HUEGLI TECH SWITZERLAND

HT GC310 - HT GC350 - HT GC500 - HT GC500*Plus*

Technical Handbook

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Products:

HT GC310 – HT GC350 – HT GC500 – HT GC500*Plus*

A product powered by

ICES AUTOMAZIONE

Revision

Revision	Date	Page	Remark
01	07/05/2009	102	First English version
02	15/12/2009	103	Added par. 2.18 and other minor changes and corrections.
03	13/01/2010	116	Added HT GC350 and HT GC500 details.
04	30/07/2010	127	Valid for release 1.09 of the controllers
05	30/10/2010	127	Valid for release 1.10 of the controllers. 2.1.5.6, 3.3, 4.3, 4.4.1, 4.5.1, 7.1, 7.5.1, 8.18, 9.18
06	15/04/2011	155	Changes in the structure document
07	10/12/2012	156	Changes for SW ver. 1.13 and HT GC500*Plus* model

Contents

Parameters summary

1. Introduction

1.1 Forward

Warning: Before installing and using the device, carefully read this handbook.

1.2 References

[1] SICES EAAM0302xxXA (GC310/GC350 Parameter tables) or EAAM032200XA (GC500 Parameter tables).

[2] SICES EAAS0303xxEN – GC310 Serial communication.

[3] SICES EAAM0136xxEN – Operating manual for J1939 and MTU MDEC interfaces

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

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

[6] EAAM0199xxEN (where xx greater or equal to 06) – Parallel function Handbook

[7] EAAN0347xxEN – GC500 Plant configuration and Power management

[8] EAAN0340xxEN – GC500 Parallel programming notes

1.3 Requirements

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

In this document it is not present a description detailed of all the programming parameters: to this purpose see [1]. The document [1] should be considered integral part of this manual.

1.4 Definitions

Throughout this document the words “BLOCK” or “ALARM” is used to indicate an alarm that makes generation function impossible and causes immediate generator shutdown.

The word “UNLOAD” is used to indicate an alarm that makes generation function impossible and causes the automatic generator shutdown; before the controller shuts-down the generator, the power is transferred to the mains or to other gensets (if possible) and a proper cooling down cycle is performed.

The words “DISABLE” or “DEACTIVATION” are used to indicate an alarm that makes generation function impossible and causes the automatic generator shutdown after a proper cooling down cycle.

The word “WARNING” is used to indicate a warning that requires an operator action but doesn’t require the automatic generator shutdown.

Throughout this document, the words SOFTWARE and FIRMWARE are used as synonymous if they are referred to the board firmware.

1.5 Symbols

In this document a vertical bar on the right margin or a gray background indicates that the chapter or the paragraph has been amended with respect to the last document's version.

1.6 Software revisions

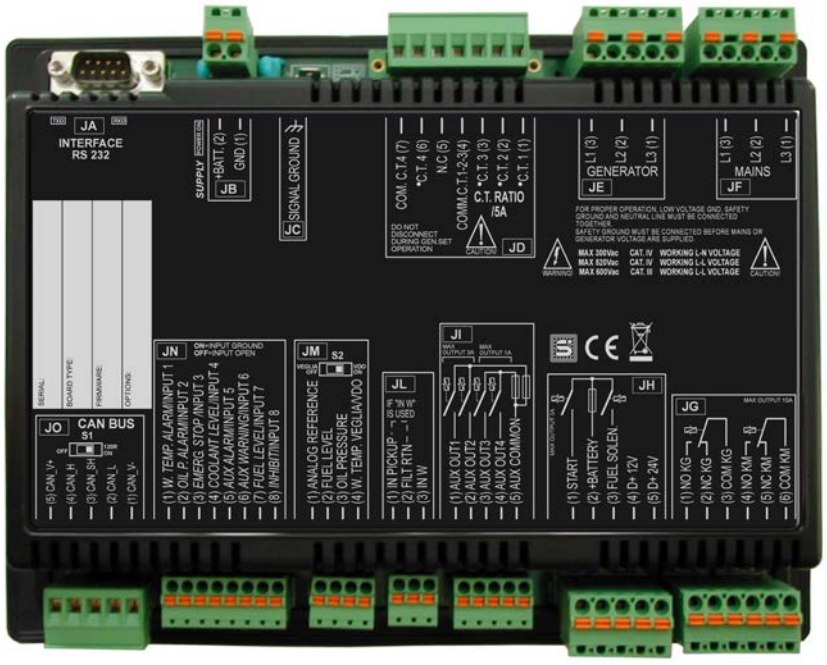
Software code version is reported in a format like EB0220156xxyy, where xx is the major version number and yy is the minor version number. Thus, code EB02201560001 refers to 00.01 software release.

