POWER FROM WITHIN

GC315 - GC400 CONTROLLERS

SMARTECH

A DIVISION OF MECC ALTE

TECHNICAL MANUAL

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Revision	Date	Notes
00	28/03/2014	The first version of the manual, drawn-up for version 01.06 of the controller.
01	21/05/2014	Modified section 4.2 and Chapters 3, 8 and 9.
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1 Introduction

1.1 Nomenclature

This manual is valid for all models of the controllers GC315 and GC400. The controller models are different in the communication options available and in the presence of ANALOGUE outputs. The following table shows the options available on each model.

Controller	USB	RS232	RS485	Ethernet	Internal Modem	CAN engine	CAN sharing	ANALOGUE outputs
GC315	Yes					Yes		
GC315^{Plus}	Yes	Yes	Yes	Yes		Yes		
GC315^{Link}	Yes	Yes	Yes		Yes	Yes		
GC400	Yes	Yes	Yes	Yes		Yes	Yes	Yes
GC400^{Link}	Yes	Yes	Yes		Yes	Yes	Yes	Yes
GC400^{Mains}	Yes	Yes	Yes			Yes	Yes	Yes
GC400$^{Mains+Link}$	Yes	Yes	Yes		Yes	Yes	Yes	Yes

In the manual, when referring to the controllers, the model's name will be used to refer to the specific model. Otherwise:

- **GC315x**: to refer to all models GC315, GC315^{Link}, GC315^{Plus}.
- **GC400x**: to refer to all models GC400, GC400^{Link}, GC400^{Mains} and GC400$^{Mains+Link}$
- **LINK LTE** to refer to all models GC315^{Link} GC400^{Link} GC400$^{Mains+Link}$ equipped with a module that uses **GPRS/EDGE**, **LTE Cat M1** and **NB-IoT** radio access technology (RAT)**.**

In order to avoid misunderstanding, the basic models GC315 and GC400 will be referred as **GC315x and GC400x: they are used only in the manual, they do not appear on the front panel of the controller.**

1.2 Reference documents

[1] Mecc Alte EAAM0458xx Software Manual BoardPrg4.

[2] Mecc Alte EAAS0341xx Serial Communication and SMS Protocol.

[3] Mecc Alte EAAS0449xx Modbus Registers GC315.

[4] Mecc Alte EAAS0505xx Modbus Registers GC400.

[5] Mecc Alte EAAM0136xx User Manual J1939 interfaces.

[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 EAAM0199xx Parallel Functions Manual DST4602/GC500/GC400x.

[9] Mecc Alte EAAM0867xx Smart Cloud v1.2.0 Manual

1.3 Information on safety

A lot of accidents are caused by the insufficient knowledge or by the lacking of application of the safety rules to apply during the operating or maintenance procedures.

In order to avoid accidents, before carrying out any operating or maintenance procedure, read, understand and follow the precautions and warnings in this manual.

This manual contains the following indications:

CAUTION!	**This indication is used in the safety messages of the manual when there are possible danger situations that may cause injuries or death if the danger is not avoided.** **This safety messages describe the normal precautions needed to avoid danger. Ignoring these precautions can cause serious damage to property and/or injury to persons.**
WARNING!	**This indication is used in the safety messages for dangers that, if not avoided, may cause injuries, damages or malfunctioning.** **The message can also be used only for minor dangers that may cause damage to equipment and/or people.**
INFORMATION!	**This term indicates that the message includes useful information for the development of the operation or procedures clarifications.**

1.4 Maintenance and cleaning

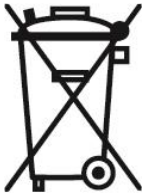
The maintenance of this device must be carried out by qualified personnel, in observance of the law in force, in order to prevent from damages to persons or things.

The cleaning of the front panel can be carried out exclusively with a soft cloth. Do not use abrasive products, detergents or solvents.

1.5 Information concerning disposal

INFORMATION!	**On the disposal of old electrical and electronic equipment (applicable in European countries that have adopted separate waste collection systems).**

Products bearing the barred wheeled waste container symbol cannot be disposed of with normal urban waste. Old electrical and electronic equipment should be recycled in a facility authorized to process these items and dispose of the components. Contact your local authority for information on where and how to deliver such products to the authorized site nearest you. Proper recycling and disposal helps conserve resources and prevents detrimental effects for health and the environment.



1.6 Introduction and prerequisites

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

All interventions must be carried out only by qualified personnel, because dangerous voltages are present on the terminals of the device; prior to performing any operation on the same, make sure you have opened the circuit breakers and generator set switches, or that you have removed their fuses.

Do not remove or modify any of the connections while the generator set is operating Do not, for any reason, disconnect the terminals of the current transformers (CTs).

Incorrect interventions on the connections can result in disconnection of the users from the mains or from the generator.

⚠ **CAUTION!**	**Please read this manual carefully before using the device.**

⚠ **CAUTION!**	**The device uses a large number of configurable parameters, and it is therefore impossible to describe all their possible combinations and effects.**

⚠ **CAUTION!**	**The devices are supplied with a generic "default" configuration; is the responsibility of the installer to adjust the operating parameters to his/her specific application.**

Mecc Alte makes considerable efforts for a continuous improvement and upgrading of its own products; therefore, they are subject to modifications both in hardware and software, without prior notice. Some of the features described in this manual may therefore differ from those present in your device.

1.7 Switch SW1

⚠ **CAUTION!**	**Both the SW1 switches must remain in OFF position.**

The SW1 switches are reserved for accessing special features that are not part of the normal operation of the device.

If the device is powered with one of the two switches in ON position, it will not turn on. To restore normal operation, you need to cut the power to the same, turn the switches OFF and power it again.

In case the device does not turn on when powered, the first thing you must do is to check the position of the switches.

1.8 Notes on the configuration of the device parameters.

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 Meccalte Board Programmer4 PC Software** (hereinafter referred to as “BoardPrg4”) which can be downloaded for free from the Mecc Alte website www.meccalte.com

It greatly simplifies the configuration of the device and its use is strongly recommended. 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 the Mecc Alte devices; connection to the PC can be realized both directly, via the RS232 serial port, USB, or remotely via modem, RS485 serial port or ethernet network. To use the program, refer to document [1] .

1.9 Definitions

In this document, the word "**ALARM**" is used to indicate a critical fault that opens the breaker and shuts down the genset immediately without cooling down. The genset then cannot be operated until the problem is resolved and the fault is cleared on the module.

The word "**DEACTIVATION**" is used to indicate a fault that opens the breaker immediately then cools down the engine for the cooling period. Afterwards the genset will not be able to operate until the problem is resolved and the fault is cleared on the module.

The word "**UNLOAD**" (only applicable on the GC400x controllers and when the genset is in parallel with other generators or mains) is used to indicate a fault that first causes the generator to ramp down its load, once the generator power becomes zero then it opens the breaker to cool down the engine before stopping. Afterwards the genset will not be able to operate until the problem is resolved and the fault is cleared on the module. This type of fault is only applicable on the GC400x controllers.

The word "**WARNING**" is used to indicate a fault that requires the operator's attention and action but doesn't cause a shutdown or interruption of power.

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

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

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

AIF ("ANALOGUE Input Function"): the following is a code for the configuration of the ANALOGUE inputs.

AOF ("ANALOGUE Output Function"): the following is a code for the configuration of the ANALOGUE outputs.

AVF ("ANALOGUE Virtual Function"): the following is a code for the configuration of the virtual ANALOGUE inputs.

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

ST ("Status"): the following code shows the status of a dimension or a condition of the device or of one of its functions.

1.10 Conventions

In this document a vertical bar on the right margin or a grey background indicates that the chapter or the paragraph has been amended respect to the previous document's version. Changes in the fields of a table are highlighted with a grey background colour.

1.11 Terms and Abbreviations

EDGE *Enhanced Data rates for GSM Evolution (E)*

GNSS *Global Navigation Satellite System*

GPRS *General Packet Radio Service*

GPS *Global Positioning System*

GSM *Global System for Mobile*

IoT *Internet of Things*

IP *Internet Protocol*

LTE *Long Term Evolution*

LTE-M *Long-Term Evolution Machine Type Communications Category M1*

NB-IoT *Narrowband IoT*

RAT *Radio Access Technology*

RF *Radio Frequency*

SIM *Subscriber Identification Module*

SMS *Short Message Service*

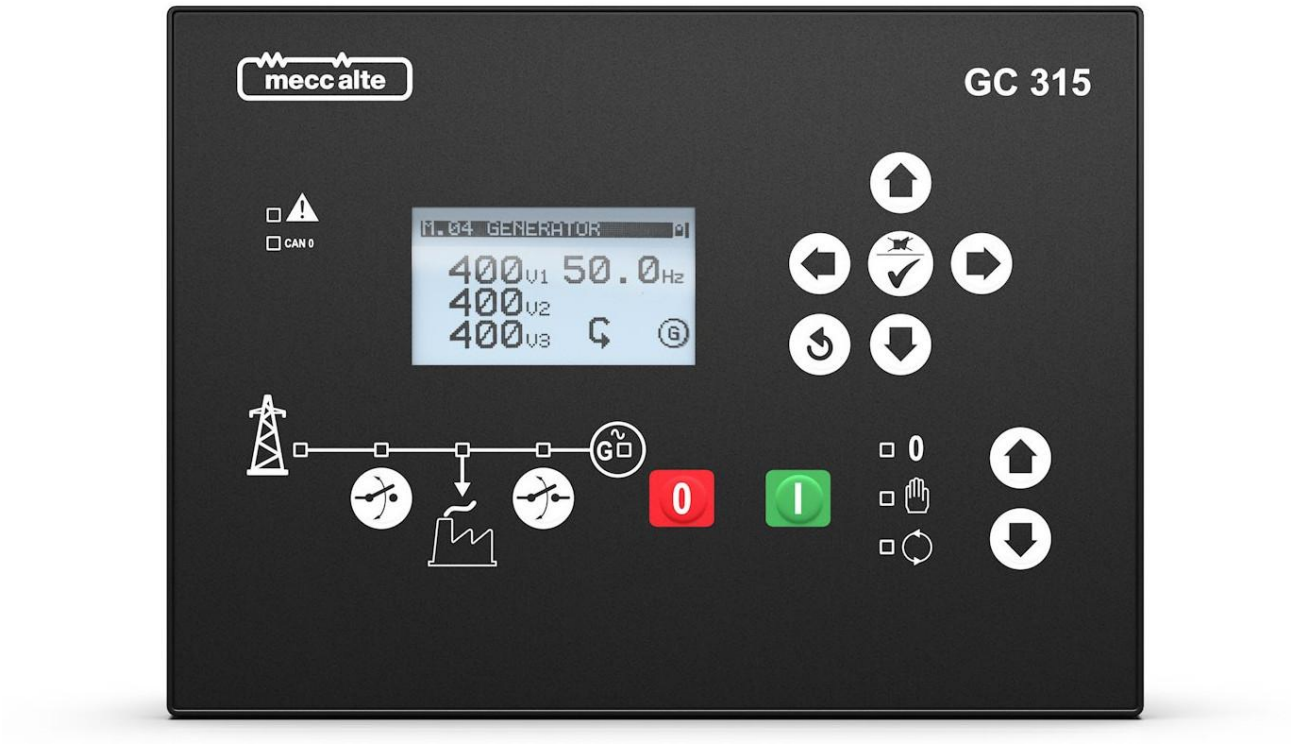
1.12 Software revisions

Several parts of this manual refer to the controller's software revisions. These revisions are marked with the assigned Mecc Alte code (shown on the rear panel of the controller). Software code version has the following format: EB0250427XXYY, where "XX" is the main revision number and "YY" is the secondary revision number. Thus, the code EB02504270100 refers to the controller's software release "1.00". The software revision is also displayed on page “S.03” of the LCD display.

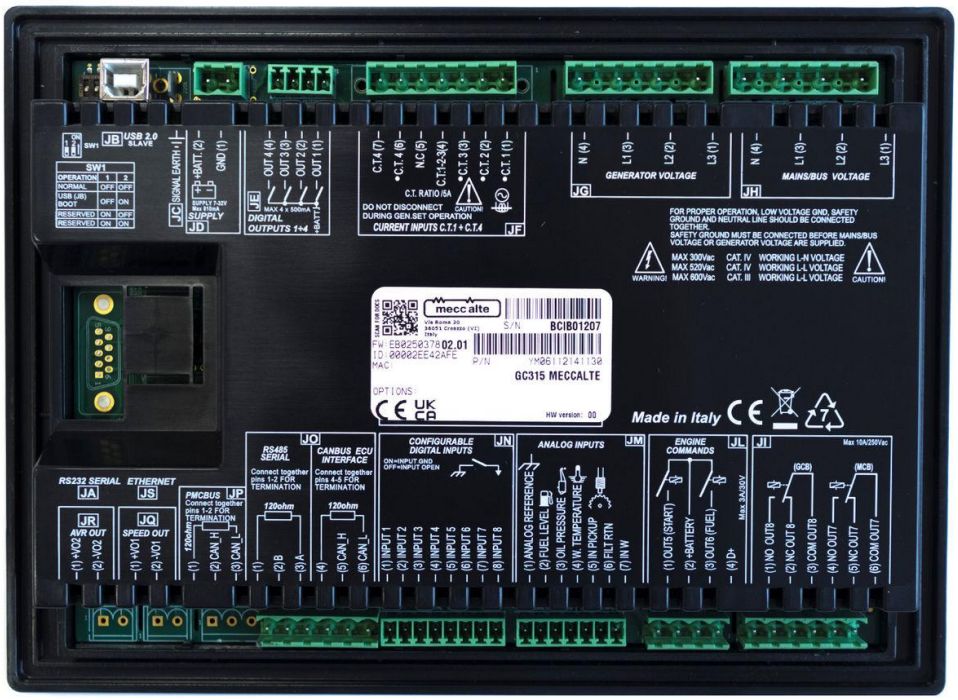
The software codes available at the release date are:

- **EB0250426xxyy: GC315x** with 1Mb Flash memory.
- **EB0250427xxyy: GC315x** with 2Mb Flash memory**.**
- **EB0250425xxyy: GC400x**

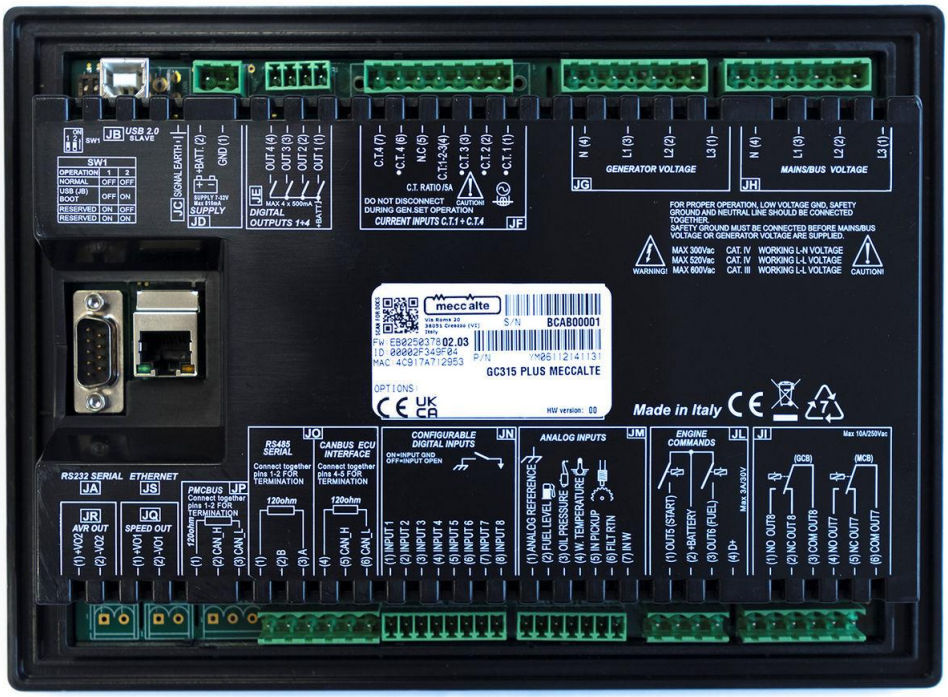
2 Views of the device



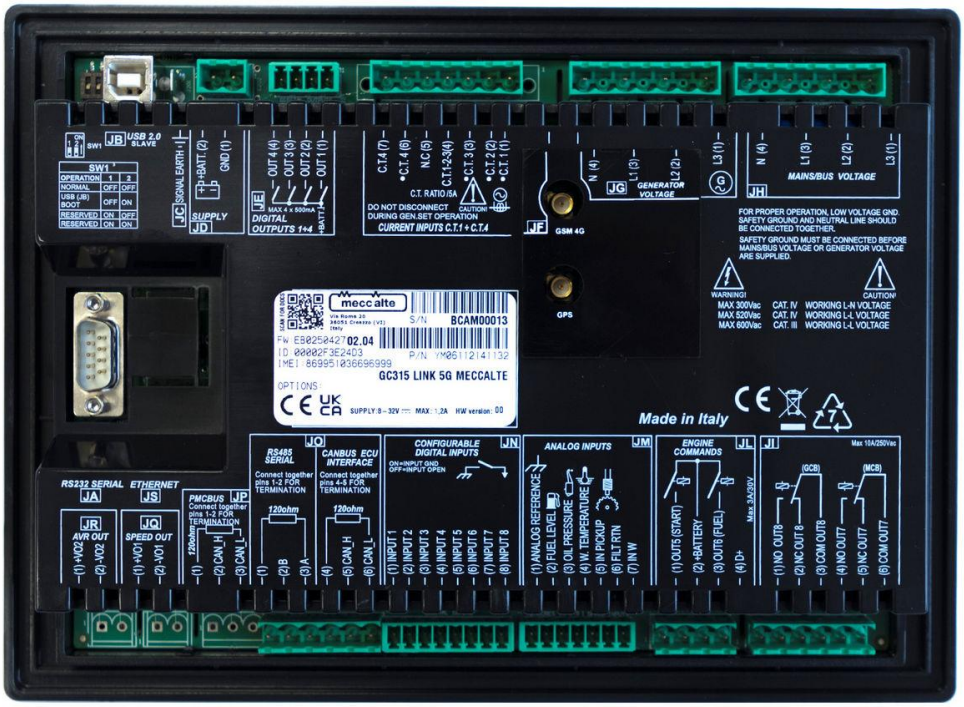
Front GC315



Rear GC315

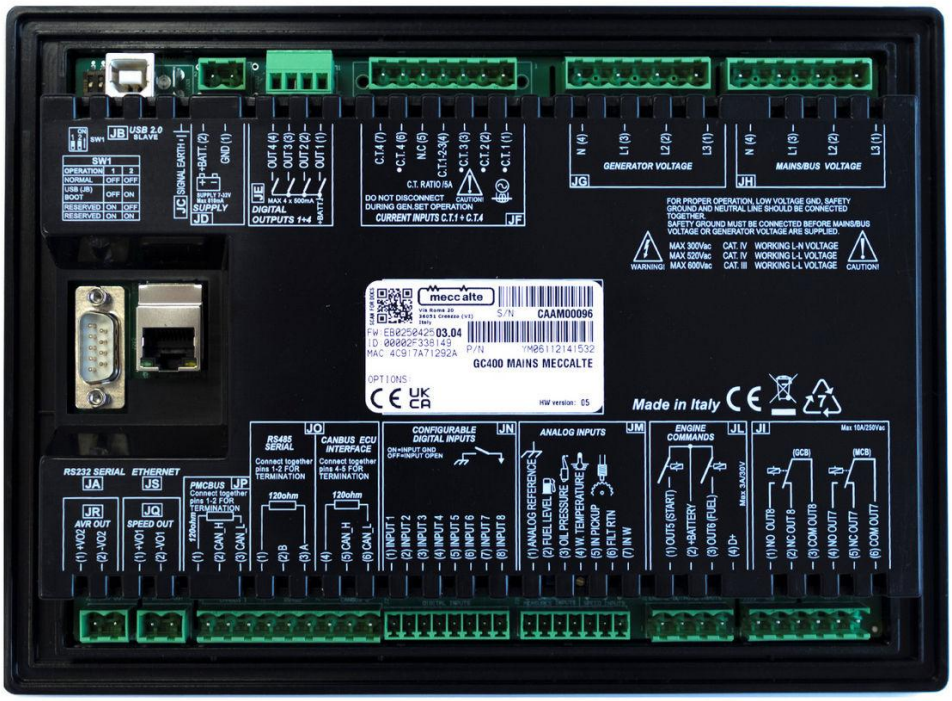


Rear GC315*Plus*

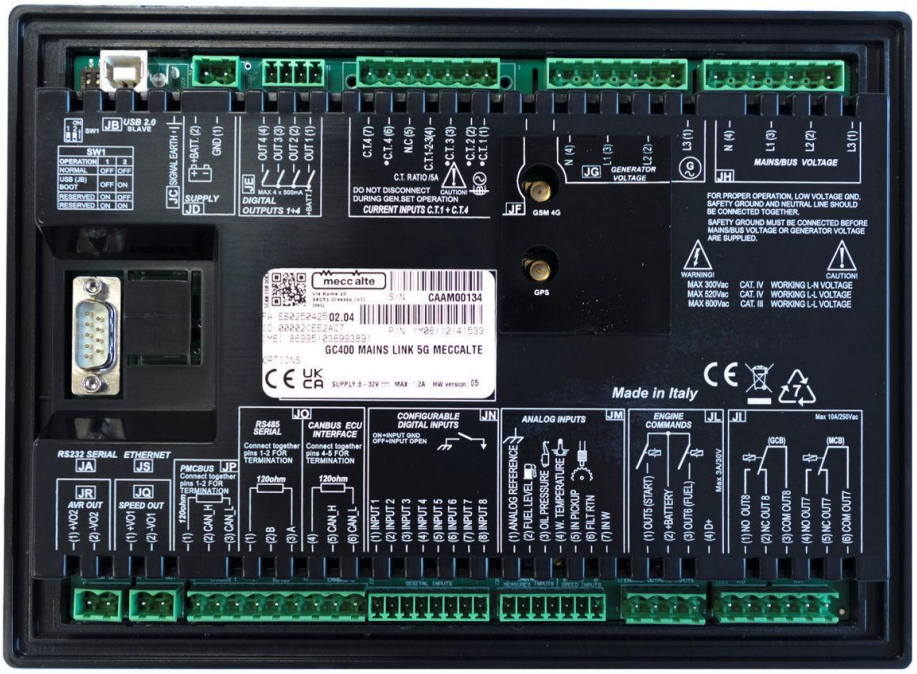


Rear GC315*Link*

Front GC400Mains



Rear GC400Mains



Rear GC400**Link** and GC400Mains+Link

3 Technical feature

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

WARNING! Connect the unit only to a DC power source that complies with the safety extra-low voltage (SELV) requirements.

Supply power voltage +VBATT (JB):	
Nominal power supply (Vn).	12 Vdc or 24 Vdc.
Power supply range (Vn variation)	From 7 to 32 Vdc for GC315, GC315^{Plus} , GC400 and GC400^{Mains} controllers From 8 to 32Vdc for GC315 ^{Link}, GC400 ^{Link} and GC400$^{Mains+Link}$ controllers. The device identifies the rated DC voltage (12 Vdc or 24 Vdc) when powered up and whenever OFF mode is selected: it is used to signal over/under voltages.
Starting minimum voltage.	During the engine cranking, the operation is guaranteed up to Vbat ≥ 5 Vdc for indefinite time.
Input capacitance.	About 880 µF.
Sampling rate.	10 kHz.
Measurement Resolution.	12 bits.
Power consumption in stand-by:	For GC315, GC315^{Plus}: 300mA @ Vbatt =13,5VDC display lamp on 280mA @ Vbatt =13,5VDC display lamp off 170mA @ Vbatt =27 VDC display lamp on 160mA @ Vbatt =27 VDC display lamp off For GC400. GC400^{Mains}: 400mA @ Vbatt =13.5VDC display lamp on 310mA @ Vbatt =13.5VDC display lamp off 210mA @ Vbatt =27 VDC display lamp on 190mA @ Vbatt =27 VDC display lamp off On the Link controller the consumption depends on the data exchange activity with the cellular network, the quality of the connection and the charging status of the optional internal battery. When the internal battery is low, the maximum power consumption in stand-by mode is: GC315 ^{Link}, GC400 ^{Link} and GC400$^{Mains+Link}$: about 650mA @ Vbatt=13.5VDC internal battery in charge about 350mA @ Vbatt=27 VDC internal battery in charge

Maximum power consumption during operation: Conditions: • Digital input & outputs active. • Analogue outputs @ +10V. • Ethernet ports in communication (GC315Plus Only) • USB communication active. • Horn Active • **static outputs and +D not active**	For GC315, GC315^{Plus}: Max 700mA @ 7 VDC 400mA @ 27 VDC 450mA @ 13,5 VDC For GC400. GC400^{Mains}: Max 800mA @ 7 VDC 430mA @ 27 VDC 480mA @ 13,5 VDC On the ***Link*** controller the consumption depends on the data exchange activity with the cellular network, the quality of the connection and the charging status of the optional internal battery. When the internal battery is low, the maximum power consumption in stand-by mode is: GC315 ^{Link} and GC400^{Link}: about 1400mA @ Vbatt=8VDC **INFORMATION! All the current supplied to the four static outputs (Digital outputs 01…04) and to the +D signal (JL-4) flows through the positive input +BATT (JB-2). The declared max current consumption does not include the load drawn by the controller's digital DC outputs. These additional loads must be considered to ensure proper sizing of the protection fuse and the wiring cable cross-section.**
Protection.	Protection against polarity reversal with built-in self-resetting fuse. Overvoltage protection with integrated TVS: typical tripping voltage 39 Vdc. Circuit protection against load dump transients and voltage surge (1.2/50 µs): ±1 KV Line-Line. ±2 KV Line-Earth.
Mains and Genset voltage inputs (JH and JG)	
Type of input.	3-phases voltage measurements (L1/L2/L3/N). Measurement of the phase to neutral and phase to phases voltages. Measurements of the neutral voltages referred to the device supply negative (GND). External fuse maximum 1 A..
Nominal range (Vn).	100 to 480 Vac phase to phase.
Measurement range.	Max 354* Vac for measures phase to neutral. Max 613* Vac for measures phase to phase. ***with voltage N-GND = 0 Vac**
Maximum voltages applicable. *	MAX 300Vac in CAT.IV for measurements phase to neutral. MAX 520Vac in CAT.IV for measurements phase to phase. MAX 600Vac in CAT.III for measurements phase to phase. * Up to 2000 m (6561 ft.)
Scale	It can be adjusted through the device parameters between 100V and 400V.

Max tension in Common-Mode from GND	Max 100 Vac @ 440Vac L-L
Connection mode	3 phases 4 wires. 3 phases 3 wires. 2 phases 3 wires. 1 phase 2 wires. Aron insertion with 2 voltage transformers.
Input impedance per path	> 320 KΩ L-L > 170 KΩ L-N > 390 KΩ L-GND > 310 KΩ N-GND
Measurement/overvoltage categories.	CAT. III, CAT. IV.
Type of measurement.	True RMS (TRMS).
Sampling rate.	10 KHz.
Measurement resolution	12 bit
Measurement accuracy	± 0,5% of full-scale reading.
Phase angle accuracy.	± 0,2° (within nominal voltage range and nominal frequency range).
Current measurement inputs (JF)	
Type of input.	3 inputs with internal SHUNT resistor optimized for the connection towards external current transformer (CT) with common CT's ratio 1 independent auxiliary current with internal shunt resistor optimized for the connection towards external current transformer (CT) that can be used as current measurement for Neutral or differential protection. It is required the use of external current transformers (CT) with a secondary current of 1A or 5A (recommended). **The return connection of the CTs to the negative power supply of the device (JD-1) is required.** **WARNING! The external CT must guarantee at minimum REINFORCED (DOUBLE) isolation for the use of the device in the Overvoltage CAT. III or Overvoltage CAT. IV**
Nominal Current (In).	-/1 Aac or -/5 Aac from current transformers.
Maximum measurement range.	Up to 5,3Aac
Input impedance.	20 mΩ.
Maximum currents allowed:	+ 40% of the rated current. Possible sinusoidal transient voltage surges up to 20 Aac with progressive loss of the measurement accuracy depending on the amplitude of the surge.
Sampling rate.	10 kHz.
Type of measurement	True RMS measurements (TRMS).
Burden per phase (auto-consumption).	< 1 VA/phase.
Measurement resolution	12 bit
Measurement accuracy	± 0,2% of full-scale reading (excluding external CT error).
Measurement resolution displayed.	Minimum 0.1 Aac (it depends on the CT ratio).

Frequency measurements	
	Frequencies measured by phase voltages L1 versus the negative terminal of the controller, for both mains/bus and genset.
Nominal Frequency (Fn).	50 Hz or 60 Hz.
Measurement range.	5 to 80 Hz.
Measurement accuracy.	± 50 mHz
Frequency minimum sensitivity on mains voltage inputs	35Vac L1-N @ 50Hz 36Vac L1-N @ 60Hz
Frequency minimum sensitivity on Genset voltage input	10Vac L1-N @ 5Hz 17Vac L1-N @ 50Hz 20Vac L1-N @ 60Hz The sensitivity decreases with the increase of the frequency for the acknowledgement of the engine running and for a higher rejection of the disturbances.
Measurement resolution	0,1Hz ± 50ppm, 35ppm/C typical
Digital inputs 01-08 (JN)	
Input type	8 not insulated digital inputs with same supply, internal supply terminal connected to the device positive JD-2 (+BATT). They are active when the input is connected to the supply negative GND. When they are open, the inputs terminals voltage is Vbatt.
Input impedance.	2.2 kΩ.
Activation/deactivation threshold	2,5Vdc
Voltage withstands	± 40Vdc with respect to negative power supply (with Vbatt= 7Vdc) -15Vdc and +40Vdc with respect to negative power supply (with Vbatt= 32Vdc)
Typical current with closed contact	6,5mA @ +Vbatt= 13,5Vdc 12mA @ +Vbatt= 27Vdc
Open circuit voltage.	Input terminal is a Vbat.
Input signal delay	It can be adjusted by the related parameter for each input
Digital outputs 01-04 (JD)	
Type of output	4 independent static outputs to battery positive. The output current is supplied by the positive supply terminal of the device JD (2) +Vbatt. All outputs are adjustable by parameter.
Maximum switching capacity	0,5Adc @ 32Vdc for each output with maximum total current for all outputs of 1 Adc
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. **INFORMATION!** With particularly inductive loads (remote control switches, electromagnets, etc.), a surge-damping diode must still be used.

Digital outputs 05 and 06 (JL) - Engine commands Start and Fuel	
Type of output	2 relays with NO contacts. Positive common input terminal (JL-2). 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): **the function can not be disabled.** 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	Surge protection diodes incorporated. INFORMATION! With particularly inductive loads (remote control switches, electromagnets, etc.), a surge-damping diode must still be used.
Digital outputs 07 and 08 (JI) - 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 in CAT.II
Output D+ and analogue input 04 (JL4)	
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	Typ 200mA @ 13,5 Vdc Typ 100mA @ 27 Vdc
Frequency	10kHz
Resolution	12 bit
Analogue inputs Engine instruments (JM-2 to JM-4) and Vref (JM-1)	
Type of input	3 adjustable analogue inputs, which can be used as engine equipment. Adjustable as resistive and digital inputs. If used as digital inputs, activation to GND. For the resistive sensors, there's an input for the measurement and compensation of the reference potential with respect to the sensor common negative (JM1-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 5Vdc
Digital inputs	Input activation threshold: 1,2Vdc Input deactivation threshold: 2,2Vdc If the input is open, it's deactivation Injected current: 25mA max.
Frequency	10kHz
Resolution	12 bit

Pick-up input for the measurement of the engine speed (JM-5 and JM-6)	
Input type.	Filtered for DC currents blocking (capacitively isolated). If the sensor has two wires, use the JM-5 (input) and JM-6 (return) terminal. If the sensor has only one wire, use only the JM-5 (input) terminal. To use the MPU (Magnetic Pick-Up) input, the number of teeth on the flywheel (the number of pulses per revolution of the engine) must be configured
Minimum voltage	1,3Vac @ 3kHz
Maximum voltage	60Vac
Frequency range	1Hz – 10000Hz
Frequency measurement tolerance.	± 0.2% of full-scale reading.
Flywheel teeth.	0 to 999.
Resolution.	1 rpm.
“W” inputs for the measurement of the engine speed (JM-7)	
Input type.	Filtered for DC currents blocking (capacitively isolated). Use the W input (JM-7) with internal noise filter by connecting pins 5 and 6 of the JM connector together. To use the W input, the RPM/W ratio must be configured.
Minimum voltage.	Typical 2.5 Vac @ 3kHz.
Maximum voltage.	60 Vac.
RPM range.	1 to 5000.
Frequency measurement tolerance.	± 0,2% of full-scale reading.
RPM/W ratio.	0 to 255.
Resolution.	1 rpm.
Analogue outputs 01 and 02 (JR and JQ) (Only for GC400x)	
Type of output	2 galvanically insulated ±10Vdc voltage outputs They can be used for the AVR and engine speed analogue regulation.
Regulation range	From -10Vdc to +10Vdc (the range can be reduced by parameters)
Resolution	16 bit (0,3mV/bit)
Minimum load impedance	>10 kΩ
Insulation rated voltage	3000 Vac Insulation for 60s
Insulation resistance	>1000MΩ @ 500Vdc
COM1 - RS232 Communication interface (JA)	
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**

COM2 - RS485 Communication interface (JO) (Only GC315Plus and GC400x)	
Type of interface	1 RS485 serial port standard TIA/EIA, with galvanic insulation. Terminal resistor connectible by connecting to each other terminals 1 and 2 of JO
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	1000 Vdc Insulation for 60s
Insulation resistance	>1000MΩ @ 500Vdc
	INFORMATION! twisted pair shielded cable is recommended to achieve specification and optimisation of immunity-noise.
USB 2.0 Communication interface (JB)	
Type of interface	1 USB2.0 serial port not insulated; it's used in Function mode.
Function Mode	Connection to PC by USB Driver USB Connector type B. Type of transmission Modbus RTU Slave
Maximum distance	3 m (9.84 ft).
CAN0 - CANBUS Communication interface ECU (JO)	
Type of interface	1 CANBUS serial ports with galvanic insulation (CAN0) Canbus connection with protocol SAE J1939 and MTU for ECU engine control. Terminal resistor connectible by connecting to each other terminals 4 and 5 of JO
Rated impedance	120Ω
Insulation voltage	1000 Vac Insulation for 60s
Maximum distance.	The maximum length of the communication bus wiring depends on the configured baud rate, cable capacitance, inductance, and shielding. CAN bus 0: maximum 40 m (133 ft).
CAN1 - CANBUS Communication interface PMCBus (JP) (Only and GC400x)	
Type of interface	1 CANBUS serial ports with galvanic insulation (CAN1) Canbus connection with protocol Mecc Alte PMCBus for the communication with other devices. Terminal resistor connectible by connecting to each other terminals 1 and 2 of JP.
Rated impedance	120Ω
Insulation voltage	1000 Vac Insulation for 60s
Maximum distance.	The maximum length of the communication bus wiring depends on the configured baud rate, cable capacitance, inductance, and shielding. CAN bus 1: maximum 200 m (656 ft).

Ethernet Communication interface (JS) (Only GC315Plus and GC400x)	
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	Functional Insulation. 1500 Vac Insulation for 60s.
Rated surge voltage.	±1 KV (1.2/50 µs).
Real-time clock	
Type RTC.	Provides year, month, day, weekday, hours, minutes, seconds and 100th seconds based on a 32.768 kHz quartz crystal.
Battery back-up.	Rechargeable.
Life span (operation without power supply).	Approximatively 3 months: depending on ambient temperature.
Battery field replacement.	Field replacement of the battery is not allowed. In case of battery replacement please contact Mecc Alte.
Display	
Type of display	Transflective graphic monochrome LCD with backlight illumination with white leds.
Resolution	128 x 64
Pixel Size	0,48 x 0,48 mm
Visual area dimensions	70 x 39 mm
Environmental conditions	
Operating temperature	From -25°C to +60°C From -25°C to +50°C (for GC315^{Link} and GC400^{Link} with internal battery)
Storage temperature	From -30°C to +80°C From -25°C to +50°C (for GC315^{Link} and GC400^{Link} with internal battery)
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).
Pollution degree.	PD2.
Box	
Material	PC
Size	244(L) x 178(H) x 40(D) mm
Weight	GC315 600g GC315^{Plus} 620g GC315^{Link} 650g GC400 650g GC400^{Link} 750g GC400^{Mains} 650g GC400$^{Mains/Link}$ 750g
Protection degree	IP55 with gasket for the front panel IP20 for the panel interior

3.1 Measurement resolution

Mains voltages and generator	1Vrms accuracy ±0,5% F.S.
Current	Min. 0,1A (depends on the C.T.), accuracy ±0,2% F.S.
Mains frequencies and generator	0,1Hz ± 50ppm, 35ppm/C typical
Powers	Min. 0,1 kW/kVA/kvar (depends on the C.T. ratio)
Power Factor	0,01
Energy	1 kWh/kvarh
Engine speed	1 rpm
Oil pressure	0,1bar (below 10bar)
Coolant temperature	0,1°C / 0,1°F
Fuel level	0,1%

3.2 Additional characteristics of LINK LTE series device (GPRS/EDGE/LTE)

<table>
<tr><td>Protocol stack</td><td colspan="2">3GPP Release 13</td></tr>
<tr><td rowspan="2">Radio Access Technology (RAT)</td><td colspan="2">LTE Cat. M1
LTE Cat. NB-IoT
Band: B1/B2/B3/B4/B5/B8/B12/B13/B18/B17/B19/B20/B26/B28/B39*
*B39 Supported only with LTE Category M1</td></tr>
<tr><td colspan="2">GSMGPRS/EDGE
Band: 850/900/1800/1900Mhz</td></tr>
<tr><td rowspan="2">Transmitting power</td><td>GPRS power class:
EGSM900: 4 (2W)
DCS1800: 1 (1W)</td><td>EDGE power class:
EGSM900: E2 (0.5W)
DCS1800: E1 (0.4W)</td></tr>
<tr><td colspan="2">LTE power class:
CAT M1 and NB-IoT: 3 (0.25W)</td></tr>
<tr><td rowspan="2">Data Transmission Throughput</td><td>LTE CAT-M1:
Uplink up to 375kbps (Half duplex)
Downlink up to 300kbps (Half duplex)
Uplink up to 1Mbps (Full duplex)
Downlink up 1Mbps (Full duplex)</td><td>LTE NB-IoT:
Uplink up to 66kbps
Downlink up to 34kbps</td></tr>
<tr><td>EDGE Class:
Uplink up to 236.8Kbps
Downlink up to 236.8Kbps</td><td>GPRS:
Uplink up to 85.6Kbps
Downlink up to 85.6Kbps</td></tr>
<tr><td rowspan="3">Global Navigation Satellite System (GNSS)</td><td>GPS
1575.42 ± 1.023Mhz</td><td>GLONASS
1597.52–1605.92Mhz</td></tr>
<tr><td>Galileo
1575.42 ± 2.046Mhz</td><td>BeiDou
1561.098 ± 2.046Mhz</td></tr>
<tr><td colspan="2">Receiver Type: 16-channel C/A Code</td></tr>
</table>

	Sensitivity GNSS Tracking: -167 dBm (GPS) /-157 dBm (GLONASS) Reacquisition: -157 dBm Cold starts: -148 dBm
	Stand-alone Time to First Fix (TTFF) Cold start: <35s Hot start: <1s
	Accuracy in open sky < 2.5m (CEP50)
Antenna RF (GSM/LTE)	50 ohm nominal characteristic impedance
Antenna GNSS	50 ohm nominal characteristic impedance The plug of the Link device provides automatically the power supply required (Max 35mA@3,3Vdc).
Inertial motion sensors features	**3D Accelerometer:** Linear acceleration measurement range: ±2 g/±4 g/±8 g/±16 g Linear acceleration sensitivity FS = ±2 g 1 mg/digit FS = ±4 g 2 mg/digit FS = ±8 g 4 mg/digit FS = ±16g 12 mg/digit **3D Gyroscope:** Angular rate measurement range: ±250/±500/±2000 dps Angular rate sensitivity FS = ±250 dps 8.75 mdps/digit FS = ±500 dps 17.50 mdps/digit FS = ±2000 dps 70 mdps/digit
Internal Battery optional	Lithium-Ion internal rechargeable battery Nominal Voltage: 3.7V Nominal Capacity:1800mAh
	Full charge requires approximately 12 hours
	The battery life time depends on several factors, such as the environment temperature, the data sending frequency and the mobile network signal intensity. Minimum about 10h with data transmission interval of 3 min and good signal level; it is higher using the energy saving mode.

4 Installation

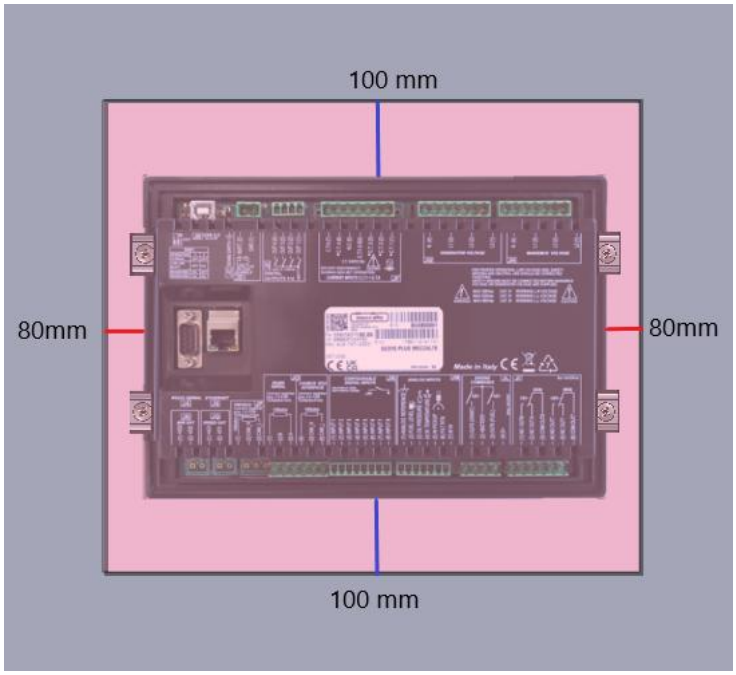
4.1 Mounting

The device must be mounted permanently on an electrical panel or cabinet. The back of the device must be accessed only through the use of keys or tools, and only by personnel authorized to perform maintenance operations. The device must be mounted so as to make it impossible to remove it without using tools. The electric control panel has to guarantee an adequate protection against bad weather.

The following clearances are required around the device to ensure sufficient self-ventilation:

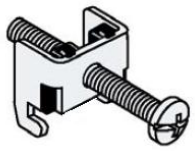
- At least 80 mm to both the right and left of the mounting cutout (in **x** direction) for ventilation.
- At least 100 mm above and 100 mm below the mounting cutout (in the **y** direction) for ventilation.
- At least 80 mm behind the rear panel of the device (in the **z** direction).

The following figure shows the clearances for mounting the devices and minimum free space (pink color):



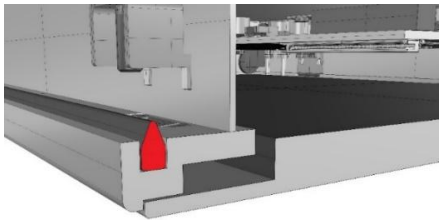
4.1.1 Fixing clamps

The device must be mounted using four fixing clamps from the accessory pack.



4.1.2 Gasket assembly

The supplied silicon gasket provides improved sealing between the device and the switchboard door. The gasket must be fitted to the device before installing it into the control cabinet door. Take care to ensure the gasket is correctly fitted to the device to maintain the integrity of the seal.



The gasket is shaped like a triangle. The base of the triangle must be inserted into the cavity of the device; the upper edge of the triangle must engage with the control cabinet door.

INFORMATION: a gasket that has been used for a long period may have scratches or dirt on its surface and could have lost much of its dust and drip resistance. Change the gasket once a year or when scratches or dirt become visible

4.1.3 Panel-cut Dimensions

INFORMATION: the material around the mounting cutout must provide sufficient strength to guarantee lasting and safe mounting of the device.

INFORMATION: to achieve the degrees of protection declared, it must be ensured that deformation of the material cannot occur due to the force of the mounting clips or operation of the device

The degrees of protection of the device can only be guaranteed if the following requirements are met:

- Material thickness at the mounting cutout for a degree of protection IP65: 1 mm to 4 mm.
- Permissible deviation from plane at the mounting cutout: ≤ 0.5 mm This condition must also be fulfilled for the mounted device.
- Permissible surface roughness around the seal: ≤ 120 µm.
- The installation area is dry and free from contamination, such as dust or lubricant.

Cut out the door so that it has a groove with the dimensions 218(L) x 159(H) mm.

4.1.4 Mounting the device

- Place the panel on a clean and level surface with the display face pointing downward.
- Check that the installation gasket of the panel is seated securely and runs all the way around the perimeter of the frame.
- Create the correct sized opening required to install the panel, using the installation dimensions.
- Insert the device into the panel cutout and verify that the unit fits correctly in the cutout.
- Once the device is positioned, insert the nose of the fixing clamps into the slot on the sides of the device.
- Pull the fixing clamps backwards towards the back of the device.
- Ensure that the gasket is properly positioned in the groove and against the panel.
- Tighten the clamping screws until they contact the control cabinet door.
- Tighten the screws on all clamps, alternating from one side to the other until the front bezel is secure against the mounting panel. Torque the screws to 0,2-0,3 Nm.
- Over tightening of these screws may result in the clamp inserts or the housing breaking.

INFORMATION: do not exceed the recommended tightening torque.

INFORMATION: the mounting surface and the operating device may not become deformed because of the fixing clamps or through the operation of the device

4.2 Wiring

Due to high voltages associated to the measurement circuits of the controller, all the conductive parts of the electrical panel must necessarily be connected to the protective earth by means of permanent connections.

Installing an overcurrent protection device is required for each phase of the mains and generator voltage inputs. 1A fuses can be conveniently used.

The conductor cross-section of the protective earth of the electrical panel must be at least equal to the section of the wires used for wiring the mains or generator voltage to the panel. In addition, it must comply with the limit value of the overcurrent protection used.

For CAT.III applications, the maximum phase-to-neutral voltage allowed is 300Vac, while the phase-to-phase voltage is 520Vac. Maximum voltage with respect to the protective earth is 300Vac.

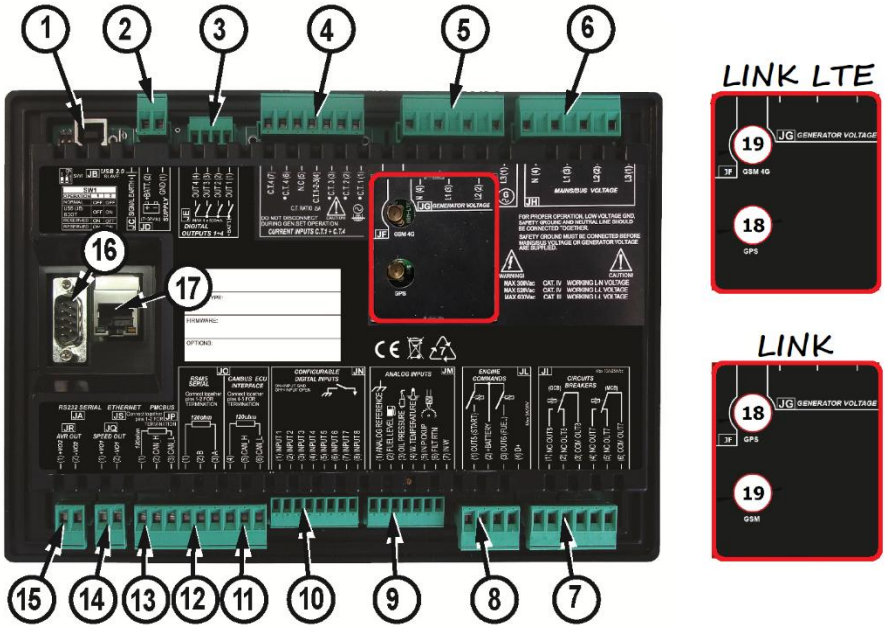
For CAT.IV applications, the maximum phase-to-neutral voltage allowed is 345Vac, while the phase-to-phase voltage is 600Vac. Maximum voltage with respect to the protective earth is 345Vac.

The device can operate in CAT.III or CAT.IV only if the external current transformers (TA) guarantee a REINFORCED (DOUBLE) insulation.

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

⚠ **ATTENTION!**	**Terminal temperatures may reach up to 80 °C during operation.Use copper conductors only, rated for a minimum insulation temperature of 90 °C (e.g., 90 °C PVC insulated wires or equivalent).** **Using conductors with a lower temperature rating may result in insulation damage and fire hazard**

5 Connections and IN/OUT configuration



No.	NAME	DESCRIPTION	CONNECTOR
1	JB	USB	USB B
2	JD	Power supply	2 poles x2.5mm² Screw terminal
3	JE	Auxiliary Outputs	4 poles x1.5mm² Screw terminal
4	JF	Currents Input	7 poles x2.5mm² Screw terminal
5	JG	Generator Voltages	4 poles x2.5mm² Screw terminal
6	JH	Mains Voltages	4 poles x2.5mm² Screw terminal
7	JI	Remote control switches	6 poles x2.5mm² Screw terminal
8	JL	Engine commands	4 poles x2.5mm² Screw terminal
9	JM	Pick-Up / W - Engine tools	7 poles x1.5mm ² Screw terminal
10	JN	Digital inputs	8 poles x1.5mm ² Screw terminal
11	JO	ECU Can-bus J1939 (not available on GC315)	6 poles x2.5mm² Screw terminal
12		RS485 Interface (not available on GC315)	
13	JP	PCMBUS Interface for parallel functions (available only for GC400x)	3 poles x2.5mm² Screw terminal
14	JQ	ANALOGUE output for speed regulator (available only for GC400x)	3 poles x2.5mm² Screw terminal

15	**JR**	ANALOGUE output for voltage regulator (available only for GC400x)	3 poles x2.5mm^2 Screw terminal
16	**JA**	Interface RS232 (Only GC315^{Plus})	9 Poles Male Canon
17	**JS**	Ethernet (not available on GC315, GC315^{Link}, GC400^{Link} and GC400$^{Mains+Link}$)	RJ45
18	**GPS**	GNSS Receiver Antenna (**Link LTE**)	1 SMA female connector
19	**GSM 4G**	RF Antenna for GSM-LTE (only for **Link LTE**)	1 SMA female connector

5.1 GC315xx plant type

The GC315x device can manage three types of plants:

- **SPM – Single Prime Mover**: it is a plant where the mains is not present; the generator is usually started manually or from remote to supply the loads.
- **SSB – Single Stand By**: it is the case of the emergency plant in which the electric mains status is monitored; the genset is usually started automatically in case of anomalies on the mains and it is stopped when anomalies stop.
- **DRIVE** – **only engine:** the controller does not manage a generator set, but only an engine (motor pump or other).

The selection is done through parameter P.0802

P.0802 = 0 SPM plants.

P.0802 = 1 SSB plants (default configuration)

P.0802 = 11 DRIVE plants

The digital outputs of the GC315x can be configured to activate/deactivate according to the type of plant selected. AND/OR logics must be used, with the following states:

- ST.336: SPM system
- ST.337: SSB system
- ST.346: DRIVE system

5.2 GC400x plant type

The GC400x device 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 (GC400x 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 GC400x directly manages the grid), MSB to plants consisting of several gensets (an MC controller is required for the grid management, GC400x 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 GC400x 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, GC400x 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 GC400x 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, GC400x 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 GC400x 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, GC400x 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 2.11, GC400x 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.

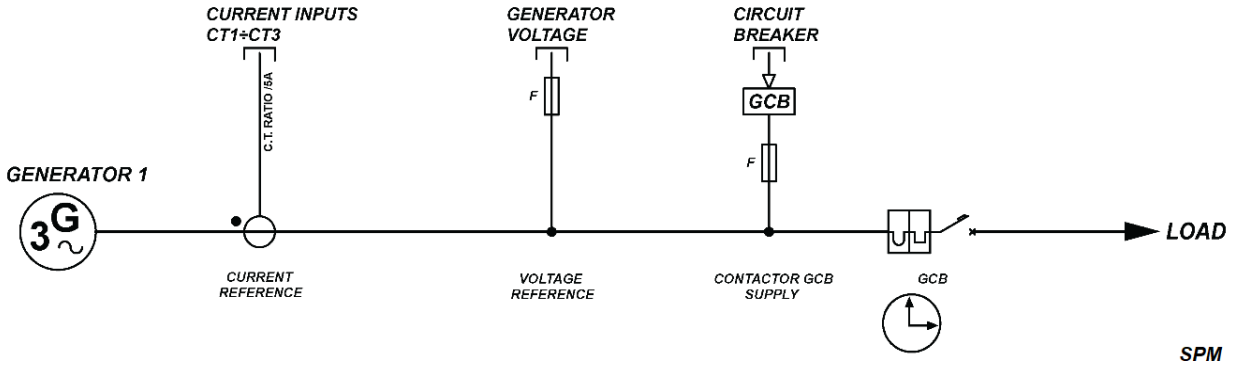
The new plant is selected when. In the previous conditions, the status of the digital inputs is stable for one second.

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:

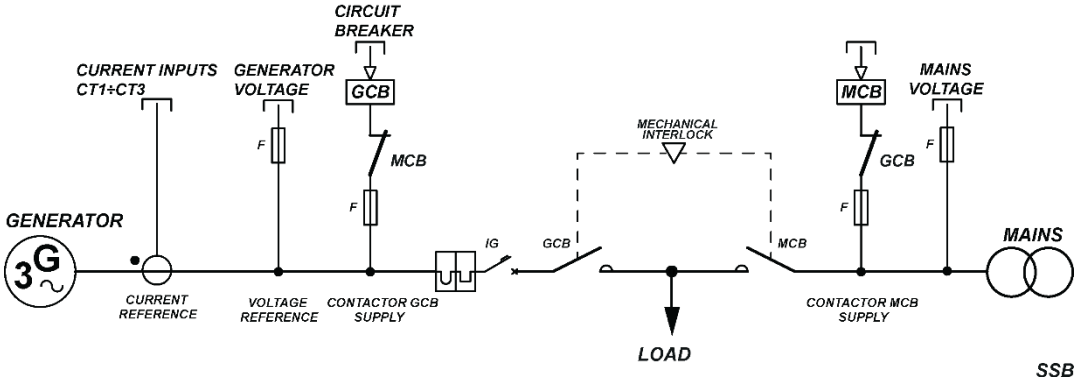
- ST.336: SPM plant
- ST.337: SSB plant
- ST.338: SSB + SSTP plant
- ST.339: SPTM plant
- ST.340: SPTM + SSB plant
- ST.341: MPM plant
- ST.342: MSB plant
- ST.343: MSB + MSTP plant
- ST.344: MPTM plant
- ST.345: MPTM + MSB plant

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.

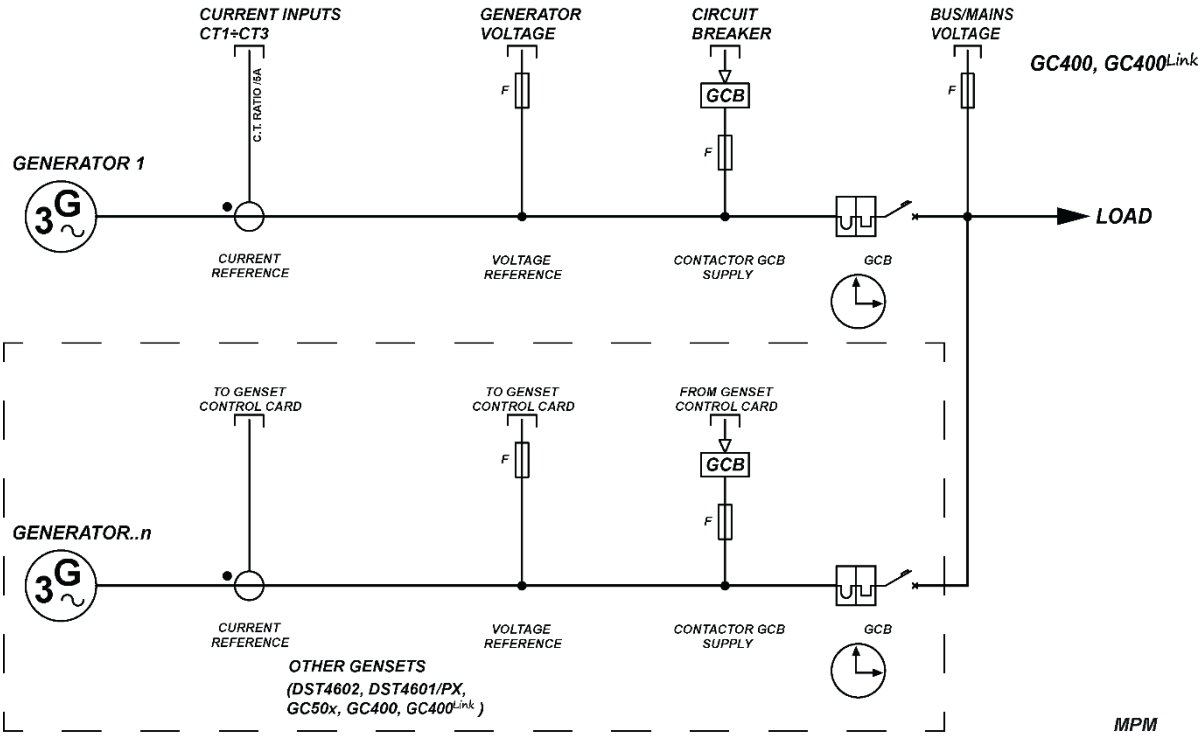
5.3 Basic Diagram (GC315x, GC400x in SPM plants)



5.4 Basic Diagram (GC315x, GC400x in SSB or SSB+SSTP plants)



5.5 Basic Diagram (GC400x in MPM plant)

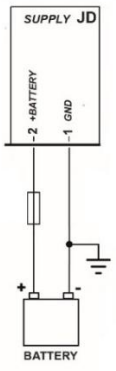


5.6 Functional earth (JC)

The connection to the functional earth JC is mandatory, to guarantee the proper operation of the device and compliance with the EU Electromagnetic Compatibility Directive.

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

5.7 Device (JD) supply



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

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

Although the device is protected by a built-in self-resetting fuse, it is recommended that you use a fuse for the protection of the positive line **2-+BATT**. of supply.

The device automatically recognizes when it is powered if the generator set battery nominal voltage is 12 or 24V for managing the related logics and alarms. The recognition also takes place every time you switch to mode **OFF/RESET**.

Note: connect the positive voltage only after the connections are all established. Before connecting the positive voltage, open all the panel.

⚠ **ATTENTION!**	**In order to respect the safety rules, an isolation of the supply from the public mains has to be guarantee in any case and must be lower than the one of a safety transformer compliant with norm IEC61558-2-6 or equivalent**.

⚠ **ATTENTION!**	**All the current supplied to the four static outputs (JE) and to the +D signal (JL-4) flows through the positive input JD-2 (+BATT). The declared max current consumption does not include the load drawn by these digital DC outputs of the controller. These additional loads must be considered to ensure proper sizing of the protection fuse and the wiring cable cross-section.**

5.8 Digital inputs (JN, JM)

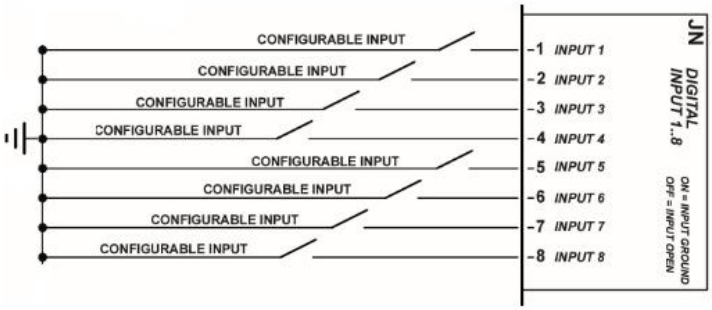
The controller is equipped with 8 configurable digital inputs.

