty frequency (P.0974) and empty voltage (P.0986) for DROOP.
- Setpoint of active power (P.0858) and of cos phi (P.0860) for the SYSTEM BASE LOAD mode.
- Setpoint of active power for the LOCAL BASE LOAD (P.0884 and P.0902) mode.
- Setpoint of active power for the IMPORT/EXPORT (P.0888) mode.
- Setpoint of cos phi for the LOCAL BASE LOAD and IMPORT/EXPORT (P.0894) mode.

The setpoints are only shown if they are not acquired from analogue inputs and if they are included in the plant configuration.

6.5.4.14 M.14 SETPOINTS 2

This page shows (in just one point) all the applicable setpoints for the plant, relative to the speed governor and the voltage regulator. It is like page M.13. The adjustable setpoints are:

- Offset of speed (P.0840) and voltage (P.0867).
- Empty frequency (P.0974) and empty voltage (P.0986) for DROOP.
- Setpoint of active power (P.0858) and of cos phi (P.0860) for the SYSTEM BASE LOAD mode.
- Setpoint of active power for the LOCAL BASE LOAD (P.0884 and P.0902) mode.

- Setpoint of active power for the IMPORT/EXPORT (P.0888) mode.
- Setpoint of cos phi for the LOCAL BASE LOAD and IMPORT/EXPORT (P.0894) mode.

The setpoints are only shown if they are not acquired from analogue inputs and if they are included in the plant configuration.

6.5.4.15 M.15…M.19 AVR

It contains a series of standard information (J1939-75) acquired via CAN-BUS from the automatic voltage regulator. The amount of information available depends on the type of device to which you are connected. Information not available is not displayed. The number of pages displayed therefore depends on the actual information transmitted by the voltage regulator. The information shown on this page are:

- spn 1122 - Engine Alternator Bearing 1 Temperature.
- spn 1123 - Engine Alternator Bearing 2 Temperature.
- spn 1124 - Engine Alternator Winding 1 Temperature.
- spn 1125 - Engine Alternator Winding 2 Temperature.
- spn 1126 - Engine Alternator Winding 3 Temperature.
- spn 2436 – Average frequency
- spn 2437 - Frequency L1
- spn 2438 - Frequency L2
- spn 2439 - Frequency L3
- spn 2440 - Average L-L voltage
- spn 2441 - Voltage L1-L2
- spn 2442 - Voltage L2-L3
- spn 2443 - Voltage L3-L1
- spn 2444 - Average L-N voltage
- spn 2445 - Voltage L1-N
- spn 2446 - Voltage L2-N
- spn 2447 - Voltage L3-N
- spn 2448 – Average current
- spn 2449 - Current L1
- spn 2450 - Current L2
- spn 2451 - Current L3
- spn 2452 - Total active power
- spn 2453 - Active power L1
- spn 2454 - Active power L2
- spn 2455 - Active power L3
- spn 2456 - Total reactive power
- spn 2457 - Reactive power L1
- spn 2458 - Reactive power L2
- spn 2459 - Reactive power L3
- spn 2460 - Total apparent power
- spn 2461 - Apparent power L1
- spn 2462 - Apparent power L2
- spn 2463 - Apparent power L3
- spn 2464 - Total power factor
- spn 2465 - Power factor L1
- spn 2466 - Power factor L2
- spn 2467 - Power factor L3
- spn 2518 - Load type (total) (0=leading, 1=lagging)
- spn 2519 - Load type L1 (0=leading, 1=lagging)
- spn 2520 - Load type L2 (0=leading, 1=lagging)
- spn 2521 - Load type L3 (0=leading, 1=lagging)

- spn 2468 - Exported active energy
- spn 2469 - Imported active energy
- spn 3380 - Excitation voltage
- spn 3381 - Excitation current.

6.5.4.16 M.20…M.25 AVR

From version 1.32, the controller supports the management of external configuration files that describe the Canbus communication with the automatic voltage regulators. These files may include the definition of one or more pages for the display, dedicated to displaying the specific measures / states of that device (usually when they do not follow the J1939-75 standard).

The controller offers up to six pages. The title of each page is defined in the configuration file for the voltage regulator, as well as the number of measurements shown and their description. Attention: since the descriptions are defined in the external file, they do not adapt to the language selected on the controller (typically they are in English).

6.5.5 Engine measurements (E.XX)

The engine related measurements and parameters are shown in this mode. The number of displayed pages and the display of some parameters can vary depending on the engine type (J1939, MTU o without communication interface). You can scroll through the various pages using the LEFT and RIGHT buttons.

6.5.5.1 E.01 ENGINE 1

It contains basic measurements for engine management:

- Engine Oil pressure
- Coolant temperature
- Engine speed

If some of these measures are not available, they are shown with dashes.

Under each measurement, the controller also displays a bar showing graphically the current measurement with respect to the bottom scale: on the bar are also represented eventual thresholds. The colour with which the bar is filled is green if the measure is in tolerance, red if it is out of tolerance (for alarm) or yellow if the measure is out of tolerance (warning).

6.5.5.2 E.02 ENGINE 2

It contains other measurements for engine management:

- Voltage of starting battery (measured by the controller).
- Fuel level
- Oil temperature

If some of these measures are not available, they are shown with dashes.

Under each measurement, the controller also displays a bar showing graphically the current measurement with respect to the bottom scale: on the bar are also represented eventual thresholds. The colour with which the bar is filled is green if the measure is in tolerance, red if it is out of tolerance (for alarm) or yellow if the measure is out of tolerance (warning).

6.5.5.3 E.03 ENGINE 3

It contains other quantities for the engine management, **when they are acquired using the analogue inputs of the controller**. If the same measurements are acquired using the CANBUS connection, they are displayed on other pages. This page is automatically hidden if none of the following measures are available:

- coolant level (AIF.1210 or AIF.1211 functions in the configuration of the analogue inputs).
- oil level (AIF.1200 or AIF.1201 functions in the configuration of the analogue inputs).
- air temperature in the intake duct (AIF.1601 function in the configuration of the analogue inputs).
- turbocharger pressure (AIF.1641 function in the configuration of the analogue inputs).
- exhaust gas temperature (left bank) (AIF.1603 function in the configuration of the analogue inputs).
- exhaust gas temperature (right bank) (AIF.1605 function in the configuration of the analogue inputs).

If some of these measures are not available, they are hidden.

6.5.5.4 E.04 ENGINE COUNTERS

This page contains various counters (managed by the controller board), which concern the engine:

- Cranks counter (resettable to zero).

- Counter of operating hours (resettable to zero).
- Counter of load operating hours with GCB closed (resettable to zero)
- Counter of operating hours in OVERRIDE (resettable).
- Counter of operating hours (total, not resettable to zero).

The first four counters are resettable (individually). To reset a counter, the operator must:

- 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 ESC digits for 5 seconds.
- Press the ESC pushbutton.

From version 1.21, these counters are protected with the password configured by parameter P.0001 (protection level: user). If a password has been configured in P.0001, to be able to reset the counters, it must first be entered (login) in parameter P.0000 ("access code").

6.5.5.5 E.05 SERVICE

This page contains various counters (managed by the controller board), which concern the engine:

- Counter of the remaining hours to maintenance 1 (not resettable).
- Counter of the remaining hours to maintenance 2 (not resettable).
- Days remaining and date for the next maintenance (not resettable).

The page is hidden if no deadlines are set for the maintenance operations.

6.5.5.6 E.06 FUEL PUMP

The page is available only if at least one output is configured for the pump management and it contains the following information:

- The current managing mode of the fuel pump (MAN-OFF, MAN-ON, AUTO).
- The pump status (on/off).
- An indication of the fuel level referred to the pump management (required starting, required stop, in hysteresis).

If the management of the pump is related to the level analogue sensor, then the controller displays with a graphic bar the current fuel level, also indicating the start/stop thresholds of the pump.

It is possible to vary the fuel pump managing mode from this page, without going to programming. To do so you must:

- Press ENTER: the squared brackets which contain the current mode start flashing.
- Use the vertical scrolling UP and DOWN digits to select the desired mode.
- Confirm with ENTER or cancel the modification with ESC.

See 7.7.13 for a detailed description of the functionalities offered by the controller for the fuel pump command.

6.5.5.7 E.07-08-09 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 E.07.
- AIF.2003: page E.08.
- AIF.2005: page E.09.

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.

6.5.5.8 E.10 DASHBOARD

This page, as indicated by the title, shows all the standard warning lights (lamps) activated either by the engine control unit or by the automatic voltage regulator. This information are acquired via CANBUS. If none of this information is available, the page is not visible. The lamps displayed are:

-  SPN 1081 (“WAIT TO START LAMP”). It is necessary to wait for the engine control unit to finish the preliminary operations before the engine can be started.
-  SPN 624 (“AMBER WARNING LAMP”). The engine control unit (or the voltage regulator) is signalling on the CANBUS the presence of a diagnostic code (therefore of a problem) which at the moment does not prevent its operation.
- 

SPN 623 (“RED STOP LAMP”). The engine control unit (or the voltage regulator) is signalling on the CANBUS the presence of a diagnostic code (therefore a problem) that prevents its operation
-  Indicates that the regeneration of the diesel particulate filter is inhibited following explicit command. It is usually displayed in solid yellow (it is a state, not an anomaly). If, however the condition remains for a long time and the soot level in the filter becomes extremely high, the ECU activates a diagnostic code with red lamp (icon with a STOP sign shape) and stops the engine: in this case the icon becomes red (fixed or flashing, like red lamp). It is linked to SPN 3697 (“DIESEL PARTICULATE FILTER LAMP COMMAND”) or 6915 (“SCR SYSTEM CLEANING LAMP COMMAND”). If regeneration is in progress it is displayed in green.
-  Indicates that regeneration of the diesel particulate filter is required. It is yellow. It is fixed (not blinking) if the quantity of particulate in the filter is above the "regeneration request" threshold but below the warning threshold. It becomes flashing if it is above the warning threshold. It is related to SPN 3703 (“DIESEL PARTICULATE FILTER ACTIVE REGENERATION INHIBITED DUE TO INHIBIT SWITCH”) or 6918 (“SCR SYSTEM CLEANING INHIBITED DUE TO INHIBIT SWITCH”).
-  SPN 3698 (“EXHAUST SYSTEM HIGH TEMPERATURE LAMP COMMAND”). It signals a high temperature (real or possible) in the emissions management system (HEST – High Emission System Temperature), probably because regeneration is in progress or about to start: the ECU could apply a reduction in engine performance (derating). It is yellow, not flashing.

-  SPN 5245 (“AFTERTREATMENT DIESEL EXHAUST FLUID TANK LOW LEVEL INDICATOR”). Indicates a low level of the Diesel Exhaust Fluid (DEF) tank. It can be steady if the level is below normal, flashing if the low level determines a power derating.

-  Indicates that the engine emissions system has a malfunction or is working outside the standard operating conditions. It is yellow, it can be fixed or flashing. It is related to SPN 1213 ("MALFUNCTION INDICATOR LAMP") and 3038 ("FLASH MALFUNCTION INDICATOR LAMP")

  This page also shows all the diagnostic codes activated by the engine ECU or by the voltage regulator, **even if the controller is in OFF / RESET**.

  Note: the controller forces this page to be displayed every time a lamp is activated.

6.5.5.9 E.11 Emission levels exceedance

It contains a series of standard diagnostic information (J1939-DM32) concerning the exceeding of the emission levels, acquired via CAN-BUS from the engine control unit. The controller displays this page only if the ECU transmits this diagnostic information.

A maximum of eight diagnostic information is managed, each of which contains:

- The SPN code, that identifies the engine component causing or having the problem.
- The FMI code, that identifies the type of problem.
- The time (in hours) from here this diagnostic code is active.
- The time (in hours) that this diagnostic code has been active in the past.
- The remaining time (in hours) to the derating of the engine performances.

If two or more codes are active at the same time, they are alternated on the display every two seconds.

6.5.5.10 E.12…E.19 ECU

It contains a series of standard information (J1939) acquired via CAN-BUS from the engine control unit. The number of information available depends on the type of control unit to which you are connected. Information not available is not displayed. The number of pages displayed therefore depends on the actual information transmitted by the engine control unit. The information shown on this page are:

- spn 22: Engine Extended Crankcase Blow-by Pressure
- spn 51: Engine Throttle Position.
- spn 52: Engine Intercooler Temperature.
- spn 81: Aftertreatment 1 Diesel Particulate Filter Intake Pressure
- spn 91: Accelerator Pedal Position 1.
- spn 92: Engine Percent Load At Current Speed.
- spn 94: Engine Fuel Delivery Pressure.
- spn 96: Fuel Level 1
- spn 98: Engine Oil Level.
- spn 100: Engine Oil Pressure.
- spn 101: Engine Crankcase Pressure.
- spn 102: Engine Intake Manifold #1 Pressure.
- spn 105: Engine Intake Manifold #1 Temperature.
- spn 106: Engine Intake Air Pressure
- spn 106: Engine Intake Air Pressure

- spn 107: Engine Air Filter 1 Differential Pressure
- spn 108: Barometric Pressure.
- spn 109: Engine Coolant Pressure.
- spn 110: Engine Coolant Temperature.
- spn 111: Engine Coolant Level.
- spn 132: Engine Intake Air Mass Flow Rate
- spn 156: Engine Injector Timing Rail 1 Pressure.
- spn 157: Engine Injector Metering Rail 1 Pressure.
- spn 158: Key switch Battery Potential.
- spn 166: Engine Rated Power.
- spn 168: Battery Potential / Power Input 1
- spn 171: Ambient Air Temperature.
- spn 172: Engine Intake 1 Air Temperature
- spn 173: Engine Exhaust Gas Temperature
- spn 174: Engine Fuel Temperature 1.
- spn 175: Engine Oil Temperature 1.
- spn 182: Engine Trip Fuel.
- spn 183: Engine Fuel Rate.
- spn 189: Engine Rated Speed.
- spn 190: Engine Speed.
- spn 247: Engine Total Hours of Operation.
- spn 249: Engine Total Revolutions
- spn 250: Engine Total Fuel Used.
- spn 411: Engine Exhaust Gas Recirculation 1 Differential Pressure
- spn 412: Engine Exhaust Gas Recirculation 1 Temperature
- spn 441: auxiliary temperature 1
- spn 442: auxiliary temperature 2
- spn 512: Driver's Demand Engine - Percent Torque.
- spn 513: Actual Engine - Percent Torque.
- spn 514: Nominal Friction - Percent Torque.
- spn 515: Engine's Desired Operating Speed.
- spn 544: Engine Reference Torque
- spn 977: Fan Drive State
- spn 1108: Engine Protection System Timer Override
- spn 1029: Trip Average Fuel Rate.
- spn 1127: Engine Turbocharger 1 Boost Pressure
- spn 1135: Engine Oil Temperature 2.
- spn 1136: Engine ECU Temperature.
- spn 1172: Engine Turbocharger 1 Compressor Intake Temperature
- spn 1180: Engine Turbocharger 1 Turbine Intake Temperature
- spn 1181: Engine Turbocharger 2 Turbine Intake Temperature
- spn 1182: Engine Turbocharger 3 Turbine Intake Temperature
- spn 1183: Engine Turbocharger 4 Turbine Intake Temperature
- spn 1241: Engine Fuel System 1 Gas Mass Flow Rate
- spn 1636: Engine Intake Manifold 1 Temperature (High Resolution)
- spn 1637: Engine Coolant Temperature (High Resolution)
- spn 1639: Fan Speed
- spn 2432: Engine Demand – Percent Torque

6.5.5.11 E.20 DPF REGENERATION

The controller fully supports the TIER4 (US) and STAGE V (EU) directives concerning generators emissions. This support consists of two parts:

- Visualization. A minimum of measurements is required:

- Percent of soot in the Diesel Particulate Filter (DPF).
- Percentage of ash in the Diesel Particulate Filter (DPF).
- Diesel Emissions Fluid (DEF) level.
- Icons (shown on page E.10)

- Commands. The specification provides two separate commands, to be sent to the ECU, to influence the regeneration of the DPF:

- Inhibition of regeneration. This command should only be activated when the full power of the generator is required. Regeneration, in fact, involves temperature increases that may require a derating of engine performance. It should be a transient condition: if the level of soot in the filter increases and the ECU cannot regenerate it, at some point the ECU will still apply a derating and eventually it could stop the engine.
- Forcing of regeneration. It is the opposite command: verifying from the previous lamps the request for regeneration from the ECU, the operator can force it in the moments more favourable to him.

The controller implements these commands in two ways:

- Parameter P.0446. This parameter can take three values:

  - 0 - Automatic. It does not send any commands to the ECU, which is therefore free to perform the regeneration whenever it wants.
  - 1 – Forced. It sends the forcing command to the ECU for the maximum time configured by parameter P.0447 (if P.0447=0, for infinite time), then the parameter is reset to 0-Automatic. If the ECU can, it carries out a regeneration cycle, which involves overheating the emission treatment system and derating the engine. Following this command, some of the lamps described above can be activated.
  - 2 – Inhibited. It activates the ECU inhibition command, which therefore does not regenerate, even if required.

  The parameter can be modified directly from page E.20.

- As an alternative to the parameter, it is possible to use two digital inputs configured with the following functions:

  - DIF.2071: inhibits regeneration.
  - DIF.2072: forces regeneration.

  If there is one of the inputs, parameter P.0446 can no longer be changed, because the inputs go to force the value of the parameter.

  You can also use virtual digital inputs to build complicated logics to manage the regeneration of the filter.

  As a rule, the controller uses the Can bus line to send these commands to the ECU. It is also possible to use digital outputs, configured with the following functions:

- DOF.1035: regeneration inhibited.
- DOF.1036: regeneration forced.

The status of the two commands (forcing and inhibiting) is available for the AND/OR logics through the ST.137 and ST.138 states

Some ECUs, to perform the "active" regeneration of the particulate filter, must necessarily increase the engine speed. For this reason, they require consent from the controller before activating this process. The controller, as a rule, sends the consent to "active" regeneration if the GCB circuit breaker is open: however, if there is a digital input configured with the DIF.2073 function, then regeneration is allowed when this input is active.

Consequently, if the GCB is open and the ECU is performing the "active" regeneration (SPN3700 = 1), the maximum frequency / speed protections are disabled (by contact, by frequency measurement and by rpm measurement).

This page displays the fundamental states in the management of the filter regeneration and allows you to inhibit or force the regeneration of the particulate filter. In fact, it allows you to modify parameter P.0446 directly, without entering the programming menus.

The displayed statuses are:

- SPN 3701 (“AFTERTREATMENT DIESEL PARTICULATE FILTER STATUS”): indicates whether or not filter regeneration is required, based on the levels of ash and/or soot.
- SPN 3700 (“AFTERTREATMENT DIESEL PARTICULATE FILTER ACTIVE REGENERATION STATUS”). Indicates the status of the active regeneration process of the filter.
- SPN 3699 (“AFTERTREATMENT DIESEL PARTICULATE FILTER PASSIVE REGENERATION STATUS”). Indicates the status of the passive filter regeneration process.
- Status of the MANUAL regeneration process of the filter (only for SCANIA engines).
- All the causes that prevent the regeneration of the filter:
  - SPN 3702 (“DIESEL PARTICULATE FILTER ACTIVE REGENERATION INHIBITED STATUS”)
  - SPN 3703 (“DIESEL PARTICULATE FILTER ACTIVE REGENERATION INHIBITED DUE TO INHIBIT SWITCH”)
  - SPN 3711 (“DIESEL PARTICULATE FILTER ACTIVE REGENERATION INHIBITED DUE TO LOW EXHAUST TEMPERATURE”)
  - SPN 3712 (“DIESEL PARTICULATE FILTER ACTIVE REGENERATION INHIBITED DUE TO SYSTEM FAULT ACTIVE”)
  - SPN 3713 (“DIESEL PARTICULATE FILTER ACTIVE REGENERATION INHIBITED DUE TO SYSTEM TIMEOUT”)
  - SPN 3714 (“DIESEL PARTICULATE FILTER ACTIVE REGENERATION INHIBITED DUE TO TEMPORARY SYSTEM LOCKOUT”)
  - SPN 3715 (“DIESEL PARTICULATE FILTER ACTIVE REGENERATION INHIBITED DUE TO PERMANENT SYSTEM LOCKOUT”)
  - SPN 3716 (“DIESEL PARTICULATE FILTER ACTIVE REGENERATION INHIBITED DUE TO ENGINE NOT WARMED UP”)
  - SPN 3750 (“AFTERTREATMENT 1 DIESEL PARTICULATE FILTER CONDITIONS NOT MET FOR ACTIVE REGENERATION”)

The controller makes available some information concerning the regeneration on the following internal states:

- ST.368: Active regeneration status: not active (spn3700 = 0).
- ST.369: Active regeneration status: active (spn3700 = 1).
- ST.370: Active regeneration status: it will start shortly (spn3700 = 2).
- ST.371: DPF status: regeneration not requested (spn3701 = 0).
- ST.372: DPF status: regeneration required - lowest level (spn3701 = 1).
- ST.373: DPF status: regeneration required - moderate level (spn3701 = 2).
- ST.374: DPF status: regeneration required - highest level (spn3701 = 3).

6.5.5.12 E.21…E.23 EXHAUST GAS THREATMENT

It contains a series of standard information (J1939) acquired via CAN-BUS from the engine control unit, concerning emissions management (AFTERTREATMENT). The number of information available depends on the type of control unit to which you are connected. Information not available is not displayed. The number of pages displayed therefore depends on the actual information transmitted by the engine control unit. The information shown on this page are:

- SPN 4765 ("AFTERTREATMENT 1 DIESEL OXIDATION CATALYST INTAKE TEMPERATURE")
- SPN 4766 ("AFTERTREATMENT 1 DIESEL OXIDATION CATALYST OUTLET TEMPERATURE")
- SPN 4781 ("AFTERTREATMENT 1 DIESEL PARTICULATE FILTER SOOT MASS")
- SPN 3719 ("AFTERTREATMENT 1 DIESEL PARTICULATE FILTER SOOT LOAD PERCENT")
- SPN 5466 ("AFTERTREATMENT 1 DIESEL PARTICULATE FILTER SOOT LOAD REGENERATION THRESHOLD")
- SPN 3720 ("AFTERTREATMENT 1 DIESEL PARTICULATE FILTER ASH LOAD PERCENT")
- SPN 3251 ("AFTERTREATMENT 1 DIESEL PARTICULATE FILTER DIFFERENTIAL PRESSURE")
- SPN 3242 ("AFTERTREATMENT 1 DIESEL PARTICULATE FILTER INTAKE TEMPERATURE")
- SPN 81 (" AFTERTREATMENT 1 DIESEL PARTICULATE FILTER INTAKE PRESSURE")
- SPN 3246 ("AFTERTREATMENT 1 DIESEL PARTICULATE FILTER OUTLET TEMPERATURE")
- SPN 3721 ("AFTERTREATMENT 1 DIESEL PARTICULATE FILTER TIME SINCE LAST ACTIVE REGENERATION")
- SPN 1761 ("AFTERTREATMENT 1 DIESEL EXHAUST FLUID TANK VOLUME")
- SPN 3031 ("AFTERTREATMENT 1 DIESEL EXHAUST FLUID TANK TEMPERATURE 1")
- SPN 3515 ("AFTERTREATMENT 1 DIESEL EXHAUST FLUID TEMPERATURE 2")
- SPN 3516 ("AFTERTREATMENT 1 DIESEL EXHAUST FLUID CONCENTRATION")
- SPN 5963 ("AFTERTREATMENT 1 TOTAL DIESEL EXHAUST FLUID USED")
- SPN 6563 ("AFTERTREATMENT TRIP DIESEL EXHAUST FLUID")
- SPN 4360 ("AFTERTREATMENT 1 SCR INTAKE TEMPERATURE")
- SPN 4363 ("AFTERTREATMENT 1 SCR OUTLET TEMPERATURE")
- SPN 4332 ("AFTERTREATMENT 1 SCR SYSTEM 1 STATE")
- SPN 4331 ("AFTERTREATMENT 1 DIESEL EXHAUST FLUID ACTUAL DOSING QUANTITY")
- SPN 4334 ("AFTERTREATMENT 1 DIESEL EXHAUST FLUID DOSER 1 ABSOLUTE PRESSURE")
- SPN 5246 ("AFTERTREATMENT SCR OPERATOR INDUCEMENT SEVERITY")
- SPN 3241 ("AFTERTREATMENT 1 EXHAUST TEMPERATURE 1")
- SPN 3236 ("AFTERTREATMENT 1 EXHAUST GAS MASS FLOW RATE")
- SPN 3237 ("AFTERTREATMENT 1 INTAKE DEW POINT")
- SPN 3238 ("AFTERTREATMENT 1 EXHAUST DEW POINT")
- SPN 3239 ("AFTERTREATMENT 2 INTAKE DEW POINT")
- SPN 3240 ("AFTERTREATMENT 2 EXHAUST DEW POINT")
- SPN 5826 ("EMISSION CONTROL SYSTEM OPERATOR INDUCEMENT SEVERITY")

6.5.5.13 E.24 ADBLUE PUMP

GC600 hides this page if the operator did not configure any digital output with the DOF.1037 function (“AdBlue pump”).

It shows the following information:

- The pump command mode:
  - MAN-OFF.
  - MAN-ON.
  - AUTO.
- The AdBlue fluid level in the daily tank (spn 1761 “Aftertreatment 1 Diesel Exhaust Fluid Tank Volume”). GC600 displays it with a horizontally filled bar, which also graphically shows the pump start/stop thresholds
- Activation requests for the pump, depending on the AdBlue fluid level:
  - Start required.
  - Stop required.
  - In hysteresis.
- The actual status of the pump, eventually with the time remaining before the next change of status:
  - pump off.
  - pump on.

From this page, you can manually select the control mode of the pump:

- Press the ENTER button: GC600 will highlight in reverse the current mode.
- Use the ▲ and ▼ buttons to select the desired mode.
- Confirm by pressing the ENTER button or cancel the change by pressing the EDC button.

For information on pump management, see paragraph 7.7.14.

6.5.5.14 E.25…E.30 ECU

The controller supports the management of external configuration files that describe the Canbus communication with the electronic engine control units. Such files may include the definition of one or more pages for the display, dedicated to displaying the measurements / states specific to that control unit (usually when they do not follow the J1939 standard). For example, if you use the files related to MAN DATALOGGER, the controller displays all the measurements acquired by those units in a single page.

The controller provides up to six pages. The title of each page is defined in the configuration file for the engine, as well as the number of measures shown and their description. **Attention:** since the descriptions are defined in the external file, they do not fit the language selected on the controller (typically they are in English).

6.5.6 Measurement from CAN-BUS PMCB (B.XX)

In this mode, the measurement of the statuses acquired by the CAN-BUS PMCB, which connects among them all Mecc Alte devices is displayed. All pages of this mode are only shown if the CAN-BUS PMCB is enabled (P.0800 <> 0).

6.5.6.1 B.01 CONTROLLERS ON PMCB

This page shows, in order, the list of controlers for mains (MC), generators (GC), tie breakers (BTB) and renewable sources (RN) recognized on the PMCB CAN bus connection. PMCB addresses of all detected controllers are displayed. It is useful for diagnostic purposes.

6.5.6.2 B.02-03-04 GENSETS

These pages show the significant data of each genset that operates on the PMBC can bus. Each page shows up to 8 gensets. Only the relevant pages are shown. It is used one line for each genset, which contains the PMCB address, the active power, the reactive power and the status. The status is shown in red if the genset is not available for automatic operation. Inside a page, each controller shoes the genset data managed in reverse.

If the operator activates bit 5 of parameter P.0495, the controller displays the active and apparent powers in percentages instead of in kW and in kVA.

6.5.6.3 B.05 TOTAL ON PMCB

This page shows the totals calculated on all the genset controllers connected on CAN-BUS PMCB. The following are shown:

- The total nominal power of the supplying gensets (MDPt, kW).
- The total active power supplied (kW).
- The total reactive power supplied (kvar).
- The total active energy (kWh, sum of energy counters of all genset control boards).
- The total reactive energy (kvar, sum of energy counters of all genset control boards).

If the operator activates bit 5 of parameter P.0495, the controller displays the active and apparent powers in percentages instead of in kW and in kVA.

6.5.6.4 B.06 LOAD MANAGEMENT

This page is dedicated to the functions of “load management” (see [10]). By the term “load management” is intended the capacity of the system to start/stop the gensets to only have the strictly necessary gensets running to supply the load (with a small margin, but not too much). This page shows some information relevant for this function.

The information shown is:

- The enabling for this controller of the “load management” function.
- The “load management” mode currently selected (it establishes the criteria with which the genset to be started are chosen).
- The “master” (it is the primary genset, the one which would not be ever stopped). For some “load management” modes this information is not displayed.
- The priority of this generator. For some “load management” modes this information is not displayed.
- Based on the selected mode, the controller can show in how many hours the system will select a new “master” genset.

- The list of the genset controllers, ordered based on the priority (first the genset with major priority, the last to be stopped). For some “load management” modes this information is not displayed.

  It is possible to manually select the “master” genset (or the priority of this generator) directly from this page:

- Press the ENTER pushbutton.
- Use UP and DOWN buttons to select the address of the “master” genset selected.
- Confirm with ENTER.

6.5.6.5 B.07 LOAD MANAGEMENT

This page is dedicated to the functions of “load management” (see [10]). By the term “load management” is intended the capacity of the system to start/stop the gensets to only have the strictly necessary gensets running to supply the load (with a small margin, but not too much). This page shows some information relevant for this function.

The information shown is:

- The power supplied by the gensets (percentage with respect to the maximum power the gensets currently running can afford).
- The threshold (%) to compare with the power calculated at the previous point, over which a new genset must be started (or it is necessary to pass to a combination of gensets with a higher nominal power).
- The power supplied by the gensets (percentage relative to the maximum) calculated in case the less priority genset is stopped (or combination of gensets with less nominal power).
- The threshold (%) to compare with the power calculated at the previous point, under which a new genset must be started (or it is necessary to pass to a combination of gensets with a lower nominal power).

  If in addition to the normal “load management” also the management of the “load stock” is enabled, this page alternates every two seconds the values above described with:

- The current load stock (the difference between nominal power of the gensets and the supplied power).
- The minimum load stock required to activate a new genset.
- The current load stock (difference between nominal power of the gensets and supplied power calculated in the hypothesis that the less priority genset is stopped (or that a combination of gensets with less nominal power).
- The minimum load stock required to deactivate one of the gensets.

  Some of these measurements can be viewed in reverse to indicate an “out of threshold” situation (which can require the start or stop of the genset).

  When possible, the controller displays also the remaining time to the start of a new genset or to the stop of one of the running gensets.

6.5.7 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

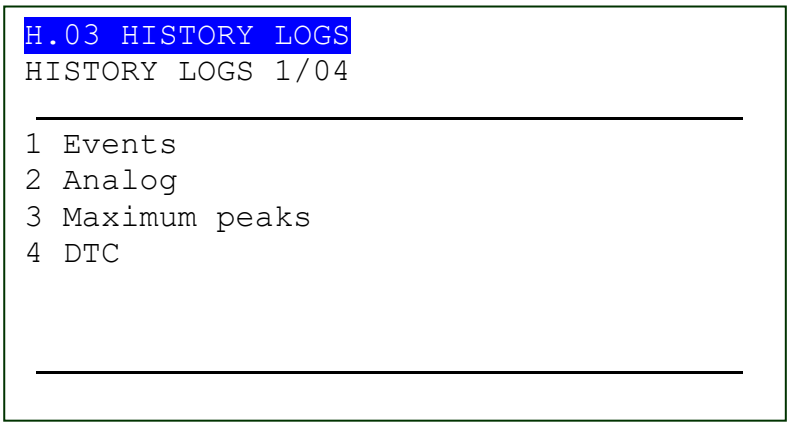
3. Maximum peaks
4. Diagnostic codes (DTC – “Diagnostic Trouble Code”).

These archives can be accessed in any function mode and status of the controller. To select the function, use the buttons ▲ and ▼ under the display 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.

6.5.7.1 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”.