SW revision is shown on the page "S.06" of the LCD display.

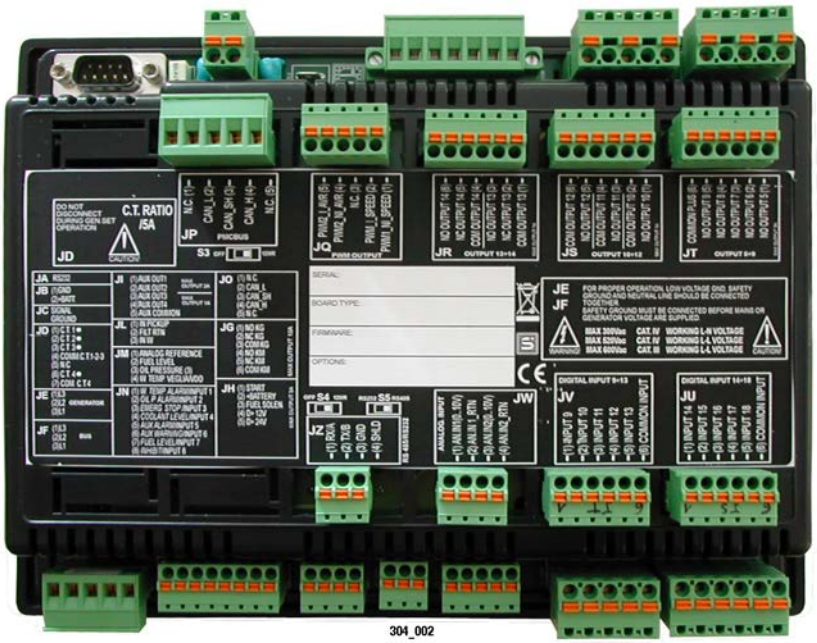
Available software codes are:

- EB0220156xxyy: HT GC310 rev. A.
- EB0220162xxyy: HT GC310 rev. B.
- EB0220167xxyy: HT GC350.
- EB0220169xxyy: HT GC500 and HT GC500*Plus*