In addition to the 8 JN inputs, if not used as measurement inputs, you can also use the JM ANALOGUE inputs as digital inputs (refer to par. 5.11) and, with different methods, also terminal JL-4 (signal +D, refer to par. 5.11.22).

You can also increase the number of digital inputs by adding two optional DITEL 16 modules connected via CAN-BUS, up to a total number of 32 additional digital inputs (see par. 0).

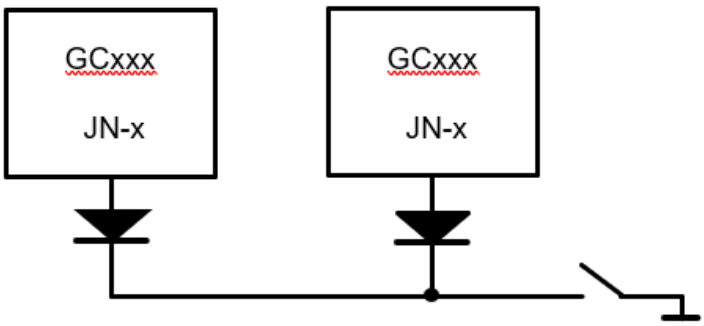
In addition, there are 16 “virtual” inputs available, which are not really present on the controller or on the expansions, but they are obtained as a result of the logical combination of physical or virtual inputs, outputs, alarms or logical states by means of proper programming via BoardPrg4. The virtual inputs can be configured as feature and can be used the same way as the physical inputs; refer to par.5.8.3.

5.8.1 JN – Digital inputs



The device has 8 digital inputs, which can be activated by connecting them to GND. When left floating, the input brings itself to +Vbatt. Avoid situations where intermediate or undefined voltage levels can occur.

The same command signal of an input can be shared by several different devices (for instance one signal that goes to two GC315). In this case it is recommended to separate the inputs with diodes, as shown in the figure below. This is to prevent the false activation of the input when one of the devices is being turned off.



By default, the functions of the JN inputs on the controller GC315x are the following:

Terminal	Function
JN-1	**DIF.4232 – "Maximum coolant temperature"**
JN-2	**DIF.4221 – "Minimum oil pressure"**
JN-3	**DIF.0000 – "Not used"**
JN-4	**DIF.4004 – "Generic interlock"**
JN-5	**DIF.4004 – "Generic interlock"**
JN-6	**DIF.4001 – "Generic warning"**
JN-7	**DIF.4212 – "Low fuel level"**
JN-8	**DIF.2501 - "Genset operation inhibit"**

By default, the functions of the JN inputs on the controller GC400x are the following:

Terminal	Function
JN-1	**DIF.3001 – "GCB circuit breaker status"**
JN-2	**DIF.2702 – "Enable load function"**
JN-3	**DIF.0000 – "Not used"**
JN-4	**DIF.0000 – "Not used"**
JN-5	**DIF.4232 – "Maximum coolant temperature"**
JN-6	**DIF.4221 – "Minimum oil pressure"**
JN-7	**DIF.4212 – "Minimum fuel level"**
JN-8	**DIF.2501 - "Genset operation inhibit"**

5.8.2 Virtual digital inputs

In addition to the 8 digital physical inputs and the 32 of the DITEL module, the controller also operates 16 virtual digital inputs. The same are operated by the controller just as if they were physical inputs (with no limitation), but the status of the virtual inputs is not acquired from the hardware, but it is determined through the software. In fact, every digital input can have an AND/OR logic associated, which determines its status (see par.5.9.5).

A practical example of use. Suppose you want to activate a warning if the mains voltage 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 out of tolerance or absent").
- The virtual digital input will therefore be active when the GCB is closed and the mains 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.

5.8.3 Configuration of the digital inputs

By default, all the digital inputs are considered “active” when the related terminal is connected to the supply negative of the controller; they are considered “not active” when the related terminal is not connected to anything. **The logic state of the input can be reversed with respect to the physical state by ticking the “Reversed polarity” box on the input configuration page on BoardPrg4.** The box is only visible if the function selected is other than DIF.0000 – “Unused”.

You can also reverse the logic state (still individually for each input), by operating directly on the controller, using the parameters P.2000 (for inputs 1...8 found on the controller), P.2100 (for the ANALOGUE inputs when the same are used as digital), P.2200 and P.2250 for the 32 optional inputs of the two DITEL expansions.

Said parameters have a bit for each input:

- 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 left open (connecting the input to ground will change to “not active” the status).

As default, all the bits are set to 0.

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

- One parameter which configures its function (P.2001 for input 1).
- One parameter which configures any delay (P.2002 for input 1).
- One parameter allows to define a text message to display. (P.2003 for input 1).

All inputs, whether they are physical or virtual inputs, are managed the same way.

The parameters which configure the delay and the message for an input are used by the controller only for certain features of the inputs. The table below shows when they are used.

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

The identification codes of the inputs' functions starting with 3xxx concern operating states, those that start with 4xxx trigger alarms (interlocks, deactivations, warnings).

Function of the xx input	Name	Delay	Message	Description
DIF.0000	Not used.			Input not used.
DIF.1001	GCB close command.			It only acts in MAN and in TEST, used to control the manual closing of the GCB circuit breaker. If there is no input with the function DIF.1002, it acts as “toggle”: it controls the opening of the breaker when the same is closed and vice versa.
DIF.1002	GCB open command.			It only acts in MAN and in TEST, used to control the manual closing of the GCB circuit breaker.
DIF.1003	**Only GC400x**. GCB commanded externally.			It indicates to the controller that the circuit breaker will be temporarily controlled by external logics: the controller will acknowledge the situation without activating fault.
DIF.1004	**Only GC400x**. GCB commanded externally.			It is used when GCB is controlled by external devices: the external device activates this input if it needs the controller to do the synchronization and to supply the “synchronized” contact.
DIF.1031	MCB close 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 in reality as toggle: it commands the closure of the breaker when the same is open and commands the opening when the same is closed.

DIF.1032	MCB open command.			Only acts in MAN and in TEST, used to control the manual opening of the MCB breaker.
DIF.1033	**Only GC400x**. MCB commanded externally.			It indicates to the controller that the circuit breaker will be temporarily controlled by external logics: the controller will acknowledge the situation without activating fault.
DIF.1034	**Only GC400x**. MCB commanded externally.			It is used when MCB is controlled by external devices: the external device activates this input if it needs the controller to do the synchronization and to supply the “synchronized” contact.
DIF.2001	Alarms reset command.			When the input becomes active, the controller executes a reset of all anomalies. That is equivalent to change the controller mode to OFF-RESET and back again to the working mode.
DIF.2002	(GC400x and from version 1.44 of GC315x) Alarms 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	(GC400x and from version 1.44 of GC315x) 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 for the time configured in P.0420. If the input activates again during the test, it immediately stops.
DIF.2030	(GC400x and from version 1.44 of GC315x) 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 for the time configured in P.0420. If the input activates again during the test, it immediately stops.
DIF.2031	Request for TEST mode.			If the input is active, the controller status changes from AUTO to TEST (controller should be at rest in AUTO mode). When it becomes inactive, the status changes back to AUTO.
DIF.2032	Request for REMOTE START.	Yes		If the input is active, the controller status changes from AUTO to REMOTE START (controller should be at rest in AUTO mode). When it becomes inactive, the status changes back to AUTO.
DIF.2033	Manual start request.			When the input is “activated” (only in mode MAN) the controller makes a start attempt (only one) the same way an automatic start is performed, i.e., it controls the starter motor until starting is accomplished or failed.
DIF.2034	Manual arrest command.			When the input is activated (in MAN mode) the controller stops the engine. This is equivalent to pressing the STOP button.
DIF.2061	Low speed request.			When this input is “active”, the controller disables the minimum frequency and minimum voltage protections of the generator, because it assumes that the engine is running at a speed lower than the usual. The controller also prevents the GCB closing. In the case of certain CAN-BUS engines, the controller also controls the reduced rotational speed of the engine.
DIF.2062	Engine protections override.			When the input is “active”, all the protections for the engine, which normally act as interlock, discharge or deactivation elements, become mere warnings
DIF.2063	Complete protections override.			When the input is activated, all the protections (except for few), which involve interlocks or deactivations, become warnings.
DIF.2064	(GC400x and from version 1.44 of GC315x) Genset protections override.			When the input is “active”, all the protections for the engine, which normally act as interlock, discharge or deactivation elements, 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. 8.6.4.12.
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. 8.6.4.12.
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	**Only GC400x**. 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	**Only GC400x**. Second power setpoint.			When the input is “active”, the power setpoint during the parallel with the mains is represented by parameter P.0902 instead of P.0884.
DIF.2093	**Only GC400x**. Select import-export mode.			When the input is “active”, the controller goes to “import/export” mode during the parallel with the mains, whatever is the mode configured in P.0880.
DIF.2094	**Only GC400x**. Select DROOP mode.			When the input is “active”, the controller activates the DROOP mode for the control of AVR and voltage.
DIF.2095	**Only GC400x**. It disables the kW control.			When the input is “active”, the controller disables all PI regulators for the management of the active and reactive power.
DIF.2096	**Only GC400x**. Genset transfer.			When the input is “active”, the controller transfers the load from mains to genset and then opens the MCB.
DIF.2099	**Only GC400x**. Local BASE LOAD.			When the input is “active”, the controller works in BASE LOAD even if the parameter P.0880 is set as SYSTEM BASE LOAD.
DIF.2121	**Only GC400x**. Select the master genset.			Used in “load management”. See document [8].
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.
DIF.2181	**Only GC400x**. Immediate supply.			It is used in plants composed by more gensets: if the input is active, the switch of the load between mains and gensets is carried out after the closing of the first circuit breaker GCB.
DIF.2211	**Only GC400x**. Enable Load Sharing.			It is used if the sharing of the active power is managed by an external device: the controller uses the signal coming from this device only if the input is active.
DIF.2241	(GC400x and from version 1.44 of GC315x) Fuel Pump in MAN-OFF mode.			When the input is active, the fuel pump mode is forced in “Manual-OFF”.
DIF.2242	(GC400x and from version 1.44 of GC315x) Fuel Pump in MAN-ON mode.			When the input is active, the fuel pump mode is forced in “Manual-ON”.
DIF.2243	(GC400x and from version 1.44 of GC315x) Fuel Pump in AUTO mode.			When the input is active, the fuel pump mode is forced in “Automatic”.
DIF.2271	OFF by remote control.			When this input is active, the operation mode of the controller is forced into OFF-RESET and you cannot use the buttons on the panel to change it. 9.1**NOTE: when this input is deactivated, if there are no inputs configured with the functions DIF.2272 and DIF.2273, the operation mode returns to what it was prior to the activation of the input**
DIF.2272	MAN by remote control:			When this input is active, the operation 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 operation mode of the controller is forced into AUTO and you cannot use the buttons on the panel to change it.
DIF.2330	**Only GC400x**. Select no power reserve for the load function.			It is used in the “load management”. See document [8].
DIF.2331	**Only GC400x**. Select power reserve #1 for the load function.			It is used in the “load management”. See document [8].
DIF.2332	**Only GC400x**. Select power reserve #2 for the load function.			It is used in the “load management”. See document [8].
DIF.2333	**Only GC400x**. Select power reserve #3 for the load function.			It is used in the “load management”. See document [8].
DIF.2361	**Only GC315x**. Increase speed			Activating the input increases the engine speed (only in the case of CAN-BUS engines, equipped with speed control) The parameter P.0712 defines the speed increase rate.
DIF.2362	**Only GC315x**. Reduce speed			Activating the input reduces the engine speed (only in the case of CAN-BUS engines, equipped with speed control) The parameter P.0712 defines the speed reduction rate.
DIF.2501	Genset operation inhibit.			When the input is “active”, the automatic start of the engine is inhibited. For this function, the parameters “Delay” and “Message” are not used, whatever their value. The “REMOTE START” mode is not influenced by this function
DIF.2502	Inhibition to taking of load			In automatic mode, when this input is “active”, GCB is forced to open (and possibly MCB is forced to close).
DIF.2503	MCB closure inhibition			In automatic mode, when this input is “active”, MCB is forced to open (even if the mains is present and the generator is stopped).
DIF.2511	2511-Front panel lock			When the input is "active," many of the button commands are disabled.
DIF.2512	2512-Remote commands lock			When the input is "active," commands received through the communication ports are disabled.
DIF.2513	2513-Front panel/remote commands lock			When the input is "active," both button commands and those received through the communication ports are disabled.
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	**Only GC400x**. Enable load function.			It is used in the “load management”. See document [8].
DIF.2703	Enable the load thresholds.			If the input is not active, the management of the load thresholds (described in par. 11.4) 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. 5.11.3 do not trigger the relevant protections.
DIF.2706	(GC400x and from version 1.44 of GC315x) Enable the serial ports commands			If this input is not active, the commands sent by the Modbus registers HOLDING REGISTER 101 and 102 are not accepted.
DIF.2708	**Only GC400x**. Enable the restrictive thresholds (“1”) for PPR.			If this input exists but it’s not active, the protections configured by P.0922 and P.0924 for the parallel with the mains are disabled. See document [8].
DIF.2709	(GC400x and from version 1.44 of GC315x). Allow start.			In case of a request for automatic start, the controller activates its internal sequence for the engine start, but it does not activate any real command until this input (if it exists) activates (for example it is useful to manage the pre-ventilation).

DIF.2710	**Only GC400x**. Enable the acquisition of the setpoint for the BASE LOAD from ANALOGUE input.			If this input exists and it is active, the power setpoint for the parallel with the mains is acquired by an ANALOGUE input properly configured. If it exists and it is not active, the setpoint is the parameter P.0884.
DIF.2711	**Only GC400x**. Enable the acquisition of the speed from ANALOGUE input.			If this input exists and it is active, the speed setpoint is acquired by an ANALOGUE input properly configured. If it exists and it is not active, the setpoint is the parameter P.0840.
DIF.2712	**Only GC400x**. 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.2713	**Only GC400x**. Enable protection 27Q (PPR).			If this input exists but it's not active, the protection for the parallel with the mains "27U< & Q" is disabled.
DIF.2714	**Only GC400x**. Enable the acquisition of the frequency for the DROOP from ANALOGUE input.			If this input exists and it's active, the frequency setpoint for the DROOP is acquired by an ANALOGUE input properly configured. If it exists and it's not active, the setpoint is the parameter P.0974.
DIF.2715	**Only GC400x**. Enable the load function in DROOP mode.			If this input exists and it is active, the load function works on the controllers in DROOP instead of in ISOCHRONOUS.
DIF.2716	**Only GC400x**. Enable the load function in BASE LOAD mode.			If this input exists and it is active, the load function works on the controllers in SYSTEM BASE LOAD instead of in ISOCHRONOUS.
DIF.2723	Only GC400x. 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 is used to detect the actual status of the KM/MCB circuit breaker. In case of discordance between status and command, a signalling will outline it.
DIF.3002	MCB breaker status.	Yes		It is used to detect the actual status of the KM/MCB circuit breaker. In case of discordance between status and command, a signalling will outline it. Warning can be also issued in this case or, even, depending on the configuration, the genset 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	**Only GC400x**. MGCB status.			It acquires the status of the general circuit breaker that connects the gensets parallel bars to the load (and to the mains). It acknowledges the status of "parallel with the mains" and disables the "load function" if the loads are not connected to the gensets.
DIF.3004	**Only GC400x**. Other gensets GCB status.			Use this input if the genset has to work in parallel with other gensets managed by non-Mecc Alte controllers. It indicates to DST4602 that at least another genset has its own GCB closed.
DIF.3005	**Only GC400x**. NECB (Neutral Earth Circuit Breaker) status.			It acquires the circuit breaker status for the genset neutral earth.
DIF.3101	External mains sensor.			When the input is "active" the mains is considered to be "in tolerance".
DIF.3102	**Only GC400x**. No voltage on the parallel bars.			It is used in parallel plants, where the controller cannot directly measure the voltage on the parallel bars. The active input indicates that there is not voltage on the bars.
DIF.3103	**Only GC400x**. External protections for the parallel with the mains.			Connect to this input the external device that manages the parallel protection with the mains. The input must be active when there is no protection.
DIF.3201	Generic status (page 1).		Yes	If this input is "active", the controller will show the text defined by the related text parameter on page S.08 of the display.
DIF.3202	Important generic status (page 1).		Yes	If this input is "active", the controller displays the text set in the related parameters associated to the input on page S.08, which is displayed immediately

DIF.3203	Generic status (page 2).		Yes	If the related input is “active”, the controller will show the text defined by the related text parameter on page S.09 of the display.
DIF.3204	Important generic status (page 2).		Yes	If this input is “active”, the controller displays the text set in the related parameters associated to the input on page S.09, which is displayed immediately
DIF.3205	Generic status (page 3).		Yes	If the related input is “active”, the controller will show the text defined by the related text parameter on page S.10 of the display.
DIF.3206	Important generic status (page 3).		Yes	If this input is “active”, the controller displays the text set in the related parameters associated to the input on page S.10, which is displayed immediately
DIF.3301	Fuel level for pump start.			If the input is “active” the fuel pump is started (see par. 11.1).
DIF.3302	Fuel level for pump stop.			If the input is “active” the fuel pump is stopped (see par. 11.1)
DIF.3311	Level for starting AdBlue pump			See 11.11
DIF.3312	Level for stopping AdBlue pump			See 11.11
DIF.4001	Generic warning.	Yes	Yes	If the input is “active”, a warning is issued: the message shown is the one set by means the related “text” parameter.
DIF.4002	**Only GC400x**. Generic unload.	Yes	Yes	If the input is “active”, an unload is activated: the text displayed is the one set in the parameters associated to the input.
DIF.4003	Generic deactivation.	Yes	Yes	If the input is “active”, a deactivation command is issued: the message shown is the one set by means of the related parameters.
DIF.4004	Generic interlock.	Yes	Yes	If the input is “active”, an alarm (block) is issued: the message shown is the one set by means the related “text” parameter.
DIF.4011	Warning (after oil delay).	Yes	Yes	If the input is “active”, an alarm (block) is issued if the time set by means P.0216 is elapsed from the engine running detection. The message shown is the one set by means the related “text” parameter.
DIF.4012	**Only GC400x**. Unload (after oil delay)	Yes	Yes	When the input is “active”, if the time from the engine start has passed as configured in P.0216, an unload is activated: the text displayed is the one set in the parameters related to the input.
DIF.4013	De-activation (after oil delay).	Yes	Yes	When the input is “active”, if the time set by means of the P.0216 parameter from engine start has elapsed, a deactivation command is issued: the message shown is the one set by means of the related parameters. If the “override” function of the engine protections is enabled, a warning is issued, instead of a deactivation
DIF.4014	Alarm (after oil delay).	Yes	Yes	If the input is “active”, an alarm (block) is issued if the time set by means P.0216 is elapsed from the engine running detection. The message shown is the one set by means the related “text” parameter. If the DIF.2062 – “Override engine protections”, or the DIF.2063- “Complete Protections Override” functions are active, a warning is issued instead of an interlock. See par. 10.5
DIF.4021	Warning (if GCB is closed).	Yes	Yes	If the input is "active" and the output command for the function GCB, is active, a warning is issued. The message shown is the one set by means the related text parameter.
DIF.4022	**Only GC400x**. Unload (if GCB is closed)	Yes	Yes	If the input and the GCB command are “active”, an unload is activated: the text displayed it the one set in the parameters related to the input.
DIF.4023	Deactivation (if GCB is closed).	Yes	Yes	If the input and the GCB command are “active”, a deactivation is activated: the text displayed it the one set in the parameters related to the input.
DIF.4024	Interlock (if GCB is closed).	Yes	Yes	If the input is "active" and the command for the GCB is also active, an interlock is activated. The message shown is the one set by means of the related parameters.

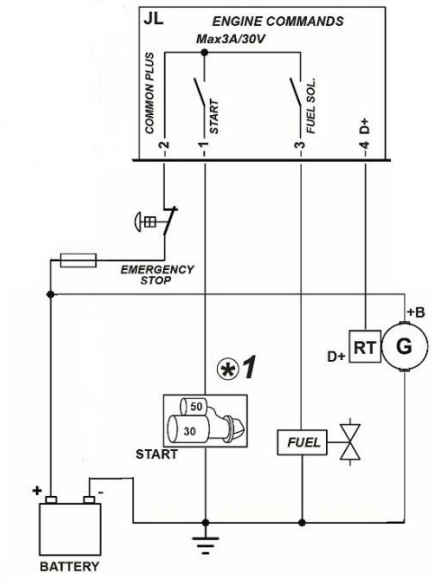
DIF.4031	Warning (if FUEL is enabled).	Yes	Yes	If the input is “active” and the output command for the fuel solenoid is active (JL_03), a warning is issued. The message shown is the one set by means the related “text” parameter.
DIF.4032	**Only GC400x**. Unload (if FUEL is enabled)	Yes	Yes	If the input is “active” and the output command for the fuel solenoid is active (JL_03), an unload is issued. The message shown is the one set by means the related “text” parameter.
DIF.4033	Deactivation (if FUEL is enabled).	Yes	Yes	If the input is “active” and the output command for the fuel solenoid is also active (JL_03), a deactivation command is issued: the message shown is the one set by means of the related parameters.
DIF.4034	Interlock (if FUEL is enabled).	Yes	Yes	If the input is “active” and the output command for the fuel solenoid is active (JL_03), an alarm (block) is issued. The message shown is the one set by means the related “text” parameter.
DIF.4041	Warning (if GAS is enabled).	Yes	Yes	If the input is “active” and the command of an output set as DOF.1004 – “Gas valve” is also active, a warning is issued: the message shown is the one set by means of the related parameters.
DIF.4042	**Only GC400x**. Unload (If GAS is enabled)	Yes	Yes	If the input is “active” and the command of an output set as DOF.1004 – “Gas valve” is also active, an unload is issued: the message shown is the one set by means of the related parameters.
DIF.4043	Deactivation (if GAS is enabled).	Yes	Yes	If the input is “active” and the command of an output set as DOF.1004 – “Gas valve” is also active, a deactivation is issued: the message shown is the one set by means of the related parameters.
DIF.4044	Interlock (if GAS is enabled).	Yes	Yes	If the input is “active” and the command of an output set as DOF.1004 – “Gas valve” is also active, an interlock is issued: the message shown is the one set by means of the related parameters.
DIF.4051	Warning (the fuel pump is turned 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 blocks the fuel pump as long as this input is “active”
DIF.4052	**Only GC400x**. Unload (the fuel pump is turned 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 blocks the fuel pump as long as this input is “active”
DIF.4053	(GC400x and from version 1.44 of GC315x) Deactivation (the fuel pump is turned 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 blocks the fuel pump as long as this input is “active”
DIF.4054	(GC400x and from version 1.44 of GC315x) Interlock (the fuel pump is turned off)	Yes	Yes	If the input is “active”, an interlock is issued: the message shown is the one set by means the related “text” parameter. The controller blocks the fuel pump as long as this input is “active”
DIF.4062	**Only GC400x**. Unload (subject to OVERRIDE)	Yes	Yes	When the input is “active”, an unload is usually activated. If the function “engine protections OVERRIDE” is activated, a warning is issued. The text displayed is the one set in the parameters related to the input.
DIF.4063	(GC400x and from version 1.44 of GC315x) Deactivation (subject to OVERRIDE)	Yes	Yes	When the input is active, a deactivation is usually activated. If the function “engine protections OVERRIDE” is activated, a warning is issued. The text displayed is the one set in the parameters related to the input.
DIF.4064	Alarm (subject to OVERRIDE).	Yes	Yes	If the input is “active”, normally an interlock is activated. If the “override engine protections” function is enabled, a warning is issued. The message shown is the one set by means of the related parameters.
DIF.4211	Minimum fuel level	Yes		If the input is “active”, an interlock with a fixed description (language-dependant) is activated. This function can be also used for the “Fuel pump management” (see par. 11.1).
DIF.4212	Low fuel level	Yes		If the input is “active”, a warning with a fixed description (language-dependant) is activated. This function can be also used for the “Fuel pump management” (see par. 11.1).

DIF.4213	High fuel level	Yes		If the input is “active”, a warning with a fixed description (language-dependant) is activated. This function can be also used for the “Fuel pump management” (see par. 11.1).
DIF.4221	Minimum oil pressure	Yes		When the input is “active”, if the time set by means of the P.0216 parameter from engine start has elapsed, a fixed description (language-dependant) interlock is activated.
DIF.4222	Low oil pressure	Yes		When the input is “active”, if the time set by means of the P.0216 parameter from engine start has elapsed, a fixed description (language-dependant) warning is activated.
DIF.4231	High coolant temperature	Yes		When the input is “active”, if the time set by means of the P.0216 parameter from engine start has elapsed, a fixed description (language-dependant) warning is activated.
DIF.4232	Maximum coolant temperature	Yes		When the input is “active”, if the time set by means of the P.0216 parameter from engine start has elapsed, a fixed description (language-dependant) warning is activated.
DIF.4241	Overload.	Yes		Normally, the “tripped” contact of the machine protection breaker is connected to this input. If the input is “active”, an interlock with a fixed description (language-dependant) is activated.
DIF.4251	Overspeed	Yes		If the input is “active”, an interlock with a fixed description (language-dependant) is activated.
DIF.4261	**Only GC400x**. Auto-production line	Yes		If the input is “active”, the controller doesn’t work in parallel with the mains and it stops the genset.

5.9 Digital outputs (JL, JI, JE)

By default, the controller has 8 digital internal relay outputs on connectors JL, JI and JE. It is possible to add two modules DITEL 16 IN, each managing up to two relay modules DITEL 8 OUT, for a total of 32 additional outputs other than the one included in the controller.

5.9.1 Engine commands (JL)



Basic diagram for switching off when de-energizing

The **JL** connector is configured by default for connecting the starter motor (**START**), fuel solenoid valve (**FUEL SOLENOID**); although not configured by default, there is also an output for energizing/controlling the operation of the battery recharge alternator (**+D**). Unless used to configure the engine (for example engines with CAN-BUS), the two outputs can be reconfigured from parameter for other purposes and also terminal +D may be used as digital input or additional voltage measurement input.

The status of the START and FUEL outputs is displayed on page S.13 (0= output inactive, 1= output active).

The standard functions of the JL outputs configured by default are the following:

Terminal	Function
JL-1	DOF.1005 – “Command for engine start”
JL-3	DOF.1003 – “Fuel valve”

In detail:

5.9.1.1 JL-2 COMMON PLUS Common positive

Common positive input for the START and FUEL outputs. It must be connected to the starter battery and must be fuse protected, with a capacity suitable for the current to be delivered, through a contact of the emergency button, i.e., this connection must be interrupted when the emergency button is pressed (NOTE: this does not apply to systems with arrest while energized). Several emergency buttons may be used by series connecting them to each other.

If no voltage is present (i.e., when pressing the emergency button) in the operating modes (MAN, AUTO, TEST, etc.) the device causes the A048 emergency stop blockage.

You cannot configure the controller to disable the emergency stop blockage.

The voltage to the JL-2 terminal is measured to the purpose of managing the relevant alarm and is displayed on page S.15, under entry EM-S

Caution: do not use the terminal as common negative for the two relay outputs. Within the outputs there are damper diodes for opening over voltages that would be conducted and immediately damaged.

5.9.1.2 JL-1 START Command for the engine starter motor

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 JL-2; although one is already present inside, with particularly inductive loads (remote control switches, electromagnets, etc.) it is recommended to use a damper diode for opening over voltages.

Caution: for currents above the nominal value, it's recommended to use an external 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 command is not necessary (for example with CAN-BUS interface engines), the output can be configured for other purposes by means of the parameter P.3005.

5.9.1.3 JL-3 FUEL SOLENOID Fuel solenoid command

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 JL-2; although one is already present inside, with particularly inductive loads (remote control switches, electromagnets, etc.) it is advisable to use a damper diode for opening over voltages.

Caution: for currents above the nominal value, it's recommended to use an external relay.

The output is configured by default to control the fuel interception solenoid valve with de-energizing arrest systems (see below); if not used for this purpose (for example in the case of engines with CAN-BUS interface), it can be reconfigured to serve other purposes by means of the parameter P.3006.

Two different ways to stop the engine are implemented in GC315.

Drop-down stop system

With this system (most widely used and default configuration of the GC315) the engine is started by delivering power to the solenoid valve, which opens/closes the fuel flow and is turned off by cutting the power.

So, the controller activates the JL-3 FUEL SOLENOID outlet prior to starting the engine (at least a delay of 200 ms is provided 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 mainly used for safety reasons: in case of arrest during de-energizing, in fact, if you accidentally disconnect the wire connected to the JH-3 terminal, 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 **JE-1** is configured for the command of arrest during energizing. You can configure any other output or even the same output **JL-3 FUEL SOLENOID** (**while observing the warning below**) to give the shutdown command by setting the relevant parameters.

WARNING! The series connection of the emergency stop button to terminal JL-2 DOES NOT WORK WITH SYSTEMS OF ARREST DURING ENERGIZING because you would get the opposite effect, i.e., cutting the power to the stop valve, even if the GC315 activates the **A048 Emergency stop LOCK** and the output configured as stop command anyway. For these systems, in case you need to guarantee the operation of the mushroom pushbutton irrespective of the operation of the GC315, it must have a double contact: one NC connected in series to the JL-3, as shown before, to cut the power to the starter motor and one NO between battery plus and valve/stop command with no intermediate fuses which, when activated, delivers positive voltage to the stop valve by bypassing the GC315 command.

5.9.1.4 JL-4 +D Energizing and checking the operation of the recharge alternator

NOTE: To configure the JL-4 for the +D connection at recharge alternator energizing you need to configure the parameter P.4041 with the value AIF.1300 – "Signal +D". To use the JL-4 for functions not correlated to +D refer to par.5.9.4 and correlated. The output is configured by default as AIF.0000 – "Unused".

When the controller starts the engine, the JL-4 terminal supplies the necessary power for energizing the battery recharge alternator.

With stationary engine and alternator, the alternator +D terminal is practically a short circuit to the battery negative and the voltage at its ends is close to 0V. During and after engine starting, as well as under normal operating conditions, with the revolution of the recharge alternator, the +D voltage rises up to the value of the battery voltage. When the engine stops, or even if only the recharge alternator stops because of the breakage of the drive belt, the +D voltage returns to 0V. The same thing happens in case of malfunction of the alternator.

The power delivered with the alternator stationary is limited internally and is 200mA for 12V systems and 100mA for 24V systems through an automatic threshold on the value of the battery voltage. The transition point between the two power levels occurs at approximately Vbatt=19VDC.

The energizing command is activated on the engine start command.

During the engine start cycle, up to when the engine is no longer acknowledged as started with a method whatsoever (voltage, frequency, rpm, +D voltage, oil pressure), the command is kept active for 30s continuously and then is deactivated/activated every 5s (5s ON followed by 5s OFF) until the starting sequence ends. When the engine is acknowledged as started, the command is kept active for 5 more seconds and then is released.

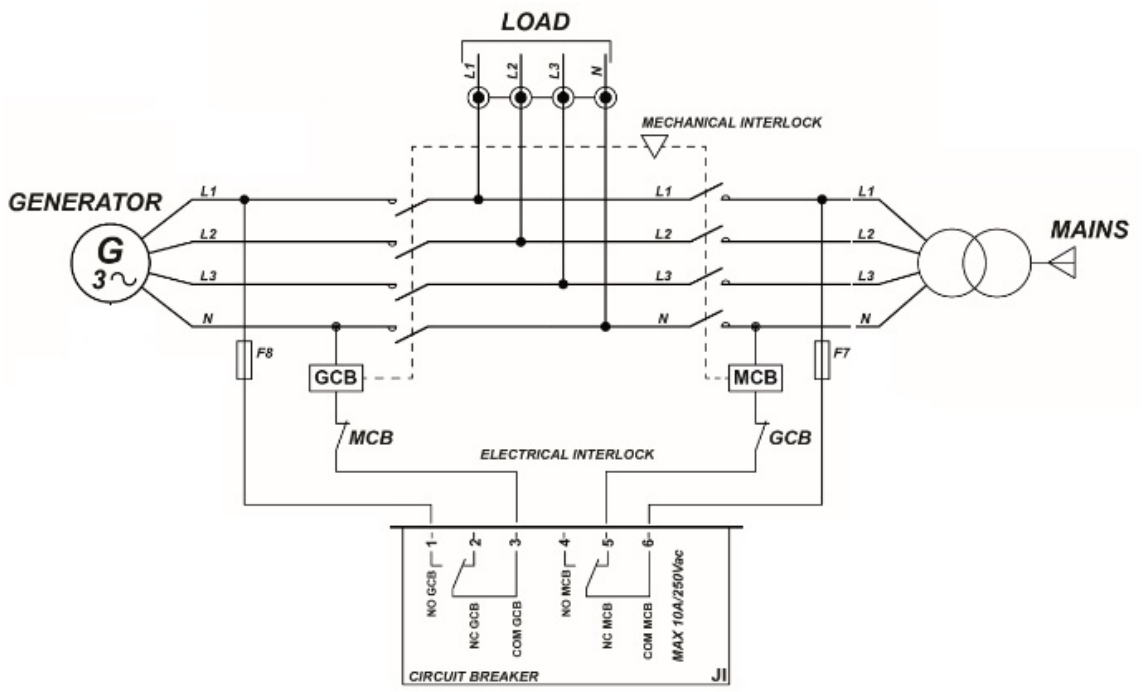
GC315 also uses the JL-4 to measure the +D voltage of the recharge alternator, both during engine start and during its operation. It is displayed in the S.15 menu, under item D+.

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 engine operation the +D voltage of the recharge alternator drops below 0V or if it does not rise after start, once the P.0349 time is up, it is assumed that the belt is broken or at least that there is a malfunction and the controller activates the anomaly AL.005 ("A005 – Broken belt") that can be configured with the parameter P.0357 (as warning, deactivation or lock) to protect the engine from the lack of operation of the mechanical parts driven by the belt.

Using parameters P.0230 and P.0231 it is possible to enable/disable the acknowledgement of engine started by D+ signal; by using the parameter P.0349 it is possible to disable the AL.005 anomaly ("A005 – Broken belt").

5.9.2 Outputs for JI loads change-over command



The controller uses two 10A@250Vac dry contact relays for controlling loads change-over. On the JI connector there is a changeover dry contact for each of the two relays.

Terminal	Function
JI-1	Normally open contact, of the GCB relay.
JI-2	Normally closed contact, of the GCB relay.
JI-3	Common contact of the GCB relay.
JI-4	Normally open contact, of the MCB relay.
JI-5	Normally closed contact, of the MCB relay.
JI-6	Common contact of the MCB relay.

The outputs functions included in the GC315x controller are the following:

Terminal	Function
JI-4	DOF.2004 – “MCB stable opening command”
JI-1	DOF.2034 – “GCB stable closing command”

The outputs functions included in the GC400x controller are the following:

Terminal	Function
JI-4	DOF.2032 – “GCB impulsive opening command”
JI-1	DOF.2033 – “GCB impulsive closing command”

Below an example of use of the two commands for plants that do not include the parallel with the mains or with other gensets (GC315x, GC400x with SPM or SSB plants).

By default, the GCB command is used to connect the loads to the generator, while the MCB command is used to connect the loads to the mains. Both relays can be used for other functions.

You must use the normally closed contact of the MCB and the normally opened contact of the GCB: that way, even if the controller is not powered, the loads remain still connected to the mains.

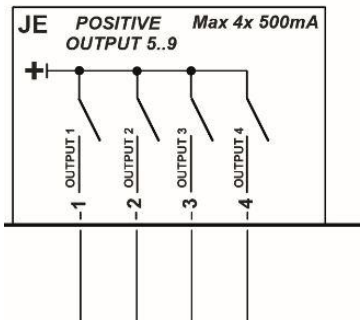
Three different systems can be used to change-over the loads:

- SWITCH (SIRCOVER): with only one command, the loads are changed-over to the mains or to the generator. Use the JI-01 and JI-03 terminals to control the SIRCOVER: that way, with the controller unpowered, the loads are automatically changed-over to the mains. The MCB output (terminals 4... 6 of the JI) is not used, therefore it can be associated to a different function. Configure parameter P.0220 with the time the SIRCOVER needs for the changeover: that way the controller avoids reversing the command before the changeover is completed (operation that risks blocking the SIRCOVER). Instead, reset the P.0219 parameter, because the pause between mains and genset and vice-versa is ensured by the SIRCOVER.
- Two separate circuit breakers (for GC315x, preferably mechanically and electrically interlocked). The command for the breaker connecting the loads to the generator (GCB) must be taken between terminals 1 and 3 of the JI connector. That way, with the controller unpowered, the contact opens and the GCB breaker separates the generator from the loads. The command for the breaker connecting the loads to the mains (MCB) must be taken between terminals 5 and 6 of the JI connector. That way, with the controller unpowered, the contact closes and the MCB breaker separates the loads from the power mains. Set to zero parameter P.0220 (the command can always be reversed immediately) and set within parameter P.0219 the pause interval that you want during change-over. The controller logics prevent a non-synchronized simultaneous closing of both GCB and MCB; however, an external protection logic, dependent upon the plant type, shall be used.
- One circuit breaker (for manual gensets where the mains is missing). Use the JI-01 and JI-03 terminals to control the breaker: that way, with the controller unpowered, the loads are separated from the generator. Set to zero both parameter P.0220 and parameter P.0219.

For the changeover operation see par. 8.7.

If there is only one circuit breaker, the MCB output (terminals 4... 6 of the JI) is not used, therefore it can be associated to a different function (see par. 5.9.4).

5.9.3 Auxiliary outputs (JE)



The device manages four digital outputs, entirely programmable. When activated, they bring themselves to the positive supply voltage on the **JD-2** supply terminal. The rated capacity of each output is 500mA; the total power is, therefore, of 1A. **Never exceed these values during standard operation.**

The outputs are independent and protected individually from overloads, short circuits, polarity reversal and overheating. The overload protection cuts in to limit the current spikes to an instantaneous value of 4A, to allow the activation of loads that require a transient inrush current greater than the rated. If this condition persists, after 150us the thermal protection cuts in progressively, until the output is turned off.

With inductive loads (power relays, electromagnetic actuators), although some are already present inside, it is advisable to use diodes for damping opening over voltages.

All the current delivered by the outputs must be made available through the **JE 2-+BATT; make sure that any safety fuse on the supply plus has a capacity and response time suitable to power and protect both the outputs and the GC315 under any condition of use.**

The outputs functions configured by default are the following:

Terminal	Function
JE-1	DOF.1006 – "Excitation stop command"
JE-2	DOF.3152 – "External acoustic horn"
JE-3	DOF.0000 – "Not used"
JE-4	DOF.0000 – "Not used"

5.9.4 Digital outputs configuration

All controller digital outputs (JE, JL and JI) and those of the additional DITEL modules are completely configurable individually.

The status of the digital outputs is displayed on page S.13 and S.14 (0= output inactive, 1= output active).

By default, all outputs are activated when the related function requires it (for example the fuel pump output starts operating when the pump must be activated).

Using the BoardPrg4 it's possible to reverse the activation by simply ticking the "Reverse polarity" box on the top of the configuration page of every single output.

By operating directly on the controller, you can reverse anyway the outputs logic (still individually for each output), even by means of the parameters P.3000 for the outputs on the controller (a total of 8 bit), P.3200 (16 bit) for the two DITEL 8 OUT additional modules connected to the first DITEL 16 IN controller and P.3250 (16 bit) for the two DITEL 8 OUT additional modules connected to the second DITEL 16 IN:

- A zero-bit means that the output is normally on standby and starts operating when the related feature requires it.
- A one-bit means that the output is normally operating and goes on standby when the related function requires it.

The mapping of the outputs on the controller is:

BIT	Value	Output
0	1	Output 1
1	2	Output 2
2	4	Output 3
3	8	Output 4
4	16	Output 5 (JL-1)
5	32	Output 6 (JL-3)
6	64	Output 7 (JI-4)
7	128	Output 1 (JI-1)

While the mapping of the outputs on the two DITEL 8 OUT modules is:

BIT	Value	Output
0	1	Output 1
1	2	Output 2
2	4	Output 3
3	8	Output 4
4	16	Output 5
5	32	Output 6
6	64	Output 7
7	128	Output 8
8	256	Output 9
9	512	Output 10
10	1024	Output 11
11	2048	Output 12
12	4096	Output 13
13	8192	Output 14
14	16384	Output 15
15	32768	Output 16

Basically, if you want to reverse the logic of an output you need to add the corresponding value into its parameter:

For example, if you want to invert outputs 3 and 4 on the controller you have to set P.3000 =12 (i.e., 4+8); if you want to invert outputs 5 and 10 of the second DITEL genset (16 IN + 16 OUT) you have to set P.3250=1056 (i.e., 32+1024)

As default, all the bits are set to 0.

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

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

- 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 below the outputs configurable on the digital outputs:

Code	Description.	Note
DOF.0000	Not used.	
DOF.0102	(GC400x and from version 1.44 of GC315x) It is commanded by the serial ports.	The controller does not command the output with its own internal logics, but with the commands it receives through the serial ports.
DOF.0103	AND/OR logics.	The status of the output is the result of the combination of the AND/OR logics. See par. 06.5
DOF.1001	Glow plugs preheating.	Command for glow plugs preheating for Diesel engines; see par. 9.6.2
DOF.1002	Engine control unit enabling.	Command for ECU enabling; see par. 9.6.2
DOF.1003	Fuel valve.	Command for the fuel interception solenoid; see par. 9.6.2

DOF.1004	Gas valve.	Command for activating the gas valve (for gas engines); see par. 9.6.2
DOF.1005	Engine start command.	Command for the starter motor; see par. 9.6.2
DOF.1006	Stop command.	Command for engine stop with arrest when energized; see par. 5.9.1.3 and par. 8.6.2
DOF.1007	Low speed command.	Some engines are provided with an output to reduce the rotational speed; see par. 9.6.2
DOF.1008	Select battery 1.	Select battery 1 to start the engine; see par. 9.6.4.1
DOF.1009	Select battery 2.	Select battery 2 to start the engine; see par. 9.6.4.1
DOF.1031	Coolant preheating.	Thermostat command for coolant pre-heating; see 11.2
DOF.1032	Fuel pump.	Fuel pump activation command.
DOF.1033	Pre-lubrication command.	Command to activate the pre-lubrication pumps before starting the engine; see par. 9.6.2
DOF.1034	Fuel pump solenoid.	Command to activate the fuel interception solenoid on the fuel pump line; see par. 11.1
DOF.1035	Inhibit DPF regeneration.	Command to inhibit the regeneration of the particulate filter; see par. 8.6.4.12.
DOF.1036	Force DPF regeneration.	Command to force the regeneration of the particulate filter; see par. 8.6.4.12.
DOF.1037	AdBlue pump	See 11.11
DOF.1038	Solenoid for AdBlue pump	See 11.11
DOF.2001	MCB (NC) under voltage coil.	See par. 9.7.1
DOF.2002	MCB opening coil.	See par. 9.7.1
DOF.2003	MCB closing coil.	See par. 9.7.1
DOF.2004	MCB stable opening command.	See par. 9.7.1
DOF.2031	GCB under voltage coil.	See par. 9.7.1
DOF.2032	GCB opening coil.	See par. 9.7.1
DOF.2033	GCB closing coil.	See par. 9.7.1
DOF.2034	GCB stable closing command.	See par. 9.7.1
DOF.2061	**Only GC400x**. NECB command.	It commands the opening and the closing of the NECB. It is used in plants in parallel among gensets or with the mains.
DOF.2091	**Only GC400x**. GTS closing command.	It commands the opening and the closing of the GTS circuit breaker (together with the command for the MTS circuit breaker, it's possible to manage an external switch even in case of parallel among more gensets).
DOF.2092	**Only GC400x**. MTS closing command.	It commands the opening and the closing of the MTS circuit breaker (together with the command for the GTS circuit breaker, it's possible to manage an external switch even in case of parallel among more gensets).
DOF.3001	OFF/Reset. **(**GC400x and from version 1.44 of GC315x)	It is activated when the controller is in OFF/RESET mode.
DOF.3002	Man. **(**GC400x and from version 1.44 of GC315x)	It is activated when the controller is in MANUAL mode.
DOF.3003	Auto. **(**GC400x and from version 1.44 of GC315x)	It is activated when the controller is in AUTOMATIC mode.
DOF.3004	Test.	It is activated when the controller is in TEST mode.
DOF.3005	Remote start. **(**GC400x and from version 1.44 of GC315x)	It is activated when the controller is in REMOTE START mode.

DOF.3011	Controller not in OFF/RESET mode	It is activated when the controller is in MAN or AUTO mode.
DOF.3012	One of the automatic modes.	It is activated when the controller is in one of the automatic operation modes that is AUTO, TEST or REMOTE START.
DOF.3031	**Only GC400x**. Voltage on parallel bars.	It is activated when there is voltage on the parallel bars.
DOF.3032	Generator in tolerance	It is active when the generator parameters are in the normal operation window
DOF.3033	Mains in tolerance	It is active when the mains parameters are within the “mains presence” window
DOF.3034	**Only GC400x**. Mains in tolerance (protections for parallel with the mains)	This output is deactivated when there is an anomaly on the mains voltage that requires the interruption of the parallel with the mains.
DOF.3035	**Only GC400x**. First command for 27Q	It is the first command of the 27Q protection for the parallel with the mains.
DOF.3036	**Only GC400x**. Second command for 27Q	It is the second command of the 27Q protection for the parallel with the mains.
DOF.3037	**Only GC400x**. Parallel to the grid allowed	This output is activated when the mains status allows the closing of the GCB circuit breaker and the parallel with the mains.
DOF.3061	Engine running.	Active after detection of the engine running status, even when it is started manually.
DOF.3062	Ready to supply (GC400x and from version 1.44 of GC315x)	It is activated if the engine is working and if the “delay before supply” has been carried out (P.0218)
DOF.3091	**Only GC400x**. Synchronization for GCB	It is activated during the synchronisation for the closing of the GCB circuit breaker.
DOF.3092	**Only GC400x**. Synchronization for MCB	It is activated during the synchronisation for the closing of the MCB or MGCB circuit breaker.
DOF.3093	**Only GC400x**. Synchronization in progress	It is activated during the synchronisation for the closing of the GCB, MCB or MGCB circuit breaker.
DOF.3094	**Only GC400x**. Synchronized	It is activated during the synchronisation for the closing of the GCB, MCB or MGCB circuit breaker, when the genset is synchronous with the mains or with the parallel bars.
DOF.3095	**Only GC400x**. In parallel with other gensets	It is activated when the genset is supplying in parallel with the mains.
DOF.3096	**Only GC400x**. In parallel with the mains	It is activated when the genset is supplying in parallel with other gensets (but not with the mains).
DOF.3121	Load thresholds	It is activated to report, depending on the configuration, a status of high load or low load. See par. 11.4
DOF.3151	Reset faults.	It is activated when the controller goes in RESET mode.
DOF.3152	Outside siren.	It is activated together with the internal siren.
DOF.3153	Lamp test. (GC400x and from version 1.44 of GC315x)	It is activated in OFF/RESET mode by pressing the STOP key: it can be used to turn on possible external led to the controller, and have one only procedure to test the leds
DOF.3154	Acknowledge of the anomalies (GC400x and from version 1.44 of GC315x)	The board activates this output for one second when the internal sequence for the acknowledgement of anomalies is carried out.
DOF.3155	Reset of the modem	The board activates this output for two seconds when the internal sequence to reset the modem is carried out.

DOF.3180	**Only GC400x**. No power reserve for load function	Used for the load management, see [8].
DOF.3181	**Only GC400x**. Power reserve #1 selected for load function	Used for the load management, see [8].
DOF.3182	**Only GC400x**. Power reserve #2 selected for load function	Used for the load management, see [8].
DOF.3183	**Only GC400x**. Power reserve #3 selected for load function	Used for the load management, see [8].
DOF.3184	**Only GC400x**. Enough power reserve for load function	Used for the load management, see [8].
DOF.4001	Warnings	It is activated in presence of warnings
DOF.4002	**Only GC400x**. Unloads	It is activated in presence of unloads
DOF.4003	Deactivations. **(**GC400x and from version 1.44 of GC315x)	It is activated in presence of deactivations
DOF.4004	Alarms. **(**GC400x and from version 1.44 of GC315x)	It is activated in presence of alarms
DOF.4005	Alarms, deactivations and unloads.	It is activated in the presence of alarms, deactivations and unloads.
DOF.4031	Generator faults.	It is activated in the presence of faults of the generator, i.e.: • 001: Minimum generator voltage. • 002: Maximum generator voltage. • 003: Minimum generator frequency. • 004: Maximum generator frequency. • 006: Maximum current. • 008: Standard operation conditions not met. • 015: Overload (from contact) • 016: Short circuit. • 052: Generator's voltages unbalance. • 053: Currents unbalance. • 055: Wrong phases sequence. • 056: Low generator voltage. • 058: Low generator frequency. • 059: High generator voltage. • 060: High generator frequency. • 061: Excitation loss.

DOF.4032	Engine faults.	It is activated in the presence of faults of the engine, i.e.: • 005: Belt break (D+ battery-charger failure) • 021: Engine not stopped. • 022: Engine not started. • 031: High coolant temperature (from contact). • 032: High coolant temperature (from analogue sensor) • 033: Maximum coolant temperature (from contact). • 034: Maximum coolant temperature (from analogue sensor) • 037: Start battery low voltage. • 038: Start battery high voltage. • 039: Service required 1. • 040: Service 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: Service required (days counter) • 054: High oil temperature (from analogue sensor) • 062: Fault in connection to the CAN bus. • 065: Low coolant temperature (from analogue sensor) • 096: Magnetic pickup failure • 098: Engine communication lost. • 105: Belt from Can-Bus is broken. • 132: High temperature of the coolant from the Can-Bus. • 134: Maximum temperature of the coolant from the Can-Bus. • 135: Minimum level of the coolant from Can-Bus. • 136: Low level of the coolant 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 the alarms (locks) from Can-Bus

DOF.4033	Speed controller faults.	It is activated in case of faults in the engine rotational speed, i.e.: • 003: Minimum generator frequency. • 004: Maximum generator frequency. • 011: Power reverse. • 017: Overspeed (from contact) • 018: Overspeed (from pick-up). • 019: Overspeed (from frequency). • 060: High generator frequency. • 118: Overspeed from Can-Bus.
DOF.4034	Fuel faults.	It is activated in case of faults in the fuel level, i.e.: • 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) • 064: Fuel pump failure. • 160: Water in fuel from Can-Bus.
DOF.4035	Breakers faults.	It is activated in case of faults of the GCB and MCB breakers, i.e.: • 013: Mains circuit breaker not closed • 014: Genset circuit breaker not closed • 023: Mains circuit breaker not open • 024: Genset circuit breaker not open

5.9.5 AND/OR logics

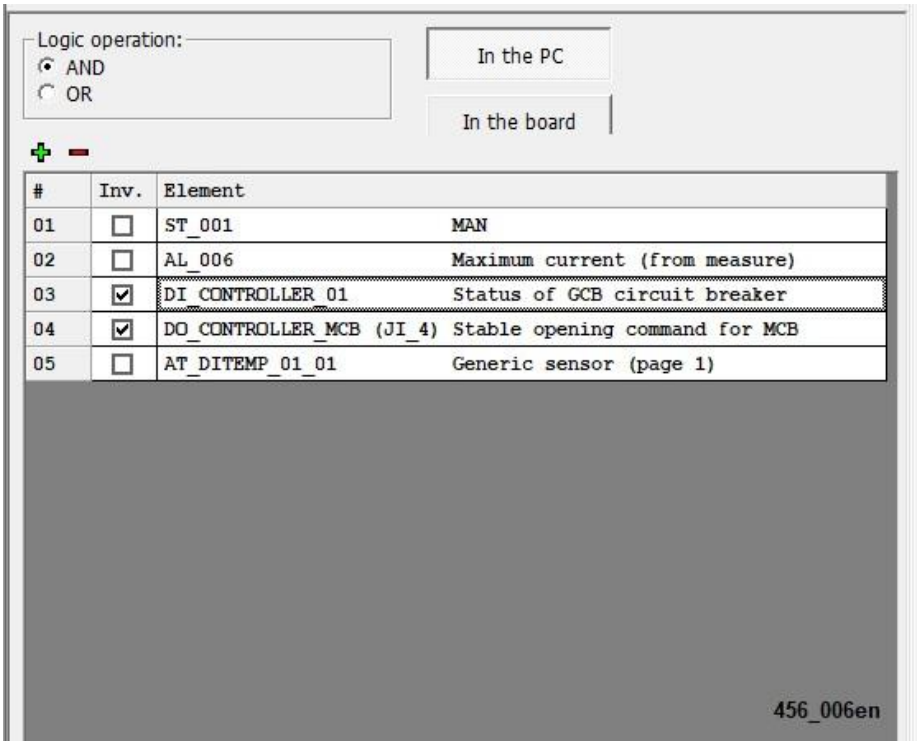
The AND/OR logics are, basically, a list of Boolean conditions (true/false, on/off, 1/0), which can be configured by the operator (programming), which the controller evaluates and the result of which can be assigned to a digital output or to a virtual digital input (see par. 5.8.2). Use the DOF.0103 function to use the AND/OR logics with a digital output.

NOTE: the AND/OR logics cannot be configured directly from the panel of the controller, but through a PC equipped with the BoardPrg4 software.

The operator must first decide if the list of conditions must be evaluated as AND (all must be checked) or as OR (it is enough that one condition is met). **You cannot have mixed AND/OR logics (this can be done using digital virtual inputs; see below).**

You can add up to 30 conditions. Each condition can be denied individually: in the previous figure, for instance, the controller will check that the digital input 3 and the digital output 8 are both **inactive.** The following conditions can be added:

- DI_XXX: logic states of all the digital inputs (physical or virtual).
- DO_XXX: logic states of all the digital outputs.
- AL_XXX: warnings/locks present.
- ST.XXX: internal states of the controller.
- AT_XXX: states concerning the thresholds on ANALOGUE measures



The following table shows the list of the internal states 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	**Only GC400x**. Unloads cumulative
ST.010	Deactivations cumulative.
ST.011	Locks cumulative
ST.012	Unacknowledged warnings cumulative
ST.013	**Only GC400x**. Unknown unloads cumulative
ST.014	Unacknowledged deactivations cumulative
ST.015	Unacknowledged locks cumulative
ST.016	Mains voltage/frequency present.
ST.017	Mains out of tolerance or absent
ST.018	Delay for mains within tolerance.
ST.019	Mains in tolerance
ST.020	Delay for mains out of tolerance or absent

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	**Only GC400x.** Bar voltage live
ST.051	**Only GC400x.** Protection 27Q active
ST.052	**Only GC400x.** Protections parallel with the mains active (mains off)
ST.053	**Only GC400x.** Protection 27 active (U<<, 1° threshold)
ST.054	**Only GC400x.** Protection 59 active (U>>, 1° threshold)
ST.055	**Only GC400x.** Protection 81< active (f<<, 1° threshold)
ST.056	**Only GC400x.** Protection 81> active (f>>, 1° threshold)
ST.057	**Only GC400x.** Protection ROCOF active
ST.058	**Only GC400x.** Protection VECTOR JUMP active
ST.059	**Only GC400x.** Protection 27 active (U<<, 2° threshold)
ST.060	**Only GC400x.** Protection 59 active (U>>, 2° threshold)
ST.061	**Only GC400x.** Protection 81< active (f<<, 2° threshold)
ST.062	**Only GC400x.** Protection 81> active (f>>, 2° threshold)
ST.064	GCB status
ST.065	MCB status
ST.066	**Only GC400x.** MGCB Status
ST.068	Impulse closing command for GCB
ST.069	Impulse closing command for MCB
ST.070	GCB under voltage coil command
ST.071	Impulse open command for GCB
ST.072	Impulse closing command for GCB
ST.073	GCB under voltage coil command
ST.074	Impulse open command for MCB
ST.075	Impulse closing command for MCB
ST.080	Inhibition of the start from contact

ST.081	Inhibition of the start from clock/calendar
ST.082	**Only GC400x.** Start inhibition from load function
ST.083	**Only GC400x.** Start inhibition because it is not possible to supply in island mode and the mains fails.
ST.084	**Only GC400x.** Start inhibition because another genset has the GCB not open
ST.088	Inhibition of the GCB closing from contact
ST.089	**Only GC400x.** GCB closing inhibition because it is not possible to supply in in island mode and the mains fails.
ST.090	Inhibition of the GCB closing from serial port
ST.091	**Only GC400x.** GCB closing inhibition because another genset has the GCB not open
ST.092	**Only GC400x.** GCB closing inhibition because of a back-synchronisation
ST.093	**Only GC400x.** GCB closing inhibition from MC100.
ST.096	Ready to deliver
ST.097	**Only GC400x.** Input synchronisation
ST.098	**Only GC400x.** Back synchronisation
ST.099	**Only GC400x.** Synchronised
ST.100	**Only GC400x.** Load ramp
ST.101	**Only GC400x.** Unload ramp
ST.102	**Only GC400x.** Supply in parallel with the mains
ST.103	**Only GC400x.** Supply in parallel among gensets
ST.104	Power delivery
ST.108	**Only GC400x.** Emergency plant
ST.109	**Only GC400x.** Plant in parallel with the mains
ST.110	**Only GC400x.** Plant in parallel among gensets
ST.111	**Only GC400x.** No MC100 on PMCB bus
ST.112	**Only GC400x.** Synchronism every second
ST.113	**Only GC400x.** Synchronism every minute
ST.114	**Only GC400x.** Synchronism every hour
ST.127	Daylight Save Time
ST.128	Glow plugs preheating command
ST.129	Engine enable command
ST.130	Fuel electro valve command
ST.131	Gas valve command
ST.132	Start engine command
ST.133	Excitation stop command
ST.134	Min. speed command (IDLE)
ST.135	Water preheating command
ST.136	Prelube command
ST.137	Inhibit DPF regeneration

ST.138	Force DPF regeneration
ST.139	AdBlue pump command
ST.140	AdBlue solenoid command
ST.144	**Only GC400x.** GCB closed on genset 01
ST.145	**Only GC400x.** GCB closed on genset 02
ST.146	**Only GC400x.** GCB closed on genset 03
ST.147	**Only GC400x.** GCB closed on genset 04
ST.148	**Only GC400x.** GCB closed on genset 05
ST.149	**Only GC400x.** GCB closed on genset 06
ST.150	**Only GC400x.** GCB closed on genset 07
ST.151	**Only GC400x.** GCB closed on genset 08
ST.152	**Only GC400x.** GCB closed on genset 09
ST.153	**Only GC400x.** GCB closed on genset 10
ST.154	**Only GC400x.** GCB closed on genset 11
ST.155	**Only GC400x.** GCB closed on genset 12
ST.156	**Only GC400x.** GCB closed on genset 13
ST.157	**Only GC400x.** GCB closed on genset 14
ST.158	**Only GC400x.** GCB closed on genset 15
ST.159	**Only GC400x.** GCB closed on genset 16
ST.176	**Only GC400x.** Master Genset
ST.224	Calendar 1
ST.225	Calendar 2
ST.226	Calendar 3
ST.227	Calendar 4
ST.228	Calendar 5
ST.229	Calendar 6
ST.230	Calendar 7
ST.231	Calendar 8
ST.232	Calendar 9
ST.233	Calendar 10
ST.234	Calendar 11
ST.235	Calendar 12
ST.236	Calendar 13
ST.237	Calendar 14
ST.238	Calendar 15
ST.239	Calendar 16
ST.240	Timer 1
ST.241	Timer 2
ST.242	Timer 3

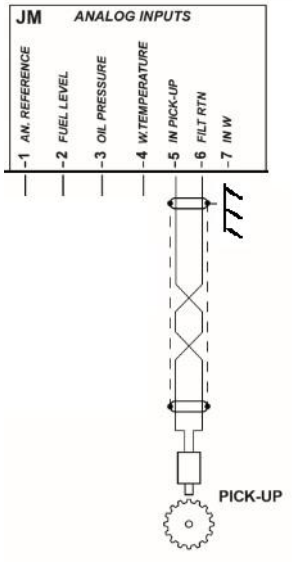
ST.243	Timer 4
ST.256	CAN 0 BUS-OFF
ST.257	CAN 0 ERR-PASSIVE
ST.258	CAN 0 ERR-ACTIVE
ST.259	No communication on CAN 0
ST.260	**Only GC400x.** CAN 1 BUS-OFF
ST.261	**Only GC400x.** CAN 1 ERR-PASSIVE
ST.262	**Only GC400x.** CAN 1 ERR-ACTIVE
ST.263	**Only GC400x.** No communication on CAN 1
ST.304	START button
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 10 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.346	Application type: DRIVE
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.998	Always active
ST.999	Always inactive

Using the virtual digital inputs, you can create mixed AND/OR logics (consisting of both AND and OR). Suppose you want to activate the digital output #1 when the digital inputs #1 and #2 are both active or when digital input #3 is active.