6.5.7.2 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	Mains statuses
3	04	01.00	Genset statuses
4	08	01.00	Engine statuses
5	10	01.00	MCB and MGCB statuses.
6	20	01.00	MCB and MGCB commands.
7	40	1.00	Start/stop requests

8	80	01.00	Fuel pump commands.
9	100	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.1004	01.00	Yes	TEST
EVT.1005	01.00	Yes	REMOTE START
EVT.1010	01.00		Mains off
EVT.1011	01.00		Mains on
EVT.1012	1.00		Mains in tolerance
EVT.1013	01.00		Inhibition active
EVT.1014	01.00		Inhibition not active
EVT.1020	01.00		Genset off
EVT.1021	01.00		Genset on
EVT.1022	1.00		Generator in tolerance
EVT.1030	01.00		GCB close command
EVT.1031	01.00		GCB open command
EVT.1032	01.00		GCB closed (from digital input)
EVT.1033	01.00		GCB open (from digital input)
EVT.1035	01.00		MCB close command
EVT.1036	01.00		MCB open command
EVT.1037	01.00		MCB closed (from digital input)
EVT.1038	01.00		MCB open (from digital input)
EVT.1040	01.00		Engine stopped
EVT.1041	01.00		Starting cycle
EVT.1042	01.00		Engine running.
EVT.1043	01.00		Cooling cycle
EVT.1044	01.00		Stopping cycle
EVT.1045	01.00		Idle cycle (low speed)
EVT.1050	01.00		Manual stop command
EVT.1051	01.00		Manual stop command
EVT.1052	01.00		Automatic start command
EVT.1053	01.00		Automatic stop command
EVT.1054	01.00		TEST start command from digital input.
EVT.1055	01.00		TEST stop command from digital input.
EVT.1056	01.00		TEST start command from serial port
EVT.1057	01.00		Testing stop command (from serial port)
EVT.1058	01.00		TEST start command from clock/calendar.
EVT.1059	01.00		TEST stop command from clock/calendar.
EVT.1060	01.00		TEST start command from SMS
EVT.1061	01.00		TEST stop command from SMS.
EVT.1062	01.00		Starting command for failure to close MCB.
EVT.1063	01.00		Starting command from MC100
EVT.1070	01.00		Fuel pump activated
EVT.1071	01.00		Fuel pump deactivated
EVT.1072	01.38		AdBlue pump activated
EVT.1073	01.38		AdBlue pump deactivated

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.1080	01.00		Active switching inhibition (of genset loads).
EVT.1081	01.00		Not active switching inhibition (of genset loads).
EVT.1082	01.00		Engine protection override activated
EVT.1083	01.00		Engine protection override deactivated
EVT.1086	01.04	Yes	Clock updated for daylight saving time.
EVT.1087	01.04	Yes	Clock updated for standard time.
EVT.1091	01.00		Mains loss protection “27 U<<” sprang
EVT.1092	01.00		Mains loss protection “59 U<<” sprang
EVT.1093	01.00		Mains loss protection “81 f<<” sprang
EVT.1094	01.00		Mains loss protection “81 f<<” sprang
EVT.1095	01.00		Mains loss protection “81 R” (Df/Dt) sprang
EVT.1096	01.00		Mains loss protection “Vector Jump” sprang
EVT.1097	01.00		Mains loss protection (da MC100) sprang
EVT.1098	01.00		Mains loss protection (from contact) sprang
EVT.1099	01.00		Mains loss protection refreshed
EVT.1100	01.00		Mains loss protection “27 U<” sprang
EVT.1101	01.00		Mains loss protection “59 U>” sprang
EVT.1102	01.00		Mains loss protection “81 f<” sprang
EVT.1103	01.00		Mains loss protection “81 f>” sprang
EVT.1104	01.00		Protections 27 enabled
EVT.1105	01.00		Mains loss protection “27 U<& Q?" sprang
EVT.1121	01.00		Power limitation for mains high frequency activated.
EVT.1122	01.00		Power limitation for mains high frequency deactivated.
EVT.1123	01.00		Power limitation by contact #1 activated.
EVT.1124	01.00		Power limitation by contact #1 deactivated.
EVT.1125	01.00		Power limitation by contact #2 activated.
EVT.1126	01.00		Power limitation by contact #2 deactivated.
EVT.1127	01.00		Power limitation for mains low frequency activated.
EVT.1128	01.00		Power limitation for mains low frequency deactivated.
EVT.1131	01.00		Engine stop for too much power limitation activated.
EVT.1132	01.00		Engine stop for too much power limitation deactivated.
EVT.1133	01.33		Power setpoint limitation for high voltage enabled
EVT.1134	01.33		Power setpoint limitation for high voltage disabled
EVT.1135	01.33		Start of power setpoint limitation for high voltage
EVT.1136	01.33		End of power setpoint limitation for high voltage
EVT.1137	01.33		Start of power setpoint limitation by ext. command
EVT.1138	01.33		End of power setpoint limitation by ext. command
EVT.1151	01.00		Mains loss protection “27 U<” restored.
EVT.1152	01.00		Mains loss protection “59 U>>” restored.
EVT.1153	01.00		Mains loss protection “81 f<<” restored.
EVT.1154	01.00		Mains loss protection “81 f>>” restored.
EVT.1155	01.00		Mains loss protection “81 R” (Df/Dt) restored.
EVT.1156	01.00		Mains loss protection “Vector Jump” restored.
EVT.1157	01.00		Mains loss protection (by MC100) restored.
EVT.1158	1.00		Mains loss protection (by contact) restored.
EVT.1160	01.00		Mains loss protection “27 U<” restored.
EVT.1161	01.00		Mains loss protection “59 U>” restored.

EVT.1162	01.00		Mains loss protection “81 f<” restored.
EVT.1163	01.00		Mains loss protection “81 f>” restored.
EVT.1164	01.00		Protections 27 disabled.
EVT.1165	01.00		Mains loss protection “27 U<& Q?” restored.
EVT.1191	01.33		The parallel with the mains is allowed
EVT.1192	01.33		The parallel with the mains is not allowed
EVT.1201	01.00		Load taking inhibition (from Modbus) active.
EVT.1202	01.00		Load taking inhibition (from Modbus) active.
EVT.1203	01.00		Load taking inhibition (for some GCB not open) active.
EVT.1204	1.00		Load taking inhibition (for ongoing synchronization on MCB) active.
EVT.1205	01.00		Load taking inhibition (for MC100 board command) active.
EVT.1221	01.00		“Automatic intervention inhibition” active (from clock/calendar).
EVT.1222	01.00		“Automatic intervention inhibition” not active (from clock/calendar).
EVT.1223	01.00		“Automatic intervention inhibition” active (for out of tolerance mains for SPtM e MPtM plants).
EVT.1224	01.00		“Automatic intervention inhibition” not active (for out of tolerance mains for SPtM e MPtM plants).
EVT.1225	01.00		“Automatic intervention inhibition” active (for GCB not open).
EVT.1226	01.00		“Automatic intervention inhibition” not active (for GCB not open).
EVT.1241	01.00		Load function disabled (from parameter)
EVT.1242	01.00		Load function disabled (digital input)
EVT.1243	01.00		Load function disabled (for supply mode)
EVT.1244	01.00		Load function disabled (from MC100)
EVT.1245	01.00		Load function disabled (for mains in tolerance)
EVT.1246	01.00		Load function disabled (for inhibitions at starting)
EVT.1247	01.00		Load function disabled (for MGCB open)
EVT.1248	01.00		Load function disabled (as the exit from the parallel is required for other causes)
EVT.1249	01.00		Load function disabled (controller not in AUTO)
EVT.1250	01.00		Load function disabled (there are alarms)
EVT.1261	01.00		Starting required by load function (as disabled)
EVT.1262	01.00		Starting required by load function (load function just enabled)
EVT.1263	01.00		Starting required by load function (no GCB closed)
EVT.1264	01.00		Starting required by load function (START pushbutton pressed)
EVT.1265	01.00		Starting required by load function (initial delay)
EVT.1266	01.00		Starting required by load function (priority list not valid)
EVT.1267	01.00		Starting required by load function (selected genset)
EVT.1268	01.00		Starting required by load function (for minimum number of supplying gensets)
EVT.1269	01.00		Starting required by load function (because it is the master genset)
EVT.1270	01.00		Starting required by load function (for load threshold)
EVT.1271	01.00		Starting required by load function (for load stock)
EVT.1272	01.00		Starting required by load function (for priority order)
EVT.1273	01.00		Starting required by load function (for priority order)
EVT.1281	01.00		Starting required by load function (for not selected genset)
EVT.1282	01.00		Starting required by load function (for threshold and load stock)
EVT.1291	01.00		New master genset
EVT.1292	01.00		The supply mode for the load function is isochronous.
EVT.1293	01.00		The supply mode for the load function is SYSTEM BASE LOAD
EVT.1294	01.00		The supply mode for the load function is DROOP
EVT.1321	01.00		Number of gensets connected to bus PMCB varied

The column “even if blocked” indicates which events are anyway recorded even if the records are blocked (see 6.5.7.4)

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 a warning.
- 3000: if the anomaly is an unload.
- 4000: if the anomaly is a deactivation.
- 5000: if the anomaly is an alarm.

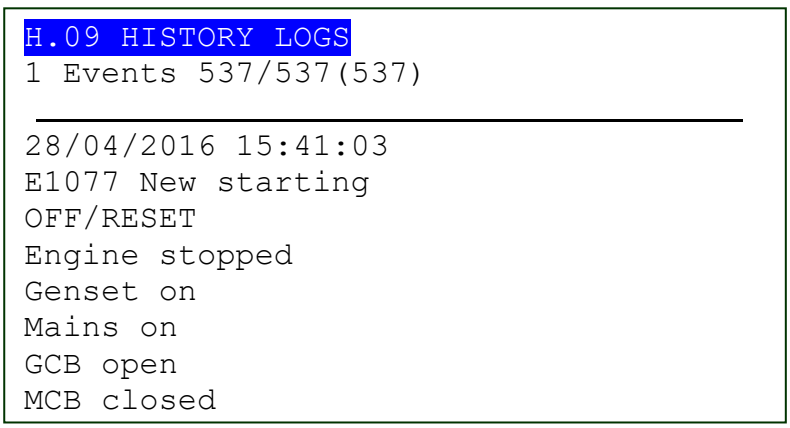
For example, anomaly 273 will be recorded as "2273" when it is activated as a warning, as "5273" if it is activated as an alarm. By viewing the events from the board panel, the event code "2273" is automatically displayed as "W273", the code 5273 is displayed as "A273".

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.
- Engine status.
- Genset status.
- Mains status.
- GCB, MCB and MGCB circuit breakers status.
- GCB and MCB circuit breakers current command.
- Mains/Busbar phase-to-phase voltages and frequency.
- Genset 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.
- Engine rotation speed, lubricant pressure, coolant temperature and fuel level.

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, 4 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 engine, generator, mains and switches.

Page 2 It shows mains and generator frequency and voltages. It shows the L1- L2 phase-to-phase frequency and voltage of the genset.

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

Page 4 It shows the total active power (kW), total reactive power (kvar), the total power factor, the battery voltage, engine rotation speed, lubricant pressure.

Page 5 It shows the coolant temperature and fuel level.

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

6.5.7.3 Pages for analogues

The controller 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 engine is running.
- P.0443: interval (in seconds) for the recording into the archive of analogue measurements, used when the engine is stopped.

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:

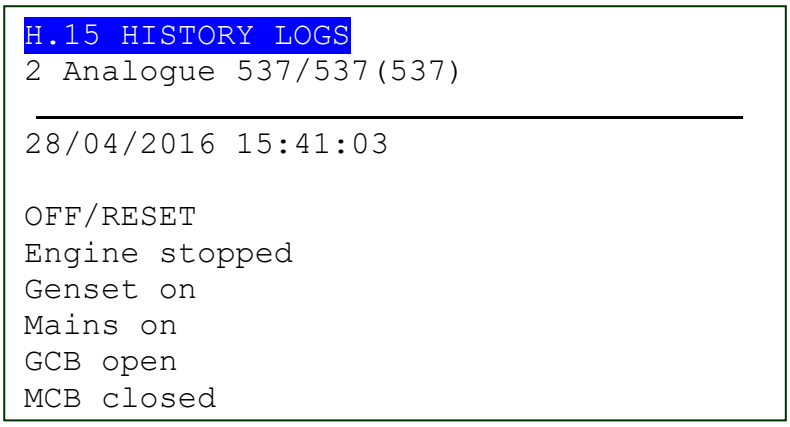
- Date/Time
- Operating mode of the controller.
- Engine status.
- Genset status.
- Mains status.
- GCB, MCB and MGCB circuit breakers status.
- GCB and MCB circuit breakers current command.

- Mains/Busbar phase-to-phase voltages and frequency.
- Genset 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.
- Engine rotation speed, lubricant pressure, coolant temperature and fuel level.

If the operator activates bit 5 of parameter P.0495, the controller displays the active and apparent powers in percentages instead of in kW and in kVA.

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 engine, generator, mains and switches.

Page 2 It shows mains frequency and voltages. It shows the L1- L2 phase-to-phase frequency and voltage of the genset.

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

Page 4 It shows the total active power (kW), total reactive power (kvar), the total power factor, the battery voltage, engine rotation speed, lubricant pressure.

Page 5 It shows the coolant temperature and fuel level.

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

6.5.7.4 Locked recordings

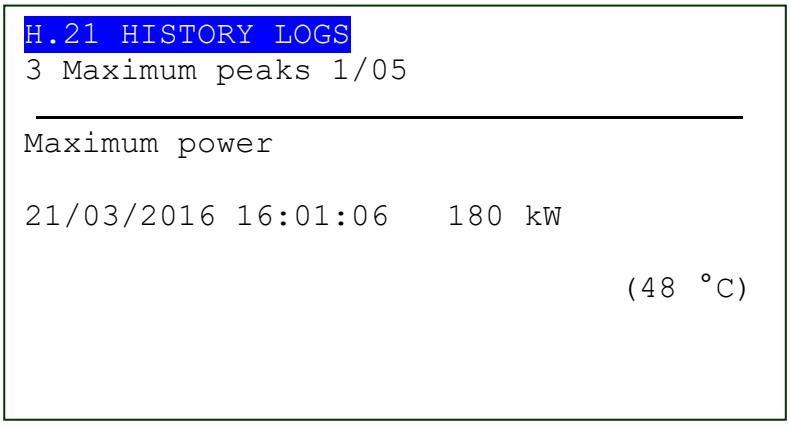
The board does not perform recordings in the archive of analogues and in the archive of events if it is in OFF/RESET mode and when an alarm, a deactivation or an unload have been activated. Exceptions are some event codes (highlighted by the wording “Yes” in the column “even if blocked” of the table in 6.5.7.2) 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.

6.5.7.5 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.
- Coolant temperature: the maximum peak is being 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 5).

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

- Maximum power
- Maximum current (L1)
- Maximum current (L2)
- Maximum current (L3)
- Maximum coolant 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 coolant temperature is recorded together with the power.

- 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.

6.5.7.6 Diagnostics pages for external devices connected by Canbus (DTC)

The controller stores the DTCs sent over the CAN-BUS CAN0 line by external devices (the engine control unit, the voltage regulator).

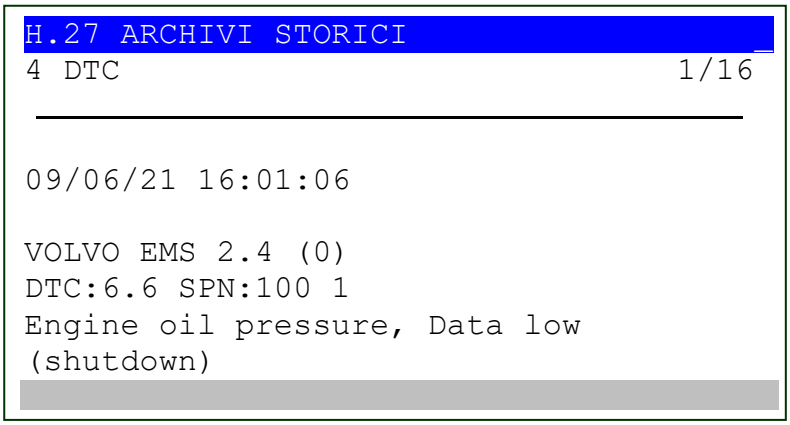
For each diagnostic code, the controller stores:

- Date/time
- The name of the external device who generated it (since version 1.15).
- The SPN code (code standardized by SAE J1939 specification) (if available).
- The FMI code (code standardized by SAE J1939 specification) (if available).
- The number of activations of this code (provided by SAE J1939 specification) (if available).
- The numeric code specific for the external device (DTC) (if available).

Some of these data may not be available, depending on the external device connected to the CAN-BUS: in case, they are replaced with dashes.

This archive can store up to 16 records. Every following record overwrites the older one. Use the UP and DOWN buttons to scroll cyclically trough all recordings. NOTE: the more recent record is associated to the highest number. Each diagnostic code is displayed on a single page (so LEFT and RIGHT keys are not used):

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



The second line shows which diagnostic code is currently displayed, the total number of recorded diagnostic codes and the maximum size of the archive.

Right below you will find recording date and time. In the central part of the page the codes described above are displayed. In the lower part, if possible, a textual description of the problem is displayed.

6.5.7.7 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.

6.5.7.8 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 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

Five modes are available for the device management.

- **OFF_RESET**: the genset is stopped (or in phase of stopping), the anomalies are all cancelled, and it is possible to access programming to modify the parameters. GCB switch is open to insulate the genset from the loads. MCB switch (if included) is closed to connect the loads to the mains.
- **MAN:** the genset start and stop, and the circuit breakers GCB and MCB management (if included) oversee the operator (the controller does not perform these operations automatically): being the protections activated, the controller can automatically open GCB, stop the genset and close MCB (if included) in case of need. The access to programming is allowed, but only some parameters can be modified.
- **AUTO**: the genset start and stop and the GCB and MCB circuit breakers management oversee the controller (the operator cannot intervene). All protections are enabled. The access to programming is allowed, but only some parameters can be modified.
- **TEST**: this working mode is almost identical to AUTO mode. It differs in the fact that the engine is in any case started (automatically) also with mains on and/or inhibition of automatic intervention. The controller has explicit commands to activate the test without closure of GCB or with closure of GCB; it also has generic commands: in these cases, with parameter P.0222 “Enabling load in TEST”, it is possible to indicate to the controller if it has to automatically close the GCB circuit breaker. In any case, the operator has the faculty of command the MCB and GCB circuit breakers as in MAN (if enabled by bit #3 of parameter P.0249). When the controller goes back to AUTO (at the end of the test), the loads are automatically switched in the mains (if included) and the engine is stopped with normal procedure. The controller automatically passes from TEST to AUTO if the conditions for an automatic intervention of the genset happen. The access to programming is allowed, but only some parameters can be modified.
- **REMOTE START**: this working mode is almost identical to AUTO. It differs only in the fact that the engine is in any case started (automatically) also with mains on and/or inhibition to the automatic intervention: the controller automatically provides the closure of GCB circuit breaker (prior to MCB open if temporary parallel with the mains is not included). This mode is priority compared to TEST (it can interrupt or replace the periodic test). It is also priority compared to AUTO (once the remote start is activated, any requests of automatic intervention are ignored). The operator cannot manually control the GCB and MCB switches. Accessing programming is allowed, though only some parameters can be modified.

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 given 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 command is 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.

  To enable the TEST mode requires the controller being first set to AUTO w/o any automatic start request (refer to the engine sequence description). All possible TEST function activation modes are described below. If in test mode, the AUTO/TEST indicator flashes at a duty of 50%. You can shift to TEST mode as follows:
- Pressing the START pushbutton. Shifting to TEST mode is immediate. To return to AUTO mode, press again the START pushbutton. This feature can be disabled using bit 1 of P.0495. If the TEST duration (P.0420) is configured (different from zero), this test ends automatically after the time indicated. Parameter P.0222 establishes if the test is empty or loaded.
- When a suitably configured digital input activates with function DIF.2031 “Request of Test mode”, the controller shifts to TEST and returns to AUTO when deactivates. Parameter P.0222 establishes if the test is empty or loaded.
- By using a digital input configured with the function DIF.2029 (“Request for the test mode without load - impulse”). The controller evaluates the input activation moment (impulse): the controller switches to TEST when it activates this input and goes back to AUTO at the end of the time configured in P.0420(if P.0420 is set to zero, the test is not carried out). If there is a second activation of the input during the test, the test is immediately stopped. During this test, the controller doesn’t close the GCB circuit breaker, independently from the value configured in P.0222.

- By using a digital input configured with the function DIF.2030(“Request for the test mode with load - impulse”). The controller evaluates the input activation moment (impulse): the controller switches to TEST when it activates this input and goes back to AUTO at the end of the time configured in P.0420(if P.0420 is set to zero, the test is not carried out). If there is a second activation of the input during the test, the test is immediately stopped. During this test, the controller closes the GCB circuit breaker, independently from the value configured in P.0222.
- By properly configuring the parameters:
  - P.0418: Weekly test calendar.
  - P.0419: Test start time.
  - P.0420: Test starting duration.

  They allow selecting the days of the week and a time slot within which the working mode switches from AUTO to TEST (to keep it efficient). In this case, the passage to TEST is automatic in the scheduled days and hour. The controller returns to AUTO when the TEST time interval ends. Parameter P.0222 establishes if the test is empty or loaded.
- By means of a proper command via SMS (see [3]). For this feature to be used, the parameter P.0420 Test starting duration shall not be set to zero (it indicates in effect the duration of the test). In this case, the controller shifts from TEST after receiving the SMS and returns to AUTO after the time P.0420. Parameter P.0222 establishes if the test is empty or loaded.
- From a pc connected to serial ports, USB serial port, Ethernet port or via modem (with Modbus protocol RTU or Modbus/TCP). The controller shifts to TEST when it receives the command, returns to AUTO when it receives the opposite command or when it considers the serial connection interrupted (60 seconds without messages). 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:
  - “12” to require the vacuum TEST mode.
  - “14” to require the load TEST mode.
  - "21" to return to AUTO.

To active the REMOTE START mode, the board must be in AUTO or in TEST mode. Moreover, it is possible to configure an input with DIF.2701 function ("enable remote start request"): if the input exists, it should be active. This mode can be activated in one of the following modes:

- Through a control sent from MC100 boards on PMCB CAN-BUS.
- By means of the digital input configured with the feature DIF.2032 (“remote start request”). If input is active, the REMOTE START mode is entered and it is leaved deactivating the input.
- By means of a proper command via SMS (see [3]). In this case, the controller shifts to REMOTE START as soon as it receives the SMS and returns to AUTO when it receives the opposite command. In this case, it is possible to configure an input with DIF.2701 function (“enable remote start request”): if the input exists, it should be active (normally wired on a switch at control panel front to enable the remote commands).
- By properly configuring the parameters P.0426, P.0427 and P.0428, it is possible to define an hour range within which the working mode automatically switches to REMOTE START. Parameter P.0426 allows to establish in which days of the week this function is active. The remaining two allow to set an hour range valid for all selected days. The range start time (P.0427) refers to the days set in P.0426, while the range end time (P.0428) refers to the same day, if its value is

higher than P.0427, or to the following day if lower (across midnight). Moreover, setting P.0427 and P.0428 to the same value, you define a full day range.

- From a pc connected to serial ports, USB serial port, Ethernet port or via modem (with Modbus protocol RTU or Modbus/TCP). The controller shifts to REMOTE START once it receives the command, returns to AUTO when it receives the opposite one (it remains in REMOTE START if the serial connection interrupts before receiving the opposite command). In this case, it is possible to configure an input with DIF.2701 function ("enable remote start request"): if the input exists, it should be active (normally wired on a switch at control panel front to enable the remote commands). 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:
- "13" to require the REMOTE START mode.
- "21" to return to AUTO.

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".
- EVT.1004: the new mode is "TEST".
- EVT.1005: the new mode is "REMOTE START".

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.3004 - "Test". The board activates this output when in TEST mode.
- DOF.3005 - "REMOTE START". The board activates this output when in REMOTE START mode.
- DOF.3011 - "Not in OFF/RESET". The board activates this output when in AUTO or MAN mode.
- DOF.3012 - "One of the automatic modes". It activates when a controller is in an automatic operation mode, that is AUTO, TEST, or REMOTE START.

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

- ST.000 - "OFF/RESET".
- ST.001 - "manual"
- ST.002 - "Automatic".
- ST.003 - "Test".
- ST.004 - "remote start".

7.2 Plant types

The controller is able to manage ten different plant types:

- **SPM** and **MPM (Prime Mover)**: in these plants the public grid is not present; the gensets are normally started manually (locally or remotely), to supply the loads.

  SPM refers to plants composed of a single genset, MPM to plants consisting of several gensets (the controller provides all the required functions for the parallel between them).

- **SSB** and **MSB (Stand By)**: these plants work as emergency to the public grid; the gensets are normally started automatically in case of anomalies on the grid and stopped when the anomalies cease. Parallel with the grid is not allowed.

  SSB refers to plants consisting of a single genset (where the controller directly manages the grid), MSB to plants consisting of several gensets (an MC controller is required for the grid management, GC600 provides all the required functions for parallel between gensets).

- **SSB+SSTP** and **MSB+MSTP (Stand By + Short Time Parallel)**: these plants are very similar to the previous ones, where the gensets are normally started automatically in case of anomalies on the public grid, and stopped when the anomalies cease. Transient parallel with the grid is allowed.

  SSB+SSTP refers to plants composed of a single genset (where the controller directly manages the grid, including the functions required for the parallel with it). MSB+MSTP refers to plants composed of several gensets (an MC controller is required for the grid management and synchronization with it, GC600 provides all the other functions required for the parallel between generators and/or the grid).

- **SPtM** and **MPtM (Parallel to Mains)**: they are pure production plants in parallel to the public grid. The gensets are normally started automatically only if the grid is permanently present and in tolerance; in case of anomalies on the grid, the generators are disconnected from it (and from the loads), and eventually stopped.

  SPtM refers to plants composed of a single genset (where the controller directly manages the grid, including the functions necessary for the parallel with it). MPtM refers to plants composed of several gensets (an MC controller is required to manage the grid and general circuit breakers, GC600 provides all the other functions required for the parallel between gensets and/or the grid).

- **SPtM+SSB** and **MPtM+MSB** (Parallel to Mains + Stand By): these are the most complete plants. The gensets are always started. If the public grid is present and in tolerance, they produce energy in parallel to it; otherwise, they supply the local loads.

  SPtM+SSB refers to plants composed of a single genset (where the controller directly manages the grid, including the functions required for the parallel with it). MPtM+MSB refers to plants composed of several gensets (an MC controller is required to manage the grid and general circuit breakers, GC600 provides all the other functions required for the parallel between gensets and/or the grid).

The selection is made using parameter P.0802

- P.0802 = 0 for SPM plants.
- P.0802 = 1 for SSB plants.
- P.0802 = 2 for SSB + SSTP plants.
- P.0802 = 3 for SPtM plants
- P.0802 = 4 for SPtM + SSB plants.
- P.0802 = 5 for MPM plants.
- P.0802 = 6 for MSB plants.
- P.0802 = 7 for MSB + MSTP plants.
- P.0802 = 8 for MPtM plants
- P.0802 = 9 for MPtM + MSB plants.

From version 1.24, GC600 allows to select the plant type using digital inputs. This function is useful in gensets prepared for rental: the manufacturer can foresee different operating modes (all preconfigured) and select them using a selector on the electrical panel (better if protected with a key). The final operator cannot change the selection made by the manufacturer.

To select the plant type with digital inputs:

- Set parameter P.0802 with the value "10-Selected from digital input".
- Configure one or more digital inputs with the following functions:
  - DIF.2161-Select the SPM plant.
  - DIF.2162-Select the SSB plant.
  - DIF.2163-Select the SSB + SSTP plant.
  - DIF.2164-Select the SPTM plant.
  - DIF.2165-Select the SPTM + SSB plant.
  - DIF.2166-Select the MPM plant.
  - DIF.2167-Select the MSB plant.
  - DIF.2168-Select the MSB + MSTP plant.
  - DIF.2169-Select the MPTM plant.
  - DIF.2170-Select the MPTM + MSB plant.

If parameter P.0802 is set to "10", at least one of the inputs configured with the previous functions must always be active. If there are no inputs configured with the previous functions, or if all the configured inputs are "inactive", after five seconds the controller activates the anomaly 273 ("incoherent parameters"):

- It is activated as a **warning** if there is at least one configured input, and previously it has been activated (so a valid plant has been selected, the controller continues to use it).
- It is activated as an **alarm (shutdown)** if, when the controller is switched on, no input is active or configured (in this case there is no valid previous selection and the controller cannot select any plant).

If several inputs are active at the same time, the controller uses the one with the smaller "DIF" function.

To select a different plant, you must:

- Stop the engine and wait for stopping.
- Set the controller in OFF/RESET mode.
- Activate the digital input related to the new plant type, and deactivate the one related to the old one.

The new plant is selected when, in the previous conditions, the status of the digital inputs is stable for one second.

If, following the selection of a new plant, it is necessary to carry out other actions, it is possible to configure the digital outputs of the controller to activate/deactivate depending on selected plant. The AND/OR logics must be used, with the following states:

- ST.336: SPM plant
- ST.337: SSB plant
- ST.338: SSB + SSTP plant
- ST.339: SPTM plant
- ST.340: SPTM + SSB plant
- ST.341: MPM plant
- ST.342: MSB plant
- ST.343: MSB + MSTP plant
- ST.344: MPTM plant
- ST.345: MPTM + MSB plant

If you want to combine the selection of a plant with the loading of a specific alternative configuration, you can use the virtual digital inputs: set them with the functions DIF.2151…DIF.2154, and activate them with the proper AND/OR logic, using the internal states listed above.

7.3 Mains sensor / parallel bars

GC600 has a three-phase sensor that can be used to acquire the mains or parallel bars voltage of the system. This sensor is available on JG connector. For the connection, see paragraph 5.

P.0126 parameter determines whether this sensor is connected to the mains or to the parallel bars:

- P.0126 =0: parallel bars.
- P.0126 =1: mains.

Normally, for the types of systems composed of multiple generators, the sensor is used to measure the voltage on the parallel bars (in these cases, the mains are normally acquired by a MC100 board). On the contrary, for systems which consist of a single generator, it is preferred to acquire the mains. It is not mandatory to act in this way.

The board uses parameters to configure the sensor, regardless of its use for the mains or for the parallel bars:

- P.0105: rated frequency (Hz).
- P.0116: mains/bars nominal voltage. Its value must be the nominal phase-to-phase voltage for three-phase systems and phase–to–neutral voltage for single-phase systems.
- P.0119: indicates a three-phase mains/bars (3) or a single-phase one (1).
- P.0129: indicates if the neutral line is connected to the board (1) or not (0). On single-phase systems the parameter shall be set to 1.
- P.0117: value of the primary (Vac) of any voltage transformers linked to JG connector.
- P.0118: value of the secondary (Vac) of any voltage transformers linked to JG connector.

Note: if nominal voltage (P.0116) is set to zero, the board will anyway perform measures and display them, but for system management purposes, the tension is considered as not present.

Note: if it is indicated that that the neutral is not connected to the board, GC600 will not display phase voltages and Neutral-Earth voltage.

7.3.1 Sensor for the parallel bars

Definition:

- For systems which consist of more generators, "parallel bars" indicate that part of the circuit in which the lines of the alternators are linked. It can be separated from the users by MGCB switch.
- For systems consisting of a single generator, "parallel bars" indicate users.

GC600 needs to verify the presence of voltage on the parallel bars, to verify if a switch (GC, but also MCB) can be closed without synchronization.

The information "no voltage on parallel bars" can be acquired in two ways:

- Using the mains/bars sensor for parallel bars (P.0126=0). In this way, the board uses a fixed threshold corresponding to 33% of rated voltage (with a 3% hysteresis): if all measured voltages are below this threshold, the parallel bars are "voltage free".
- Use a digital input configured with DIF.3102 function ("No voltage on parallel bars"): when the input is active, the parallel bars are "voltage free".

7.3.1.1 Signalling

The following functions for the configuration of the digital outputs are connected to the voltage on the parallel bars:

- DOF.3031 ("Voltage on parallel bars"): the output is activated if there is voltage on the parallel bars.
- DOF.0103 - “(Logics AND/OR)”.
  - ST.048 the output is activated if there is voltage on the parallel bars.

7.3.2 Mains sensor

Depending on the type of system, GC600 may need to determine the status of the mains, for two reasons:

- For systems that do emergency service to the mains, to control automatic starts and stops of the engine in the event of anomalies on the mains.
- For systems that require the parallel with the mains, to verify whether the status of the mains allows the parallel and, if the parallel is already underway, to disconnect the generator in case of anomalies of the mains.

See the document [10] for a description of the use of the mains sensor for the parallel with the mains. This chapter instead describes the use of the mains sensor for the emergency service.

GC600 can determine the status of the mains in three ways, described below.

7.3.2.1 Status of the mains acquired by a MC100 board

If one or more MC100 boards are connected to the PMCB CAN-BUS, GC600 uses as status of the mains the one transmitted by these boards. MC100 boards can only be used on systems composed of multiple generators, where, as a rule, the generators do not directly measure the mains. If different MC100s transmit the status of their mains, GC600 creates a “global” status with the following logics (assessed in the order in which they are described):

- If at least a MC100 board indicates that the mains are steadily “present but out of tolerance”, then for the controller the mains are steadily "present but out of tolerance".
- If at least a MC100 board indicates that the mains are steadily “not present”, then for the controller the mains are steadily "not present".
- If at least a MC100 board indicates that the delay due to “mains out of tolerance” is in progress, then for the controller the delay due to "mains out of tolerance" is in progress.
- If at least a MC100 board indicates that the delay due to “mains within tolerance” is in progress, then for the controller the delay due to "mains within tolerance" is in progress.
- For the controller the mains are steadily "within tolerance".

The delays for “mains within tolerance” and “mains out of tolerance” are managed by MC100, then P.0205 and P.0206 parameters are ignored.

If the controller receives the status from the mains, it ignores its internal sensor and any external sensors connected to its digital inputs.

7.3.2.2 Mains status acquired by a digital input

It is possible to configure a digital input with DIF.3101 function ("External mains sensor"): GC600 considers the mains "present and within tolerance" if the digital input is active. The delays configured with P.0205 and P.0206 parameters apply in this case (see 7.3.3).

If there is a digital input configured with DIF.3101 function, it is also used if the internal sensor is enabled (see next paragraph): in this case GC600 considers the mains “present and within tolerance” GC600 if the digital input is active (whatever the voltage connected to the internal sensor is); but if the digital input is not active, GC600 uses the mains status acquired by the internal sensor.

If there is no digital input configured with DIF.3101function, and if the board cannot use the internal sensor to acquire the status of the mains, it is possible to use the digital input (if any) dedicated to the protections for the parallel with the mains (see document [10])also to determine the status of the mains for the emergency service. This input is configured with DIF.3103 function ("External protections for the parallel with the mains"). The mains is considered to be “present and within tolerance” if the digital input is active (the delays configured with P.0205 and P.0206 parameters apply in this case - see 7.3.3).