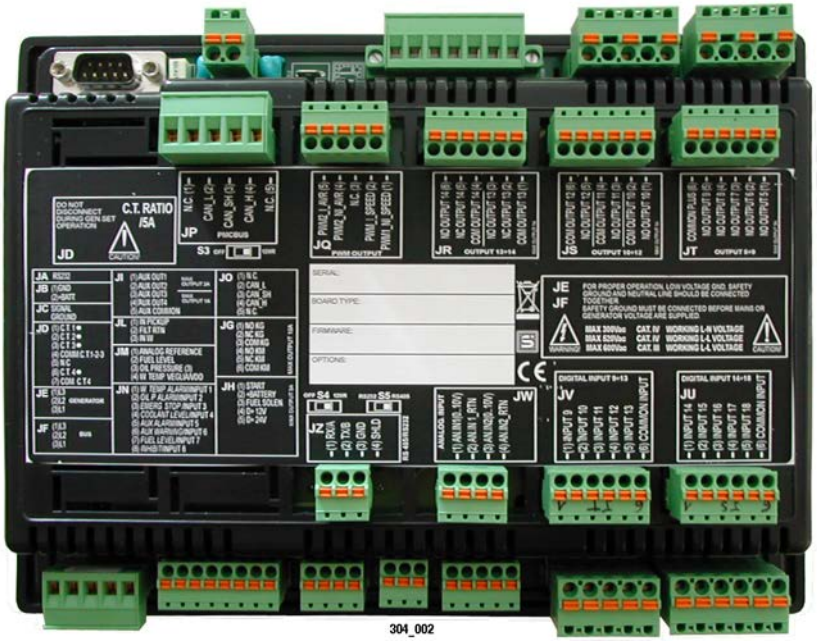
2. Connections



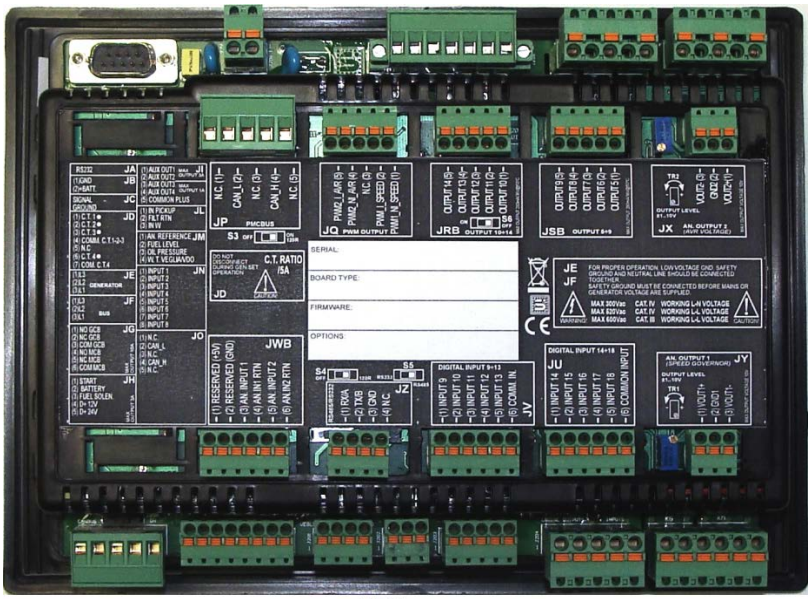
HT GC310 rear panel



HT GC350 rear panel



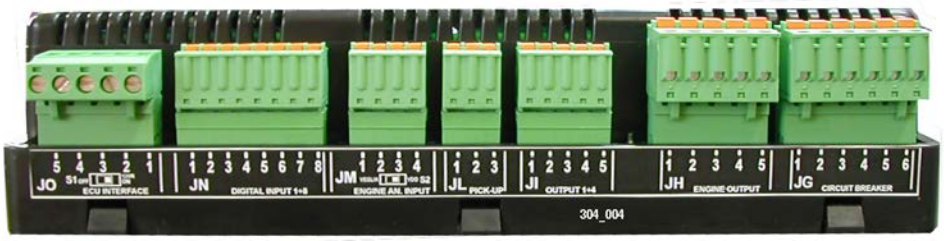
HT GC500 rear panel



HT GC500*Plus*. rear panel

HT GC350 Top view

HT GC500 - HTGC500*Plus* Top View



HT GC350 – HT GC500 – HT GC500*Plus* Bottom view

For the appropriate use of the device, it must be installed in a fixed way in a panel. The connections of the equipment don't have to be accessible without the use of specific keys or utensils. It must not be possible to remove the device without the aid of tools.

2.1 Common connections for all devices

2.1.1 Connection to the public grid (or to common bus for HT GC500 / HT GC500*Plus* only)

It is required to install an external over current protection for each phase of the mains/bus connected to the device. The input impedance of mains/bus input of the board, under normal operation condition, is greater than 1 MOhm. A threshold of protection of 1A is suitable.

The connection to the public electric grid or common bus is made through the connector JF of the card.

Tri-phase connection:

- Connect phase L1 (or R) to terminal 3 of JF connector.
- Connect phase L2 (or S) to terminal 2 of JF connector.
- Connect phase L3 (or T) to terminal 1 of JF connector.
- No neutral connection is available

Single-phase connection

- Connect phase (L) to terminal 3 of JF connector.
- Connect neutral (N) to terminal 2 of JF connector.
- Terminal 1 of JF connector must be let unconnected.