First, we have to associate to the virtual digital input #1 (for instance) and AND/OR logic configured as AND, which checks that the first two inputs are both active. Then we have to associate to the digital output #1 an AND/OR logic configured as OR, which checks that the virtual digital input #1 or the digital input #3 are active. In practice, the virtual digital input #1 is used as “support” for the AND condition. In this case you need not associate a function to the virtual digital input.

5.10 Engine rotational speed measurement (PICK-UP or W) JM-5, JM-6, JM-7



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.

Even if there is no measuring system available, the controller can still calculate and show the rotational speed, from the generator frequency.

5.10.1 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 sinusoidal; the frequency depends on the rotational speed of the engine and on the number of revolutions of the flywheel.

The maximum input voltage with the engine in standard operation is about 3Vac; in case voltage is lower, the signal can be increased by turning the pick-up in order to bring it closer to the gear wheel, paying the utmost attention not to hit it when turning the flywheel.

Connections:

- **JM-5** pick-up signal positive input
- **JM-6** pick-up signal negative input
- With the one-wire pick-up, only connect the **JM-5**

Usually, you can use a single pick-up, connected either to a controller or to another device, such as a speed regulator, but paying attention to 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.

5.10.2 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 square wave, with an amplitude ranging from 0 to Vbatt and a frequency proportional to the

engine speed, but depending on how the alternator is built and on the ratio between the diameters of the pulleys onto which the driving belt runs.

In order to use the W signal, it is required:

- Connect the W signal of the battery charger alternator to the terminal **JM-7**.
- Connect terminal **JM-5** to terminal **JM-6** (short circuit).

As already mentioned, the W signal frequency is proportional to the battery recharge alternator rotational speed, and not to the engine running speed: in fact, between them there is a belt. Therefore, you have to set a ratio (parameter P.0111) to allow the controller to convert the frequency of the W signal (battery recharge alternator revolutions per second) in engine revolutions per minute. This ratio depends on many factors and it is not easy to calculate. 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 by this ratio and set the new value.

Restarting the engine, the speed measure should be close to the actual speed. Then, manually adjust the value P.0111 until you get the right display, considering that, for the same true speed, the value displayed by the controller decreases when increasing P.0111. To determine the engine speed, the generator frequency can also be used.

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

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

5.10.3 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 four poles alternators, this ratio is 30 (engine speed is 30 times higher than alternator frequency). To use this feature, the following settings are needed:

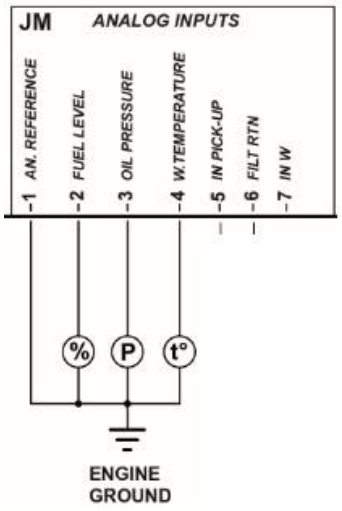
- Set P.0110 to 0 (disables pick-up).
- Set P.0111 to 0 (disables W).
- Set P.0127 to the right ratio.

5.11 Analogue inputs (JM, JL)

The device is provided with three inputs designed for the connection to the resistive-type sensors JM-2, JM-3, JM-4 and one JL-4, powered (as an alternative to using it a +D signal).

You can also use an optional DIVIT external expansion module and two DIGRIN or DITHERM expansion modules connected by CAN-BUS to acquire 4 more voltage or current signals and up to 6 temperatures. As GC315 does not have CANBUS, it can use the expansion modules DIVIT, DIGRIN and DITHERM.

5.11.1 JM – Analogue Inputs



The device is equipped with three inputs designed for the connection to resistive-type sensors JM-2, JM-3, JM-4. There is also an input for the measurement of their common ground potential JM-1.

The four values of the voltage measured on terminals, and their related value of sensors resistance, are displayed on page S.15.

It's possible also to configure the three inputs JM-2, JM-3 and JM-4 singularly as additional digital inputs. In order to activate the input, you need to connect it to the ground, and let it floating to deactivate it. They will appear in the configuration menu of the digital inputs and they will be managed exactly as the other inputs; see par. 5.5.3. If one or more inputs are configured as digital inputs, their statuses is displayed on page S.11 (0=input not active, 1=input active). The inputs that are not configured as digital will be displayed with a hyphen.

5.11.1.1 Input JM-1 ANALOGUE reference (ANALOGUE Reference)

It is not a real measure input: it is used together with the three inputs for resistive sensors and has not effect on JL-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 genset, 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 negative and earthing connections, for example due to the presence of the battery recharge device inside the electric panel.

The system is able to efficiently compensate for both positive and negative potentials, ranging between -2.7VDC and +4VDC, with sensors resistance values of 100 ohm. The range of compensation increases for lower resistance values and decreases for higher values of resistance, being optimized for the resistance values of the sensors in normal operating conditions of the system.

The measure of the voltage with respect to the GND terminal is displayed on page S.15, under item JM1; the measuring range of the system, and therefore the value indicated, can be higher than the one useful for compensation, mentioned above.

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 genset; JM-1 can therefore be connected to a grounding system or to a bolt on the engine.

If the negative of one or several sensors is isolated from the engine or the genset chassis, for example in the case of floats for fuel level measurement mounted on the plastic tanks or electrically separated from the genset, you need to connect the JM-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 to make the wire lies near high power and high voltage cable.

5.11.1.2 Input JM-2 (FL, Fuel Level)

The input has a useful resistance measurement range between 0 and 1500 ohm; within this range the measurement error guaranteed is less than 1%, with a voltage to the JM-1 terminal with respect to the GND=0. Higher resistance values can be measured, although with gradually decreasing precision.

Even if its natural function is the measurement of the fuel level, it can be used to acquire many measures too.

5.11.1.3 JM-3 (OP Oil Pressure)

The input has a useful resistance measurement range between 0 and 2000 ohm; within this range the measurement error guaranteed is less than 1%, with a voltage to the JM-1 terminal with respect to the GND=0. Higher resistance values can be measured, although with gradually decreasing precision.

Even if its natural function is the measurement of the oil pressure, it can be used to acquire many measures too.

5.11.1.4 Input JM-4 (CT Coolant Temperature)

The input has a useful resistance measurement range between 0 and 1700 ohm; within this range the measurement error guaranteed is less than 1%, with a voltage to the JM-1 terminal with respect to the GND=0. Higher resistance values can be measured, although with gradually decreasing precision.

Even if its natural function is the measurement of the coolant temperature, it can be used to acquire many measures too.

5.11.2 JL-4 Analogue Input

If the engine does not require the energizing connection, you can configure JL-4 as auxiliary powered ANALOGUE input, with measuring range 0-32VDC with respect to the power negative of the controller (GND), associating to it one of the functions available by means of the P.4041 parameter.

It can be used to acquire many measures.

It is possible to configure the JL-4 input as additional digital input. It is considered active when the voltage measured is higher than 4.0VDC; it is considered not active when the voltage measured is lower than 3.5VDC. Therefore, it cannot be activated by connecting it to the ground as per the other inputs. If it is configured as digital input, its status is displayed on page S.11 (0=input not active, 1=input active).

5.11.3 Configuration of analogue inputs

You can apply a conversion curve to all the physical ANALOGUE inputs JM-2, JM-3, JM-4 and JL-4 (not to the virtual ANALOGUE inputs).

Each ANALOGUE input, both the four inputs on the controller and the optional ones on the expansion module, be they physical or virtual, have eight parameters associated; see below for example the ones related to input JM-3; for the parameters of the other inputs, physical, of the expansions or for the virtual ones see or the I/O configuration page of the BoardPrg4.

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

We have:

- One parameter which configures its function (P.4017 for input JM-3).
- One parameter which configures any message to be shown on the display (P.4018 for input JM-3).
- Two thresholds consisting of three parameters each:
    - One parameter which configures the threshold value (P.4019 and P.4022 for input JM-3).
    - One parameter which configures the delay for managing the “out of threshold” (P.4020 and P.4023 for input JM-3).
    - One parameter which configures the checking options and the actions in case of “out of threshold” (P.4021 and P.4024 for input JM-3).

NOTE: the thresholds defined here do not depend on any threshold set within the “protections” menus; for example, for the coolant temperature sensor you can set a high temperature threshold through the parameter P.0337 to stop the engine and a pair of independent temperature thresholds through the parameters described above, used to create other alarms, different signals or logics.

The parameter containing the message for a certain ANALOGUE input (in the example above, what is written in the P.4018 parameter) is displayed and used by the controller every time the thresholds are used to activate warnings and/or alarms (see below)

It is also used for the following functions of the ANALOGUE inputs: AIF.2001, AIF.2003 and AIF.2005 of the type “Generic sensor (page X)”, **available only on certain inputs.** In this case the measure acquired will be displayed according to the X value (1, 2 or 3) on pages E.08, E.09 and E.10, preceded by the message configured. **NOTE: you can also use the AIF.2051 function instead of the previous three. in this case, the measure acquired will not be displayed on display; however, you can still use it with the thresholds to manage digital outputs and activate warnings/locks.**

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 measure is higher than the threshold. If this bit is “ON”, the controller checks if the measure is lower than the threshold.
- Bit 2. If this bit is “OFF”, the controller sets to OFF the internal status related to this ANALOGUE measure if the measure is “out of threshold”. If this bit is “ON”, the controller sets to ON the internal status related to this ANALOGUE measure if the measure is “out of threshold”.
- Bit 5. If this bit is “ON”, the controller issues a warning if the measure is “out of threshold”.
- Bit 7. If this bit is “ON”, the controller issues a deactivation command if the measure is “out of threshold”.
- Bit 8. If this bit is “ON”, the controller issues a lock command if the measure is “out of threshold”.
- Bit 11. If this bit is “ON”, the controller checks that the GCB is closed, to activate possible warnings/locks configured with the preceding bits.
- Bit 12. If this bit is “ON”, the controller activates a fault only if the fuel valve is activated.
- Bit 13. If this bit is “ON”, the controller activates a fault only if the gas valve is activated.
- Bit 14. If this bit is “ON”, to activate any warning/lock configured with the preceding bits, the controller checks the status of any digital input configured with the function “2705 - Disable the protections on the ANALOGUE measures”. The warnings/locks will be activated if no digital input is configured as such, or if they are all OFF.
- Bit 15. If this bit is “ON”, the fault entails the arrest of the fuel pump
- Bit 16. If this bit is “ON”, the fault is subject to engine protections override

You can set any combination of these bit.

Using the two thresholds and the AND/OR logics together, you can activate a digital output regarding the value of an ANALOGUE measure, with hysteresis. Suppose you want to activate a digital output if the mains frequency exceeds 50.5 Hz. First of all, you have to maintain a minimum hysteresis on the threshold, otherwise, when the mains frequency is close to the threshold, the output will continue to switch on and off, due to minimum variations of the frequency itself. So, suppose you want to activate the output if the frequency exceeds 50.5 Hz and deactivate the output if the frequency is lower than 50.3 Hz. To do that, we can use, for example, the virtual ANALOGUE input #1 (see par.5.8.2) which has been configured to contain the mains frequency.

Let us 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 0 OFF, bit 1 ON)
- P.4056 (threshold #2): 50.3 Hz
- P.4057 (delay #2): 0.5 sec
- P.4058 (configuration #2): 0001 (bit 0 ON, bit 1 OFF)

The first threshold is used to activate the internal status related to the ANALOGUE input. Looking at the configuration parameter you can see that:

- Bit 0 OFF (checks that the measure is higher than the threshold).
- Bit 1 ON (activates the internal status in “out of threshold” condition).

The second threshold is used to deactivate the internal status related to the ANALOGUE input. Looking at the configuration parameter you can see that:

- Bit 0 ON (check that the measure is lower than the threshold).
- Bit 1 OFF (deactivates the internal status in “out of threshold” condition).

So, with the previous programming, the controller activates the internal status related to the ANALOGUE input when the measure is greater than 50.5 Hz for 0,5 seconds; it deactivates the internal status when the measure is less than 50.3 Hz for 0,5 seconds.

Using the AND/OR logics (see par. 5.9.5), you can “copy” the internal status on a physical output.

The following table shows the list of functions that can be associated to the GC315x ANALOGUE inputs:

Function	Description	Message	Thresholds	JM_2	JM_3	JM_4	JL_V	DIVIT	DIGRIN / DITHERM
AIF.0000	Not used			X	X	X	X	X	X
AIF.0100	Used as digital input			X	X	X	X		
AIF.1000	Oil pressure (VDO)	X	X		X				
AIF.1001	Oil pressure (generic)	X	X		X		X	X	
AIF.1100	Oil temperature (VDO)	X	X	X		X			
AIF.1101	Oil temperature (generic)	X	X	X		X	X	X	X
AIF.1110	Coolant temperature (VDO)	X	X			X			
AIF.1111	Coolant temperature (generic)	X	X			X	X	X	X
AIF.1200	Oil level (VDO)	X	X	X					
AIF.1201	Oil level (generic)	X	X	X			X	X	
AIF.1210	Coolant level (VDO)	X	X	X					

AIF.1211	Coolant level (generic)	X	X	X			X	X	
AIF.1220	Fuel level (VDO)	X	X	X					
AIF.1221	Fuel level (generic)	X	X	X			X	X	
AIF.1231	Fuel level in volume (generic)	X	X	X			X	X	
AIF.1300	D+ Signal	X	X				X		
AIF.1601	Manifold temperature	X	X				X	X	X
AIF.1603	Exhaust gas temperature – left	X	X				X	X	X
AIF.1605	Exhaust gas temperature – right	X	X				X	X	X
AIF.1641	Turbo pressure	X	X				X	X	
AIF.2001	Generic sensor (page 1)	X	X				X	X	X
AIF.2003	Generic sensor (page 2)	X	X				X	X	X
AIF.2005	Generic sensor (page 3)	X	X				X	X	X
AIF.2051	Generic sensor	X	X				X	X	X

The following table shows the list of functions that can be associated to the GC400x ANALOGUE inputs:

Function	Description	Message	Thresholds	JM	JL_V	DIVIT	DIGRIN / DITHERM
AIF.0000	Not used			X	X	X	X
AIF.0100	Used as digital input			X	X		
AIF.1000	Oil pressure (VDO)	X	X	X			
AIF.1001	Oil pressure (generic)	X	X	X	X	X	
AIF.1100	Oil temperature (VDO)	X	X	X			
AIF.1101	Oil temperature (generic)	X	X	X	X	X	X
AIF.1110	Coolant temperature (VDO)	X	X	X			
AIF.1111	Coolant temperature (generic)	X	X	X	X	X	X
AIF.1200	Oil level (VDO)	X	X	X			
AIF.1201	Oil level (generic)	X	X	X	X	X	
AIF.1210	Coolant level (VDO)	X	X	X			
AIF.1211	Coolant level (generic)	X	X	X	X	X	
AIF.1220	Fuel level (VDO)	X	X	X			
AIF.1221	Fuel level (generic)	X	X	X	X	X	
AIF.1231	Fuel level in volume (generic)	X	X	X	X	X	
AIF.1300	D+ Signal	X	X		X		
AIF.1601	Manifold temperature	X	X	X	X	X	X
AIF.1603	Exhaust gas temperature – left	X	X	X	X	X	X
AIF.1605	Exhaust gas temperature – right	X	X	X	X	X	X
AIF.1641	Turbo pressure	X	X	X	X	X	
AIF.2001	Generic sensor (page 1)	X	X	X	X	X	X
AIF.2003	Generic sensor (page 2)	X	X	X	X	X	X
AIF.2005	Generic sensor (page 3)	X	X	X	X	X	X
AIF.2051	Generic sensor	X	X	X	X	X	X
AIF.2101	Speed offset			X	X	X	

AIF.2103	External Synchronizer			X	X	X	
AIF.2105	MCB External Synchronizer			X	X	X	
AIF.2107	GCB External Synchronizer			X	X	X	
AIF.2109	External load sharing			X	X	X	
AIF.2111	Frequency Setpoint			X	X	X	
AIF.2201	Voltage offset			X	X	X	
AIF.2211	Voltage Setpoint			X	X	X	
AIF.2301	Local BASE LOAD Setpoint			X	X	X	
AIF.2303	Mains power			X	X	X	
AIF.2305	DROOP Setpoint (Hz)			X	X	X	
AIF.2307	System BASE LOAD Setpoint			X	X	X	
AIF.2321	Limitation of the active power			X	X	X	
AIF.2401	Local power factor Setpoint			X	X	X	
AIF.2403	DROOP Setpoint (V)			X	X	X	
AIF.2405	System power factor Setpoint			X	X	X	

All odd AIF.XXXX functions require the use of the BoardPrg4 for the definition or the load of the sensor characteristic curve (see par.5.8.5), except for the measurements acquired by DITHERM/DIGRIN modules, which are already expressed in °C and do not require any conversion.

Instead, the functions AIF.1000, AIF.1100, AIF.1110, AIF.1200, AIF.1200, AIF.1210, AIF.1220 use pre-set conversion curves suitable for the VDO most common sensors.

VDO Temperature Sensors (AIF.1100, AF.1110)	
0°C	1800 ohm
50°C	195 ohm
100°C	38 ohm
150°C	10 ohm

VDO Pressure Sensors (AF.1000)	
0 bar	10 ohm
10 bar	180 ohm

VDO Level Sensors (AIF.1200, AIF.1210, AIF.1220)	
0%	180 ohm
100%	0 ohm

5.11.4 Virtual ANALOGUE inputs

The controller, besides the ANALOGUE inputs, manages also 8 virtual ANALOGUE inputs. They are managed by the controller exactly as they were physical inputs (without any limitation). The status of the virtual inputs is not acquired by hardware but by software. Through the parameter “function” of every virtual ANALOGUE input, it is possible to “copy” one of the internal measurements available in the ANALOGUE input:

- AVF.4001 - "Genset frequency"
- AVF.4006 - "Genset voltage L1-L2"
- AVF.4007 - "Genset voltage L2-L3"
- AVF.4008 - "Genset voltage L3-L1"
- AVF.4009 - "Genset voltage L-L average"
- AVF.4012 - "Mains frequency"
- AVF.4017 - "Mains voltage L1-L2"
- AVF.4018 - "Mains voltage L2-L3"
- AVF.4019 - "Mains voltage L3-L1"
- AVF.4020 - "Mains voltage L-L average"
- AVF.4023 - "Phase current L1"
- AVF.4024 - "Phase current L2"
- AVF.4025 - "Phase current L3"
- AVF.4026 - "Auxiliary current (also N)"
- AVF.4031 - "Active power L1"
- AVF.4032 - "Active power L2"
- AVF.4033 - "Active power L3"
- AVF.4034 - "Total active power"
- AVF.4041 - "Total apparent power"
- AVF.4047 - "Total reactive power"
- AVF.4058 - "Total power factor"
- AVF.4059 - "Total Cosfi"
- AVF.4063 - "Genset partial active energy"
- AVF.4065 - "Genset partial reactive energy"
- AVF.4069 - "Mains partial active energy"
- AVF.4071 - "Mains partial reactive energy"
- AVF.4075 - "Active power on loads"
- AVF.4088 - "Speed"
- AVF.4091 - "Oil level"
- AVF.4092 - "Coolant level"
- AVF.4093 - "Fuel level"
- AVF.4094 - "Fuel level in volume"
- AVF.4096 - "Immediate consumption"
- AVF.4097 - "Average consumption"
- AVF.4105 - "Battery voltage measured by the controller"
- AVF.4108 - "Engine start number"
- AVF.4111 - "Engine working hours (ECU)"
- AVF.4112 - "Engine working hours"

- AVF.4114 - "Engine partial working hours with closed GCB (partial)"
- AVF.4116 - "Engine missing working hours to maintenance 1 (partial)"
- AVF.4118 - "Engine missing working hours to maintenance 2 (partial)"
- AVF.4116 - "Days missing to maintenance (partial)"
- AVF.4121 - "Oil pressure"
- AVF.4122 - "Coolant pressure"
- AVF.4123 - "Fuel pressure"
- AVF.4126 - "Manifold air pressure"
- AVF.4134 - "Temperature"
- AVF.4136 - "Oil temperature"
- AVF.4137 - "Coolant temperature"
- AVF.4138 - "Fuel temperature"
- AVF.4139 - "Manifold temperature"
- AVF.4140 - "Turbocharger temperature"
- AVF.4141 - "Manifold exhaust gas (left)"
- AVF.4142 - "Manifold exhaust gas (right)"
- AVF.4143 - "Intercooler temperature"
- AVF.4153 - "Soot level"
- AVF.4154 - "Ash level"
- AVF.4156 - "DEF level (AdBlue)"
- AVF.4158 - "Aftertreatment 1 Diesel Particulate Filter Outlet Temperature"
- AVF.4160 - "Aftertreatment 1 Diesel Particulate Filter Intake Temperature"
- AVF.4162 - "Aftertreatment 1 Diesel Particulate Filter Differential Pressure"

It is not possible to use these functions for the configuration of the physical ANALOGUE inputs.

The purpose of the virtual ANALOGUE inputs is double:

- Allowing to enable warning/blocks related to the internal measurements available.
- Enabling digital outputs according to the value of the internal measurements available.

See example in par. 5.11.3.

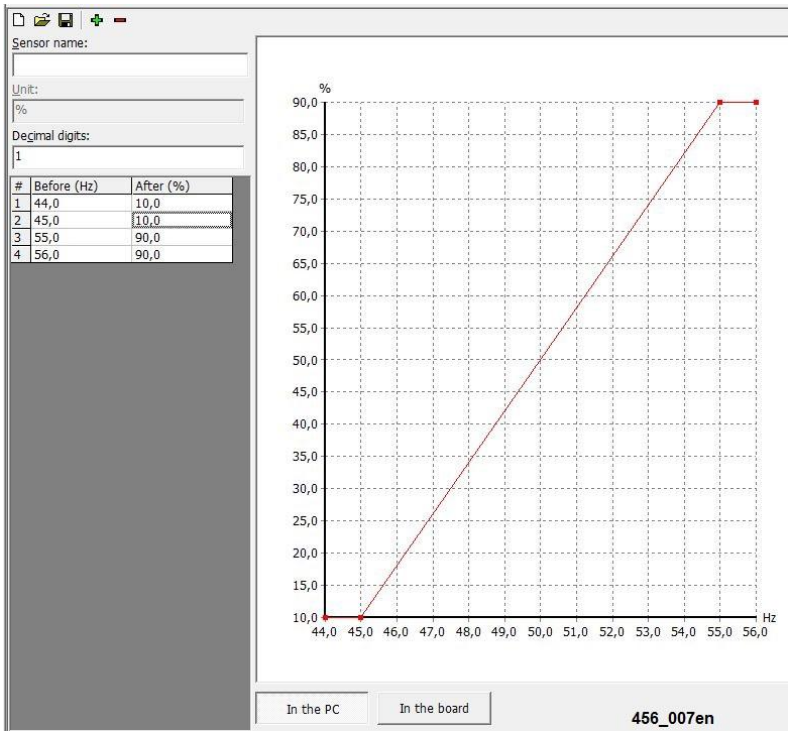
5.11.5 Conversion curves

The conversion curves are a tool which allow you to convert a numerical value into another numerical value. They can be used for the ANALOGUE inputs and for the ANALOGUE output, for two purposes:

- Convert the value acquired from an ANALOGUE input (of voltage, current or resistance (physical) found on the controller board or on the optional expansion modules, from electrical value into the real unit of measurement of the sensor.
- Convert an internal measure of the controller board into a percentage value, prior to “writing” it on an ANALOGUE output.

NOTE: the conversion curves cannot be configured directly from the panel of the controller board, but through a PC equipped with the BoardPrg4 software.

Once created, the curves can be saved on file to be reused, including on other controllers.



The figure above shows a conversion curve associated to an ANALOGUE output. The ANALOGUE output has been configured with the function AOF.3101 - Genset frequency. In this configuration, the output will run at 10% for a frequency of 45Hz or lower, and at 90% for a frequency of 55 Hz or higher; for frequency values ranging between 45 Hz and 55 Hz, the output will have a value between 10% and 90%.

You can add up to 32 points in the graph, thus creating also non-linear curves. See in the example that the curve configured has two horizontal segments at the beginning and at the end, obtained by entering two equal values in the “After” column, corresponding to two different values in the “before” column. 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%.

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. So, you can create an archive of the conversions associated to the sensors used.

In case the curve is associated to a physical ANALOGUE input configured with the functions AIF.2001, AIF.2003 and AIF.2005 (“Generic sensor”), the measure converted will be displayed on pages E.08, E.09 and E.10: in this case you can also specify (through the conversion curve) how many decimal digits will the value displayed have, as well as its unit of measurement).

5.12 Analogue outputs (JQ, JR)

5.12.1 Analogue outputs on the controller (only GC400x)

On GC400x only, there are two ANALOGUE outputs to allow the interface with the majority if the devices that need a current or voltage as input signal. To define the function of these outputs there are two parameters available, P.6001 for the output JQ and P.6002 for the output JR.

Terminal	Voltage
JQ - 1	Voltage ANALOGUE sensor with positive polarity.
JQ - 2	Voltage ANALOGUE sensor with negative polarity.

Terminal	Voltage
JR – 1	Voltage ANALOGUE sensor with positive polarity.
JR – 2	Voltage ANALOGUE sensor with negative polarity.

The outputs are galvanically insulated, so both outputs terminals must be used. The total variation goes from -10Vdc to +10Vdc. If it is necessary to reduce the variation, you need to add some specific conversion curves to the output's configuration (see par. 5.8.5); if the outputs are configured with the functions AOF.1000 and AOF.1002, it is possible to use the controller's parameters (without conversion curves) to reduce the output variation:

- AOF.1000 Function: use parameters P.0856 and P.0857.
- AOF.1002 Function: use parameters P.0862 and P.0863.

The following description refers to P.0856 and P.0857, but the explanation is valid for P.0862 and P.0863 too.

- To delimit the output from 0Vdc to 10Vdc:
  - P.0856 = 50%
  - P.0857 = 100%
- To delimit the output from 0Vdc to 5Vdc:
  - P.0856 = 50%
  - P.0857 = 75%
- To delimit the output from -2Vdc to +2Vdc:
  - P.0856 = 40%
  - P.0857 = 60%

5.12.2 Configuration of the ANALOGUE outputs

Every ANALOGUE output (2 for the GC400x controller and 4 for the DANOUT module) is fully configurable. Each output is associated to a parameter (P.6001 for the output 1) that configure its function.

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.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.

Output XX function	Description
AOF.0000	Not used.
AOF.0102	Managed by serial ports (GC400x and from version 1.44 of GC315x)
AOF.1000	**Only GC400x.** Speed regulator
AOF.1001	**Only GC400x.** Speed regulator (generic)

AOF.1002	**Only GC400x.** Voltage regulator
AOF.1003	**Only GC400x.** 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	**Only GC400x.** Mains power

When using the functions AOF.3001 and following, you need to define the proportion between the measure selected (voltage, frequency, etc.) and the % value with respect to the output full scale by means of the use of conversion curves (see par. 5.8.5).

5.13 Optional additional modules

Using the CAN-BUS engine connection you can connect **GC315x/GC400x** (except for GC315 that has no CAN-BUS interfaces) to the following optional additional modules:

- 2 DITHERM/DIGRIN modules (2 DITHERM, 2 DIGRIN or 1 DITHERM + 1 DIGRIN):
  - DITHERM: 3 galvanically isolated thermocouples for temperature measurement.
  - DIGRIN: 3 galvanically isolated Pt100 sensors for temperature measurement.
- 1 DIVIT module:
  - 4 galvanically isolated ANALOGUE inputs 0...5V/0...10V – 0...10mA/0...20mA
- 1 DANOUT module:
  - 4 galvanically isolated ANALOGUE outputs 0...5V/0...10V – 0...10mA/0...20mA
- 2 DITEL 16IN modules:
  - 16 galvanically isolated 16 digital inputs (32 inputs in total). Each DITEL 16IN module can be connected to 2 DITEL 8OUT modules relays (32 digital inputs in total). It is not possible to use the output modules without a related inputs module.

For the configurations to be made on the modules, refer to their user manuals.

Below we use the name DITEMP to refer to a temperature measurement module (DITHERM or DIGRIN).

To configure the modules on the **GC315x/GC400x**, it is necessary to set the number of modules available with the parameters:

- P.0141 The number of DITEL 16 IN modules (with any OUT module) (max 2)

- P.0142 The number of DITEMP modules (i.e., DITHERM or DIGRIN) (max 2)
- P.0143 The number of DIVIT modules (max 1)
- P.0144 The number of DANOUT modules (max 1)

Only for GC400x, you need to indicate what CAN-BUS interface is connected to the expansion modules, by means of the parameter P.0140:

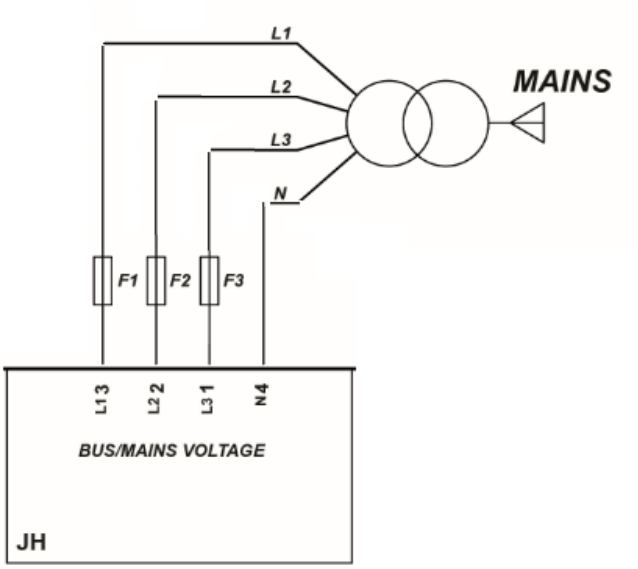
- P.0140=0: the expansion modules are connected to the engine CAN-BUS (JO). This is the pre-set CAN-BUS interface and should be always used.**The only case in which it cannot be used is when this interface is connected to a MTU engine with MDEC controller.**
- P.0140=1: the expansion modules are connected to the engine CAN-BUS for the parallel functions (JP). In order to connect the modules to this CAN-BUS interface, you need to use an additional CAN-BRIDGE module, to avoid that the data transmitted by the modules are received from all the GC400x controllers connected to the CAN-BUS for the parallel functions.

Note: GC315x has only the JO interface, so there is no parameter P.0140. Still, the modules cannot be connected to JO if it is used for the connection to a MTU engine with MDEC controllers.

Once the modules presence is configured, they appear as digital or ANALOGUE inputs or outputs and are driven the same as the ones actually present on the controller board (except for the DANAOUT module since on the controller board there are no ANALOGUE outputs)

In BoardPrg4, once the presence of a module is configured, it appears in the I/O menu on the left column, with each individual input/output ready to be configured.

5.14 Connection to the public electric mains/parallel bars (JH)



The connection to the public electric mains is made through the connector JH of the controller board.

Note for GC400x: the connection to the connector JH varies in accordance to the type of plant:

- **SPM: the JH connector is not used.**
- **SSB: connect the public mains to the JH connector. In this way, the controller can acknowledge faults on the mains and start the genset.**
- **SSB+SSTP: connect the mains to the JH connector. In this way, the controller can acknowledge faults on the mains and start the genset. By means of this connection, moreover, the controller is able to synchronize the genset to the mains to carry out the short-time parallel and avoid the black-out on loads when it's not necessary.**
- **MPM: connect the parallel bars to the JH connector. In this way, the controller can synchronize the genset to other gensets to carry out the parallel.**

Use the parameter P.0126 to indicate the GC400x controller what has been connected to JH:

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

Tri-phase connection:

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

Two-phase connection:

- Connect phase L1 (or R) to terminal 3 of JH connector.
- Connect phase L2 (or S) to terminal 2 of JH connector.
- Connect neutral (if any) (N) to terminal 4 of JH connector.

Single-phase connection:

- Connect phase (L) to terminal 3 of JH connector.
- Connect neutral (N) to terminal 4 of JH connector.

Parameters P.0119 allows to select the tri-phase/bi-phase/single-phase mode.

For CAT.III application, the max applicable voltage is 300 Vac (phase-to-neutral) and 520 Vac (phase-to-phase). Maximum voltage to ground is 300 Vac.

The controller board uses phase L1 (terminal JH-3) to measure the frequency of the mains.

If working voltages are greater than these values, step-down transformer must be used in order to respect the specified limits. Nominal voltages on primary and secondary side of the voltage transformer are configurable by means P.0117 and P.0118. 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.

It is optionally possible to order a version of the device with max 100Vac (phase-phase) voltage inputs to be used with VT with 100V secondary ones. In this case it is necessary to configure P.0152 parameter for 100V working.

Warning! Do not connect devices provided with optional 100V max inputs directly to mains or to 400V bus not to damage the device.

5.14.1 Measurement of the mains neutral

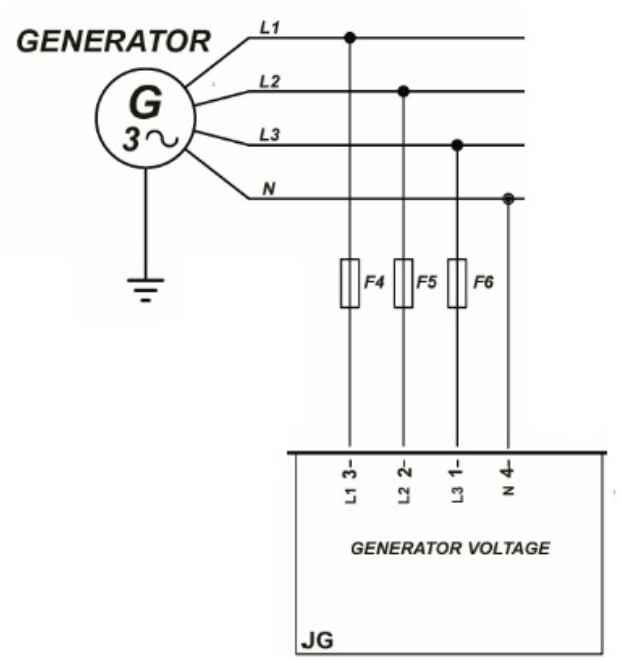
The device, in three-phase connection, can function both with the neutral connection and without it; selection is performed through the P.0119 parameter.

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

The values of the V1-N, V2-N and V3-N phase voltages and the VN voltage of the neutral in relation to GND for the mains are displayed on page M.03.

If the device is configured not to measure the neutral voltage, then page M.03 will not be displayed.

5.15 Connection to the genset (JG)



The connection to the generator is made through the JG connector of the controller board.

Tri-phase connection:

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

Two-phase connection:

- Connect phase L1 (or R) to terminal 3 of JG connector.
- Connect phase L2 (or S) to terminal 2 of JG connector.
- Connect neutral (if any) (N) to terminal 4 of JG connector.

Single-phase connection

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

Parameters P.0101 allows to select the tri-phase/bi-phase/single-phase mode.

For CAT.III application, the max applicable voltage is 300 Vac (phase-to-neutral) and 520 Vac (phase-to-phase). Maximum voltage to ground is 300 Vac.

The controller board uses phase L1 (terminal JG-3) to measure the frequency of the generator.

If working voltages are greater than these values, step-down transformer must be used in order to respect the specified limits. Nominal voltages on primary and secondary side of the voltage transformer are configurable by means 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.

It is optionally possible to order a version of the device with max 100Vac (phase-phase) voltage inputs to be used with TV with 100V secondary ones. In this case it is necessary to configure P.0151 parameter for 100V working.

Warning! Do not connect devices provided with optional 100V max inputs directly to 400V generator voltage not to damage the device.

5.15.1 Measurement of the generator neutral

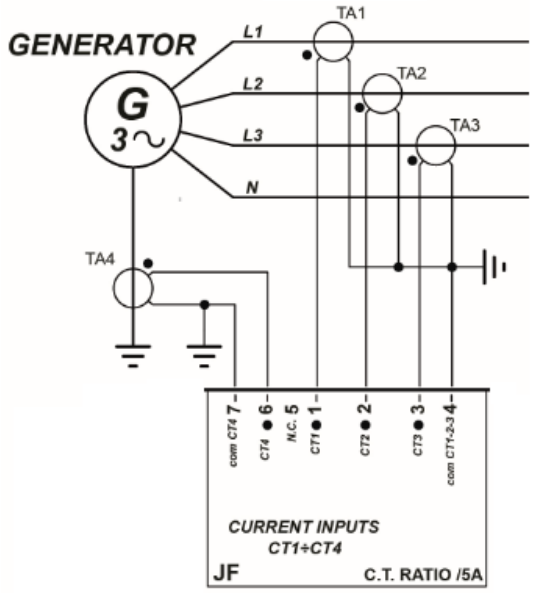
The device, in three-phase connection, can function both with the neutral connection and without it; selection is performed through the P.0101 parameter.

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

The values of the V1-N, V2-N and V3-N phase voltages and the VN voltage of the neutral in relation to GND for the mains are displayed on page M.05.

If the device is configured not to measure the neutral voltage, then page M.05 will not be displayed.

5.16 Current transformer connection (JF)



The measurement of the currents must be made exclusively by current transformers (TA) with a secondary 5A and characterized by a level of isolation in accordance with the system in which the device is installed: at minimum an insulation REINFORCED (DOUBLE) for the use of the device in overvoltage category III or IV.

The current measurement shall be made exclusively by means of current transformers (CTs). **Do not connect mains voltage conductors to JF.**

Currents transformers having a nominal current of approximately 5 Ac on the secondary side are the solution that preserves the best available measurement precision of the controller board. Any current measurement needs a power of about 1VA; however, CTs of 5VA are recommended, to compensate for leaks along the connection cables.

The maximum current that the device can measure directly is of 5.3Ac, beyond which the measurement circuit gets saturated. The controller board is still able to measure, but with gradually decreasing precision, down to about 15 Ac solely **for transient situations,** such as measuring over currents or short circuit currents on the system, using an algorithm to compensate for the saturation of the measurement circuits.

The CTs for the measurement of the three currents have only one terminal clip for the return current, i.e., the JF-4; the fourth auxiliary current has a return separated from the other three through the JF-7 terminal clip.

The measurement is carried out by shunt.

NOTE: the returns of all CTs (including the auxiliary JF-7) must also be connected to the genset starting battery negative.

If the CTs have to be connected to other devices in addition to the controller, it must be the last in the series. For acquiring the currents of the three phases of the generator, the JD connector is used:

- Connect to terminal JF-1 one terminal of the phase L1 C.T.
- Connect to terminal JF-2 one terminal of the phase L2 C.T.
- Connect to terminal JF-3 one terminal of the phase L3 C.T.
- Connect to terminal JF-4 a common connection of the remaining terminals of C.T.s

For single phase connection, terminals JF-2 and JF-3 should not be connected.

The P.0107 and P.0139 parameters are used for setting the current values of the CTs primary and secondary.

Using the P.0124 parameter you can define whether the CTs on the three phases are positioned on the generator (as shown in the drawing above) or on the load, so as to measure also the power absorbed by the mains. This also has an effect on the operation sequence and the display of symbols and currents and power/energy measures that appear on the menu pages M.01, M.06, M.07, M.08 and M.09.

5.16.1 Auxiliary current

The measurement of the currents must be made exclusively by current transformers (TA) with a secondary 5A and characterized by a level of isolation in accordance with the system in which the device is installed: at minimum an insulation REINFORCED (DOUBLE) for the use of the device in overvoltage category III or IV.

The device allows for acquiring a fourth measure of current, usable for example for a differential protection. By default, the fourth measure is not used.

The board is configured for the connection of a current transformer (C.T.) for the measure of the current: if it is required to use a toroid (instead of a C.T.) it is necessary to ask for the special option in phase of order (E6202111000XX).

The parameters P.0108 and P.0140 define the currents of the CTs primary and secondary for the auxiliary current.

The P.0130 parameter determines where the auxiliary current is measured:

0 - On the generator

1 - On the loads

2 - On the mains.

The P.0131 parameter allows you to select if and how the auxiliary current is used:

0 - Not used

1 - General use.

2 - Neutral on the generator

3 – Differential protection

Settings 1 and 2 allow to establish a threshold (par. P.0367 and P.0368) and to determine what action should be taken when the same is exceeded. The setting 2 allows the controller to calculate the genset current differential protection (see 5.16.1.1). Settings 2 and 3 allow to set a threshold (par. P.0377 and P.0378) on the differential current: when exceeding it, an alarm is activated.

You can configure a digital input with the function DIF.2704 – “Disable the protections on the 4th current”: If the input is active, the thresholds, even if set, are ignored and no fault is generated in case the thresholds are exceeded.

5.16.1.1 Differential current

To use the current differential protection, the CT of the auxiliary current should measure the current on the neutral of the generator and the P.0131 parameter should be set as “2 – Neutral on the generator”.

That way, the device calculates the vector sum of all the four currents measured and therefore detects and calculates any imbalance, allowing you to implement, by means of the parameters P.0377 and P.0378 a threshold for the maximum current differential protection.

The triggering of the protection generates a lock.

5.17 Communication

The device is supplied with many communication ports for connecting to a PC, modem, networks etc. Some of these ports are available only on **GC315^{Plus}/GC315^{Link} /GC400$^{Mains+Link}$/GC400^{Mains}**.

GC315x is supplied with:

- USB connection type B to PC, for FW updating and parameter programming

GC315^{Plus} / GC400 is supplied with:

- USB connection type B to PC, for FW updating and parameter programming.
- RS232 Serial connection (max 12m), see par. 5.14.1.
- RS485 Serial connection with galvanic isolation; maximum connection length under optimal conditions, 1200m. The 120ohm termination resistor is built-in; to enable it, all you have to do is connect pins 1 and 2 of the JO to each other. Shielded cable with 120ohm impedance should be used (such as BELDEN 3105A Multi-conductor-EIA Industrial RS-485PLT/CM). See par. 5.14.2.
- CAN-BUS connection to the engine ECU and the additional optional modules (DITEL, DITHERM, DIGRIN and DIVIT), with galvanic isolation. The 120ohm termination resistor is built-in; to enable it, all you have to do is connect pins 4 and 5 of the JQ to each other. It requires the use of a specific shielded cable (such as HELUKABEL 800571). See par. 5.15.
- RJ45 connector for connection to Ethernet networks 10/100 (GC315ETH version).

For details concerning the communications see the specific paragraphs and the document [2].

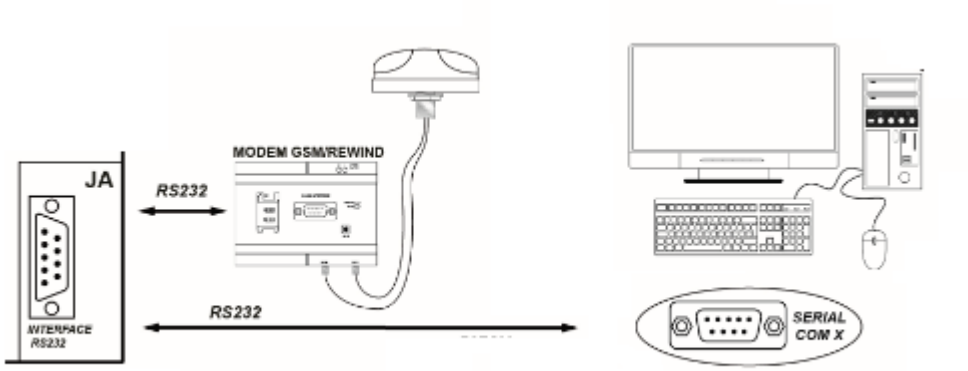
For the CAN-BUS connections see documents [4] and [7].

These communication ports (excluding the CAN-BUS port) support the Modbus RTU protocol, in SLAVE/SERVER mode. Through Modbus, it is possible to read from the controller all measures and states. It is also possible to modify the configuration parameters (knowing the access passwords) and send commands (knowing the command password).

You can protect the write/command access to the communication ports with two passwords:

- P.0469 (menu 1.1.2). It is an alphanumeric password of up to seven characters. By default, it is blank, which means no password. If set to any value other than blank, it protects the controller from any write access (commands, counter reset, parameter setting). To be able to access in writing, first write the correct password in the provided registers (again via Modbus)
- P.0004 (menu 1.1.2). It is a numeric password (0… 9999). By default, it is set to “123”. If set to any value other than “0”, it protects the controller from commands received through the communications ports. To send commands via Modbus to the controller, you must precede each command with the password contained in P.0004. It is also possible to disable the commands received through the communication ports, using a digital input configured with the functions DIF.2512 (“Remote commands lock”) or DIF.2513 (“Front panel/remote commands lock”)

5.17.1 Serial port 1 RS232 (JA) – Not available for GC315



RS232 JA
connector (serial port 1) can be used for interfacing with an external device provided with RS232 interface, such as, for example, a modem or a PC. The maximum length of the connection should be no more than 12m.

The connection can be used for programming the parameters of the device through the BoardPrg4 program, or for connecting to a supervising program such as the Mecc Alte Supervisor SS3.

You can also use it to acquire the measures of some engine electronic controllers (CUMMINS, GERAFLEX).

For the functions and protocols implemented, refer to document [2]. See below the diagram of the connector:

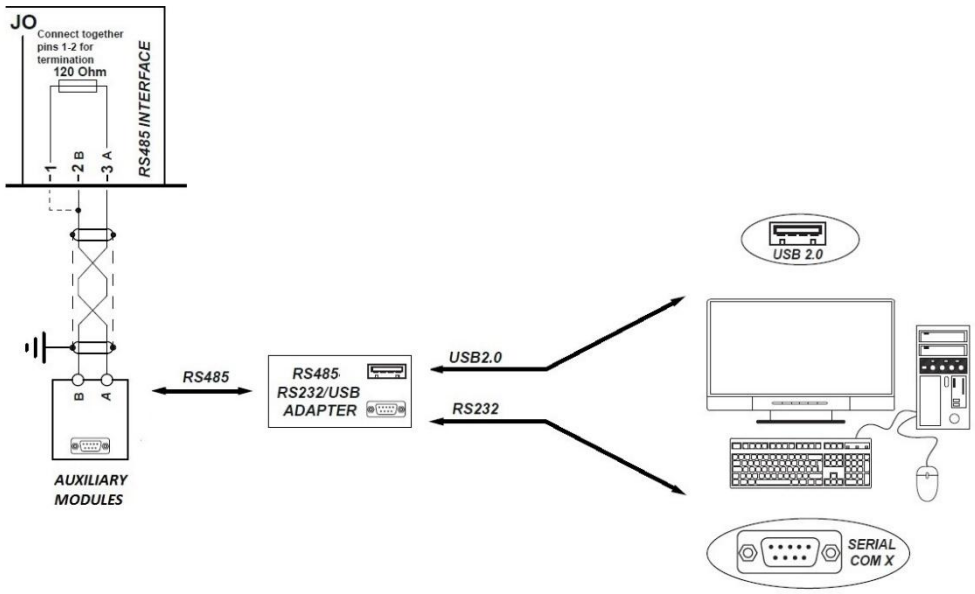
- JA_01: not connected
- JA_02: RXD
- JA_03: TXD
- JA_04: DTR
- JA_05: GND
- JA_06: DSR
- JA_07: RTS
- JA_08: not connected
- JA_09: not connected

To configure the use of the serial port 1 you need to configure the parameters

- P.0451 Use of serial port 1
- P.0452 Modbus address serial port 1
- P.0453 Baud rate serial port 1
- P.0454 Settings, serial port 1
- P.0470 Modbus registers order, serial port 1

The description of these parameters is found in document [1].

5.17.2 Serial port 2 RS485 (JO) – Not available for GC315



The device can be equipped with a serial portRS485 (serial port 2), which is galvanically isolated and separated from serial port 1 (RS232, and which can be used to connect via Modbus to a PC or other devices. You can also use it to acquire the measures of some engine electronic controllers (CUMMINS, GERAFLEX).

For details concerning the RS485 connection, its use and the programming of the parameters, refer to document [1].

Connections:

- JO-3 Connection RS485 A
- JO-2 Connection RS485 B

The RS485 connection needs a 120Ohm termination resistor on both ends of the cable. The device has the resistor built-in; to enable it, all you need to do is jumper connect JO-1 and JO-2 to each other

You cannot connect a modem on serial port 2; as for the rest, you can use it for the same connections as serial port RS232, using RS485/RS232 or RS485/USB adaptors where necessary.

The galvanic isolation ensures the safe operation of the connection, including between remote devices and devices with earth potentials different from t.

The length of the connection should be no more than 1200m; however, it depends on the transmission baudrate set. A specific shielded cable should be used (see 4.2) with grounded shielding mesh.

To configure the use of the serial port 2 you need to configure the parameters

- P.0471 Use of serial port 2
- P.0472 Modbus address serial port 2
- P.0473 Baud rate serial port 2
- P.0474 Settings, serial port 2
- P.0475 Modbus registers order, serial port 2

The description of these parameters is found in document [1].

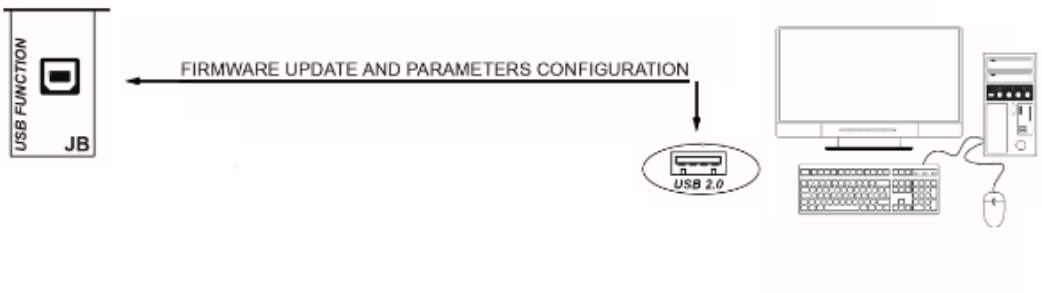
On serial port 2 cannot be connected a modem; for the rest, it is possible to use it for the same connections possible from RS232 serial port using RS485/RS232 adaptors or RS485/USB when necessary.

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.

5.17.3 USB (JB)



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

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

- Enabling the device firmware
- Parameter's programming

Loading/replacing the firmware of the device is a specific operation of Mecc Alte; in addition to the operating FW to be loaded, it requires a particular procedure and specific programs and normally this procedure must not be carried out by the person who performs the installation, except in specific situations previously agreed on with Mecc Alte.

The USB port can be used for programming the parameters with the BoardPrg4 program, as an alternative to the serial connection RS232/RS485 or to Ethernet. After installing the driver, the PC will acknowledge the controller as a new serial port, to be used just as if it were an RS232 serial.

The configuration parameters are:

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

5.17.4 Ethernet (JS) – Not available on GC315, GC315^{Link} and GC400^{Link}

On some models of the controller, a RJ45 serial port is provided for data exchange connection via Ethernet network.

For details regarding the network connection and the protocol, refer to document [2].

You can connect the device to a LAN network, or directly to a PC (point to point connection).

The connection allows for the use of the Mecc Alte Supervisor SS3 SWs, configuration of the BoardPrg4 and of all the available features using the TCP/IP protocol.

The device connection in a LAN network also allows to keep both the inner time updated with the UTC time and the dispatch of data and events updated towards the Smart Cloud server and to keep the possibility to give a public IP address (static or dynamic) directly to the device itself.

Parameters for the configuration:

Parameter	Type	Description	Default value
P.0500	01.10	IP address	192.168.0.1
P.0501	01.10	Subnet Mask	255.255.255.0
P.0502	01.10	Network Gateway	0.0.0.0
P.0503	01.10	Modbus port. Specify the port to be used for the Modbus TCP communication	502
P.0505	01.10	MODBUS records order. When 32-bit information are required, it determines whether to send the first most significant 16 bit first, or the ones less significant	0-LSWF
P.0508	01.10	NPT Server port	123
P.0509	01.10	NPT server IP address	0.0.0.0
P.0510	01.10	Primary DNS server IP address	0.0.0.0
P.0511	01.10	Secondary DNS server IP address	0.0.0.0
P.0513	01.10	DHCP server port	67
P.0514	01.10	DHCP server IP address	255.255.255.255
P.0515	02.03	Period of inactivity (min)	5

To join the device inside a LAN network is necessary to configure the parameters P.0500, P.0501 and P.0502. It is possible to proceed in two different ways:

- It is possible to configure the three above mentioned parameters manually, with congruent values with the network which we are connecting to (the sub-net mask and the router/gateway are specific of each network, the IP address must be a univocal address in the network). To proceed this way, it is necessary that the parameter P.0514 is set to 0.0.0.0 or that the parameter P.0513 is set to zero.
- It is possible to dynamically get from the network 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 the parameter P.0514 is set to 255.255.255.255 or that the parameter P.0513 is set to 67 (67 is the TCP standard port for the DHCP server; if your server use a different port set it to P.0513).

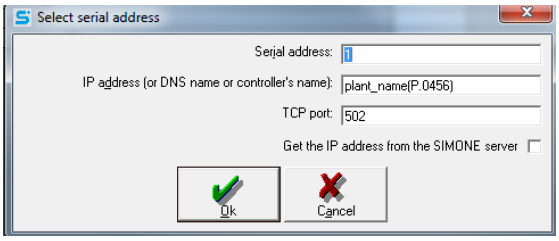
Once the controller has valid values for the parameters P.0500, P.0501 and P.0502, it can be contacted through TCP-Modbus protocol on the configured IP address and on the configured port with P.0053, i.e., with the supervision SW (Mecc Alte Supervisor SS3) and configuration SW (BoardPrg4).

The controller also supports the DNS protocol (Domain Name System). The DNS system is a system used for the conversion of the network knots names into IP addresses and vice versa.

The controller uses this function to convert the server name (Cloud Link server address) into an IP address, but also to sign up on the network with a name. The name has to be configured through P.0456 and must be univocal in the network. To use the DNS system is required:

- If you do not 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 into P.0511).
- If you use a DHCP server (see above), the IP address of the DNS server is received by the controller directly through the DHCP server.

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



The parameters P.0508 and P.0509 allows to set the IP address and the NTP server port (Network Time Protocol), to be used to connect to a NTP server in such a way to keep the inner time and the given time zone synchronized and updated (that is UTC time “Coordinated Universal Time”). By setting both the parameters to zero, the function will be disabled. For further details, see chapter 10.9.1. The real IP addresses (those configured manually or those obtained from the DHCP server) are visible on page S.05.

When no packets are received on the Ethernet port for a duration longer than the configured Period of Inactivity (P.0515), the on-board Ethernet port is reset. This is a safe procedure to prevent hardware faults, and also allow fault recovery and auto-negotiation on the network. When P.0515 is set to 0, the port is never automatically reset and this feature is disabled.

5.17.4.1 Ethernet – 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:

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

It is a request-response protocol; the Manager queries the board by sending the request messages (GetRequest, SetRequest, GetNextRequest and GetBulkRequest) and the controller (Agent) will reply with Response. Furthermore, when an "event" occurs, the controller 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 board 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:

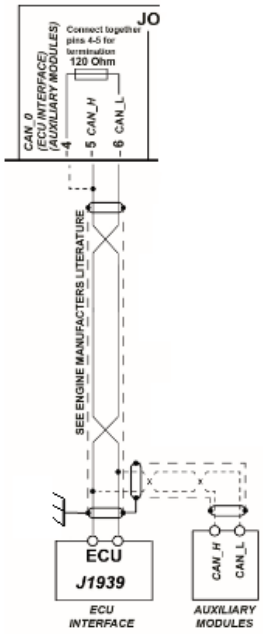
Bit	Value (hex)	Description
0	0001	For alarms, warnings and deactivations
2	0004	For mains status
3	0008	For generator status
4	0010	For engine status
6	0040	For board operating mode

NOTE: the MIB files (Meccalte_GC315_v2B.mib for GC315 e Meccalte_GC400_v2B.mib for GC400) are available on the Mecc Alte web site www.meccalte.com

5.18 CAN-BUS connections

For the below described connections, use a cable suitable for the CAN-BUS (see docs [7][1]).

5.18.1 CAN-BUS (JO) connection – not available for GC315



Using engine equipped with ECU (Electronic Control Unit) and CAN-BUS interface, most of the previous detailed connections are no more required. With only one connection (CAN-BUS to be more precise) the controller is able to start or stop the engine, as well as to control its speed, to make several measurements (such as running speed, coolant temperature and oil pressure) and to display the diagnose codes activated by the engine itself.

Similarly, with the same CANBUS connection the controller is also able to connect to the automatic voltage regulator (AVR), to control the voltage and acquire diagnostic trouble codes and measurements.

For features and operation details, as well as for the configuration of the CAN-BUS communication parameters, see documents [5], [6] and [7].

The CAN-BUS interface is galvanically isolated. CAN-BUS connection is carried out by means connector JO. **The same bus is also used for connecting to the optional modules DITHERM, DIGRIN, DIVIT, DITEL and DANOUT.**

Connections:

- Connect terminal JO-5 to terminal CAN_H of the engine's control unit and/or to the automatic voltage regulator.
- Connect terminal JO-6 to terminal CAN_L of the engine's control unit and/or to the automatic voltage regulator.
- 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 termination resistor is built-in; to enable it, all you need to do is jumper connect JO-4 and JO-5 to each other.

NOTE: the termination must be always enabled, unless the connection proceeds to other devices and the Controller is not one of the two ends.

Use the parameters from 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 configuring the additional expansion modules, see par. 5.10

5.18.2 CAN-BUS (JP) connection – only available for GC400x

This CAN-BUS interface is only available for GC400x and must only be used for plants composed by more than one generator (MPM). It is useful to connect all Mecc Alte genset controllers to each other (not necessarily only GC400x): through this communication channel (PMBC – Power Management Communication Bus) the controllers exchange all necessary data to manage the parallel functions (see doc. [8]).

The CAN-BUS interface is galvanically isolated. **The bus itself can be also used for the connection to the 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 expansion modules data of a controller are sent to the other controllers connected to this CAN-BUS too (see 5.10).**

Connections:

- Connect the JP-2 terminal to the CAN_H terminal of the other Mecc Alte controllers.
- Connect the JP-3 terminal to the CAN-L terminal of the other Mecc Alte controllers.
- Connect the shielded cable to the protection or signal ground on both sides (ensure that the inner Control Panel and the engine frame are kept at the same potential.

The CAN-BUS needs a terminal resistance by 120 Ohm on the two ends of the cable. It is therefore necessary to insert such resistance only on the first and the last Mecc Alte controllers.

Note: the connection of the controllers can never be a star but must be linear.

The termination resistor is integrated into our controller; to insert it is only required to bridge JP-2 with JP-1.