7.3.2.3 Mains status acquired by the internal sensor

To use the mains/bars sensor to acquire the status of the mains, P.0126 parameter should be set to “1-mains”. Refer to 7.2 the parameters that configure the mains/bars sensor.

To assess the mains status, the controller can perform up to four different checks that can be individually disabled. These checks are individually described (with examples) below: please, remember that disabling both voltages and frequency checks is not possible (in this case, mains is always considered not present).

7.3.2.3.1 Frequency check

Parameter	Description	Default value	Frequency (Hz)
P.0105	Rated frequency	50 Hz	50.00
P.0236	Low frequency threshold	90.0 %	45.00
P.0237	High frequency threshold	110.0 %	55.00
P.0201	Maximum hysteresis	2.5 %	1.25

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

- P.0236 = 0%.
- P.0237 = 0%.
- P.0237 = 200%.
- P.0236 >= P.0237

The hysteresis on the various thresholds is calculated as half the difference between P.0237 and P.0236. However, it is limited by the maximum value set with parameter P.0201. 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:

0.00 ——————————————

A band: **low**

45.00 ——————————————

B band: hysteresis

46.25 ——————————

C band: **in tolerance**

53.75 ——————————

D band: hysteresis

55.00 ——————————

G band: **high**

XXX ——————————

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”.

7.3.2.3.2 Voltage’s check

Parameter	Description	Default value	Voltage in Vac
P.0119	Number of phases	3	-
P.0116	Rated voltage	400 Vac	400
-	Mains presence threshold	20.0 %	80
P.0203	Low voltage threshold	80.0 %	320
P.0204	High voltage threshold	110.0 %	440
P.0201	Maximum hysteresis	2.5 %	10

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

- P.0203 = 0%.
- P.0204 = 0%.
- P.0204 = 200%.
- P.0203 >= P.0204

The hysteresis on the various thresholds is calculated as half the difference between P.0204 and P.0203. However, it is limited by the maximum value set with parameter P.0201. The hysteresis applies to:

- Downwards towards mains 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 ——————————

A band: **absent**

70 ——————————

B band: hysteresis

80 ——————————

C band: **low**

320 ——————————

D band: hysteresis

330 ——————————

E band: **in tolerance**

430 ——————————

F band: hysteresis

440 _____

G band: **high**

XXX _____

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.0244 to “1”, the same checks are also made on the phase voltages (nominal voltage calculated by dividing the phase-to-phase nominal P.0116 by 1.73 - squared root of 3).

7.3.2.3.3 Unbalance check

Parameter	Description	Default value	Voltage (Volt)
P.0116	Rated voltage	400 Vac	400
P.0238	Mains asymmetry threshold	10.0 %	40

In three-phases systems, the mains can be 'out of tolerance' in case the absolute value of the three phase-to-phase voltages differs more than the set threshold. The control is disabled on single-phase systems.

Note: GC600 makes no verification on the displacement angle of the three phases, but only on the amplitude of phase-to-phase voltages.

To disable this check, simply set parameter P.0238 to zero.

With the default values of the parameters, if the difference in absolute value between whatever two phase-to-phase voltages is higher than 40 Vac, the mains is considered out of tolerance (the lighting MAINS LIVE flashes with 25% on). If the differences in absolute value among phase-to-phase voltages are all lower than 40 Vac, the mains is considered within tolerance. No hysteresis is managed for this check.

7.3.2.3.4 Rotation direction check

Parameter	Description	Default value
P.0239	Required phase sequence	0-None

For three-phase systems mains can be 'out of tolerance' in case the rotation direction of the three phase-to-phase voltages differs from the specification set with parameter P.0239. On single-phase systems this control is disabled.

To disable this check, simply set parameter P.0239 to “0-None”.

With P.0239 parameter it is possible to select the direction of rotation required for the mains: "1-clockwise" or "2-anticlockwise".
The mains are considered “out of tolerance” if the actual direction of rotation differs from the configured one (the lighting MAINS LIVE flashes with 25% on).

7.3.2.3.5 Internal sensor status

To diagnose the mains “global” status, the following algorithms are used, shown in their computing order:

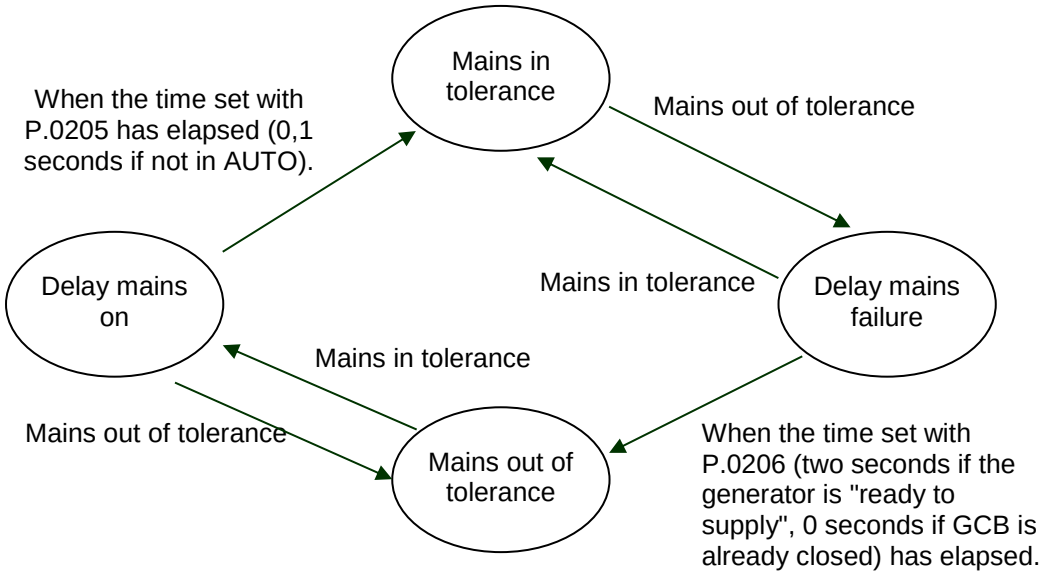
- If all voltages and frequency are in a status of "Not present", also the global status is "Not present".
- If all voltages and frequency are in a status of "Within tolerance", also the global status is "Within tolerance". In this case, if the check of the rotation direction or the check on the unbalance do not give positive result, the mains is considered “Low”.
- In case the status of at least one voltage or the frequency is “High”, also the global status is “High”.

- ". In this case, if the control of the direction of rotation or the control on the asymmetry do not give a positive outcome, the mains is considered "Low".

7.3.3 Mains global status

What described in this paragraph shall not apply if the status of the mains is acquired via PMCB CAN-BUS or via one or more MC100 boards.

Whichever the method used to acquire the mains instant status, to the extent of the plant operation logics, the mains global status is described in four steps:



The use of the “mains presence delay” (configured with parameter P.0205) depends on the presence of the generator supplying the loads, and on the configuration of parameter P.0250. It is a bit-managed parameter. At the moment two bits are defined:

- Bit 0: used when the controller is in OFF/RESET mode. In this mode, the controller does not normally manage the “mains presence delay” (to re-power the loads as soon as possible, since they are not powered by the generator). By setting bit 0 of P.0250 to “1”, the controller manages the "mains presence delay".
- Bit 1: used when the controller is in AUTO mode. In this mode, the duration of the “mains presence delay” depends on the presence of the generator supplying the loads, and on the value of this bit:
  - Generator supplying the loads: the duration of the “mains presence delay” is set by parameter P.0205.
  - Generator not supplying the loads and bit 1 of P.0250 is “1”: the duration of the “mains presence delay” is set by parameter P.0205.
  - Generator not supplying the loads and bit 1 of P.0250 is “0”: the duration of the “mains presence delay” is 0 seconds.

7.3.4 Events and signalling

The board records the following events if the status of the mains changes (if enabled with bit 2 of P.0441 parameter):

- EVT.1010: Mains voltage absent.
- EVT.1011: Mains voltage present, but “out of tolerance”.
- EVT.1012: Mains voltage present, and “in tolerance”.

The following function is also available for the configuration of the outputs linked to the mains status.

- DOF.3033 - “Mains in tolerance”. The board activates this output when the mains voltages and the frequency are in tolerance from the time configured.

The board makes controls and statuses of the switches available, for AND/OR logics, through the following internal statuses:

- ST.016 - “Presence of mains voltage/frequency”
- ST.017 “Mains out of tolerance or absent”.
- ST.018 - “Delay for mains in tolerance”
- ST.019 - “Mains in tolerance”.
- ST.020 - “Delay for mains out of tolerance or off”

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

- AOF.3201 ("mains frequency").
- AOF.3211 ("average mains voltage").
- AOF.3221 ("active mains power").

7.4 Genset

The board acquires generator (single or three-phase) voltage and frequency to protect the loads and the generator itself from operating outside its tolerance thresholds. For connecting the generator to the board, see par. 5.12.

GC600 manages two types of generators: synchronous generators and asynchronous generators. Use P.0100 parameter to select the type of generator.

7.4.1 Nominal sizes

Set the generator rated voltage in P.0102 parameter (Vac, set the phase-to-phase rated voltage on three-phase systems). Set the generator rated frequency in P.0105 parameter (Hz). Set the generator rated power in P.0106 parameter (kVA).

It is important to set these data because the thresholds for some protections are expressed as their percentage. Moreover, the board calculates the rated current of the system from these parameters:

Single-phase system: $$I_{nom} = \frac{P.0106 * 1000}{P.0102}$$

Three-phases system: $$I_{nom} = \frac{\left({}^{(P.0106 * 1000)}\!/\!_{3} \right)}{\left({}^{P.0102}\!/\!_{\sqrt{3}} \right)}$$

7.4.2 Asynchronous generator

This type of generator can only be used for power generation in parallel with the mains. Its particularity, in fact, is not to generate any voltage if it is not in parallel with the mains. The type of system should therefore be SPtM or MPTM and GCB switch should be "not synchronized" (P.0854 parameter, see document [10])

The working sequence is therefore different from the one of normal synchronous generators operated by the board:

- The engine is started only if the mains is present and the parallel with the mains is allowed.

- GC600 can recognize “started engine” and “engine at operating speed” conditions only through the engine rotation speed. GC600 should therefore acquire this a measure, through its measurement inputs or via CAN0 CAN-BUS line.
- Before closing GCB switch, GC600 verifies whether there is voltage on the parallel bars: the closing of GCB is however performed without synchronization, because until the GCB is closed, the generator does not generate any tension.

7.4.2.1 “Engine at operating speed" verification.

Parameter	Description	Default value	Speed (rpm)
P.0133	Engine Nominal Speed	1500 rpm	1500.0
P.0224	Stopped engine threshold due to voltage	7.0 %	105.0
P.0225	Started engine threshold	20.0 %	300.0
P.0305	Minimum frequency threshold	90.0 %	1350.0
P.0307	Maximum frequency threshold	110.0 %	1650.0
P.0201	Maximum hysteresis	2.5 %	37.5

Generator minimum and maximum frequency thresholds are used: as they are percentage values, in this case they are referred to rated speed, instead to rated frequency. The hysteresis on the various thresholds is set with P.0201parameter. The hysteresis applies to:

- Upwards towards minimum frequency threshold (i.e., with the default values of the parameters, between 1350 and 1385.7 rpm).
- Downwards towards maximum frequency threshold (i.e., with the default values of the parameters, between 1612.5 and 1650 rpm).

These values define the following bands:

0.0 ——————————

A band: **absent**

105.0 ——————————

B band: hysteresis

300.0 ——————————

C band: **low**

1350.0 ——————————

D band: hysteresis

1385.7 ——————————

E band: **in tolerance**

1612.5 ——————————

F band: hysteresis

1650 ——————————

G band: **high**

XXX ——————————

If the rotation speed is in "B", "D" or "F" brackets, it keeps the status it had before (hysteresis). For example, if the rotation speed was in "E" bracket and now is in "D" bracket, it is still considered "within tolerance". On the contrary, if voltage was in the “C” band and now is in “D” band, it is considered “Low”.

For asynchronous generators, the condition of "engine at operating speed" corresponds to the "generator within tolerance" condition.

7.4.2.2 Magnetization resistances

In the management of asynchronous generators, it is customary to use resistances to allow the magnetization of the generator. These resistances are inserted one second before the closing of GCB switch: they connect the mains to the

generator (bypassing GCB switch), allowing a (limited) circulation of current in the generator. This current is therefore used for the magnetisation of the generator.

These resistances are short-circuited by GCB switch, once it is closed. If GCB cannot be closed, however, these resistances heat up a lot. Their use is not allowed for a period longer than three seconds: expired this time (with GCB still open) the board disconnects the resistances and prevents a new closing of GCB for the time set with P.0257parameter, to allow the resistances to cool down before using them again.

GC600 provides for DOF.2121 function ("Magnetization of the asynchronous generator") for the configuration of the digital output that should control the remote-control switch that connects/disconnects magnetization resistances: the board activates the output when it wants to insert the resistances.

GCB closing sequence is therefore:

- Activation of DOF.2121 output and subsequent insertion of the resistances.
- Waiting for one second to allow the magnetization of the generator.
- Activation of the control for the closing of GCB switch.
- If GCB closes, the board disconnects the resistances and the procedure ends.
- If GCB cannot be closed within three seconds, the board removes the control to close GCB, disconnects the resistances and waits P.0257 seconds. Then the sequence restarts from the beginning.

Note that the attempt to close GCB lasts two seconds, regardless of the time set on the digital input that acquires its feedback (to not leave the resistances inserted for more than three seconds).

7.4.2.3 Power-factor capacitors

In the management of asynchronous generators, it is customary to use capacitors for the correction of the power factor of the same generator.

GC600 provides for DOF.2122 function ("Power-factor capacitors") to configure the digital output that should control the remote-control switch that connects/disconnects the capacitors.

The board enables the output to connect the capacitors after P.0258 time (“Delay for the insertion of power-factor capacitors”) from the closing of GCB switch. The output is deactivated as soon as GCB switch is opened.

7.4.3 Synchronous generator

To determine the genset status, the controller checks both the voltage and the frequency of the genset itself.

7.4.3.1 Frequency

Parameter	Description	Default value	Frequency (Hz)
P.0105	Rated frequency	50 Hz	50.00
P.0228	Stopped engine threshold due to frequency	10.0 %	5.00
P.0229	Started engine threshold due to frequency	20.0 %	10.00
P.0305	Minimum frequency threshold	90.0 %	45.00
P.0307	Maximum frequency threshold	110.0 %	55.00
P.0202	Maximum hysteresis	2.5 %	1.25

The hysteresis on the various thresholds is set with P.0202parameter. 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:

0.00
A band: **absent**
5.00
B band: hysteresis
10.00
C band: **low**
45.00
D band: hysteresis
46.25
E band: **in tolerance**
53.75
F band: hysteresis
55.00
G band: **high**
XXX

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 other hand, in case it was within the “A” band, and now is within “B” band, it is considered “Absent”.

Thresholds P.0305 and P.0307 are used also to manage the generator/engine protections on frequency. These protections can be individually disabled setting to zero the relevant parameter that specifies the delay (respectively P.0306 and P.0308). Even if the protections are disabled, thresholds are however used to define the frequency status: this allows not to switch the loads on the generator if the electrical magnitudes are out of the tolerance band.

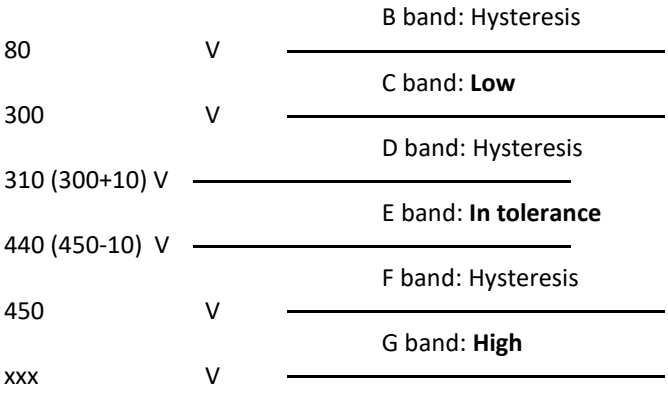
7.4.3.2 Voltages

Parameter	Description	Default value	Voltage (Volt)
P.0102	Rated voltage	400 V	400
P.0226	Stopped engine threshold due to voltage	17.5 %	70
P.0227	Started engine threshold due to voltage	20.0 %	80
P.0301	Minimum voltage threshold	75.0 %	300
P.0303	Maximum voltage threshold	112.5 %	450
P.0202	Hysteresis	2.5 %	10

To the two configurable thresholds (P.0301 and P.0303) applies the hysteresis entirely configured in the direction for the threshold input. This means that the voltage is out of tolerance if external to thresholds P.0301 and P.0303, in tolerance if internal to threshold P.0301+hysteresis and P.0303-hysteresis, otherwise it maintains the previous status.

Considering these values, the following bands are identified:

0 V
A band: **Absent**
70 V



If the voltage is in the “B”, “D”, “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.0328 to “1”, the same checks are also made on the phase voltages (nominal voltage calculated by dividing the phase-to-phase nominal P.0102 by 1.73 - squared root of 3).

Thresholds P.0301 and P.0303 are used also to manage the generator protections on voltage. These protections can be individually disabled setting to zero the relevant parameter that specifies the delay (respectively P.0302 and P.0304). Thresholds are however used to define voltage status: this allows not to switch the loads on the generator if the electrical magnitudes are out of the tolerance band, even though protections are disabled.

7.4.3.3 Overview

To diagnose the mains “global” status, 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”.
- ". In this case, if the control of the direction of rotation or the control on the asymmetry do not give a positive outcome, the mains is considered "Low".

7.4.4 Genset status.

For general management purposes, generator operation can be described in three steps:

- **Permanently out of tolerance**: the status of voltages and/or frequency of the generator (or of the rotation speed for asynchronous generators) should be different from "Within tolerance" consecutively for two seconds. The “GENERATOR LIVE” light is off if the voltages and the frequency are in “Absent” status, otherwise it flashes.
- Steady present: generator’s voltages and frequency status (or of the rotation speed for asynchronous generators) must be fully “in tolerance” for at least 0.5 seconds. **The “GENERATOR LIVE” light is fixed on**
- **Transitory:** during the transition between the two previous statuses. In this phase the “GENERATOR LIVE” light flashes.

7.4.5 Events and signalling

The board records the following events if the status of generator changes (if enabled with bit 3 of P.0441parameter):

- EVT.1020: Genset voltage absent
- EVT.1021: Genset voltage present, but “out of tolerance”.

- EVT.1022: Genset voltage present, and “within tolerance”.

The following function is also available for the configuration of the digital outputs linked to the genset status.

- DOF.3032 - “Genset in tolerance”. The board activates this output when the genset voltages and the frequency are in tolerance from the time configured.

The board makes controls and statuses of the genset available, for AND/OR logics, through the following internal statuses:

- ST.024 - “Genset voltage/frequency present”
- ST.025 - “Genset out of tolerance or absent”
- ST.026 - “Delay for genset within tolerance”
- ST.027 - “Genset in tolerance”.
- ST.028 - “Delay for genset out of tolerance or absent”

The following functions to configure the analogue outputs are linked to the management of the generator. The outputs are controlled according to the dimension of an analogue value of the generator. Use the "conversion curves" to adapt the single value to the output (0-100%):

- AOF.3101 (“generator frequency”).
- AOF.3111 (“generator average voltage").
- AOF.3121 (“generator active power").

7.5 Inhibition to genset automatic intervention

In automatic mode, GC600 determines, based on the type of system and the current conditions, whether to start the generator. In these conditions, it is possible to force the stopping of the generator by using the "inhibition to automatic intervention" function of the generator.

This internal function, once activated, takes priority over any other function: the generator will be shut down and it will not possible to restart it. The function operates in AUTO mode, but not in TEST and REMOTE START modes. The activation of this function does not require the activation of anomalies.

It is possible to activate this function in different ways, described in the following paragraphs. The “INHIBIT” lock lamp (🔒) turns on in the up-right corner of the display when an inhibition is active.

7.5.1 Inhibition from contact

The controller can use a digital input programmed for inhibiting the gen-set automatic operation (function DIF.2501 – Inhibit gen-set operation). In case of an “active” input, the engine is never automatically started, not even if the plants condition required.

Use parameter P.0207 to set a delay between input's physical activation and this function's logic activation: the delay can only be applied if the controller is in AUTO mode, otherwise the delay is null.

Use parameter P.0208 to set a delay between input's physical deactivation and this function's logic deactivation: in case the generator is already running, the delay is two seconds (firm).

When function DIF.2501is matched with a digital input, the acquisition of this input is subordinated to the set time in P.P.0207and/or P.0208; the acquisition time related to the digital input is ignored.

The board records any status variation of this inhibition to start in the event log (if enabled with bit 7 of P.0441parameter):

- EVT.1013: Inhibition active
- EVT.1014: Inhibition not active

7.5.1.1 Differences between Mains Simulation and Inhibition

The two functions have different operating logic and purposes. The first emulates the internal mains sensor behaviour, the second is used to explicitly impede the start of the system whatever the mains status; this reflects to the status signalling, which, in this way, remains more coherent with the real status of the system.

7.5.2 Inhibition from clock

By using P.0421, P.0422 and P.0423 parameters, it is possible to select the days of the week and a time bracket during which the generator is enabled to work. Outside this time bracket (and during not-selected days), the “inhibition to automatic intervention” function of the generator is active (and then the generator will be stopped).

Parameter P.0421 allows to set the generator's weekly operation days. The remaining two allow to set an hour range valid for all selected days. The range start time (P.0422) refers to the days set in P.0421, while the range end time (P.0423) refers to the same day, if its value is higher than P.0422, or to the following day if lower (across midnight). Moreover, setting P.0422 and P.0423 to the same value, you define a full day range.

The board records any status variation of this inhibition to start in the event log (if enabled with bit 7 of P.0441 parameter):

- EVT.1221: inhibition activated
- EVT.1222: inhibition deactivated

7.5.3 Inhibition to load management

In systems in parallel among more generators it is possible to use the "load management" (see document [10]) This function only activates the generators needed to meet the power required by loads in specific times That is, exceeding generators are stopped even though, for example, it is an emergency plant and mains is Off. The “load management” uses the “inhibition to automatic intervention” function to stop generators.

7.5.4 Inhibition due to mains failure

In systems that provide only the supplying in parallel with the mains (see [10]), should the mains fail, GC600 would force the opening of GCB switch and, after a configurable waiting time (P.0899), it would activate the “inhibition to automatic intervention” to stop the generator until the mains is again "within tolerance".

The controller records every variation of this specific inhibition:

- EVT.1223: inhibition activated
- EVT.1224: inhibition deactivated

7.5.5 Inhibition due to “GCB switch not open”

In multiple generator parallel plants, a generator's GCB switch might not open when the generator is stopped. In this condition, notwithstanding the stop command, the engine would keep running with all external services unpowered (oil pumps and the like). In this condition, notwithstanding the stop command, the engine would keep running with all external services unpowered (oil pumps and the like). In these conditions, it is possible to stop the closure of GCBs of the other generators (P.0804), and also to force their opening in case they are already closed: the generators are stopped (by means of the “inhibition to automatic intervention”) waiting until the problem is solved.

The controller records every variation of this specific inhibition:

- EVT.1225: inhibition activated
- EVT.1226: inhibition deactivated

7.5.6 Signalling

The board makes the statuses of the single “inhibition to automatic interventions” available for the AND/OR logics, through the following internal statuses:

- ST.080: from contact.
- ST.081: from clock.
- ST.082: from load management.
- ST.083: due to mains failure.
- ST.084: due to GCB switch not open”

7.6 Inhibition to taking of load

In automatic mode, once the generator has been started, GC600 normally always tries to close GCB switch. In these conditions, it is possible to force the opening of GCB switch by using the “inhibition to power load” function.

This internal function intervenes in all automatic modes (AUTO, TEST and REMOTE START). The activation of this function does not require the activation of anomalies.

If the "inhibition to power load" is activated when GCB is already closed, the board tries to open it, by carrying out generator power discharge first (if possible)

It is possible to activate this function in different ways, described in the following paragraphs.

The controller records an event when the "inhibition to power load" is deactivated:

- EVT.1081: inhibition deactivated

7.6.1 Inhibition from contact

It is possible to configure a digital input through DIF.2502 function (“inhibition to power load”). When this input is active, the inhibition to power load is active. Also see function EJP description on par. 9.7

the controller records an event when this inhibition is activated:

- EVT.1080: inhibition activated (by contact).

7.6.2 Control from serial ports

These commands can be enabled by a digital input configured with function DIF.2706 "Enable controls from the serial ports": if this input exists, it should be active. The commands can be protected with a password (P.0004) which must be entered before any command. 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:
  - “31” or “32” inhibition to power load (it forces GCB open).
  - “33” to deactivate the inhibition to the automatic supply.

The control remains active for 30 seconds from the time it is received by GC600: it is therefore necessary to repeat it about every 25 seconds until the inhibition to power load should be kept active.

The controller records an event when this inhibition is activated:

- EVT.1202: inhibition activated

7.6.3 Due to failure of the mains

In systems that provide the supply in parallel with the mains only (see [10]), if the mains fails, GC600 will force the immediate opening of GCB switch, and will activate the “inhibition to power load” in order to stop its closure. The inhibition will be cancelled when the mains is "within tolerance" again.

The controller records an event when this inhibition is activated:

- EVT.1201: inhibition activated

7.6.4 Inhibition due to “GCB switch not open”

In multiple generator parallel plants, a generator's GCB switch might not open when the generator is stopped. In this condition, notwithstanding the stop command, the engine would keep running with all external services unpowered (oil pumps and the like). In this condition, notwithstanding the stop command, the engine would keep running with all external services unpowered (oil pumps and the like). In these conditions, it is possible to impede the closure of GCB of the other gensets (P.0804) and also to force its opening, if they were already closed: the controller activates the “inhibition to taking of load” to impede the closure (or force the opening) of GCB.

The controller records an event when this inhibition is activated:

- EVT.1203: inhibition activated

7.6.5 Inhibition from MC100 board

If GC600 is “controlled” by MC100 (see document [10]), MC100 can activate the “inhibition to power load” to force the opening of GCB switches of all generators.

The controller records an event when this inhibition is activated:

- EVT.1205: inhibition activated

7.6.6 Inhibition to synchronization on MCB ongoing

In a system composed of more than one generator, that can supply both stand alone and in parallel with the mains (MSB + MSTP or MPtM + MSB), some external logics (among which MC100) can intervene on supplying generators voltage and frequency to synchronize the generator bar to the mains to close MCB or MGCB switch. At this stage, GC600 activates the inhibition to power load if its own GCB is open: in this way it stops its closure, in order not to disturb the ongoing synchronization.

The controller records an event when this inhibition is activated:

- EVT.1204: inhibition activated

7.6.7 Signalling

The board makes the statuses of the single "inhibition to power load" available, for AND/OR logics, through the following internal statuses:

- ST.088: from contact.
- ST.089: due to mains failure.
- ST.090: for controls from the serial port.
- ST.091: “inhibition for GCB not open”.
- ST.092: Inhibition to synchronization on MCB ongoing
- ST.093: for control from MC100 board.

7.7 Engine

The controller can start, stop and protect the engine by means of a series of thresholds on the acquired measures (oil pressure, coolant temperature, speed etc.).

7.7.1 Nominal power

GC600 allows specifying the rated power of the engine (P.0125parameter, in kW). It is important to set this figure, because the thresholds for some protections are expressed as its percentage.

Moreover, all PI controllers that manage the active power during delivery in parallel with other generators or with the mains, work with percentages of power values referred to this parameter: the modification of this parameter may require a new calibration of PI controllers (see document [10]).

7.7.2 Rated engine speed

The generators are usually designed to work with both the most common frequencies (50Hz and 60Hz). Obviously, at different frequencies, the rated rotation speed of the engine varies. Because some thresholds are expressed as a percentage of rated speed, GC600 should know the present rated speed.

GC600 allows setting two nominal rotation speeds for the engine via P.0133 and P.0134 parameters (both expressed in rpm): it uses the one specified in P.0133 (“Primary engine rated speed”) if the nominal frequency (P.0105) is lower than 55 Hz, otherwise it uses P.0134 parameter ("Secondary engine rated speed").

7.7.3 Engine speed

The board can perform a measurement of the engine rotation speed, to display it, optionally use it to diagnose the statuses of started/stopped engine, and optionally use it to manage a maximum speed protection (A018).

GC600 can acquire this measure in different ways, listed in the order in which they are assessed:

- The measure can be acquired by a pick-up on the engine. See initial chapters for the connection of the signal. To enable this measure, in P.0110 parameter the number of teeth of the rim on which the pick-up works should be set. This is a known value and, anyway, easily computed. If P.0110 is set to a nonzero value, the following points are ignored.
- The measure can be acquired by the signal W of the engine battery charging alternator. See initial chapters for the connection of the signal. To enable this measure, it is necessary to set the ratio between the frequency of the signal W and the rotation speed in P.0111 parameter (expressed in revolutions/second) of the engine, and P.0110 parameter should be set to zero. Such a ratio depends on different factors and it is not easily obtainable. If a frequency meter is available, simply start the engine (it will run at is rated and known speed, i.e., 1,500 rpm) and measure the W signal frequency, and then calculate the ratio. If a frequency meter is not available, the following method can be used:
  - Set a random value for P.0111 (e.g., 15).
  - Start the engine and, when at operating speed, note the rpm value shown by the controller.
  - Calculate the ratio between the displayed speed and the actual engine speed (displayed/actual).
  - Multiply the value previously set in P.0111 for such ratio and set the new value.
  - Restarting the engine, the speed measure should be close to the actual speed. It is then possible to proceed by manually adapting the P.0111value up to obtain the correct view, keeping in mind that at equal real speed, the more P.001 increases, the more the values displayed by the controller decreases. If P.0111 is set to a nonzero value, the following points are ignored.
- To determine the engine speed, the generator frequency can also be used. In this case, it is necessary to set the known ratio between engine rotation speed and the frequency of the generator in P.0127 parameter, and P.0110 and P.0111 parameters should set to zero. For example, a normal generator works at 1500 rpm to deliver 50Hz: set P.0127 to 30 (1500/50). If P.0127 is set to a nonzero value, the following points are ignored.

- The board can also read the engine rotation speed directly from the electronic control unit (ECU) of the engine itself through the CAN0 CAN-BUS. To do this, it is simply necessary to enable the CAN-BUS (P.0700 different from zero), and P.0110, P.0111 and P.0127 parameters should be set to zero.

7.7.4 Acquiring of analogue measurements

GC600 can acquire a great number of analogue measurements from the engine. For electronic engines, these measures are usually read directly from the ECU of the engine through the CAN-BUS connection.

Anyway, it is possible to configure the analogue inputs from the board and from the expansion modules to acquire these measures. If the same measure is acquired by an analogue input and received by the ECU of the engine via CAN-BUS, the one acquired by the analogue inputs is used.

The following functions are available for the configuration of the analogue inputs:

- AIF.1000 (“oil pressure – VDO”). This function can only be used for analogue inputs 3...6 GC600 automatically uses the characteristic curve of 0-10 bar VDO sensor (10 Ohm 0 bar, 180 Ohm 10 bar).
- AIF.1001 (“oil pressure – generic”). Use a conversion curve to configure the sensor.
- AIF.1100 (“oil temperature – VDO”). This function can only be used for analogue inputs 3...6 GC600 automatically uses the characteristic curve of 0-120 °C VDO sensor (290 Ohm 40 °C, 10 Ohm 150 °C).
- AIF.1101 (“oil temperature – generic”). Use a conversion curve to configure the sensor.
- AIF.1110 (“coolant temperature – VDO”). This function can only be used for analogue inputs 3...6 GC600 automatically uses the characteristic curve of 0-120 °C VDO sensor (290 Ohm 40 °C, 10 Ohm 150 °C).
- AIF.1111 (“coolant temperature – generic”). Use a conversion curve to configure the sensor.
- AIF.1200 (“oil level – VDO”). This function can only be used for analogue inputs 3...6 GC600 automatically uses the characteristic curve of VDO sensor (10 Ohm 100%, 180 Ohm 0%).
- AIF.1201 (“oil level – generic”). Use a conversion curve to configure the sensor.
- AIF.1210 (“coolant level – VDO”). This function can only be used for analogue inputs 3...6 GC600 automatically uses the characteristic curve of VDO sensor (10 Ohm 100%, 180 Ohm 0%).
- AIF.1211 (“coolant level – generic”). Use a conversion curve to configure the sensor.
- AIF.1220 (“fuel level – VDO”). This function can only be used for analogue inputs 3...6 GC600 automatically uses the characteristic curve of VDO sensor (10 Ohm 100%, 180 Ohm 0%).
- AIF.1221 (“fuel level – generic”). Use a conversion curve to configure the sensor.
- AIF.1231 (“fuel level in litres – generic”). Use a conversion curve to configure the sensor.
- AIF.1601 Air temperature in the intake pipe Use a conversion curve to configure the sensor.
- AIF.1603 Exhaust gas temperature (left bank) Use a conversion curve to configure the sensor.
- AIF.1605 Exhaust gas temperature (right bank) Use a conversion curve to configure the sensor.
- AIF.1641(“pressure of air coming out from the turbocharger”). Use a conversion curve to configure the sensor.

7.7.5 Engine running/stopped status acknowledgement

Three engine statuses are defined:

- **Stop:** the activation of the command for the starter motor is allowed.