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

For CAT.IV use, the maximum working voltage is 300Vac (phase-neutral) and 520Vac (phase to phase). Maximum voltage to the protection ground is 300Vac.

For CAT.III use, the maximum working voltage is 345Vac (phase-neutral) and 600Vac (phase to phase). Maximum voltage to the protection ground is 600Vac.

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.

The frequency measurement is carried out on phase L1 (terminal JF_3).

2.1.2 Connection to the generator

It is required to install an external over current protection for each phase of the grid connected to the device. The input impedance of grid input of the board, under normal

operation condition, is greater than 1 MOhm. A threshold of protection of 1A is suitable.

The connection to the public electric grid is made through the connector JE of the card.

Tri-phase connection:

- Connect phase L1 to terminal 3 of JE connector.
- Connect phase L2 to terminal 2 of JE connector.
- Connect phase L3 to terminal 1 of JE connector.
- No neutral connection is available

Single phase connection

- Connect phase to terminal 3 of JE connector.
- Connect neutral to terminal 2 of JE connector.
- Terminal 1 of JE connector must be let unconnected.

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

For CAT.IV use, the maximum working voltage is 300Vac (phase-neutral) and 520Vac (phase to phase). Maximum voltage to the protection ground is 300Vac.

For CAT.III use, the maximum working voltage is 345Vac (phase-neutral) and 600Vac (phase to phase). Maximum voltage to the protection ground is 600Vac.

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.

The frequency measurement is carried out on phase L1 (terminal JE-3).

2.1.3 Current transformer connection

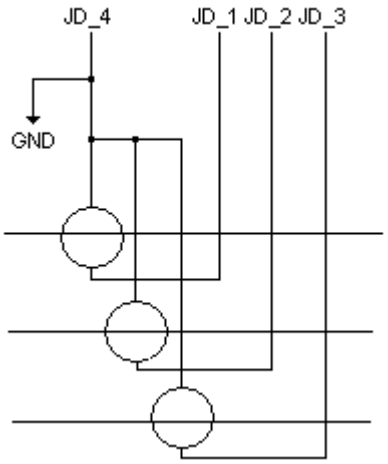
Current transformers (C.T.) must be used in order to allow to HT GCxxx controller to measure the AC current. Use C.T. that have a nominal current of 5A on the secondary side. Above 5.4 Aac, the controller input saturate. In any case it will be able to measure, with less precision, up to 15 Aac.

If the same TA have to be used to supply other device in addition to the HT GCxxx, this one have to be the last one in the connection chain. Current transformers have to be connected to connector JD:

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

The common connection of C.T.**s have to be connected to the negative side of the supply of HT GCxxx.**

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



The C.T.s are normally connected on the power lines of the generator. With HT GCxxx, there is the possibility to connect them on the load side of the changeover: in this way, HT GCxxx measures the currents and the powers also absorbed by the loads when these are connected to the electric grid. You use the parameter P.0124 to define where the C.T.s are connected.

2.1.4 Connection of the auxiliary current measurement

HT GCxxx allows to acquire a fourth measure of current, usable for example for a differential protection. For default, the board is configured for the connection of a current transformer (TA) for the measure of the current: if it is required to use a toroid (instead of a TA) it is necessary to ask for the special option in phase of order.

Up to SW version 01.11, parameter P.0109 could be set to value “0-Not used” and “1-Used”. Starting from version 01.12, the same parameter allow also to select the transformer source setting it to “1-CT” or to “2-Toroid” (that must be done in accordance to the installed interface).

2.1.4.1 Using a CT

Use a transformer that, at the maximum current to be measured, supplies around 5 Aac on the secondary side. The board measures at the most 5.4 Aac, besides this threshold the measure circuit saturates. If the CT has to be connected to other devices in addition to the HT GCxxx, the HT GCxxx has to be the last device of the chain.

- Connect to the terminal JD-6 one terminal of CT
- Connect to the terminal JD-7 the connection return of CT

The CT return has to be connected also to the negative supply of the controller.