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

6 Link LTE Controllers

6.1 Preface Link LTE

The new **GC315^{Link}** e **GC400^{Link}** controllers are equipped with an **LTE Cat.M1** and **NB-IoT** Multimode module and quad-band **2G** fallback (**GPRS/EDGE)** with multi-regional coverage.

They embed also a Global Navigation Satellite System (**GNSS**) receiver, using **GPS**, **GLONASS, GALILEO** or **BeiDou** system, to provide and reliable positioning information with a high accuracy and performance.

The flexibility extends further with dynamic system selection as **Cat.M1, NB-IoT**, and **GPRS/EDGE** in single mode or as a preferred connection that does not require a module reboot to switch between modes. They provide a solution for applications that require broad geographic coverage, even in areas where **LTE Cat.M1** and **NB-IoT** are not widely available yet.

New **LINK LTE** devices deployed in the field today, can then be activated on existing **2G** networks and still leverage the benefits of **LTE Cat.M1** and **NB-IoT** technology once it becomes available.

The system can be used for different purposes:

- For using the **Mecc Alte Smart Cloud** system
- To remotely connect to the device via internet, i.e., using the **Mecc Alte Supervisor SS3** program
- To enter the programming of the remote parameter via internet
- To receive **SMS*** messages in case of alarms or information about the plant status.
- To send commands to the plant through **SMS*** messages
- To possibly update the FW by remote by using the **Mecc Alte Supervisor SS3** program

It 'also present a system for detecting displacements composed of an accelerometer and a gyroscope. If the generator is improperly moved the device will send a series of warning messages and coordinates acquired from the navigation system (**GNSS**) so you can track the route on a map.

The devices can also be equipped, in option, with internal lithium battery, which guarantees several operation hours to the **SMS*** sending system, the position and status data even in case the device main supply is removed.

The battery is automatically recharged and does not need to be periodically replaced.

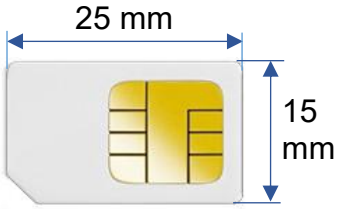
Note: Module is able to make and receive SMS*, make GPRS/EDGE/LTE traffic but is unable to make and receive voice calls.

***SMS:** the networks on which cellular Narrowband is deployed, do not always support SMS services over **LTE NB-IoT** or **LTE Cat M1**. Several operators have yet not deployed the SMS functionality for Narrowband. Contact your network provider for details.

HW Configuration Link LTE

⚠ **WARNING! Each operation of insertion/extraction of the SIM must be performed when the device is switched off, that is with no external supply and with the selector of the internal battery in NO BATTERY position (only with optional internal battery present). The access lid must be removed solely in absence of the genset and main/bus voltage.**

6.1.1 The SIM Card (Only Link LTE)



The device necessarily requires a SIM for its operation.

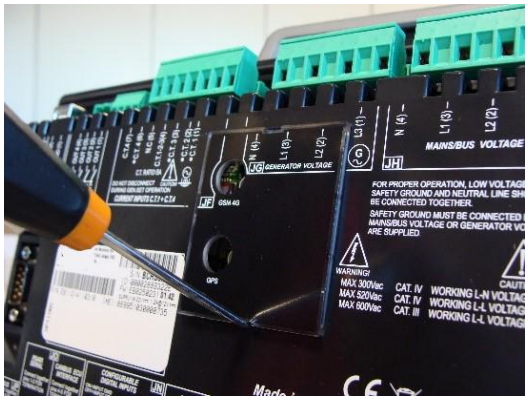
If you wish to use the packet data functions (communicate with the device through TCP/IP, use of Mecc Alte Smart Cloud system etc.) a SIM with an internet connection active plan is required. The SIM card in the device determines whether the device supports **GSM/GPRS/EDGE**, **LTE Cat M1** and **NB-IoT** or all these connections.

Make sure that your SIM supports the packet data network type you want to use. - i.e., if you want to use the module in **LTE Cat M1** network you have to confirm with the operator that the particular SIM card supports **LTE Cat M1** network.

SIM Type: standard SIM Card type **Mini-SIM** (or **PLUG-IN**).

6.1.2 SIM Holder (Only Link LTE)

ⓘ **INFORMATION*: Make sure SIM card does not require PIN code. If it does, it is possible to disable it in any common network unlocked mobile telephone*.**

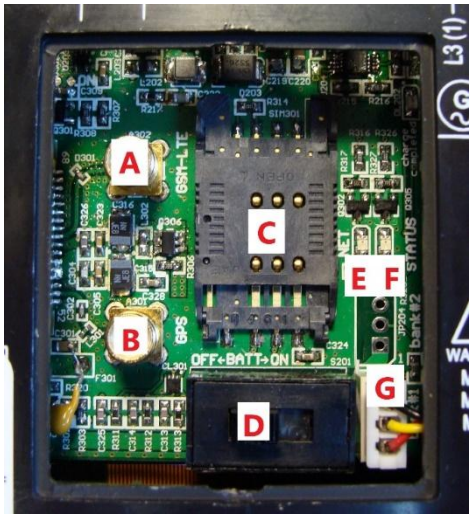


Ensure the device is powered off, then remove the back cover from the device.

Remove the access cover that encloses the SIM holder, the antenna connectors and the battery switch.

Insert a small screwdriver in the little retention hooks and make a slight leverage to remove the panel.

After opening the cover, you will see the following parts:



- **A.** SMA FEMALE connector for GSM - LTE antenna.
- **B.** SMA FEMALE connector for GNSS antenna.
- **C.** SIM card holder slide.
- **D.** Switch for internal optional battery (inserted/not inserted).
- **E.** Yellow LED: indicator for Network Status (NET).
- **F.** Green LED: indicator for Module power on/off status (STATUS).
- **G.** Internal Battery connector

6.1.3 SIM insertion (Only Link LTE)

Pull back the upper cover, it clicks as it unlocks. (fig.1).

Open the SIM card holder, it hinges towards you (fig.2).

Fig.1

Fig.2

Slide in the SIM card, ensuring the “edge cut-out” is as shown (fig.3).

Close the cover, press it down and slide it as shown until it clicks into place (fig.4).

Fig.3

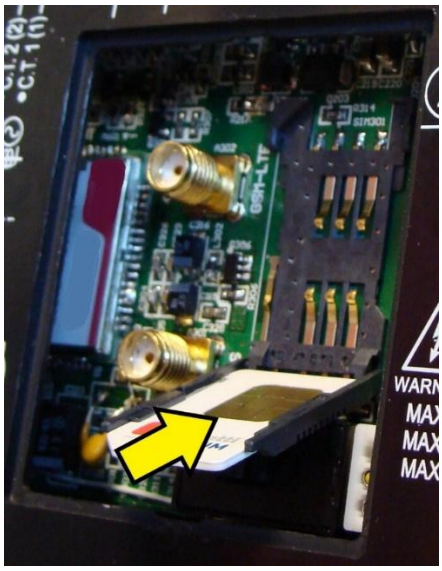


Fig.4

6.1.4 GSM/LTE and GNSS antenna (Only Link LTE)

Connect the antennas when the device is off; let the cable pass through the lid holes paying attention not to invert the two convectors between themselves. **Tighten the connectors by hand without using wrenches or pincers**. (fig.5)

GSM/LTE antenna must be connected to the GSM-LTE SMA plug on the Link device; use only omnidirectional antennas. The maximum gain allowed to antenna and its cable is 3 dB. The impedance of the antenna must be 50 ohm. It is not allowed to connect the antenna directly on the plug but a minimum of 3 m of proper coaxial cable is required.

GPS antenna or GPS+GLONASS antenna must be connected to the GPS SMA plug on the link device.

Use only active antennas with impedance of 50 ohm.

The GPS plug of the Link device provides automatically the power supply required (Max 35mA@3,3Vdc).

Move the switch to the right in “BATTERY ON” position if the device with the internal battery is to be used (see paragraphs between 6.4.6).

Fig.5

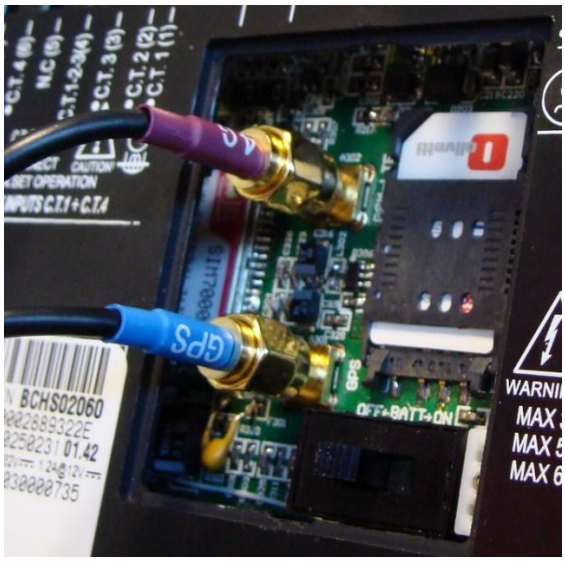


Fig.6

Close the access cover by pressing in the vicinity of the latches (fig.6).

It is possible to use a combined antenna GSM/LTE+GPS/GLONASS or GSM/LTE+GPS antennas.

In this case both GPS/GLONASS and GSM/LTE antennas are integrated in just one body; they can be provided on request together with the Link devices.

⚠WARNING*: A separation distance of at least 30 cm (11.81 inches) between the GSM/LTE antenna and the body of the user and other persons must be maintained at all times.*

6.1.5 LED indicator (Only Link LTE)

Controller LINK have two LEDs indicating modem's operating states (Fig.7).

LED light work's behaviour as below:

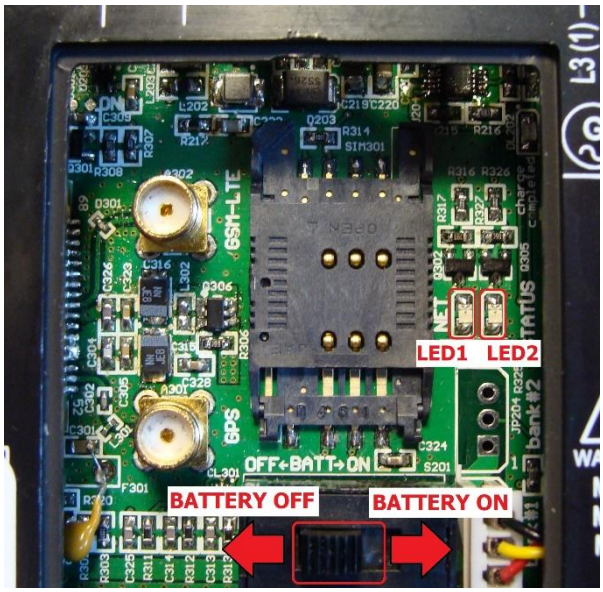
- **LED1 (Net)**: yellow LED flashes with different modalities according to the connection status with the mobile network.

  64ms ON and 800ms OFF: modem not registered to the mobile network.

  64ms ON and 3000ms OFF: modem registered to the mobile network.

  64ms ON and 300ms OFF: modem is exchanging data on the mobile network.
- **LED2 (Status):** green LED indicates whether the module is on and ready to use.

  Both OFF: the modem is off or in Power Save Mode.



6.1.6 Lithium-Ion internal Battery (Only Link LTE)

The **GC315**[Link] e **GC400**[Link] controllers can be supplied optionally with a Lithium-Ion internal rechargeable battery, which is able to ensure only its data transmission and localization for some hours in case of lack of the main supply.

The battery is activated/deactivated through the switch (fig.7).

With the circuit breaker in **OFF BATTERY** position (that is moved to left) the internal battery is totally disconnected; the operation of the modem and all functions of the **Link LTE** controllers are only possible when present the main supply of the controller.

With internal battery present and switch in **BATTERY ON** position (that is moved to right) the battery is recharged automatically in presence of controller supply and keeps the device active when the supply is missing.

The full charge requires approximately 12 hours, after which the battery is in permanent buffer charge.

The battery is controlled by an internal circuit witch continuously monitors its voltage. If the voltage drops below the recharge threshold, another charge cycle begins and current is once again supplied to the battery.

A thermal regulation optimizes the charge cycle time while maintaining internal battery reliability.

The internal battery can be recharged only when the controller temperature is between 0°C and +50°C.

The internal battery is lithium ions type and has a small level of self-discharge but present though.

The internal battery contains a safety system that disconnects it if its voltage drops below a minimum operating threshold, but still allows recharging; if the voltage drops further for self-discharge below a further second level, the system disconnects the battery internally and permanently; once this second level has been activated, it is no longer possible to charge the battery, which must be replaced.

Reaching this second level takes a few months, however, with the battery completely discharged.

Letting the battery discharge completely (circuit breaker on BATTERY ON) in not supplied controllers as those stocked or in not supplied plants since used without making a periodic recharge (i.e., once per year) could therefore make the internal batteries unusable for a long period. Thus, we strongly recommend to leave the circuit breaker on BATTERY OFF in case the system or the controller are not going to be used for a long period.

The device operation time in battery mode depends on several factors, such as the environment temperature, the data sending frequency and the mobile network signal intensity. The duration of the battery can be highly increase by activating one of the two types of energy saving.

INFORMATION*: Leave the switch on BATTERY OFF when the device does not have the main power supply (JD) and should not be used for a long time: this allows you not to unnecessarily discharge the internal battery.*

WARNING*: In the internal battery operating state and in the absence of the main power supply (JD), the device is not able to manage the operation of the genset. It must be left in OFF/RESET mode.*

During the operation with battery the most part of the controller functions are deactivated. In details:

- The display lamp remains off.
- The digital inputs are all always active and cannot be used for alarm and pre-alarm signals
- The digital and relay outputs are deactivated
- The analogical measures have no meaning and go down the scale
- The USB port, the RS485 serial port and the CANBUS port are inactive
- The internal siren is inactive

What remains active:

- The data communication via the cellular network
- Sending and receiving **SMS*** message
- The **GNSS** geo-location
- The RS232 serial port
- The display LCD (with lamp off)
- The accelerometer and a gyroscope
- The keys

6.2 Parameter's configuration (Link LTE)

To activate the function of the **Link LTE** types, it is necessary to set the parameter P.0450 to the "1-Link Module" or "2-Link Module with battery".

Always verify that on the Link LTE controllers the P.0450 parameter is set to "1 Link Module" or "2-Link Module with battery"; in other versions it must be set to "0 - external Modem".

6.2.1 SMS messages

The **Link LTE** controllers can send alerts directly to a mobile phone via **SMS*** (mobile originated SMS); to do so, the device can need to be programmed to send **SMS*** to a specific phone.

To this purpose it is necessary to:

1. Set one or more telephone numbers (**P.0457, P.0459, P.0461, P.0463**), indicating for each number that it is to be used as the recipient of an SMS*. This is obtained by setting the parameters for each telephone number entered to "1" (**P.0458, P.0460, P.0462, P.0464**).
2. Using the "Communication events" parameter, configure which system events should cause the **SMS*** to be sent.

In case that the device is configured with at least one phone number dedicated to SMS transmission and it is configured for at least one event inside the "Communication events" parameter, at the selected event occurrence the device performs the following step-by-step sequence:

1. Selects the first phone number configured for **SMS*** transmission.
2. Sends an **SMS*** to that number.

3. Checks if one or more **SMS*** are set for each phone number. If not, or if all the programmed SMS transmissions have been performed, it carries out the following item 4 step. Otherwise, it waits five seconds and carries out item 2 step.
4. Checks if further phone numbers configured for **SMS*** transmission exist. In case that-these exist, the device waits five seconds and carries out item 2 step. Otherwise, it stops the step-by-step sequence, until the next warning event occurrence.

I.e.: at each new anomaly event (set for **SMS*** transmission generation) occurrence, the quantity of programmed **SMS*** is transmitted to each configured phone number, in accordance with "Number of SMS for each event" parameter configuration. For the **SMS*** you can receive and for the commands you can send see the document [2] **(EAAS0341xx Serial Communication and SMS protocol).**

***SMS:** the networks on which cellular narrowband is deployed, do not always support SMS services over **LTE NB-IoT** or **LTE Cat M1**. Several operators have yet not deployed the SMS functionality for Narrowband. Contact your network provider for details.

INFORMATION: It is important that you deactivate the PIN code check: insert the SIM in a phone and deactivate the PIN code before using it in the Link LTE devices.

6.2.2 Mobile network configuration and data connection

To use the communication on 2G/LTE network it is necessary to configure some parameters that allow the device to connect to the mobile operator appropriately.

For the data exchange through TCP/IP protocol, the IP address is assigned to the controller directly from the mobile network and the controller will then be contactable using this IP address.

Page S.05 shows the IP address given to the controller by the data mobile network. It is also possible to interrogate the controller via **SMS*** to know the current IP address.

It is not possible, instead, to join the controller using the name configured with the parameter P.0456.

If you are using the Mecc Alte Supervisor SS3, it is possible to connect to the plant in any moment by setting the section dedicated to the connection between the Mecc Alte Smart Cloud server.

Below are the minimum configuration parameters to be set to allow the device to connect to the mobile network and communicate with the Mecc Alte Smart Cloud system via TCP/IP protocol**.**

These parameters can be modified on the controller through the relative programming menu, with the BoardPrg4xx and also through the web service in the appropriate configuration page of the device:

Parameter	Name	Default
P.0570	Mobile network mode	1-GSM/GPRS
P.0571	LTE category	2-CAT M and NB-Iot
P.0551	APN primary (access Point Name)	
P.0552	APN primary username (optional)	
P.0553	APN primary password (optional)	
P.0554	APN primary (access Point Name)	
P.0555	APN primary username (optional)	
P.0556	APN primary password (optional)	
P.0557	Connection mode	1-Stay connected
P.0558	Modbus/TCP enable	0-No
P.0559	Modbus/TCP port	502

- **P.0570** parameter configures the preferred Network Mode to:
  - **0 ("Automatic"):** automatic connection between GSM/GPRS/EDGE or LTE network.

    In this mode, the device decides independently, based on the available networks and signal strength, which type of network to connect.

    When first power up, it will search with the following priority: CAT-M > NB-IOT > GSM/GPRS/EDGE.

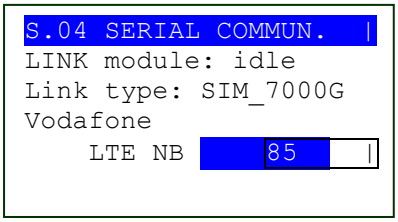
    Search time depends on signal strength and active mobile networks detect. It may be necessary to wait several minutes before the first connection to the mobile network is established.
  - **1 ("GSM/GPRS"):** connection to the GSM/GPRS/EDGE network only
  - **2 ("LTE")**: connection to the LTE network only
- **P.0571 parameter configures the preferred LTE network mode to:**
  - **0 ("CAT-M"):** connection to the CAT-M1 network only.
  - **1 ("NB-IoT"):** connection to the NB-IoT network only.
  - **2 ("CAT-M and NB-IoT"):** automatic connection between CAT-M or NB-IoT network**.**

If you have a **SIM** not enabled for **LTE** connections (**CAT.M1 or NB-IoT**) or if these two new technologies are not available, we recommend setting parameter **P.0570** to **1-GSM/GPRS** to force the connection to the **GSM/GPRS/EDGE** network and make the first connection faster.

- **P.0551 parameter configures the APN (Access Point Name) of the mobile operator used. Some operators require access credentials (username e password) to access the APN: in this case use the parameters P.0552 and P.0553 to configure username and password. If access credentials are not required (standard), leave P.0552 and P.0553 empty.**
- **P.0557 parameter configures how the controller has to connect to the data mobile network:**
  - **0 ("Disconnect every time**"). In this mode the controller connects to the data mobile network every time it has to send data to the server and disconnects as soon as it has sent the data. If this mode is used, the data exchange with the Modbus/TCP protocol with the controller is not possible.
  - **1 ("Stay connected**"). This mode is suggested: the controller connects to the data mobile network as soon as possible and remains connected until it is possible. In this mode the data exchange with the Modbus/TCP protocol with the controller is possible (BoardPrg4, Mecc Alte Supervisor SS3).
- **P.0558 parameter activate/deactivate the data exchange with the protocol Modbus/TCP on the mobile network: when it is enabled, the parameter P.0559 configures the TCP port on which the controller is able to communicate.**

Page S.04 shows:

- the active connection type GSM, EDGE, LTE NB-IoT or LTE CAT-M1.
- the Mobile Network Operator (MNO) currently connected (Vodafone, TIM….). If the SIM card does not return the full name the Mobile Country Code (MCC) + Mobile Network Code (MNC) is shown.
- the mobile network signal intensity.



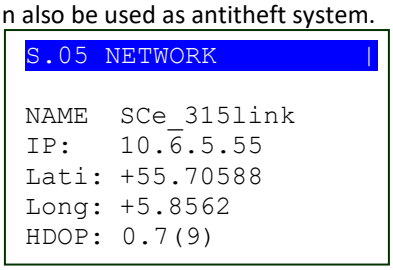
6.2.3 GNSS Receiver

To use the Global Navigation Satellite System (**GNSS**) internal receiver, using **GPS**, **GLONASS, GALILEO** or **BeiDou** system, the internal module must be enabled with the parameter **P.0580** *(*GPS module enable) set to "**1-YES**". Connect also the GNSS antenna.

The purpose of this module is to detect the controller position (latitude/longitude). Once detected, the position coordinates can be asked via **SMS*** and it can be used to pinpoint the genset on a map (many business sites allow this operation).

The position becomes most important in the use with Mecc Alte Smart Cloud system. Directly from the WEB interface it is possible to display the position of a genset on a map, and it will also be possible to display the tracking of a rented genset in a period of time: both these functions are useful for rented gensets but can also be used as antitheft system.

The controller displays the **GNSS** coordinates on page S.05. The coordinates flash if the **GNSS** module is not able in that moment to determine the position (therefore the last position detected is shown). It also shows the **HDOP** (Horizontal Dilution of Precision) value: it is a precision indicator (the lower it is, the sharper the position).



Finally, next to the HDOP value, they are indicated in brackets:

- the number of satellites that are "view" by the **GNSS** module (when searching for coordinates).
- the number of satellites used for the "**FIX**" of the coordinates (once the correct position has been determined).

If the **GNSS** module is not used, it is still possible to manually set the latitude (**P.0581**) and longitude (**P.0582**) of the generator set to display the position on the map or on the Smart Cloud WEB interface (for example in the versions with Ethernet board that communicate with the Mecc Alte Smart Cloud system).

6.2.4 Energy saving mode

On **Link LTE** controllers equipped with optional internal battery it is possible to configure an “energy saving” mode which allows to let the battery duration and therefore the connection to Smart Cloud system much longer.

To activate the “energy saving” mode, it is necessary to set the parameter P.0450 to the “**2-Link Module with battery**”.

This mode is managed by the following parameters:

- **P.0591**: Threshold for battery low voltage (Default 0).
- **P.0592**: Delay for battery low voltage (Default 0 - energy saving deactivated).
- **P.0594**: Accelerometer sensibility threshold (0=high 127=low). (Default 8).
- **P.0595**: Number of events from accelerometer (Default 3).

These parameters are in the programming menu 4.7.4 Energy Saving.

The mode gets active when the controller supply voltage goes below **P.0591** for at least the **P.0592** time. Putting 0 into **P.0592** the mode is deactivated. The activation of the mode is indicated by the flashing of the LED ALARM once every 10 seconds.

In practice, when the supply voltage gets lower or disappears, the controller functions are reduced to the minimum in order to optimize the duration of the battery. The display is turned off and the electronic of the controller, the modem and the **GNSS** receiver work with reduced modalities.

The internal accelerometer is able to detect whether the device, and therefore the control panel or the genset, is moved and creates an appropriate event including the position data.

Through parameters **P.0594** and **P.0595** it is possible to set the level of sensibility of the accelerometer and the number of “accelerations” to be detected in a time of two minutes before creating the accelerometer event. This to avoid the creation of events due to vibrations, impacts or wind blows and not therefore to effective movement. Every two minutes the acceleration count automatically restart from zero.

There being no further accelerometer events and persisting low or absent voltage supply conditions, the device is brought back to energy saving mode.

The behaviour in the **Energy Saving** status is the following:

1. The internal modem is switched off.
2. The **GNSS** module is switched off.
3. The LEDs of the device are all off except for the ALARM LED, which flashes every 10 seconds.

4. The microprocessor of the device enters the low power state and wakes up every 10 seconds to watch the power supply voltage.

The controller exits the **Energy Saving** state only under one of the following conditions:

- The supply voltage rises above the minimum value set in **P.0591 - Threshold for low battery voltage** (with a hysteresis of 300/400mV) after about 3-4 seconds. In this case, the output behaviour from the Energy Saving state is as follow:
  1. The controller's microprocessor leaves the low-power state.
  2. The internal modem is switched on.
  3. The **GNSS** module is switched on.
  4. The connection with the mobile network is re-established.
  5. The controller resumes normal functionality.

- A movement is detected by the internal motion sensor (Accelerometer). In this case, the output behaviour from the Energy Saving state is as follow:
  6. The controller's microprocessor leaves the low-power state.
  7. The internal modem is switched on.
  8. The **GNSS** module is switched on.
  9. The connection with the mobile network is re-established.
  10. If no other movement has been detected by the internal motion sensor (Accelerometer), the controller returns to the Energy Saving state initially described.

⚠**WARNING***: In the internal battery operating state and in the absence of the main power supply (JD), the device is not able to manage the operation of the genset. It must be left in OFF/RESET mode,*

The controller has to be considered as working in a particular mode, not able to manage the genset, but only the communication system.

7 Mecc Alte Smart Cloud System

Mecc Alte Smart Cloud system is a centralized cybersecure system of data collection: such data are then consultable through a WEB interface. It allows users to connect, continuously monitor and even control multiple Mecc Alte controllers in the cloud in a limited way. The controllers can communicate with Smart Cloud system both through Ethernet port and through GPRS/LTE modem using TLS 1.2 security protocol and removing the requirement for static and public IP address.

The controller uses a proprietary Cloud Link protocol as the preferred connection type that supports any type of network. Thus, it can be connected behind the router on the internal network or on the public internet. The required parameters are Channel ID (P.0563), Cloud Link User (P.0564) and Cloud Link Password (P.0565) are unique for each of them.

Parameter	Name	Default
P.0560	Cloud Link enable	0-No
P.0561	Cloud Link server Address	smartcloud.meccalte.com
P.0562	Cloud Link Server Port	23010
P.0563	Cloud Link Channe ID	
P.0564	Cloud Link User	
P.0565	Cloud Link Password	

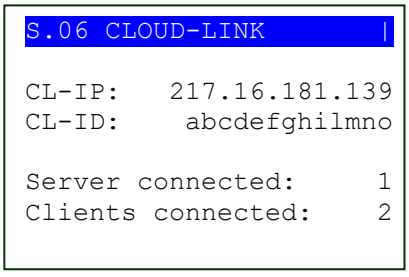
These parameters are configurable on the controller through the relative programming menu, with the BoardPrg4xx in the appropriate configuration page of the device. In details:

- **P.0560** parameter set to value “1-YES” enables the data issue towards Smart Cloud server.
- **P.0561** parameter configures the IP address or the name of the Smart Cloud server. It is possible to set the IP server address in text format or the server’s name in full (i.e., “smartcloud.meccalte.com”) which will be converted by the controller into IP address using the DNS server (suitably configured or automatic on GPRS). It is possible to disable the connection towards the server setting the empty string.
- **P.0562** parameter configures the Smart Cloud server port. By setting the port address to zero the connection towards the server is disabled. The default port is 23010.
- **P.0563** parameter configures the Cloud Link channel identifier.
- **P.0564** parameter configures the Cloud Link user.
- **P.0535** parameter configures the Cloud Link password. It requires Super User password to be modified.

The Cloud Link credentials are provided with the controller. In case these have not been provided, please get in touch with Mecc Alte.

It is also necessary to keep the date and time updated, possibly by enabling the NTP protocol (see P.0508 and P.0509 parameters).

The client identifier of the controller and the status information for the communication with Smart Cloud are displayed on page S.06. In details:



- **CL-IP**: identifies the IP address of the Smart Cloud server to which the data are sent.

- **CL-ID**: identifies the plant name which is supposed to correspond to the one given on Mecc Alte Smart Cloud to allow an easy identification of the device on Smart Cloud server web page.
- **Server connected**: indicates the number of servers connected to the controller and that the supervision connection is active to Cloud-Link.
- **Clients connected**: indicates the number of clients connected to the controller (which are exchanging data via the Modbus TCP/IP protocol).

For details about Mecc Alte Smart Cloud server see document [9].

8 Main functions

8.1 Front panel GC315x

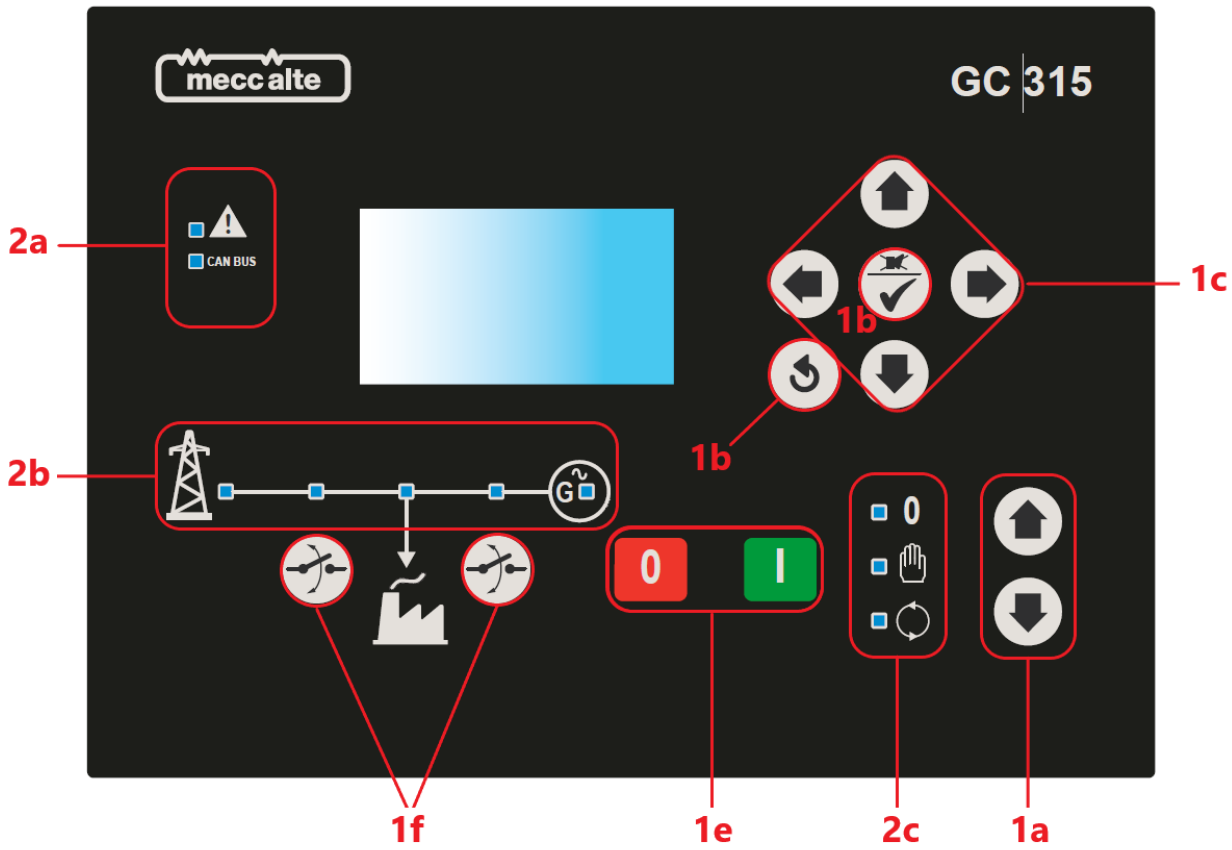


Fig. 1 – Front Panel GC315x

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**).

8.2 Front Panel GC400^{Mains} and GC400$^{Mains+Link}$

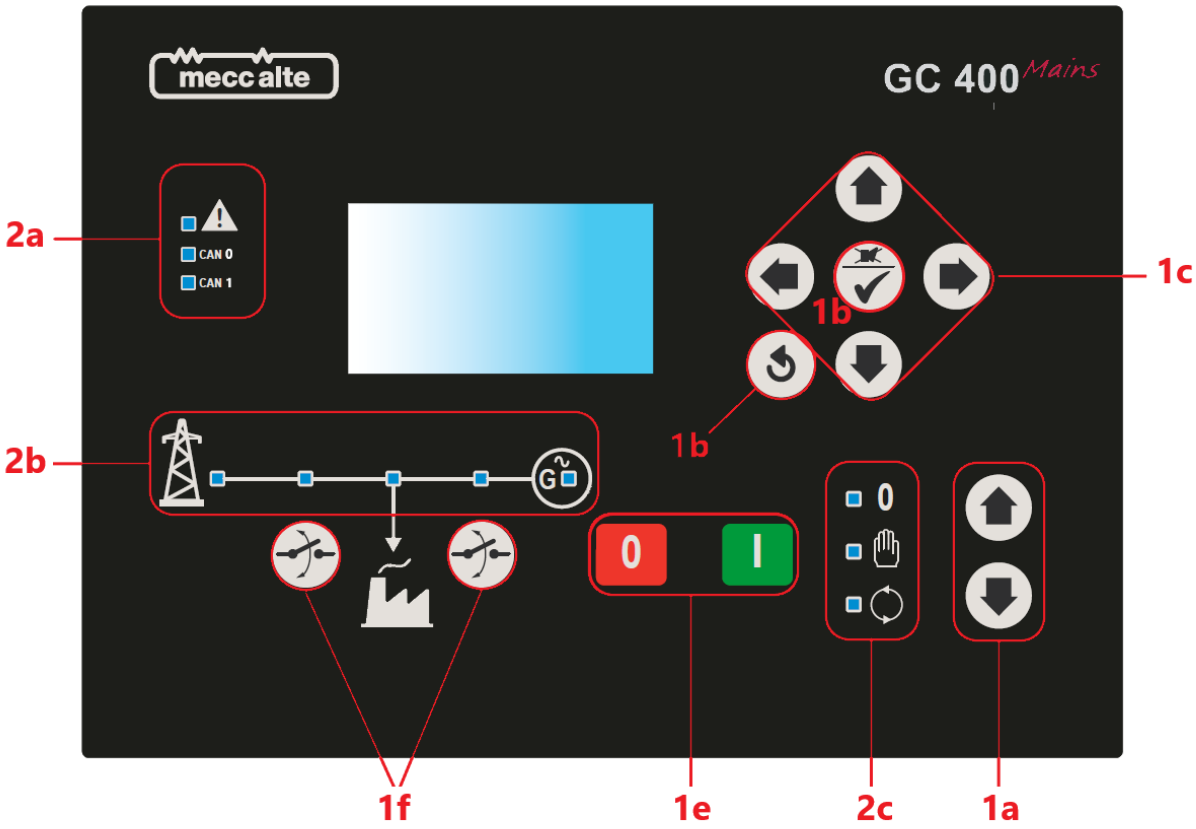


Fig. 2 – Front Panel GC400x

KEY

1 - Pushbuttons

2 - Indicators

The controls consist of 11 buttons (**1a, 1b, 1c, 1d, 1e, 1f**).

The front panel also has 10 luminous indicators (**2a, 2b, 2c**).

8.2.1 Front Panel GC400 and GC400^{Link}

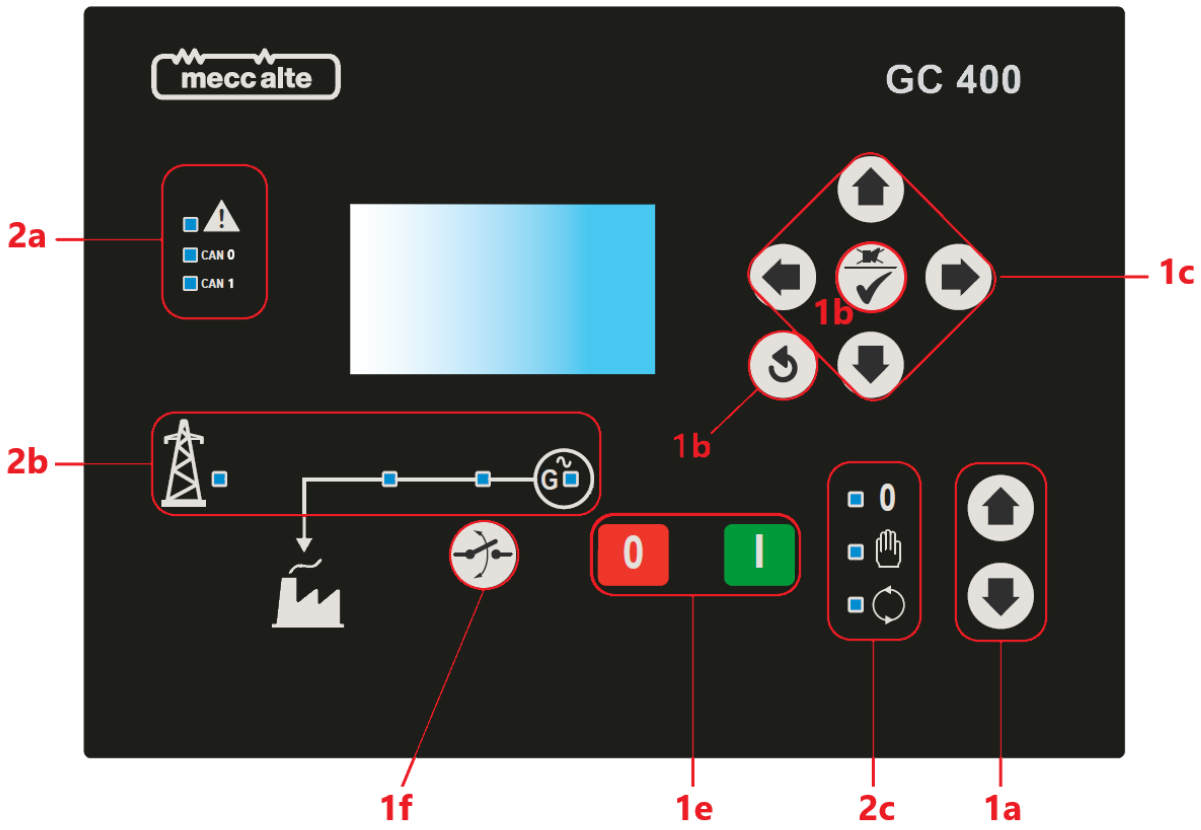


Fig. 2 – Front Panel GC400x

KEY

1 - Pushbuttons

2 - Indicators

The controls consist of 11 buttons (**1a, 1b, 1c, 1d, 1e, 1f**).

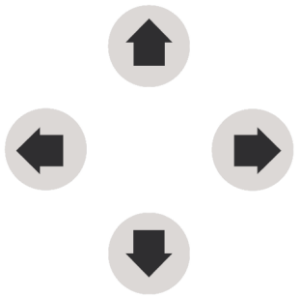
The front panel also has 10 luminous indicators (**2a, 2b, 2c**).

8.3 Selector (ref. to fig. 1)

By default, each time you press any button, the controller emits a short confirmation tone. You can turn off the sound by setting bit seven of parameter P.0495 to 1.

It is possible to disable quite all the commands activated with the buttons, using a digital input configured with the functions DIF.2511 (“Front panel lock”) or DIF.2513 (“Front panel/remote commands lock”): the commands are enabled if the input is not active or if it does not exist. In the following tables, the second column indicates whether the digital input blocks the commands.

Pushbuttons		LOCK	Function
	OFF/RESET ***PROGRAM***	YES	The generator is disabled; warnings and lockouts are cancelled. You can program the parameters.
MODE UP   **MODE DOWN**	**MAN (Manual)**	YES	The Genset control module is set for manual genset control. Press the **START**  button to start the engine. Press the **STOP**  button to stop the engine. With the engine running at full speed: Press the **MCB**  button for manual opening/closing control of utility contactors on the mains. Press the **GCB**  button for manual opening/closing control of utility switches/contactors on the generator.
Ref. 1a	**AUTO (Automatic)** ***TEST***	YES	The genset control module is set for the automatic management of the generator set operation, which trips in the event of voltage anomalies on the mains and automatically manages the switching of the Utilities. By pressing the **START** button it is possible to activate/deactivate the **TEST** mode. This, unless configured differently, does not switch the load from the mains to the generator and vice-versa and the utility remains de-energized during switching. This feature can be disabled using bit 1 of P.0495. The **STOP** button, causes the stop of the generator if running and the activation of a lockout unless configured otherwise.
 **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. When pressed in any menu, it displays on the upper line the engine status.

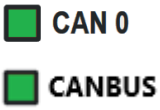
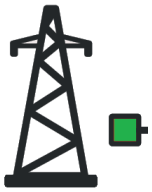
Pushbuttons	LOCK	Function
		In **OFF**/RESET mode and depending on the selected page, if pressed together with the **ENTER** button for at least 5 seconds, it can reset counters to zero, reload default values of the programming parameters or cancel the history logs (in the version equipped with **CAN-BUS**, it allows to force exit from **BUS OFF** mode). When used during the keyboard regulation function, it aborts the function.
 **Rif. 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** mode. In **PROGRAM** mode, they are used to position the cursor when entering the strings. The horizontal navigation buttons, used in combination with the **Esc/SHIFT** button, allow to adjust the contrast. To decrease the contrast (lighten), press the combination of buttons **Esc/SHIFT** + **LEFT** . To increase the contrast (darken), press the combination of buttons **Esc/SHIFT**+ **RIGHT**. In **PROGRAM** and **HISTORY LOGS** mode you can scroll the menus and the variables/settings. You can increase/decrease the value of the variable to change the settings. Used in combination with the **Esc/SHIFT** button you can scroll through the menu ten entries at a time or increase/decrease the variables ten units at a time.
 **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 the LOG menu, you can activate the **HISTORY LOG** function and open the selected log, “acknowledge” any EEPROM errors at power-up. Upon the occurrence of an alarm or lockout, the pressing of the button recognizes the presence of an error and turns off the siren. A further press of the button resets any alarm signals if the operating conditions have returned to normal. Lockout signals can only be reset by activating the "OFF/RESET" mode.
 **MCB** **Ref. 1f**	YES	The button is disabled in the “**OFF/RESET**”, “**AUTO**” and “**TEST**” modes. In “**MAN**” it is used to open and/or close the mains contactor to the utilities. To open the mains switch **MCB**, with the engine idle, press and hold the “**MCB**” button for at least 5 seconds.
 **GCB** **Ref. 1f**	YES	The button is disabled in the “**OFF/RESET**”, “**AUTO**” and “**TEST**” modes. In “**MAN**” it is used to open and/or close the generator contactor to the utilities. The closure of the utilities to the generator is only possible if the relative electrical measures are within tolerance range.
 **START** **Ref. 1e**	YES	In **MAN** mode it can be used to start the engine. The button can be configured in two ways:

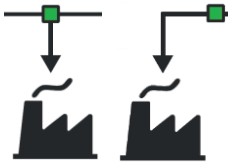
Pushbuttons	LOCK	Function
		• P.0252 = 0: fully manual (the starter motor is engaged all the time the button is pressed or until the engine running is detected). • P.0252 > 0: fully automatic (simply press and release the "**START**" button to activate an automatic start sequence of maximum P.0252 tries). 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 genset control module is activated, keeping it pressed at the same time as the **STOP** button allows access to the special functions.
0 **STOP** **Ref. 1e**	YES	Used to control the stop of the engine in "**MAN**" mode. The button can be configured in two ways (bit 0 of P.0495): Stop of the engine in **AUTO**, **TEST** or **REMOTE START** mode with the activation of a lockout. No function. The enabling of the button in **AUTO**, **TEST** or **REMOTE START** is irrelevant. Pressed with the genset control module in **OFF/RESET** mode, runs the **LAMP TEST** on all the indicator lights (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 genset control module is activated, keeping it pressed at the same time as the **START** button allows access to the special functions.

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

LED OFF	LED steady ON	LED flashing
□	▣	⧈

	Signalling		Function
▣ 0 **Ref. 2c**	**PROGRAM OFF/RESET**	▣	Indicates that the operation mode is OFF/RESET
		⧈	Indicates that you are accessing the PROGRAMMING menu
		□	The Genset control module is in another operating mode
▣ ✋ **Ref. 2c**	**MANUAL**	▣	Indicates that the operation mode is MANUAL
		□	The Genset control module is in another operating mode
▣ ↻	**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

	Signalling		Function
Ref. 2c		☐	The Genset control module is in another operating mode
 Rif. 2°	**ALARM**	■	Indicates the presence of at least one lockout, one deactivation or power-off
		▣	Signals at least one pre-alarm
		☐	No error
 Ref. 2a	**STATUS ECU INTERFACE**	■	Indicates that the **CAN-BUS** interface is active, operating in **ERROR-ACTIVE** mode (ECU and/or AVR and/or expansion modules)
		▣	Flashing at 25% ON signals a COM error (J1939 or MTU): the port is in **ERROR-PASSIVE** mode.
			Flashing at 75% ON signals a COM error (J1939 or MTU): the port is in **BUS-OFF** mode.
		☐	Indicates that the **CAN-BUS** is disabled.
 Rif. 2a	**CAN1**	■	Indicates that the **CAN-BUS** interface is active, operating and in ERROR-**ACTIVE** mode
		▣	Flashing at 25% ON signals a COM error: the interface is in **ERROR-PASSIVE** mode.
			Flashing at 75% ON signals a COM error: the interface is in **BUS-OFF** mode.
		☐	Indicates that the **CAN-BUS** is disabled.
 Rif. 2b	**MAINS LIVE**	■	Mains voltages are present and steady in tolerance range. The digital input **MAINS SIMULATION** is active in the configured time.
		☐	Mains voltages are not present. The digital input **MAINS SIMULATION** is not active.
		▣	Flashes at 50% during transition between the previous two states.
			Flashing at 25% the mains voltages are on but below the tolerance range.
			Flashing at 75% the mains voltages are on but over the tolerance range.
 Ref. 2b	**GENERATOR LIVE**	■	Generator voltage and frequency are present and stead within the tolerance range.
		☐	Generator voltage and frequency are not present.
		▣	Flashes at 50% during transition between the previous two states.
			Flashing at 25% the mains power and frequency are on but below the tolerance range.
			Flashing at 75% the mains power and frequency are on but over the tolerance range.

	Signalling		Function
 Ref. 2b	**MCB (only GC315x and GC400^{Mains}/GC400$^{Mains+Link}$)**	☐	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.
 Rif. 2b	**BUSLIVE**	▣	Indicates the voltage presence on **BUS** line
		☐	Indicates the voltage absence on **BUS** line
		⧈	Flashing at 50%: only for GC400x during the synchronization (flashes in alternation with GCB during input synchronization, flashes alone during the back synchronisation
 Rif. 2b	**GCB**	☐	The GCB breaker is commanded open.
		▣	The GCB breaker is commanded closed.
		⧈	Flashing at 25% ON if open after a closing command.
			Flashing at 75% ON if closed after an opening command.
			Flashing at 50%: only for GC400x during synchronisation (flashes in alternance with BUS LIVE).

8.5 Multifunctional display

8.5.1 LCD lighting

The backlight lamp is managed by the Genset control module, which switches off the backlight 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, 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 the P.0493 parameter, you can force the lamp to stay always on when is engine is started.

8.5.2 Contrast adjustment

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

Press in sequence the **Esc/SHIFT** button + **LEFT** to reduce the contrast (lighten), press the **Esc/SHIFT** button + **RIGHT** to increase it (darken).

8.5.3 Mode navigation

The display has different display modes with various pages.

Mode	Description	Page identifier
PROGRAMMING	Programming	P.XX
STATUS	Status information	S.XX
MEASURES	Electrical measurements	M.XX
ENGINE	Engine measurements	E.XX
PMCB (**ONLY GC400x**)	Pages about parallel functions	B.XX
HISTORY	History logs	H.XX

Generally, navigation between modes takes place via buttons **UP** **Rif. 1c** and **DOWN** **Ref. 1c**.

To view the pages within this mode, use the buttons **LEFT** **Ref. 1c** and **RIGHT** **Ref. 1c**.

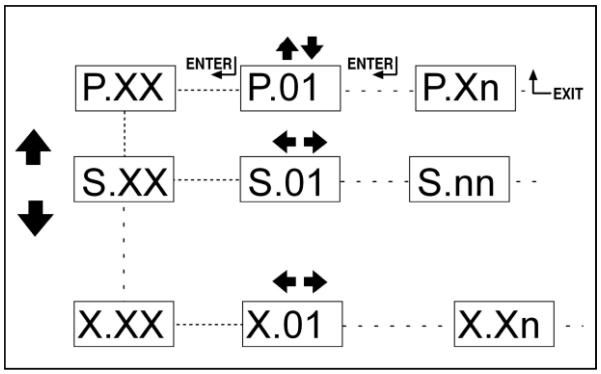


Fig. 2 - Mode navigation

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

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

Some of the pages can be automatically hidden by the controller depending on the system configuration parameters.

From version 1.58 of GC315 and 2.17 of GC400, it is possible to use parameters P.2992, P.2993, P.2994 and P.2995 to hide some pages relating to categories “S”, “M”, “E” and “B”. These parameters can be set in bits, where each bit corresponds to a display page. For example, setting P.2992 to “00000001” (bit 0 active) hides page M.01.

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

KEY:
1 - Status bar
2 - Data area

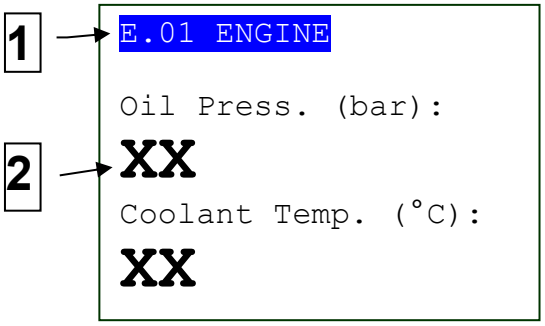


Fig. 4 – Display areas

8.5.5 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

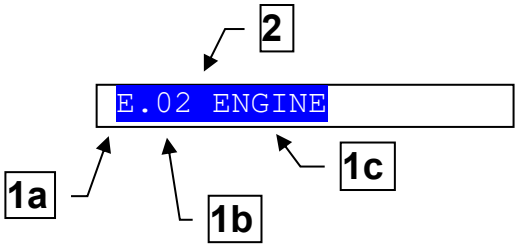


Fig. 5 – Display of the top status bar

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.

On the right side, a key icon may appear if:

- A digital input configured with the functions DIF.2511 (“Front panel lock”) or DIF.2513 (“Front panel/remote commands lock”) is disabling the front panel commands.
- A digital input is forcing the controller operating mode (OFF/RESET, MAN, AUTO), and therefore you cannot use the “MODE ▲” and “MODE ▼” buttons.

ATTENTION! the “@” symbol may also appear on the right to indicate that the controller is modifying the non-volatile memory: do not disconnect the power supply when this symbol is visible, otherwise you risk losing the contents of the memory itself.

8.5.6 Configurable measurement units

The controller provides three parameters allowing to customize the most common used measurement units:

- P.0191 (for temperature): it allows selecting among Celsius or Fahrenheit degrees.
- P.0192 (for pressure): it allows selecting among “bar” and “psi”.
- P.0193 (for volume): it allows selecting among litres and gallons (both US and imperial).

The controller automatically converts all acquired measurements into the selected units and shows them properly.

ATTENTION! the operator must take care of threshold and conversion curves (both must be properly set depending on the selected units). The controller never automatically converts thresholds and curves.

Note that changing one of the previous three parameters results in clearing the history logs.

8.6 Display mode

8.6.1 Programming (P.XX)

The controller manages a high number of parameters that allow the manufacturer, the installer or the final user to configure it in order to adapt it to specific system requirements. This document does not contain the parameters list (even though many of them are quoted in the description of the controller functions. In this document the general programming structure and the operating procedure to read and/or modify parameters are described.

To modify a parameter, scroll with the **UP** and **DOWN** buttons to menu P.03-Programming and press **ACK/ENTER** to start.

To exit programming menu and to return to the main screen press the **ESC/SHIFT** button.

⚠ WARNING: Assigning an incorrect value to one or more parameters can cause malfunctions, damage to things or injury to people. The parameters must only be changed by qualified personnel. Parameters can be password protected (refer to par. 8.6.1.2).

8.6.1.1 Organization

This mode lets you display and change the programming parameters.

KEY:
1 - Status bar
2 - Current menu
3 - Current parameter
4 - Parameter value

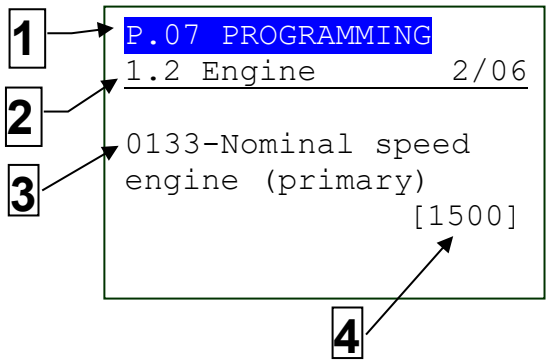


Fig. 6 display areas

Each programming parameter 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 Ref.2, below the upper status bar, allows to identify the current menu using the ID number of the menu and the associated text. A pair of numbers is displayed on the right of this line, 2/ 06 in the example in fig. 3.

The first indicates which entry in the menu is selected or which page is displayed, the seconds indicates how many entries or pages can be displayed in the current menu/submenu.

When pressing the **Esc/SHIFT** button, the first line Ref.1 is temporarily replaced by a status message concerning the engine sequence.

8.6.1.2 Protection password

Access to programming mode can be controlled through 4 different PASSWORD levels, listed in priority order.

- Super User password
- Manufacturer password
- Installer password
- User Password

Each parameter of the controller board is associated to a protection level.

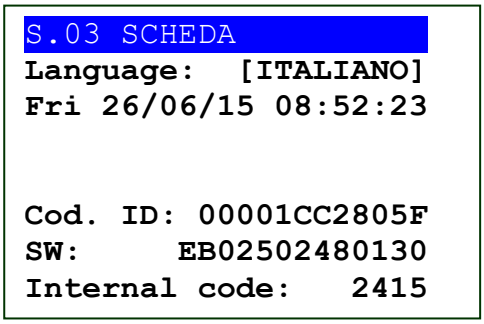
A parameter associated to “Super User” level can be only modified using Super User password. A parameter associated to the Manufacturer level can be modified by the Manufacturer himself (or by Super User password). A parameter associated to Installer level can be modified by the Manufacturer and by the Installer (or by Super User password). A parameter associated to the end User can be modified by the Manufacturer, the Installer and the User (and by Super User password).

The general rule provides that parameters can only be modified when the controller board is in “OFF/RESET”. Some parameters, as an exception, can be modified regardless of the status of the controller board, including with the engine running. As a general rule, if a parameter cannot be modified, it will be enclosed between “< “and” >” while, if it can be modified, it is enclosed between “[” and “]”: that is, valid also for the restrictions due to password

If the operator has to modify a parameter, he must input first the proper password in the parameter P.0000 (1.1.1 Authentication”), so that the controller can recognize it as “Super User”, “Manufacturer”, “Installer” or “User” by dialling the suitable password in the parameter P.000 (menu “1.1.1 Authentication, path “PROGRAMMING\1.SYSTEM\1.1 Security\1.1.1 Authentication”). After completing this operation, it will be possible to modify the required parameters. The access code entered remains saved in P.0000 for about 10 minutes since the end of programming. After this time, the code is automatically reset to zero and must be re-entered to access programming again.

It is possible to customize the passwords through parameters P.0001 (Manufacturer password), P.0002 (Installer password) and P.0003 (User password), available in the menu 1.1.2 Password configuration”, path “Programming\1 System\ 1.1 Security\ 1.1.2 Password”. The “0” value for these parameters indicates not set password. Super User password, instead, is a special password, preassigned in the factory 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 two hours of operation of the engine. When this time has expired, a new password has to be requested to Mecc Alte.

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



If the password is lost, you can reconfigure it using a higher-level password. For this reason, we recommend to configure at least the “manufacturer” password (P.0001”). In effect, if another person sets it or sets a lower password (even only for distraction) without communicate it, it will not be possible to modify any parameter anymore. On the contrary, if you know the “manufacturer” password, it will be in any case possible to cancel or modify the other passwords. Contact our service centre if the “manufacturer” password is lost.

The following examples show all combinations of passwords assignation.

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

Any operator is seen as a "manufacturer”, with no need of setting anything in “P.0000-Access code”. Therefore, all the parameters are modifiable from anyone (this is the default mode).

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

No parameter modification is allowed. When entering the “UUU” code in “P.0000-Access code”, the operator is identified as “End User” but, as no password is associated to “Installer” and “Manufacturer”, the controller acknowledges him/her as "Manufacturer”. After entering code all parameters are modifiable.

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

No parameter modification is allowed. When entering “UUU” in “P.0000-Access code”, the operator is identified as “End User” and is allowed to modify all parameters associated to the end user. By entering “III”, the operator is identified as "installer” but, as no password is associated to the manufacturer, the controller identifies him/her as "manufacturer”. After entering code all parameters are modifiable.

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

No parameter modification is allowed. When entering “UUU” in “P.0000-Access code”, the operator is identified as “End User” and is allowed to modify all parameters associated to the end user. By entering “III”, the operator is identified as "installer” and is allowed to modify all parameters associated to “installer” and “end user”. When entering “CCC”, the operator is identified as "manufacturer” and is therefore allowed to modify any parameter of the controller board.

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

As no password is associated to End User and Installer, programming the relevant parameters is allowed without entering anything in “P.0000-Access code”. To modify the parameters associated to Manufacturer, simply enter “CCC” in “P.0000-Access code”.

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

As no password is associated to the End User, programming the relevant parameters is allowed without entering anything in “P.0000-Access code”. When entering “III” in “P.0000-Access code” the operator is identified as “installer” but, as no password is associated to “manufacturer”, the controller identifies him/her as "manufacturer”. After entering code all parameters are modifiable.

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

As no password is associated to End User, programming the relevant parameters is allowed without entering anything in “P.0000”. By entering “III”, the operator is identified as "installer” and is allowed to modify all parameters associated to “installer” and “end user”. When entering “CCC” in P.0000, the operator is identified as “manufacturer” and is allowed to modify all parameters.

Example 8: P.0001=”CCC” P.0002=000 P.0003=”UUU”

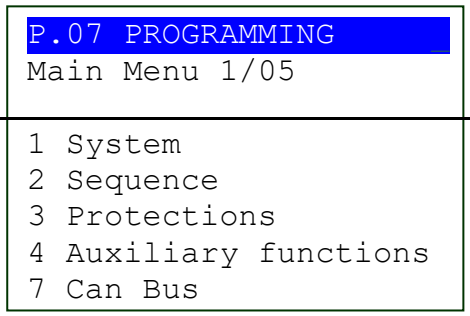
No parameter modification is allowed. When entering the “UUU” code in “P.0000-Access code”, the operator is identified as “End User” but, as no password is associated to “Installer” and “Manufacturer”, the controller acknowledges him/her as "installer”. Therefore, he/she is allowed to modify all controller parameters associated to installer and end user. When entering “CCC” in “P.0000 - Access code”, the operator is identified as “manufacturer” and is allowed to modify all parameters.

A parameter value can always be read but it can only be modified in case the "P.0000” contains a proper password. Parameters P.0001, P.0002, P.0003 and P.0469 (serial ports password) are excluded: actually, they are not displayed in case "P.0000-Access code” does not contain a proper password.

Parameter P.0469 – Serial ports password can only be viewed and/or modified through operator panel and with at least Installer rights.

8.6.1.3 Operating procedure

This procedure will describe the keyboard and display use.