- **In motion:** the engine is not considered as “running”, therefore:
  - If the command for the starter motor is active, it is kept trying to start the engine.
  - If the command for the starter motor is not active, the board impedes its activation (as the engine is rotating).
- **Running:** the board deactivates the command of the starter motor and impedes its reactivation.

The board acknowledges the engine status evaluating the following conditions:

- Engine speed This control is enabled if the measurement of the rotation speed is available.

  Two percentage thresholds are available (P.0224 and P.0225), which must be both different from zero and P.0225 must be higher than P.0224 (otherwise this check is disabled).

  The instant status of the engine is:
  - **Stop** if the rotation speed is lower than P.0224.
  - In motion: if the rotation speed is higher than P.0224, but lower than P.0225.
  - **Running:** if the rotation speed is higher than P. 0225.
- From the voltage of the signal D + of the engine battery charger alternator. This control is enabled if the measurement of the D+ voltage is enabled (P.4041 must be set as AIF.1300 – “Signal D+”).

  Two percentage thresholds are available (P.0230 and P.0231), which must be both different from zero and P.0231 must be higher than P.0230 (otherwise this check is disabled).

  The instant status of the engine is:
  - **Stop** if the D+ voltage is lower than P.0230.
  - **In motion:** if the rotation speed is higher than P.0230, but lower than P.0231.
  - **Running:** if D+ voltage is higher than P. 0231.
- From low and/or minimum oil pressure contacts. This control is enabled if parameter P.0232 is different from zero and if the digital inputs are configured to acquire the statuses of the oil pressure switches (DIF.4221 and/or DIF.4222). The instant status of the engine is:
  - **Stop** if all inputs are active (with engine stopped, in effect, the oil pressure falls, and these contacts should activate).
  - **Running** if at least one input is not active for the time configured by P.0232.
- From generator voltage. Two percentage thresholds are available (P.0226 and P.0227), which must be both different from zero and P.0227 must be higher than P.0226 (otherwise this check is disabled).

  The instant status of the engine is:
  - **Stop** is the voltages measured on **all** genset phases are lower than P.0226.
  - **In motion** if the voltage measured on **at least one** genset phase is higher than P.0226, but **all of them** are lower than P.0227.
  - **Running** if the voltage measured on **at least one** genset phase is higher than P.0227.
- From generator frequency. Two percentage thresholds are available (P.0228 and P.0229), which must be both different from zero and P.0229 must be higher than P.0228 (otherwise this check is disabled).

  The instant status of the engine is:

- **Stop** if the genset voltage is lower than P.0228.
- **In motion:** if the genset frequency is higher than P.0228, but lower than P.0229.
- **Running:** if the genset frequency is higher than P. 0229.

- From CAN-BUS connection (ECU interface): if the engine signals the status of Start on CAN-BUS. This control is no longer used if the CAN-BUS connection is disabled (parameter P.0700 “Engine type” set to 0).

The engine is globally considered:

- Stop if **all** previous checks (all those not disabled) indicate the “stop” status continuously for **five seconds.**
- **In motion**, if **at least one** of the previous checks indicate “in motion” or “running”.
- **Running,** if **at least one** of the previous checks indicates “running” continuously for **at least 0,2 seconds.**

7.7.6 Engine commands

The board can manage many digital outputs for engine command. Following the list of functions for the configuration of the digital outputs, with an acronym used later and a description:

Function	Acronym	Description
DOF.1001	**GLOW_PLUGS**	Command for glow plug pre-heating for DIESEL engines.
DOF.1002	**ECU_ENABLE**	Command of enabling for the engine junction box. It activates together with FUEL command, but it can deactivate after FUEL command (it is useful to stop electronic engines, without causing depressions in the fuel ducts).
DOF.1003	**FUEL**	Command for fuel solenoid valve.
DOF.1004	**GAS**	Command for GAS solenoid valve (only GAS engines).
DOF.1005	**START**	Command for the starter motor
DOF.1006	**STOP**	Command for the solenoid to stop the engine.
DOF.1007	**IDLE**	Command to activate the reduced speed (IDLE) on the engine.
DOF.1008	**BATT1**	Command used for the management of the double battery.
DOF.1009	**BATT2**	Command used for the management of the double battery.
DOF.1031	**PREHEAT**	Command for engine pre-heating.
DOF.1033	**PRELUBE**	Command for engine pre-lubricating.

All digital outputs of the controller are configurable, and it is possible to associate in any way the engine commands to the controller outputs (use parameter P.3001 and following with the functions listed in the chart). With the default configuration, some commands are pre-assigned:

- STOP: output 1 (JD-1).
- START: output 15 (JJ-1).
- FUEL: output 16 (JJ-3).

The commands are also available as internal statuses for the AND/OR logics (DOF.0103):

- ST.128 (GLOW_PLUGS).
- .129 (ECU_ENABLE).
- ST.130 (FUEL).
- ST.131 (GAS).
- ST.132 (START).
- ST.133 (STOP).

- ST.134 (IDLE).
- ST.135 (PREHEAT).
- ST.136 (PRELUBE).

As follows, the controls are described individually.

Note: for electronic engines connected via CAN0 CAN-BUS to GC600, many of these controls are managed directly through the CAN-BUS connection, and therefore it is not necessary to configure the outputs. If the outputs are configured, the board controls them, although the engine is connected in CAN-BUS.

7.7.6.1 Engine preheating control (PREHEAT)

The board can control an external heating system, to maintain the temperature of the engine cooling liquid above a specific temperature. This to heat the engine, so that it is ready to deliver at any time.

This function is disabled if the board does not acquire the temperature of the cooling liquid (neither via CAN-BUS from the engine control board nor through the AIF.1110 or AIF.1111 analogue inputs functions).

The function is configured via P.0355 and P.0356parameters:

- P.0355: temperature below which the heating system must activate.
- P.0356: temperature above which the one the heating system must deactivate.

The threshold P.0356 must be set to a value higher than P.0355: the two thresholds guarantee a hysteresis to avoid continue turn the heating system on/off due to minimum temperature shifts. The heating activates if the temperature drops below the threshold P.0355 for at least one second; it turns off when the temperature rises above the threshold P.0356 for at least one second.

This function is always active, even when the engine is running: it is clear however that when the engine is running, the temperature of the coolant will always be higher than P.0356threshold, therefore the heating system will always be disabled.

7.7.6.2 Engine pre-lubrication control (PRELUBE)

The board can control the engine pre-lubrication pump. In practice, before starting the engine (so when the mechanic pump of the engine is not working yet), the board can control an auxiliary pump to have the lubricating oil already under pressure when the engine starts moving.

To enable this function, it is necessary to set P.0242 parameter ("Maximum duration of pre-lubrication cycle") to a value other than zero.

The board activates the pre-lubrication control at the beginning of the starting cycle, along with the opening of the fuel solenoid valve. The output is active for the entire pre-lubrication cycle: it ends after P.0242 seconds, or if the board realizes that the lubricating oil is under pressure.

The board considers that the lubricating oil is under pressure if at least one of the following conditions is met:

- If the board acquires the measurement of the lubricant pressure (from the engine control unit via CAN0 CAN-BUS, or via the analogue inputs, AIF.1000 or AIF.1001functions):
  - If the lubricant low-pressure threshold is set (P.0339 <> 0), when the measured pressure is higher than the threshold.
  - If the lubricant low-pressure threshold is not configured, but minimum pressure threshold is configured (P.0341 <> 0), when the measured pressure is higher than the threshold.
- If the board does not acquire the measurement of lubricant pressure, or if both P.0339 and P.0341 thresholds are set to zero:

- If the digital input is configured to acquire "oil low pressure" (DIF.4222) when this input is not active.
- If no digital input is configured to acquire "oil low pressure", but the digital input to acquire the "oil low pressure" (DIF.4221) is configured when this input is not active.

When the pre-lubrication cycle is ended, the starting sequence goes on (with the starter motor): The pre-lubrication controls remains anyway active until the engine starts or until the starting sequence is interrupted. In case of repeated attempts to start, the pre-lubrication control persists: the time configured with P.0242 is counted, but only during the first attempt.

7.7.6.3 9.4.6.3 Glow plugs pre-heating control (GLOW_PLUGS)

This control is intended for the old diesel engines, for which it was necessary to heat glow plugs before starting the engine. It can still be used to insert a delay between the opening of the fuel solenoid valve and the starter motor control: sometimes, as a matter of fact, if the two controls are activated together, the vacuum in the fuel ducts caused by the starter motor does not allow the correct opening of the valve (it gets stuck).

To enable this function, it is necessary to set P.0209 parameter ("Pre-heating cycle maximum duration") to a value other than zero.

The controller activates the glow plugs pre-heating command at the beginning of the starting cycle, along with the opening of the fuel solenoid valve. The output remains active throughout the glow plugs pre-heating cycle: it ends after P.0209 seconds.

When the cycle ends, the starting sequence goes on (with the starter motor control): the glow plugs pre-heating control remains active until the engine starts or until the starting sequence is interrupted. In case of repeated attempts to start, the glow plugs pre-heating control goes on: the time configured with P.0209 is counted, but only during the first attempt.

Warning: the glow plugs pre-heating cycle is performed simultaneously with the pre-lubrication cycle. If P.0242 parameter is set to a value higher than P.0242, the glow plugs pre-heating cycle will last P.0209seconds as well.

7.7.6.4 Using two battery sets (BATT1 e BATT2)

The controller can control engine cranks alternately managing two battery sets to ensure engine cranks. To use this function requires at least one output configured with function DOF.1008 (BATT1).

If only BATT1 output is configured, then the controller activates this output to select battery #1, it disables this output to select battery #2.

If both BATT1 and BATT2 outputs are configured, then the active board activates BATT1 output to select battery #1 and BATT2 output to select battery #2. It also guarantees a minimum time of two seconds with both outputs off during the shift between battery #1 and battery #2.

Finally, GC600 guarantees a minimum delay of two seconds between the selection of a battery and the starter motor control.

In automatic, the board performs on battery #1 the number of starting attempts configured with P.0211 parameter. If the engine does not start, it switches on battery # 2 and performs again the same number of starting attempts. If the engine has not been started yet, it activates A022 Alarm ("failure to start").

In manual mode, the board always performs only one starting attempt, and then it always performs it on battery #1.

The automatic starting sequence is:

- BATT1 output enabled, BATT2 output disabled.

- 2-second wait (note 1).
- First crank attempt.
- Pause
- ……
- Last crank attempt.
- 2 seconds delay
- BATT1 output disabled, BATT2 output disabled.
- 2 seconds delay
- Only if BATT2 output exists: BATT1 output disabled, BATT2 output enabled.
- Only if BATT2 output exists: 2-second wait (note 2).
- First crank attempt with the second battery.
- Pause
- ……
- Last crank attempt with the second battery.
- Failed crank alarm.
- 2 seconds delay.
- BATT1 output disabled, BATT2 output disabled.

Note 1: the two-second initial delay between the selection of battery #1 and the starter motor control is performed at the same time of the pre-lubrication cycle and the glow plugs pre-heating cycle, and it could be extended to the longer time between those configured in P.P.0242 and P.0209.

If the engine starts up, the sequence ends. The output BATT1 or BATT2 active in that moment is disabled after a 2 seconds delay after detecting started engine.

7.7.6.5 Control to enable the engine control unit (ECU_ENABLE)

7.7.6.6 Fuel solenoid valve control (FUEL)

These two controls are activated simultaneously at the beginning of the starting sequence. Both remain active even with started engine, until the starting of the shutdown sequence:

- The ECU_ENABLE control is removed immediately at the beginning of the shutdown sequence.
- The FUEL control is removed after P.0234 seconds ("delay between STOP and FUEL controls") from the starting of the stopping cycle.

The FUEL control should be used to control the solenoid valve placed on the fuel line. At the beginning of the starting sequence, the board opens the valve, thus allowing the fuel to get to the engine. At the beginning of the stopping sequence, the board closes the solenoid valve: the engine receives no more fuel and then it stops.

The ECU_ENABLE control should be used to give a consent to the starting of electronic control units of the engines. Lacking this consent, it is reflected in the shutdown of the fuel injection system: therefore, without this consent then the engine cannot start, but instead it will be stopped if it was running.

If ECU_ENABLE (not present) or STOP (present) controls are used to stop the engine, but a solenoid valve is anyway present on the fuel line, it is possible that the vacuum in the fuel circuit caused by the engine that is stopping may prevent the correct movement of the solenoid valve. In these cases, by using P.0234 parameter, it is possible to delay the closing control of the fuel solenoid valve with reference to the stop control (ECU_ENABLE or STOP) of the engine: the engine is stopped through its own stopping system and, when the engine is stopped, the fuel solenoid valve can be closed.

7.7.6.7 Command for the starter motor (START)

This control should be used for the direct control of the starter motor. The board enables the START output to start the engine and shall remove it immediately when it detects a “started engine” status. In this way, it ensures the immediate release of the starter motor ring gear, therefore avoiding that the starter motor is dragged by the engine. In case of failure to start, the board deactivates the START output at the end of the starting attempt.

The duration of each starting attempt is automatically determined by the P.0210 parameter (“Duration of the starting control”). This duration may be increased for gas engines (see below).

The cycle duration of the manual start depends on parameter P.0252:

- 0: the duration of the start attempt is established by the operator; the attempt interrupts when the operator releases the START button.
- > 0: the duration of the start attempt is selected by parameter P.0210.

For start cycles controlled through the serial port, the instructions for the automatic are valid.

7.7.6.8 Fuel solenoid valve control (GAS)

This control only makes sense for GAS engines. The aim is to perform the washing cycle of the engine. When a GAS engine is turned off, in the feeding circuit unburned gas is still present. If it is not disposed of before the next starting, it could be dangerous because it could explode unrestrainedly. Therefore, each time the engine is started, the washing cycle to remove this unburned gas is performed. The cycle consists in making the engine run, through the starting motor, without opening the GAS valve: the vacuum caused by the engine is enough to remove the unburned gas.

This function is enabled by setting P.0241 parameter to a value higher than zero. The GAS solenoid valve is opened after P.0241 seconds from the time the starter motor was activated (START): for this reason, if the duration of the starting cycle (P.0210)) is lower than P.0241 parameter, it is automatically lengthened to a second more than P.0241.

If the starting attempt ends without that the engine has started, the board closes the GAS valve, and, at the next starting attempt, the washing cycle will be repeated.

7.7.6.9 Engine stop command when energized (STOP)

This control is used in systems where it is preferred to give priority to the supply by the generator. When the FUEL control is used, as a matter of fact, a failure of the solenoid valve control system results in its closure, and the resultant stop of engine consequently.

The STOP control is instead active only during the stopping cycle. Its purpose is to block the flow of fuel to the engine only during the stopping phase: when the engine has been stopped, the output is disabled, so allowing the reopening of the fuel pipeline. In this case, it is always possible to start the engine, even at the presence of a fault on the STOP control: at the limit it will not be possible to stop the engine.

The STOP control is activated at the beginning of the stopping cycle, at the same time when the ECU_ENABLE control is removed. The STOP control will remain active for the time set with P.0213 parameter ("Duration of the stop control").

Note: If the engine stops in a shorter time, and a restarting of the engine is required, the STOP control is disabled before.

7.7.6.10 Idle speed command (IDLE)

This control is used to activate the reduced rotation speed, directly on the rpm regulator of the engine.

The output is active during the entire IDLE cycle. Note: if there is a request for IDLE before starting the engine, the control will be already active from the beginning of the starting sequence. Similarly, if the IDLE request is active during the stopping cycle, the control is active as well.

The IDLE cycle can be requested in two ways:

- By setting a nonzero delay in P.0233 parameter ("Low speed cycle duration"). The board performs an IDLE cycle at each stating of the engine (both manual and automatic). The maximum duration of the IDLE cycle is the one set with P.0233 parameter. It is however possible to link the duration of the cycle to the temperature of the coolant. By setting a nonzero value in P.0223 parameter ("Minimum temperature for the consent to supply"), the board monitors the temperature of the coolant and, as soon as it is above P.0223 threshold, it stops the IDLE cycle.
- With a digital input configured with DIF.2061 function (“Request for reduced speed”). When the input is active, the board runs the IDLE cycle.

  During the IDLE cycle, minimum frequency and minimum voltage protections of the generator are disabled. At the end of the IDLE cycle, before enabling the protections, the board requires that voltages and frequency are within tolerance: if it is not the case, the board activates A008 shutdown ("no steady status").

  During the IDLE cycle the board does not allow the closing of GCB switch. If the IDLE cycle is requested (with the digital input) while GCB is closed, the board opens GCB switch first (in case by discharging power if the generator is parallel to anything), and then activates the IDLE control.

  For some electronic engines, it is possible to specify the rotation speed (rpm) for the low-speed operation through parameter P.0710.

7.7.7 Consent to starting

GC600 provides for DIF.2709 function ("Consent to starting") for the configuration of the digital inputs.

The board uses this input as consent to start: if the starting of the engine is required and there is an input configured with this function, GC600 waits until the input is active before performing the starting cycle. When the starting is initiated, the input is not more checked (it can also be deactivated). The purpose of this input is to manage external sequences, such as, for example, the pre-ventilation of the room where the generator is installed. Example of use:

- When the board receives a request to start, its internal management mode shifts to "start", but if the digital input is not active, the actual starting procedure will not be performed.
- The internal “start” status can activate a digital output (DOF.0103 function “AND/OR logics” function “AND/OR logics” with ST.036status). This output can activate the external pre-ventilation sequence.
- When the external sequence is finished, it will have to activate the digital input configured as DIF.2709: at this point, the controller goes on with the starting of the engine.

  This function is particularly useful when GC600 should work with a MC100 board. In this case, in fact, it is not possible to use the "inhibition to automatic intervention" function to prevent the starting of the engine during the pre-ventilation phase (or others): MC100, in fact, when it wants to start a generator, switches the related GC600 to REMOTE START, where the requests for "inhibition to automatic intervention" are ignored.

  It is also useful if the external sequences should be performed also in MAN (because in MAN the requests of "inhibition to automatic intervention" are ignored).

7.7.8 Manual control sequence

7.7.8.1 Manual start

With the board in MAN, it is possible to request the starting of the engine in three ways:

- With the START key of the panel.

There are two possible sequences of manual:

- Sequence totally manual: it is used in MAN if the parameter P.0252 (“Number of manual crank attempts”) is zero. The duration of the start attempt is established by the operator; the attempt interrupts when the operator releases the START button.
- Sequence totally manual: it is used in MAN if the parameter P.0252 (“Number of manual crank attempts”) is different from zero. The duration of the start attempt is selected by parameter P.0210. The controller performs P.0252 start attempts, activating the “fail to start anomaly” if the engine does not start.

  If the operator releases the START key when the engine has not been started yet, the board leaves the fuel (also GAS) circuit open for 10 seconds (to check if the engine starts): then, in case, it starts an automatic stop cycle. Starting from version 00.64, the GAS valve is immediately closed when the START key is released (if the engine is not started).

  If the engine starts, the board automatically provides to remove the command of the starter motor. During the manual start, the board will automatically perform pre-lubrication, glow plugs pre-heating and cleaning cycles. The starting is always performed with battery #1 (if two batteries are configured).

- With a digital input configured with DIF.2033 function (“Manual starting control”). This input is managed exactly as the START key: same as said above.
- It is possible to control the starting of the engine manually with a control through the serial ports. These commands can be enabled by a digital input configured with function DIF.2706 "Enable controls from the serial ports": if this input exists, it should be active. To start the engine manually, it is necessary to write (within 5 seconds) the Modbus registers in sequence:
  - HOLDING REGISTER 101: write the password configured with the parameter P.0004.
  - HOLDING REGISTER 102: enter the value “11”.

  In response to this control, the board performs the starting as if it were in automatic. But it performs only one start attempt, and if it fails, it does not activate A022 "failure to start" shutdown.

  Note: if the starting is requested in MAN when the engine is already running (but it was not started by the board), GC600 acknowledges the situation: it activates all engine controls as if it had started it, except for the starter motor, that is not activated.

  Note: the start-up in MAN is always done by means of battery 1 (in case there are 2 batteries).

7.7.8.2 Manual stop

With the board in MAN, it is possible to request the stopping of the engine in four ways:

- With the STOP key on the board panel of the card.
- With a digital input configured with DIF.2034 function ("Manual stop control"). This input is managed exactly as the STOP key: same as said above. This input is managed exactly as the START key: same as said above.
- It is possible to control the stopping of the engine manually with a control through the serial ports. These commands can be enabled by a digital input configured with function DIF.2706 "Enable controls from the serial ports": if this input exists, it should be active. To start the engine manually, it is necessary to write (within 5 seconds) the Modbus registers in sequence:

- HOLDING REGISTER 101: write the password configured with the parameter P.0004.
- HOLDING REGISTER 102: enter the value “21” OR “22”.

In all cases, GC600 performs an emergency automatic stop cycle.

Note: the stop cycle can also be performed with already stopped engine.

7.7.9 Automatic command sequence

Before describing automatic start/stop procedures, it is necessary to define when the engine should be started and stopped automatically.

The engine is started automatically if there are no alarms, unloads and deactivations and if at least one of these conditions is present:

- If the TEST is activated (see 7.1).
- If the REMOTE START is activated (see7.1).
- If there is no active “inhibition to automatic intervention” of the generator (see 7.5) and the automatic intervention of the generator is required. This request depends on the type of system (see [10]):
  - Stand-alone production systems. The request for intervention is always active.
  - Emergency system to the mains. The request for intervention is active if the mains is out of tolerance or if MCB switch is not closed (if configured).
  - System for the production in parallel with the mains only. The request for intervention is active when the mains is present and if voltage and frequency measures authorize the parallel.

In automatic mode, the engine can be stopped in two ways:

- With normal procedure. After opening the GCB switch (possibly after discharging power), the board performs a cooling cycle of the engine (only if previously the load was connected to the generator), by keeping it running without load. This procedure applies if:
  - No automatic start request is pending (see above)
  - It triggers an "inhibition to automatic intervention", with the board in AUTO.
  - An anomaly, qualified as “deactivation” or “unload” occurred (it is an anomaly typically dangerous for loads but not for the engine).

If the Bit 1 of parameter P.0249 is set to "1" the controller enable the cooling cycle also in **manual** mode.

This cycle is performed (if the GCB switch has been closed at least once since the engine was started and / or if the coolant temperature is higher than the threshold P.0271) in the following cases:

- The operator presses the STOP key on the keypad (or the stop command is sent to the MAN from the communication ports).
- An "unload" or "deactivation" anomaly is activated.

In both cases, the operator can stop the cooling cycle by giving a second MAN stop command (or with a new command from the communication ports).

- With an emergency procedure. This procedure requires immediate engine stop, without engine cooling cycle. It applies if:
  - The key switch is turned on OFF/RESET

- Any anomaly described as an "unload" is activated. In automatic mode, the stop commands from panel (STOP button, if not disabled by bit 0 of parameter P.0495) from serial port and from SMS are included in this category since they activate the alarm A007 (manual stop in auto mode).

7.7.9.1 Automatic start

The board automatically executes the number of starting attempts configured with P.0211 parameter ("Number of starting attempts") for each battery set. At the end, if the engine is not started, it activates A022 alarm - "Failure to start".

Each starting attempt has the maximum duration configured with P.0210 parameter ("Duration of the starting control"). It however ends if the condition of started engine is detected. Within the starting procedure, GC600 automatically manages pre-lubrication, glow plugs pre-heating and cleaning cycles.

Between a starting attempt and the next one, the board makes a pause with a duration configured with P.0212 parameter ("Delay between two starts"). This pause may be longer when the selected battery set is changed.

If, during a starting attempt, the board recognizes the started engine condition, it waits for the maximum time configured with P.0217 parameter ("Maximum time for steady statuses") until voltages and frequency of the generator are within tolerance:

- If during the pause the engine stops, the board will go on with the next starting attempts.
- If generator voltages and frequency are "within tolerance", the starting procedure is ended: from this time on, also minimum voltage and minimum frequency protections are active.
- If, at the end of the pause, voltages or frequency are not "within tolerance", the board activates A008 alarm " Engine not started".

If the low-speed cycle is required, the previous pause will be performed after it is finished.

At the end of the automatic starting procedure, the board manages a further delay that allows the generator to stabilize/warm up before being connected to the load. This delay can be configured with P.0218 parameter ("delay before delivery"): it does not work in MAN.

7.7.9.2 Standard automatic stop

This procedure starts after the board has opened GCB switch (or at least after the board has tried to open). Any power discharge of the generator has already been done.

If during the automatic operations the board closed GCB switch, it considers that the generator was heated by the load, and that it therefore needs to cool down before being stopped. Then a cooling cycle is performed. It is simply consisting in keeping the engine started without load for the time set with P.0215 parameter ("Duration of the cooling cycle"). The cooling cycle can be aborted before the time set with P.0215 if the coolant temperature becomes lower than the threshold set with P.0271 parameter (if this threshold is different from zero).

Often the generators have a whole range of auxiliary services (pumps, fans and so on) that are essential for the proper functioning of the generator. These auxiliary services are normally powered from an AC voltage: if this voltage is not available, the generator cannot stay in motion. It often happens that, for example in generators that only produce in parallel with the mains, these services are powered by mains voltage, and therefore the generator should be stopped as soon as the mains fails.

GC600 allows configuring the source from which these services are supplied, via P.0240 parameter ("The engine services are supplied by:"):

- 0: generator voltage.
- 1: voltage on the parallel bars.
- 2: voltage on users.

- 3: mains voltage.

If GC600 realizes that there is no voltage on the selected source, the cooling cycle is stopped immediately (this function works only on the cooling cycle, not in all the other management phases of the engine). By setting P.0240 to "0", the board can always run the cooling cycle.

7.7.9.3 Automatic emergency stop

The emergency stop procedure consists in stopping the engine without performing the cooling cycle. This procedure is common also in the standard stop, after the cooling cycle.

During the stopping cycle, the board removes ECU_ENABLE and FUEL controls (the second with P.0234seconds of delay) and activates the STOP control for P.0213seconds. The board waits until the engine stops. The maximum duration of the shutdown cycle is configurable with P.0214 parameter (" Duration of the stopping cycle"): if at the end of this phase the engine has not stopped, A021 alarm is activated - " Engine not stopped".

Note: normally the stopping cycle lasts P.0214 seconds even if the engine stops in a shorter time. If during the stopping cycle a new automatic intervention of the generator is required, the same stopping cycle will be arrested only when the engine is completely stopped. In this case GC600 ensures that the STOP and FUEL controls do not overlap.

7.7.10 Masking of oil protections

GC600 provides a parameter that allows configuring a delay (from the moment when the "started engine" condition is recognized) within which the oil pressure protections are disabled. This is to allow time for the pump to pressurize oil and prevent false alarms. The delay is configurable with P.0216 parameter ("Engine protection masking time").

7.7.11 Events

The controller records the following events if the status of the engine varies (if enabled by the bit 4 of P.0441 parameter):

- EVT.1040: if the motor is idle.
- EVT.1041: starting cycle in progress.
- EVT.1042: the engine is running.
- EVT.1043: cooling cycle in progress.
- EVT.1044: stopping cycle in progress.
- EVT.1045: low speed cycle in progress.

Moreover, the controller records the following events at the changing of start/stop requests (if enabled by the bit 7 of P.0441 parameter):

- EVT.1050: manual start request.
- EVT.1051: manual arrest command.
- EVT.1052: starting automatic request.
- EVT.1053: stopping automatic request.
- EVT.1054: starting automatic request (from contact).
- EVT.1055: stopping automatic request (from contact).
- EVT.1056: starting automatic request (from serial port).
- EVT.1057: stopping automatic request (from serial port).

- EVT.1058: starting automatic request (from clock/calendar).
- EVT.1059: stopping automatic request (from clock/calendar).
- EVT.1060: starting automatic request (from SMS).
- EVT.1061: stopping automatic request (from SMS).
- EVT.1062: starting automatic request (for non-closed MCB).
- EVT.1063: starting automatic request (from MC100 board).

7.7.12 Signalling

The following functions for the configuration of the digital inputs are linked to engine management (besides those described for engine direct controls):

- DOF.3061: the output will be activated if the engine is in motion.
- DOF.3062the output will be activated if the engine is in motion and if the “delay before supplying” (P.0218) has been performed.
- DOF.0103 (Logics AND/OR)
  - ST.032: the output will be activated if the engine is in motion.
  - ST.033: the output will be activated if the engine is in motion and if the “oil protection masking” time span has elapsed (P.0216).
  - ST.035: engine stopped.
  - ST.036: starting cycle ongoing.
  - ST.037: low speed cycle ongoing.
  - ST.038: delay before supplying ongoing.
  - ST.039: engine: ready for power delivery.
  - ST.040: cooling cycle in progress.
  - ST.041: stopping cycle in progress.

The following functions, for the configuration of analogue outputs, are linked to engine management. The outputs are managed based on an engine analogue value. Use the "conversion curves" to adapt the single value to the output (0-100%):

- AOF.3001 (“engine speed”).
- AOF.3011 (“oil pressure”).
- AOF.3013 (“oil temperature”).
- AOF.3015 (“oil level”).
- AOF.3023 (“coolant temperature”).
- AOF.3025 (“coolant level”).
- AOF.3035 (“fuel level”).

7.7.13 Fuel pump

The genset implements the full management of the fuel pump, to pump the fuel from the storage tank to the tank on the generator. For the management of the pump, GC600 must acquire the fuel tank level on board of the generator: for this purpose, a float with contacts or an analogue level sensor can be used (that can be selected through P.0401 parameter “type of sensor for fuel pump”).

The pump can be managed automatically or manually using the controls on the front panel through page E.06 (see 6.5.5.6).

7.7.13.1 Functioning mode

Three functioning modes of the fuel pump are provided:

- MANUAL-OFF: the pump is deactivated.
- MANUAL-ON: the pump is activated in any case, and it is deactivated only with the maximum level of the tank on board the generator.
- AUTOMATIC: the pump is activated and deactivated automatically based on the tank level on board the generator.

The functioning mode can be selected in three different ways:

- Through the digital inputs configured through the functions:
  - DIF.2241: forces the pump in MANUAL-OFF mode.
  - DIF.2242: forces the pump in MANUAL-ON mode.
  - DIF.2243: forces the pump in AUTOMATIC mode.

  If at least one of these inputs is active, the pump functioning mode is forced and cannot be changed with the other methods described below. In case more than one input is active simultaneously, higher priority is assigned to MANUAL-OFF, followed by MANUAL-ON and then AUTOMATIC.
- By changing P.0400 parameter (“fuel pump mode”).
- “E.06” page of GC600 display is dedicated to the fuel pump. From this page it is possible to change the pump functioning mode: From this page it is possible to modify the operation mode of the pump:
  - Press the ENTER pushbutton.
  - Use the ENTER button.
  - Press ENTER to confirm or EXIT to abort.

  Note: if no keys are pressed for 60 seconds, the modification procedure is automatically terminated.

7.7.13.2 Use with an analogue level transducer

To use this function:

- The level analogue transducer should be connected to one of the analogue inputs of GC600 or to DIVIT expansion modules. The utilized analogue input should be configured through AIF.1220 functions (dedicated to VDO sensor, 0%-180 Ohm, 100%-0 Ohm) or through AIF.1221 function (configurable).
- Set the thresholds to control the pump according to this transducer (parameters P.0401=0).
- Set the thresholds to activate/deactivate the pump (parameters P.0402 and P.0403).
- If configured, also the minimum thresholds are used, low and high fuel level (parameters P.0347, P.0345, P.0343).

Attention: if the first two conditions are verified, the board manages the pump, whatever the thresholds value. The thresholds defined in the last condition are also used if the relative intervention times are set to zero (to disable the anomalies). Very important is the thresholds setting which should be ranked by level (from down up), as follows: minimum, low, start, stop, high. As already explained, the controller operates even if thresholds are not in this order; all you need is the first three ones lower than the last two ones (within each of the two groups they can be swapped, but it is not recommended).

7.7.13.3 To use this function requires:

To use this function, it is necessary:

- That the contact level transducer exists.
- Set the thresholds to control the pump according to this transducer (parameters P.0401 =1).
- That at least the contacts of pump start and stop are respectively connected to two configurable outputs of the board.
- If connected, also the minimum contacts, low and high fuel level are used.

Attention: if the first two conditions are verified, the board manages the pump, whatever the contacts connected. The contacts indicated in the last condition are also used if the relative intervention times are set to zero (to disable the anomalies). Pay attention to their configuration. Finally, the contacts must respect the following convention:

- Minimum level contact (input with function DIF.4211): closed if the level is under threshold of minimum level.
- Low level contact (input with function DIF.4212): closed if the level is under threshold of low level.
- Start contact (input with function DIF.3301): closed if the level is under threshold of pump start.
- Stop contact (input with function DIF.3302): closed if the level is under threshold of pump stop.
- High level contact (input with function DIF.4213): closed if the level is over threshold of pump stop.

7.7.13.4 Level evaluation

The controller assigns the actual fuel level by calculating in the order all the following evaluations:

- If the level is lower than the pump start threshold, the controller assigns the “start” position.
- If a low-level threshold exists, and the level is lower than threshold, the controller assigns the “low” position.
- If a minimum level threshold exists, and the level is lower than the threshold, the controller assigns the “minimum” position.
- If the level is higher than the stop threshold, the controller assigns the “stop” position.
- If a maximum level threshold exists, and the level is higher than the threshold, the controller assigns the “maximum” position.
- If none of the previous condition is met, the controller assigns the “hysteresis” position.

7.7.13.5 Pump control

The board uses two controls to manage the fuel pump, that can be associated to any digital output (P.3001 parameter and subsequent ones) with the functions:

- DOF.1032 (“fuel pump”).
- DOF.1034 (“Fuel pump solenoid”).