2.1.4.2 Using a TOROID for auxiliary current (only from software version 0.12)

If installed the proper measure option, any HT GCxxx can use a toroid to measure the auxiliary current.
The maximum measure current on the primary side is about 40 Ac (depending on the toroid ratio), beyond this value the circuit saturates.

In this case, P.0108 defines the winding ratio of the toroid (not the primary nominal current).

Activation threshold (Ampere) and trip delay (set in seconds) should be set by means P.0637 and P.0638.

Protection will be activated if the measured current is greater than P.0367 threshold for more than P.0368 seconds.

Protection is enabled only if engine is running and can be disabled also by means a digital input configured with the function “69”.

Toroid should be configured in the following way:

- Connect JD-6 to the main toroid terminal
- Connect JD-7 to the toroid return terminal.

The return terminal must be also connected to the negative voltage of the supply and cranking battery.

2.1.5 Engine connection

2.1.5.1 Crank battery connection

For CAT.IV application, the negative voltage of the auxiliary supply voltage (GND at terminal JB_1) must be connected to the protective ground. Otherwise ask to SICES redefinition of the operating condition.

In order to supply the HT GCxxx controller, connect the crank battery in the following way:

- Connect negative terminal of the battery to the terminal JB-1
- Connect positive terminal of the battery to the terminal JB-2

Inside HT GCxxx controller there is an over current protection on the positive terminal. In any case, if an external protection is added, the nominal value should be 2A.

If at least one of the available outputs of the connector JH (see later) is used, it is also necessary to connect the positive battery to the terminal JH-2, through a contact of the button of emergency (that is this connection must have interrupted to pulsating of emergency pressed). This connection, in fact, feeds the commands of starting and arrest of the motor (over that the excitement of the alternator position-batteries): such commands must have removed in case of emergency.

Alternatively, positive voltage can be connected directly to terminal JH-2 and provide an external contact to enable the FUEL SOLENOID and the START COMMAND depending on the EMERGENCY STOP condition.

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

2.1.5.2 Connection of battery charger alternator excitation (D+)

This connection is required if the motor is equipped with a battery charger alternator of the type with no permanent magnets. In these cases, at the starting of the motor it is necessary to make to circulate a current in such alternator (said current of excitement) so that it starts to produce a voltage for the charge of the batteries. The HT GCxxx is able to inject this current of excitement. To use this functionality provide the following connections:

- If the battery is a 12V type, connect the D+ signal of the battery charger alternator to the terminal JH-4, leaving unconnected the terminal JH-5.
- If the battery is a 24V type, connect the D+ signal of the battery charger alternator to the terminal JH-5, leaving unconnected the terminal JH-4.

During engine cranking, terminals JH_4 and JH_5 supply the excitation current to the battery charger (about 120mA @ 24VDC and about 240mA @ 12VDC).

HT GCxxx is able to detect the voltage on the terminal JH-4 and JH-5. In this way the following two tasks are carried out:

- Engine running/stop detection
- Detection of battery alternator not rotating while the engine is running. That means that probably the fan belt, that makes the alternator rotating, is broken. In this case an ALARM (BLOCK) is issued.

Using parameter P.0115 it is possible to enable/disable the two functions (see document [1]).

2.1.5.3 Cranking motor connection

Cranking motor command is available on terminal JH-1; if this command is not required (some engine interfaced by J1939 can be started with "soft command"), this terminal can be used for other purpose setting properly parameter P.0585, see par. 2.1.7 and [1]. This terminal provides a positive voltage supplied by means of terminal JH-2. A current capability is of 3A. If more current is required, use an external boost relay.

The controller active this output whenever an engine start is required and deactivates it within 00-300 ms from the engine running detection.

2.1.5.4 Connection for stopping the engine

Two different ways to stop the engine are implemented in HT GCxxx controllers.

Drop-down stop system

This system provide the stop command deactivating the fuel valve that enable/disable the fuel supply of the engine or removing supply to the speed governor. This command is available through the terminal JH-3: this terminal can't be used for other function and thus should be let unconnected if not used (for example in case of "soft" stop command via CAN-BUS).