- **1 (SYSTEM):** Menu 1-SYSTEM allows to show how the controller connects to the engine and to the generator and the kind of plant. Correct setting of these parameters is paramount as almost all protection activation thresholds are expressed as a percentage of these parameters.
- **2 (SEQUENCE):** Working sequence configuration can be modified through the menu 2-SEQUENCE. In this menu it is possible to set threshold percentages and acquisition times, plus enabling/disabling operation sequences related functions.
- **3 (PROTECTIONS):** Protections management is accessible through the menu 3-PROTECTIONS. As to this, it is important to know that, in order to enable/disable a protection, you may simply modify the associated time, leaving the threshold unchanged: by setting the time to zero, the protection is disabled. However, this general rule provides some exceptions. Refer to the chapter on faults, par. 0, which describes, for each of the faults, the method to disable it.
- **4 (AUXILIARIES FUNCTIONS):** All operations not related to system, sequence and protections configuration, can be performed through the menu 4-AUXILIARY FUNCTIONS. This menu contains other menus used for configuring engine auxiliary functions, calendars and history logs and serial communication.
- **7 (CAN BUS):** The engine menu 7-CAN BUS allows to set the way the controller communicates on the bus to acquire the engine measures and, should need be, send commands.
- **8 (PARALLEL):** 8-PARALLEL menu (only for GC400x) allows to configure all functions regarding the parallel with the mains or with the other gensets.

8.6.1.3.1 Access to programming

The programming is accessible with the controller in any operation state, while parameters can only be modified, in general, with the controller board in **OFF/RESET**.To enter programming mode, use the UP ▲ and DOWN ▼ buttons till the base PROGRAMMING mode (P.03) screen is displayed.

When in a mode that limits the use of vertical scrolling buttons, it could be necessary to press one or several times the **ESC** button (this situation can occur when displaying history logs or during some operations, such as setting the fuel pump control mode).

Then, press **ENTER** to access programming

The menu or variable selected before the last exit from programming are automatically displayed when starting the procedure (the main menu is displayed the first time you access). This is true if the programming procedure has been previously aborted by changing the operation mode of the controller board in MAN or AUTO or after maximum time with no programming operation has elapsed or keeping the **ESC** button pressed for more than two seconds.

8.6.1.3.2 Menu selection

Current menu name, selected menu item and number of menu items are always displayed in the second line. Menu items (submenus) are displayed in the following lines. The item selected is displayed in REVERSE. Use the ▲ e ▼ buttons to cyclically scroll through the menu to the lower and upper index items (i.e., pressing the ▲ allows to directly cycle from the first item to the last one).

Press the **ENTER** n to access the selected (highlighted) sub-menu. Press the **ESC** to leave the menu (back to the previous menu or to the base screen if exiting programming in the main menu).

8.6.1.3.3 Parameter 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 following lines are used to display single parameters. In detail:

- The fourth and the fifth lines show a unique code of the parameter (four decimal digits), followed by the description in the current language
- The sixth line shows the variable value, between brackets, aligned to the right side “< >”.
- For some parameters, on the eighth line, a value is shown, which is in some way related to the actual parameter value. For example, in the case of the rated generator power, the rated plant current is shown, derived from the rated generator voltage (P. 0102) and from the parameter itself (rated power, P.0106). Sometimes, this additional measure can be displayed for showing its absolute value, when the parameter is a percentage of other values.

Use the ▲ e ▼ buttons to cyclically scroll through the menu to the lower and upper index items (i.e., pressing the ▲ allows to directly cycle from the first item to the last one and vice versa). Press the **ENTER** button to enable the parameter modification procedure (see following paragraph). Press the **ESC** button to leave the menu (back to the previous menu).

8.6.1.3.4 Modify a parameter

You may only modify parameters displayed between square brackets ([]). A parameter between (major/minor) symbols < > cannot be modified. In this case it could be necessary to set an appropriate password or stop the genset.

In case modifying the displayed parameter is allowed, press the **ENTER** button; the square brackets ([]) enclosing the value will blink to signal that the modification is in progress. To confirm the new value, press again the **ENTER** button; to abort and return to the original value, press **ESC** button;

Parameter types are the following:

- **Bits:** Some parameters are managed with bits. Each bit set to 1 enables a function and each bit set to 0 disables a function. Each bit is assigned a value. The parameter must be set as the result of the sum of the values associated to the functions you require to enable. 8 bits can be used. The description of these parameters is shown in a table like the one below:

Bit	Value	Description
0	1	Enable function 1
1	2	Enable function 2
2	4	Enable function 3
3	8	Enable function 4
4	16	Enable function 5
5	32	Enable function 6
6	64	Enable function 7
7	128	Enable function 8

In case the operator wants:

  - To disable all functions: he/she must set to 0 the relevant parameter.
  - To enable all functions: the value to be set is the sum 1+2+4+8+16+32+64+128 = 255.

- Enable, for example, the functions 3, 4, 6 and 8: the value to be set is the sum 4+8+32+128 = 172 (where 4 is the value associated to the function 3; 8 to the function 4; 32 to the function 6 e 128 to the function 8).

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

- 255 → FF
- 0 → 00
- 172 → AC

See the descriptions on the hexadecimal strings.

- **Numeric**: the value can be modified by pressing the ▲ and/or ▼ buttons, in order to increase or decrease one unit from the most rightwards decimal digit (if you press the above buttons plus SHIFT, the figure will be increased or decreased by ten units at a time). The change is cyclical: increasing over the maximum value when will lead to the minimum one and vice versa.
- **Numeric selected in a pre-defined list** (for example the number of phases of the generator): same goes for the numeric parameters, considering that the UP ▲ and/or DOWN▼ buttons allow for passing to the fallowing/previous value in the pre-defined list (pressing the above buttons plus SHIFT, you go to the value ten units after/before the current one).
- **Numeric selected in a number-string couples list** (e.g., the type of pressure sensor): same as the previous point.
- **Time**: same as numerical parameters, with one exception: the controller manages the increment/decrement maintaining valid values (example: increasing from “00.59”, the value goes to “01.00” and not to “00.60”).
- **Strings** (e.g., telephone numbers): in this case the display shows also a cursor indicating the currently selected character in the string. The▲▼ buttons work on the selected character (passing to the one after/before in the ASCII table. If you press the above buttons plus SHIFT, you will move to the one 10 units before/after). The ◄► buttons allow to select the character to be modified. **You can set the ASCII characters from 32 (Space) to 127 (Escape). It is not possible to set extended ASCII characters (over 127) and the control ones (from zero to 31).**
- **Hexadecimal strings** (e.g., output bitmaps): same as for the string parameters, but the selectable characters are only “0-9” and “A-F” (only capitals for the latter).

8.6.1.3.5 Set up limits

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

This goes for individual parameters; however, it is possible to set two or more parameters in incongruent or incompatible ways. It is up to the operator to prevent this from occurring.

8.6.1.3.6 Exit from programming

There are three ways to exit programming mode:

- Press the **EXIT** button 'n' times to scroll back to the main menu, then press it again to exit programming. The main menu will be displayed on the next access to programming.
- Pressing and holding the **ESC** button for two seconds from any location will cause instantaneous exit from programming and next access will get you to the very same point.
- Turn the operation mode of the controller to **AUTO** or **MAN**: next access will get you to the very same point.

8.6.1.4 Loading default values

⚠ **WARNING: This procedure permanently reloads all factory parameters according to access rights.**

Sometimes, it may be useful to reload parameters factory values. To do so, it is first of all necessary to select OFF/RESET mode, access programming, and then press and hold the **ACK/TEST** and **ESC/SHIFT** buttons simultaneously for five seconds. Reload of factory values will be confirmed by a message on the display. **Factory values are reloaded only for parameters for which you are granted access rights.**

8.6.2 Status information (S.xx)

In this way, information on the system status is provided. You can scroll through the various pages using the LEFT and RIGHT buttons.

8.6.2.1 S.01 STATUS

Page **S.01 (STATUS)** shows system status information. Part of this information is shown on the top status bar keeping the SHIFT digit pressed. It contains:

- Working status of the generator (stopped, running, supplying, etc.).
- Working mode of the controller (MAN, AUTO, etc.).
- The status of the electrical mains (absent, low, high etc.)
- The eventual presence of inhibitions to the genset start-up (for GC400x also includes the inhibition from the “load management” or from the ongoing back synchronization).
- The eventual presence of inhibitions to the users switching on genset.
- Possible enabling of the engine protections override.
- **Only GC400x**: the protection status for parallel with the mains
- **Only GC400x**: the operation indication in DROOP mode
- **Only GC400x**: the operation indication “controlled by a MC100 controller”.
- **Only GC400x**: the indication of some genset in “not open GCB” condition.
- **Only GC400x**: the indication of particular situations detected by the engine’s controllers (power derating, turning off of a cylinder bank etc.)

Some information are shown alongside an elapsing time; for example, during engine cooling down, the residual time is shown.

8.6.2.2 S.02 ANOMALIES

Page S.02 (FAULTS) is automatically shown in case a new fault arises. For every anomaly, it is shown:

- A letter that identify the type.
  - “A”: alarm (block)
  - “U”: download (only **GC400x**)
  - “D”: deactivation.
  - “W”: warning.
- A three-digit numeric code that uniquely identify the anomaly. This code flash until it is acknowledged pressing the “ACK” pushbutton.
- An alphanumeric description, which depends on the language currently selected and which in some cases can be customized using the controller parameters.

Every fault uses one or two rows of the display LCD. The fault shown in the highest position is the most recent, chronologically. If the space available is not enough to display all the faults, only the most recent will be displayed. In order to see the other, it is required to:

- Press the ENTER key
- Use the ▲▼ keys to scroll the anomalies
- Press EXIT to leave the mode

Some anomalies require the display of some additional information. For example:

- The anomalies 198 and 199 (cumulative of pre-alarms/alarms received via CAN-BUS from the electronic control units of the engines or from the automatic voltage regulator) also require the display of the single diagnostic codes. For every diagnostic code it is shown:
  - The device that generated it (engine control unit or voltage regulator).
  - The SPN code (it is a standard code defined by the SAE J1939 standard, which identifies the mechanical component that is having the problem).
  - The FMI code (it is a standard code defined by the SAE J1939 standard, which identifies the type of problem).
  - How many times this diagnostic code has been activated (OC).
  - The alarm code specific for the external device connected (DTC).
  - An alphanumerical description (in English) of the problem.

For some external device, the SPN, FMI and OC are not shown, but the DTC code and an alphanumeric description are always displayed.

If one or more of the above-mentioned information is not available, it will be replaced by dashes or it will simply not be displayed. If multiple diagnostic codes are active at the same time, they will be cyclically alternated on the display every 2 seconds. The diagnostic codes are stored (even if the external device deactivates them) until the yellow/red Can-Bus indicator light warning is acknowledged with the “ACK” button.

- 273 anomaly (incoherent parameter, only present on GC400x) requires the display of the problem cause.
- The additional information regarding the anomalies are shown on the last three lines of the display. If two or more anomalies are shown, to display the additional information is necessary to:
- Press **ENTER**.
- Select the anomaly

8.6.2.3 S.03 BOARD

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

- The language currently used by the device. It is also possible to select a different language: press ENTER, select a language with the digits ▲ and ▼ and confirm with ENTER. **Note: the controller is provided with a few languages onboard. With the BoardPrg4 program it is possible to transfer other languages to the controller**
- Current date and time in long format (flashing if the clock is not valid)
- The unambiguous serial number of the controller board (called ID CODE).
- The code of the software currently loaded on the controller board (see par. 1.9).
- **Only for GC400x**: the internal code necessary to obtain a Mecc Alte level temporary password (see 8.6.1.2).

8.6.2.4 S.04 SERIAL COMMUNICATION

This page is dedicated to the serial communication towards the serial ports and through USB. In case of functional problems, please, verify the content of this page.

For each serial port (and also for USB) it is displayed the status (stand-by, outgoing communication, etc.)

For Link controllers or if an external modem is connected to the controller on the RS232 serial port, on the first two lines will be displayed:

- The modem model used.
- In case of a GSM/GPRS external modem and for Link LTE controllers:
  - The active connection type (Only Link LTE): GSM/GPRS/EDGE (EDGE), LTE NB-IoT or LTE CAT-M
  - the Mobile Network Operator (MNO) currently connected (Vodafone, TIM….). If the SIM card does not return the full name the Mobile Country Code (MCC) + Mobile Network Code (MNC) is shown.

- the mobile network signal intensity

8.6.2.5 S.05 NETWORK

This page is not available ion GC315. It is dedicated to the status of the connection and of the communication via TCP/IP on Ethernet interface or via GPRS.

For **GC315**[Plus] and **GC400** controllers (with ETHERNET interface), the controller shows:

- The status of the connection:
  - "On standby": no communication in course and Ethernet cable disconnected;
  - "On standby-connected": no communication in course and cable connected to the Ethernet network;
  - "Communication in course": communication in course and cable connected to the Ethernet network.
- The MAC address of the physical network interface.
- The IP address of the controller, the router/gateway address, the Subnet-mask and the server DNS address. Such values can be those set with the parameters of the controller, or those dynamically obtained by DHCP server (see 5.17.4).
- For **GC315Link/GC400xLink** controllers (equipped with GPRS internal module), the controller shows:
- The IP address assigned to the controller by the GPRS network.
- Some useful information for the connection to Smart Cloud server.
  - Controller name
  - Latitude and Longitude acquired by the GNSS module or set through the parameters of the controller. This information flashes if the GNSS module is not able to set the position.
  - The HDOP (Horizontal dilution Of Precision) value: it is a precision indicator (the lower it is, the sharper the position).
  - the number of satellites that are "view" by the GNSS module (when searching for coordinates) or the number of satellites used for the "FIX" of the coordinates (once the correct position has been determined).

8.6.2.6 S.06 CLOUD LINK (SMART CLOUD)

This page is not available on **GC315**. The page is only displayed if the P.0560 parameter is at value 1. It shows the client identifier (useful to search it in Smart Cloud system) and the IP address of Smart Cloud server (with GPRS internal modem, instead of the IP address is shown the DNS name of the server). It also shows the status of the communication with the server:

- Number of the server connected.
- Number of the clients connected.

8.6.2.7 S.07 CAN-BUS

The page displays the status of the CAN-BUS interface of the controller **GC315 h**as only one CAN-BUS interface, **GC400x** has two of them. For each interface are shown:

- Communication status of bus. There are three possible indications:
  - ERROR-ACTIVE: normal operation
  - ERROR-PASSIVE: communication is working despite faults (errors).
  - BUS-OFF: Genset has interrupted the connection to the bus due to too many errors.
- The counters of the communication errors. The instantaneous counters of the transmission/reception errors and the maximum values reached from them are displayed. It is possible to reset the maximum values (and in the meanwhile to force the output from the status of BUS-OFF) by pressing for 5 seconds

the digits ENTER e ESC/SHIFT at the same time. In the GC400x controller, since there are two CAN interfaces, it is first necessary to select the CAN interface and then reset the counters: to select an interface press the digit ENTER and use ▲ and ▼.

8.6.2.8 S.08-09-10 GENERAL STATUS

These pages are dedicated to the display of the general status acquired by the digital inputs, configured with the DIF.3201 and DIF.3202 functions (page 1), DIF.3203 and DIF.3204 (page 2), DIF.3205 and DIF.3206 (page 3).

The pages use one line for each configured input. If more than 7 inputs are configured on a page, the controller displays all of them turning (6 at a time) every two seconds: Keeping SHIFT pressed the turning can be stopped. If there are no configured inputs on a page, the page is not displayed.

On each line the controller shows the configured text for the digital input and the logic status of the input (1/0).

If the DIF.3202, DIF.3204 and DIF.3206 are used, when the input is activated, the controller forces the display if the relative page.

8.6.2.9 S.11 DIGITAL INPUTS

This page displays the status of:

- Digital inputs of the controller
- Analogue inputs used as digital (if they are not used as digital inputs, some dashes are shown.
- Virtual digital inputs.

Pressing the **ACK/ENTER** button, it is possible to display the turning inputs in different ways:

- **LOGIC STATE**: The input's logic state (active or inactive) used by the Genset in the management of the operating sequence.
- **PHYSICAL STATE**: Electrical level (active or inactive, or high or low) actually present on the input; this can be the opposite in comparison to the corresponding logic state. Displayed in negative.
- **BY FUNCTION**: the controller shows a list of the functions which are really associated to the digital inputs, displaying the logic status (1/0) relative to each function, independently from the input really associated to the functions. If more than 6 functions are used for the digital inputs, the controller shows them all turning (6 at a time) every two seconds: keeping SHIFT pressed the turning stops.

8.6.2.10 S.12 DIGITAL INPUTS

The page is only displayed if some DITEL modules have been configured (see 5.13). It displays the status of the digital inputs acquired by the DITEL modules. If a DITEL module does not communicate correctly, the controller displays some dashes instead of the status of the inputs. Pressing the digit **ACK/ENTER** it is possible to display the turning inputs in two different ways:

- **LOGIC STATUS**: the controller shows the logic level of the input (active or not active) used in the management of the operation sequence.
- **PHYSICAL STATUS**: the controller displays the electric level (active or not active, high or low) really present on the input; it can be opposite compared to the corresponding logic status. It is shown in negative.

8.6.2.11 S.13 DIGITAL OUTPUTS

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

Pressing the **ACK/ENTER**, it is possible to display the turning inputs in three different ways:

- **LOGIC STATUS**: the controller displays the logic level of the outputs (active or not active) used in the sequence and operation management.
- **PHYSICAL STATUS**: the controller displays the electrical level (active or not active, high or low) really present on the output; it can be opposite to the corresponding logic status. It is shown in negative.

- **BY FUNCTION**: the controller displays a list of the 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 6 functions are used for the digital outputs, the controller shows them all turning (6 at a time) every two seconds: keeping SHIFT pressed the turning stops.

8.6.2.12 S.14 DIGITAL OUTPUTS

The page is only displayed if some DITEL modules have been configured (see 5.13). It displays the status of the digital inputs acquired by the DITEL modules. If a DITEL module does not communicate correctly, the controller displays some dashes instead of the status of the inputs. Pressing the digit **ACK/ENTER** it is possible to display the turning inputs in two different ways:

- **LOGIC STATUS**: the controller shows the logic level of the input (active or not active) used in the management of the operation sequence.
- **PHYSICAL STATUS**: the controller displays the electric level (active or not active, high or low) really present on the input; it can be opposite compared to the corresponding logic status. It is shown in negative.

8.6.2.13 S.15 ANALOGUE INPUTS

The page displays the value of the analogue inputs of the controller (JM connector), of the emergency stop (EM-S) and of the D+. For each input the measure in Volt is displayed, for terminals JM-2, JM-3 and JM-4 the measure in ohm is also displayed.

8.6.2.14 S.16 ANALOGUE INPUTS

The page is only displayed if the DITHERM or DIGRIN modules have been configured (see 5.10).

On the left side, the type of module really connected is shown (DIGRIN, DITHEL or “DITEMP” if the module does not communicate correctly. On right side the temperature acquired by the modules are shown. They can be replaced by:

- “------" if the expansion module does not transmit the measure
- “OPEN”: if the module indicates that the sensor is disconnected.
- “+OVER”: if the module indicates that the input signal has a too high value, symptom of failure.
- “-OVER”: if the module indicates that the input signal has a too low value, symptom of failure.

8.6.2.15 S.17 ANALOGUE INPUTS

The page is available only if the **DIVIT** expansion module is installed in the system. (see 5.10).

On the right side, the measures acquired by the modules are shown (with no conversion). They can be replaced by:

- “------" if the expansion module does not transmit the measure
- “OPEN”: if the module indicates that the sensor is disconnected.
- “+OVER”: if the module indicates that the input signal has a too high value, symptom of failure.
- “-OVER”: if the module indicates that the input signal has a too low value, symptom of failure.

8.6.2.16 S.18 ANALOGUE OUTPUTS (only GC400x)

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

- 0%: -10 Vdc
- 50%: 0 Vdc
- 100% +10 Vdc

Pressing the ENTER digit a display for function is shown: the controller shows a list of functions really associated to the analogue outputs, showing the analogue value of each function, independently from the output. If more than 6 functions are used for the digital outputs, the controller shows them all turning (6 at a time) every two seconds: keeping SHIFT pressed the turning stops.

8.6.2.17 S.19 ANALOGUE OUTPUTS

The page is available only if the **DANOUT** expansion module is installed in the system (see 5.10).

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

8.6.2.18 S.20 MAINS PROTECTION (only GC400x)

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

It shows the status of all parallel protections with the mains. The disabled protections are not shown. The controller displays the initials of any enabled protection (e.g., “27<<”: the initial is displayed in reverse if the protection springs (mains out of tolerance). The possible codes are: “27<<”, “27<”, “27Q”, “59>”, “59>>”, “81<<”, “81<”, “81>”, “81>>”, “81R”, “VJ”, “MC” (from MC100), “DI” (from contact). See doc. [8].

8.6.3 Electrical measurements (M.XX)

This mode displays all the information on the measurements taken by the Genset control module on the electric lines. You can scroll through the various pages using the LEFT and RIGHT buttons.

8.6.3.1 M.01 SYSTEM

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

- The mains. The symbol of the mains is solid if the mains is within the tolerance range and flashing if the mains is missing or if it exceeds the tolerance range.
- The generator. The symbol of the generator is in “reverse” if the engine is started and if the generator is powered. On GC315, if parameter P.0802 is set to "11-Drive", the generator symbol is replaced by the engine symbol.
- The loads. The symbol of the load is displayed in “reverse” if the loads are powered from the mains or from the generator. Through bit 7 of parameter P.0494, it is possible to show the icon of a pump instead of the classic one of a factory.
- The GCB and MCB circuit breakers (for GC400x can be also displayed the MGCB circuit breaker). The symbol of the circuit breaker shows:
  - The open/closed status.
  - The difference between status and the breaker command (in this case the two contact points of the breaker flash).
  - The possibility of using the synchronization for closing the breaker (if syncing can be used, the two contact points of the breaker are empty squares, otherwise they are full).

On GC315, if parameter P.0802 is set to "11-Drive", the symbol of the circuit breaker is replaced by the symbol of a clutch.

- The power flows, displayed with arrows in the three branches of the system. The arrow points in the direction of the power. The arrow flashes (to indicate a faulty situation) in case of reversed power on the generator and in case of negative power to the loads.
- The active power measure and that of the power factor. On GC315, if parameter P.0802 is set to "11-Drive", the generator powers are replaced by the engine speed, and the powers on the user are hidden
- Only for GC400x, also the setpoints of active power/power factor for the operation in parallel with the mains.
- Only for GC400x, the average voltage and frequency of the mains can also be displayed.

With parameter P.0494 it is possible to personalize the display, hiding one or more previous information.

If the bit 5 of parameter P.0495 is activated it is possible to alternate, by pressing the **ENTER/ACK** button, the display of the active power measurement between the real value (kW) and the value as a percentage (%) of its nominal value (P.0125).

8.6.3.2 M.02 MAINS/BARS

This page shows the Phase-Phase concatenated voltages and the frequency of the electrical mains (or of the parallel bars for GC400x), in addition to the rotation direction of the phases (clockwise or counterclockwise). For three-phase systems, the phase-to-phase voltages are displayed; for bi-phase systems, the first phase-to-phase voltage, the two phase-to-neutral voltages and the voltage between neutral and negative battery are displayed; for the one-phase systems, the phase-to-neutral voltage and the voltage between neutral and negative battery are displayed (the others are replaced by dashes) and the rotation direction is not displayed.

To the bottom right there is an icon that allows immediate identification of the fact that the page is related to the MAINS measures.

This page is hidden on GC315 if parameter P.0802 is set to “11-Drive”.

8.6.3.3 M.03 MAINS/BARS

This page shows only for three-phase systems and only if the system is configured to use the neutral connection (see par. 5.11.1). The three phase-neutral voltages are shown and the negative of the battery, in addition to the rotation direction of the phases (clockwise or counterclockwise).

To the bottom right there is an icon that allows immediate identification of the fact that the page is related to the MAINS/BARS measures.

This page is hidden on GC315 if parameter P.0802 is set to “11-Drive”.

8.6.3.4 M.04 GENERATOR

This page shows the Phase-to-Phase concatenated voltages and the frequency of the generator, in addition to the rotation direction of the phases (clockwise or counterclockwise). For three-phase systems, the phase-to-phase voltages are displayed; for bi-phase systems, the first phase-to-phase voltage, the two phase-to-neutral voltages and the voltage between neutral and negative battery are displayed; for the one-phase systems, the phase-to-neutral voltage and the voltage between neutral and negative battery are displayed (the others are replaced by dashes) and the rotation direction is not displayed.

To the bottom right there is an icon that allows immediate identification of the fact that the page is related to the GENERATOR measures.

This page is hidden on GC315 if parameter P.0802 is set to “11-Drive”.

8.6.3.5 M.05 GENERATOR

This page is only shown for the three-phase systems and only if the system is configured to use the neutral connection (see par. 5.12.1). The three phase-to-neutral voltages are shown and the voltage between the neutral and the battery negative are displayed, in addition to the rotation direction of the phases (clockwise or counterclockwise).

To the bottom right there is an icon that allows immediate identification of the fact that the page is related to the GENERATOR measures.

This page is hidden on GC315 if parameter P.0802 is set to “11-Drive”.

8.6.3.6 M.06 CURRENTS

This window displays the phase currents (one for single-phase and two for bi-phase, the others are replaced by dashes) of the Generator/Load measured by the controller board. **NOTE: these currents are normally those supplied by the generator. But if the measure CTs are connected on the load lines instead of the generator lines, the displayed currents can be those absorbed by the mains. To the bottom right it is shown, time by time, the icon of the generator**

or of the mains so to identify the real current source. For bi-phase and three-phase systems also the negative sequence current is shown.

If the fourth current is adequately configured, the controller also displays:

- **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 if P.0131=3).

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

- The CT of the auxiliary current has the same ratio of the generator CTs.
- The auxiliary current CT is connected to the same line of the generator CTs.

This page is hidden on GC315 if parameter P.0802 is set to “11-Drive”.

8.6.3.7 M.07 POWERS 1

This page shows the active powers (kW), the power factors and the loading types on individual phases and globally (one for single-phase and two for bi-phase, the others are replaced by dashes). At the right bottom corner, the generator or mains icon is displayed, to indicate which powers you are looking at (see note in 8.6.3.7).

If the bit 5 of parameter P.0495 is activated it is possible to alternate, by pressing the **ENTER/ACK** button, the display of the active power measurements between the real value (kW) and the values as a percentage (%) of their nominal value (P.0125).

This page is hidden on GC315 if parameter P.0802 is set to “11-Drive”.

8.6.3.8 M.08 POWERS 2

This page shows the reactive powers (kvar), and the apparent powers (kVA) on individual phases and globally (one for one-phase and two for bi-phase, the others are replaced by dashes). At the right bottom corner, the generator or mains icon is displayed, to indicate which powers you are looking at (see note in 8.6.3.8).

If the bit 5 of parameter P.0495 is activated it is possible to alternate, by pressing the **ENTER/ACK** button, the display of the apparent power measurements between the real value (kVA) and the values as a percentage (%) of their nominal value (P.0106).

This page is hidden on GC315 if parameter P.0802 is set to “11-Drive”.

8.6.3.9 M.09 ENERGY

This page shows the active and reactive power counters (partial and total) counted by the controller board **when the loads are connected to the generator.**

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 this purpose it is necessary to:

- Press **ACK/ENTER**: one of the counters will be highlighted.
- Use the vertical scrolling buttons **UP** and **DOWN** to select the counter you want to reset to zero.
- Press and hold the **ACK/ENTER** and **ESC/SHIFT** buttons for five seconds.
- Press the **ESC/SHIFT** key

Attention: from version GC315 1.49 and GC400 2.10, if a password has been configured in parameter P.0001 ("user" protection level), it will not be possible to reset the counters until this password is entered (login) in parameter P.0000 (" Access code").

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

This page is hidden on GC315 if parameter P.0802 is set to “11-Drive”.

8.6.3.10 M.10 ENERGY 2

This page shows the active and reactive power counters (partial and total) counted by the controller board **when the loads are connected to the mains/bars**. **This page is only visible if the controller has been configured to work with the CTs on the loads, instead of on the mains (P.0124 = 1 – On the loads).**

The reactive power is counted only is positive (it is not counted in case of energy reverse). The reactive energy 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 this purpose, it is necessary to:

- Press **ACK/ENTER**: one of the counters will be highlighted.
- Use the vertical scrolling buttons **UP** and **DOWN** to select the counter you want to reset to zero.
- Press and hold the **ACK/ENTER** and **ESC/SHIFT** buttons for five seconds.
- Press the **ESC/SHIFT** key

Attention: from version GC315 1.49 and GC400 2.10, if a password has been configured in parameter P.0001 ("user" protection level), it will not be possible to reset the counters until this password is entered (login) in parameter P.0000 (" Access code").

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

This page is hidden on GC315 if parameter P.0802 is set to “11-Drive”.

8.6.3.11 M.11 AUX MEASURE (only GC400x)

In this page, some additional information about voltages and currents of the generator, used for the 27Q parallel - mains protection. It is shown:

- The positive sequence current (I+).
- The negative sequence current (I-).
- The positive sequence voltage (V+).
- The negative sequence voltage (V-).
- The positive reactive power sequence (kvar).

8.6.3.12 M.12 REGOLATIONS (only GC400x)

This page is useful in the parallel applications. It can display at the same time voltages and frequency of generator and mains/bars. It is possible to directly modify from this page the commands for the speed and voltage governors. On the last two lines, in effect, the stand-by values for the two generators are present or, in alternative, the voltage and frequency setpoints (they depend on the controller configuration and on the status of the plant). In both cases, it is possible to modify such values by hand:

- Press ENTER: one of the two values is highlighted.
- Using ENTER or ◄►, the other value is selected (cyclically).
- Using ▲ and ▼ it is possible to modify the selected value (pressing both together with SHIFT the modification is quicker).
- Press ESC/SHIFT to end the modification.

The modification is immediately interrupted if no digits are pressed for 10 seconds.

Note: some of these setpoints could be acquired be the analogue inputs: in this case, on this page they are displayed as well, but it is no possible to modify them though.

8.6.3.13 M.13 SYNCHRONIZATION (only GC400x)

This page shows the necessary information for the synchronization.

The phase difference is shown through a horizontal bar, which performs as a synchronoscope. It normally shows the phase angles between -180° and +180°. When the phase error goes under 20°, the bar is reduced to show angles between -20° and +20° (in this case the bar is shown in reverse).

Below the bar 5 small rectangles are shown. The first 3 indicates if the voltage, frequency and phase differences allow the closure of the breaker (if the rectangle is empty the difference is too high and the breaker cannot be closed). The fourth shows an eventual discrepancy of the rotation direction of the phases (also in this case the empty rectangle indicates that the breaker cannot be closed). When the first four rectangles are all full, the status of the system is correct for the closure of the breaker: the fifth rectangle becomes therefore full and the controller commands the closure of the breaker.

To the page bottom there are the “stand-by” values for the two regulators or, in alternative, the voltage and frequency setpoints (it depends on the configuration of the controller and on the status of the plant). If the values are not connected to an analogue input, it is possible to modify them directly from this page (see previous paragraph). In this way, it is possible to perform a manual synchronization.

If the voltage/frequency references cannot be modified manually, if you press SHIFT the controller displays the current value of the regulation commands (of frequency and voltage, in %) instead of the references (it shows them in reverse, to recognise them from the references.

8.6.3.14 M.14 PARALLEL (only GC400x)

This page shows the useful information when the generator is in parallel with the mains or with other generators. The active, reactive power and the power factor are shown. Are also shown the currents, the average voltage and the frequency of the generator.

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.

8.6.3.15 M.15 SETPOINT (only GC400x)

This page shows and allows to change (in just one point) all the adjustable setpoints for the plant, related to voltage and speed regulators. It is useful because page M.01 only shows the main setpoints in a specific moment. For example, if a plant can work in both BASE LOAD and DROOP mode, page M.01 will only show the setpoints related to the current operating mode, while page M.09 will show all of them: in this way, the operator can adjust the setpoints before changing the operating mode. The adjustable setpoints are:

- Speed (P.0840) and voltage (P.0867) offsets.
- Frequency (P.1604) and voltage (P.1654) setpoints.
- No-load frequency (P.0974) and voltage (P.0986) for DROOP.
- Active power (P.0858) and cosfi (P.0860) setpoints for the SYSTEM BASE LOAD mode.
- Active power setpoint for the LOCAL BASE LOAD mode (P.0884 and P.0902).
- Active power setpoint for the IMPORT/EXPORT mode (P.0888).
- Cosfi setpoint for the LOCAL BASE LOAD and IMPORT/EXPORT modes (P.0894).

The setpoints are displayed only if they are not acquired by analogue inputs and if they are set for the plant configuration.

8.6.3.16 M.16 SETPOINT2 (only GC400x)

This page shows (in just one point) all the adjustable setpoints for the plant acquired by analogue inputs, related to voltage and speed regulators. It is similar to page M.02. The adjustable setpoints are:

- Speed and voltage offsets.
- Frequency and voltage setpoints.
- No-load frequency and voltage for DROOP.
- Active power and cosfi setpoints for the SYSTEM BASE LOAD mode.
- Active power setpoint for the LOCAL BASE LOAD mode.
- Cosfi setpoint for the LOCAL BASE LOAD mode.

The setpoints are displayed only if they are used in the current plant configuration.

8.6.3.17 M.11…M.16 AVR (GC315x) M.17…M.22 AVR (GC400x)

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

8.6.3.18 M.17…M.22 AVR (GC315x) M.23…M.28 AVR (GC400x)

From version 1.57 of GC315x and 2.16 of GC400x, 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).

8.6.4 Engine measurements (E.xx)

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

8.6.4.1 E.01 ENGINE 1

It contains the fundamental measurements for engine management:

- Oil pressure
- Coolant temperature
- Speed

If any of these values is not available, it'll be shown with dashes. If a CAN-BUS connection is active, the model of engine selected is also displayed.

8.6.4.2 E.02 ENGINE 2

It contains other measurements for engine management:

- Battery voltage
- Fuel level

If any of these values is not available, it'll be shown with dashes.

8.6.4.3 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 temperature (AIF.1100 or AIF.1101 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.

8.6.4.4 E.04 COUNTERS

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

- Start-up 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**: one of the counters will be highlighted.
- Use the vertical scrolling buttons **UP** and **DOWN** to select the counter you want to reset to zero.
- Press and hold the **ENTER** and **ESC** buttons for five seconds.
- Press the **ESC**.

Attention: from version GC315 1.49 and GC400 2.10, if a password has been configured in parameter P.0001 ("user" protection level), it will not be possible to reset the counters until this password is entered (login) in parameter P.0000 (" Access code").

8.6.4.5 E.05 MAINTENANCE

This page contains different counters (managed by the controller) that involve the service requests for the engine:

- Counter for the hours left to service 1 (not resettable)
- Counter for the hours left to service 2 (not resettable)
- Service days left and set date (not resettable)

8.6.4.6 E.06 FUEL PUMP

The page is available only if at least one digital output is configured for managing the fuel pump, and 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 (starting required, arrest required, in hysteresis).

If the pump management is linked to the ANALOGUE level sensor, then the controller board displays by means of a graphic bar, the current fuel level, showing also the thresholds for pump start/arrest.

From this page you can change the management mode for the fuel pump without having to go to programming. To do that, you must:

- Press the **ENTER** button: the square brackets between which the current mode is displayed start flashing.
- Use the vertical scrolling buttons **UP** and **DOWN** to select the desired mode.
- Confirm with **ENTER** or cancel the modification with **ESC**.

For a detailed description of the features offered by the controller board for the control of the fuel pump, see 11.1.

8.6.4.7 E.07 GERAFLEX

This page is only displayed if as a CAN-BUS (P.0700) engine type the value “240 – GERAFLEX” has been selected. Actually, the connection with this engine is performed through serial port configured as Master (P.0451 = 2 or P.0471 = 2). Some specific information of this engine is displayed:

- Battery voltage
- Air temperature in the aspiration duct
- Actuator position
- Time for injection
- Hours of work
- Presence of anomalies

8.6.4.8 E.08…E.10 EXTERNAL MEASURES

These pages are dedicated to the measures acquired by the analogue inputs configured as “generic sensor”. The operator can acquire the measures not related to the controller operation and display them. Also, he can gather them (with any criteria), displaying them on one of the three available pages. The sharing of the measures on the different pages is done through the function configured in the analogue inputs:

- AIF.2001: page E.08.
- AIF.2003: page E.09.
- AIF.2005: page E.10.

The controller shows one measure per line: it shows the text configured for analogue input (P.4018 analogue input 1), followed by the measure. If more than 7 measures are associated to one of these pages, the controller shows them all, rotating them on the display every two seconds: keep SHIFT pressed to stop the rotation in the current display.

8.6.4.9 E.11 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”).
- 
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.

8.6.4.10 E.12 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.

8.6.4.11 E.13…E.23 CANBUS

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 –

8.6.4.12 E.24 DPF REGENERATION

From version 1.44 of GC315x and 2.06 of GC400x, 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.11)
- 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 a maximum of P.0447seconds (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.24.

- 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).

8.6.4.13 E.25…E.29 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")

8.6.4.14 E.30 ADBLUE PUMP

The page is available only if at least one digital output is configured to manage the pump for refilling the AdBlue fluid in the daily tank. It contains the following information:

- The current management mode of the pump (MAN-OFF, MAN-ON, AUTO).
- The status of the pump (on/off).
- An indication of the AdBlue fluid level, referring to the management of the pump (start required, stop required, in hysteresis).

If the pump management is referred to the analogue measurement of the level in the tank (SPN 1761 SAE J1939), the controller shows the current level with a graphic bar, also indicating the start/stop thresholds of the pump.

It is possible to change the pump management mode from this page, without having to go to programming. To do this, you must:

- Press the ENTER key: the square brackets that enclose the current pomp operating mode begin to flash.
- Use the UP and DOWN buttons to select the desired mode.
- Confirm with ENTER or cancel the modification with ESC.

See 11.11 for a detailed description of the functions offered by the controller for the management of this pump.

8.6.4.15 E.31…E.36

From version 1.12 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).

8.6.5 Measures from CAN-BUS PMCB (only for GC400x) (B.xx),

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

8.6.5.1 B.01 MC/BTB (only GC400x).

This page shows the list of the mains controllers (MC) and the tie-breaker controllers (BTB) recognised on the Can-Bus PMCB connection. It is useful for diagnostic purposes.

On the top the PMCB addresses of all MC100 controllers are shown. On the bottom the PMCB addresses of all BTB100 controllers are shown.

8.6.5.2 B.02 B.03 B.04 Generators (only GC400x)

These pages show the significant data of each genset that operates on the PMBC Canbus. Each page shows up to 7 gensets. Only the relevant pages are shown. It is used one line for each genset, which contains the PMCB address, the active power and the reactive power.

8.6.5.3 B.05 Totals on PMCB (only GC400x)

This page shows the totals calculated on all genset controllers connected on CAN-BUS PMCB. It is shown:

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

8.6.5.4 B.06 Load management (only GC400x)

This page is dedicated to the “load management” function (see [8]). “Load management” means the ability of the system to start/stop the gensets in order to only start the smallest number of gensets necessary to supply the load (with a minimum margin). This page shows some important information for this function.

The information shown is:

- The enabling of the function “load management” for this controller.
- The “load management” mode selected establishes the criteria according to which the gensets to be started are chosen.
- The “master” genset (the priority genset, the one that should never be stopped). For some mode of “load management” this information is not shown.
- According to the mode selected, the controller can show how many hours before the system selects a new “master” genset.
- The list of the addresses of the genset controllers, ordered based on priority (gensets with higher priority first, those that will be stopped last). For some mode of “load management” this information is not shown.
- It is possible to select the “master” genset manually directly from this page.
- Press ENTER.
- Use UP and DOWN digits to select the address of the “master” genset wanted.
- Confirm by pressing ENTER.

8.6.5.5 B.07 Load management (only GC400x)

This page is dedicated to the function “load management” (see [8]). “Load management” means the ability of the system to start/stop the gensets in order to only start the smallest number of gensets necessary to supply the load (with a minimum margin). This page shows some important information for this function.

The information shown is:

- The power supplied by the gensets (percentage compared to the maximum power that can be borne by the gensets running).

- The threshold (%) to be compared to the calculated power in the previous point, further to which a new genset must be started (otherwise combination of more gensets based on nominal power).
- The power supplied by the gensets (percentage compared to the maximum power) calculated considering that the less priority genset stops (or selecting the combination of less gensets based on nominal power).
- The threshold (%) to be compared to the calculated power in the previous point, below which a new genset must be started (or combination of less gensets based on nominal power).
- If a “load reserve” management is enabled in addition to the usual “load management”, this page alternates the above written values every two seconds with:
- The existing load reserve (the difference between the genset nominal power and the supplied power).
- The minimum load reserve required to start a new genset.
- The existing load reserve (the difference between the genset nominal power and the supplied power) calculated in case the less priority genset stops (or combination of less gensets based on nominal power).
- The minimum load reserve required to stop one of the gensets.

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

When possible, the controller also displays the time left for the starting of a new genset or for the stopping of one of the gensets running.

8.6.6 History logs (H.xx)

When in operation and not in **OFF/RESET** mode, the controller performs periodical or on-event recordings that can be partially configured with programming parameters.

The controller manages five types of archive:

1. Events
2. Fast ANALOGUEs
3. Slow ANALOGUEs
4. Maximum peaks
5. DTC

The history logs can be accessed in any controller working status. To access archive visualization, press the ▲ and ▼ buttons till the HISTORY LOGS (H.01) page is displayed.

When in a mode limiting the use of vertical scroll buttons you may require to press repeatedly the ESC button.

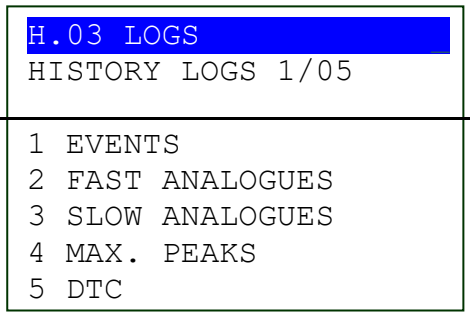
Pressing ESC/SHIFT while on the main page of the HISTORY LOGS mode, the upper status bar will display a status message related to the engine sequence, while the last line of the display will show the following message:

ENTER: visual.log

Then press ENTER to enable the mode (moving to page “H.03”).

At the start of the procedure, the menu of the various archives functions is displayed.

8.6.6.1 Log selection



The first line always shows the numerical indication of the selected function and the number of functions in the menu. The following display lines are used in order to show the selectable functions. The selected item is highlighted in reverse (REVERSE).
Use the ▲ e ▼ buttons to cyclically scroll through the menu to the lower and upper index items (i.e., pressing the ▲ allows to directly cycle from the first item to the last one). Press ENTER to enable the selected function (the one highlighted in reverse); press the ESC button to return to page “H.01”.

8.6.6.2 Events pages

When previously configured events occur, the controller adds a record in this archive. Full capacity is 126 records. If the archive is full and a new event occurs, the less recent is overwritten (so always the last 126 events are stored). For each event, besides a numerical code identifying it, the following data are recorded: date/time of the event, the operating mode of the controller, engine, mains and change-over status in that moment. If the event is an anomaly, measures described for the ANALOGUE archives are also stored. Configuring the events to be recorded is possible with parameter **P.0441**:

Bits management:

Bit	Hexadecimal value P.0441	Firmware version	Description
1	01	01.02	Controller modes.
2	02	01.02	Mains status.
3	04	01.02	Generator status.
4	08	01.02	Engine status.
5	10	01.02	Switches status.
6	20	01.02	Switches controls.
7	40	01.02	Start/stop requests.
8	80	01.02	Fuel pump controls.

Below you will find a table showing the codes of all possible events:

Code	Even if blocked	Rel.	GC	Recording cause
EVT.1001	Yes	01.02		Controller in OFF_RESET mode
EVT.1002	Yes	01.02		Controller in MAN mode
EVT.1003	Yes	01.02		Controller in AUTO mode
EVT.1004	Yes	01.02		Controller in TEST mode

EVT.1005	Yes	01.02		Controller in REMOTE START mode
EVT.1010		01.02		Mains failure
EVT.1011		01.02		Mains on
EVT.1012		01.02		Mains in tolerance
EVT.1013		01.02		Inhibition activated (from configurable input)
EVT.1014		01.02		Inhibition not activated (from configurable input)
EVT.1020		01.02		Generator failure
EVT.1021		01.02		Generator on
EVT.1022		01.02		Generator in tolerance
EVT.1030		01.02		GCB Close command
EVT.1031		01.02		GCB Open command
EVT.1032		01.02		GCB closed (from digital input)
EVT.1033		01.02		GCB open (from digital input)
EVT.1035		01.02		MCB Close command
EVT.1036		01.02		MCB Open command
EVT.1037		01.02		MCB closed (from digital input)
EVT.1038		01.02		MCB open (from digital input)
EVT.1040		01.02		Engine stopped
EVT.1041		01.02		Starting cycle
EVT.1042		01.02		Engine running
EVT.1043		01.02		Cooling cycle
EVT.1044		01.02		Stopping cycle
EVT.1045		01.02		Idle cycle (idle speed)
EVT.1050		01.02		Manual start command
EVT.1051		01.02		Manual stop command
EVT.1052		01.02		Auto start command
EVT.1053		01.02		Auto stop command
EVT.1054		01.02		Command for start in TEST mode from digital input.
EVT.1055		01.02		Command for stop in TEST mode from digital input.
EVT.1056		01.02		Command for start in TEST mode from serial port
EVT.1057		01.02		Command for stop in TEST mode from serial port
EVT.1058		01.02		Command for start in TEST mode from clock/calendar
EVT.1059		01.02		Command for stop in TEST mode from clock/calendar
EVT.1060		01.02		Command for start in TEST mode from SMS

EVT.1061		01.02		Command for stop in TEST mode from SMS
EVT.1062		01.02		Starting command for failure to close MCB.
EVT.1063		01.30	**GC400**	Starting command from MC100 controller
EVT.1070		01.02		Fuel pump on
EVT.1071		01.02		Fuel pump off
EVT.1072		01.62		AdBlue fluid pump on
EVT.1073		01.62		AdBlue fluid pump off
EVT.1074	Yes	01.02		Reset
EVT.1075		01.02		Clock/Calendar not valid (but used by some functions)
EVT.1076	Yes	01.02		Date/time update
EVT.1077	Yes	01.02		New controller power-on
EVT.1078	Yes	01.32		Default values of the parameters recharged
EVT.1080		01.02		Change-over inhibition active (from the loads on the generator).
EVT.1081		01.02		Change-over inhibition not active (from the loads on the generator).
EVT.1082		01.02		Engine protections override on
EVT.1083		01.02		Engine protections override off
EVT.1086	Yes	01.32 02.00		Daylight Save Time on
EVT.1087	Yes	01.32 02.00		Standard Time on
EVT.1091		01.30	**GC400**	Mains loss protection "27 U<<" activated
EVT.1092		01.30	**GC400**	Mains loss protection "59 U>>" activated
EVT.1093		01.30	**GC400**	Mains loss protection "81 f<<" activated
EVT.1094		01.30	**GC400**	Mains loss protection "81 f>>" activated
EVT.1095		01.30	**GC400**	Mains loss protection "81R" (Δf/Δt) activated
EVT.1096		01.30	**GC400**	Mains loss protection "Vector Jump" activated
EVT.1097		01.30	**GC400**	Mains loss protection (from MC100) activated
EVT.1098		01.30	**GC400**	Mains loss protection (from contact) activated
EVT.1099		01.30	**GC400**	Mains loss protection restored
EVT.1100		01.30	**GC400**	Mains loss protection "27 U<" activated
EVT.1101		01.30	**GC400**	Mains loss protection "59 U>" activated
EVT.1102		01.30	**GC400**	Mains loss protection "81 f<" activated
EVT.1103		01.30	**GC400**	Mains loss protection "81 f>" activated
EVT.1104		01.30	**GC400**	protections 27 enabled.
EVT.1105		01.30	**GC400**	Mains loss protection "27 U< & Q→" activated

EVT.1121		01.30	**GC400**	Power limitation for mains high frequency activated.
EVT.1122		01.30	**GC400**	Power limitation for mains high frequency deactivated.
EVT.1123		01.30	**GC400**	Power limitation by contact #1 activated.
EVT.1124		01.30	**GC400**	Power limitation by contact #1 deactivated.
EVT.1125		01.30	**GC400**	Power limitation by contact #2 activated.
EVT.1126		01.30	**GC400**	Power limitation by contact #2 deactivated.
EVT.1127		01.30	**GC400**	Power limitation for mains low frequency activated.
EVT.1128		01.30	**GC400**	Power limitation for mains low frequency deactivated.
EVT.1131		01.30	**GC400**	Engine stop for too much power limitation activated.
EVT.1132		01.30	**GC400**	Engine stop for too much power limitation deactivated.
EVT.1133		02.19	**GC400**	Power setpoint limitation for high voltage enabled
EVT.1134		02.19	**GC400**	Power setpoint limitation for high voltage disabled
EVT.1135		02.19	**GC400**	Start of power setpoint limitation for high voltage
EVT.1136		02.19	**GC400**	End of power setpoint limitation for high voltage
EVT.1137		02.19	**GC400**	Start of power setpoint limitation by ext. command
EVT.1138		02.19	**GC400**	End of power setpoint limitation by ext. command
EVT.1151		01.30	**GC400**	Mains loss protection "27 U<<" restored
EVT.1152		01.30	**GC400**	Mains loss protection "59 U>>" restored
EVT.1153		01.30	**GC400**	Mains loss protection "81 f<<" restored
EVT.1154		01.30	**GC400**	Mains loss protection "81 f>>" restored
EVT.1155		01.30	**GC400**	Mains loss protection "81R" (Δf/Δt) restored
EVT.1156		01.30	**GC400**	Mains loss protection "Vector Jump" restored
EVT.1157		01.30	**GC400**	Mains loss protection (from MC100) restored
EVT.1158		01.30	**GC400**	Mains loss protection (from contact) restored
EVT.1160		01.30	**GC400**	Mains loss protection "27 U<" restored
EVT.1161		01.30	**GC400**	Mains loss protection "59 U>" restored
EVT.1162		01.30	**GC400**	Mains loss protection "81 f<" restored
EVT.1163		01.30	**GC400**	Mains loss protection "81 f>" restored
EVT.1164		01.30	**GC400**	Protections 27 disabled.
EVT.1165		01.30	**GC400**	Mains loss protection "27 U< & Q→" restored
EVT.1191		02.19	**GC400**	The parallel with the mains is allowed
EVT.1192		02.19	**GC400**	The parallel with the mains is not allowed
EVT.1201		01.30	**GC400**	Load taking inhibition (from Modbus) active.
EVT.1202		01.30	**GC400**	Load taking inhibition (from Modbus) active.
EVT.1203		01.30	**GC400**	Load taking inhibition (for some GCB not open) active.
EVT.1204		01.30	**GC400**	Load taking inhibition (for ongoing synchronization on MCB) active.
EVT.1205		01.30	**GC400**	Load taking inhibition (for MC100 board command) active.
EVT.1221		01.44 01.30		Automatic intervention inhibition" active (from clock/calendar).

EVT.1222		01.44 01.30		Automatic intervention inhibition" not active (from clock/calendar).
EVT.1223		01.30	**GC400**	"Automatic intervention inhibition" active (for out of tolerance mains for SPtM e MPtM plants).
EVT.1224		01.30	**GC400**	"Automatic intervention inhibition" not active (for out of tolerance mains for SPtM e MPtM plants).
EVT.1225		01.30	**GC400**	"Automatic intervention inhibition" active (for GCB not open).
EVT.1226		01.30	**GC400**	"Automatic intervention inhibition" not active (for GCB not open).
EVT.1241		01.30	**GC400**	Load function disabled (from parameter)
EVT.1242		01.30	**GC400**	Load function disabled (digital input)
EVT.1243		01.30	**GC400**	Load function disabled (for supply mode)
EVT.1244		01.30	**GC400**	Load function disabled (from MC100)
EVT.1245		01.30	**GC400**	Load function disabled (for mains in tolerance)
EVT.1246		01.30	**GC400**	Load function disabled (for inhibitions at starting)
EVT.1247		01.30	**GC400**	Load function disabled (for MGCB open)
EVT.1248		01.30	**GC400**	Load function disabled (as the exit from the parallel is required for other causes)
EVT.1249		01.30	**GC400**	Load function disabled (controller not in AUTO)
EVT.1250		01.30	**GC400**	Load function disabled (there are alarms)
EVT.1261		01.30	**GC400**	Starting required by load function (as disabled)
EVT.1262		01.30	**GC400**	Starting required by load function (load function just enabled)
EVT.1263		01.30	**GC400**	Starting required by load function (no GCB closed)
EVT.1264		01.30	**GC400**	Starting required by load function (START pushbutton pressed)
EVT.1265		01.30	**GC400**	Starting required by load function (initial delay)
EVT.1266		01.30	**GC400**	Starting required by load function (priority list not valid)
EVT.1267		01.30	**GC400**	Starting required by load function (selected genset)
EVT.1268		01.30	**GC400**	Starting required by load function (for minimum number of supplying gensets)
EVT.1269		01.30	**GC400**	Starting required by load function (because it is the master genset)
EVT.1270		01.30	**GC400**	Starting required by load function (for load threshold)
EVT.1271		01.30	**GC400**	Starting required by load function (for load stock)
EVT.1272		01.30	**GC400**	Starting required by load function (for priority order)
EVT.1273		01.30	**GC400**	Starting required by load function (for priority order)
EVT.1281		01.30	**GC400**	Starting required by load function (for not selected genset)
EVT.1282		01.30	**GC400**	Starting required by load function (for threshold and load stock)
EVT.1291		01.30	**GC400**	New master genset
EVT.1292		01.30	**GC400**	The supply mode for the load function is isochronous.
EVT.1293		01.30	**GC400**	The supply mode for the load function is SYSTEM BASE LOAD
EVT.1294		01.30	**GC400**	The supply mode for the load function is DROOP
EVT.1321		01.30	**GC400**	Number of gensets connected to bus PMCB varied

The anomalies are themselves saves as events. They are registered with their own alarm code with in addition:

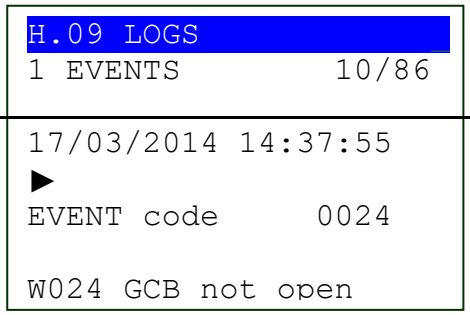
- 2000: if they are pre-alarms
- 3000: if they are downloads (**only GC400x**)

- 4000: if they are deactivations
- 5000: if they are faulty

When displayed, the value 2000, 3000, 4000 or 5000 is removed and replaced by the letter “W”, “U”, “D” or “A” before the alarm code.

For example, by simulating an emergency stop event, we will obtain the display of: 0048: A048 Emergency stop. The same event, read through serial, will be displayed with: 5048, where 5 = failure and 048 = Emergency Stop.

To display every event, the controller uses at least three pages of the display: if the event displayed is one of the 21 most recent anomalies, it uses seven pages. The main page has the following format:



The second line of each event page shows what event is currently displayed (10) and any partial event stored (86). Once the total number of events available is reached, the partial value will remain fixed at the limit value (126) up to a possible log resetting. The example in the previous figure shows event 10 of 86 stored (out of 126 available).

The fourth line of each event page displays the date/time of the record; on the right it also displays two arrows indicating the availability of further pages to the right or to the left of the current page for the current event.

The lines from the fifth to the eighth show different information, depending on the selected page.

- The first page shows the numerical code of the event (W024 in the given example) and the clear description of the event, in this case a warning W (“W024 GCB closed”).
- The system status when the event was recorded are displayed in the second page: the controller operation modes, as well as engine status, generator status, mains status and change-over status.
- The third page shows the communication status (GCB and MCB) when the event was recorded.
- Pages from the fourth to the seventh are described in the analogues log.

The most recent event is associated to the highest number. Use the ▲ and ▼ buttons to scroll cyclically trough all recordings.

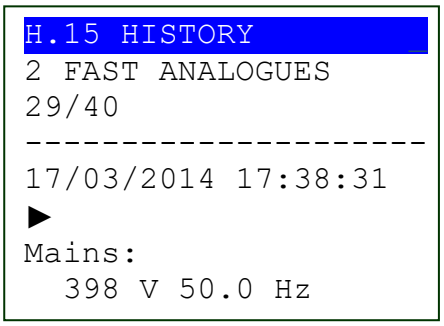
Using the ◄ and ► buttons, you can browse through the pages related to the event.

8.6.6.3 Pages for ANALOGUEs

The controller records the ANALOGUE magnitudes described below (with engine On or Off); the recording frequency is configured with the parameter P.0442 (seconds) and P.0443 (minutes):

- Mains phase-to-phase voltages and frequency.
- Generator frequency and phase-to-phase voltages.
- Generator currents.
- Active, reactive and apparent powers, the power factor and the type of plant total load.
- Starting battery voltage, engine rotation speed, coolant temperature, oil pressure and engine fuel level.

Each record is associated with its date/time. The measures not acquired (because the controller was not set to acquire them) are replaced by dashes.
To display all records, the controller uses four pages of the display. The main page has the following format:



The second line of each page shows what record is currently displayed (29) and any partial record stored (40). Once the total number of records available is reached, the partial value will remain fixed at the limit value up to a possible log resetting. The example in the previous figure shows record 29 of 40 stored (out of 42 available).

The fourth line of each page displays the date/time of the record; on the right it also displays two arrows indicating the availability of further pages to the right or to the left of the current page for the current record.

The lines from the fifth to the eighth show different information, depending on the selected page.

- The first page displays all the values of the mains/bars, at the time of recording: frequency and voltage
- The second page displays all the values of the generator, at the time of recording: frequency and voltages
- The third page displays all the values of the load, currents and powers, at the time of recording: currents, apparent power, active and reactive power, power factor.
- The fourth page displays all the values of the engine, at the time of recording: battery voltage, Engine speed oil pressure, Oil pressure, Coolant temperature, Fuel level.

The more recent record is associated to the highest number. Use the ▲ and ▼ buttons to scroll cyclically trough all recordings.

Using the ◄ and ► buttons, you can browse through the pages related to the recordings.

8.6.6.4 Fast ANALOGUEs logs

The fast ANALOGUEs are recorded at a pace configurable by means of the parameter **P.0442** (interval in seconds) and the default interval is 60 seconds. This archive provides a total storage capability of **42** (engine-On and engine-Off) records. Every following record overwrites the older one. The controller records the ANALOGUE values described in par. 8.6.6.3.

8.6.6.5 Slow ANALOGUEs logs

The slow ANALOGUEs are recorded at a pace configurable by means of the parameter **P.0443** (interval in minutes) and the default interval is 30 minutes. This archive provides a total storage capability of **64** (engine-On and engine-Off) records. Every following record overwrites the older one. The controller records the ANALOGUE values described in par. 8.6.6.3.

8.6.6.6 Locked recordings

ANALOGUE and events recordings are temporarily OFF when the key switch is in "OFF/RESET" mode.

When the records are locked, a lock appears on the second line, after the text "HISTORY LOGS", in all the windows of the history log.
In this situation, the controller's internal counters keep decreasing the time left to the expiry of the next recording.

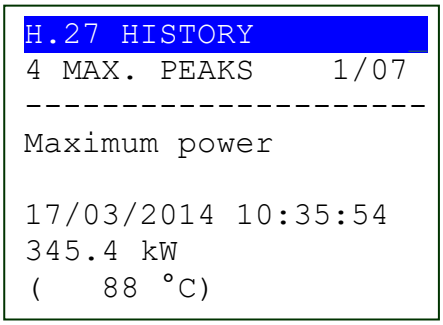
When the operation mode shifts from "**OFF/RESET**" to "**MAN**" or "**AUTO**" mode, a check is performed in order to verify whether some recording counter expired. If so, the recorded date and time of the status change are stored, otherwise the count continues till the next recording is stored.