The output for the pump control is mandatory (otherwise this function is disabled).

The output for the electromagnetic valve is optional. When it is used, it is necessary to configure a delay in P.0405 parameter (“delay between solenoid valve and fuel pump”): The board guarantees the opening of the solenoid valve

P.0405 seconds before activating the pump, and the opening of the solenoid valve P.0405 seconds after closing the pump. All that to avoid that the vacuum caused by the pump within the fuel circuit could bring about some malfunctioning of the solenoid valve (it could get stuck).

The board controls the pump based on the fuel level and on the working mode:

- AUTOMATIC. Referring to the position evaluated in the previous paragraph, the pump:
  - Activates if the level is “start”, “low” or “minimum”.
  - Deactivates if the level is “stop” or “maximum”.
  - Retains the actual command if in “hysteresis”.
- MANUAL-ON. Pump can be activated and deactivated according to operator needs. However, the controller prevents the start if the level (see previous paragraphs) is “stop” or “maximum”.
- MANUAL-OFF. The pump is deactivated

The board can anyway stop the pump (even if the previous logic would require its start) when the following conditions are present:

- In case anomalies activated by the digital inputs configured through the functions are active:
  - DIF.4051 “warning (turns off the fuel pump)”.
  - DIF.4052 “unload (turns off the fuel pump)”.
  - DIF.4053 “deactivation (turns off the fuel pump)”.
  - DIF.4054 “alarm (turns off the fuel pump)”.

Warning: it is the anomaly that stops the pump, not the activation of the input.

- In case anomalies activated by thresholds on analogue inputs are active (P.4003 ...P.4008 parameters for analogue input 1). This happens only if the anomaly has been specifically configured to stop the pump, through the bit 15 of the threshold configuration parameter (P.4005 for the first threshold on the first analogue input). Warning: it is the anomaly that stops the pump, not the activation of the input.
- Moreover, you can set the maximum fuel pump activation time with parameter P.0404. This parameter should be used to set the time needed for the pump to fill the equipment tank, in the worst conditions: empty tank and engine started at maximum power. If the pump stays in motion (both from manual and automatic control) for a longer time span, the board activates W064 warning: in fact, it is likely the presence of a failure of the pump or, anyway, that the pump is not drawing from the storage tank. The pump is stopped until W064 warning is activated: when the operator “cancels” it, the pump restarts with another cycle.
- The board allows configuring the electric source that must supply the pump, through P.0406 parameter (“Supplying of the fuel pump”):
  - 0: generator voltage.
  - 1: voltage on the parallel bars.
  - 2: voltage on users.
  - 3: mains voltage.
  - 4: from an always present voltage.

If the board detects that there isn't voltage on the selected source uninterruptedly for five seconds, it will stop the pump (set P.0406 on “4” to disable this control).

- The pump is disabled in OFF/RESET, but only if this mode persists consecutively for five seconds.

7.7.13.6 Events

The board will record the following events, if the fuel pump status changes (if enabled with the bit 8 of P.0441parameter):

- EVT.1070: the pump is started.
- EVT.1071: the pump is stopped.

7.7.14 Pump for AdBlue fluid

GC600 implements a complete management of the pump for loading the AdBlue fluid from the storage tank into the daily tank.

For use this feature, you must configure one of the digital outputs of GC600 with the DOF.1037 function (“AdBlue pump”). It is also possible to configure a digital output to control a solenoid on the pump line (DOF.1038 “Solenoid for the AdBlue pump”). In this case, parameter P.1495 (“Delay between solenoid and AdBlue pump”) configures the delay between the two commands (the solenoid opens before starting the pump and closes after stopping the pump).

Pump management includes automatic operation and manual controls, accessible from the front panel. Page E.24 (visible only with an output configured for pump control) allows selecting the pump control mode (see 6.5.5.13).

INFORMATION! the pump control mode is a normal parameter of GC600 (P.1490 “AdBlue pump mode”) and therefore you can also change it from programming.

The available operating modes are:

- AUTO: GC600 starts/stops the pump according to the AdBlue level in the daily tank, with a hysteresis band that prevents continuous starts/stops.
- MAN-ON: GC600 stops the pump only when the tank is full. No hysteresis band: as soon as the tank is no longer full, GC600 starts the pump.
- MAN-OFF: GC600 keeps the pump always stopped, even when the tank is empty.

Parameter P.1496 ("Power supply for the AdBlue pump") selects which is the power source of the pump between:

- 0 – Generator.
- 1 – Parallel bars.
- 2 – Users.
- 3 – Mains.
- 4 – Always supplied (the power supply source is always present).

GC600 turns off the pump if the selected source is not available. In OFF/RESET, GC600 always keeps the pump stopped.

GC600 can work both with a contact level detection system and with an analogue measurement.

7.7.14.1 Using an analogue level transducer

To use this feature, GC600 requires that:

- GC600 must acquire the AdBlue fluid level via CAN BUS from the ECU (SPN 1761 - SAE J1939). The ECU must therefore provide this measure.
- Do not configure the contacts for the level (see next paragraph), otherwise GC600 uses those.
- Parameters P.1492 and P.1493 must configure the activation and deactivation thresholds for the pump. Check that the activation threshold (P.1492) is lower than the deactivation threshold (P.1493).

7.7.14.2 Using a contact level transducer

To use this feature, GC600 requires that:

- The contact level transducer must exist.
- The start and stop contacts must exist, and the operator must connect them to two digital inputs of GC600.

The contacts must respect the following convention:

- Pump start command (function DIF.3311): activated when the AdBlue fluid level is below the start threshold.
- Pump stop command (function DIF.3312): activated when the AdBlue fluid level is **below** the stop threshold.

7.7.14.3 Evaluation of the level

GC600 determines the state of the AdBlue fuel level (for the purpose of controlling the pump) by calculating in the order all the following evaluations:

- If the level is below the pump start-up threshold, it assigns the **start** status.
- If the level is higher than the pump stop threshold, it assigns the **stop** status.
- Otherwise, it assigns the **Hysteresis** status.

7.7.14.4 Automatic command of the pump

With reference to the state evaluated in the previous paragraph, GC600:

- Activates the pump if the level position is **start**.
- Deactivates the pump if the position is **stop**.
- Keeps the current command if the position is **Hysteresis**.

7.7.14.5 Manual command of the pump

The operator can activate and deactivate the pump at will. GC600, however, prevents starting if the level status (see previous paragraphs) is **stop**.

7.7.14.6 Protections

Parameter P.1494 allows setting the maximum activation duration of the pump. This parameter should set the time required for the pump to fill the daily tank in the worst conditions. If GC600 cannot fill the daily tank within this time (both in manual and automatic control), it stops the pump and activates the pre-alarm AL.095: it is in fact probable that there is a pump failure or in any case that the pump is not getting AdBlue fluid from the storage tank. As soon as the operator recognized the anomaly, the pump restarts.

7.7.14.7 Signalling

GC600 makes the commands for the pump and the solenoid valve available in two internal states (usable in AND/OR logics):

- ST.139: pump command.

- ST.140: solenoid command.

Furthermore, GC600 records the activations and deactivations of the pump in the historical archive of the events, if bit seven of parameter P.0441 is active:

- EVT.1072: fuel pump activated.
- EVT.1073: fuel pump deactivated.

7.8 Switches management

GC600 can control GCB switch. For systems composed of a single generator (P.0802 <= 4), it is also able to control MCB switch.

On the contrary, it can't control MGCB switch, if any.

Anyway, GC600 accepts that these switches could be controlled by external logics (steadily or temporarily).

Through the P.0854 parameter it is possible to configure the way GC600 must manage the GCB switch:

- 0: the switch is controlled by GC600, and GC600 cannot use synchronization to close it.
- 1: the switch is controlled by GC600, and GC600 can use synchronization to close it
- 2: the switch is controlled by an external device, and GC600 cannot use synchronization to close it.
- 3: the switch is controlled by an external device, and GC600 can use synchronization to close it.

At the same way, through P.0855 parameter, it is possible to configure the way GC600 must manage MCB switch (see previous description).

7.8.1 Digital outputs

Four different commands can be used for the management of the MCB breakers:

- DOF.2001 - "MCB (NC) Under voltage coil". This feature can be used to supply the minimum voltage coil (if any) of the circuit breaker. The controller enables this output when it wants to open the breaker and disables it when it wants to close the breaker: the real closing command will be activated with at least 0.5 seconds after the disabling of this output. A contact which is normally closed will be therefore be used, so that when the controller is not supplied, the minimum voltage coil is enabled, and the breaker can be closed. Should the breaker open without any explicit command from the board (for example due to its protections twitch) it is possible to configure a delay between the breaker opening and the activation of this command (P.0246, for default set to zero): this function is useful for some small size breakers in order to acquire the TRIP contact (which resets immediately as soon as the breaker is commanded in opening).
- DOF.2002 - "MCB opening coil". The controller enables this output when it wants to open the circuit breaker: the output goes back in standby once the circuit breaker feedback indicates that it is open (or when the opening time-out expires).
- DOF.2003 - "MCB closing coil". The controller enables this output when it wants to close the circuit breaker (ensuring that the function DOF.2001 has been active for at least 0.5 seconds): the output goes back in standby once the circuit breaker indicates that it is closed (or when the closing time-out expires, or the synchronism condition no longer exists).
- DOF.2004 - "MCB steady opening command" The board activates this output when it wants to open the switch: (by assuring that the possible DOF.2001 function is active for, at least, 0.5 seconds): the output remains activated even with open switch, too. The controller disables this output when it wants to close the breaker: the output remains disabled even with the breaker closed. Therefore, for the MCB breaker to close with the controller unpowered, the **normally closed** contact must be used. Use this output with the remote-control switches, not with the motorized breakers.

Four different commands can be used to manage GCB breakers:

- DOF.2031 - “GCB Under voltage coil”. This feature can be used to supply the minimum voltage coil (if any) of the circuit breaker. The controller disables this output when it must open the breaker and enables it when it must close the breaker: the real closing command will be activated with at least 0.5 seconds after the enabling of this output. Should the breaker open without any explicit command from the board (for example due to its protections twitch) it is possible to configure a delay between the breaker opening and the de activation of this command (P.0247, for default set to zero): this function is useful for some small size breakers in order to acquire the TRIP contact (which resets immediately as soon as the breaker is commanded in opening).
- DOF.2032 - “GCB opening coil”. The controller enables this output when it wants to open the circuit breaker: the output goes back in standby once the circuit breaker feedback indicates that it is open (or when the opening time-out expires).
- DOF.2033 - “GCB closing coil”. The controller enables this output when it wants to close the circuit breaker (ensuring that the function DOF.2031 has been active for at least 0.5 seconds): the output goes back in standby once the circuit breaker indicates that it is closed (or when the closing time-out expires, or the synchronism condition no longer exists).
- DOF.2034 - “GCB steady closing command”. The controller enables this output when it wants to close the circuit breaker (ensuring that DOF.2031 has been active for at least 0.5 seconds): the output stays active even with circuit breaker closed. The controller disables this output when it must open the breaker: the output remains enabled even with the breaker open. Use this output with the remote-control switches, not with the motorized breakers.

7.8.2 Digital inputs

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

7.8.2.1 Acquiring breakers status

Three functions are available to get the feedback of the switch:

- DIF.3001 - “GCB switch status” Utilize this function to get the feedback of the switch (active input when the switch is closed).
- DIF.3002 - “MCB switch status” Utilize this function to get the feedback of the switch (active input when the switch is closed).
- DIF.3003 - “MCB switch status” Utilize this function to get the feedback of the switch (active input when the switch is closed).

It isn’t always mandatory to connect the feedback of the switches to the board: it depends on the type of system (see the document [10]). If GC600 gets feedbacks, it will use them to:

- Issuing failed opening or failed closing warnings (MCB and GCB).
- For its own operating sequence.
- It is also used to detect the status of the circuit breaker when it is commanded by external devices.
- To show the status of the circuit breakers on the front panel LEDs.

The delay associated to the input (P.2002 for input 1 or equivalent parameter for the other inputs) is used as maximum time for opening or closing the breaker (MCB and GCB).

In theory, for those systems that don’t do the parallel with other gensets or with the mains, the board might also operate without this feedback. In this case, the board considers that the breaker is closed as soon as the closure command is activated; it considers that it is open as soon as the opening command is activated. As a matter of facts, it is always better to connect the feedback.

Through parameter P.0847 it is possible to define if the MCB breaker is supplied by mains voltage. In this case, with mains off, MCB opens, but the board does not activate the relative warning of MCB closure failed.

7.8.2.2 Temporary override of switch controls

It is possible to use some digital inputs to communicate to GC600 that the control of one or both switches is temporarily managed by an external device (even if P.0854 and P.0855 parameters indicate that the switch is controlled by the board):

- DIF.1003 - “GCB controlled externally”.
- DIF.1033 - “MCB 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.

7.8.2.3 Manual controls for the switches

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

- DIF.1001 - “GCB close command”.
- DIF.1002 - “GCB open command”.
- DIF.1031 - “MCB close command”.
- DIF.1032 - “MCB open command”.

7.8.2.4 Request for synchronization

If a switch isn’t controlled by the board, it will be anyway possible to take advantage of the internal synchronization function (see document [10]). When the external logic wants to close a switch and synchronization is required, it will have to ask GC600 for the synchronization, by activating a digital input. The following functions are available to configure the digital input:

- DIF.1004 - “Request for synchronization for GCB”.
- DIF.1034 - “Request for synchronization for MCB”.

For more details refer to the document [10].

7.8.2.5 Forcing MCB to open

A digital input can be configured with the DIF.2503 function (“MCB closure inhibition”). If the controller is in AUTO, TEST or REMOTE START mode, and an input configured with this function is activated, the controller opens the mains circuit breaker (MCB) and keeps it open, **even if the network is present**.

7.8.3 OFF/RESET management logic

In this mode, the board always controls GCB when opening. If MCB is controlled by the controller, it will be controlled when closing. Note: if MCB is configured as “supplied by mains” (P.0847 different from zero) and the mains fails, the board never tries to control the closing of MCB, not even in OFF/RESET mode.

7.8.4 Management logic in MAN

GCB command is activated only if all following conditions are verified:

- If the voltages and the frequency of the genset are in the tolerance bans since a certain time.
- If the engine has been started by the board (the contact for the solenoid fuel valve must be active).
- If there are not alarms, unloads or deactivations.

The document[10]describes in details the logics by which the board allows to open/close the breakers manually (the logics depend on the type of system).

This paragraph, instead, describes haw it is possible to send open/close manual commands of the breakers to the board.

- Using the digits of the board.

MCB button exists only on GC600^{Mains} controllers. For some types of systems (SSB, SSB+SSPT), also GC600 can command the MCB circuit breaker: use the combination of digits SHIFT+GCB to operate on MCB. With MCB button (or SHIFT+GCB), the operator can open/close the MCB breaker. It is always possible to open MCB (if the engine is idle, it is necessary to keep the button pressed for 5 seconds). It is always possible to close MCB: if GCB is closed, the controller activates the synchronization. If it is not possible to use the synchronization, then the operation depends on the bit 3 of parameter P.0495:

- Bit 3 = 1: the controller proceeds to open GCB before closing MCB.
- Bit 3 = 0: the controller does not do anything; the operator must open GCB first, then close MCB.

With GCB button, the operator can open/close the GCB breaker. It is always possible to open GCB. The circuit breaker can be closed, instead, only if the engine is started and if the voltages and the frequency of the genset are “in tolerance”: if MCB is closed, the board activates the synchronization. If it is not possible to use the synchronization, then the operation depends on the bit 3 of parameter P.0495:

- Bit 3 = 1: the controller proceeds to open MCB before closing GCB.
- Bit 3 = 0: the controller does not do anything; the operator must open MCB first, then close GCB.

In case of use of a

- By using the digital inputs of the controller (to connect external buttons that allow the manual opening/closing of the circuit breakers). See paragraph7.8.2.3for the list of the available function.

All these commands work on the passage between “not active” to “active” of the input, not on the “active” steady status. For each breaker it is possible to use both commands or only those in closure. If only the closing command is used, it acts as “toggle”: it commands the breaker opening if it is closed, or its closing if it is open. It is valid what described for MCB and GCB buttons on the previous point.

- Using the commands received from the serial ports. 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:
  - “31” or “32” to open the GCB circuit breaker.
  - “33” to close the GCB circuit breaker.
  - “41” to open the MCB circuit breaker.
  - “43” to close the MCB circuit breaker.

For a detailed sequence relevant to any single type of system, please refer to the document [10].

Warning: the P.0235 parameter determines what happens on the GCB circuit breaker when the operating mode turns from an automatic mode (AUTO, TEST or REMOTE START) to MAN:

- P.0235=0 GCB holds its status.
- P.0235=1 GCB is opened immediately and without performing power discharge.

7.8.5 Management logic in TEST

Starting from version 1.24, the manual control of the circuit breakers is disabled by default in TEST mode (the circuit breakers are therefore managed as described in the next paragraph). To enable them, set bit #3 of parameter P.0249 to “1”.

7.8.6 Switching logic in AUTO mode

The document [10] details the logics by means the controller manages the switches in AUTO, TEST and REMOTE START (anyway logics depend on the kind of system).

7.8.7 Changeover switch.

Only for the SSB type of system (single generator in emergency to mains), the board can control a commutator instead of the switches. To do this, it is enough not to configure any output for the control of MCB (but to configure it as “internally controlled” through P.0855 parameter). Use the “Steadily GCB closure control” (DOF.2034) to control the commutator.

Moreover, it is possible to configure a minimum time span before which it isn't possible (either manually or automatically) to reverse the commutator control (P.0220 “Contactor’s control holding time”). This is useful because if the command is inverted during the movement phase, with some type of power switches it is possible that they lock themselves, and a manual action will be required to unlock them.

7.8.8 Commutation management

If the board controls both MCB and GCB switches, but it cannot use synchronization to close a switch (for any reason), it can always use commutation (if enabled with the bit 3 of parameterP.0495): open the other switch and then close the needed switch. In this case, it is possible to configure the duration of the pause with both switches open, by means of P.0219 parameter (“contactors controls exchange time”).

7.8.9 Events and signalling

The board will record any variation of the control and of the status of the switch in the event archive, if it is enabled respectively through the bits 5 and 6 of P.0441 parameter:

- EVT.1030: GCB close command
- EVT.1031: GCB open command
- EVT.1032: GCB closed.
- EVT.1033: GCB open.
- EVT.1035: MCB close command
- EVT.1036: MCB open command
- EVT.1037: MCB closed.
- EVT.1038: MCB open.

The board makes controls and statuses of the switches available, for AND/OR logics, through the following internal statuses:

- ST.064 - "GCB status"
- ST.065 - "MCB status"
- ST.066 - "MGCB status"
- ST.068 - “GCB steady closing command”.

- ST.069 - “MCB steady closing command”.
- ST.070 - “GCB Under voltage coil command”.
- ST.071 - "Impulse open command for GCB”
- ST.072 - "Impulse close command for GCB”
- ST.073 - “MCB Under voltage coil command”.
- ST.074 - "Impulse open command for MCB”
- ST.075 - "Impulse close command for MCB”

8 Anomalies

This chapter describes all the anomalies managed by the controller. Some of these act as protections for the loads, for the generator or for the engine. There is also signalling of specific events in the plant management. Before describing them in detail, some definitions are required.

We define three typologies of anomaly:

- **Warnings**: these anomalies do not require shutting the engine down. They point out to situations that are not dangerous now, but the operator must take some action because, if ignored, they could degenerate in one of the following categories.
- **Unloads:** these anomalies have features like deactivations (see below). As they do not create problems for the loads and the genset, in parallel operations opening of the power connection is preferably performed after power unloading. This is performed by fast unloading ramp. However, it is not possible to restart the engine until the anomaly has not been acknowledged.
- **Deactivations**: these anomalies require shutting the engine down. They create hazards for the loads but not immediately for the engine. For this reason, the controller opens immediately the GCB breaker (without discharging the power from the generator), then it stops the engine with standard procedure, i.e., with the cooling cycle. However, it is not possible to restart the engine until the anomaly has not been acknowledged.
- **Alarms**: these anomalies require shutting the engine down. They create hazards for the loads and/or for the engine and the generator. For this reason, the controller opens immediately the GCB breaker (without discharging the power from the generator), and stops the engine immediately with standard procedure, i.e., without the cooling cycle. It is not possible to restart the engine until the anomaly is acknowledged.

Up to version 01.09 (but even with higher versions if bit 0 of P.0249 is **not** activated), the controller follows these rules:

- An alarm can be activated only if no other alarms are already active (there are some exceptions to this rule and will be underlined in the rest of the paragraph). Unloads, deactivations and warnings can be present.
- A deactivation can be activated only if no alarms and other deactivations are already active. Whereas, other warnings and other unloads can be present.
- An unload can be activated only if no alarms, deactivations and other unloads are already active. Whereas, other warnings can be present.
- A warning can be activated only if no alarms, deactivations and unloads are already active. Whereas, other warnings can be present.

Starting from version 01.10, if you set the bit 0 of P.0249, the controller doesn’t follow the previous rules; thus, any alarm can always be activated (no matter if other alarms are still activated).

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 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 isn't a warning, it will disconnect the generator from users or from parallel bars (with or without power discharge) and it will stop the engine (with or without cooling cycle).

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”). They 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 unloads, deactivations and 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 a warning is active.

- DOF.4002: the output will be activated if at least an unload is active.
- DOF.4003: the output will be activated if at least a deactivation is active.
- DOF.4004: the output will be activated if at least an alarm is active.
- DOF.4005: the output will be activated if at least a warning or an unload or a deactivation or an alarm are active.
- DOF.4031: the output will be activated if at least an anomaly linked to the generator is active. What follows is the list of anomalies that activate this output:

- 008 (“Operating conditions failure”).
- 099 (“Minimum speed for asynchronous generators”).
- 003 (“Minimum generator frequency”).
- 058 (“Low generator frequency”).
- 060 (“High generator frequency”).
- 004 (“Maximum generator frequency”).
- 001 (“Minimum generator voltage”).
- 056 (“Low generator voltage”).
- 059 (“High generator voltage”).
- 002 (“Maximum generator voltage”).
- 052 (“Generator voltages unbalance”).
- 055 (“Wrong phases sequence”).
- 053 (“Current unbalance rate”).
- 061 (“Lost excitation”).
- 015 (“Maximum current (from contact)”).
- 006 (“Maximum current (from measure)”).
- 016 (“Short-circuit”).

- DOF.4032: the output will be activated if at least an anomaly linked to the engine is active. What follows is the list of anomalies that activate this output:

- 022 (“Over crank”).
- 021 (“Engine not stopped”).
- 005 (“Battery-charger failure (from D+)”).
- 105 (“Battery-charger failure (from CAN-BUS)”).
- 065 (“Low coolant temperature”).
- 031 (“High coolant temperature (from contact)”).
- 032 (“High coolant temperature (from measure)”).
- 132 (“High coolant temperature (from CAN-BUS)”).

- 033 (“Maximum coolant temperature (from contact)”).
- 034 (“Maximum coolant temperature (from measure)”).
- 134 (“Maximum coolant temperature (from CAN-BUS)”).
- 135 (“Minimum coolant level (from CAN-BUS)”).
- 136 (“Low coolant level (from CAN-BUS)”).
- 043 (“Low oil pressure (from contact)”).
- 044 (“Low oil pressure (from measure)”).
- 144 (“Low oil pressure (CAN-BUS)”).
- 041 (“Minimum oil pressure (from contact)”).
- 042 (“Minimum oil pressure (from measure)”).
- 142 (“Minimum oil pressure (from CAN-BUS)”).
- 054 (“High oil temperature (from measure)”).
- 158 (“High oil temperature (from CAN-BUS)”).
- 035 (“Maximum oil temperature (from measure)”).
- 159 (“Maximum oil temperature (from CAN-BUS)”).
- 037 (“Low battery voltage - 1st threshold (from measure)”).
- 137 (“Low battery voltage from CAN BUS”).
- 038 (“High battery voltage - 1st threshold (from measure)”).
- 198 (“Warnings - Yellow lamp (from CAN-BUS)”).
- 199 (“Alarms - Red lamp (from CAN-BUS)”).
- 062 (“CAN-BUS 0 (engine): BUS-OFF.
- 098 (“CAN-BUS 0 (engine): maximum time w/o data”).
- 039 (“Needed maintenance”).
- 040 (“Maintenance required 2”).
- 049 (“Maximum power”).
- 050 (“Maintenance required (from days counter)”)

- DOF.4033: the output will be activated if at least an anomaly linked to the speed control is active. What follows is the list of anomalies that activate this output:

- 018 (“Maximum speed (from measure)”).
- 019 (“Maximum speed (from Hz)”).
- 118 (“Maximum speed (from CAN-BUS)”).
- 099 (“Minimum speed for asynchronous generators”).

- 003 (“Minimum generator frequency”).
- 058 (“Low generator frequency”).
- 060 (“High generator frequency”).
- 004 (“Maximum generator frequency”).
- 011 (“Power reverse”).

- DOF.4034: the output will be activated if at least an anomaly linked to the fuel is active. What follows is the list of anomalies that activate this output:

- 025 (“Minimum fuel level (from contact)”).
- 026 (“Minimum fuel level (from measure)”).
- 027 (“Low fuel level (from contact)”).
- 028 (“Low fuel level (from measure)”).
- 029 (“High fuel level (from contact)”).
- 030 (“High fuel level (from measure)”).
- 160 (“Water in fuel from CAN BUS)”).

- DOF.4035: the output will be activated if at least an anomaly linked to switches is active. What follows is the list of anomalies that activate this output:

- 013 (“MCB not closed”).
- 014 (“GCB not closed”).
- 023 (“MCB not open”).
- 024 (“GCB not open”).

The board makes controls and statuses of the switches available, for AND/OR logics, through the following internal statuses:

- ST.006: the internal status will be activated for a second after a command of faults acknowledgement.
- ST.007: the internal status will be activated for a second after a command of faults reset.
- ST.008: the internal status will be activated if at least a warning is active.
- ST.009: the internal status will be activated if at least an unload is active.
- ST.010: the internal status will be activated if at least a deactivation is active.
- ST.011: the internal status will be activated if at least an alarm is active.
- ST.012: the internal status will be activated if at least a not-recognized warning is active.
- ST.013: the internal status will be activated if at least a not-recognized unload is active.
- ST.014: the internal status will be activated if at least a not-recognized deactivation is active.
- ST.015: the internal status will be activated if at least a not-recognized alarm is active.

8.5 OVERRIDE of protections

WARNING: the use of these functions can cause serious damages to the engine. Mecc Alte cannot be considered anyway liable due to malfunctioning and damages to things and/or people occurred because of the utilization of the OVERRIDE function.

This term defines the capacity of the controller of temporarily disabling (in particular conditions and on specific request) a series of protections. The OVERRIDE function, when is activated, turns a set of alarms, deactivations and unloads into simple “warnings”: in this way, the board indicates, anyway, the presence of problems, but doesn't reduce the supplying capacity of the generator. In some situations, in fact, supply to users is put before the preservation of the engine. You should consider, for example, hospitals: there are situations in which it is preferable to damage the engine, and supply power for the longest period possible, rather than safeguarding the engine, but leaving operating rooms without light.

The board manages three different OVERRIDE requests for protections; all of them can be activated through digital inputs. Use the following functions to configure the digital inputs:

- DIF.2062 (“Engine protections override”).
- DIF.2063 (“Full protections Override”).
- DIF.2064 (“Override of generator protections”).

Each OVERRIDE function turns a specific set of alarms/deactivations/unloads into " warnings". The document [1] has a table indicating all anomalies of the controller: the column “OVER” indicates, for each anomaly, the OVERRIDE functions it is subject. The column includes:

- Letter “F” if the anomaly is subject to total OVERRIDE.
- Letter “E” if the anomaly is subject to engine protections OVERRIDE.
- Letter “G” if the anomaly is subject to generator protections OVERRIDE.

Besides what indicated in the table, the OVERRIDE function also affects "generic" anomalies connected to analogue and digital inputs. The following functions for the configuration of digital inputs activate anomalies that are subject to engine protections OVERRIDE and to total OVERRIDE, too:

- DIF.4012 – “unload (after oil delay)”.
- DIF.4013 – “deactivation (after oil delay)”.
- DIF.4014 – “alarm (after oil delay)”.
- DIF.4062 - “unload (subject to OVERRIDE)”.
- DIF.4063 - “deactivation (subject to OVERRIDE)”.
- DIF.4064 – “alarm (subject to override)”.

As to protections activated through thresholds on analogue measures, it is possible to subject these anomalies to engine protections OVERRIDE (and to total OVERRIDE, too) through the 16 bits of the threshold configuration parameter (P.4005 for the first threshold on the first analogue input).

The board will show a message on “S.01” page when one of these OVERRIDE functions is activated. Warning: engine electronic control units can manage directly OVERRIDE requests. In this case, ECUs do not stop the engine in case of anomalies. They usually indicate the active OVERRIDE status on CAN0CAN-BUS: the controller also displays this OVERRIDE status S.01 page.

The board records an event every time that an OVERRIDE request is activated (EVT.1082). Moreover, it records an event among the records, whenever all OVERRIDE requests cease (EVT.1083).

OVERRIDE activated.

8.6 Anomalies connected to digital inputs

The board manages a significant number of digital input, by taking also the expansion modules (DITEL) that it can manage into account. 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 the controller (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 806 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 (warning, deactivation, unload or alarm) and 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, DIF.4002, DIF.4003, DIF.4004. The board will activate this anomaly if the digital input is uninterruptedly active for the configured (P.2002) time span.
- DIF.4011, DIF.4012, DIF.4013, DIF.4014. The anomaly can be activated only if the engine has been started by the controller, and if it is in motion from, at least, the time span configured in P.0216 (“engine protection masking time”). The board will activate this anomaly if the digital input is uninterruptedly active for the configured (P.2002) time span. The anomaly is subject to the engine protections OVERRIDE and to total OVERRIDE, too (see 8.5).
- DIF.4021, DIF.4022, DIF.4023, DIF.4024. The anomaly can be activated only if GCB switch is closed. The board will activate this anomaly if the digital input is uninterruptedly active for the configured (P.2002) time span.
- DIF.4031, DIF.4032, DIF.4033, DIF.4034. The anomaly can be activated only if the fuel electromagnetic valve is open (FUEL, see 7.7.6). The board will activate this anomaly if the digital input is uninterruptedly active for the configured (P.2002) time span.
- DIF.4041, DIF.4042, DIF.4043, DIF.4044. The anomaly can be activated only if the GAS electromagnetic valve is open (GAS, see 7.7.6). The board will activate this anomaly if the digital input is uninterruptedly active for the configured (P.2002) time span.
- DIF.4051, DIF.4052, DIF.4053, DIF.4054. The board will activate this anomaly if the digital input is uninterruptedly active for the configured (P.2002) time span. The anomaly activation causes the stopping of the fuel pump (see 9.1).
- DIF.4062, DIF.4063, DIF.4064. The board will activate this anomaly if the digital input is uninterruptedly active for the configured (P.2002) time span. The anomaly is subject to the engine protections OVERRIDE and to total OVERRIDE, too (see 8.5).

8.7 Anomalies connected to analogue inputs

The board can manage a high number of analogue inputs, also considering those acquired by DIGRIN, DITHERM and DIVIT expansion modules.

For each analogue input, the controller 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, the operator should configure the error message that will be shown on the board display when the anomaly is activated. It must 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 5.8.4.

Warning: by setting the delay to "0", the anomaly isn't disabled.

8.8 Fault 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 configured input.

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

- Enabling an anomaly means that the minimum necessary conditions verify for the controller to observe the provoking cause.
- Activating an anomaly means the verification of the provoking cause, after the enabling has happened.

8.8.1 01 – Minimum generator voltage (27<<)

Type: **Deactivation**

Parameters connected:
P.0101 Number of phases of the generator
P.0102 Generator rated voltage
P.0301 Minimum voltage threshold
P.0302 Minimum voltage delay
P.0328 Enables the verifications also on the phase voltages.

To disable: **P.0302=0**

Enabled in: **MAN*, AUTO, TEST, REMOTE START**

The protection is enabled only with started engine (active FUEL control) and after the genset voltage and frequency have been seen “in tolerance”. It is disabled during the starting and stopping phase of the engine. In MAN it is enabled only if the GCB breaker is closed.

It will be activated if at least one of the generator voltages goes under P.0301threshold (percentage of P.0102) uninterruptedly for P.0302time span.

For three-phase systems, the protection normally works on the phase-to-phase voltages: setting P.0328 to 1 the protection considers also the phase voltages.

* In **MAN** it is only enabled if the GCB breaker is closed or if the bit 2 of parameter P.0249 is set to "1".

This protection acts on the digital outputs configured with the DOF.3190 and DOF.3191 functions.

8.8.2 02 – Maximum generator voltage (59>>)

Type: **Alarm**

Parameters connected: **P.0101** Number of phases of the generator
P.0102 Generator rated voltage
P.0303 Maximum voltage threshold
P.0304 Maximum voltage delay
P.0328 Enables the verifications also on the phase voltages.

To disable: **P.0304=0**

Enabled in: **MAN, AUTO, TEST, REMOTE START**

The protection is enabled only when engine running (FUEL command active). It is disabled during the starting and stopping phase of the engine.

It is enabled if at least one of the generator voltages goes over the threshold P.0303 (percentage of P.0102) continuously for the time P.0304.

For three-phase systems, the protection normally works on the phase-to-phase voltages: setting P.0328 to 1 the protection considers also the phase voltages.