The voltage available on terminal JH-3 is feed by means terminal JH-2 and a 3A relays. If more current is required, use an external boost relay.

This command is activated before the start command (at least a delay of 200 ms is provided between this command activation and the start activation).

It is deactivated when the engine has to be stopped; 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

A pick-up stop system is used in old and low cost system or whenever it is required that engine will not stop in case of connection failure.

No dedicated output is provided for this command. In any case it is possible to use any programmable output for this purpose. Configuration can be accomplished by means parameters P.0581 or equivalent (see section 2.1.7).

As default terminal JI-1 is configured for this function.

2.1.5.5 Engine speed measurement connection

HT GCxxx is able to detect the rotation speed of the engine by means a magnetic pick-up or, alternatively, by means the W signal from the battery charger alternator (it is also possible to get the measure from the engine by means CAN interface).

Connection of a magnetic pick-up

A magnetic pick-up can be used in order to detect the engine speed.

- Two wire pick-up: connect one wire to the terminal JL-1 and the other to the negative battery. Terminals JL-2 and JL-3 must be remain unconnected.
- Single wire pick-up: connect the wire to the terminal JL-1. Terminals JL-2 and JL-3 must be remain unconnected.

The pick-up detects the magnetic flux variation of teeth wheel mounted on the engine shaft. With the purpose to calculate the rotation speed in rpm, it is required to set in the controller, by means parameter P.0110, the number of teeth of the wheel; leave this parameter to 0 if terminal JL-1 is left unconnected.

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

- Connect the W signal of the battery charger alternator to the terminal JL-3
- Connect terminal JL-1 to terminal JL-2

The rotation speed of the charger alternator is proportional but not equal to engine speed. It is thus required to specify the speed ratio; that can be done by means parameter P.0111.

May be a little difficult to calculate the actual speed ratio. One solution is to run the engine at 1500 rpm (measuring the speed in some way) and measuring the frequency of the W using a frequency meter.

An empirical way to carry out this configuration is the following:

- Set a tentative value in P.0111, for example 15.
- Start the engine to the nominal speed (1500 rpm) and take note of the rpm speed shown on the HT GCxxx display.
- Calculate the rate between the shown speed and the actual one of the engine (shown/actual).
- Multiply the previous set value set in P.0111 by the calculate value e set to it P.0111.

Starting again the engine, the board should show now the correct speed. In case required carry out again the procedure in order to improve the accuracy. Alternatively increase P.0111 value to decrease the shown value and vice versa.

In order to measure the actual speed during the calibration, it is possible to use the generator frequency multiplied by 30.

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

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

Using generator 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 then alternator frequency). To use this feature, the following settings are needed:

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

2.1.5.6 Coolant temperature sensor connection

Different resistive coolant sensor types can be connected to the HT GCxxx controller:

- VDO 120°C (51,2 Ohm @ 90 °C)
- VDO 150°C (36,5 Ohm @ 120 °C)
- VEGLIA (for IVECO-AIFO engines)
- BERU

These sensors have a wide range of resistor values. The ones that are very different are the two VDO transducers.

In order to grant measurement precision and reliability, a switch (named S2) is provided near the connector JM (in order to access the switch, remove the connector). If it is in ON position, the connected sensor must be VDO; if it is in OFF position the sensor can be VEGLIA or BERU.

Connection:

- If the sensor has two wires, connect one wire to engine chassis or to the control panel ground depending on the connection of “ANALOG REFERENCE” JM-1 terminal. If it has only one wire the ground connection is made through the sensor body.
- Connect the sensor to the terminal to JM-4
- If the sensor has only one wire, connect the terminal JM-1 (“ANALOG REFERENCE”) to the engine chassis. Otherwise, depending also on the other sensor connection, you can select to connect this terminal to engine chassis or to panel ground. **Notice: this connection should be made using a dedicated wire having the shortest possible length. Avoid making the wire lies near high power and high voltage cable.**

Set properly parameter P.0113 in order to select the sensor connected to the controller. If no sensor is connected, leave the parameter to 0.