8.6.6.7 Pages for peaks

The controller performs a series of recordings of maximum and minimum peaks for some significant measures.

- 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 particular phase associated.
- Coolant temperature: the maximum peak is being recorded, with date/time associated.

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



The second line shows the record currently displayed, out of the total number of records (the total number of records is 5).

The fourth line shows a description of the peak recording currently displayed:

- Maximum power
- Maximum current. (L1)
- Maximum current. (L2)
- Maximum current. (L3)
- Maximum coolant temperature

The sixth line shows the recording date and time. The seventh line displays the recorded measure (power, current etc.) A second measure recorded together with the main measure can be displayed on the eighth line:

- The coolant temperature is recorded together with the power.
- The power factors on individual phases are recorded together with the currents.
- If certain data are not available at the time of recording, dashes will be displayed.

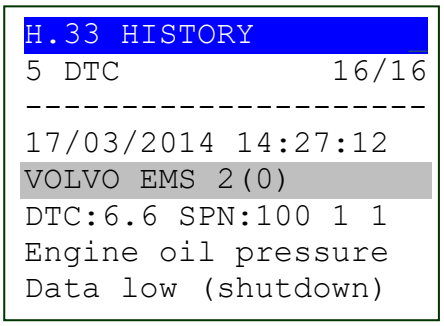
Use the ▲ and ▼ buttons to scroll cyclically trough all recordings. The ◄ and ► buttons are not used because the controller uses only one page of the display.

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

The controller records the diagnostic codes that the engine control unit (ECU Interface) and the voltage regulator (AVR) send on the CAN-BUS line.

Basically, depending on the connected external device, the diagnostic message consists of the DTC, SPN and fault description. This archive have can store up to 16 records. Every following record overwrites the older one.

To display all records, the controller uses 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 16).

The fourth line shows the recording date and time.

The fifth line identifies the external device that triggered the diagnostic code.

The sixth line shows the diagnostic code. It contains:

- DTC (Diagnostic Trouble Code): it is a non-standard diagnostic code, specific to the connected external device, which can be found in the technical manual of the external device (in the example, the code "6.6" in the engine technical manual will describe the low oil pressure problem).
- SPN (Suspect Parameter Number): is a numeric code showing the engine part/component that generated the diagnostic code (in the example, “100” identifies oil pressure measure).
- FMI (Fault Mode Identifier): is a numeric code between 0 and 31 that identifies the kind of problem (in the example, “1” indicates an excessively low value of the measure, thus requiring engine stop).
- OC (Occurrence Count): indicates how many times this diagnostic code has already been activated (example “2”).

In addition, if the combination of the SPN and FMI codes (or the DTC code) is known to the controller, a text description of the problem is displayed.

The seventh and eighth line show a text description of the problem, if available.

The more recent record is associated to the highest number. Use the ▲ and ▼ buttons to scroll cyclically trough all recordings. The ◄ and ► buttons are not used because the controller uses only one page of the display.

8.6.6.9 Exit from archives visualization

There are two ways to exit from archive visualization:

- Press the **ESC** button 'n' times to scroll back to page H.01
- Change the operating mode of the controller.

In both cases, page H.01 will display; you may move to other display modes using the ▲ and ▼ buttons.

8.6.6.10 Reset archives to zero

To reset an archive to zero, it is necessary to display it first and then keep the digits ACK/ENTER and ESC/SHIFT per 5 secondi, until when the controller shows a message of reset to zero. The archive of maximum peaks does not reset to zero: when ACK/ENTER and ESC/SHIFT are pressed for five seconds on this archive, the controller forces the measure value as maximum peak.

8.7 Selection of the language

The device allows to select the language for all writings displayed on the multi-functional display. 5 languages are currently available: Italian, English, Portuguese, French and Russian (English is the default language). For GC400x, the

directly available languages are only English and Portuguese. The others can be transferred to the controller (one at a time) through the BoardPrg4 software. See 8.6.2.3 for language selection procedure.

9 Working sequence

9.1 Operating modes

There are five device management modes:

- **OFF_RESET**: the genset is off (or in the arrest phase), the anomalies are all cancelled and you can access the programming to modify the parameters. The GCB switch is open to isolate the generator from the loads. The MCB breaker is closed to connect the loads to the mains.
- **MAN**: genset start up and loads change-over to the generator are to be performed by the operator (the controller board does not perform these operations automatically). Genset arrest and loads change-over to the mains are normally to be performed by the operator: however, when the protections are enabled, the controller board can, if necessary, perform these operations automatically. Accessing programming is allowed, though only some parameters can be modified.
- **AUTO**: genset start/stop and the management of the GCB and MCB breakers are performed by the controller board (the operator cannot interfere). All protections are enabled. Accessing programming is allowed, though only some parameters can be modified.
- **TEST**: this operation mode is nearly identical to AUTO. The only difference is that the engine is anyway (automatically) started even with mains and/or automatic intervention inhibition contact ON. The parameter P.0222 “Enabling test loading”, allows indicating to the controller if it must automatically change-over the loads to the generator. In any case, the operator is authorized to control the MCB and GCB breakers just like in MAN. When the controller goes back to AUTO mode (when the test is finished), the loads are automatically changed-over to the mains and the engine is stopped with normal procedure. The controller automatically switches from TEST to AUTO in case existing conditions require an automatic intervention by the genset. Accessing programming is allowed, though only some parameters can be modified.
- **REMOTE START**: nearly identical to AUTO. The only difference is that the engine is anyway (automatically) started even with mains and/or automatic intervention inhibition contact ON; the loads are changed-over to the generator. AUTO mode supersedes TEST mode (i.e., it can interrupt or replace the periodic test). It is also overriding with respect to the AUTO (once the remote start is activated, any request for automatic intervention is ignored). The operator is not allowed to manually operate the GCB and MCB switches. Accessing programming is allowed, though only some parameters can be modified.

9.1.1 OFF/MAN/AUTO mode

The operating mode can be selected in two different ways:

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

When one of these inputs is active, the operating mode of the controller is forced and you can no longer use the buttons on the panel, nor the controls of the serial ports to change it (the first line of the display shows a key-shaped icon).

When neither of these inputs is active, you are again able to use the buttons and the controls of the serial ports to change the operating mode.

If there are multiple active inputs at the same time, priority is given to the input that forces the OFF / RESET mode, followed by the one that forces MAN mode and finally the one that forces AUTO mode.

You needn't use all three inputs. For example, you can use a single input to force AUTO status: when the input is active the controller is always in AUTO mode, and when it is deactivated, the controller remains in AUTO mode, but you can use the buttons to change-over 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 are only managed if none of the above-described inputs is active. The commands can be protected by a password (P.0004) which must be entered before any command and can be deactivated through a digital input (DIF.2706). To send the command it is necessary to write in sequence (within 5 seconds):
- HOLDING REGISTER 101: write the password configured with the parameter P.0004.
- HOLDING REGISTER 102: write the value:
  - “1” to require the OFF/RESET mode.
  - “2” to require the MAN mode.
  - “3” to require the di AUTO mode.

9.1.2 TEST 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. The TEST mode is signalled by the flashing of the AUTO indicator light on the panel (50% on – 50% off). You can shift to TEST mode as follows:

- Pressing the “START” button on the controller's panel. Shifting to TEST mode is immediate. Press again the same buttons to return to AUTO mode. This feature can be disabled using bit 1 of P.0495.
- By properly configuring the parameters:
  - P.0418: Weekly test schedule.
  - P.0419: Test start time
  - P.0420: Test duration

These parameters allow for weekly programming of the time intervals for TEST mode engine start (to keep it efficient). In this case, shifting to TEST mode automatically occurs at set days and times. The controller returns to AUTO when the TEST time interval ends.

- By means of a proper command via SMS (refer to document [2]. In order for this feature to be used, the parameter P.0420 “Test duration” shall not be set to zero (it indicates, in fact, the TEST duration). In this case, the controller shifts from TEST after receiving the SMS and returns to AUTO after the time P.0420 Test starting duration (min).
- From a PC connected to a serial port (with Modbus RTU protocol). The controller shifts to TEST after receiving the command from the serial port, then, returns to AUTO after receiving the opposite command or when it detects an interrupted serial connection (60 seconds w/o messages). To send the command you need to write in sequence (within 5 seconds):
  - HOLDING REGISTER 101: enter the password configured with the parameter P.0004.
  - HOLDING REGISTER 102: enter the value:
    - “12” to require TEST mode.
    - “21” to go back to AUTO mode.
- When a digital input, properly set with code 2031 “Test mode request” is activated, the controller shifts to TEST and returns to AUTO when the same input is deactivated.
- 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 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 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.

9.1.3 REMOTE START mode

To activate **REMOTE START** mode, instead, the controller must first of all be in AUTO or in TEST mode. In addition, in case an input is configured with code DIF.2701 – "Enable remote start request" in the parameters of any input, this input shall be active. You may shift to REMOTE STARTUP in the following cases:

- Configuring a digital input of the controller to acquire the "Remote start request" with code DIF.2032. When this input is active, the controller shifts to REMOTE STARTUP; it deactivates when reverting to AUTO.
- By means of a proper command via SMS (refer to document [2]). 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, you need to configure an input for acquiring the contact enable remote start request, code DIF2701, and the input shall be active (normally wired on a panel for enabling remote commands).
- Using parameters P.0426, P.0427 and P.0428 it is possible to define on a weekly basis hourly operation intervals when the genset shifts automatically to REMOTE START. In particular, parameter P.0426 allows to set the week days in which this function is active and the remaining two allow you 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 defines a full day's range.
- From a PC connected to the serial port, USB port, ETHERNET port or via modem (with RTU Modbus or TCP Modbus). The controller shifts to REMOTE STARTUP after receiving the command from the serial port; it then reverts to AUTO when receiving the opposite command (it remains in REMOTE STARTUP mode in case the serial connection is interrupted before receiving the opposite command). In this case, you need to configure an input for acquiring the "contact enable remote start-up request", code DIF2701, and the input shall be active (normally wired on a panel for enabling 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 you need to write in sequence (within 5 seconds):
  - HOLDING REGISTER 101: enter the password configured with the parameter P.0004.
  - HOLDING REGISTER 102: enter the value:
    - "13" to require REMOTE START mode.
    - "21" to go back to AUTO mode.

9.1.4 Operating mode at Power-On

When powered on, the controller selects the operating mode in according to the settings on parameter P.0490 "Operating mode at power-on" (menu 4.7.2). If the parameter is set to 3 - "Last operating mode", the controller restores the mode that was active before power-off.
Upon startup, the controller remains in OFF/RESET mode for approximately one second. After this interval, the mode defined by parameter P.0490 is activated.

If the " MODE ▲" button is kept pressed during this interval, the controller will remain in OFF/RESET mode, regardless of P.0490 parameter setting.

9.1.5 Communication and events

The controller records any change of the operating mode in the events log, if it is enabled with bit 0 of the P.0441 parameter:

- EVT.1001: records the shift to OFF/RESET mode.
- EVT.1002: records the shift to MAN mode.
- EVT.1003: records the shift to AUTO mode.
- EVT.1003: records the shift to TEST mode.
- EVT.1003: records the shift to REMOTE START mode.

There are some features available for configuring the digital outputs related to the operating mode:

- DOF.3001 - “Off/reset”. The controller activates this output when in OFF/RESET mode.
- DOF.3002 - “Man”. The controller activates this output when in MAN mode.
- DOF.3003 - “Auto The controller activates this output when in AUTO mode.
- DOF.3004 - “TEST”. The controller activates this output when it is in TEST mode.
- DOF.3005 - “Remote Start”. The controller activates this output when in AVVIAMENTO REMOTO mode.
- DOF.3011 - “Not in OFF/RESET”. The controller activates this output when it is in AUTO or MAN mode.
- DOF.3012 - “One of the automatic modes”. The output is activated when the controller is in one of the automatic operation modes, that is AUTO, TEST or REMOTE START.

In addition, the controller makes available its own operation mode for the AND/OR logics by means of the following internal statuses:

- ST.000 - “OFF/RESET”.
- ST.001 - “Manual”.
- ST.002 - “Automatic”.
- ST.003 - “Test”.
- ST.004 - “Remote start”.

9.2 Mains

ATTENTION! The device manages the mains voltage in all plants, except with SPM type plants. What indicated in this paragraph does not make sense on SPM type plants (P.0802 =0).

The controller acquires the system's mains voltage (single-phase or bi-phase or three-phase) to the purpose of commanding automatic start-ups and arrests of the engine in case of anomaly on the mains (always for GC315x, for SSB and SSB+SSTP plant for GC400x). In emergency systems, the controller board starts the generator (and changes-over the loads to it) when the mains is out of tolerance; it changes-over the loads to the mains and stops the genset when the mains returns in tolerance.

The mains must be connected to the JH connector. On a three-phase system, ensure to connect the three phases and the neutral; on a single-phase system, ensure to connect the L phase on connector 3 and the neutral on 4.

The status of the mains can be acquired in various ways:

- From the JH connector of the controllers (see par. 5.14).

  In any case, in order for the GC315 to be able to measure the mains voltage and frequency from the JH connector, the operator must set the nominal voltage of the mains using the parameter P.0116.
- By means of the digital input configured with the feature “DIF.3101 – External mains sensor”. When said input is active, the mains is considered in tolerance; when it is not active, the main is considered out of

tolerance. **NOTE: if the digital input is active, the mains is considered in tolerance, even if the measure of the JH sensor is enabled and if said measure indicates that the mains is out of tolerance.**

9.2.1 Internal sensor

In the event the JH sensor can be used to acquire the mains measures, there are various parameters that influence its management:

- P.0126: **only for GC400x**. To use the JH connector with the mains, this parameter must be set to "1-Mains".
- P.0105: rated generator frequency. Also used as mains rated frequency. All thresholds associated to mains frequency are expressed as a percentage of this parameter.
- P.0119: configures the mains sensor as three-phase (3) or bi-phase (2) or single-phase (1).
- P.0116: rated mains voltage. Phase-to-phase rated voltage shall be set for bi phase/three-phase systems; single-phase, for single phase systems. Thresholds are expressed as a percentage of it. If set to zero, mains voltage is considered still not present, even if physically connected (it is anyway measured and displayed).
- P.0152: allows to select if the controller is in standard version (0) or if it has been required with 100 V inputs (1).
- P.0117: primary value (in Volt) of any VT connected to connector JH.
- P.0118: secondary value (in Volt) of any VT connected to connector JH.
- P.0244: enables the checks on thresholds and hysteresis including on the phase voltages of the mains (on the phase-to-phase voltages they are always enabled).
- P.0201: hysteresis applied to all the thresholds related to mains voltage and frequency. It is a percentage value related to P.0116 and to P.0105.
- P.0203: mains low frequency threshold (percentage related to P.0116) (below which the mains is considered anomalous).
- P.0204: mains high frequency threshold (percentage related to P.0116) (above which the mains is considered anomalous).
- P.0236: mains low frequency threshold (percentage of P.0105); below this value, mains is considered anomalous and the engine is started.
- P.0237: mains high frequency threshold (percentage of P.0105); over this value, mains is considered anomalous and the engine is started.
- P.0238: mains voltages asymmetry threshold (percentage of P.0116); over this value, mains is considered anomalous and the engine is started. Only applicable to bi phase/three-phase systems.
- P.0239: Rotation direction required for mains voltage. Only applicable to bi phase/three-phase systems.

In order 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).

9.2.1.1 Frequency check

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

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

Here follows an example about the various threshold used, including default values for a.m. parameters.

Parameter	Description	Default value	Frequency in Hz
P.0105	Rated frequency	50 Hz	50.00
P.0236	Minimum frequency threshold	90.0 %	45.00

P.0237	Maximum frequency threshold	110.0 %	55.00
P.0201	Maximum hysteresis	2.5 %	1.25

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, to the minimum frequency threshold (i.e., between 45.00 and 46.25 Hz).
- Downwards to the maximum frequency threshold (i.e., between 53.75 Hz and 55.00 Hz).

These values define the following bands:

0.00 V
A band: **low**
45.00 V
B band: hysteresis
46.25 (45.00 + 1.25) V
C band: **in tolerance**
53.75 (55.00 – 1.25) V
D band: hysteresis
55.00 V
G band: **high**
xxx V

If the frequency is within the bands “B” or “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 “C” band, and now is within “D” band, it is considered “Low”.

9.2.1.2 Voltage's check

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

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

Here follows an example about the various threshold used, including default values for a.m. parameters.

Parameter	Description	Default value	Voltage in Volts
P.0116	Rated voltage	400 V	400
-	Mains presence threshold	20.0 %	80
P.0203	Minimum voltage threshold	80.0 %	320
P.0204	Maximum voltage threshold	110.0 %	440
P.0201	Maximum hysteresis	2.5 %	10

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, to mains availability threshold (i.e., between 70 V and 80 V).
- Upwards, to the minimum voltage threshold (i.e., between 320 V and 330 V).
- Downwards to the maximum voltage threshold (i.e., between 430 V and 440 V).

These values define the following bands:

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

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

Such status are managed at individual phase level.

On three phase plants, if the P.0244 parameter is set, the same checks are also done on the phase voltages (the phase nominal voltage is calculated by dividing the nominal connected P.0116 for 1.73 (square root of 3).

9.2.1.3 Asymmetry check

In bi-phase / three-phase 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.

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

Here follows an example about the various threshold used, including default values for a.m. parameters:

Parameter	Description	Default value	Voltage in Volts
P.0116	Rated voltage	400 V	400
P.0238	Mains asymmetry threshold	10.0 %	40

In case the absolute value of two phase-to-phase voltages differs more than 40 V, the mains is seen as out of tolerance (the MAINS LIVE lamp flashes with 25% on). In case the absolute values of all phase-to-phase voltages are lower than 40 V, the mains is seen in tolerance. No hysteresis is managed for this check.

If the parameter P.0244 is set, to “1”, the same controls are also done on the phase voltages (the phase nominal voltage is calculated by dividing the nominal connected P.0116 for 1.73 (square root of 3).

9.2.1.4 Rotation direction check

For bi-phase / three-phases systems, mains can be 'out of tolerance' in case the rotation direction of the phases differs from the specification set with parameter P.0239 “Phase’s frequency required on mains“.

To disable this check, simply set parameter P.0239 to zero.

In case a “clockwise” rotation direction is required, please set “1” in P.0239; in case the rotation direction is “counter-clockwise”, the mains is seen as 'Out of tolerance' (the MAINS LIVE lamp flashes with 25% on).

In case a “counter-clockwise rotation direction is required, please set “2” in P.0239; in case the rotation direction is “clockwise”, the mains is seen as out of tolerance (the MAINS LIVE lamp flashes with 25% on).

9.2.1.5 Internal sensor status

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

- In case the status of all existing voltages (1 or 3) **and** the frequency are “Absent”, also the global status is “Absent”.
- In case the status of all existing voltages (1 or 3) **and** the frequency is “In tolerance”, also the global status is “In tolerance”.
- In case the status of at least one voltage **or** the frequency is “High”, also the global status is “High”.
- In case none of the previous conditions occurs, global status is “Low”.

In case the tests show that the mains is “In tolerance”, perform also the following tests:

- If we have an unusually high asymmetry on the voltages, the global status is “Low”.
- If the direction of rotation of the mains is different from the one configured, the global status is “Low”.

9.2.2 External sensor

The use of a digital input is provided, configured with the function DIF.3101 - “Sensor of external mains”, for the connection with a generic mains sensor in alternative, or in addition to the internal sensor.

The status of the mains is considered:

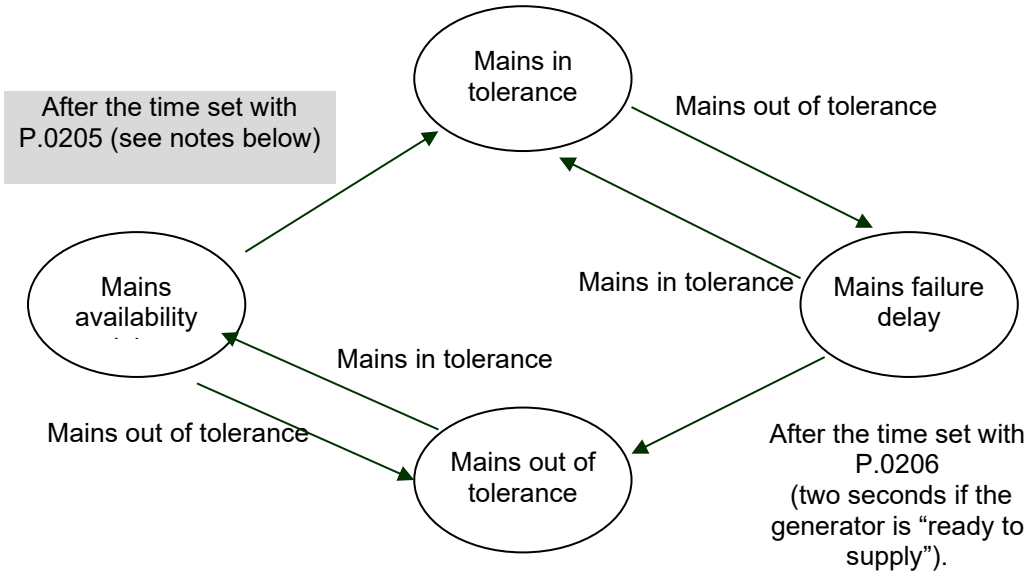
- “Absent” if the input is no active.
- “In tolerance” if the input is active.

Note: if the input is active, the mains is considered in tolerance, even if the measure from the JH sensor is enabled and such measure indicates that the mains is out of tolerance.

It is valid what written in the next paragraph, as per the internal sensor.

9.2.3 Mains global status

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 one or more generators 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 generators). 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 generators supplying the loads, and on the value of this bit:
  - At least one generator supplying the loads: the duration of the “mains presence delay” is set by parameter P.0205.
  - No generator supplying the loads and bit 1 of P.0250 is “1”: the duration of the “mains presence delay” is set by parameter P.0205.
  - No generator supplying the loads and bit 1 of P.0250 is “0”: the duration of the “mains presence delay” is 0 seconds.

9.2.4 Communication and events

The controller records any change of the mains status in the events log, if it is enabled with bit 1 of the P.0441 parameter:

- EVT.1010: Lack of network voltage.
- EVT.1011: Network voltage present, but “out of tolerance”.
- EVT.1012: Network voltage present and “in tolerance”.

The following feature for the configuration of the digital outputs related to the mains status is also available:

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

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

- ST.016 - "Mains voltage/frequency present"
- ST.017 - “Mains out of tolerance or absent”
- ST.018 - "Delay for mains within tolerance"
- ST.019 - “Mains within tolerance”.
- ST.020 - "Delay for mains out of tolerance or absent"

9.3 Generator

GC315 acquires generator (single or bi-phase or three-phase) voltage and frequency in order to protect the loads and the generator itself from operating outside its tolerance thresholds. For connecting the generator to the GC315, see par. 0.

On GC315, by setting P.0802 to “11-Drive”, it is possible to work with the engine only, without the generator. To work in this way, you need to:

- Set P.0802 to “11-Drive”.
- Make sure that GC315 is able to acquire the engine speed (from pick-up, from W or from Can Bus communication). **This point is fundamental, because the controller has no other way to verify the under-speed and over-speed conditions**.
- Set parameters P.0305, P.0306, P.0307 and P.0308 correctly. They normally configure the minimum and maximum frequency protections: when working without the generator they are used for speed protection (the percentage values are calculated with respect to the rated engine speed - P.0133 or P.0134).
- Set parameters P.0333 and P.0334 correctly (over-speed protection).

Once this is done, the controller works in this way:

- It hides all M.XX pages except M.01.
- On page M.01 the generator symbol is replaced with the engine symbol, the circuit breaker with the clutch symbol and the power measurements are replaced by the engine speed (rpm). The power measurements on the loads are also hidden.
- The “operating conditions failure” situation is evaluated only on the engine speed, even in MAN mode.
- Generator related events are not logged.
- The following alarms are not managed:
  - 01 – minimum voltage.
  - 02 - maximum voltage
  - 03 - minimum frequency.
  - 04 - maximum frequency.
  - 6 - maximum current.
  - 11 – power reverse.

- 16 - short circuit.
- 45 - maximum auxiliary current.
- 49 - maximum active power.
- 52 – voltage unbalance.
- 53 - current unbalance.
- 55 - wrong phases sequence.
- 56 - low voltage.
- 58 - low frequency.
- 59 - high voltage.
- 60 - high frequency.
- 61 - loss of filed.
- 100 - maximum differential current.
- 203 - maximum negative sequence current

- The anomaly "D099 - Minimum engine speed" is now managed. After the engine has reached the rated speed at start-up (between the thresholds P.0305 and P.0307), if it falls below the threshold P.0305 for P.0306 seconds, the controller activates the anomaly. It is an alarm: it forces the immediate opening of the GCB, and stops the engine without the cooling cycle. **Note: in this case the thresholds P.0305 and P.0307 are to be considered as percentages of the rated speed (P.0133 or P.0134).** For this reason, if you program them from the controller, the last display line shows the equivalent value both in Hz and in rpm.

9.3.1 Frequency

Several parameters are related to frequency measure:

- P.0105: rated generator frequency. All frequency measure related thresholds are expressed percentage of it.
- P.0228: threshold (percentage of P.0105) under which the engine is considered stopped.
- P.0229: threshold (percentage of P.0105) above which the generator is considered started.
- P.0305: low voltage threshold (percentage related to P.0105) below this value the generator cannot be connected to the loads.
- P.0307: high voltage threshold (percentage related to P.0105) above this value the generator cannot be connected to the loads.
- P.0395: low frequency threshold (percentage of P.0105) (under this threshold, the generator sets a warning).
- P.0397: high frequency threshold (percentage of P.0105) (over this threshold, the generator sets a warning).
- P.0331: maximum frequency threshold (percentage of P.0105); over this threshold, the engine must be stopped due to risk of damage to both the engine and the alternator.

Here follows an example about the various threshold used, including default values for a.m. parameters.

Parameter	Description	Default value	Frequency in Hz
P.0105	Rated frequency	50 Hz	50
P.0228	Stopped engine threshold due to frequency	10.0 %	5
P.0229	Started engine threshold due to frequency	20.0 %	10
P.0305	Minimum frequency threshold	90.0 %	45
P.0307	Maximum frequency threshold	110.0 %	55
P.0202	Hysteresis	2,5 %	1.25

To the two settable thresholds (P.0305 and P.0307) the hysteresis is entirely applied in the threshold input direction. This means that the frequency is out of tolerance if out of thresholds P.0305 and P.0307. It is in tolerance if within the thresholds P.0305+hysteresis and P.0305-hysteresis, otherwise it maintains the previous status.

0 Hz
A band: **absent**
5 Hz
B band: **hysteresis**
10 Hz
C band: **minimum**
45 Hz
D band: **low**
46 Hz
E band: **in tolerance**
54 Hz
F band: **high**
55 Hz
G band: **Maximum**
60 Hz
Band H: **Overspeed**
xxx Hz

If the frequency is in “B”, “D”, “F” bands, it maintains the status it had before (hysteresis). For example, if the frequency was in “E” band, and now is in “D” band, it is still considered in tolerance. On the other hand, if it was in “C” band and now is in “D” band, it is considered “Low”.

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 in order 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.

9.3.2 Voltages

Many parameters influence generator voltage measures:

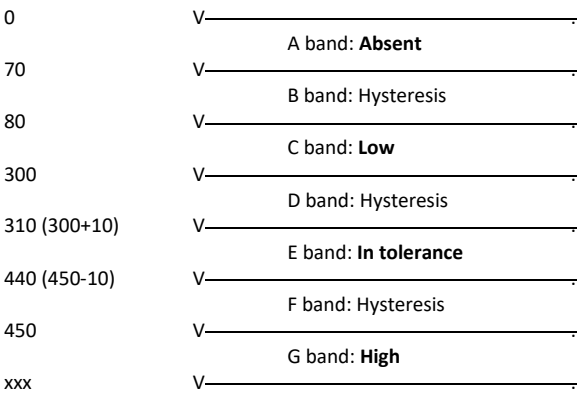
- P.0101: indicates if it is a three-phase (3) or two-phase (2) or a single-phase generator (1).
- P.0102: rated generator voltage. Phase-to-phase rated voltage shall be set for bi-phase or three-phase systems; single-phase, for single phase systems. Thresholds are expressed as a percentage of it.
- P.0151: allows to select if the controller is in standard version (0) or if it has been required with the 100 V inputs (1).
- P.0103: rated voltage (in Volt) for the primary of any VT (voltage transformers) connected to connector JG.
- P.0104: rated voltage (in Volt) for the secondary of any VT (voltage transformers) connected to connector JG.
- P.0328: enables the checks on thresholds and hysteresis including on the phase voltages of the generator (on the phase-to-phase voltages they are always enabled).
- P.0202: hysteresis applied to all the thresholds related to generator voltage. It is a percentage value of P.0102.
- P.0226: threshold (percentage of P.0102) under which the engine is considered stopped.
- P.0227: threshold (percentage of P.0102) over which the engine is considered started.
- P.0301: low generator voltage threshold (percentage of P.0102); under this value the generator cannot be connected to the loads.
- P.0303: high generator voltage threshold (percentage of P.0102); over this value the generator cannot be connected to the loads.

Here follows an example about the various threshold used, including default values for a.m. parameters.

Parameter	Description	Default value	Voltage in Volts
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

The hysteresis fully configured in the direction for the threshold entry, applies to the two configurable thresholds (P.0301 e P.0303). This means that generator voltage is out of the tolerance if out of the thresholds P.0301 and P.0303; it is in tolerance if between P.0301 + hysteresis and P.0303 – hysteresis; otherwise, the previous status is maintained.

Keeping in account these values, the following bands are defined:



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”.

On bi phase/three phase plants, if the P.0328 is set to “1”, the same controls are also done on phase voltage. (the phase nominal voltage is calculated by dividing the nominal connected P.0116 for 1.73 (square root of 3).

Such status is managed at individual phase level. With a bi phase/three-phase system, in order to diagnose the generator “global” status, the following algorithms are used, shown in the order they are computed:

- In case all the bi phase/three phases are in “Absent” status, global status is also “Absent”.
- In case all the bi phase/three phases are in “In tolerance” status, global status is also “In tolerance”.
- In case at least one phase is in “High” status, global status is also “High”.
- In case none of the previous conditions occurs, global status is “Low”.

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 in order 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.

9.3.3 Overview

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

a) Steady out of tolerance: the generator voltages **and/or** frequency status must be continuously other than "In tolerance" for two seconds.
The "GENERATOR LIVE" lamp is Off if voltages and frequency are in "Absent" status, otherwise it blinks.

b) Steady within tolerance: generator's voltage **and** frequency global status must be "within tolerance" for at least 0.5 seconds. "GENERATOR LIVE" lamp is steady On.

c) Transient: shifting from status "a" to status "b" or vice versa. The "GENERATOR LIVE" lamp blinks. On the front panel only status "a", "b", and "c" are displayed, by means of the "GENERATOR LIVE" lamp. Global and individual voltage phases and frequency "Absent" status etc. are not shown: however, they can be read with Modbus protocol via the serial port.

9.3.4 Communication and events

The controller records any change of the generator's status in the events log, if it is enabled with bit 2 of the P.0441 parameter:

- EVT.1020: Lack of voltage on the generator.
- EVT.1021: Generator voltage present, but "out of tolerance".
- EVT.1022: Generator voltage present and "within tolerance".

The following feature for the configuration of the digital outputs related to the generator status is also available:

- DOF.3032 - "Generator in thresholds". The controller activates this output when the generator voltages and frequency are within tolerance from the time configured.

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

- ST.024 - "Generator voltage/frequency present"
- ST.025 - "Generator out of tolerance or absent"
- ST.026 - "Delay for generator within tolerance"
- ST.027 - "Generator within tolerance"
- ST.028 - "Delay for generator out of tolerance or absent"

9.4 Automatic intervention of the generator inhibited.

In AUTO mode, whatever the kind of plant and the Mains status, two causes can anyway inhibit the genset automatic start:

- Operating time range.
- Digital input.
- **Only for GC400x**: for the load management (the gensets running are enough to supply the load). See [8].
- **Only for GC400x**: another genset connected to the parallel bars is in "GCB not open" condition. See [8].

When there is an inhibition active, a flashing lock is displayed in the top right corner of the display.

Note: the inhibition status does not affect TEST and REMOTE START modes.

9.4.1 Inhibition from contact

The controller can use a digital input programmed for inhibiting the genset automatic operation (function "2501" - genset operation inhibit). In case of an "active" input, the engine is never automatically started, not even if the plants condition require.

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

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

When a function with value 2501 is coupled with a digital input, acquisition of this input depends on the time set in P.0207 and/or P.0208; the acquisition time related to the digital input is skipped.

The controller also makes available, to the use of AND/OR logics, the internal status ST.080 - "Contact starting inhibition".

The controller records any change of the inhibition status in the events log, if it is enabled with bit 6 of the P.0441 parameter:

- EVT.1013: Inhibition activated (from configurable input)
- EVT.1014 Inhibition not activated (from configurable input)

9.4.2 Inhibition from clock

Using parameters P.0421, P.0422 and P.0423, it is possible to define on a weekly basis the hourly operation ranges. In particular, 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 defines a full day's range.

Apart from the days and time configured, the inhibition to the automatic intervention is active.

The controller also makes available, to the use of AND/OR logics, the internal status ST.081 - "Clock/calendar starting inhibition".

9.5 Differences between Mains Simulation and Inhibition

The two functions provide different operation logics and purpose. The first one emulates the internal sensor, while the second one is specifically used for preventing system start-up, whatever the mains status. In this way, status indication is more coherent with the real status of the system.

9.6 Engine

GC315 can start, stop and protect the engine by means of a series of thresholds on the acquired measures (oil pressure, coolant temperature, speed etc.). Before describing engine management sequences, it is necessary to define in which way the controller determines the engine running status.

9.6.1 Engine running/stopped status acknowledgement

There are three engine status:

- **Stopped**: the activation of the command is allowed for starter motor.
- **In movement**: the engine is not considered running, therefore:
  - If the command for the starter motor is active, it is maintained to try to get the engine started.
  - If the command for the starter motor is not active, the controller impedes the starting. (as the engine is rotating).
- **Running**: the controller deactivates the command of the starter motor and impede its restart.

The controller recognises the status of the engine considering the following conditions:

- From the engine rotation. This control is enabled if the measure of the rotation is available:
  - Parameter P.0110 "Number of teeth of the crown of the pick-up" different from zero.
  - Parameter P.0111 "rpm/W" different from zero ratio.

- Parameter P.0127 “rpm/Hz” different from zero ratio.
- CAN-BUS Connection with the enabled engine.

Two thresholds are available (P.0224 e P.0225), which have to be both different from zero and P.0225 has to be major than P.0224 (otherwise this check is disabled). The instantaneous status of the engine is:

- **Stopped** if the rotation speed is lower than P.0224.
- **In movement** 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 signal voltage D+ of the generator battery charger. This control is enabled if the measure of the D+ voltage is enabled (P.4041 must be set as AIF.1300 – “D+ signal”).

Two thresholds are available (P.0230 e P.0231), which have to be both different from zero and P.0231 has to be major than P.0230 (otherwise this check is disabled).

The instantaneous status of the engine is:

- **Stopped** if the D+ voltage is lower than P.0230.
- **In movement** if the D+ voltage is higher than P.0230, but lower than P.0231.
- **Running** if the D+ voltage is higher than P. 0231.

- From oil pressure. This control is enabled if parameter P.0232 is different from zero and if digital inputs are configured to acquire the status of the oil pressure switches (DIF.4221 and/or DIF.4222), or if the pressure measurement is available (from analogue input or Can Bus). The instantaneous state of the engine is:
  - **Stopped** if the oil pressure is below the minimum threshold (with the engine stopped, in fact, the oil pressure drops, and these contacts should activate).
  - **In movement** if the oil pressure is above the minimum threshold, from the time configured with P.0232.
- From generator voltage. Two thresholds are available (P.0226 and P.0227), which have to be both different from zero and P.0227 has to be major than P.0226 (otherwise this check is disabled).
- The instantaneous status of the engine is:
  - **Stopped** if the voltages measured on **all generator** phases are lower than P.0226.
  - **In movement** if the voltage measured on at **least one generator** phase is higher than P.0226, but all are lower than P.0227.
  - **Running** if the voltage measured on at **least one generator** phase is higher than P. 0227.
- From generator frequency. Two thresholds are available (P.0228 and P.0229), which have to be both different from zero and P.0229 has to be major than P.0228 0226 (otherwise this check is disabled).
- The instantaneous status of the engine is:
  - **Stopped** if the generator frequency is lower than P.0228.
  - **Moving** if the generator frequency is higher than P.0228, but lower than P.0229.
  - **Running** if the generator frequency is higher than P. 0229.
- From CAN-BUS (ECU Interface): if the engine signals the status of started on CAN-BUS. This control is not used if the CAN-BUS connection is disabled (parameter P.0700 “Engine type” set to 0).

The engine is generally considered:

- **Stopped if** all previous checks (all those not enabled) show the “stopped” status “fermo” consecutively for **five seconds**.
- **In movement**, if at **least one** of the previous checks show “in movement” or “running”.
- **Running**, if at **least one** of the previous checks show “running” consecutively for at **least 0,2 seconds**.

9.6.2 Engine commands

The controller can handle the following different commands for engine management:

- **START**: command for the starter.
- **FUEL**: command for the fuel solenoid valve.
- **STOP**: stop command when energized.
- **PREHEAT**: command for Diesel engines glow-plugs preheating.
- **PRELUBRICATION**: engines pre-lubrication command.
- **GAS**: command for the gas valve (for gas engines).
- **IDLE**: command to activate engine low speed.
- **ENABLE ENGINE**: this command is activated together with the FUEL command, but can be deactivated before the FUEL command (useful for electronic engines shutdown without causing any vacuum in the fuel pipes).

All digital outputs of the controller are configurable and therefore the engine commands can be associated in any way to the outputs of the controller (see par. 5.9.4). The START and FUEL outputs are assigned by default to outputs OUT 5 and OUT 6; since said outputs consist of relays and are protected from over currents, but it is still possible to reassign them when needed,

As the other five commands are optional, dedicated outputs are not available. However, you may associate any of these commands to any of the outputs, taking into account their type. Configuration is possible with parameters from P.3001 to P.3016 (menu 1 System, 1.7 digital Inputs/Outputs, 1.7.3 digital Outputs, 1.7.3.1 digital Outputs) using the following values:

- **DOF.1001:** glow-plugs preheating (PREHEAT).
- **DOF.1002:** engine control unit enable (ENABLE ENGINE)
- **DOF.1003:** fuel valve (FUEL).
- **DOF.1004:** gas valve (GAS).
- **DOF.1005:** start command (START).
- **DOF.1006:** stop command when energized (STOP).
- **DOF.1007:** low speed command (IDLE).
- **DOF.1033:** pre-lubrication command

By default, commands for glow-plugs preheating, for gas valve, low speed and engine control unit are not used, whereas the stop command when energized is associated to the output OUT 1 of terminal 1 of connector JE, whereas the command for the starter motor is by default associated to terminal 1 of the JH connector.

9.6.3 ECU supply

This command should be used to supply the ECU. It is not mandatory. If present, its behaviour depends on the following parameters:

- P.0718: it specifies when the controller should power the ECU:
  - 0: When it needs to start the engine.
  - 1: When it needs to start the engine, or if the controller is in MAN mode.
  - 2: Always
- P.0719: it allows configuring a delay between the activation of this command and the begin of the cranking sequence. The purpose is to provide time to the ECU to properly power-up before starting the engine.
- P.0720: it allows configuring a delay between the stop command of the engine and the deactivation of this command. The purpose is to allow the ECU to finish all stopping operations before switching it off.

If the output exists, when it is deactivated, the controller never activates the anomaly AL-098 “Communication failure with the ECU”.

9.6.4 Manual control sequence

9.6.4.1 Start-up

There are two possible sequences of start-up:

- Manual sequence: it is used in MAN if the parameter P.0252 (“Number of manual crank attempts”) is higher than zero. In the manual sequence, the duration of start-up attempt is established by the operator: the attempt is interrupted when the operator releases the START button.
- Automatic sequence: it is used in all other cases. In the automatic sequence, the duration of the start-up attempt is selected with parameter P.0210.

In MAN, if P.0252 is different from zero, the controller performs P.0252 start attempts, activating the “fail to star anomaly” if the engine does not start; in addition, the start-up in MAN is always done by means of battery 1 (in case there are 2 batteries).

The start-up sequence is activated if there are no failures, downloading and deactivations, and if at least one of these conditions happens:

- MANUAL:
  - Pressing START.
  - **Only for GC400x**. Activating a digital input configured with the function IF.2033 (“start-up manual command”). The input is managed as it was the digit START.
  - Using the commands received from the serial ports, USB, ETHERNET, or through modem (**in this case the automatic sequence is used**). The commands can be protected by a password (P.0004) which has to be sent before any command, and can be deactivated through a digital input (DIF.2706). To send the command it is necessary to write in sequence (within 5 seconds):
- HOLDING REGISTER 101: write the configured password with parameter P.0004.
- HOLDING REGISTER 102: write value “11”.
- AUTOMATIC:
  - If TEST mode is activated (see the paragraph that describes the controller operation mode).
  - If REMOTE STARTING is activated (see the paragraph that describes the controller operation mode).
  - If an automatic starting is required and no inhibition to the starting is activated (see 9.4).

The stand-by status are those of **stop** and **no stop**. The controller deactivated all commands to engine for both. The **no stop** status means that the engine has been started by others or that it did not stop at a stop cycle (only possible if the excitation stop system is used). From the controller point of view the two status are different, since the engine protection are never activated as the controller considers that there is another device which it has started and is being checking the engine.

From stand-by status, when a starting cycle is required (manual or automatic sequence), if the engine was **not stop**, the engine control unit is not commanded and we pass to the **running** status (in MAN) or that of **start-up confirmation** (in AUTO). If the engine was stopped, instead, it passes to the starting **consent wait status**.

The status of **consent wait status** is only performed if there is a configured digital input with function DIF.2709. The purpose of this input is to condition the real starting of the engine to an external logic (e.g., To allow the pre-ventilation for gas gensets). If no digital input is configured with function DIF.2709, or if the input is active, the sequence proceeds with the engine **pre-lubrication** cycle. During this status all engine commands are deactivated.

The **pre-lubrication cycle** is performed if the parameter P.0242 is set (“maximum duration of pre-lubrication cycle”) to a value different from zero. The cycle ends at the end of time P.0242, or after two seconds from when the controller recognises that the oil is in pressure:

- If the controller acquires the analogue measure of pressure, when this measure goes over the low-pressure threshold (P.0339), or, if deactivated, when it goes over the minimum pressure threshold (P.0341).
- If some digital inputs of the controller are configured with functions DIF.4221 and/or DIF.4222 (contacts of low and minimum oil pressure) when at least one of these inputs deactivates.

During this cycle, commands PRE-LUBRICATION, FUEL, ENGINE ENABLING, PREHEAT and IDLE are active (if requested). At the end, we pass to the **pre-heating** cycle.

The **pre-heating** is performed if parameter P.0209 is set ("pre-heating cycle duration) different from zero. In this state the PRE-LUBRICATION, ENGINE ENABLING, PREHEAT and IDLE COMMANDS ARE ACTIVE. It is not obligatory to configure an input as pre-heating command; this allows to use it even without pre-heating in order to add a delay between commands FUEL and START. This cycle is performed in parallel with the **pre-lubrication** cycle, that is, the two cycles start in the same moment.

If either the **pre-lubrication** nor the **pre-heating** cycles are performed, the controller manages an intermediate status of the duration of 0,2 seconds, where commands PRELUBRICATION, FUEL, ABILITAZIONE MOTORE, PREHEAT and IDLE (if requested). This status is necessary to guarantee a minimum delay between the opening of the fuel electro-valve and the activation of the engine control unit. This because some electro-valves have a mechanic problem according to which if there is fuel flow during the opening, they get stuck.

From the previous status, we proceed to the engine **starting** or, if configured, with the **washing** cycle.

The washing cycle is only needed for gas engines. It consists in activating the engine control unit keeping the GAS valve closed. In this way a depression is created, which extracts the remaining gases, before the engine starting. The cycle is performed if parameter P.0241 ("**washing** cycle duration") is different from zero. At the end of the configured time, we proceed to the engine **starting**. In this status, PRE-LUBRICATION, FUEL, ENGINE ENABLING, PREHEAT and IDLE commands are active (if requested).

During the **starting,** the PRE-LUBRICATION, FUEL, ENGINE ENABLING, PREHEAT, GAS, IDLE (if requested) and START commands are active. If the controller recognises the engine running status, the sequence goes on with the **low-speed** cycle. If, instead, the starting cycle ends (see previous notes about the starting sequence in manual mode) without diagnosing the started engine status, the sequence proceed with:

- The **starting check** status, if we are in MAN. Actually, the given command could be enough for the engine, which therefore could get started. In this state the engine has to be checked for a maximum time of 10 seconds to check if it starts. PRE-LUBRICATION, FUEL, ENGINE ENABLING, GAS and IDLE (if requested) are active, to facilitate the eventual starting. If the engine get started, we pass to the **low-speed** status, otherwise at the end of the 10 seconds we come back to the **stop** status.
- The **delay between the two start attempts** status if we are in AUTO, TEST or REMOTE STARTING. The duration of this status is configured with parameter P.0212 ("Delay between two start attempts"). At the end we proceed towards the **washing** status. This status is performed for a number of times configured with parameter P.0211 ("Number of starting attempts"): if after all configured attempts the engine does not activate, the controller activates the failure AL.022 ("A022 failed starting") and proceed with the **stop** status. In this status, commands PRE-LUBRICATION, PRE-HEATING, FUEL, ENGINE ENABLING, and IDLE (if requested) are active, so to use this status for the pre-heating of the Diesel engine spark plugs.

The **low-speed** status is performed if parameter P.0233 ("low speed cycle duration") is different from 0 or if a configured digital input is active as DIF.2061 ("Request of reduced speed"). In this state, FUEL, ENGINE ENABLING, GAS and IDLE commands are active. If the controller is connected via CAN-BUS to the engine, the low-speed command is directly managed on the bus. To this purpose, it is available parameter P.0710 that allows to configure the engine rotation during this phase (not every engine support it. Some has their own pre-defined low speed rating). Otherwise, to give this command it is necessary to configure an input (DOF.1007 – "reduced speed command"). The cycle ends when the configured time ends or when the digital input deactivates. If the controller acquires the water-cooling temperature (from CAN-BUS or from sensor), it is also possible to configure a minimum temperature threshold for supply consent to interrupt the cycle (P.0223 – "Minimum temperature for supply consent"): if the temperature of such liquid goes consecutively for two seconds over the threshold, the cycle is interrupted (it is not interrupted if a digital input DIF.2061 is active "Reduced speed request"). At the end of the cycle, we proceed with the status of:

- **Running** if we are in MAN. See note on the next point.
- **Starting confirmation** if we are in AUTO, TEST or REMOTE STARTING. For GC315, if the selected application in P.0802 is "11 - DRIVE", this status is used in MAN mode also. This status is necessary to wait that the genset reaches the full speed. The engine could, in effect, turn off (the controller could have diagnosed it only because it is the engine control unit which lets it move). In these cases, the controller has to attempt to start it again, up to the end of the configured attempts. From this status we proceed towards **in running** if the genset reaches the full speed (in this case the starting is real and an eventual turning off is symptom of big anomalies on the genset); if the engine stops, we proceed towards the **delay between two attempts;** towards the **stop** status if the engine does not stop, but the genset does not reach the full speed within the time configured with parameter P.0217 ("Maximum time for full speed conditions"): the controller activates the failure AL.008 ("A008 – Failed full speed conditions"). In this status the FUEL, ENGINE ENABLING and GAS commands are active.

In **running** status, the FUEL, ENGINE ENABLING and GAS commands are active.

9.6.4.1.1 Use of two fleets of batteries

The controller is able to command the engine starting by managing two fleets of batteries, alternating them to guarantee a sure engine starting (only in automatic mode). In manual mode, the starting will always be performed with battery 1. To use this procedure, it is necessary to use the following functions for digital outputs:

- DOF.1008 – "select battery 1".
- DOF.1009 – "select battery 2".

In order to use this function, at least one configured output with function DOF.1008 must exist. In this case, the starting sequence becomes the following:

- Output "select battery 1" **activated**, output "select battery 2" **deactivated**
- Wait 2 seconds (it can be increased with the glow plug pre-heating)
- First starting attempt
- Pause
- Last starting attempt
- Wait 2 seconds
- Output "select battery 1" de**activated**, output "select battery 2" **activated**.
- Wait 2 seconds
- **If there is the DOF.1009 output**: Output "select battery 1" de**activated**, output "select battery 2" **activated**
- **If there is the DOF.1009 output**: Wait 2 seconds (It can be increased by raising the waiting time between the two starting)
- First starting attempt with second battery
- Pause
- Last starting attempt with second battery
- Failed starting alarm.
- Wait 2 seconds
- Output "select battery 1" **activated**, output "select battery 2" **deactivated**

If the engine starts, the sequence is ended. The output "battery selection n" active in that moment is deactivated with a delay of two seconds on the detection of started engine. If no exit is configured with the DOF.1008 function, the starting sequence remains standard.

9.6.4.1.2 Starting on low battery

If the engine starter battery voltage is too low. In this case, the controller starts the engine to make sure that the engine, through its charge alternator, recharges the battery. This function is enabled if parameter P.9655 is different from zero, and you can configure it with the following parameters:

- P.0362 (“Pre-alarm level for low battery voltage”). It is a percentage of the rated voltage of the starter battery (12/24 Vdc).
- P.0363 (“Delay for low battery voltage pre-alarm”). It is the delay (used as filter) before starting the engine.
- P.9655 (“Charging time for low battery voltage”). It is the time that the engine remains running. Set to zero to disable this feature.
- P.9656 (“Enable generator supply while start for low battery”). It is the option to enable GCB closing and supply the loads.

If the starter battery voltage remains below the P.0362 threshold consecutively for P.0363 seconds, the controller starts the engine and keeps it running for P.9655 minutes. If there are no other requests for automatic intervention or set the explicit request by P.9656, the controller does not connect the loads to the engine/generator.

This function is available only in AUTO mode and the battery recharging is performed in TEST mode.

9.6.4.2 Stop

The engine can be stopped in two ways:

a) With normal procedure. Such procedure consists in performing an engine cooling cycle (only if the load has previously been connected to the genset), keeping it running without load. This procedure only applies in AUTOMATIC mode if:
   - There are no more automatic starting requests (see above)
   - An anomaly as “deactivation” or as “downloading” has been activated (a typically dangerous anomaly for the load 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).

b) With emergency procedure. Such procedure provides the immediate stop of the engine, without cooling cycle. It applies if:
   - The controller is forced in OFF_RESET.
   - If the stop is requested in MAN.
   - Any anomaly classified as “failure” is activated and if the engine is in a different status from **stop** and **no stop**.

The stop sequence is performed in the following cases:

- When a failure, download or deactivation happen.
- Using the commands received from the serial ports USB, ETHERNET or through modem. The commands can be protected by a password (P.0004) which has to be sent before every command and can be disabled

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 configured password with parameter P.0004.
- HOLDING REGISTER 102: write value “21” (standard stop) or “22” (emergency stop).

- In MANUAL:
  - Pressing “STOP” from the controller panel.
  - **Only for GC400x**. Activating a configured digital input with function DIF.2034 (“stop manual command”). The input is exactly managed as it was the digit STOP.
- In AUTOMATIC:
  - When the automatic intervention of the genset is no more requested.

Note: normally if you press the digit STOP in AUTOMATIC, the controller activates the failure A007 (“manual stop in automatic”): the engine is therefore stopped with emergency procedure. It is possible to disable the digit STOP in automatic acting on bit 0 of parameter P.0495 (keyboard options).

The stop phase can be also performed when the engine is already stopped.

9.6.4.2.1 Standard procedure

The stop standard procedure consists in performing a **cooling** cycle for the engine first (during which the controller disconnects the genset from the loads). Such cycle is performed only if during the **running** status the loads have been connected to the generator. During this cycle, the FUEL, ENGINE ENABLING and GAS commands are active. The duration of the cycle is configurable with parameter P.0215 (“Duration of 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. If these services are powered by mains voltage, therefore the generator should be stopped as soon as the mains fails.

The controller allows configuring the source from which these services are supplied, via P.0240 parameter ("The engine services are supplied by:"):

- 0: generator voltage.
- 2: voltage on users.
- 3: mains voltage.

If the controller 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.

From this status it is possible to go back to the **in running** status if the stop requests cease and there is at least one starting request (for example, we were in this status following to the back from mains, but during this status the mains fails again). The cycle can be interrupted also if there is an emergency stop request (a failure or the controller in OFF_RESET). In this case, or at the end of time P.0215, we proceed with the emergency stop cycle.

9.6.4.2.2 Emergency procedure

The emergency procedure consists in stopping the engine without performing the cooling cycle. Such procedure is also common to the normal stop, after, thus, the cooling cycle.

During the stop phase, the ENGINE ENABLING, GAS, START and PREHEAT are removed and it the STOP command is activated instead. The FUEL command is removed after the configured time with parameter P.0234 (“Delay between commands STOP and FUEL”). This to avoid that the engine in stopping phase cause a depression in the fuel ducts, which could cause electro-valve jam at the next opening command. The duration of this phase is configurable with parameter P.0213 (“duration of stop pulse in excitement”. At the end, we pass to the **stop waiting** phase. If during this phase all

the stop requests cease and there is at least one starting request, we pass to the **stop cancelation** one and only if the engine has been diagnosed stopped.

It is not possible to interrupt an automatic stop cycle as situations can be happen where it is difficult to restart the engine if it was not completely stopped.

During the **stop waiting** phase all engine commands deactivate and therefore the stop of the engine is waited. The duration of such waiting is configurable with parameter P.0214 ("Duration of stopping cycle"), from which the configured time with P.0213 is subtracted ("Duration of stopping command"). At the end of this phase, if the engine has not stopped, the failure AL.021 is activated ("A021 – failed stop") and we pass to the status of **no stop**. The whole phase of **stop waiting** (and then also the failure A021) can be disabled anyway by setting zero in parameter P.0214. If the engine stops, it goes back to the **stop** status. This phase cannot be interrupted to perform further starting.

The **cancel stop** phase is only necessary to allow a short delay between the deactivation of the eventual STOP command and the FUEL activation. This delay is of 0,2 seconds, at the end of which we go back to the **stop** status, from where we will proceed immediately with the starting if there are the conditions (and restarting from zero with the counting of the starting attempts).

9.6.5 Communication and events

The controller records any change of the engine's status in the events log, if it is enabled with bit 3 of the P.0441 parameter:

- EVT.1040: Engine stopped
- EVT.1041: Starting cycle
- EVT.1042: Engine running.
- EVT.1043: Cooling cycle
- EVT.1044: Stopping cycle
- EVT.1045: Idle cycle (idle speed)

The controller records any change of the start/stop requests in the events log, if it is enabled with bit 6 of the P.0441 parameter:

- EVT.1050: Manual start command
- EVT.1051: Manual stop command
- EVT.1052: Auto start command
- EVT.1053: Auto stop command
- EVT.1054: Command for start in TEST mode from digital input.
- EVT.1055: Command for stop in TEST mode from digital input.
- EVT.1056: Command for start in TEST mode from serial port
- EVT.1057: Command for stop in TEST mode from serial port
- EVT.1058: Command for start in TEST mode from clock/calendar
- EVT.1059: Command for stop in TEST mode from clock/calendar
- EVT.1060: Command for start in TEST mode from SMS
- EVT.1061: Command for stop in TEST mode from SMS
- EVT.1062: Starting command for failure to close MCB.

In addition, the controller makes available the start/stop requests and the engine statuses for the AND/OR logics by means of the following internal statuses:

- ST.032 - "Engine running".
- 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 for power delivery”
- ST.040- "Engine sequence: cooling”
- ST.041- "Engine sequence: arrest”
- ST.096 - "Ready for power delivery”
- ST.104 - "Power delivery”

9.7 Breakers management

9.7.1 Digital outputs

Four different commands can be used to manage **MCB** breakers:

- DOF.2001 - "MCB (NC) Under voltage coil". This feature can be used to supply with power the under-voltage coil (if any) of the breaker. The controller enables this output when it must open the breaker, and disables 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. It is therefore necessary to use a contact which is **normally closed**, so that when the controller is not supplied, the under-voltage coil is enabled and the breaker can be closed. Should the breaker open without an explicit command from the controller, (for example, for the snap of its protections), it is possible to configure a delay between the opening of the breaker and the activation of this (P.0246, set to zero as per default): this function is useful for some breakers of small size in order to acquire the TRIP contact (which can be resettable immediately as soon as the breaker is commanded in opening).
- DOF.2002 - "MCB opening coil". The controller enables this output when it must open the breaker: the output goes back on standby once the breaker feedback shows that it is open (or when the opening time-out expires).
- DOF.2003 - "MCB closing coil". The controller enables this output when it must close the breaker (ensuring that the feature 2001 «if available» has been active for at least 0.5 seconds): the output goes back on standby once the breaker shows that it is closed (or when the closing time-out expires, or if the synchronism condition is no longer met).
- DOF.2004 - "MCB steady opening command". The controller enabled this output when it must open the breaker (ensuring that the DOF.2001 feature «if available» has been active for at least 0.5 seconds): the output stays active even with the breaker open. The controller disables this output when it must close the breaker: the output remains disabled even with the breaker closed. Therefore, in order 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 with power the under-voltage coil (if any) of the 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 an explicit command from the controller, (for example, for the snap of its protections), it is possible to configure a delay between the opening of the breaker and the activation of this (P.0247, set to zero as per default): this function is useful for some breakers of small size in order to acquire the TRIP contact (which can be resettable immediately as soon as the breaker is commanded in opening).
- DOF.2032 - "GCB opening coil". The controller enables this output when it must open the breaker: the output goes back on standby once the breaker feedback shows that it is open (or when the opening time-out expires).
- DOF.2033 - "GCB closing coil". The controller enables this output when it must close the breaker (ensuring that the feature DOF.2031 «if available» has been active for at least 0.5 seconds): the output goes back on standby once the breaker shows that it is closed (or when the closing time-out expires, or if the synchronism condition is no longer met).
- DOF.2034 - "GCB steady closing command". The controller enables this output when it must close the breaker (ensuring that the DOF.2031 feature «if available» has been active for at least 0.5 seconds): the output stays active even with the 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.

9.7.2 Digital inputs

The digital inputs of the controller can be used for various purposes, when managing loads change-over:

9.7.2.1 Acquiring breakers status

The features of inputs DIF.3001 - “GCB breaker status” and DIF.3002 - “MCB breaker status” are used by the controller for acquiring the feedback connection input, respectively of breakers GCB and MCB. The controller uses these inputs for:

- Issuing failed opening or failed closing warnings.
- 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.

In theory, for those plants which do not provide the parallel with other gensets or with the mains. the controller could operate even without this feedback. In this case, the controller considers that the breaker is closed once the closing command is issued; it considers that the breaker is open once the opening command is issued. In reality, it is always better to connect the feedback.

By means of the P.0847 parameter you can define whether the MCB breaker is powered from the mains. In this case, if the mains is missing, MCB opens but the controller does not issue the corresponding warning of failure to close the MCB.

9.7.2.2 Temporary Override of breakers commands (only GC400x)

It is possible to use digital inputs to indicate to the GC400x controller that “temporarily” the command of one or both the breakers is managed by an external device is managed by an external device (even if from parameters P.0854 and P.0855 comes out that the breaker is commanded by the controller):

- DIF.1003 - “GCB externally commanded”.
- DIF.1033 - “MCB externally commanded”.

Up to when the input is active, the controller ever try not to open nor to close the breaker: but if the breaker moves (caused by external command), the controller conforms its own commands to the new status of the breaker, so not to cause any undesired open/close when the input is activated.