This protection acts on the digital outputs configured with the DOF.3190 and DOF.3191 functions.

8.8.3 03 – Minimum generator frequency (81<<)

Type: **Deactivation**

Parameters connected: **P.0105** Rated frequency
P.0305 Minimum frequency threshold
P.0306 Minimum frequency delay

To disable: **P.0306=0**

Enabled in: **MAN*, AUTO, TEST, REMOTE START**

The protection is enabled only with started engine (active FUEL control) and after the genset voltage and frequency have been seen “in tolerance”. It is disabled during the starting and stopping phase of the engine. In MAN it is enabled only if the GCB breaker is closed.

It will be activated if generator frequency goes below P.0305 threshold (percentage of P.0105) uninterruptedly for P.0306 timespan.

* In **MAN** it is only enabled if the GCB breaker is closed or if the bit 2 of parameter P.0249 is set to "1".

This protection acts on the digital outputs configured with the DOF.3190 and DOF.3191 functions.

8.8.4 04 – Maximum generator frequency (81>>)

Type: **Alarm**

Parameters connected: **P.0105** Rated frequency
P.0307 Maximum frequency threshold
P.0308 Maximum frequency delay

To disable: **P.0308=0**

Enabled in: **MAN, AUTO, TEST, REMOTE START**

The protection is enabled only when engine running (FUEL command active).

It is disabled during the starting and stopping phase of the engine.

It activates if the generator frequency exceeds threshold P.0307 (percentage di P.0105) continuously for time P.0308.

This protection acts on the digital outputs configured with the DOF.3190 and DOF.3191 functions.

8.8.5 05 - Belt break (battery-charger failure).

Type: **Configurable (Alarm/Warning)**

Parameters connected: **P.4123** Function for analogue input (D+)
P.0230 Threshold for stopped engine (+D)
P.0231 Threshold for running engine (+D)
P.0349 Delay for belt break
P.0357 Action for belt break

To disable: **P.0349=0**

Enabled in: **MAN, AUTO, TEST, REMOTE START**

The protection is enabled only when engine running (FUEL command active). It is disabled during the starting and stopping phase of the engine. It is enabled only if the analogue input 7 is used to receive the signal +D (AIF.1300 function in P.4123parameter) and if both P.0230 and P.0231 thresholds are different from zero (the identification of started engine is enabled by the signal +D).

It will be activated if the voltage of the signal +D remains lower than P.0230threshold, uninterruptedly for P.0349time span. The type of anomaly can be configured through P.0357 parameter.

8.8.6 06 – Maximum current (51)

Type: **Configurable**

Parameters connected: **P.0101** Number of generator phases
P.0102 Generator rated voltage
P.0106 Generator rated output
P.0309 Maximum current threshold
P.0310 Maximum current delay
P.0323 Action on maximum current / short circuit
P.0324 Protections enabling 50V-51V

To disable: **P.0310=0**

Enabled in: **MAN, AUTO, TEST, REMOTE START**

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. It is a generator protection as it limits the thermal accumulation

of the generator during the supply phase. As engine protection, the maximum power protection must be used, that is independent from the load type.

A maximum current threshold and the maximum time the generator 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. To correctly set the thresholds, perform the following steps:

- Define the system rated current (see7.4.1).
- Set the maximum current threshold with the parameter P.0309, as a percentage of the rated current.
- Set the action time in the parameter P.0310: the protection will be activated within time set if the current is constantly equal to the threshold P.0309 multiplied by $\sqrt{2}$.

To calculate the intervention time for a preferred current, please use the following formula (according to EN60255-151):

$$t_1 = P.0310 \frac{k}{\left(\frac{I}{P.0309}\right)^a - 1} + c$$

with the constants k=1, c=0 and a=2 the equation changes to the following:

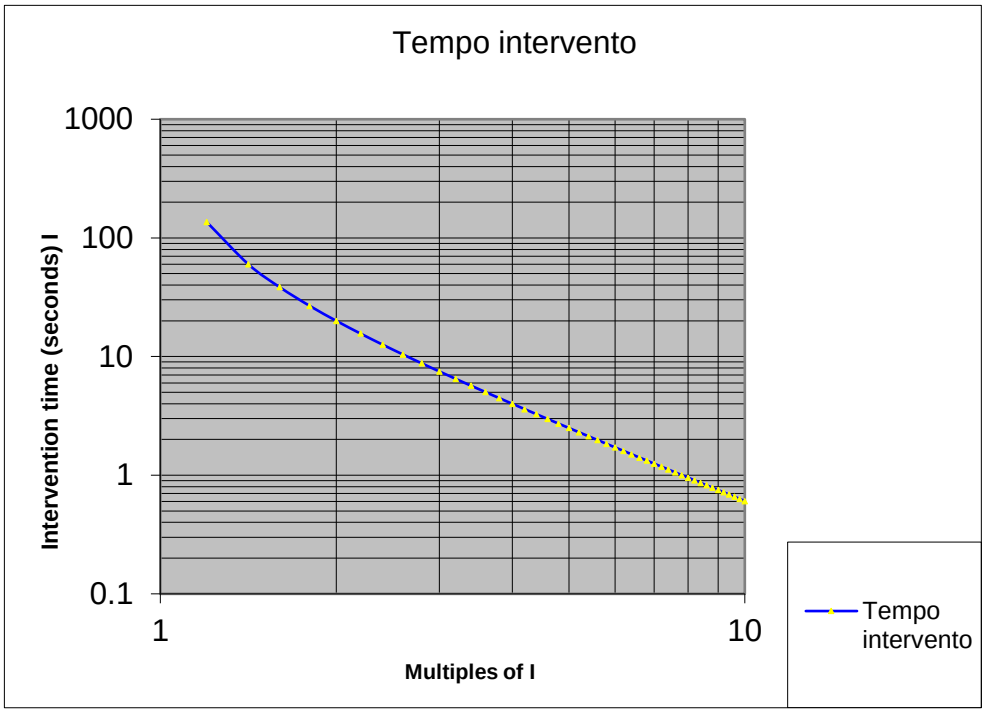
$$t_1 = \frac{P.0310}{\left(\frac{I}{P.0309}\right)^2 - 1}$$

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.0310 set to 60 seconds (I is the maximum current):

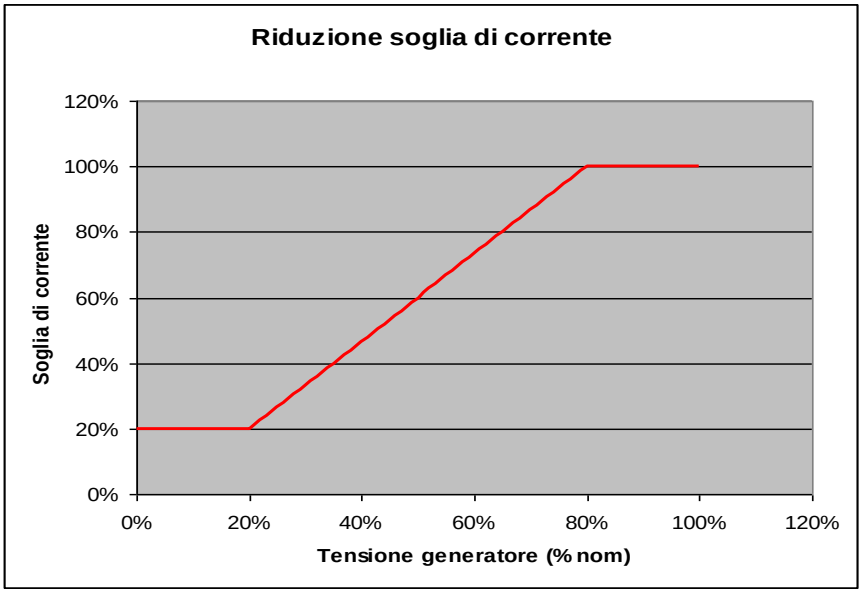
The protection is enabled only when the engine running command (FUEL active). It is disabled during the starting and stopping phase of the engine.



The type of anomaly can be configured through P.0323 parameter.

By utilizing P.0324 parameter, it is possible to convert this protection into 51V protection (values 2 or 3 in P.0324). The 51V protection differs from 51 “normal” protection for the fact that the threshold set with P.0309 is automatically reduced when the generator voltage decreases. In detail:

- If the generator voltage is higher than 80% the rated, the current threshold remains the one set.
- If the generator voltage is less or equal to 20% of the rated, the current threshold becomes 20% of the one set.
- If the generator voltage is between 20% and 80% of the rated, the current threshold is reduced in percentage.



This protection acts on the digital outputs configured with the DOF.3190 and DOF.3191 functions.

8.8.7 07 – Manual stop while in AUTO

Type: **Alarm**

Parameters connected: **P.0495** Keyboard options

To disable: **Bit 0 of P.0495=1**

Enabled in: **AUTO, TEST, REMOTE START**

The protection is enabled if bit 0 of parameter P.0495 is set to 0. It will be activated if, in AUTO, TEST and REMOTE START modes the operator presses the STOP key on the panel or if the board receives the stop control from the serial ports or through the SMS control.

8.8.8 08 – Operating conditions failure

Type: **Alarm**

Parameters connected: **P.0217** Maximum time for full speed conditions

To disable: **P.0217=0**

Enabled in: **AUTO, TEST, REMOTE START**

It is activated when the generator voltages and frequency are not steady within tolerance range within time P.0217 from the engine running acknowledgement (or from the end of the engine's idle cycle, if enabled).

8.8.9 11 – Power reverse (32)

Type: **Alarm**

Parameters connected: **P.0125** Engine rated output
P.0313 Power reverse threshold
P.0314 Power reverse delay

To disable: **P.0314=0**

Enabled in: **MAN, AUTO, TEST, REMOTE START**

The protection is enabled only when engine running (FUEL command active). It is disabled during the starting and stopping phase of the engine. It is disabled if currents aren't associated to the generator (current transformers on users and GCB switch open).

It activates if, in the previous conditions, the system total active power is negative and has an absolute value continuously above threshold P.0313, (percentage P.0125) for time P.0314.

This protection acts on the digital outputs configured with the DOF.3190 and DOF.3191 functions.

8.8.10 13 – Mains circuit breaker (MCB) not closed

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, TEST, REMOTE START**

The protection will be enabled if the board receives the feedback from MCB switch (DIF.3002 function in P.2001 parameter or equivalent) and if the delay associated to the input is different from 0 (P.2002 or equivalent). Note: for the systems in parallel with the mains it is mandatory that the board receives the feedback of the switch; in these cases, it isn't possible to disable the warning by setting the delay to zero (the board uses a 2-second delay when set to "0").

The board activates the protection when it controls the closing of GCB 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). Refer to document [10] for the description of the function that allows starting the generator when this anomaly is activated (function linked to the value of P.0221 parameter): if this function is enabled, the controller activates the warning after only one attempt of closure of the circuit breaker.

Note: this anomaly can be activated also with an already active alarm.

8.8.11 14 – Genset circuit breaker (GCB) not closed

Type: **Deactivation/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, TEST, REMOTE START**

The protection will be enabled if the board receives the feedback from GCB 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). Note: for parallel systems it is mandatory that the board receives the feedback of the switch; in these cases, it isn't possible to disable the anomaly by setting the delay to zero (the board uses a 2-second delay when set to “0”).

The board activates the protection when it controls the closing of GCB 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 a warning, in the other modes it activates a deactivation.

Note: this anomaly can be activated also with an already active alarm.

8.8.12 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, TEST, REMOTE START**

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).

8.8.13 16 – Short circuit on the generator (50)

Type: **Configurable (Alarm/Deactivation)**

Parameters connected: **P.0101** Number of generator phases
P.0102 Generator rated voltage
P.0106 Generator rated output
P.0311 Short circuit threshold
P.0312 Short circuit delay
P.0323 Action on maximum current/short circuit
P.0324 Protections enabling 50V-51V

To disable: **P.0312=0**

Enabled in: **MAN, AUTO, TEST, REMOTE START**

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.0311 threshold, indicated as percentage of the system rated current (see 7.4.1for the determination of the rated current from P.0101, P.0102 and P.0106 parameters).

The protection is enabled only when engine running (FUEL command active). It is disabled during the starting and stopping phase of the engine.

It activates when the current on at least one phase remains continuously above the P.0311 threshold for time P.0312. The type of anomaly can be configured through P.0323 parameter.

By utilizing P.0324 parameter, it is possible to convert this protection into 50V protection (values 1 or 3 in P.0324). The 50V protection differs from 50 “normal” protection for the fact that the threshold set with P.0311 is automatically reduced when the generator voltage decreases. In detail:

- If the generator voltage is higher than 80% the rated, the current threshold remains the one set.
- If the generator voltage is less or equal to 20% of the rated, the current threshold becomes 20% of the one set.
- If the generator 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)”.

This protection acts on the digital outputs configured with the DOF.3190 and DOF.3191 functions.

8.8.14 17 – Maximum speed (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, TEST, REMOTE START**

The protection is always enabled. It is disabled during the starting phase of the engine.

It will be activated if the input that receives the external contact (DIF.4251 function in P.2001 parameter or equivalent) remains active uninterruptedly for the configured time span (P.2002 or equivalent).

Note: this anomaly can be activated also with an already active alarm.

8.8.15 18 – Maximum speed (12, from rotation speed)

Type: **Alarm**

Parameters connected: **P.0110** Number of teeth of the Pick-up wheel
P.0111 Rpm/W ratio
P.0127 Rpm/Hz ratio
P.0133 Engine rating (Primary)
P.0134 Engine rating (Secondary)
P.0333 Maximum speed threshold (Pick-up/W) (%)
P.0334 Maximum speed delay (Pick-up/W).
P.0700 Engine type

To disable: **P.0334=0**

Enabled in: **MAN, AUTO, TEST, REMOTE START**

The protection will be enabled if the board gets the rotation speed of the engine (see 7.6.3). The protection is disabled during the starting phase of the engine.

It will be activated if the acquired speed is higher than P.0333 threshold (percentage of P.0133 or P.0134 rated speed, see 7.7.2)uninterruptedly for P.0334 timespan.

Note: this anomaly can be activated also with an already active alarm.

8.8.16 19 – Maximum speed (12, from generator frequency)

Type: **Alarm**

Parameters connected: **P.0105** Rated frequency (Hz)
P.0331 Maximum speed threshold (frequency) (expressed in %)
P.0332 Maximum speed delay (frequency)

To disable: **P.0332=0**

Enabled in: **MAN, AUTO, TEST, REMOTE START**

The protection is always enabled. It is disabled during the starting phase of the engine.

It will be activated if the measured frequency stays above P.0331 threshold (percentage of P.0105) uninterruptedly for P.0332 timespan.

Note: this anomaly can be activated also with an already active alarm.

8.8.17 21 – Engine not stopped.

Type: **Alarm**

Parameters connected: **P.0214 Duration of stopping cycle(s)**

To disable: **P.0214=0**

Enabled in: **AUTO, TEST, REMOTE START**

The protection is always enabled.

It be activated if, following to a stop control, the engine doesn't stop within the time span configured in P.0214 (from the stop control).

Note: this anomaly can be activated also with an already active alarm.

8.8.18 22 – Over crank

Type: **Alarm**

Parameters connected: **P.0211 Number of crank attempts**

To disable: **-**

Enabled in: **AUTO, TEST, REMOTE START**

The protection is always enabled.

It will be activated if, following to a request for starting, the engine hasn't started after P.0211 consecutive starting attempts (for every battery set).

8.8.19 23 – Mains circuit breaker (MCB) not open

Type: **Deactivation/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, TEST, REMOTE START**

The protection will be enabled if the board receives the feedback from MCB switch (DIF.3002 function in P.2001 parameter or equivalent) and if the delay associated to the input is different from 0 (P.2002 or equivalent). Note: for the systems in parallel with the mains it is mandatory that the board receives the feedback of the switch; in these cases, it isn't possible to disable the warning by setting the delay to zero (the board uses a 2-second delay when set to “0”).

The board activates the protection when it controls the opening of MCB 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).

Usually the board activates a warning; in the following conditions it activates a deactivation:

- In AUTO, when the stable command for MCB closing is used (DOF.2004 in one of the digital outputs).

- For the systems that not provide for the continuative parallel with the mains (see document [10]).

Note: this anomaly can be activated also with an already active alarm.

8.8.20 24 – Genset circuit breaker (GCB) not open

Type: **Alarm/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, TEST, REMOTE START**

The protection will be enabled if the board receives the feedback from GCB 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). Note: for parallel systems it is mandatory that the board receives the feedback of the switch; in these cases, it isn't possible to disable the anomaly by setting the delay to zero (the board uses a 2-second delay when set to "0").

The board activates the protection when it controls the opening of GCB 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).

Usually the board activates a warning; in the following conditions it activates an alarm:

- In AUTO, when the stable command for MCB closing is used (DOF.2034 in one of the digital outputs).

Note: P.0243 parameter ("enable supplying due to failure to open GCB") allows to keep the generator in motion (with GCB switch closed) when this warning is activated (P.0243=1). It should be avoided, stopping the generator because:

- If it were in parallel with another electric source, it would be dragged by this source.
- If it were supplying stand alone on a charge, stopping it with closed GCB would mean to supply the charge with out-of-tolerance voltages/frequency.

It is possible to keep the generation in motion only if there aren't alarms, deactivations or unloads.

Note: this anomaly can be activated also with an already active alarm.

Note: parameter P.0251 ("Enable the opening of MCB for GCB closed and engine not running") allows you to enable or disable the opening of the MCB circuit breaker if the GCB circuit breaker is not opened and the engine must be stopped (alarms/deactivations/unloads, controller in OFF/RESET mode, etc.). Obviously, it makes sense for systems that support parallel to the grid (even transitory).

- 0: with this value the loads are safeguarded. If the GCB fails to open due to alarms (therefore with the engine stopping/stopped), the **engine will be dragged by the mains**. This is the default value for the parameter.
- 1: with this value the generator is safeguarded. If the GCB fails to open due to alarms (therefore with the engine stopping/stopped), the controller opens MCB, preventing the mains from dragging the engine. **The loads, however, are not supplied**.

8.8.21 25 – Minimum fuel level (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, TEST, REMOTE START**

The protection is always enabled.

It will be activated if the input that receives the external contact (DIF.4211 function in P.2001 parameter or equivalent) remains active uninterruptedly for the configured time span (P.2002 or equivalent).

8.8.22 26 – Minimum fuel level (from analogue sensor)

Type: **Alarm**

Parameters connected: **P.4001** Input function 1 or equivalent for other inputs.
P.0347 Fuel level minimum threshold (%)
P.0348 Fuel level minimum delay

To disable: **P.0348=0**

Enabled in: **MAN, AUTO, TEST, REMOTE START**

The protection will be enabled if the board gets the fuel level measure (AIF.1220or AIF.1221functions in P.4001parameter or equivalent ones).

It will be activated if the received measure stays below P.0347 threshold, uninterruptedly for P.0348 time.

8.8.23 27 – Low fuel level (from contact)

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, TEST, REMOTE START**

The protection is always enabled.

It will be activated if the input that receives the external contact (DIF.4212 function in P.2001 parameter or equivalent) remains active uninterruptedly for the configured time span (P.2002 or equivalent).

8.8.24 28 – Low fuel level (from analogue sensor)

Type: **Warning**

Parameters connected: **P.4001** Input function 1 or equivalent for other inputs.
P.0345 Fuel minimum level threshold (%)
P.0346 Fuel level minimum delay

To disable: **P.0346=0**

Enabled in: **MAN, AUTO, TEST, REMOTE START**

The protection will be enabled if the board gets the fuel level measure (AIF.1220 or AIF.1221 functions in P.4001 parameter or equivalent ones).

It will be activated if the received measure stays below P.0345 threshold, uninterruptedly for P.0346 timespan.

8.8.25 29 – High fuel level (from contact)

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, TEST, REMOTE START**

The protection is always enabled.

It will be activated if the input that receives the external contact (DIF.4213 function in P.2001 parameter or equivalent) remains active uninterruptedly for the configured time span (P.2002 or equivalent).

8.8.26 30 – High fuel level (from analogue sensor)

Type: **Warning**

Parameters connected: **P.4001** Input function 1 or equivalent for other inputs.
P.0343 Fuel minimum level threshold (%)
P.0344 Fuel level minimum delay

To disable: **P.0344=0**

Enabled in: **MAN, AUTO, TEST, REMOTE START**

The protection will be enabled if the board gets the fuel level measure (AIF.1220 or AIF.1221 functions in P.4001 parameter or equivalent ones).

It will be activated if the received measure stays above P.0343threshold, uninterruptedly for P.0344time span.

8.8.27 31 – High coolant temperature (from contact)

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.
P.0216 Engine protections mask time

To disable: **P.2002=0**

Enabled in: **MAN, AUTO, TEST, REMOTE START**

The protection is enabled after P.0216 ("engine protection masking time") from the starting of the engine. This protection is disabled in the engine start/arrest phases.

It will be enabled if, according to the previous conditions, the input that acquires the external contact (DIF.4231 function in P.2001 parameter or equivalent ones) remains active, uninterruptedly for the configured time span (P.2002 or equivalent ones).

8.8.28 32 – High coolant temperature (from analogue sensor)

Type: **Warning**

Parameters connected: **P.4001** Input function 1 or equivalent for other inputs.
P.0216 Engine protections mask time
P.0335 High coolant temperature threshold
P.0336 High coolant temperature delay
P.0700 Engine type

To disable: **P.0336=0**

Enabled in: **MAN, AUTO, TEST, REMOTE START**

The protection will be enabled only if the board acquires the coolant temperature measure (see 7.7.4) (it is necessary to let the engine start void to let it cool down). The protection is enabled after P.0216 ("engine protection masking time") from the starting of the engine. This protection is disabled in the engine start/arrest phases.

It will be enabled if, according to the previous conditions, the temperature measure stays above P.0335 threshold uninterruptedly for P.0336 timespan.

8.8.29 33 – Maximum coolant temperature (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.
P.0216 Engine protections mask time

To disable: **P.2002=0**

Enabled in: **MAN, AUTO, TEST, REMOTE START**

The protection is enabled after P.0216 ("engine protection masking time") from the starting of the engine. This protection is disabled in the engine start/arrest phases.

It will be enabled if, according to the previous conditions, the input that acquires the external contact (DIF.4232 function in P.2001 parameter or equivalent ones) remains active, uninterruptedly for the configured time span (P.2002 or equivalent ones).

8.8.30 34 – Maximum coolant temperature (analogue sensor)

Type: **Alarm/Warning**

Parameters connected: **P.4001** Input function 1 or equivalent for other inputs.
P.0216 Engine protections mask time
P.0337 Maximum coolant temperature threshold
P.0338 Maximum coolant temperature delay
P.0700 Engine type

To disable: **P.0338=0**

Enabled in: **MAN, AUTO, TEST, REMOTE START**

The protection will be enabled only if the board acquires the coolant temperature measure (see 7.7.4). The protection is enabled after P.0216 (“engine protection masking time”) from the starting of the engine: it is necessary to let the engine start void to let it cool down. This protection is disabled in the engine start/arrest phases.

It will be enabled if, according to the previous conditions, the temperature measure stays above P.0337 threshold uninterruptedly for P.0338 timespan.

8.8.31 35 - Maximum oil temperature (analogue sensor)

Type: **Alarm**

Parameters connected: **P.4001** Input function 1 or equivalent for other inputs.
P.0216 Engine protections mask time
P.0375 Maximum oil temperature threshold
P.0376 Maximum oil temperature delay
P.0700 Engine type

To disable: **P.0376=0**

Enabled in: **MAN, AUTO, TEST, REMOTE START**

The protection will be enabled if the board acquires the lubricating oil temperature measure (see 7.7.4). The protection is enabled after P.0216 (“engine protection masking time”) from the starting of the engine: it is necessary to let the engine start void to let it cool down. This protection is disabled in the engine start/arrest phases.

It will be activated if, according to the previous conditions, the lubricating oil temperature measure stays above P.0375 threshold uninterruptedly for P.0376 timespan.

8.8.32 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, TEST, REMOTE START**

The protection is always enabled. It is disabled when the starter motor is activated.

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.

8.8.33 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, TEST, REMOTE START**

The protection is always enabled. It is disabled when the starter motor is activated.

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.

8.8.34 39 – Service required (first counter)

Type: **Configurable (Warning/Alarm/Deactivation)**

Parameters connected: **P.0424** Pause for maintenance 1
P.0425 Type of action for maintenance 1

To disable: **P.0424=0**

Enabled in: **MAN, AUTO, TEST, REMOTE START**

The protection is always enabled.

It activates after P.0424 engine running hours since last parameter P.0424 setting. Note: engine operating hours are counted even when engine is not started by the controller. It isn't possible to reset the anomaly by cutting off the supply to the board.

To deactivate it, it is necessary to set P.0424 parameter again, by setting it to zero for disabling the function or by confirming the present value or by setting a different one. P.0424 and P.0425 parameters need the “installer’s” access level for their programming: so, this function can be used by freighter of generators when entering into contract by the hour, to be able to stop the engine when agreed hours have elapsed. The anomaly type can be set with parameter P.0425

8.8.35 40 – Service required (second counter)

Type: **Configurable (Warning/Alarm/Deactivation)**

Parameters connected: **P.0436** Pause for maintenance 2
P.0437 Type of action for maintenance 2

To disable: **P.0436=0**

Enabled in: **MAN, AUTO, TEST, REMOTE START**

The protection is always enabled.

It activates after P.0436 engine running hours since last parameter P.0436 setting. Note: engine operating hours are counted even when engine is not started by the controller. It isn't possible to reset the anomaly by cutting off the supply to the board.

To deactivate it, it is necessary to set P.0436 parameter again, by setting it to zero for disabling the function or by confirming the present value or by setting a different one. P.0436 and P.0437 parameters need the “installer’s” access level for their programming: so, this function can be used by freighter of generators when entering into contract by the hour, to be able to stop the engine when agreed hours have elapsed. The anomaly type can be set with parameter P.0437

8.8.36 41 – Minimum oil pressure (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.
P.0216 Engine protections mask time

To disable: **P.2002=0**

Enabled in: **MAN, AUTO, TEST, REMOTE START**

The protection is enabled after P.0216 (“engine protection masking time”) from the starting of the engine: it is necessary to ignore the normal status of low pressure at the starting. This protection is disabled in the engine start/arrest phases.

It will be enabled if, according to the previous conditions, the input that acquires the external contact (DIF.4221 function in P.2001 parameter or equivalent ones) remains active, uninterruptedly for the configured time span (P.2002 or equivalent ones).

8.8.37 42 – Minimum oil pressure (from analogue sensor)

Type: **Alarm**

Parameters connected: **P.4001** Input function 1 or equivalent for other inputs.
P.0216 Engine protections mask time
P.0341 Oil pressure minimum threshold
P.0342 Minimum oil pressure delay
P.0700 Engine type

To disable: **P.0342=0**

Enabled in: **MAN, AUTO, TEST, REMOTE START**

The protection will be enabled if the board acquires the lubricating oil pressure measure (see 7.7.4). The protection is enabled after P.0216 (“engine protection masking time”) from the starting of the engine: it is necessary to ignore the normal status of low pressure at the starting. This protection is disabled in the engine start/arrest phases.

It will be enabled if, according to the previous conditions, the measure of pressure stays under P.0341 threshold uninterruptedly for P.0342 timespan.

8.8.38 43 – Low oil pressure (from contact)

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.
P.0216 Engine protections mask time

To disable: **P.2002=0**

Enabled in: **MAN, AUTO, TEST, REMOTE START**

The protection is enabled after P.0216 (“engine protection masking time”) from the starting of the engine: it is necessary to ignore the normal status of low pressure at the starting. This protection is disabled in the engine start/arrest phases.

It will be enabled if, according to the previous conditions, the input that acquires the external contact (DIF.4222 function in P.2001 parameter or equivalent ones) remains active, uninterruptedly for the configured time span (P.2002 or equivalent ones).

8.8.39 44 – Low oil pressure (from analogue sensor)

Type: **Warning**

Parameters connected: **P.4001** Input function 1 or equivalent for other inputs.
P.0216 Engine protections mask time
P.0339 Low oil pressure threshold
P.0340 Low oil pressure delay
P.0700 Engine type

To disable: **P.0340=0**

Enabled in: **MAN, AUTO, TEST, REMOTE START**

The protection will be enabled if the board acquires the lubricating oil pressure measure (see 7.7.4). The protection is enabled after P.0216 (“engine protection masking time”) from the starting of the engine: it is necessary to ignore the normal status of low pressure at the starting. This protection is disabled in the engine start/arrest phases.

It will be enabled if, according to the previous conditions, the measure of pressure stays under P.0339 threshold uninterruptedly for P.0340 timespan.

8.8.40 45 – Maximum auxiliary current

Type: **Alarm**

Parameters connected: **P.0109** Transformer type.
P.0130 Connection of transformer or toroid.
P.0108 Primary of transformer or of toroid.
P.0135 Secondary of transformer or of toroid.
P.0131 Auxiliary current use
P.0367 Threshold for auxiliary/differential current
P.0368 Delay for auxiliary/differential current

To disable: **P.0368=0**

Enabled in: **MAN, AUTO, TEST, REMOTE START**

The protection will be enabled if a valid current measure is configured. Both P.0108 and P.0109 should be different from zero, and P.0131 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 timespan.

This protection acts on the digital outputs configured with the DOF.3190 and DOF.3191 functions.

8.8.41 48 – Emergency stop

Type: **Alarm**

Parameters connected: **P.0361 Emergency stop delay**

To disable: -

Enabled in: **MAN, AUTO, TEST, REMOTE START**

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.

8.8.42 49 – Maximum power

Type: **Configurable (Warning/Alarm/Deactivation)**

Parameters connected: **P.0350** Maximum power threshold
P.0351 Maximum power delay
P.0352 Maximum power action

To disable: **P.0351=0**

Enabled in: **MAN, AUTO, TEST, REMOTE START**

The protection is enabled only when engine running (FUEL command active). It is disabled during the starting and stopping phase of the engine.

It will be activated if the measure of currents is connected to the generator (current transformer on the generator, or on users, but with closed GCB switch), and if the total active power has positive sign and is higher than P.0350 threshold (percentage of P.0125) uninterruptedly for P.0351 timespan. The type of anomaly can be configured through P.0352 parameter.

This protection acts on the digital outputs configured with the DOF.3190 and DOF.3191 functions.

8.8.43 50 - Maintenance required (days counter)

Type: **Warning**

Parameters connected: **P.0438** Interval days for maintenance

To disable: **P.0438=0**

Enabled in: **MAN, AUTO, TEST, REMOTE START**

The protection is always enabled.

It activates at 8.00 am after P.0438 have passed since when it had been set parameter P.0438 last time. Note: the days are counted also if the engine has not been started by the controller. It isn't possible to reset the anomaly by cutting off the supply to the board.

To deactivate it, it is necessary to set P.0438 parameter again, by setting it to zero for disabling the function or by confirming the present value or by setting a different one. Parameter P.0438 requires the “installer” access level for the programming.

8.8.44 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, TEST, REMOTE START**

The protection is always enabled.

It activates if the internal controller temperature is over the threshold P.0366, even for an instant.

8.8.45 52 – Generator voltages unbalance

Type: **Alarm**

Parameters connected: **P.0101** Generator number of phases
P.0102 Rated generator voltage
P.0315 Voltages unbalance threshold
P.0316 Voltages unbalance delay
P.0328 Enables verifications also on phase voltages.

To disable: **P.0316=0**

Enabled in: **MAN, AUTO, TEST, REMOTE START**

The protection is enabled only when engine running (FUEL command active). It is disabled during the starting and stopping phase of the engine. It is enabled only for three-phase systems (P.0101 = 3) and only if the genset voltages and the frequency are in tolerance (outright).

It activates if the difference between two phase-to-phase voltages (absolute value) is continuously over the threshold P.0315 (percentage if P.0102) continuously for a time of P.0316. By setting P.0328 to 1, the protection considers also the unbalance of the phase voltages.

This protection acts on the digital outputs configured with the DOF.3190 and DOF.3191 functions.

8.8.46 53 – Generator current unbalance

Type: **Alarm**

Parameters connected: **P.0101** Generator number of phases
P.0102 Rated generator voltage.
P.0106 Voltages unbalance threshold
P.0317 Voltages unbalance delay
P.0318 Current unbalance delay

To disable: **P.0318=0**

Enabled in: **MAN, AUTO, TEST, REMOTE START**

The protection is enabled only when engine running (FUEL command active). It is disabled during the starting and stopping phase of the engine. It is enabled only for three-phase systems (P.0101 = 3) and only if the currents are associated to the generator (current transformer on the generator, or on users, but with closed GCB switch).

The protection activates if the difference between any two currents (absolute value) is continuously over the threshold P.0317 for time P.0318. P.0317 threshold is expressed in percentage with reference to rated current: see 7.4.1 for the determination of rated current from P.0101, P.0102 and P.0106 parameters.

This protection acts on the digital outputs configured with the DOF.3190 and DOF.3191 functions.

8.8.47 54 – High fuel level (from analogue sensor)

Type: **Warning**

Parameters connected: **P.4001** Input function 1 or equivalent for other inputs.
P.0216 Engine protections mask time
P.0373 High oil temperature threshold
P.0374 High oil temperature delay
P.0700 Engine type

To disable: **P.0374=0**

Enabled in: **MAN, AUTO, TEST, REMOTE START**

The protection will be enabled if the board acquires the lubricating oil temperature measure (see 7.7.4). The protection is enabled after P.0216 (“engine protection masking time”) from the starting of the engine: it is necessary to let the engine start void to let it cool down. This protection is disabled in the engine start/arrest phases.