Using engine that have CAN interface, the connection of this sensor is not necessary, but if it is connected and P.0113 is not set to 0, the measure shown on the display will be the one from the analogue sensor and not from the ECU.

Starting from SW version 01.13, two additional generic sensors are now managed:

- Generic sensor 0-400 ohm
- Generic sensor 0-2800

If a generic sensor is set, it is possible to assign custom transfer curves by means the programming tool BoardPrg3.

- Setting P.0113 to 20, a sensor with a measurable resistance value up to 400 ohm is select (set S2 switch to VDO position).
- Setting P.0113 to 21, a sensor with a measurable resistance greater than 400 ohm is select (set S2 switch to VEGLIA position).

2.1.5.7 Oil pressure sensor connection

Two types of sensor are managed:

- VDO sensor 10 bar: 0÷180 Ohm nominal
- VDO sensor 5 bar: 0÷180 Ohm nominal
- VEGLIA sensor (for IVECO-AIFO engines): 0÷300 Ohm nominal

Connection:

- If the sensor has two wires, connect one wire to engine chassis or to the control panel ground depending on the connection of “ANALOG REFERENCE” JM-1 terminal. If it has only one wire the ground connection is made through the sensor body.
- Connect the sensor to the terminal to JM-3
- If the sensor has only one wire, connect the terminal JM_1 (“ANALOG REFERENCE”) to the engine chassis. Otherwise, depending also on the other sensor connection, you can select to connect this terminal to engine chassis or to panel ground. **Notice: 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.**

It is required to properly set parameters P.0112 in order to configure the controller for the connected type of sensor. Leave the parameter to 0 if nothing is connected to terminal JM-3.

Using engine that have CAN interface, the connection of this sensor is not necessary, but if it is connected and P.0112 is not set to 0, the measure shown on the display will be the one from the analogue sensor and not from the ECU.

Starting from SW version 01.13 of the software, it is also possible to manage a generic 0-300 ohm sensor to which can be assigned a custom curve by means BoardPrg3 software. To access this function, set P.0112 = 20.

2.1.5.8 Fuel level sensor connection

The controller is able to manage resistive fuel level sensor having a maximum resistance value of about 400 ohm.

Connection:

- If the sensor has two wires, connect one wire to engine chassis or to the control panel ground depending on the connection of “ANALOG REFERENCE” JM-1 terminal. If it has only one wire the ground connection is made through the sensor body.
- Connect the sensor to the terminal to JM-2

- If the sensor has only one wire, connect the terminal JM-1 ("ANALOG REFERENCE") to the engine chassis. Otherwise, depending also on the other sensor connection, you can select to connect this terminal to engine chassis or to panel ground. **Notice: 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.**

Set parameter P.0114 to enable the fuel measurement in case a sensor is connected to the input JM-2. Leave it to zero if no fuel sensor is connected.

Refer to chapter 6 for the special procedure for fuel sensor calibration.

Starting from SW version 01.13 of the software, it is also possible to manage a generic 0-400 ohm sensor to which can be assigned a custom curve by means BoardPrg3 software. To access this function, set P.0114 = 20.

2.1.5.9 CAN-BUS connection

Using engine equipped with ECU (Electronic Control Unit) and CAN-BUS interface, most of the previous detailed connections are no more required.

By means a single connection (CAN-BUS), the controller is able to start/stop the engine, preset the speed and gathering measurements and status. Moreover, in case of fault, the controller is able to show the fault code alongside a plain text message to the operator.

CAN-BUS connection is carried out by means connector JO. The terminal assignment is the same of the CANopen specification, but the protocol is different. **Notice: JO connector has gold plated contacts and terminals, do not exchange it with other connectors.** HT GCxxx's CAN interface is insulated from the supply of the controller itself. Thus an external supply should be fed to the connector.

- Connect terminal JO-1 to the positive battery. Preferred solution is connecting this terminal directly to the ECU supply terminal. If the connection is long, this solution has to be used.

- Connect terminal JO-5 to negative battery. **Unless the panel is mounted directly to the engine chassis, this terminal must be connected directly to negative connection of the ECU of the engine**.