9.7.2.3 Manual commands for breakers

It is possible to connect external open/close buttons of the breakers to the digital inputs of the controller. The controller will use these inputs (only in MAN) exactly as the MCB and GCB buttons which are on the panel.

- DIF.1001 - “Close request GCB”.
- DIF.1002 - “Open request GCB”.
- DIF.1031 - “Close request MCB”.
- DIF.1032 - “Open request MCB”.

9.7.2.4 Synchronisation request (only GC400x)

If a breaker is not commanded by the controller, it is still possible to use the internal synchronisation function (see doc.[8]). When the external logic wants to close a breaker, and the synchronisation is requested, it has to request the synchronisation to GC400x activating a digital input. The following functions are available for configuring the digital input:

- DIF.1004 - “Synchronisation request for GCB”.
- DIF.1034 - “Synchronisation request for MCB”.

For further details see doc. [8].

9.7.3 OFF/RESET management logic

In this mode, the controller always commands the GBC in opening. If MCB exists and is commanded by the controller, it is always commanded in closure. Note: if MCB is configured as “supplied by mains” (P.0847 different from zero) and the mains lacks, the controller never tries to command the MCB closure, not even in OFF/RESET.

9.7.4 MAN management logic

GCB command is activated only if all the following conditions are met:

- Generator voltages and frequency in tolerance for a proper time.
- The engine has been started by the controller (the fuel solenoid valve command must be active).
- No failures, unloads or deactivations are present.

Doc [8] describes in details the logics with which the controller allows to open/close the breakers in manual mode (the logics depend on the type of plant though).

In this paragraph, instead, it is described the way it is possible to send breakers manual open/close commands to the controller.

- Using the controller buttons.

  The MCB button only exists on controllers GC315x and GC400^{Mains}/GC400$^{Mains+Link}$.
  For some types of plants (SSB, SSB+SSPT), also GC400/GC400^{Link} is able to command the MCB breaker: use the combination of digits SHIFT+GCB to operate on MCB. By button MCB (or SHIFT+GCB), can open/close the MCB breaker. It is always possible to open MCB (with engine stopped 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 synchronisation (if it is not possible to use it – for example on GC315x, then it proceeds to open GCB before closing MCB).

  With the GCB button, the operator can open/close the GCB breaker. It is always possible to open GCB. Instead, the breaker can be closed only if the engine is activated and if the voltages and the frequency of the generator are in tolerance: if MCB is closed, the controller activates the synchronisation (if not possible to use it - for example on GC315x, then it proceeds to open MCB before closing GCB).

  In case a switch (SIRCOVER) is used, both MCB and GCB buttons act the same way, changing-over the loads alternatively between mains and generator.
- Using the digital inputs of the controller (to connect external buttons to allow for manual opening/closing of the breakers) See paragraph 8.7.2.3 for the list of available functions.

  All these commands work on passage from “not active” to “active” of the input, not on “active” stable status. For each breaker it is possible to use both commands and also only the close one. If only the close command is used, it acts as “toggle”: it commands the opening of the breaker if it is closed, and commands it closure if it is open. It is valid what described for MCB and GCB button at the previous point.
- Using the commands received from the serial ports. To send the commands you need to write in sequence (within 5 seconds):
- HOLDING REGISTER 101: enter the password configured with the parameter P.0004.
- HOLDING REGISTER 102:
  - “31” and “32” to open the GCB.
  - “33” to close the GCB.
  - “41” to open the MCB.
  - “43” to close the MCB.

For a detailed sequence corresponding to each single type of plant, see doc. [8].

Attention: parameter P.0235 (**only GC400x**) determines what happens on the GCB breaker when the operation mode passes from an automatic mode (AUTO, TEST o AVVIAMENTO REMOTO) to MAN:

- P.0235=0: GCB maintains its own status.
- P.0235=1: GCB is opened immediately and without performing the power downloading.

9.7.5 Switching logic in AUTO mode

Doc. [8] describes in details the logics according to which the controller manages the breakers in AUTO, TEST and REMOTE START (the logics depend on the type of plant anyway).

9.7.6 Switch

For GC315x and for the only type of plant SSB (single genset in emergency to the mains) of GC400x, the controller is able to command a switch instead of breakers. To do so, it is enough to configure no outputs for the MCB command (but configure it as "internally commanded" with the parameter P.0855 of GC400x). Use the "GCB Stable Close Command" (DOF.2034) to command the switch.

In addition, it is possible to configure a minimum time before which it is not possible (not in manual mode, nor in automatic) to invert the command of the switch (P.0220 "Time of maintenance switch command"). This is useful because if the command is inverted in some types of switches during the movement phase (before the completing of the switch), they could fail, causing the need of a manual intervention for the release.

9.7.7 Switch management

In the case in which the controller commands both the MCB and GCB breakers, but it cannot use the synchronisation to close a breaker, (for any reason), it can use the switch: it can open the other breaker and close the desired breaker. In this case, it is possible to configure the duration of the pause with both breakers opened, with the parameter P.0219 ("Time of switches commands exchange").

9.7.8 Automatic power delivery of the generator inhibited.

In all automatic operating modes of the controller, the GCB breaker can be forced open by certain causes, even if the operating logic of the system commands it's closing. Here is a description of these causes.

- It is possible to use a digital input configured with feature DIF.2502 – "Loading inhibition". When this input is active, the controller commands the opening of the GCB (and subsequent closing of the MCB, if possible).
  See also the description of the EJP feature in par. 11.6
- You can use a command from the serial port. Such command is temporary (only lasts 30 seconds): so, it must be acknowledged continuously if you want to keep the GCB open. To send the commands you need to write in sequence (within 5 seconds):
  - HOLDING REGISTER 101: enter the password configured with the parameter P.0004.
  - HOLDING REGISTER 102:
    - "31" or "32" to inhibit automatic power delivery (forces GCB open).
    - "33" to remove automatic power delivery inhibition.
- Inhibition for "GCB breaker not open" (**only GC400x**). In parallel plants among more than one genset, it can happen that the GCB breaker of a genset does not open when that genset has to be stopped. This is a dangerous situation, as the voltage of the other running gensets pulls the genset generator with "GCB not open". In this condition, although the stop command, the engine would keep on its rotation with eventual not supplied external services (oil pump or other). In these conditions, it is possible to prevent the closure of the GCB breakers of the other generators (P.0804), and also to force its opening in case they were already closed: the controller activates the "inhibition to the load" to prevent the closure (or to force the opening) of the GCB.

- Inhibition from MC100 controller (**only GC400x**). If GC400x is "checked" by MC100 (see doc. [8]), MC100 is able to activate the "inhibition to the load" to force the opening of the GCB breakers of all gensets.

9.7.9 MCB closure inhibition.

In all automatic operating modes of the controller, the MCB breaker can be forced open by certain causes, even if the operating logic of the system requires its closure. Here is a description of these causes.

- It is possible to use a digital input configured with the function DIF.2503 – "MCB closure inhibition". When this input is active, the controller commands the opening of the MCB, even if the mains is present and the generator is stopped. The opening of MCB will not result in the start of the generator and in the GCB closure.

This function is available in GC315 from the firmware version 1.51, in GC400 from version 2.16.

9.7.10 Communication and events

The controller records any change of the GCB and MCB breakers status in the events log, if enabled with bit 4 and 5 respectively, of the 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: open command
- EVT.1037: MCB closed.
- EVT.1038: MCB open.

The controller records any change of the change-over inhibition status in the events log, if it is enabled with bit 6 of the P.0441 parameter:

- EVT.1080: Change-over inhibition active (from the loads on the generator).
- EVT.1081: Change-over inhibition not active (from the loads on the generator).

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

- ST.064 - "Status of the GCB"
- ST.065 - "Status of the MCB"
- ST.066 - " Status of the MGCB"
- ST.068 - "GCB steady closing command".
- ST.069 - "Stable close command for MCB"
- ST.070 - "GCB under voltage coil command"
- ST.071 - "Impulse open command for GCB"
- ST.072 - "Impulse close command for GCB"
- ST.073 - "Minimum voltage coil command for MCB"
- ST.074 - "Impulsive opening command for MCB"
- ST.075 - " Impulsive close command for per MCB"

In addition, the controller makes available the generator automatic power delivery inhibition for the AND/OR logics by means of the following internal statuses:

- ST.088 - "Inhibition of the GCB closing from contact"
- ST.090 - "Inhibition of the GCB closing from serial port"

- ST.091: for GCB breaker not open".
- ST.093: for command from MC100 controller.

10 Anomalies

This chapter describes all the anomalies managed by the controller. Some act as protection 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.

Three types of anomalies are:

- **Warnings**: these anomalies do not require shutting the engine down. They point out to situations that are not dangerous at the moment, but the operator must take some action because, if ignored, they could degenerate in one of the following categories.
- **Downloading**: these anomalies have characteristics similar to the deactivations (see after). Not causing problems for the loads and for the generator though: in the parallel operation case, it is preferable that the opening of the power connection is performed only after that the power has been downloaded. This happens by means of the quick ramp of download. It is impossible by the way to restart the engine until when the anomaly has 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.
- **Failures**: 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.

Only GC400x, and GC400x up to version 01.36 (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). Discharges, deactivations and early warnings can be present.
  - A deactivation can be activated only if no alarms and deactivations are already active. Whereas, other early warnings and other discharges can be present.
  - For activating discharges, shutdowns, deactivations, or other discharges should not be present. Some other warnings can be active.
  - For activating an early warning shutdowns, deactivations or discharges should not be present. Some other warnings can be active.

Starting from version 02.00 of GC400x and 01.44 of Gc315x, 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 that purpose, in fact, you can configure an output of the controller with the feature DOF.3152 – "Outside siren". The output is controlled together with the inside beeper; the purpose is that of using a more powerful beeper or a lamp.
- Prompts the page S.02 ANOMALIES on the multifunction display. This page shows the numeric code and the current language text related to all active anomalies.
- It activates the flashing of the "ALARM" indicator light, if the anomaly belongs to the pre-alarm category, or it turns it on if the anomaly belongs to the category of discharges, deactivations or interlocks.
- If the anomaly is not a warning, the controller disconnects the generator from the load or from the parallel bars (with or without download of power) and stops the engine (with or without the cooling cycle).

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). Some deactivations or warnings can be active.

A deactivation can be activated only if no alarms and deactivations are already active. Some other warnings can be active.

To issue a warning, no interlock must be present. Some other warnings can be active.

After an anomaly the operator has three choices:

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

10.1 Silencing the horn

The operator can silence the horn:

- By pressing the ACK button. **This operation does not know the anomaly, which thus keeps on flashing on the display.**
- By a digital input configured with the function DIF.2002 (“Alarm acknowledgement command”). The acoustic horn is silenced when the input switches from “not active” to “active”.
- By using a command from the serial port. The commands can be password protected (P.0004) which has to be sent before any command and can be disabled through a digital input (DIF.2706). To send the command you need to write in sequence (within 5 seconds):
  - HOLDING REGISTER 101: enter the password configured with the parameter P.0004.
  - HOLDING REGISTER 102: enter the value “51”.

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

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

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

10.2 Acknowledging anomaly

The operator can “acknowledge” the anomaly (sequence ISA2C) in three ways:

- By pressing the ACK button on controller panel. If we press this button with horn on, it silences the horn: it is necessary to press it a second time to acknowledge the anomaly.
- By a digital input configured with the function DIF.2002 (“Alarm acknowledgement command”). The acoustic horn is silenced when the input switches from “not active” to “active”.
- By using a command from the serial port. The commands can be password protected (P.0004) which has to be sent before any command and can be disabled through a digital input (DIF.2706). To send the command you need to write in sequence (within 5 seconds):
  - HOLDING REGISTER 101: enter the password configured with the parameter P.0004.
  - HOLDING REGISTER 102: enter the value “52”. Note: this command also silences the horn, if active.

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

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

10.3 Acknowledging anomaly

An anomaly can be cancelled only if the cause of it is no more present.

The anomalies of pre-alarm type are automatically cancelled from the controller (after being acknowledged) when their cause is no more present.

To cancel the unloads, the deactivations and the failures, it is necessary to proceed in one of these ways:

- By putting the controller in OFF/RESET mode.
- By using a command from the serial port. To send the command you need to write in sequence (within 5 seconds):
  - HOLDING REGISTER 101: enter the password configured with the parameter P.0004.
  - HOLDING REGISTER 102: enter the value “53”.
- Using a digital input configured with the feature DIF.2001 - “Alarm reset command”. When the input becomes active, the controller executes a reset of all anomalies.
- Using a “SMS” command (see doc. [2]).

10.4 Communication and events

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

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

- DOF.3151 (“reset of anomalies”). The controller activates this output for one second when the internal sequence of cancelation anomalies is performed. This procedure can be used to also cancel eventual anomalies managed externally from other devices.
- DOF.3152 (“external horn”). This output is activated and deactivated together with the internal horn. It can be used to command a more powerful horn 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 - “Pre-alarms”. The output is “active” if there is at least one pre-alarm.
- DOF.4002: The output is active if there is at least one downloading.
- DOF.4003: The output is active if there is at least one deactivation.
- DOF.4004 - The output is active if there is at least one failure.
- DOF.4005: The output is active if there is at least one failure. One deactivation or one downloading.
- DOF.4031: The output is active if there is at least one anomaly related to the generator.
- DOF.4032: The output is active if there is at least one anomaly related to the engine.
- DOF.4033: The output is active if there is at least one anomaly related to the speed controller.
- DOF.4034: The output is active if there is at least one anomaly related to the fuel.
- DOF.4035: The output is active if there is at least one anomaly related to the breakers.

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

- ST.008 - "Pre-alarm cumulative"
- ST.009: The output is active if there is at least one downloading.

- ST.010 - "Deactivations cumulative"
- ST.011 - "Interlocks cumulative"
- ST.012 - "Unacknowledged warnings cumulative"
- ST.013: The output is active if there is at least one not acknowledged downloading.
- ST.014 - "Unacknowledged deactivations cumulative"
- ST.015 - "Unacknowledged interlocks cumulative"

10.5 Protection OVERRIDE

WARNING: the use of these functions can bring the engine to serious damages. Mecc Alte cannot be considered responsible for any malfunction or damages to persons and/or things occurred following to the use OVERRIDE functions.

With this term we define the ability of the controller to temporarily disable (in particular conditions and on explicit request) a series of protections. The OVERRIDE function, when activated, transforms a series of failures into simple "pre-alarms" deactivations and unloads: in this way the controller signals the presence of problems, but it does not limit the genset supply. In some situations, in effect, the load supply is privileged compared to the safeguard of the engine itself. Just think about the hospitals: sometimes it is preferable to damage an engine, but keeping on supplying energy as long as possible, then preserve the engine and let the operating rooms in the dark.

The controller manages three different requests of protection OVERRIDE, all activable through digital inputs. Use the following functions for the configuration of the digital inputs:

- DIF.2062 ("Override of engine protections").
- DIF.2063 ("complete Override of protections").
- DIF.2064 ("Override of genset protections").

Each OVERRIDE function transforms in "pre-alarms" a specific set of failure/deactivations/downloads.

In addition to what in the table, the OVERRIDE function also affects the generic anomalies related to the analogue and digital inputs. The following functions for the configuration of digital inputs activate some anomalies which are subject to OVERRIDE of the engine protections and also to the complete OVERRIDE:

- DIF.4012 - "downloading (after oil delay)" (**only GC400x**).
- DIF.4013 - "deactivation (after oil delay)".
- DIF.4014 - "failure (after oil delay)".
- DIF.4062 - "downloading (subject to OVERRIDE)" (**only GC400x**).
- DIF.4063 - "deactivation (subject to OVERRIDE)".
- DIF.4064 - "failure (subject to OVERRIDE)".

As for the protections activated through the thresholds on analogue measures, it is possible to let such anomalies subject to OVERRIDE of engine protections (and also to complete OVERRIDE) through bit 15 of the parameter of threshold configuration (P.4005 for the first threshold on the first analogue input).

The controller shows a message on page "S.01" when one of these OVERRIDE functions is active. Attention: the engine electronic control unit can manage in first person the requests of OVERRIDE. In this case, they are already the ECU which do not stop the engine in case of anomalies. They normally signal the OVERRIDE active status on the CAN-BUS CAN0: the controller also displays this status of OVERRIDE on page S.01.

The controller registers an event every time that a request of OVERRIDE is activated (EVT.1082). In addition, it registers an event in the historic log every time that all requests of OVERRIDE end (EVT.1083).

The controller manages a separate counter of the working hours when this OVERRIDE mode is activated.

10.6 Anomalies related to digital inputs

The controller manages a remarkable number of digital inputs, also considering the expansion modules (DITEL) which is able to manage. Each input can be used to activate anomalies. These anomalies are of two kinds:

- **Specific**. They are configured with functions DIF.4211 and following. The controller knows the way these anomalies have to be managed and has already error pre-defined messages (not configurable) related to each anomaly.
- **General**. They are configured with functions from DIF.4001 to DIF.4064. For these anomalies, the operator must configure the message which will have to be shown on the display. Also, using the suitable functions, the controller can be taught on how to manage the anomaly.

The specific anomalies will be described in the following paragraphs: in the description we will always refer to the parameters related to the digital input #1 of the controller (P.2001, P.2002 and P.2003).

What said is also valid for the generic anomalies. They will not be described in the next paragraphs, as they would be a repetition of the same description for each input. They are described here instead, mentioning the parameters for input #1 of the controller.

The controller assigns the numeric codes from 701 to 774 to the generic anomalies related to the digital inputs. Using the parameter which configures the function (P.2001), it is possible to select the type of anomaly (pre-alarm, downloading, deactivation and clock) and also to define the conditions in which the anomaly has to be managed. Attention: by setting the delay to “0”, the anomaly is disabled. In the following list the functions for the configuration of digital inputs used to manage the generic anomalies are listed. They are gathered in groups of 4: the four functions for each group define the type of anomaly.

- DIF.4001, DIF.4002, DIF.4003, DIF.4004. The controller activates this anomaly if the digital input remains active consecutively for the time configured (P.2002).
- DIF.4011, DIF.4012, DIF.4013, DIF.4014. The anomaly can be activated only if the engine has been activated by the controller and if it is running at least for the time configured in P.0216 (“time engine protection mask”). The controller activates these anomalies if the digital input remains active consecutively for the time configured (P.2002).
- The anomaly is subject to the OVERRIDE of the engine protections and also to the complete OVERRIDE complete (see 10.5).
- DIF.4021, DIF.4022, DIF.4023, DIF.4024. The anomaly can be activated only if the GCB breaker is closed. The controller activates these anomalies if the digital input remains active consecutively for the time configured (P.2002).
- DIF.4031, DIF.4032, DIF.4033, DIF.4034. The anomaly can be activated only if the fuel electro-valve is open (FUEL, see 9.6.2). The controller activates these anomalies if the digital input remains active consecutively for the time configured (P.2002).
- DIF.4041, DIF.4042, DIF.4043, DIF.4044. The anomaly can be activated only if the GAS electro-valve is open (GAS, see 9.6.2). The controller activates these anomalies if the digital input remains active consecutively for the time configured (P.2002).
- DIF.4051, DIF.4052, DIF.4053, DIF.4054. The controller activates these anomalies if the digital input remains active consecutively for the time configured (P.2002). The activation of the anomaly causes the stop of the fuel pump. (see 11.1).
- DIF.4062, DIF.4063, DIF.4064. The controller activates these anomalies if the digital input remains active consecutively for the time configured (P.2002). The anomaly is subject to the OVERRIDE of the engine protections and also to the complete OVERRIDE complete (see 10.5).

10.7 Anomalies related to analogue inputs

The controller can manage a high number of analogue inputs, also considering those acquired from the expansion modules DIGRIN, DITHERM and DIVIT.

For each analogue input it is possible to set two thresholds on the acquired measure and each threshold can activate an anomaly. These anomalies are generic, as the controller does not know how they have to be managed. And does not have pre-defined alarm messages. They will not be described in the next paragraphs as they would be repetitions on the same description for each analogue input. They are described here instead, mentioning the parameters for input 1.

The controller assigns the numeric codes from 305 to 432 to the generic anomalies related to the analogue inputs.

The operator has first of all to configure the error message which will be displayed on the controller when the anomaly is active. He has to use parameter P.4002, unique for the two thresholds. The controller will add a starting writing 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, six parameters are then available, to manage the thresholds, three for each threshold (P.4003, P.4004 and P.4005 for the first threshold of the first analogic input; P.4006, P.4007 and P.4008 for the second threshold of the first analogic input).

In addition to the threshold value (P.4003 or P.4006) and to the delay to be managed (P.4004 or P.4007), the operator must configure the operations related to the threshold (P.4005 or P.4008). The parameter which configures the actions is bit managed (each bit enables/disables a function related to the threshold). For the description of these paragraphs see 5.11.3.

Attention: setting the delay to "0", the anomaly **is not disabled.**

10.8 Anomalies list

NOTE: since you cannot define in advance neither which digital or ANALOGUE inputs (those from the controller or from the additional modules) will be used, nor what function will they perform, the list below refers, as an example, to the parameters of the first configurable input. The symbol **(*)** or the indication "or equivalent for the other inputs" next to a parameter show that the same varies according to the particular input configured.

We will use the words **enabling** and **activation**:

- "Enabling an anomaly" means having the minimum conditions necessary in order for the controller to observe the cause.
- "Activation of an anomaly" means having the cause, after the happened enabling.

01 – Minimum generator voltage

Type:	**Deactivation**
Category:	**Load protection**
Related parameters:	**P.0101** Generator voltages wiring **P.0102** Nominal voltage of the generator **P.0202** Generator measures hysteresis **P.0301** Under voltage threshold **P.0302** Under voltage delay **P.0328** Enables checks including on the phase voltages
To disable:	**P.0302=0**
Enabled in:	**MAN*, AUTO, TEST, REMOTE START**

This protection is only enabled if the engine has been started by the controller (if the command for the fuel solenoid is activated) It is enabled the first time (from engine start) the generator's frequency and voltages enter the tolerance

range (see generator sequence description). It is enabled if, under the conditions previously mentioned, at least one of the generator voltages is continuously below the threshold P.0301 for the time P.0302.

* In **MAN** it is only enabled if the GCB breaker is closed or if the Bit2 of parameter P.0249 is set to "1".

Remark: if generator or complete protections override function is enabled, this anomaly becomes a warning.

02 – Maximum generator voltage

Type: **Alarm**

Category: **Load/generator protection**

Related parameters: **P.0101** Generator voltages wiring
P.0102 Nominal voltage of the generator
P.0202 Generator measures hysteresis
P.0303 Maximum voltage threshold
P.0304 Maximum voltage delay
P.0328 Enables checks including on the phase voltages

To disable: **P.0304=0**

Enabled in: **MAN, AUTO, TEST, REMOTE START**

This protection is only enabled if the engine has been started by the controller (if the command for the fuel solenoid is activated) It is enabled if, under the conditions previously mentioned, at least one of the generator voltages exceeds continuously the threshold P.0303 for the time P.0304.

Remark: if generator or complete protections override function is enabled, this anomaly becomes a warning.

03 – Minimum generator frequency

Type: **Deactivation**

Category: **Load protection**

Related parameters: **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**

This protection is only enabled if the engine has been started by the controller (if the command for the fuel solenoid is activated) It is enabled the first time (from engine start) the generator's frequency and voltages enter the tolerance range (see generator sequence description). It is enabled if, under the conditions previously mentioned, the generator frequency is continuously below the threshold P.0305 for the time P.0306.

* In **MAN** it is only enabled if the GCB breaker is closed or if the Bit2 of parameter P.0249 is set to "1".

Remark: if generator or complete protections override function is enabled, this anomaly becomes a warning.

04 – Maximum generator frequency

Type: **Alarm**

Category: **Load/generator protection**

Related parameters: **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**

This protection is only enabled if the engine has been started by the controller (if the command for the fuel solenoid is activated) It is enabled if, under the conditions previously mentioned, the generator frequency exceeds continuously the threshold P.0307 for the time P.0308.

Remark: if generator or complete protections override function is enabled, this anomaly becomes a warning.

05 – Belt break (D+ battery-charger failure)

Type: **Configurable (Alarm/Warning)**

Category: **Engine protection**

Related parameters: **P.4041** Feature for ANALOGUE input (D+)
P.0230 Threshold for stopped engine (D+)
P.0231 Threshold for running engine (D+)
P.0357 Action for belt break
P.0349 Delay for belt break

To disable: **P.0349=0**

Enabled in: **MAN, AUTO, TEST, REMOTE START**

This protection is only enabled if the controller is configured to use the D+ signal (P.4041 = AIF.1300 - “D+ Signal”) and if said signal is physically connected to the JL connector.

The protection is enabled if the engine was started from the controller (if the command for fuel solenoid is activated). It is activated if the D+ signal voltage is continuously below threshold P.0230 for time P.0349.

Remark: if engine’s protections override function is enabled, this anomaly becomes a warning.

06 – Maximum current

Type: **Configurable (Alarm/Deactivation)**

Category: **Generator protection**

Related parameters: **P.0101** Generator voltages wiring
P.0102 Generator rated voltage
P.0106 Generator rated output
P.0309 Maximum current threshold
P.0310 Maximum current delay
P.0323 Action for maximum current and short circuit
P.0324 Protections enabling 50V-51V

To disable: **P.0310=0**

Enabled in: **MAN, AUTO, TEST, REMOTE START**

GC315 performs a time-dependent current protection (therefore, the higher the current overload, the shorter the reaction time). The curve used is called EXTREMELY INVERSE with function I^2t. 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. In order to correctly set the thresholds, perform the following steps:

- Define the system rated current. It can be inferred from the system rated output (P.0106 kVA generator rated output) and rated voltage (P.0102 Genset rated voltage):
  - Single-phase system: $$I_{nom} = \frac{P.0106 \times 1000}{P.0102}$$
  - Bi/Three-phases system: $$I_{nom} = \frac{\left[{}^{(P.0106 \times 1000)}/_{3}\right]}{\left({}^{P.0102}/_{\sqrt{3}}\right)}$$

    For example, on the three-phase system at 400 V out of 200 kVA, the rated current is approximately 289 A.

    When the parameter P.0106 kVA generator rated output, is set after correct configuration of parameters P.0101 “Generator voltages wiring” and P.0102 “Generator rated voltage”, the display shows the rated current.
- Set the maximum current threshold with the parameter P.0309, as a percentage of the rated current. In the previous example, setting a 350 A maximum threshold, requires entering 121 (%) in parameter P.0309.
- 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 $\sqrt{2}$. In the previous example, if you set 10 s, the protection will activate in10 seconds with approx. 495 A of constant load; in a shorter time if the current is higher; in a longer time if the current is lower; and it will never do if the current is lower than 350 A.

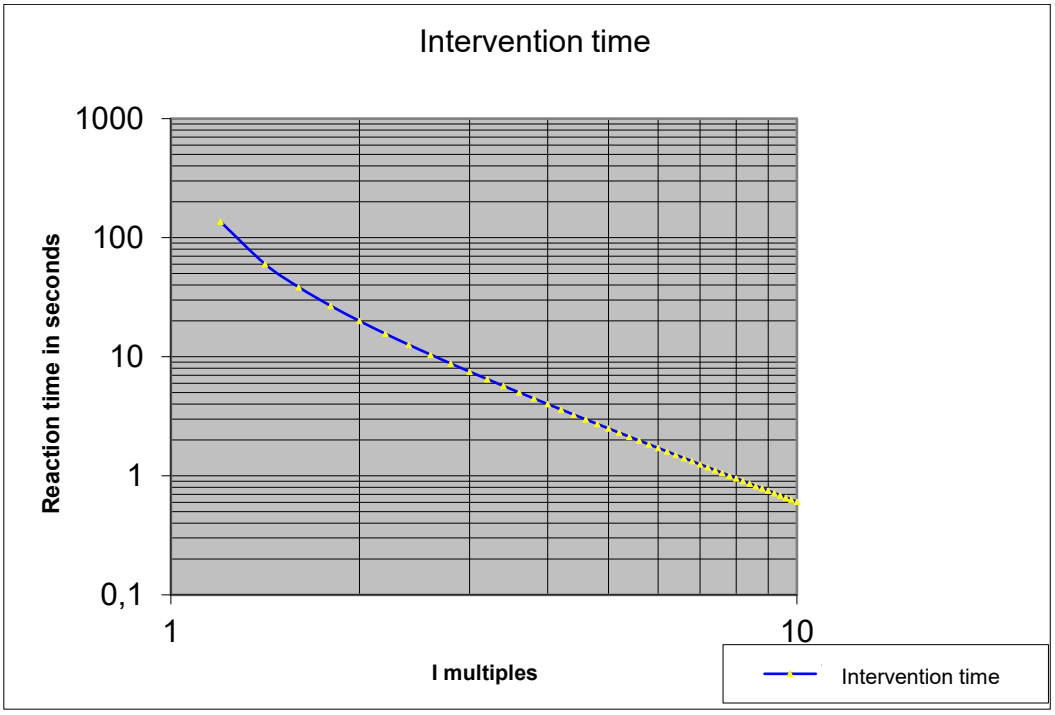
In order to calculate the intervention time for a set current, please use the following formula:

$$t_1 = \frac{P.0310}{\left(\frac{I}{P.0309}\right)^2 - 1}$$

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.

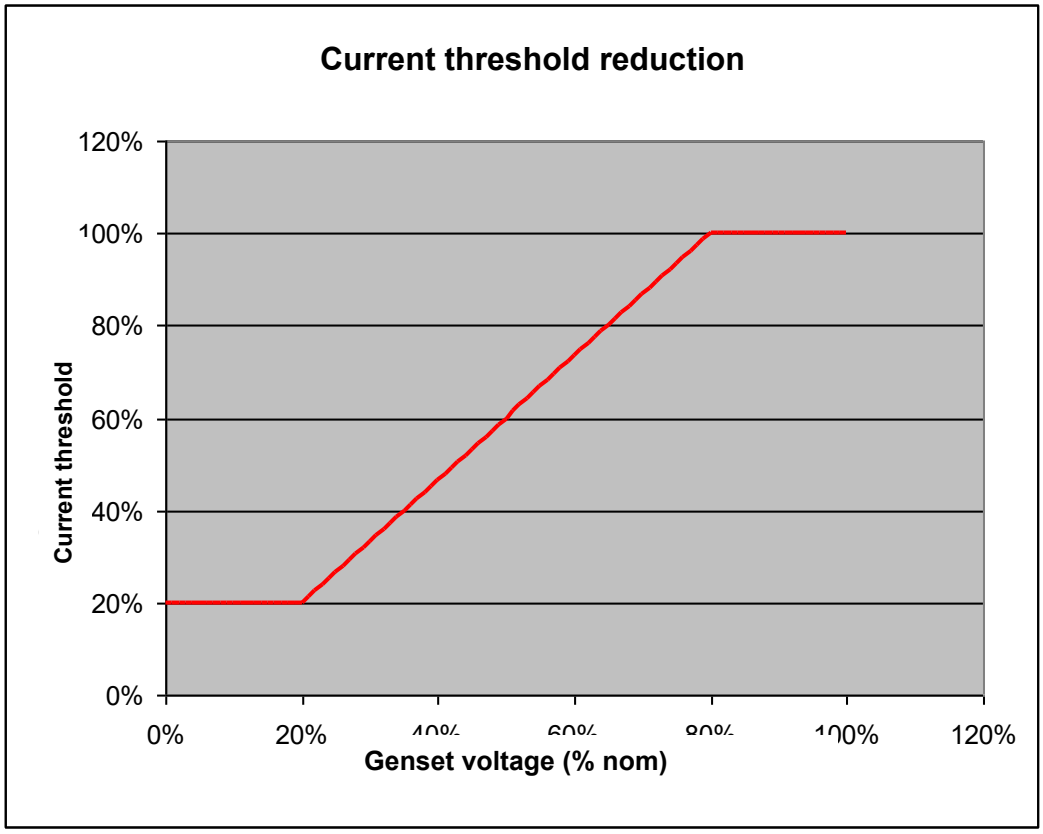
The following graph shows the curve used for enabling protection, with a value of P.0310 set to 60 seconds (I is the maximum current):



This protection is only enabled if the engine has been started by the controller (if the command for the fuel solenoid is activated) Type is configurable with parameter P.0323 (though it cannot be configured as warning).

In electrical engineering, this protection is known as protection “51”. Using the parameter P.0324, it is possible to convert this protection in protection “51V”. Protection “51V” is identical with protection “51”, but it involves a percentage reduction of the current threshold if the generator voltage drops below its rated. 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.



To activate protection “51V” instead of “51”, you need to set parameter P.0324 to 2 or 3.

Remark: if generator or complete protections override function is enabled, this anomaly becomes a warning.

07 – Manual stop while in AUTO

Type: **Alarm**

Category: **Generic**

Related parameters: **P.0495** Keyboard options

To disable: **bit 0 of P.0495=1**

Enabled in: **AUTO, TEST, REMOTE START**

This protection is always enabled for stop command through the serial ports or via SMS, and it can be disabled for the “STOP” button by setting the bit 0 of the parameter P.0495.

It is activated when pressing the “STOP” button on the front panel or sending a stop command through the serial port or via SMS, while in AUTO, TEST or REMOTE START mode.

08 – Operating conditions failure

Type: **Alarm**

Category: **Generic**

Related parameters: **P.0217** Maximum time for operating conditions

To disable: **P.0217=0**

Enabled in: **AUTO, TEST, REMOTE START**

This protection is only enabled if the engine has been started by the controller (if the command for the fuel solenoid is activated). 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).

For GC315 the protection is also enabled in MAN mode if parameter P.0802 is set to "11 - DRIVE". In this case the voltage thresholds are not used and the frequency thresholds are applied to the rated engine speed.

Remark: if generator or complete protections override function is enabled, this anomaly becomes a warning.

11 – Power reverse

Type: **Alarm**

Category: **Generator protection**

Related parameters: **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**

This protection 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 activates if, in the previous conditions, the system total active power is negative and has an absolute value continuously above threshold P.0313, for time P.0314.

The parameter P.0313 Power reverse threshold is expressed as a percentage of parameter P.0125 Engine rated output.

The protection is not active if the controller is measuring the output when the loads are connected to the mains.

Remark: if generator or complete protections override function is enabled, this anomaly becomes a warning.

13 – Mains circuit breaker (MCB) not closed

Type: **Warning**

Category: **Generic, load protection**

Related parameters: **P.2001** Feature of the input 1 or equivalent for the other inputs
P.2002 Delay for the input 1 or equivalent for the other inputs

To disable: **P.2002 =0**

Enabled in: **MAN, AUTO, TEST, REMOTE START**

This protection is enabled only when one of the digital inputs of the controller is configured to acquire the MCB status (feature DIF.3002 - "MCB breaker status" in parameter P.2001 or equivalent for the other inputs) and if a time other than zero has been set for said input (parameter P.2002 or equivalent). It activates only when MCB is commanded to close (relay in standby) and the status acquired is continuously "not active" (open) for the time set.

After this warning is issued, you can also force the engine to start and the loads to change-over to the genset by using the P.0221 parameter (Enabling power delivery for MCB fault)

14 – Genset circuit breaker (GCB) not closed

Type: **Deactivation/Warning**

Category: **Generic**

Related parameters: **P.2001** Feature of the input 1 or equivalent for the other inputs
P.2002 Delay for the input 1 or equivalent for the other inputs

To disable: **P.2002 =0**

Enabled in: **MAN, AUTO, TEST, REMOTE START**

This protection is enabled only when one of the digital inputs of the controller is configured to acquire the GCB status (feature DIF.3001 - "GCB breaker status" in parameter P.2001 or equivalent for the other inputs) and if a time other than zero has been set for said input (parameter P.2002 or equivalent). It activates only when GCB is commanded to close (relay operating) and the status acquired is continuously "not active" (open) for the time set. It only operates as warning, no automatic change-over to the mains is provided.

15 – Overload (from contact)

Type: **Alarm**

Category: **Generator protection**

Related parameters: **P.2001** Feature of the input 1 or equivalent for the other inputs
P.2002 Delay for the input 1 or equivalent for the other inputs

To disable: **P.2002 =0**

Enabled in: **MAN, AUTO, TEST, REMOTE START**

This protection is enabled only when one of the digital inputs of the controller is configured to acquire the external overload contact (feature DIF.4241 - "Overload (from contact)" in parameter P.2001 or equivalent for the other inputs) and if a time other than zero has been set for said input (parameter P.2002 or equivalent). Active if the configured input remains continuously active for the associated time.

Remark: if generator or complete protections override function is enabled, this anomaly becomes a warning.

16 – Short circuit on the generator

Type: **Configurable (Alarm/Deactivation)**

Category: **Generator protection**

Related parameters: **P.0101** Generator voltages wiring
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

To disable: **P.0312 =0**

Enabled in: **MAN, AUTO, TEST, REMOTE START**

In addition to the maximum current protection, the GC315 also provides a short circuit protection for quick intervention independently of timing for the maximum current protection curve. Protection is given by setting a threshold (P.0311) expressed as a percentage of the system rated current (see maximum current protection to calculate rated current with parameters P.0101, P.0102 and P.0106). 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 activates when the current on at least one phase remains continuously above the P.0311 threshold for time P.0312. Type is configurable with parameter P.0323 (though it cannot be configured as warning).

In electrical engineering, this protection is known as protection “51”. Using the parameter P.0324, it is possible to convert this protection in protection “51V”. Protection “51V” is identical with protection “51”, but it involves a percentage reduction of the current threshold if the generator voltage drops below its rated (see anomaly description “06 – Maximum current”). To activate protection “51V” instead of “51”, you need to set parameter P.0324 to 1 or 3.

Remark: if generator’s protections override function is enabled, this anomaly becomes a warning.

17 – Overspeed (from contact)

Type: **Alarm**

Category: **Engine protection**

Related parameters: **P.2001** Feature of the input 1 or equivalent for the other inputs
P.2002 Delay for the input 1 or equivalent for the other inputs

To disable: **P.2002 =0**

Enabled in: **MAN, AUTO, TEST, REMOTE START**

This protection is enabled only when one of the digital inputs of the controller is configured to acquire the external overspeed contact (feature DIF.4251 - “Overspeed (from contact)” in parameter P.2001 or equivalent for the other inputs) and if a time other than zero has been set for said input (parameter P.2002 or equivalent). 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. Active if the configured input remains continuously “active” for the configured time.

18 – Overspeed (from engine speed measurement)

Type: **Alarm**

Category: **Engine protection**

Related parameters: **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**

This protection is enabled only if the controller acquires the measure of the engine speed; it can acquire it through its pick-up input (JM_05, P.0110 other than zero) or through its input W (JM_07, P.0111 other than zero), from generator frequency (P.0127 other than zero) or, finally, from CAN-BUS (P.0700 other than zero). 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 activates if the acquired speed measure exceeds threshold P.0333 continuously, for time P.0334.

19 – Overspeed (from generator frequency)

Type: **Alarm**

Category: **Engine protection**

Related parameters: **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**

This protection 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 activates if the generator frequency exceeds threshold P.0331 continuously, for time P.0332.

NOTE: Parameter P.0331 is expressed in percentage with respect to P.0105.

21 – Failed stop

Type: **Alarm**

Category: **Generic**

Related parameters: **P.0214 Duration of stopping cycle(s)**

To disable: **P.0214 =0**

Enabled in: **AUTO, TEST, REMOTE START**

This protection is only enabled if the engine has been started by the controller (if the command for the fuel solenoid is activated). It activates if the engine does not stop within the time set in P.0214 (since the stop command).

This interlock can be activated even if another one is already active.

Remark: if complete protections override function is enabled, this anomaly becomes a warning.

22 – Over crank

Type: **Alarm**

Category: **Battery protection**

Related parameters: **P.0211 Number of start attempts**

To disable: **-**

Enabled in: **AUTO, TEST, REMOTE START**

This protection is always enabled. It activates if the controller has performed P.0211 consecutive engine start attempts (auto start) without success (engine running).

23 – Mains circuit breaker (MCB) not open

Type: **Deactivation/Warning**

Category: **Generic**

Related parameters: **P.2001** Feature of the input 1 or equivalent for the other inputs
P.2002 Delay for the input 1 or equivalent for the other inputs

To disable: **P.2002 =0**

Enabled in: **MAN, AUTO, TEST, REMOTE START**

This protection is enabled only when one of the digital inputs of the controller is configured to acquire the MCB status (feature DIF.3002 - "MCB breaker status" in parameter P.2001 or equivalent for the other inputs) and if a time other than zero has been set for said input (parameter P.2002). It activates only when MCB is commanded to open (relay operating) and the status acquired is continuously "active" (closed) for the time set. In auto mode it activates after three consecutive attempts. It can be:

- Deactivation: when the controller is in one of the AUTO modes and if the stable command is used for MCB closing (feature DOF.2004 in one of the digital outputs).
- Warning: for all other events.

24 – Genset circuit breaker (GCB) not open

Alarm/Warning

Category: **Generic**

Related parameters: **P.2001** Feature of the input 1 or equivalent for the other inputs
P.2002 Delay for the input 1 or equivalent for the other inputs

To disable: **P.2002 =0**

Enabled in: **MAN, AUTO, TEST, REMOTE START**

This protection is enabled only when one of the digital inputs of the controller is configured to acquire the GCB status (feature DIF.3001 - "GCB breaker status" in parameter P.2001 or equivalent for the other inputs) and if a time other than zero has been set for said input (parameter P.2002 or equivalent). It activates only when GCB is commanded to open (relay on standby) and the status acquired is continuously "active" (closed) for the time set. In auto mode it activates after three consecutive attempts. It can be:

- **Alarm**: when the controller is in AUTO mode with engine running and only if the stable command is used for GCB closing (function DOF.2034 in one of the digital outputs).
- **Warning**: for all other events.

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**.

25 – Minimum fuel level (from contact)

Type: **Alarm/Warning**

Category: **Generic**

Related parameters: **P.2001** Feature of the input 1 or equivalent for the other inputs
P.2002 Delay for the input 1 or equivalent for the other inputs

To disable: **P.2002 =0**

Enabled in: **MAN, AUTO, TEST, REMOTE START**

This protection is disabled in the engine start/arrest phases. This protection is enabled only when one of the digital inputs of the controller is configured to acquire the minimum fuel level contact of the float (feature DIF.4211 - "Minimum fuel level" in parameter P.2001 or equivalent for the other inputs) and if a time other than zero has been set for said input (parameter P.2002 or equivalent). Active if the configured input remains continuously active for the associated time.

Remark: if engine's protections override function is enabled, this anomaly becomes a warning.

26 – Minimum fuel level (from ANALOGUE sensor)

Type: **Alarm/Warning**

Category: **Generic**

Related parameters: **P.4033 Function of the input 5(FL)** Fuel level (VDO)/Fuel level (generic)
P.0347 Minimum fuel level threshold (%)
P.0348 Minimum fuel level delay

To disable: **P.0348 =0**

Enabled in: **MAN, AUTO, TEST, REMOTE START**

This protection is disabled in the engine start/arrest phases. It is enabled only when the controller is configured to use an ANALOGUE fuel level sensor (P.4033 suitably configured), or if said sensor is physically connected to the JM connector. It activates if the level measure remains continuously below or equal to threshold P.0347 (in percentage) for time P.0348.

Remark: if engine's protections override function is enabled, this anomaly becomes a warning.

27 – Low fuel level (from contact)

Type: **Warning**

Category: **Generic**

Related parameters: **P.2001** Feature of the input 1 or equivalent for the other inputs
P.2002 Delay for the input 1 or equivalent for the other inputs

To disable: **P.2002 =0**

Enabled in: **MAN, AUTO, TEST, REMOTE START**

This protection is disabled in the engine start/arrest phases. It is enabled only when one of the digital inputs of the controller is configured to acquire the low fuel level contact of the float (feature DIF.4212 - “Low fuel level” in parameter P.2001 or equivalent for the other inputs) and if a time other than zero has been set for said input (parameter P.2002 or equivalent). Active if the configured input remains continuously active for the associated time.

28 – Low fuel level (from ANALOGUE sensor)

Type: **Warning**

Category: **Generic**

Related parameters: **P.4033 (*) Feature for input 5 (FL)** Fuel level (VDO) / General fuel level or equivalent parameter for the other inputs
P.0345 Low fuel level threshold (%)
P.0346 Low fuel level delay

To disable: **P.0346 =0**

Enabled in: **MAN, AUTO, TEST, REMOTE START**

This protection is disabled in the engine start/arrest phases. It is enabled only when the controller is configured to use the ANALOGUE fuel level sensor (P.4033 suitably configured), or if said sensor is physically connected to the JM connector. It activates if the level measure remains continuously below or equal to threshold P.0345 (in percentage) for time P.0346.

29 – High fuel level (from contact)

Type: **Warning**

Category: **Generic**

Related parameters: **P.2001** Feature of the input 1 or equivalent for the other inputs
P.2002 Delay for the input 1 or equivalent for the other inputs

To disable: **P.2002 =0**

Enabled in: **MAN, AUTO, TEST, REMOTE START**

This protection is disabled in the engine start/arrest phases. It is enabled only when one of the digital inputs of the controller is configured to acquire the high fuel level contact of the float (feature DIF.4213 - “High fuel level” in parameter P.2001 or equivalent for the other inputs) and if a time other than zero has been set for said input (parameter P.2002 or equivalent). Active if the configured input remains continuously active for the associated time.

30 – High fuel level (from ANALOGUE sensor)

Type: **Warning**

Category: **Generic**

Related parameters: **P.4033 (*) Feature for input 5 (FL)** Fuel level (VDO) / General fuel level or equivalent parameter for the other inputs
P.0343 High fuel level threshold (%)
P.0344 High fuel level delay

To disable: **P.0344 =0**

Enabled in: **MAN, AUTO, TEST, REMOTE START**

This protection is disabled in the engine start/arrest phases. It is enabled only when the controller is configured to use the ANALOGUE fuel level sensor (P.4033 suitably configured), or if said sensor is physically connected to the JM connector. It activates if the level measure remains continuously above or equal to threshold P.0343 (in percentage) for time P.0344.

31 – High coolant temperature (from contact)

Type: **Warning**

Related parameters: **P.2001** Feature of the input 1 or equivalent for the other inputs
P.2002 Delay for 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**

This protection is enabled only when one of the digital inputs of the controller is configured to acquire the external high coolant temperature contact (feature DIF.4231 - “High coolant temperature” in parameter P.2001 or equivalent for the other inputs) and if a time other than zero has been set for said input (parameter P.2002 or equivalent). 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 activates if the input configured is continuously “active” for the time configured, but only after the time P.0216 (oil mask) from engine start has elapsed (this is to allow you to start the engine idle, to cool it off).

32 – High coolant temperature (from ANALOGUE sensor)

Type: **Warning**

Category: **Engine protection**

Related parameters: **P.4025 (*)** Feature for ANALOGUE input 4 (CT) or equivalent parameter for the 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**

This protection is enabled only if the controller acquires the measure of the engine coolant temperature. It can acquire it from its input (JM_04, P.4025 suitably configured) or from CAN-BUS (P.0700 other than zero). 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 activates if the temperature remains continuously above or equal to threshold P.0335 for time P.0336, but only after the time P.0216 (oil mask) from engine start has elapsed (this is to allow you to start the engine idle, to cool it off).

33 – Maximum coolant temperature (from contact)

Type: **Alarm/Warning**

Category: **Engine protection**

Related parameters: **P.2001** Feature of the input 1 or equivalent for the other inputs
P.2002 Delay for 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**

This protection is enabled only when one of the digital inputs of the controller is configured to acquire the external maximum coolant temperature contact (feature DIF.4231 - “Maximum coolant temperature” in parameter P.2001 or equivalent for the other inputs) and if a time other than zero has been set for said input (parameter P.2002 or equivalent). 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 activates if the input configured is continuously “active” for the time configured, but only after the time P.0216 (oil mask) from engine start has elapsed (this is to allow you to start the engine idle, to cool it off)

Remark: if engine’s protections override function is enabled, this anomaly becomes a warning.

34 – Maximum coolant temperature (from ANALOGUE sensor)

Type: **Alarm/Warning**

Category: **Engine protection**

Related parameters: **P.4025 (*)** Feature for ANALOGUE input 4 (CT) or equivalent parameter for the 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**

This protection is enabled only if the controller acquires the measure of the engine coolant temperature. It can acquire it from its input (JM_04, P.4025 suitably configured) or from CAN-BUS (P.0700 other than zero). 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 activates if the temperature remains continuously above or equal to threshold P.0337 for time P.0338, but only after the time P.0216 (oil mask) from engine start has elapsed (this is to allow you to start the engine idle, to cool it off)

Remark: if engine’s protections override function is enabled, this anomaly becomes a warning.

35 – Maximum oil temperature (from ANALOGUE sensor)

Type: **Alarm/Warning**

Category: **Engine protection**

Related parameters: **P.4025 (*)** Function of the ANALOGUE input 4 (CT)
P.0216 Engine protection 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**

This protection is enabled only if the controller acquires the measure of the engine oil temperature. It can acquire it from ANALOGUE input 4 (JM_04 - P.4025), or from ANALOGUE input 5 (JM_02 - P.4033), or from an input of the DITEMP expansions (configurable with feature AIF.1101 - "Oil temperature (general)" in parameter P.4131 or equivalent for the other inputs), or from CAN-BUS (P.0700 other than zero). 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 activates if the measure is continuously higher than or equal to the threshold P.0375 for time P.0376, but only after the time P.0216 (oil mask) since engine start has elapsed.

Remark: if engine's protections override function is enabled, this anomaly becomes a warning.

37 – Starter battery voltage, low

Type: **Warning**

Category: **Battery protection**

Related parameters: **P.0362** Low battery voltage threshold (%)
P.0363 Low battery voltage delay

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

Enabled in: **MAN, AUTO, TEST, REMOTE START**

It is always enabled except when the cranking motor is activated. It activates if the battery voltage is continuously lower than the threshold P.0362 for time P.0363.

The threshold P.0362 is expressed as a percentage of the rated battery voltage which is not configurable but is automatically selected by the controller between 12 e 24 Vdc. Selection is made when the controller is powered and every time it is forced in OFF/RESET mode. If the controller previously sensed a value lower than, or equal to, 17V, it considers to be powered by a 12V battery, otherwise it will consider a 24 V rated voltage.

38 – Starter battery voltage, high

Type: **Warning**

Category: **Battery protection**

Related parameters: **P.0364** High battery voltage threshold (%)
P.0365 High battery voltage delay

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

Enabled in: **MAN, AUTO, TEST, REMOTE START**

This protection is always enabled, except when the starter motor command is activated. It activates if the battery voltage is continuously above threshold P.0364 for time P.0365.

The threshold P.0364 is expressed as a percentage of the rated battery voltage which is not configurable but is automatically selected by the controller between 12 e 24 Vdc. Selection is made when the controller is powered and every time it is forced in OFF/RESET mode. If the controller previously sensed a value lower than, or equal to, 17V, it considers to be powered by a 12V battery, otherwise it will consider a 24V rated voltage.

39 – Service required (first counter)

Type: **Configurable (Warning/Alarm/Unload/Deactivation)**

Category: **Generic**

Related parameters: **P.0424** Maintenance interval (running hours)
P.0425 Kind of maintenance action

To disable: **P.0424 =0**

Enabled in: **MAN, AUTO, TEST, REMOTE START**

It activates after P.0424 engine running hours since parameter P.0424 was last set, by issuing a warning, or triggering a deactivation or an interlock, based on the settings of the P.0425 parameter. It cannot be cancelled even disconnecting the controller's power supply. Only possible setting P.0424 again, setting it to zero to disable the function or confirming the actual value or setting a new one.

Engine operating hours are counted even when engine is not started by the controller.

To be programmed, parameters P.0424 and P.0425 require “installer” access level: this function can be used for genset rental in order to lock the genset when the established hours are elapsed.

Note: if engine’s protections override function is enabled, this anomaly becomes a warning.

40 – Service required (second counter)

Type: **Configurable (Warning/Alarm/Unload/Deactivation)**

Category: **Generic**

Related parameters: **P.0436** Maintenance interval (running hours)
P.0437 Kind of maintenance action

To disable: **P.0436 =0**

Enabled in: **MAN, AUTO, TEST, REMOTE START**

It activates after P.0436 engine running hours since parameter P.0437 was last set, by issuing a warning, or triggering a deactivation or an interlock, based on the settings of the P.0437 parameter. It cannot be cancelled even disconnecting the controller's power supply. Only possible setting P.0436 again, setting it to zero to disable the function or confirming the actual value or setting a new one.

Engine operating hours are counted even when engine is not started by the controller.

To be programmed, parameters P.0436 and P.0437 require “installer” access level: this function can be used for genset rental in order to lock the genset when the established hours are elapsed.

Note: if engine's protections override function is enabled, this anomaly becomes a warning.

41 – Minimum oil pressure (from contact)

Type: **Warning/Alarm**

Category: **Engine protection**

Related parameters: **P.2001** Feature of the input 1 or equivalent for the other inputs
P.2002 Delay for 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**

This protection is enabled only when one of the digital inputs of the controller is configured to acquire the external minimum oil pressure contact (feature DIF.4221 - "Minimum oil pressure" in parameter P.2001 or equivalent for the other inputs) and if a time other than zero has been set for said input (parameter P.2002 or equivalent). 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 activates if the input configured is continuously "active" for the time configured, but only after the time P.0216 (oil mask) from engine start has elapsed (this is to allow you to ignore the normal status of low pressure, which occurs at start-up).

Remark: if engine's protections override function is enabled, this anomaly becomes a warning.

42 – Minimum oil pressure (from ANALOGUE sensor)

Type: **Warning/Alarm**

Category: **Engine protection**

Related parameters: **P.4017 (*)** Function of the ANALOGUE input 3 (OP)
P.0216 Engine protection mask time
P.0341 Minimum oil pressure threshold
P.0342 Minimum oil pressure delay
P.0700 Engine type

To disable: **P.0342 =0**

This protection is enabled only if the controller acquires the measure of the engine lubrication oil pressure. It can acquire it from its input (JM_03, P.4017 suitably configured) or from CAN-BUS (P.0700 other than zero). 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 activates if the pressure is continuously lower than or equal to threshold P.0341 for time P.0342, but only after the time P.0216 (oil mask) from engine start has elapsed (this is to allow you to ignore the normal status of low pressure, which occurs at start-up).

Note: if engine's protections override function is enabled, this anomaly becomes a warning.

43 – Low oil pressure (from contact)

Type: **Warning**

Category: **Engine protection**

Related parameters: **P.2001** Feature of the input 1 or equivalent for the other inputs
P.2002 Delay for 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**

This protection is enabled only when one of the digital inputs of the controller is configured to acquire the external low oil pressure contact (feature DIF.4222 - "Low oil pressure" in parameter P.2001 or equivalent for the other inputs) and if a time other than zero has been set for said input (parameter P.2002 or equivalent). 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 activates if the input configured is continuously "active" for the time configured, but only after the time P.0216 (oil mask) from engine start has elapsed (this is to allow you to ignore the normal status of low pressure, which occurs at start-up).

44 – Low oil pressure (from ANALOGUE sensor)

Type: **Warning**

Category: **Engine protection**

Related parameters: **P.4017 (*)** Feature for ANALOGUE input 3 (OP) or equivalent parameter for the 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**

This protection is enabled only if the controller acquires the measure of the engine lubrication oil pressure. It can acquire it from its input (JM_03, P.4017 suitably configured) or from CAN-BUS (P.0700 other than zero). 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 activates if the pressure is continuously lower than or equal to threshold P.0339 for time P.0340, but only after the time P.0216 (oil mask) from engine start has elapsed (this is to allow you to ignore the normal status of low pressure, which occurs at start-up).

45 – Maximum auxiliary current

Type: **Alarm**

Category: **Generic**

Related parameters: **P.0108** Primary of the CT for the auxiliary current
P.0140 Secondary of the CT for the auxiliary current
P.0131 Usage of auxiliary current
P.0367 Auxiliary current /neutral threshold
P.0368 Delay for auxiliary current/neutral

To disable: **P.0368 =0**

Enabled in: **MAN, AUTO, TEST, REMOTE START**

This protection is enabled only if the controller is configured to use the measurement input for the auxiliary/current neutral (parameters P.0131 other than zero). 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 activates if the auxiliary current value is continuously above threshold P.0367 for time P.0368.
You can disable this protection without having to change the parameters by activating a digital input configured with feature DIF.2704 - “Disable auxiliary current protections” (parameter P.2001 for input 1 or the equivalents for the other inputs).

NOTE: the protection does not work when the controller measures the mains currents.

Remark: if generator or complete protections override function is enabled, this anomaly becomes a warning.

48 – Emergency stop

Type: **Alarm**

Category: **Generic**

Related parameters: **P.0361** Delay for emergency shutdown

To disable: **-**

Enabled in: **MAN, AUTO, TEST, REMOTE START**

This protection is always enabled and cannot be disabled. It activates if the emergency shutdown input remains continuously “not active” for the time set in parameter P.0361 (if the value set is zero, the alarm is triggered as soon as the input becomes inactive).

It is possible to force the emergency stop alarm 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 activate the emergency stop alarm, 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 “99”.

49 – Maximum power

Configurable (Warning/Alarm/Unload/Deactivation)

Category: **Engine protection**

Related parameters: **P.0350** Maximum power threshold (percentage of P.0125)
P.0351 Maximum power delay
P.0352 Maximum power action

To disable: **P.0351 =0**

Enabled in: **MAN, AUTO, TEST, REMOTE START**

This protection is only enabled if the engine has been started by the controller (if the command for the fuel solenoid is activated). This protection is disabled in the engine start/arrest phases. It activates if the system total active power is positive and remains continuously over the threshold P.0350 for time P.0351. With parameter P.0352 it is possible to select the protection to be activated (warning, deactivation, alarm).

Note: the protection does not work when the controller measures the mains currents.

Note: if engine's protections override function is enabled, this anomaly becomes a warning.

50 – Service required (days counter)

Type: **Warning**

Category: **Generic**

Related parameters: **P.0438** = **0**

Enabled in: **MAN, AUTO, TEST, REMOTE START**

A warning is activated at 8:00 in the morning after P.0438 days have left since the P.0438 parameter has been set for the last time. It cannot be cancelled even if removing the power source controller. It can be cancelled only by confirming the current value or by setting a different one.

The days are counted even if the engine is stopped.

The P.0438 parameter requires the "installer" access level for the programming.

52 – Generator voltages asymmetry

Type: **Alarm**

Category: **Generator protection**

Related parameters: **P.0101** Generator voltages wiring
P.0102 Generator rated voltage
P.0315 Voltage's asymmetry threshold (% rated phase voltage)
P.0316 Voltage's asymmetry delay

To disable: **P.0316 =0**

Enabled in: **MAN, AUTO, TEST, REMOTE START**

This protection is only enabled if the system is bi-phase or three-phase and only if the engine has been started by the controller (if the command for the fuel solenoid is activated) and is disabled when the engine is started/stopped. In addition, generator voltage and frequency must be within the tolerance range. Threshold P.0315 is expressed as a percentage of the system rated voltage (phase voltage). It represents the maximum acceptable difference (absolute value) between two phase-to-phase voltages. It activates if the difference between two phase-to-phase voltages (absolute value) is continuously over the threshold P.0315 for time P.0316.

Remark: if generator or complete protections override function is enabled, this anomaly becomes a warning.

53 – Generator current asymmetry

Type: **Alarm**

Category: **Generator protection**

Related parameters: **P.0101** Generator voltages wiring
P.0102 Generator rated voltage

P.0106 Generator rated output
P.0317 Current asymmetry threshold (% rated current)
P.0318 Current asymmetry delay

To disable: **P.0318 =0**

Enabled in: **MAN, AUTO, TEST, REMOTE START**

This protection is only enabled if the system is bi-phase or three-phase and only if the engine has been started by the controller (if the command for the fuel solenoid is activated) and is disabled when the engine is started/stopped. In addition, the generator voltages and frequency must be within the tolerance range and the load must be changed-overt to the generator. Threshold P.0317 is expressed as percentage of the system rated current (refer to the details for maximum current protection to see how to obtain the rated current from P.0102 and P.0106). It represents the maximum acceptable difference (absolute value) between any two-phase currents. The protection activates if the difference between any two currents (absolute value) is continuously over the threshold P.0317 for time P.0318.