It will be enabled if, according to the previous conditions, the temperature measure stays above P.0373 threshold uninterruptedly for P.0374 timespan.

8.8.48 55 – Wrong phases sequence

Type: **Configurable (Warning/Alarm/Deactivation)**

Parameters connected: **P.0101** Number of generator phases
P.0319 Generator phases sequence (required)
P.0320 Wrong generator phases sequence action

To disable: **P.0319=0**

Enabled in: **MAN, AUTO, TEST, REMOTE START**

The protection is enabled only when engine running (FUEL command active). It is disabled during the starting and stopping phase of the engine. It is enabled only for three-phase systems (P.0101 = 3) and only if generator voltages and frequency are within tolerance. It is enabled only if GCB switch is open.

It starts when the direction of rotation of generator phases doesn't match with the one configured in P.0319 parameter (0=disables the function, 1=clockwise rotation, 2=counter clockwise rotation, 3=as mains/bars), with a filter time of 0.5 seconds.

This protection acts on the digital outputs configured with the DOF.3190 and DOF.3191 functions.

8.8.49 56 – Minimum generator voltage

Type: **Warning**

Parameters connected: **P.0101** Number of phases of the generator
P.0102 Generator rated voltage
P.0391 Low voltage threshold **(%)**
P.0392 Low battery voltage delay
P.0328 Enables the verifications also on the phase voltages.

To disable: **P.0392=0**

Enabled in: **MAN*, AUTO, TEST, REMOTE START**

The protection is enabled only with started engine (active FUEL control) and after the genset voltage and frequency have been seen “in tolerance”. It is disabled during the starting and stopping phase of the engine. In MAN it is enabled only if the GCB breaker is closed.

It will be activated if at least one of the generator voltages goes under P.0391 threshold (percentage of P.0102) uninterruptedly for P.0392 timespan.

For three-phase systems, the protection normally works on the phase-to-phase voltages: setting P.0328 to 1 the protection considers also the phase voltages.

* In **MAN** it is only enabled if the GCB breaker is closed or if the bit 2 of parameter P.0249 is set to "1".

This protection acts on the digital outputs configured with the DOF.3190 and DOF.3191 functions.

8.8.50 57 – Clock not valid

Type: **Warning**

Parameters connected: **P.0418** Weekly test schedule
P.0420 Test duration
P.0421 Weekly operation schedule

P.0422 Operation start time
P.0423 Operation end time
P.0426 Intervention forcing calendar

To disable: **-**

Enabled in: **MAN, AUTO, TEST, REMOTE START**

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 the weekly test (P.0418 and P.0420), the time to enable operations (P.0421, P.0422, P.0423) or the time to force intervention (P.0426, P.0427 and P.0428), have been configured.

To deactivate it, you need to set the clock.

8.8.51 58 – Maximum generator frequency

Type: **Warning**

Parameters connected: **P.0105** Rated frequency
P.0395 Low frequency threshold (%)
P.0396 Low frequency delay

To disable: **P.0396=0**

Enabled in: **MAN*, AUTO, TEST, REMOTE START**

The protection is enabled only with started engine (active FUEL control) and after the genset voltage and frequency have been seen “in tolerance”. It is disabled during the starting and stopping phase of the engine. In MAN it is enabled only if the GCB breaker is closed.

It will be activated if generator frequency goes below P.0395 threshold (percentage of P.0105) uninterruptedly for P.0396 timespan.

* In **MAN** it is only enabled if the GCB breaker is closed or if the bit 2 of parameter P.0249 is set to "1".

This protection acts on the digital outputs configured with the DOF.3190 and DOF.3191 functions.

8.8.52 59 – High generator voltage

Type: **Warning**

Parameters connected: **P.0101** Number of phases of the generator
P.0102 Generator rated voltage
P.0393 High voltage threshold **(%)**
P.0394 High voltage delay
P.0328 Enables the verifications also on the phase voltages.

To disable: **P.0394=0**

Enabled in: **MAN, AUTO, TEST, REMOTE START**

The protection is enabled only when engine running (FUEL command active). It is disabled during the starting and stopping phase of the engine.

It is enabled if at least one of the generator voltages goes over the threshold P.0393 (percentage of P.0102) continuously for the time P.0394. For three-phase systems, the protection normally works on the phase-to-phase voltages: setting P.0328 to 1 the protection considers also the phase voltages.

This protection acts on the digital outputs configured with the DOF.3190 and DOF.3191 functions.

8.8.53 60 – Maximum generator frequency

Type: **Warning**

Parameters connected: **P.0105** Rated frequency
P.0397 High frequency threshold (%)
P.0398 High frequency delay

To disable: **P.0398=0**

Enabled in: **MAN, AUTO, TEST, REMOTE START**

The protection is enabled only when engine running (FUEL command active). It is disabled during the starting and stopping phase of the engine.

It will be activated if frequency goes over P.0397 threshold (percentage of P.0105) uninterruptedly for P.0398 timespan.

This protection acts on the digital outputs configured with the DOF.3190 and DOF.3191 functions.

8.8.54 61 – Lost Excitation

Type: **Alarm**

Parameters connected: **P.0321** Excitation loss threshold (kvar)
P.0322 Excitation loss delay

To disable: **P.0322=0**

Enabled in: **MAN, AUTO, TEST, REMOTE START**

The protection is enabled only when engine running (FUEL command active). It is disabled during the starting and stopping phase of the engine.

It starts if the measure of currents is connected to the generator (current transformers on the generator, or on users, but with closed GCB switch), and if the total reactive power has a negative sign and is higher, as to the module, than P.0321 threshold, uninterruptedly for P.0322 timespan.

This protection acts on the digital outputs configured with the DOF.3190 and DOF.3191 functions.

8.8.55 62 – Faulty CAN-BUS 0 link

Type: **Configurable (Warning/Alarm/Deactivation)**

Parameters connected: **P.0700** Engine type
P.1700 Voltage regulator (AVR) type
P.0709 Can-Bus fault signal

To disable: **-**

Enabled in: **MAN, AUTO, TEST, REMOTE START**

The protection is enabled if the CAN-BUS is activated (P.0700, P.1700).

It activates if the internal CAN controller switches to BUS-OFF status due to bus communication errors.

The type of anomaly can be configured through P.0709 parameter.

8.8.56 64 – Fuel pump failure

Type: **Warning**

Parameters connected: **P.0404** Fuel pump start maximum duration
P.3001 Function of input 1 or equivalent for the other outputs

To disable: **P.0404=0**

Enabled in: **MAN, AUTO, TEST, REMOTE START**

The protection is always enabled.

It activates if the pump keeps running for the time P.0404.

Note: this anomaly can be activated also with an already active alarm.

8.8.57 65 – Low coolant temperature (from analogue sensor)

Type: **Warning**

Parameters connected: **P.4001** Input function 1 or equivalent for other inputs.
P.0353 Coolant low temperature threshold
P.0354 Coolant low temperature delay
P.0700 Type of engine

To disable: **P.0354=0**

Enabled in: **MAN, AUTO, TEST, REMOTE START**

The protection will be enabled only if the board acquires the coolant temperature measure (see 7.7.4). The protection is always enabled.

It activates if the battery voltage is continuously lower than the threshold P.0353 for time P.0354.

8.8.58 95 – AdBlue pump failure

Type: **Warning**

Parameters connected: **P.1494** AdBlue pump start maximum duration
P.3001 Function of input 1 or equivalent for the other outputs

To disable: **P.1494=0**

Enabled in: **MAN, AUTO, TEST, REMOTE START**

The protection is always enabled.

It activates if the pump keeps running for the time P.1494.

Note: this anomaly can be activated also with an already active alarm.

8.8.59 96 – Magnetic pickup failure

Type: **Configurable (warning/unload/deactivation/alarm)**

Category: **Engine protection**

Related parameters: **P.0110** Number of teeth of the pick-up wheel
P.0387 Number of teeth of the pick-up wheel
P.0388 Action for magnetic pickup failure

To disable: **P.0387 = 0**

Enabled in: **MAN, AUTO, TEST, REMOTE START**

This protection is enabled only if the controller acquires the engine speed with its input dedicated to the magnetic pick-up (P.0110 different from zero).

It is activated if the controller detects the “engine running “condition, but the measured speed is “0”. This condition must persist for the time configured with P.0387 (the protection is disabled if this time is “0”). With P.0388 the protection is configured as warning, unload, deactivation or alarm.

Remark: if engine’s protections override function is enabled, this anomaly becomes a warning.

8.8.60 97 – Communication failure with the AVR

Type: **Configurable (Warning/Alarm/Unload/Deactivation)**

Category: **Generic**

Related parameters: **P.1700** Voltage regulator (AVR) type
P.1706 Communication timeout with AVR (s)
P.1707 Action for communication failure with AVR

To disable: **P.1706 = 0**

Enabled in: **MAN, AUTO, TEST, REMOTE START**

It's enabled only if the CAN-BUS connection to the automatic voltage regulator is configured (P.1700). It is activated if the controller does not continuously receive messages from the voltage regulator for time P.1706. With P.1707 the protection is configured as warning, unload, deactivation or alarm.

Remark: if engine's protections override function is enabled, this anomaly becomes a warning.

8.8.61 98 – Communication failure with the ECU

Type: **Configurable (Warning/Alarm/Deactivation)**

Parameters connected: **P.0700** Engine type
P.0709 CAN-BUS fault signal
P.0711 Maximum time without messages from engine

To disable: **P.0709 =0 (no for MTU engines)**

Enabled in: **MAN, AUTO, TEST, REMOTE START**

The protection is enabled if the CAN-BUS is activated (P.0700).

It will be activated if the board doesn't acquire communications from the engine uninterruptedly for P.0711 timespan. By setting P.0700 with values 140 to 143, it is activated, according to MTU specification, when the board doesn't receive the NMT ALIVE PDU message from ECU uninterruptedly for the specified time span.

8.8.62 99 – Minimum speed for asynchronous generators (from measure)

Type: **Deactivation**

Parameters connected: **P.0110** Number of teeth of the Pick-up wheel
P.0111 Rpm/W ratio
P.0127 Rpm/Hz ratio
P.0133 Engine rating (Primary)
P.0134 Engine rating (Secondary)
P.0305 Minimum speed threshold (Pick-up/W) (%)
P.0306 Minimum speed delay (Pick-up/W).
P.0700 Engine type

To disable: P.0306=0

Enabled in: **MAN, AUTO, TEST, REMOTE START**

The protection will be enabled if the board gets the rotation speed of the engine (see 7.7.4). The protection is enabled only with started engine (active FUEL control) and after the genset voltage and frequency have been seen "in tolerance". It is disabled during the starting and stopping phase of the engine. In MAN it is enabled only if the GCB breaker is closed.

It activates if the acquired speed measure goes under threshold P.0305 continuously, for time P.0306. P.0305 threshold is expressed in percentage: this percentage is applied, in this case, to the rated rotation speed of the engine (P.0133 or P.0134, see 7.7.2), rather than to the rated frequency.

8.8.63 100 – Maximum auxiliary current

Type: **Alarm**

Parameters connected: **P.0377** Maximum differential current threshold (Aac)
P.0378 Maximum differential current delay

To disable: **P.0378=0**

Enabled in: **MAN, AUTO, TEST, REMOTE START**

The protection will be enabled if the board can measure a differential current. P.0108 and P.0109 must be both different from zero and:

- P.0131=2. In this case, it is also necessary that P.0108 is equal to P.0107, that P.0135 is equal to P.0139 and that P.0130 is equal to P.0124.
- P.0131=3.

This protection will be enabled only if the engine has been activated from the controller (if the fuel solenoid valve is activated), the load is switched to the genset and the controller is configured to measure the differential current. It is disabled in the engine start/stop phases. It activates if the acquired speed measure exceeds threshold P.0377 continuously, for time P.0378.

This protection acts on the digital outputs configured with the DOF.3190 and DOF.3191 functions.

8.8.64 105 – Battery-charger failure (from CAN-BUS).

Type: **Warning**

Parameters connected: **P.0700** Engine type
P.0704 Can-Bus anomalies disable mask

To disable: **bit 12 of P.0704 on**

Enabled in: **MAN, AUTO, TEST, REMOTE START**

The protection is enabled if the CAN-BUS is activated (P.0700).

It will be activated when the electronic control unit of the engine reports the anomaly on the CAN-BUS.

8.8.65 106 – Maximum exported reactive power

Type: **Alarm**

Parameters connected: **P.0379**
P.0380

To disable: **P.0380=0**

Enabled in: **MAN, AUTO, TEST, REMOTE START**

It is only enabled if the controller has been started by the controller (if the command for the fuel solenoid is activated) and is disabled in the engine start/stop phases. It is activated if the reactive power is positive and is higher than P.0379 threshold, consecutively for P.0380 time.

WARNING! The protection doesn't work when current transformers are connected to users and when users are supplied by mains or other generators.

This protection acts on the digital outputs configured with the DOF.3190 and DOF.3191 functions.

8.8.66 118 Maximum speed (from CAN-BUS 0)

Type: **Alarm**

Parameters connected: **P.0700** Engine type
P.0704 Can-Bus anomalies disable mask

To disable: **bit 11 of P.0704 on**

Enabled in: **MAN, AUTO, TEST, REMOTE START**

The protection is enabled if the CAN-BUS is activated (P.0700).

It will be activated when the electronic control unit of the engine reports the anomaly on the CAN-BUS.

Note: this anomaly can be activated also with an already active alarm.

8.8.67 132 – High coolant temperature from CAN-BUS

Type: **Warning**

Parameters connected: **P.0700** Engine type
P.0704 Can-Bus anomalies disable mask

To disable: **bit 5 of P.0704 on**

Enabled in: **MAN, AUTO, TEST, REMOTE START**

The protection is enabled if the CAN-BUS is activated (P.0700).

It will be activated when the electronic control unit of the engine reports the anomaly on the CAN-BUS. Only for SCANIA engine: the board accepts this warning, via CAN-BUS, only after P.0216 (“engine protection masking time) from engine starting.

8.8.68 134 – Maximum coolant temperature from CAN-BUS

Type: **Alarm**

Parameters connected: **P.0700** Engine type
P.0704 Can-Bus anomalies disable mask

To disable: **bit 6 of P.704 on**

Enabled in: **MAN, AUTO, TEST, REMOTE START**

The protection is enabled if the CAN-BUS is activated (P.0700).

It will be activated when the electronic control unit of the engine reports the anomaly on the CAN-BUS. Only for SCANIA engine: the board accepts this warning, via CAN-BUS, only after P.0216 (“engine protection masking time) from engine starting.

8.8.69 135 – Minimum coolant level from CAN-BUS.

Type: **Alarm**

Parameters connected: **P.0700** Engine type
P.0704 Can-Bus anomalies disable mask

To disable: **bit 8 of P.0704 on**

Enabled in: **MAN, AUTO, TEST, REMOTE START**

The protection is enabled if the CAN-BUS is activated (P.0700).

It will be activated when the electronic control unit of the engine reports the anomaly on the CAN-BUS.

8.8.70 136 – Low coolant level from CAN BUS

Type: **Warning**

Parameters connected: **P.0700** Engine type
P.0704 Can-Bus anomalies disable mask

To disable: **bit 7 of P.0704 on**

Enabled in: **MAN, AUTO, TEST, REMOTE START**

The protection is enabled if the CAN-BUS is activated (P.0700).

It will be activated when the electronic control unit of the engine reports the anomaly on the CAN-BUS.

8.8.71 137 – Low battery voltage from CAN BUS

Type: **Warning**

Parameters connected: **P.0700** Engine type
P.0704 Can-Bus anomalies disable mask

To disable: **bit 10 of P.0704 on**

Enabled in: **MAN, AUTO, TEST, REMOTE START**

The protection is enabled if the CAN-BUS is activated (P.0700).

It will be activated when the electronic control unit of the engine reports the anomaly on the CAN-BUS.

8.8.72 142 – Minimum oil pressure from CAN BUS

Type: **Alarm**

Parameters connected: **P.0700** Engine type
P.0704 Can-Bus anomalies disable mask

To disable: **bit 2 of P.704 on**

Enabled in: **MAN, AUTO, TEST, REMOTE START**

The protection is enabled if the CAN-BUS is activated (P.0700).

It will be activated when the electronic control unit of the engine reports the anomaly on the CAN-BUS. Only for SCANIA engine: the board accepts this warning, via CAN-BUS, only after P.0216 (“engine protection masking time) from engine starting.

8.8.73 144 – Low oil pressure from CAN BUS

Type: **Warning**

Parameters connected: **P.0700** Engine type
P.0704 Can-Bus anomalies disable mask

To disable: **bit 1 of P.0704 on**

Enabled in: **MAN, AUTO, TEST, REMOTE START**

The protection is enabled if the CAN-BUS is activated (P.0700).

It will be activated when the electronic control unit of the engine reports the anomaly on the CAN-BUS. Only for SCANIA engine: the board accepts this warning, via CAN-BUS, only after P.0216 (“engine protection masking time) from engine starting.

8.8.74 158 – High oil temperature from CAN BUS

Type: **Warning**

Parameters connected: **P.0700** Engine type
P.0704 Can-Bus anomalies disable mask

To disable: **bit 3 of P.0704 on**

Enabled in: **MAN, AUTO, TEST, REMOTE START**

The protection is enabled if the CAN-BUS is activated (P.0700).

It will be activated when the electronic control unit of the engine reports the anomaly on the CAN-BUS.

8.8.75 159 – Maximum oil temperature from CAN BUS

Type: **Alarm**

Parameters connected: **P.0700** Engine type
P.0704 Can-Bus anomalies disable mask

To disable: **bit 4 of P.0704 on**

Enabled in: **MAN, AUTO, TEST, REMOTE START**

The protection is enabled if the CAN-BUS is activated (P.0700).

It will be activated when the electronic control unit of the engine reports the anomaly on the CAN-BUS.

8.8.76 160 – Water in fuel from CAN BUS

Type: **Warning**

Parameters connected: **P.0700** Engine type
P.0704 Can-Bus anomalies disable mask

To disable: **bit 9 of P.0704 on**

Enabled in: **MAN, AUTO, TEST, REMOTE START**

The protection is enabled if the CAN-BUS is activated (P.0700).

It will be activated when the electronic control unit of the engine reports the anomaly on the CAN-BUS.

8.8.77 198 –Warnings from CAN-BUS 0 (cumulative) Yellow lamp

Type: **Warning**

Parameters connected: **P.0700** Engine type
P.0704 Can-Bus anomalies disable mask

To disable: **bit 15 of P.0704 on**

Enabled in: **MAN, AUTO, TEST, REMOTE START**

The protection is enabled if the CAN-BUS is activated (P.0700).

It will be activated when the electronic control unit of the engine reports the presence of at least a warning on the CAN-BUS.

8.8.78 199 – Alarms from CAN-BUS 0 (cumulative) Red lamp

Type: **Configurable**

Parameters connected: **P.0700** Engine type

P.0704 Can-Bus anomalies disable mask

To disable: **bit 16 of P.0704 on**

Enabled in: **MAN, AUTO, TEST, REMOTE START**

The protection is enabled if the CAN-BUS is activated (P.0700).

It will be activated when the electronic control unit of the engine reports the presence of at least an alarm on the CAN-BUS. The anomaly type is configurable with bit 14 of parameter P.0704: if the bit is OFF, the anomaly is a shutdown; if the bit is ON, the anomaly is a warning.

8.8.79 200 – Faulty CANBUS 1 (PMCB) connection

Type: **Warning**
Parameters connected: **P.0800 PMCB bus mode.**
To disable: **-**
Enabled in: **MAN, AUTO, TEST, REMOTE START**

The protection is enabled if the CAN-BUS is activated (P.0800).

It activates if the internal CAN controller switches to BUS-OFF status due to bus communication errors.

8.8.80 201 – CAN-BUS 1 (PMCB) addresses conflict

Type: **Warning**
Parameters connected: **P.0800** PMCB bus mode
P.0452 Modbus address (1)
To disable: **-**
Enabled in: **MAN, AUTO, TEST, REMOTE START**

The protection is enabled if the CAN-BUS is activated (P.0800).

It will be activated when two or more generator control boards connected on PMCB have the same address (configured in P.0452).

8.8.81 202 – Wrong number of generators on bus CAN-BUS 1 (PMCB)

Type: **Warning**
Parameters connected: **P.0800 PMCB bus mode.**
P.0803 Number of gensets on bus **PMCB**
To disable: **P.0803=0**
Enabled in: **MAN, AUTO, TEST, REMOTE START**

The protection is enabled if the CAN-BUS is activated (P.0800).

It will be activated when in the bus there are a number of generator control boards (not MC100 or BTB100) different from what specified by P.0803. Note: if in the system there are not BTB100 controllers that signal the bus tie breaker opened, the alarm is not activated.

8.8.82 203 – Negative sequence (46)

Type: **Deactivation**
Parameters connected: **P.0101** Generator number of phases
P.0106 Generator rated output
P.0325 Negative sequence I2 threshold (%)
P.0326 Negative sequence delay
P.0327 Nominal phase sequence
To disable: **P.0326=0**
Enabled in: **MAN, AUTO, TEST, REMOTE START**

The protection is enabled only when engine running (FUEL command active). It is disabled during the starting and stopping phase of the engine. It is enabled only for three-phase systems (P.0101 = 3) and only if the measure of currents is linked to the generator (current transformers on the generator, or on users but with closed GCB switch).

"I2" negative sequence current is calculated as 1/3 of the module of the vector sum of the three phase currents, by putting out of phase of 120° in a direction the current of L2 phase and of 120° in the other direction the current of L3 phase (it depends on the rotation direction). If the load on the three phases is balanced and of equal cos (ϕ), the "I2" current is 0. Practically, it represents an index of load imbalance, which considers also angles of current vectors and not only of modules.

P.0327 parameter ("rated phase sequence for the calculation of the direct/reverse sequence)" affects the calculation of the negative sequence current:

- P.0327=2. In this case, the default phase sequence is the counter clockwise one. For the calculation of the negative sequence, a 240° angle is added to L2 phase vector, a 120° angle is added to L3 phase vector.
- P.0327=1. In this case, the default phase sequence is the clockwise one. For the calculation of the negative sequence, a 120° angle is added to L2 phase vector, a 240° angle is added to L3 phase vector.
- P.0327=0. The default phase sequence is the present voltage one. Since it is clockwise or counter clockwise, what stated at the two previous points is true.

It will be activated when "I2" current remains higher than P.0325 threshold uninterruptedly for P.0326 timespan. P.0325 threshold is expressed in percentage with reference to rated current: see 7.4.1 for the determination of rated current from P.0101, P.0102 and P.0106 parameters.

This protection acts on the digital outputs configured with the DOF.3190 and DOF.3191 functions.

8.8.83 204 – Failure to close NECB switch

Type:	**Configurable**
Parameters connected:	**P.0161** Action for the neutral-earth circuit breaker (NECB) failure to close **P.3001** Feature of output 1 or equivalent for the other outputs **P.4001 P.4002** Function and delay of input 1 or equivalent for the other inputs.
To disable:	-
Enabled in:	**AUTO, TEST, REMOTE START**

This anomaly is available from the review 00.40. Is enabled only if the board controls NECB switch for the earthing of the neutral of the generator (DOF.2061 function in P.3001 parameter for output 1 or equivalent for the other outputs), and if it acquires its feedback (DIF.3005 function in P.4001 parameter for input 1 or equivalent for the other inputs). It is activated if the switch remains open for the time associated with the feedback input, at the presence of the closing control.

8.8.84 205 – Failure to open NECB switch

Type:	**Warning**
Parameters connected:	**P.3001** Feature of output 1 or equivalent for the other outputs **P.4001 P.4002** Function and delay of input 1 or equivalent for the other inputs.
To disable:	-
Enabled in:	**AUTO, TEST, REMOTE START**

This anomaly is available from the review 00.40. Is enabled only if the board controls NECB switch for the earthing of the neutral of the generator (DOF.2061 function in P.3001 parameter for output 1 or equivalent for the other outputs), and if it acquires its feedback (DIF.3005 function in P.4001 parameter for input 1 or equivalent for the other inputs). It is activated when the switch remains closed for the time associated with the feedback input, at the presence of the opening control.

8.8.85 206 – Failure to open NECB switch

Type:	**Configurable**

Parameters connected: **P.0381** Threshold for active power maximum error
P.0382 Delay for active power maximum error
P.0383 Action for active power maximum error

To disable: **P.0382=0**

Enabled in: **MAN, AUTO, TEST, REMOTE START**

This anomaly is available from the review 00.63. It is enabled only if the genset is running in parallel with other gensets (also during the multiple back-synchronization) or if the genset is in parallel with the mains. It activates if the difference between the power supplied and the current power setpoint is consecutively higher than the P.0381 threshold for P.0382.

Attention: the protection acts only if the real power is less than the setpoint. It deactivates if the difference between the power supplied and the instant power setpoint is consecutively higher than the P.0381 continuously for 5 seconds (not configurable). With parameter P.0383, you can configure the anomaly as warning, unload, deactivation or alarm. The anomaly is subject to the engine protections OVERRIDE (and to total OVERRIDE).

8.8.86 207 – Maximum time in parallel with the mains

Type: **Warning**

Parameters connected: **P.0890** Maximum time in parallel with the mains
P.0897 Permission for the MCB opening for maximum time in parallel with the mains

To disable: **P.0890=0**

Enabled in: **MAN, AUTO, TEST, REMOTE START**

This anomaly activates if the duration of the parallel with the mains has been set to a limit (P.0890 different from zero) and the parallel has lasted more than the time set. The controller forces the GCB opening and impedes its reclosing until the operator acknowledges the warning. This warning can be activated also in case the “genset switch” function is active, if at the end of the time set, the power has not been switched to the genset yet (because the nominal power of the genset is not enough to supply the load): in this case, if the power absorbed by the load decreases, the controller will automatically close GCB even in case of warning.

To maintain the compatibility with the previous version (which at the end of the time set forced the MCB opening), the P.0897parameter has been added. It is a bit parameter that allows to select in which conditions the MCB opening must be allowed in case the time set for the parallel with the mains is exceeded:

- Bit 1: MAN mode
- Bit 2: AUTO mode
- Bit 3: TEST mode
- Bit 4: RMOTE START mode
- Bit 8: in case of “MGCB opening failure”.

8.8.87 211 – Shared input written by multiple devices CAN-BUS (PMCB)

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 [10].

8.8.88 252 - CAN-BUS 2 (EXBUS) expansion modules missing

Type: **Warning**

Parameters connected: **P.0141** Number of DITEL modules
P.0142 Number of DITEMP modules
P.0143 Number of DIVIT modules
P.0144 Number of DANOUT modules

To disable: **P.0141=0** and **P.0142=0** and **P.0143=0** and **P.0144=0**

Enabled in: **MAN, AUTO, TEST, REMOTE START**

The protection is enabled if the CAN-BUS is activated (P.0141 or P.142 or P.143 or P.144 different from zero).

It will be activated when one or more boards configured with the previous parameters isn't communicating on the CAN-BUS. On page S.02, by selecting this warning, the board shows which module isn't communicating.

8.8.89 253 – CAN-BUS 2 (EXBUS) missing measure

Type: **Warning**

Parameters connected: **P.0142** Number of DITEMP modules
P.0143 Number of DIVIT modules

To disable: **P.0142=0** and **P.0143=0**

Enabled in: **MAN, AUTO, TEST, REMOTE START**

The protection is enabled if the CAN-BUS for the expansion modules is activated (P.0141 or P.142 or P.143 or P.144 different from zero).

It will be activated when the controller doesn’t receive an analogue measure from the CAN-BUS. The board verifies the sole presence of the utilized analogue measures (those that have a function different from zero in P.4131 parameter or equivalent ones for the other analogue inputs). On S.02 page, by selecting this warning, the board indicates which channel of which module isn't carrying out the measurement.

8.8.90 254 – CAN-BUS 2 (EXBUS) duplicate address

Type: **Warning**

Parameters connected: **P.0141** Number of DITEL modules
P.0142 Number of DITEMP modules
P.0143 Number of DIVIT modules
P.0144 Number of DANOUT modules

To disable: **P.0141=0** e **P.0142=0** e **P.0143=0** e **P.0144=0**

Enabled in: **MAN, AUTO, TEST, REMOTE START**

The protection is enabled if the CAN-BUS for the expansion modules is activated (P.0141 or P.142 or P.143 or P.144 different from zero).

It will be activated if two or more expansion modules are configured with the same address. On S.02 page, by selecting this warning, the board indicates which module has the duplicated address.

8.8.91 255 – Disconnected CAN-BUS 2 sensor (EXBUS)

Type: **Warning**

Parameters connected: **P.0142** Number of DITEMP modules
P.0143 Number of DIVIT modules

To disable: **P.0142=0** and **P.0143=0**

Enabled in: **MAN, AUTO, TEST, REMOTE START**

The protection is enabled if the CAN-BUS for the expansion modules is activated (P.0141 or P.142 or P.143 or P.144 different from zero).

It will be activated when a DIGRIN, DITHERM or DIVIT module reports the status of “disconnected sector”. On S.02 page, by selecting this warning, the board indicates which channel of which module has a disconnected sensor.

8.8.92 271 – GCB parallel failure (direct parallel)

Type: **Warning/Alarm**
Parameters connected: **P.0802** Engine type
P.0854 GCB use
P.0852 Synchronization Maximum Time (GCB)
To disable: **P.0852 = 0**
Enabled in: **AUTO, TEST, REMOTE START**

This protection is enabled only if plant configuration (P.0802, P.0854) allows the GCB breaker synchronization.

It activates when the GCB breaker does not close within the time set with P.0852 since synchronization start. It is always an alarm: it becomes a warning only if the switch is controlled externally (P.0854).

8.8.93 272 – MCB parallel failure (reverse parallel)

Type: **Warning**
Parameters connected: **P.0802** Plant type
P.0855 MCB use
P.0853 MCB maximum synchronization time
To disable: **P.0853=0**
Enabled in: **AUTO, TEST, REMOTE START**

This protection is enabled only if plant configuration (P.0802, P.0855) allows the MCB breaker synchronization.

It activates when the MCB breaker does not close within the time set with P.0853 since synchronization start.

8.8.94 273 – Incoherent parameters

Type: **Warning/Alarm**
To disable: -
Enabled in: **MAN, AUTO, TEST, REMOTE START**

The protection is always enabled.

It activates if plant configuration parameters are not coherent and/or all parameters default have been reloaded. On S.02 page, by selecting this anomaly, the board shows a description of the problem. It is almost always a warning: it is an alarm only for continuative parallel systems with the mains in case the interface switch isn't selected.

8.8.95 274 – Self-production line selected

Type: **Deactivation**
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, TEST, REMOTE START**

The protection is always enabled.

It will be activated if the input that receives the external contact (DIF.4261 function in P.2001 parameter or equivalent) remains active uninterruptedly for the configured time span (P.2002 or equivalent). Purpose of this protection is to indicate to the board that there is an open switch on the line that connects the generator to the public mains, which in fact doesn't allow the supply in parallel with the mains.

8.8.96 275 – Interface device not open

Type: **Alarm**
Parameters connected: **P.0802** Engine type
P.0900: interface device
To disable: **-**
Enabled in: **MAN, AUTO, TEST, REMOTE START**

In case of mains failure during parallel, in mains parallel plants, the generator/s must be isolated from mains by opening a breaker switch (interface breaker). If the breaker does not open within 0.5 sec. since mains failure, the controller sets this anomaly. Either MCB or GCB can act as interface breaker.

8.8.97 276 – Alarm from master controller CAN-BUS 1 (PMCB)

Type: **Warning/Alarm**
Parameters connected: **P.0800** PMCB bus mode
P.0802: plant type
To disable: **-**
Enabled in: **MAN, AUTO, TEST, REMOTE START**

This anomaly is forced by the controller MC100 when an anomaly must be signalled also to the generators control controllers (the MC100 controller display will show the actual anomaly).

8.8.98 279 – Inconsistent bar voltage

Type: **Warning/Deactivation**
Parameters connected: **-**
To disable: **-**
Enabled in: **MAN, AUTO, TEST, REMOTE START**

The board will activate this warning before closing GCB, if it notices a divergence between the effective presence of voltage on parallel bars and what it expects according to the statuses of the switches, mains and any other generator control boards connected on PMCB. The anomaly is activated only if there isn't voltage on bars when, on the contrary, it should be present. For example, if at least another generator has closed GCB, there should be voltage on parallel bars: if the board doesn't detect it (through the three-phase sensor or through a contact), after two seconds the signalling is activated. Usually the signal is a warning, it becomes a deactivation (only in case of automatic procedures) after 60 seconds if the board needs to close the GCB.

8.8.99 900 – 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.

8.8.100 301...554 - Generic anomalies linked to digital inputs

See 8.6.

8.8.101 701...806 - Generic anomalies linked to analogue inputs

See 8.7.

8.8.102 901...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 “MeccAltePlcEditor” 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 detail on page S.03. It is possible to set the clock through 4.7.1 menu or serial ports.

- History logs recordings.
- Engine TEST start weekly planning.
- Weekly planning of time intervals in which the gen-set can start automatically.
- Weekly plan of periods in which the genset automatic activation must be forced

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 reactivates 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 the server "SMARTCLOUD" or towards a NTP server (see par. In fact, every digital input can have an AND/OR logic associated, which determines its status (see par. 5.15.4). 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 "SMARTCLOUD"

Every time that the controller sends a data package to the server "SMARTCLOUD" receives a synchronization package as a response containing date and time of jet lag (that is UCT Universal Coordinated Time") including jet lag and summertime; with the value received, the calendar is updated (parameters P.0409 and P.0410 are not used).