NOTE: the protection does not work when the controller measures the mains currents.

Remark: if generator or complete protections override function is enabled, this anomaly becomes a warning.

54 – High oil temperature (from ANALOGUE sensor)

Type: **Warning**

Category: **Engine protection**

Related parameters: **P.4025 (*)** Feature for ANALOGUE input 4 (CT) or equivalent parameter for the 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**

This protection is enabled only if the controller acquires the measure of the engine lubrication oil temperature. It can acquire it from input JM_4 or from any other input configured with the feature AIF.1100 - “VDO oil temperature” or AIF.1101 - “General oil temperature” or even from CAN-BUS (P.0700 other than zero). 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 activates if the temperature is continuously over the threshold P.0373 for time P.0374, but only after the time P.0216 (oil mask) since engine start has elapsed.

55 – Wrong phase sequence

Type: **Configurable (Warning/Alarm/Unload/Deactivation)**

Category: **Generator protection**

Related parameters: **P.0101** Generator voltages wiring
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**

It represents the maximum acceptable difference (absolute value) between any of two-phase currents. This protection is only enabled if the system is bi-phase or three-phase and only if the engine has been started by the controller (if the command for the fuel solenoid is activated) and is disabled when the engine is started/stopped. In addition, the generator voltages and frequency must be within the tolerance range and the load must be changed-overt to the mains

(it prevents load closing on the genset). Parameter P.0319 allows you to select the phases frequency required (0=disables feature, 1=clockwise rotation, 2=counter-clockwise rotation, 3=like the mains). The protection activates when the generator rotation direction does not match the one configured, with a 0.5 seconds filter time. When activated, it acts as warning, deactivation or alarm as configured with P.0320.

Remark: if generator or complete protections override function is enabled, this anomaly becomes a warning.

56 – Low generator voltage

Type: **Warning**

Category: **Load protection**

Related parameters: **P.0101** Generator voltages wiring
P.0102 Rated voltage of the generator
P.0202 Generator measures hysteresis
P.0391 Low voltage threshold (%)
P.0392 Low voltage delay
P.0328 Enables checks including on the phase voltages

To disable: **P.0392 =0**

Enabled in: **MAN*, AUTO, TEST, REMOTE START**

This protection 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. In addition, the generator voltages and frequency must be within the tolerance range and the load must be changed-overt to the generator. Threshold P.0391 is expressed as a percentage of the system rated voltage (phase voltage). The protection activates when at least one of the generator voltages continuously lower than the threshold P.0391 for time P.0392.

* In **MAN** it is only enabled if the GCB breaker is closed or if the Bit2 of parameter P.0249 is set to "1".

57 – Clock not valid

Type: **Warning**

Category: **Generic**

Related parameters: **P.0418** Weekly test schedule
P.0420 Test duration
P.0421 Weekly operation schedule
P.0422 Operation start time
P.0423 Operation end time

To disable: **-**

Enabled in: **MAN, AUTO, TEST, REMOTE START**

This warning is always enabled. It activates if the controller detects a not-valid clock status, and functions using the clock are set, such as the weekly test (P.0418 and P.0420) or the operation enabling time (P.0421, P.0422, P.0423). To deactivate it, you need to set the clock.

58 – Low generator frequency

Type: **Warning**

Category: **Load protection**

Related parameters: **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**

This protection 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. In addition, the generator voltages and frequency must be within the tolerance range and the load must be changed-overt to the generator. Threshold P.0395 is expressed as a percentage of the generator rated frequency. The protection activates when the generator frequency drops continuously below threshold P.0395 for time P.0396.

* In **MAN** it is only enabled if the GCB breaker is closed or if the Bit2 of parameter P.0249 is set to "1".

59 – High generator voltage

Type: **Warning**

Category: **Load/generator protection**

Related parameters: **P.0101** Generator voltages wiring
P.0102 Rated voltage of the generator
P.0202 Generator measures hysteresis
P.0393 High voltage threshold (%)
P.0394 High voltage delay
P.0328 Enables checks including on the phase voltages

To disable: **P.0394 =0**

Enabled in: **MAN, AUTO, TEST, REMOTE START**

This protection 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. In addition, the generator voltages and frequency must be within the tolerance range and the load must be changed-overt to the generator. Threshold P.0393 is expressed as a percentage of the generator rated voltage. The protection activates when at least one of the generator voltages is continuously over the threshold P.0393 for time P.0394.

60 – High generator frequency

Type: **Warning**

Category: **Load/generator protection**

Related parameters: **P.0105** Nominal frequency
P.0397 High frequency threshold (%)
P.0398 High frequency delay

To disable: **P.0398 =0**

Enabled in: **MAN, AUTO, TEST, REMOTE START**

This protection 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. In addition, the generator voltages and frequency must be

within the tolerance range and the load must be changed-overt to the generator. Threshold P.0397 is expressed as a percentage of the generator rated frequency. The protection activates when the generator frequency rises continuously over threshold P.0397 for time P.0398.

61 – Lost Excitation

Type: **Alarm**

Category: **Generator protection**

Related parameters: **P.0321** Excitation loss threshold
P.0322 Excitation loss delay

To disable: **P.0322 =0**

Enabled in: **MAN, AUTO, TEST, REMOTE START**

This protection 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 activates if the reactive power is negative and continuously exceeds (in absolute value) threshold P.0321 for time P.0322.

NOTE: the protection does not work when the controller measures the mains currents.

Remark: if generator or complete protections override function is enabled, this anomaly becomes a warning.

62 – Faulty engine CAN-BUS 0 link

Configurable (Warning/Alarm/Unload/Deactivation)

Category: **Generic**

Related parameters: **P.0700** Engine type
P.0703 ECU Can-Bus command level
P.0709 Warning for ECU Can-Bus fault

Enabled in: **MAN, AUTO, TEST, REMOTE START**

It's enabled only if CAN-BUS is configured (P.0700 other than zero). It is activated when the internal CAN controller switches to BUS-OFF status because of bus communication errors. Parameter P.0709 is used to select the protection type (warning, unloading, interlock).

Remark: if engine's protections override function is enabled, this anomaly becomes a warning.

64 – Fuel pump failure

Type: **Warning**

Category: **Fuel pump protection**

Related parameters: **P.0404** Fuel pump start maximum duration
P.3001 Feature of output 1 or equivalent for the other outputs
P.3201 Equivalent feature for DITEL outputs

To disable: **P.0404 =0**

Enabled in: **MAN, AUTO, TEST, REMOTE START**

This protection is only enabled if there is an output configured to control the fuel pump (feature DOF.1032 – "Fuel pump" in parameter P.3001 or equivalent for the other outputs) and if a time other than zero has been set in parameter P.0404. It activates if the pump operates continuously for the time set, but the issuance of a warning does not change the pump's operating mode (it turns off the pump, which restarts as soon as the warning is acknowledged).

65 – Low coolant temperature (from ANALOGUE sensor)

Type: **Warning**

Category: **Generic**

Related parameters: **P.4025** Function of the ANALOGUE input 4 (CT)
P.0353 Low coolant temperature threshold
P.0354 Low coolant temperature delay
P.0700 Low coolant temperature delay

To disable: **P.0354 =0**

Enabled in: **MAN, AUTO, TEST, REMOTE START**

This protection is enabled only if the controller acquires the measure of the engine coolant temperature. It can acquire it from its input (JM_04, P.4025 suitably configured) or from CAN-BUS (P.0700 other than zero). It activates if the coolant temperature remains continuously below threshold P.0353 for time P.0354 (even with engine shut down).

95 – AdBlue fluid pump failure

Type: **Warning**

Category: **AdBlue fluid pump protection**

Related parameters: **P.1494** Pump maximum activation duration
P.3001 Feature of output 1 or equivalent for the other outputs
P.3201 Equivalent feature for DITEL outputs

To disable: **P.1494 = 0**

Enabled in: **MAN, AUTO, TEST, REMOTE START**

This protection is only enabled if there is an output configured to control the AdBlue fluid pump (feature DOF.1037 – "AdBlue pump" in parameter P.3001 or equivalent for the other outputs) and if a time other than zero has been set in parameter P.1494. It activates if the pump operates continuously for the time set. The activation of this warning does not change the pump's operating mode (it turns off the pump, which restarts as soon as the warning is acknowledged).

Remark: if engine or complete protections override function is enabled, this anomaly becomes a warning.

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.

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.

98 – Communication failure with the ECU

Type: **Configurable (Warning/Alarm/Unload/Deactivation)**

Category: **Generic**

Related parameters: **P.0700** Engine type
P.0797 Action for communication failure with the ECU
P.0709 CAN-BUS fault warning
P.0711 Maximum time with no message from the engine

To disable: **P.0797 = 0 (not for MTU engines)**

Enabled in: **MAN, AUTO, TEST, REMOTE START**

It’s enabled only if CAN-BUS is configured (P.0700 other than zero). For MTU MDEC engines (value from 140 to 147 in parameter P.0700), it is enabled as per specification when the controller does not continuously receive the message NMT ALIVE PDU for the set time. For the other types of engines, it is activated if the controller does not continuously receive messages from the engine for time P.0711. With P.0797 the protection is configured as warning, unload, deactivation or alarm.

Remark: if engine’s protections override function is enabled, this anomaly becomes a warning.

99 – Minimum engine speed (from measure, only for DRIVE applications)

Type: **Alarm**

Related parameters: **P.0110** Number of teeth of the Pick-up wheel
P.0111 Rpm/W ratio
P.0127 Rpm/Hz ratio
P.0133 Engine rating (@ 50Hz)
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 controller measures the rotation speed of the engine. The protection is enabled only with the engine running (FUEL solenoid activated) and after the engine speed has been considered “within tolerance". It is disabled during the starting and stopping phase of the engine.

It activates if the acquired speed measure is lower than threshold P.0305 continuously, for time P.0306. P.0305 threshold is expressed in percentage: this percentage is applied to the rated rotation speed of the engine (P.0133).

Remark: if complete protections override function is enabled, this anomaly becomes a warning.

100 – Maximum differential current

Type: **Alarm**

Category: **Generic**

Related parameters: **P.0377** Maximum differential current threshold (Aac)
P.0378 Maximum current differential delay

To disable: **P.0326 =0**

Enabled in: **MAN, AUTO, TEST, REMOTE START**

This protection is only enabled if the engine has been started by the controller (if the command for the fuel solenoid is activated), the load is changed-over to the generator and the controller is configured to be able to measure the differential current. This protection is disabled in the engine start/arrest phases. It activates if the differential current is continuously over threshold P.0377 for time P.0378.

105 – Battery charger failure (from CAN-BUS).

Type: **Warning**

Category: **Engine protection**

Related parameters: **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**

This protection is enabled only if the board is connected to the engine via the CAN BUS (P.0700 different from zero). It is activated when the engine signals the battery-charger alternator failure status over the CAN BUS.

106 – Maximum reactive power exported (only GC400x)

Type: **Failure**

Connected parameters: **P.0379 P.0380**

To disable: **P.0380 = 0**

Enabled in: **MAN, AUTO, TEST, REMOTE START**

It is enabled only if the engine has been started by the controller (if the command for the fuel electro-valve is activated) and it is disabled in engine start-up and stop phases. It is activated if the reactive power is positive and higher than threshold P.0379, consecutively for time P.0380.

ATTENTION: this protection is not enabled when the current transformers (CTs) are connected to the loads lines and when the loads are supplied by the mains or by other generators.

118 – Maximum speed from CAN BUS

Type: **Alarm**

Category: **Engine protection**

Related parameters: **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**

This protection is enabled only if the board is connected to the engine via the CAN BUS (P.0700 different from zero). It is activated when the engine signals the overspeed state over the CAN BUS.

132 – High coolant temperature from CAN-BUS

Type: **Warning**

Category: **Engine protection**

Related parameters: **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**

This protection is enabled only if the board is connected to the engine via the CAN BUS (P.0700 different from zero). It is activated when the engine signals the coolant high temperature state over the CAN BUS.

134 – Maximum coolant temperature from CAN-BUS

Type: **Warning/Alarm**

Category: **Engine protection**

Related parameters: **P.0700** Engine type
P.0704 Can-Bus anomalies disable mask

To disable: **bit 5 of P.704 on**

Enabled in: **MAN, AUTO, TEST, REMOTE START**

This protection is enabled only if the board is connected to the engine via the CAN BUS (P.0700 different from zero). It is activated when the engine signals the coolant maximum temperature state over the CAN BUS.

Remark: if engine's protections override function is enabled, this anomaly becomes a warning.

135 – Minimum coolant level from CAN-BUS.

Type: **Warning/Alarm**

Category: **Engine protection**

Related parameters: **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**

This protection is enabled only if the board is connected to the engine via the CAN BUS (P.0700 different from zero). It is activated when the engine signals the minimum coolant level state over the CAN BUS

Remark: if engine's protections override function is enabled, this anomaly becomes a warning.

136 – Low coolant level from CAN BUS

Type: **Warning**

Category: **Engine protection**

Related parameters: **P.0700** Engine type
P.0704 Can-Bus anomalies disable mask

To disable: **bit 6 of P.0704 on**

Enabled in: **MAN, AUTO, TEST, REMOTE START**

This protection is enabled only if the board is connected to the engine via the CAN BUS (P.0700 different from zero). It is activated when the engine signals the low coolant level state over the CAN BUS.

137 – Low battery voltage from CAN BUS

Type: **Warning**

Category: **Engine protection**

Related parameters: **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**

This protection is enabled only if the board is connected to the engine via the CAN BUS (P.0700 different from zero). It is activated when the engine signals the low battery voltage state over the CAN BUS.

142 – Minimum oil pressure from CAN BUS

Type: **Warning/Alarm**

Category: **Engine protection**

Related parameters: **P.0700** Engine type
P.0704 Can-Bus anomalies disable mask

To disable: **bit 1 of P.704 on**

Enabled in: **MAN, AUTO, TEST, REMOTE START**

This protection is enabled only if the board is connected to the engine via the CAN BUS (P.0700 different from zero). It is activated when the engine signals the minimum oil pressure state over the CAN BUS.

Remark: if engine's protections override function is enabled, this anomaly becomes a warning.

144 – Low oil pressure from CAN BUS

Type: **Warning**

Category: **Engine protection**

Related parameters: **P.0700** Engine type
P.0704 Can-Bus anomalies disable mask

To disable: **bit 0 of P.0704 on**

Enabled in: **MAN, AUTO, TEST, REMOTE START**

This protection is enabled only if the board is connected to the engine via the CAN BUS (P.0700 different from zero). It is activated when the engine signals the low oil pressure state over the CAN BUS.

158 – High oil temperature from CAN BUS

Type: **Warning**

Category: **Engine protection**

Related parameters: **P.0700** Engine type
P.0704 Can-Bus anomalies disable mask

To disable: **bit 2 of P.0704 on**

Enabled in: **MAN, AUTO, TEST, REMOTE START**

This protection is enabled only if the board is connected to the engine via the CAN BUS (P.0700 different from zero). It is activated when the engine signals the high oil temperature state over the CAN BUS.

159 – Maximum oil temperature from CAN BUS

Type: **Warning/Alarm**

Category: **Engine protection**

Related parameters: **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**

This protection is enabled only if the board is connected to the engine via the CAN BUS (P.0700 different from zero). It is activated when the engine signals the maximum oil temperature state over the CAN BUS.

Note: if engine's protections override function is enabled, this anomaly becomes a warning.

160 – Water in fuel from CAN BUS

Type: **Warning**

Category: **Engine protection**

Related parameters: **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**

This protection is enabled only if the board is connected to the engine via the CAN BUS (P.0700 different from zero). It is activated when the engine signals the water in fuel state over the CAN BUS.

198 – Warnings – Yellow lamp (from CAN-BUS)

Type: **Warning**

Category: **Engine protection**

Related parameters: **P.0700** Engine type
P.0704 Can-Bus anomalies disable mask

To disable: **bit 14 of P.0704 on**

Enabled in: **MAN, AUTO, TEST, REMOTE START**

This protection is enabled only if the board is connected to the engine via the CAN BUS (P.0700 different from zero). It is activated when the engine signals the active state of its yellow lamp over the CAN BUS.

199 – Alarms cumulative – Red lamp (from CAN-BUS)

Type: **Configurable (Warning/Interlock)**

Category: **Engine protection**

Related parameters: **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**

This protection is enabled only if the board is connected to the engine via the CAN BUS (P.0700 different from zero). It is activated when the engine signals the active state of its red lamp over the CAN BUS. Using bit 13 of P.0704 it is possible to configure the protection as warning or alarm.

Remark: if engine's protections override function is enabled, this anomaly becomes a warning.

200 – CAN-BUS connection 1 (PMCB) failed (only GC400x)

Type: **Pre-alarm**

Related parameters: **P.0800** bus mode PMCB

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 gets to BUS-OFF status due to communication errors on bus.

201 – Address conflict on CAN-BUS bus 1 (PMCB) (only GC400x)

Type: **Pre-alarm**

Related parameters: **P.0800** bus mode PMCB

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 activates if two or more genset controllers connected on PMCB have the same address (configured in P.0452).

202 – Wrong number of generators on CAN-BUS 1 (PMCB) (solo GC400x)

Type: **Pre-alarm**

Related parameters: **P.0800** bus mode PMCB

P.0803 number of gensets on bus **PMCB**

To disable: **P.0803 =0**

Enabled in: **MAN, AUTO, TEST, REMOTE START**

The protection activates if the CAN-BUS is activated (P.0800).

It activates if in the bus there are a number of genset controllers (not MC100 or BTB100) different from what indicated by da P.0803. Note: if in the system are present BTB100 controllers which indicate that the tie is open, the alarm is not activated.

203 – Negative sequence

Type: **Deactivation**

Category: **Generic**

Related parameters: **P.0106** Generator rated output
P.0325 Negative sequence I2 threshold (%)
P.0326 Negative sequence delay

To disable: **P.0326 =0**

Enabled in: **MAN, AUTO, TEST, REMOTE START**

This protection is only enabled if the engine has been started by the controller (if the command for the fuel solenoid is activated) and if the load has been changed-over to the generator. This protection is disabled in the engine start/arrest phases. It activates if the current I2 stays continuously over the threshold P.0325 expressed in percentage of the generator rated output (parameter P.0106) for time P.0326, but only after time P.0216 (oil mask) since engine start has elapsed.

Remark: if generator or complete protections override function is enabled, this anomaly becomes a warning.

204 – Failed closure of NECB breaker (only GC400x)

Type: **Pre-alarm**

Related parameters: **P.3001** Output function 1 or equivalent for other outputs.
P.4001 P.4002 Function and delay of input 1 or equivalent for other inputs.

To disable: -

Enabled in: **AUTO, TEST, REMOTE START**

This anomaly is available from revision 00.40. It is only enabled if the controller commands the NECB breaker for the grounding of the generator neutral (function DOF.2061 in parameter P.3001 for output 1 1 or equivalent for other outputs), and if acquires the feedback (function DIF.3005 in parameter P.4001 for input 1 or equivalent for other inputs). It activates if the breaker remains open for the time related to the feedback input, in presence of the closure command.

205 – Failed opening of NECB breaker (only GC400x)

Type: **Pre-alarm**

Related parameters: **P.3001** Input function 1 or equivalent for other outputs.
P.4001 P.4002 Function and delay of input 1 or equivalent for other inputs.

To disable: -

Enabled in: **AUTO, TEST, REMOTE START**

This anomaly is available from revision 00.40. It is only enabled if the controller commands the NECB breaker for the grounding of the generator neutral (function DOF.2061 in parameter P.3001 for output 1 1 or equivalent for other outputs), and if acquires the feedback (function DIF.3005 in parameter P.4001 for input 1 or equivalent for other inputs). It activates if the breaker remains open for the time related to the feedback input, in presence of the opening command.

206 – Failure to open NECB switch (only GC400x)

Type: **Adjustable**

Related parameters: **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**

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 5 seconds (not adjustable). With parameter P.0383, you can configure the anomaly as warning, unload, deactivation or shutdown. The anomaly is subject to the override of the genset protections (and to the total override).

207 – Maximum time in parallel to the grid switch (only GC400x)

Type: **Warning**

Related parameters: **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.

In order to maintain the compatibility with the previous version (which at the end of the time set forced the MCB opening), the P.0897 parameter 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 0: MAN mode.
- Bit 1: AUTO mode.

- Bit 2: TEST mode.
- Bit 3: REMOTE START mode.
- Bit 7: in case of “MGCB opening failure”.

Note: the parameter is aimed just to allow the operation of old plants in case of a firmware update. In new plants, it should be left at zero.

252 – CAN-BUS (EXBUS) expansion modules missing

Type: **Warning**

Category: **Generic**

Related parameters: **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**

This warning is enabled if a number of modules other than zero has been set (in parameters P.0141, P.0142, P.0143 or P.0144). It is activated if one or more controllers connected to CAN-BUS (EXBUS) are not available and/or have an addresses conflict.

253 – CAN-BUS (EXBUS) missing measure

Type: **Warning**

Category: **Generic**

Related parameters: **P.0142** Number of DITEMP modules
P.0143 Number of DIVIT modules

To disable: **P.0142=0** e **P.0143=0**

Enabled in: **MAN, AUTO, TEST, REMOTE START**

This warning is enabled if a number of ANALOGUE modules other than zero has been set (in parameters P.0142 or P.0143). It activates if one or more CAN-BUS (EXBUS) measures are not properly configured or in case of faulty sensor. The relevant page shows the faulty channel and module.

254 – CAN-BUS (EXBUS) duplicate address

Type: **Warning**

Category: **Generic**

Related parameters: **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**

This warning is enabled if a number of modules other than zero has been set (in parameters P.0141, P.0142, P.0143 or P.0144). It is activated in case of hardware addresses conflict for one or several controllers connected to CAN-BUS (EXBUS).

255 - Connection with CAN-BUS (EXBUS) sensor timed out.

Type: **Warning**

Category: **Generic**

Related parameters: **P.0142** Number of DITEMP modules
P.0143 Number of DIVIT modules

To disable: **P.0142=0** e **P.0143=0**

Enabled in: **MAN, AUTO, TEST, REMOTE START**

This warning is enabled if a number of ANALOGUE modules other than zero has been set (in parameters P.0142 or P.0143). It activates if the ANALOGUE sensor has not been physically connected to the ANALOGUE input of the controller on CAN-BUS (EXBUS).

271 – Direct parallel failed (only GC400x)

Type: **Pre-alarm/Failure**

Related parameters: **P.0802** Plant type

P.0854 GCB use

P.0852 Maximum time for GCB synchronisation

To disable: **P.0852** = 3200

Enabled in: **AUTO, TEST, REMOTE START**

The protection is activated only if the plant configuration (P.0802, P.0854) allows the synchronisation on GCB breaker.

It activates if the GCB breaker does not close within the configured time with P.0852 from the beginning of the synchronisation. It is a failure anyway: it becomes a pre-alarm only if the breaker is commanded externally (P.0854).

272 – Reverse parallel failed (solo GC400x)

Type: **Pre-alarm/Failure**

Related parameters: **P.0802** Plant type

P.0855 MCB use
P.0853 Maximum time for MCB synchronisation

To disable: **P.0853 = 0**

Enabled in: **AUTO, TEST, REMOTE START**

The protection is activated only if the plant configuration (P.0802, P.0855) allows the synchronisation on MCB breaker.

It activates if the MCB breaker does not close within the configured time with P.0853 from the beginning of the synchronisation.

273 – Incoherent parameters (only GC400x)

Type: **Pre-alarm/Failure**

To disable: -

Enabled in: **MAN, AUTO, TEST, REMOTE START**

The protection is always enabled.

It activates if the plant configured parameters are not coherent among them and/or the defaults of all parameters have been reloaded. On page S.02, by selecting this anomaly, the controller shows a description of the problem. It is nearly always a pre-alarm: it is a failure only for the continuative parallel to mains plants, if the interface breaker is not selected.

274 – Sectioned auto production line (only GC400x)

Type: **Deactivation**

Related parameters: **P.2001** Function of address 1 or equivalent for other inputs.
P.2002 Delay for input 1 or equivalent for other inputs.

To disable: **P.2002 =0**

Enabled in: **MAN, AUTO, TEST, REMOTE START**

The protection is always enabled.

It activates if the input that acquires the external contact (function DIF.4261 in parameter P.2001 or equivalent) remains active consecutively for the configured time (P.2002 or equivalent). The purpose of this protection is to indicate to the controller that there is an open breaker in the line connecting the generator to the public mains, which, as a matter of fact, impedes the supply in parallel with the mains.

275 – Interface device not open (only GC400x)

Type: **Failure**

Related parameters: **P.0802:** plant type

P.0900: interface device

To disable: **-**

Enabled in: **MAN, AUTO, TEST, REMOTE START**

In those plants of parallel with the mains, if the mains lacks during the parallel, the generator/s must be isolated from the mains by opening a breaker (called interface breaker). It that breaker does not open within 0,5 sec. From the mains lack, the controller activates this anomaly. The interface breaker can be both MCB and GCB.

276 – Alarm from CAN-BUS master controller 1 (PMCB) (only GC400x)

Type: **Pre-alarm/Failure**

Related parameters: **P.0800** PMCB bus mode
P.0802: plant type

To disable: -

Enabled in: **MAN, AUTO, TEST, REMOTE START**

This anomaly is forced by a MC100 controller when it needs to signal an anomaly also in genset control boards (the operator will have to look at the display on MC100 controller to understand the kind of anomaly).

279 – Bar voltage not coherent (only GC400x)

Type: **Pre-alarm/Deactivation**

Related parameters: -

To disable: -

Enabled in: **MAN, AUTO, TEST, REMOTE START**

The controller activates this signalling before closing the GCB if it finds a discrepancy between the real voltage presence on the parallel bars and that supposed based on the status of the mains breakers and that of the eventual other genset controllers connected on the PMCB. The anomaly is activated only if there is no voltage on the bars when it is supposed to be. For example, if at least another genset has the GCB closed, there must be voltage on the parallel bars: if the controller does not detect it, (through the bi-phase or three-phase sensor o through a contact), it activates the warning after two seconds. The warning is normally a pre-alarm. It becomes a deactivation (only in automatic modes) after 60 seconds if the controller does not need to close the GCB.

10.8.1 305..432 - Generic anomalies linked to analogue inputs

See 10.7.

10.8.2 701...774 - Generic anomalies linked to digital inputs

See 10.6.

11 Other functions

11.1 Fuel pump

GC315 applies full management of the fuel pump, for loading the storage tank into the tank on the machine. The pump can be managed automatically or manually using the controls on the front panel.

Three functioning modes of the fuel pump are provided:

- **AUTO**: the controller starts/stops the pump depending on the level of the fuel in the tank on board the machine, with a hysteresis band that prevents continuous starts/arrests.
- **MAN-ON**: the pump is stopped only when the tank is full. No hysteresis band is managed: as soon as the tank is no longer full, the pump starts.
- **MAN-OFF**: the pump is always off, even with the tank empty.

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”).
- From pages E.06 (which can be seen only if an output for pump control is configured) it is possible to use the normal setting procedure (ENTER to initiate, ▲ and ▼ to modify and ENTER to confirm) to select the pump control mode. **NOTE: the fuel pump control mode is a normal parameter (P.0400) of the controller, therefore it can be modified including from the programming windows.**

Through the parameter P.0406 you can select which of the following is the pump's power supply:

0 – Generator

1 – parallel bars (only GC400x)

2 - Loads

3 - Mains

4 - Always powered (power supply is always present).

The controller keeps the pump off if the selected source is not available (maintaining the selected operation mode though). With the controller in OFF_RESET the pump is always stopped.

The controller is able to operate both with a system for level detection on contacts, and with an ANALOGUE tool.

In order for this feature to be usable, the DOF.1032 code – “Fuel pump” must be set in one of the configurable outputs of the controller or of the DITEL expansion modules.

Another possibility is to configure a digital output to command and interception solenoid on the pump line (DOF.1034 – “Fuel pump solenoid command”).

In BoardPrg4 we have the menu 4.2.1 for pump configuring. Anyway, you can set each individual parameter directly from the controller.

Parameter P.0405 configures the delay between the activation of the solenoid command (digital output configured as DOF.1034 – “Fuel pump solenoid command”) and the pump start command (digital output configured as DOF.1032 – Fuel pump command”).

11.1.1 Use with an ANALOGUE level transducer

To use this function requires:

- It is recommended to have an ANALOGUE transducer configured on an ANALOGUE input.
- Configure the controller to control the pump in accordance with said transducer (parameter P.0401=0).
- Set at least the thresholds to activate/deactivate the pump (parameters P.0402 and P.0403).
- If set, also minimum, low and high fuel levels are used (parameters P.0347, P.0345, P.0343).

Warning: if the first two conditions are met, the controller will control the pump no matter what the threshold values are. In particular, the last condition set thresholds are used even though related operation times are set to zero (for disabling 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).

11.1.2 To use this function requires:

To use this function requires:

- Make sure you have a contact level transducer.
- Configure the controller to control the pump in accordance with said transducer (parameter P.0401=1).
- Connect at least the pump start/stop contacts respectively to two configurable inputs of the controller.
- If connected, the minimum, low and high fuel level contacts are also used.

Warning: if the first two conditions are met, the controller will control the pump no matter what the connected contacts are. In particular, the contacts related to the last connection are used even though relevant operation times are set to zero (for disabling anomalies). So, please pay attention to configuration. Last, contacts must match the following pattern:

- Minimum level contact (input with feature DIF.4211): closed if the level is below the minimum level threshold.
- Low level contact (input with feature DIF.4212): closed if the level is below the low-level threshold.
- Start-up contact (input with feature DIF.3301) closed if the level is below the pump start-up threshold.
- Stop contact (input with feature DIF.3302) closed if the level is below the pump stop threshold.
- High level contact (input with feature DIF.4213): closed if the level is **over** the pump stop threshold.

11.1.3 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.

11.1.4 Automatic pump control

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”.

11.1.5 Manual pump control

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”.

11.1.6 Protections

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 remains operational (either manually or automatically) for more then said time, the controller stops it (without changing the control mode), and issues warning W064: probable pump failure or pump not sucking from the storage tank. As soon as the alarm is acknowledged by the operator, the pump restarts.

In many cases you need to be able to block the pump (with a signal on the display) due to certain situations of the system, such as when the storage tank is empty. In these case you need to:

- Configure a digital input of the controller with feature DIF.4051 – “Fuel pump warning” (in parameter P.2001 or equivalents).
- Associate a delay to that input (in parameter P.2002 or in the equivalent parameters).
- Configure a message for the alarm (in parameter P.2003 or in the equivalents): for example, “TANK EMPTY”.

If the input remains active for the time configured, the controller issues a warning (the text of which will be the one configured) and stops the pump (without changing its operating mode).

11.2 Engine Coolant preheating

The controller can monitor the engine cooling temperature in order to activate a heating device in case of very temperature.

To use this feature, first you need to configure one of the outputs with code DOF.1031 – “Coolant preheating”. This output will be used to control the heating system. GC315 must measure the coolant temperature by means of its own ANALOGUE input or via CAN-BUS.

Parameters P.0355 and P.0356 are used to configure the operation thresholds:

- 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 in order 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.

11.3 Loads protection from mains breaker damages

Usually, in the case mains is present, the controller releases loads changed-over on it. If for any reasons the breaker closing the loads on mains does not work, loads will remain not connected. Using this feature, you can make sure that, in the situation described, the controller starts the engine and changes-over the loads to the generator.

To use this function requires:

- At least one of the configurable inputs of the controller should check that the loads are really closed on the mains, assigning the feature DIF.3022 – "Mains Circuit breaker status" to one of the digital inputs with parameter P.2001 or its correspondent for the specific input.
- The time associated with this input (P.2002 o correspondent) must be other than zero.
- Two operation modes available for enabling delivery after failed MCB closure:

1. **P.0221 = 0 does not enable the output due to failed MCB closure**

   In these cases, if the unit is controlling mains loads closing, but acquires an MCB open status (continuously for the time associated to the input), it will perform the following:

   - GCB open
   - With engine shut off, it makes an attempt to close the MCB; if the engine is already running because the genset was already delivering power, it starts a sequence of three attempts for MCB closing (in one of the auto modes)
   - It activates the warning **W13** "MCB not closed"
   - The engine does not start or it is being stopped if already running and the load remains in black-out

2. **P.0221 = 1 Enables output due to MCB failed closure with black-out on loads**

   In these cases, if the unit is controlling mains loads closing, but acquires an MCB open status (continuously for the time associated to the input), it will perform the following:

   - It activates the warning **W272** "Mains reverse synchronization failure"
   - GCB open
   - If the engine is shut off, it makes an attempt to close the MCB; if the engine is already running, it starts a sequence of three attempts for MCB closing (in one of the auto modes)
   - It activates the warning **W13** "MCB not closed"
   - It starts the engine if it is shut off, or it keeps the genset operating, if already running.
   - It closes the GCB by powering again the load through the genset.
   - No further attempt for MCB closing is made until an operator "acknowledges" the warning

Now loads will no longer be automatically changed-over on mains. To do that, you need to:

- Put the controller in MAN mode.
- Change-over manually loads on mains.
- Put the controller back in AUTO mode.

After these operations are completed, the warning W013 will be immediately disabled and a stop cycle with cooling will be started. Nevertheless, if the mains breaker does not close again, warning will be again activated, the cooling cycle will be interrupted and loads will be again changed-over on genset.

Usually, this function is not enabled with the key switched to MAN, and it is disabled if the inhibit input is active.

The warning is activated only if mains is present: this because the breaker is powered by the mains so that, when the mains fails, the status signal will not activate even with the breaker closed.

11.4 Load thresholds

This function must not be mismatched with the "Load function" available for the parallel systems described in the "Parallel functions handbook".

This function allows to monitor the trend of the active power in order to diagnose:

- A low load condition
- A high load condition, to disconnect, in case, a part of the loads.

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 1 to select the high-power monitoring).

“0-Low power” is selected by default, but with a 0% reaction threshold, so the feature is disabled.

In some cases, you need to be able to disable the feature with it is of no use. In these cases, you need to configure a digital input with feature DIF.2703 – “Enable the loading thresholds” in parameters P.2001 or equivalents. If such an input already exists, the feature is enabled only when it is “active”.

11.4.1 Low load

The purpose of this function is to diagnose a low power condition (low load) and communicating the problem through one of the controller's digital outputs (with more gensets in parallel this output could be used to deactivate some of the gensets). To associate an output to this function, the code DOF.3121 – “Load thresholds” must be configured in the parameter P.3001 (or the corresponding parameter for the other outputs). If no output is configured in this way, the function will not work.

The controller watches the total active power delivered by the generator, comparing it to two thresholds (which set, therefore, a hysteresis band): the output is activated (therefore signalling the low power condition) if the power stays 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. These thresholds and delays are set with following parameters:

- 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.

From the moment the contact of DIF.2703 - “Enable load thresholds” (if any) is activated, a timing begins (the length of which is configured with parameter P.0482), during which the output is maintained low regardless of the power. This time allows the system to stabilize before starting to watch powers.

11.4.2 High load

Purpose of this function is to diagnose a high-power status (high load) to disconnect part of the less important loads. Everything we said in the previous paragraph applies, though taking into account that the output is activated if the power exceeds threshold P.0485 and deactivated when the power drops below threshold P.0483.

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.

11.5 Alternative parameters configuration

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 voltages wiring.
- P.0102: Generator nominal voltage
- P.0103: Generator VT primary voltage

- P.0104: Generator VT secondary voltage.
- P.0105: Generator nominal frequency.
- P.0106: Generator nominal power (kVA).
- P.0107: CT primary for generator/load.
- P.0108: CT primary for auxiliary current.
- P.0109: Transformer type for auxiliary current.
- P.0116: Mains nominal voltage
- P.0117: Mains VT primary voltage.
- P.0118: Mains VT secondary voltage.
- P.0119: Mains voltages wiring.
- P.0124: Connection of CT
- P.0125: Engine nominal power (kW).
- P.0126: Use of mains/bars voltage (only GC400x).
- P.0130: Auxiliary current connection
- P.0131: Auxiliary current use
- P.0133: Nominal engine speed (primary).
- P.0134: Nominal engine speed (secondary).
- P.0135: Secondary CT or toroid for auxiliary current.
- P.0139: CT secondary for generator/load.
- P.1604: Frequency Setpoint (only GC400x).
- P.1605: Voltage Setpoint (only GC400x).
- P.0713: Speed at 0% command.
- P.0714: Speed at 100% command.
- P.1703: Voltage corresponding to 0%.
- P.1704: Voltage corresponding to 100%.
- P.1708: 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.

Caution: when an alternative configuration is copied in the operating parameters, the previous values of the operating parameters are lost. The only way to restore them is to have them stored in another alternative configuration and recall it.

This function is usually used with multiple-voltage and/or multiple-frequency panels: wiring the cams of a selector to the panel on the inputs of the controller, you can manually switch voltages and frequency without having to use the parameters of the controller.

NOTE: parameter change occurs only with engine shut off and with the controller in OFF_RESET mode.

Among the various parameters used in the alternative configurations, there is also the engine speed. For some CAN-BUS engines (such as the Volvo engines), the engine speed can be controlled directly from the GC315, by means of the P.0701 parameter (and consequently it can be done using the alternative configurations). Refer to [4] for gear shift, because the operation is more complex.

11.6 EJP function

Notes: GC315 is unable to directly track EJP information from the mains. To use this function an external detector must 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 genset, 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 has to 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 start-up 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).
- Configure a second digital input with feature DIF.2502 – “Loading inhibition) (in parameter P.2004 or the equivalents).

Then connect the NO contact of signal A to first configured input and the contact **NC** of signal B to second input. **NOTE: the feature “Loading inhibition” blocks the load connection, even if the genset has been started automatically for other reasons. To prevent this problem, use a logic that prevents the activation of this feature if the generator was not started with the “REMOTE START” feature.**

When both signals are inactive, the controller does not receive the remote start request and remains at rest in AUTO mode. The "Inhibition of supply" contact is skipped.

When signal A activates, both controller inputs will be 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. So, also in this phase the CHANGE-OVER INHIBITION is skipped. In this phase, window S.01 shows the remaining time to start-up.

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 “Change-over sequence disabling” input is no longer skipped, and, being it active (connected on contact NC), it prevents the loads change-over on generator.

When signal B activates, the “Change-over sequence disabling” input deactivates, thus allowing the load change-over on generator.

When the mains is on, both signals A and B deactivate. Therefore, the controller reverts to AUTO mode, due to mains on, performs the engine stop (with cooling cycle).

11.7 Maintenance

The controller can automatically inform the operator about programmed maintenance, by means of two engine working hours and days counters.

11.7.1 Counter for the hours left to maintenance 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. Instead, P.0425 is used to configure what type of warning should be issued at expiry: a warning, an unloading or an interlock (the anomaly code is A039 or D039 or W039).

The function is enabled if the parameter P.0424 contains a value other than zero. The count starts in the moment this parameter is set. When the time configured has elapsed, the controller stores the status of the service request in the non-volatile memory. In this way, also powering the controller off, signalling is not lost and cannot be reset. If an alarm has been selected withy 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, in order to modify these parameters, an installer level password is required.

11.7.2 Counter for the hours left to maintenance 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. Instead, P.0437 is used to configure what type of warning should be issued at expiry: a warning, an unloading or an interlock (the anomaly code is A040 or D040 or W040).

The function is enabled if the parameter P.0436 contains a value other than zero. The count starts in the moment this parameter is set. When the time configured has elapsed, the controller stores the status of the service request in the non-volatile memory. In this way, also powering the controller off, signalling is not lost and cannot be reset. If an alarm has been selected withy 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, in order to modify these parameters, an installer level password is required.

11.7.3 Counter for the days left to maintenance

This function is configurable with parameters P.0438, which set how many days left to the required maintenance (independently from the engine operation). The expiry date will be reminded with a warning, (the anomaly code is W050).

The function is enabled if the parameter P.0438 contains a value other than zero. The count starts in the moment this parameter is set. When the date configured expires, exceeding 8:00 of the set day (non-programmable fixed hour), the controller stores the status of the service request in the non-volatile memory. In this way, also powering the controller off, signalling is not lost and cannot be reset.

To cancel the maintenance request (and the related signalling), it is required to set the parameter P.0438 again: 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, in order to modify these parameters, an installer level password is required.

11.8 Counters

The controller manages internally the following counters:

1. Partial active power meter (kWh) (resettable), with power measured when the loads are connected to the generator; it measures only the supplied power and does not measure in case of power reverse.
2. Total active power meter (kWh), with power measured when the loads are connected to the generator; it measures only the supplied power and does not measure in case of power reverse.
3. Partial reactive power meter (kvarh) (resettable), with power measured when the loads are connected to the generator: it measures the absolute value.
4. Total reactive power meter (kvarh), with power measured when the loads are connected to the generator: it measures the absolute value.
5. Partial active power meter (kWh) (resettable), with power measured when the loads are connected to the mains **(only if the CTS are mounted on the loads).**
6. Total active power meter (kWh), with power measured when the loads are connected to the mains **(only if the CTS are mounted on the loads).**
7. Partial reactive power meter (kvarh) (resettable), with power measured when the loads are connected to the mains **(only if the CTS are mounted on the loads):** it measures the absolute value.
8. Total reactive power meter (kvarh), with power measured when the loads are connected to the mains **(only if the CTS are mounted on the loads):** it measures the absolute value.
9. Engine starts counter (resettable to zero).
10. Partial engine running hours counter (resettable to zero).
11. Counter for the total engine running hours left to maintenance 1.
12. Counter for the total engine running hours left to maintenance 2.
13. Load working time with GCB closed (hours) counter (resettable to zero)
14. Partial engine running hours counter (resettable to zero) with engine protections OVVERRIDE active.
15. Controller total power supply time (hours) counter
16. Total counter of the controller supplying hours

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. Non-volatile memories have limited life cycles, therefore reducing memory writing to minimum is required. Therefore, a counter may not be immediately saved as its value changes; consequently, before powering the controller off, ensure to know when and how the counters were saved.

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).

- Every time the controller is set to OFF_RESET.
- For each hour the controller is powered.
- When parameter P.0424 is changed (maintenance interval 1) and the parameter P.0436 is changed (maintenance interval 2).

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. It is enough to switch the controller to OFF-RESET to force data saving, before switching off the power.

11.8.1 Counters reset

The resetting procedure is common for all the counters, but it only applies to some of them, based on the page displayed on the multifunctional display. See in paragraph 8.6.4.3 the description of the display page that contains the counter to be reset to zero.

11.9 Clock

The controller is provided with a standard hardware clock. It is shown in detail in the page S.03. It can be set through the programming menu 4.7.1 – Date/Time or the serial port, and is used for many functions:

- History logs recordings
- Engine TEST start-up weekly planning.
- Weekly planning of time intervals in which the genset can start automatically.

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

11.9.1 Automatic update of the clock

In case the controller is equipped with an Ethernet connection, the controller clock can be automatically updated through the connection towards a NTP server (see par. 5.17.4). The controller registers the event “EVT.1076 - modified date and time” in the data log, only if the difference between the new time received and the current one is higher than one minute.

Server NTP

The NTP server (queried by the controller every 5 minutes) returns back to the controller the date and the time of the reference time zone (or the CUT time “Coordinated Universal Time”) from which the controller can calculate and update itself with the internal dater keeping its own time zone and the eventual daylight saving. To this purpose, the following parameters are available:

- P.0409: Legal time:
  - “0-No” Not current daylight saving (leaves the time unchanged).
  - “1-Yes” Current daylight saving (it adds one hour to the one received).
  - “2-Automatic (only Europe)”: automatically calculates if the daylight saving is current or not. It is only valid for Europe as since 2002 it has been unified (it activates at 01:00 of the last Sunday of March and deactivates at 01:00 of the last Sunday of October.
  - “3-Automatic (via calendar)”: the activation/deactivation of the daylight save time is configurable by calendars 15 and 16.

- P.0408: Daylight save time offset (1=15 min.; 4=1 hour).The setting limits range from 0 to 48 and allow to manage the offset in minutes to be added or subtracted from the current time in the case of daylight-saving time or standard time (with a quart of hour resolution).
- P.0410: Time Zone (1=15 min.; 4=1 hour).The setting limits are from -47 to + 48 and allow to manage all the earth time zone with a quart of hour resolution.

11.9.2 Engine TEST start-up weekly planning.

The engine TEST start-up is planned on a weekly basis. Thus, it is possible to select in which days the engine must be started for TEST.

WARNING! Periodical test start-up is not linked to manual or auto engine starts.

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 for the parameter is the sum of the “value” fields in the following table related to the days you are interested in.

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 18 (16+2).
- P.0419: allows to set start time for the TEST (Hours and minutes).
- P.0420: allows to configure the TEST duration (in minutes).

P.0420 sets the duration instead of an end test time. This is due to the same parameter being also used for TEST activated by an SMS command.

11.9.3 Weekly scheduling of engine operating time intervals.

In some applications, it is useful to inhibit the automatic intervention of the engine for mains failure in hours or days where the mains is 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 genset 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 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

- 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 genset start is required only Monday through Friday, between 08:00 and 18:00, you must set:

P.0421 = 62 (2+4+8+16+32)

P.0422 = 08:00

P.0423 = 18:00

11.9.4 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 has to 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 has to 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 has to 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).

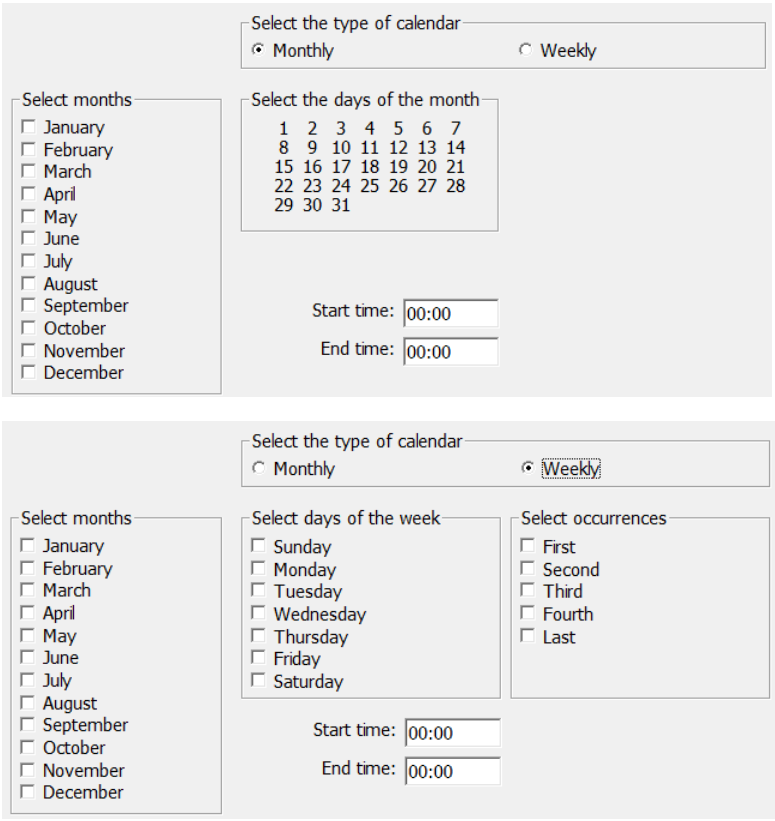
- P.0427: it allows setting the starting time of the forcing (in hours and minutes).

- P.0428: it allows setting the ending time of the forcing (in hours and minutes).

11.9.5 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:

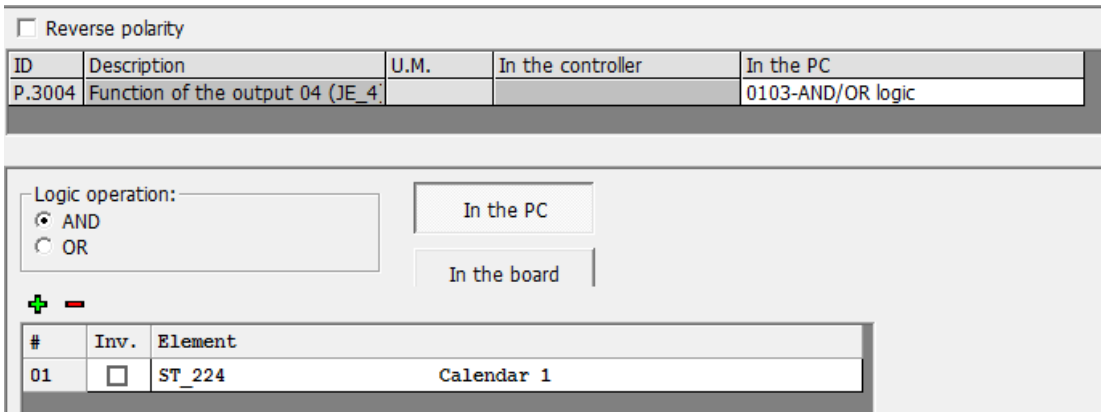
BIT	Value	Hexadecimal	Occurrence
0	1	00000001	First occurrence
1	2	00000002	Second occurrence
2	4	00000004	Third occurrence
3	8	00000008	Forth occurrence
4	16	00000010	Last occurrence

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:

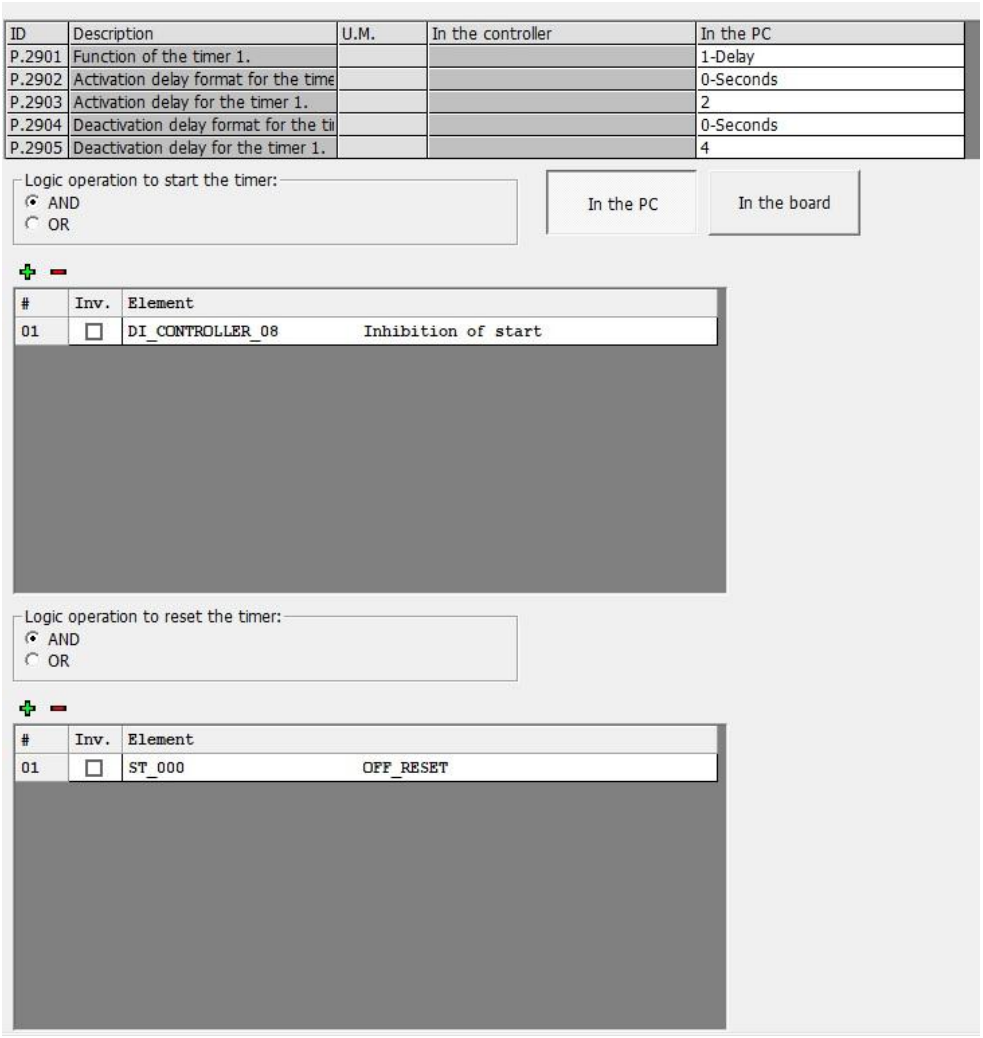
- Calendar 15.
  - Select “weekly” (bit 14 of P.1900 = “1”).
  - Last Sunday of October:
    - Select “October” (P.1957 = “0200”).
    - Select “Sunday”, “Last” (P.1958 = “00010010”).
  - The activation should happen at 02:00:
    - Select “2:00” as start time (P.1959).
    - Select “2:01” as end time (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).

11.9.6 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.

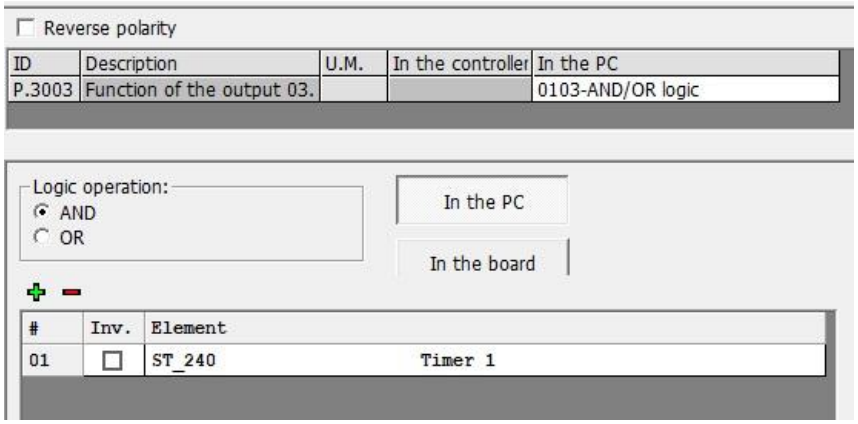
Each timer can work in four different modes, selectable by means parameter P.2901 (for the timer 1 or equivalent for the other timers):

- 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:



11.10 Non-volatile memory

The controller has a non-volatile memory inside (which does not need power), used to store various information such as parameters, counters etc. The memory is subdivided into various areas. 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. Said message contains a numerical code (in hexadecimal form); each bit to 1 of said code corresponds to an area of the memory that is not valid. Here is a table listing the areas and their bit.

Area	Rel.	Bit	Value	Description
1	1.00	0	1 (0001)	Coefficients for the calibration of the measuring inputs of the controller.
2	1.00	1	2 (0002)	Various information (language selected, lcd display contrast, maintenance request).
3	1.00	2	4 (0004)	Counters
4	1.00	3	8 (0008)	History log for diagnose codes acquired via CAN-BUS from the engine.
5	1.00	4	16 (0010)	History log of the maximum peaks.
6	1.00	5	32 (0020)	Parameters alternative configurations.
7	1.00	6	64 (0040)	Parameter

8	1.00	7	128 (0080)	**GC315 Only:** Text parameters (e.g., configurable messages related to the inputs)
8	3.10	7	128 (0080)	**GC400 Only:** 2nd parameter area
9	3.10	8	256 (0100)	**GC400 Only:** Text parameters (e.g., configurable messages related to the inputs)

If, for example, the value between brackets is “0004”, it means that only the counters area is not valid. If the value is “0041”, it means that the parameters areas (0040) and the Current language area (0001) are not valid.

If any of the areas is not valid, the normal operating sequences are not carried out until the operator presses the “ENTER + EXIT” buttons: in fact, the situation must be taken note of, because it may cause malfunctions (for example, imagine what would happen if the invalid area were the one of the parameters) Only when the operator presses “ENTER + EXIT” the controller reloads the default settings for the data stored in the invalid areas: it means that, in the event the controller is shut off without pressing “ENTER + EXIT”, next time you turn it on you will get again the invalid memory report.

11.11 AdBlue fluid pump

The controller implements a complete management of the pump for refilling the AdBlue fluid daily tank from the external storage tank. Pump management includes automatic operation and manual controls, accessible from the front panel.

Three pump operating modes are available:

- AUTO: the pump is started/stopped by the controller according to the level of the AdBlue fluid in the daily tank, with a hysteresis band that prevents continuous starts/stops.
- MAN-ON: the pump is stopped only with the daily tank full. No hysteresis band is managed: as soon as the tank is no longer full, the pump starts.
- MAN-OFF: the pump is always off, even when the daily tank is empty.

The operating mode can be selected in two ways:

- By modifying parameter P.1490 (“AdBlue pump mode”).
- From page E.30 (which is only visible if a digital output is configured for the pump control) it is possible to use the normal setting procedure (ENTER to begin, ▲ and ▼ to modify and ENTER to confirm) to select the control mode of the pump.

Using parameter P.1496 it is possible to select which is the power source of the pump between:

0 – Generator

1 – Generators’ busbars (GC400x only)

2 – Loads

3 – Mains

4 – Always supplied (power supply is always present).

The controller keeps the pump off if the selected power source is not available (while maintaining the selected operating mode). With the controller in OFF_RESET mode, the pump is always stopped.

The controller can work both with a contact level detection system and with an analogue level measurement.

This function is enabled if at least one of the configurable digital outputs of the controller is set with function DOF.1037 - “Pump for AdBlue”.

It is also possible to configure a digital output to control an interception solenoid valve on the pump line (DOF.1038 - “Solenoid valve for the AdBlue pump”).

In BoardPrg4 there is menu 4.2.4 for the configuration of the pump. However, it is possible to set the individual parameters by acting directly on the controller.

Parameter P.1495 configures the delay between the activation of the solenoid valve command and the pump start command.

11.11.1 Use with an analogue level measurement

To use this function, it is necessary that:

- The level measurement is acquired via Canbus by the engine control unit (SPN 1761 - SAE J1939). The ECU must therefore provide this measure.
- The contacts for the level must not be configured (see next paragraph), otherwise the controller uses those.
- At least the thresholds for activating and deactivating the pump are configured (parameters P.1492 and P.1493).

Check that the activation threshold (P.1492) is lower than the deactivation threshold (P.1493).

11.11.2 Use with a contact level transducer

To use this function, you need to:

- That the contact level transducer exists.
- That the start and stop contacts are connected to two configurable inputs of the controller.

Contacts must respect the following convention:

- Start contact (input with function DIF.3311): closed when the level is below the starting threshold of the pump.
- Stop contact (input with function DIF.3312): closed if the level is below the pump stop threshold.

11.11.3 Evaluation of the level

The controller assigns the current position of the AdBlue fluid level by evaluating all of the following conditions in order:

- If the level is below the pump start threshold, it assigns the "start" position.
- If the level is higher than the pump stop threshold, it assigns the "stop" position.
- If none of the above conditions are true, assign the position "Hysteresis".

11.11.4 Automatic management of the pump

With reference to the position evaluated in the previous paragraph, the pump is:

- Activated if the level position is “start”.
- Disabled if the position is “stop”.
- Keeps the current command if the position is “hysteresis”.

11.11.5 Manual management of the pump

The pump can be activated and deactivated as required by the operator. However, the controller prevents starting if the level position (see previous paragraphs) is "stop".

11.11.6 Protections

With parameter P.1494 it is possible to set the maximum activation duration of the pump. The time necessary for the pump to fill the daily tank, in the worst conditions, should be set in this parameter. If the pump remains running (both by manual and automatic control) for longer than this time, the controller stops it (without changing the control mode)

and activates the warning W095: probably there is a fault in the pump or however the pump is not drawing from the storage tank. As soon as the alarm is acknowledged by the operator, the pump restarts.

11.11.7 Signalling

The controller makes available the internal commands for the pump and the solenoid valve in two internal statuses (usable in AND/OR logics):

- ST.139: pump control.
- ST.140: solenoid valve control.

In addition, the activation and deactivation of the pump are recorded in the event log (if bit 7 of parameter P.0441 is active):

- EVT.1072: pump activation.
- EVT.1073: pump deactivation.

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