Server NTP

The server TNP (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.
- "4-Automatic (via SMARTCLOUD)": the activation/deactivation of the daylight save time is configurable by the SMARTCLOUD serve.
- 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 Engine TEST start weekly planning.

The starting test plans is made on weekly base. That is, it is possible to indicate in which days of the week the engine must be started in test and in which not.

ATTENTION: the activation of the periodic test is in no way related to the manual or automatic starts of the engine.

I.e., the engine may have been used just few minutes before, but test will anyway start at due time. In addition to the dates, it is also possible to select a start time and duration. This time interval is common to all the days selected.

The parameters related to this function are the following:

- P.0418: allows to specify in which days of week the engine TEST will be performed. It is a bit-configurable parameter; each bit of the parameter corresponds to a day of the week. The value you must set for the parameter is the sum of the value field of the following table for the days needed.

Bit	Hexadecimal value	Day
1	01	Sunday
2	02	Monday
3	04	Tuesday
4	08	Wednesday
5	10	Thursday
6	20	Friday
7	40	Saturday

For example, if you want to perform the TEST only on Monday and Thursday, you must set 12 (10+02).

- P.0419: allows to set start time for the TEST (Hours and minutes).
- P.0420: allows to configure the TEST duration (in minutes).

P.0420allows to configure the TEST duration (in minutes). This is because the same parameter is used also for the TEST activated by an SMS command.

9.2.3 Engine TEST start weekly planning.

In some applications, it is useful to inhibit the automatic intervention of the engine for mains failure in hours or days where the mains are not used. For example, if a factory is closed on Sunday, the engine should never start in this day for mains fault (because it consumes unnecessary fuel). With this function you can select in which days and in which time intervals the gen-set can start automatically. The planning is made on a weekly basis: therefore, it is possible to plan in which days the generator must operate. Besides days, it is possible to set a single auto operation enable time slot common to all selected days.

The parameters related to this function are the following:

- **P.0421:** allows to specify in which days of week the engine can start automatically. It is a bit-configurable parameter; each bit of the parameter corresponds to a day of the week. The value you must set for the parameter is the sum of the value field of the following table for the days needed.

Bit	Hexadecimal value	Day
1	01	Sunday
2	02	Monday
3	04	Tuesday
4	08	Wednesday
5	10	Thursday
6	20	Friday
7	40	Saturday

- **P.0422:** allows to configure the start of the time interval during which the engine can start automatically (in hours and minutes).
- **P.0423**: allows to configure the end of the time interval during which the engine can start automatically (in hours and minutes).

Usually, P.0422 will be set to a value lower than P.0423. On the contrary, if it contains a higher value, the controller infers that the time interval is set across midnight: in this case, the time set with P.0422 refers to the days selected with P.0421, while the time set with P.0423 refers to the following days.

For example, in case an automatic gen-set start is required only Monday through Friday, between 08:00 and 18:00, you must set:

P.0421 = 3E (02+04+08+10+20)

P.0422 = 08:00

P.0423 = 18:00

9.2.4 Weekly planning of intervention forcing.

The planning of intervention forcing is performed weekly. That is, it is possible to indicate on which days of the week the generator must intervene, even if the status of the system doesn't require the intervention. Besides the days, it is possible to specify from what time to what time the intervention must be forced. This time interval is common to all the days selected.

The parameters related to this function are the following:

- P.0426: it allows specifying on which days of the week the intervention of the generator must be forced. It is a bit-configurable parameter; each bit of the parameter corresponds to a day of the week. The value to be set for the parameter is the sum of the value fields in the following table related to the days needed.

Bit	Hexadecimal value	Day
1	01	Sunday
2	02	Monday
3	04	Tuesday
4	08	Wednesday
5	10	Thursday
6	20	Friday
7	40	Saturday

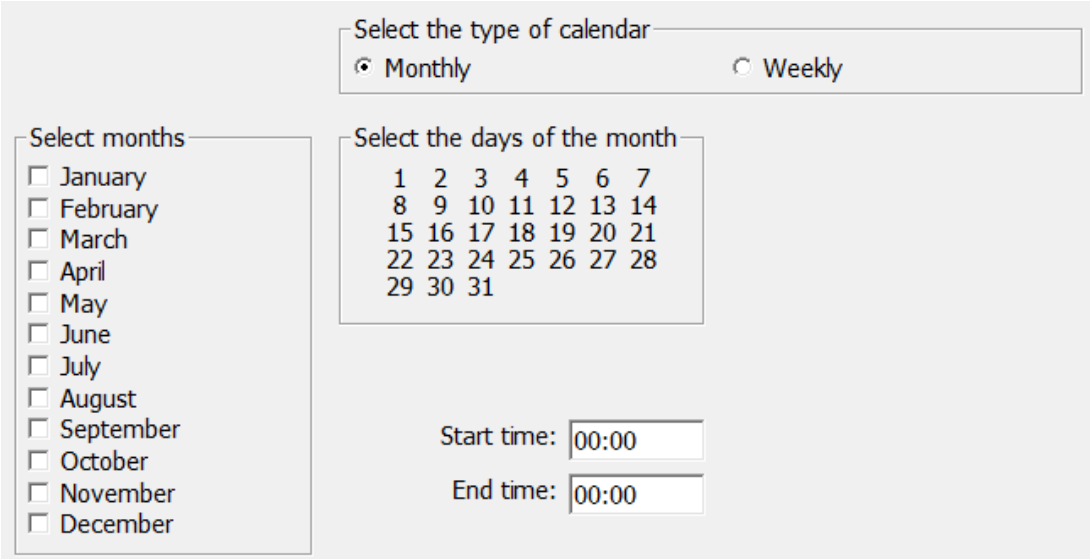
For example, to configure the forcing of the intervention only on Monday and Thursday, it is necessary to set 12 (10+02).

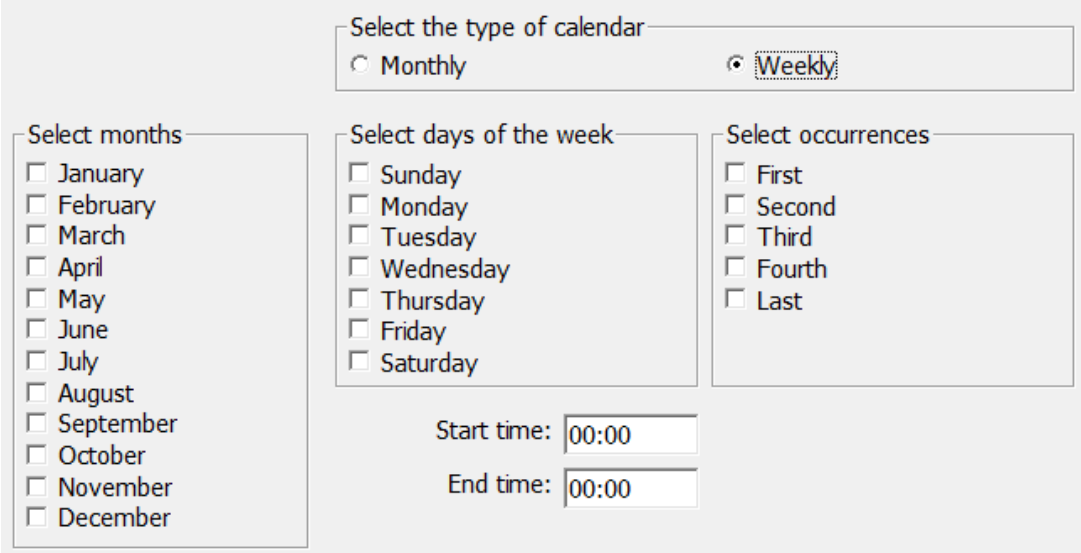
- P.0427: it allows setting the starting time of the forcing (in hours and minutes).
- P.0428: it allows setting the ending time of the forcing (in hours and minutes).

9.2.5 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:

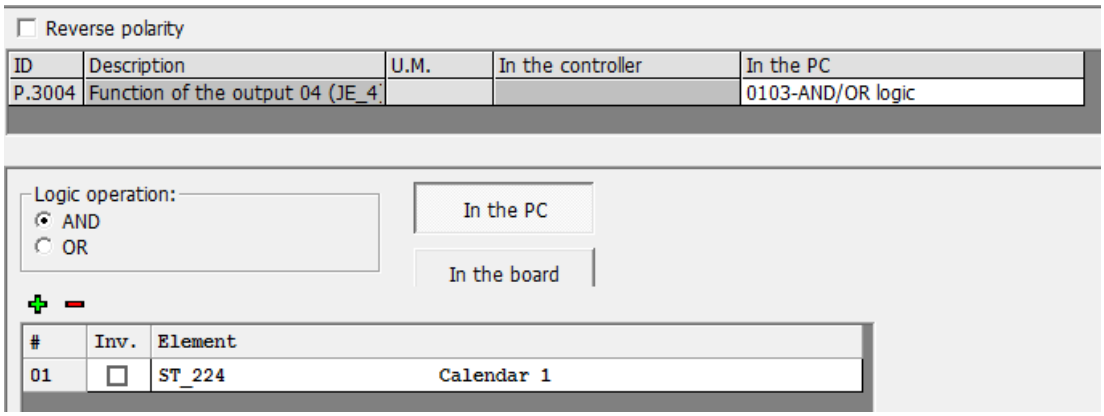
BIT	Value	Hexadecimal	Occurrence
0	1	00000001	First occurrence
1	2	00000002	Second occurrence
2	4	00000004	Third occurrence
3	8	00000008	Forth occurrence
4	16	00000010	Last occurrence

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).

9.2.6 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):

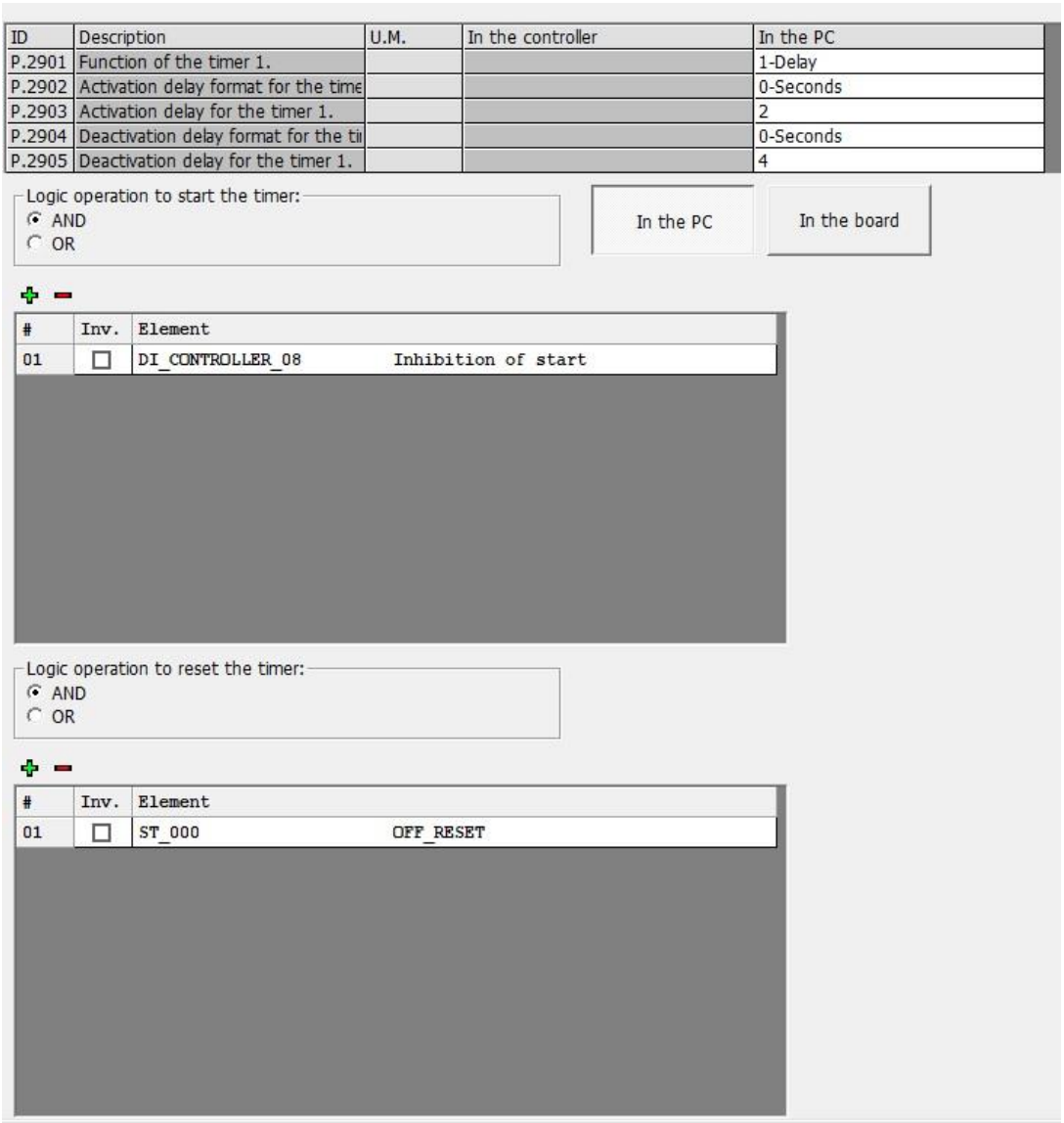
- P.2901: function of the timer 1.
- P.2902: Activation delay format for the timer 1.
- P.2903: Activation delay for the timer 1.
- P.2904: Deactivation delay format for the timer 1.
- P.2905: Deactivation delay for the timer 1.

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.

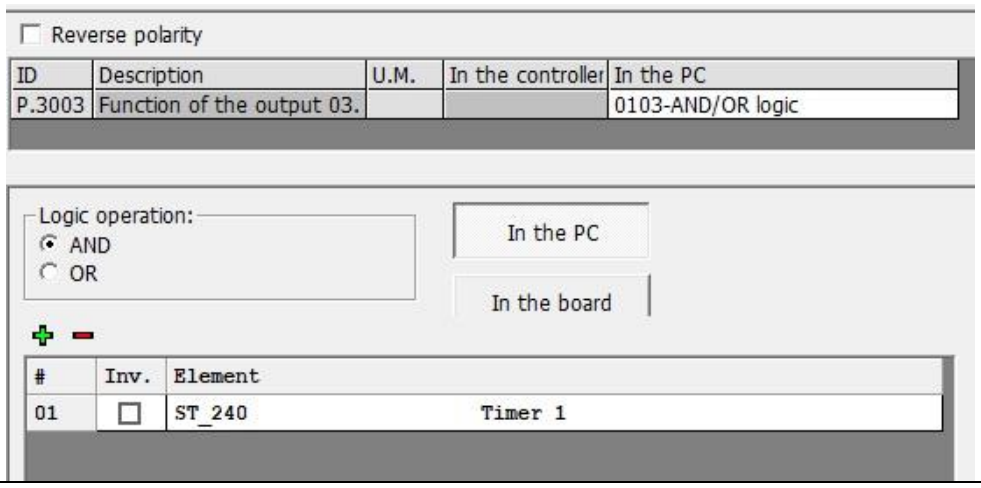
Each timer can work in four different modes, selectable by means parameter P.2901 (for the timer 1 or equivalent for the other timers):

- 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 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:

- Engine starts counter (resettable to zero).
- Engine running hours counter
- Engine running hours counter (resettable to zero)
- Load working time with GCB closed (hours) counter (resettable to zero)
- Operation hours counter with protection override (resettable to zero).
- Time to next service (hours) counter 1
- Time to next service (hours) counter 2
- Controller total power supply time (hours) counter
- Resettable active power meter (kWh): it measures only the supplied power and does not measure in case of power reverse.
- Total counter for the active power produced by the generator (kWh): it only counts supplied power, it doesn't count in case of power inversion.
- Resettable counter for the reactive power produced by the generator (kvarh), it counts in absolute value.
- Total counter for the reactive power produced by the generator (kvarh), it counts in absolute value.
- Resettable counter for the active power measured on the mains (kWh).
- Total counter for the active power measured on the mains (kWh).
- Resettable counter for the reactive power measured on the mains (kvarh).
- Total counter for the reactive power measured on the mains (kvarh).
- Controller total power supply time (hours) counter

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:

- Immediately after each engine start (with engine running, not after each start attempt).
- Immediately after each engine stop (when controller acknowledges the engine stopped status, not when stop is requested).
- After each engine running hours counter increase (total, also if the engine has been started for instance six times for ten minutes each time).
- After each total engine running hours counter increase (total, also if the engine has been started for instance six times for ten minutes each time).
- Each time the load engine working hours counter is increased (total, also if the engine has been started for instance six times for ten minutes each time).
- Each time the working hours counter with engine protections OVVERRIDE active is increased (total, also if the engine has been started for instance six times for ten minutes each time).
- 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. 6.5.5.3 The description of the displayed page containing the counter to be reset

9.5 Loads protection from mains breaker damages

Please refer to the document [10] that details this function.

9.6 Load thresholds

The function in hand should not be mistaken for the “load management” available in parallel systems, whose description is indicated within the document [10].

This function allows to monitor the trend of the active power to diagnose:

- A low-power condition.
- A high-power condition, to disconnect part of the loads, if needed.

It is necessary to choose a priori the condition to be monitored (using the P.0481 parameter: set it to zero to select the low power monitoring, set it to one to select the high-power monitoring).

As default, the “0-Low power” mode is selected, but with intervention threshold 0%, therefore the function is disabled.

To associate an output to this function, the code DOF.3121 (load thresholds) must be configured in the parameter P.3001 parameter (or equivalents). If no output is configured in this way, the function will not work.

It is possible to enable this function through a digital input configured by means of DIF.2703 function ("Enable load thresholds"): if the input exists, the function will be enabled when the input is activated. If the function is disabled, the output configured through DOF.3121function will be always disabled.

Function is configured with the following parameters:

- P.0482: initial observation delay If the enabling input exists (DIF.2703), during the first P.0482 seconds starting from the input activation, the board will control the output at rest: this happens to allow time to the system for stabilizing before starting to control the power.
- P.0483: lower threshold (percentage of the rated power P.0125).
- P.0484: delay associated to the lower threshold (in seconds).
- P.0485: higher threshold (percentage of the rated power P.0125).
- P.0486: delay associated to the higher threshold (in seconds).

If the thresholds P.0483 and P.0485 are set to zero or are not congruent, the function will be disabled.

9.6.1 Low power

Aim of this function is to diagnose a low power (or low load) status and point it out by means of a digital output of the board: in a situation of more than one generators in parallel, this output could be used to deactivate some generators, even if the "load management" (see [10]) allows to do the same but in a cleverer way.

The controller watches the total active power delivered, comparing it with two thresholds (so setting a hysteresis band): the output is activated (signalling the low power condition) if the power drops below the lower threshold for the set time. In the same way, the output is disabled if the power rises above the upper threshold for the set time. In the same way, the output is disabled if the power rises above the upper threshold for the set time.

9.6.2 High power

Purpose of this function is to diagnose a high-power status (high load) to disconnect part of the less important loads. The controller watches the total active power delivered, comparing it with two thresholds (so setting a hysteresis band): the output is disabled if the power remains below the lower threshold for the set time. In the same way, the output is enabled if the power rises above the upper threshold for the set time. The output is activated in a maximum power condition and can directly be used as control for disconnecting loads. Ensure to pay attention to the thresholds: when a part of the loads is disconnected, the power will decrease. If the lower threshold is too high, the output will be disabled, and this could cause the load to be reconnected, with a pendulum effect.

9.7 EJP function

Warning: the controller is not able to receive EJP information directly from the mains. To use this function, an external detector device should be used. This detector must provide two output signals coherent with said function.

The EJP function allows to start the engine and warm it before mains failure, so when it will happen, loads can be immediately changed-over on gen-set, reducing to the minimum the time the loads remain unsupplied.

The system is based on two signals, available through the mains provider:

A. A signal activated well in advance with respect to the mains failure (e.g., approx. 30 mins).

B. A signal activated just before mains failure.

We want to start the engine in (a settable) advance in relation to signal B; however, the load must be taken only when B is active. The controller can perform this operation following the steps below:

- A and B signals must remain active until mains reactivates.

- Both signals must be connected to relays with exchanging contacts.
- The time between A and B signals activation must be known.

To use this function the controller must be configured in the following way:

- Configure a digital input with feature DIF.2701 – “remote start request” in parameter P.2001 or the equivalents for the other inputs). In addition, this input requires configuring the engine crank delay (in seconds, in the parameter P.2002 or equivalent), since A activates. If, for example, we want to warm the engine for five minutes and the A signal will activate 30 minutes before B, it will require to set 1500 seconds, i.e., 25 minutes (it is possible to set delays up to 4000 seconds, i.e., 66 minutes).
- The configuration of a digital input by means of DIF.2502 function (“inhibition to power load”, P.2004 parameter or equivalent).

So, it is necessary to connect the NO contact of the signal A to the first configured input, and the NC contact of the signal B to the second input. **NOTE: the “Inhibition taking load” function impedes the connection of the load even if a genset has been started automatically for other causes. To prevent this problem, use a logic which impedes the activation of this function if the genset has not been started with function “REMOTE START”.**

When both signals are inactive, the controller does not receive the remote start request and remains at rest in AUTO mode. The contact of “inhibition taking load” is ignored.

When signal A is active, both the inputs of the controller will result active. The controller will not immediately shift to REMOTE START mode but will do only after the time set in P.2002 (or equivalents) is elapsed. Therefore, also in this phase, the input of Inhibition to switching is ignored. In this phase, window S.01 shows the time left for the starting.

After the time since activation of signal A, the controller shifts to REMOTE START mode and performs the engine start. But in this phase, the input of “Switching sequence disabling” is no more ignored and being active (connected on contact NC) will impede the switching of the users on the genset.

When signal B activates, the input of “Inhibition taking the load” deactivates, allowing the switching of the users on the genset.

When the mains return, both signals A and B deactivates. Therefore, the controller reverts to AUTO mode, due to mains on, performs the engine stop (with cooling cycle).

9.8 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 BoardPrg4.

You cannot program or modify the configurations from the controller.

The parameters present in each alternative group are the following:

- P.0101: Generator number of phases.
- P.0102: Generator nominal voltage
- P.0103: Primary of generator voltmeter transformers.
- P.0104: Secondary generator voltmeter transformers.
- P.0105: Generator nominal frequency.
- P.0106: Generator nominal power (kVA).

- P.0107: Primary of the generator/user current transformer.
- P.0108: Primary of the current transformer or toroid ratio for auxiliary power.
- P.0109: Transformer type for auxiliary current.
- P.0116: P.0116: nominal voltage.
- P.0117: Primary of mains voltmeter transformers.
- P.0118: Secondary of mains voltmeter transformers.
- P.0119: Mains phases number.
- P.0124: Connection of generator/user current transformers
- P.0125: Engine nominal power (kW).
- P.0126: Use of mains/bars sensor.
- P.0128: Is the neutral of the generator connected to the controller?
- P.0129: Is the neutral of the generator connected to the controller?
- P.0130: Auxiliary current connection.
- P.0131: Auxiliary current use.
- P.0135: Secondary of current transformer or toroid ratio for auxiliary current
- P.0139: Secondary of generator/user current transformer.
- P.0713: Speed at 0% command
- P.0714: Speed at 100% command
- P.1604 (since version 1.20): Setpoint for the frequency.
- P.1654 (since version 1.20): Setpoint for the voltage.
- P.1703 (since version 1.32): Voltage corresponding to 0%.
- P.1704 (since version 1.32): Voltage corresponding to 100%.
- P.1708 (since version 1.42): Rated voltage for AVR.

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 into the working configuration causes the loss 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 engine stopped and with the controller in OFF_RESET.

Among the different parameters which are in the alternative configuration there is also the rotation of the engine, for some CAN-BUS engines, (e.g., Volvo engines), it is possible to command the rotation speed of the engine directly from the controller, acting on parameter P.0701 (and consequently it is possible to do it using the alternative configurations). Refer to [5] for the change of speed as the operation is more difficult.

9.9 Maintenance

The controller can automatically signal the request of periodic maintenance to the operator through two counters of engine working hours and days counter.

9.9.1 Maintenance hours Counter 1

This function is configurable with parameters P.0424 and P.0425. With P.0424, it is possible to set extra operation hours for maintenance service. In P.0425, the type of signalling to be activated at the time limit is configured: a warning, a deactivation, an unload or an alarm (the anomaly code is A039 or D039 or U039 or W039).

The function is enabled if the parameter P.0424 contains a value other than zero. The counting starts in the moment in which the parameter is set. When the hours passed are configured, the controller saves in a not volatile memory the status of maintenance requested. In this way, also removing the supply to the controller, this signalling is not lost, and it cannot be cancelled. If an alarm has been selected with P.0425, then the generator cannot be used again. This function allows to manage rental contracts “by hour number”.

To cancel the maintenance request (and the relevant signal) requires setting again the parameter P.0424: to disable the function, set the parameter to zero; to set the next maintenance after the same period as the previous one, simply confirm the existing parameter; or set a new interval.

Note that these parameters require an installer password.

9.9.2 Maintenance hours counter 2

This function is configurable with parameters P.0436 and P.0437. With P.0436, it is possible to set extra operation hours for maintenance service. In P.0437 the type of signalling to be activated at the time limit is configured: a warning, a deactivation, an unload or an alarm (the anomaly code is A040 or D040 or U040 or W040).

The function is enabled if the parameter P.0436 contains a value other than zero. The counting starts in the moment in which the parameter is set. When the hours passed are configured, the controller saves in a not volatile memory the status of maintenance requested. In this way, also removing the supply to the controller, this signalling is not lost, and it cannot be cancelled. If an alarm has been selected with P.0437, then the generator cannot be used again. This function allows to manage rental contracts “by hour number”.

To cancel the maintenance request (and the relevant signal) requires setting again the parameter P.0436: to disable the function, set the parameter to zero; to set the next maintenance after the same period as the previous one, simply confirm the existing parameter; or set a new interval.

Note that these parameters require an installer password.

9.9.3 Days counter for maintenance

This function is configurable with parameter P.0438, where it is configured in how many days the request for maintenance will be done (independently from the engine operation). The time limit of the maintenance will be signalled with a warning (anomaly code W050).

The function is enabled if the parameter P.0438 contains a value other than zero. The counting starts in the moment in which the parameter is set. When the date of the controller goes over the 8:00 of the configured day (fixed hour not programmable), the controller saves in the not volatile memory the status of request of the maintenance. In this way, also removing the supply to the controller, this signalling is not lost, and it cannot be cancelled.
To cancel the maintenance request (and the relevant signal) requires setting again the parameter P.0438: to disable the function, set the parameter to zero; to set the next maintenance after the same period as the previous one, simply confirm the existing parameter; or set a new interval.

Note that these parameters require an installer password.

9.10 PICO function

In some areas of the world, at certain times of the day, the supply from the mains has a huge cost. This function allows using the generator to supply users in a given time slot (week calendar setting).

Basically, within set days and time slots, the board should start the generator and put it in parallel with the mains. When in parallel, it should transfer the power absorbed by the users from the mains to the generator, then it should open the mains switch. The parallel with the mains should have a maximum configurable duration: elapsed this time, MCB switch should be opened. At the end of the time slot, the board puts back the group in parallel with the mains, transfers users' power from the generator to the mains, opens GCB switch and stops the generator. Also, in this case the duration of the parallel with the mains should be limited.

The controller should then (but it is not mandatory) be able to measure the power on the interchange point with the mains. It is possible to use an external instrument to carry out this measurement and connect it to an analogue input of the controller (AIF.2303 function for P.4001 parameters or equivalent). Alternatively, it is possible to use the fourth current transformer of the controller to perform this measurement. In this case set:

- P.0126 = 1 (mains/bars sensor used to measure the mains).
- P.0109 = 0 (it uses a current transformer for the fourth current).
- P.0108 = x (fourth current transformer primary).
- P.0135 = x (fourth current transformer secondary).
- P.0130 = x (connection for auxiliary current).
- P.0131 = 4 (fourth current used to calculate the power on the mains).

After this, the board calculates power on phase L1 of the mains and, for three-phase systems, it multiplies it by three, therefore assuming a balanced load. This value is then multiplied by P.0132 coefficient (default 1.0), which allows correcting load imbalances.

To activate the “load transfer” function from the generators to the mains, it is necessary to configure a digital input with DIF.2096 function: this input should be active. Moreover:

- If the controller is able to measure the power on the mains, the “import/export” mode can be selected for the parallel with the mains (P.0880 = 2) and select "0 kW" (P.0888) as power on the interchange point.
- Alternatively, select “BASE LOAD” mode for the parallel with the mains (P.0880 = 1) and set alleged users' power in P.0884.

See document [10] that describes the "transfer to the generators" function in details.

Use P.0426, P.0427 and P.0428 parameters to select the time slot during which the intervention of the generator should be forced (see description in 9.2.4).

The maximum time that the generator can stay in parallel with the mains is generally decided by the Supplier of the power mains; it can be set with P.0890“Maximum time in parallel with the mains” parameter. By leaving the parameter

to zero, no limitation is set on the duration of the parallel to mains. See description of W207 warning, which is linked to this function.

9.11 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	1.00	1	0001	Coefficients for the calibration of the measuring inputs of the controller.
2	1.00	2	0002	Different information (selected languages, LCD display contrast, maintenance request).
3	1.00	3	0004	Counters
4	1.00	4	0008	History log for diagnose codes acquired via CAN-BUS from the engine.
5	1.00	5	0010	History log of the maximum peaks.
6	1.00	6	0020	Parameters alternative configurations.
7	1.00	7	0040	Setpoint for the PLC
8	1.00	8	0080	Parameter:
9	1.00	9	0100	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 “0081”, this means that the parameters zones (0080) 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.

9.12 CAN-BUS connection with engines

The controller has a CAN-BUS interface (CAN0) dedicated to the interfacing with electronic external devices. Those devices can be:

- The engine control units (ECU).
- The automatic voltage regulators (AVR) (since version 1.15).
- Some specific devices controlling the air/fuel ratio (Gas Mixers).

To activate the connection, first, it is necessary to select one or more external devices.

9.12.1 Engine control unit (ECU)

Parameter P.0700 allows to select the ECU (from the list of supported engines). It is possible to select (directly from the controller or via BoardPrg4) one of the provided ECU. Alternatively, by setting the value 300 in P.0700, it is possible (only via BoardPrg4) to select an external file (parameter F.0700) relating to the requested ECU (Mecc Alte continuously implements new files for new ECUs or for new versions of existing ECUs).

It is then possible to decide whether to receive only information from the ECU or whether to also send commands (P.0703):

- By setting P.0703 to "0", the controller does not transmit anything on the CAN-BUS.
- By setting P.0703 to "1", the controller only requests information that is not "automatically" transmitted by the ECU, but does not transmit commands.
- By setting P.0703 to a value between "2" and "90", the controller also transmits all the commands provided by the ECU with the exception of the speed regulation command.
- By setting P.0703 to a value between “91” and “99”, the controller also transmits the speed regulation command. **NOTE: for some ECU the value "98" activates special functions, see specific documentation**.

  For speed control, the controller internally uses a percentage command. However, some ECUs accept a command directly in rpm: using the parameters P.0713 and P.0714 it is possible to convert the internal percentage in rpm before transmitting it to the ECU. **NOTE: the values 1380 and 1620 are two special values for the two previous parameters; they configure a variation of +/- 8% on the rated rotation speed, which is also maintained at 60 Hz**. It is also possible to specify the value in rpm for the low-speed cycle (P.0710).

  If the ECU signals specific anomalies (therefore not through the cumulative yellow and red lamps), the controller manages them with direct warnings/alarms (codes from 105 to 160). Using parameter P.0704 it is possible to mask these alarms on the controller (**attention: the ECU can still stop the engine**).

  Specific options for each ECU can be activated with parameter P.0715. Furthermore, for the “generic ECU” selected with the value "1" in P.0700, parameter P.0716 specifies the address that the controller must use to transmit commands to the ECU.

  In some cases, it is possible to activate the DROOP mode (for adjusting the rotation speed) directly in the ECU (P.0708).

  Finally, it is possible to set a maximum time through parameter P.0711: the controller will activate an anomaly if it does not receive messages from the ECU for this time.

9.12.2 Voltage regulator (AVR)

Parameter P.1700 (available from version 1.15) allows to select the voltage regulator (from the list of supported models). It can be modified only through BoardPrg4, to select one of the available external files (Mecc Alte continuously implements new files for new regulators or for new versions of existing regulators).

It is then possible to decide whether to receive only information from the AVR or whether to also send commands (P.1701):

- By setting P.1701 to "0", the controller does not transmit anything on the CAN-BUS.
- By setting P. 1701 to "1", the controller only requests information not "automatically" transmitted by the AVR, but does not transmit commands.
- By setting P.1701 to a value between "91" and "99", the controller also transmits the voltage regulation command.

  P.1702 ("Transmission address for voltage regulator"). It is the address that the controller must use when sending messages to the AVR. For some AVRs it is not used (because it is already statically defined in the file that describes the regulator). For others, however, it must be set as required by the AVR manufacturer.

  P.1703 and P.1704 ("Voltage corresponding to 0% or 100% of the internal command"). If the AVR manages a voltage setpoint directly in Volts, with these parameters you can convert the internal controller command (which is always a percentage) into a voltage range, based on the application.

  P.1708, instead, configures the nominal voltage for the AVR, which may differ from that of GC600 due to any transformers or due to the wiring of the voltages to the AVR. If the AVR supports it, GC600 automatically transfers this set-point to it, thus automating management in multi-voltage applications (see 9.8).

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