For the following connections, use a STP (Shielded Twisted Pair) cable having 120 Ohm of impedance and 0.5 mm^2 of section (20 AWG).

- Connect terminal JO-2 to the CAN_H terminal of ECU

- Connect terminal JO-4 to the CAN_L terminal of ECU

- Connect the shield to the protective ground on the both sides (be sure that both the protective ground will be at the same potential). Do not connect the shield to terminal JO-3.

A 120 Ohm terminating resistor is required at both ends of the connection. Since, usually, CAN engine connection is point-to-point connection, the resistor must be connected on the controller side. Removing the connector JO, it is possible to access a selector "S1" that allows to close/open the terminating resistor connection. **Notice: in quite all application, the terminating resistor must be connected**.

Use parameters of menu 7 such as P.0700 to configure the controller for the connected engine.

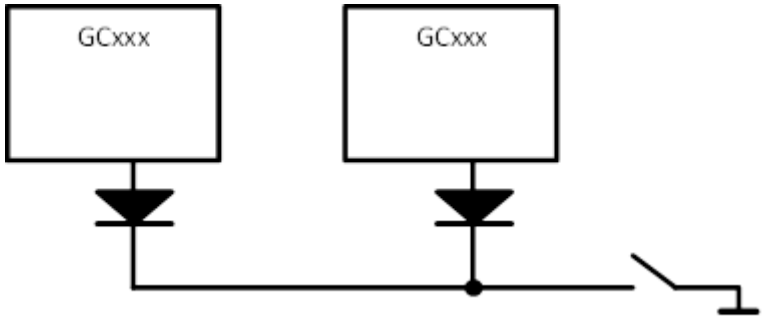
Be sure before make the connection that the engine type is supported by the controller.

HT GC500/HT GC500Plus controllers use a self-powered interface, thus terminal JO-1 and JO-5 must be left unconnected.

2.1.6 Generic digital inputs

HT GCxxx is equipped by 8 insulated digital input; they can be accessed through connector JN. In order to activate an input, it is required to connect the terminal to the negative ground of the controller (JB-1).

It is advisable, whenever two different controller share the same digital input signal, to separate the inputs by means diode as shown in the picture. This solution prevent not wanted input activation in case one of the controller is powered off.



All the eight inputs are configurable; that means that for each input can be selected any available predefined input function. The following table lists the default configuration of this input.

HT GC310/HT GC350

Terminal	Function
JN-1	**15-Maximum coolant temperature**
JN-2	**13-Minimum oil pressure**
JN-3	**28-Emergency stop**
JN-4	**Minimum coolant level (03-Auxiliary alarm + dedicated text message)**
JN-5	**03-Auxiliary alarm (block)**
JN-6	**01-Auxiliary warning**
JN-7	**09-Low fuel level**
JN-8	**40-Inhibition**

HT GC500/HT GC500Plus

Terminal	Function
JN-1	**07 – Generator circuit breaker (GCB) status**
JN-2	**06 – Mains circuit breaker (MCB) status**
JN-3	**28 – Emergency stop**
N-4	**39 – Parallel to the mains protections status**
JN-5	**50 – Dead bus**
JN-6	**17 – Overload**
JN-7	**09 – Low fuel level**
JN-8	**40 – Inhibition**

For a detail of the available functions refer to par 4.4.1. It is possible by means P.0501 to configure each input function to be activated if the related input is not active.

If other digital inputs are required, it is possible to configure one or more of the three engine analogue inputs (JM-2, JM-3 and JM-4) in order to work as digital inputs. In this case, the predefined analogue functions will be not available. **These inputs are not insulated. JM-1 connection is not used for digital function mode.**

By means P.0501 it is possible to change from active-low to active-high (or float) the functionality of the inputs. The configuration can be made individually for each input.

2.1.7 Generic digital outputs

The controller has four relays that can be accessed by means connector JI. If a relay is activated, it makes available the voltage applied to terminal JI-5 (any voltage from 0 to 40V).

Terminals JI-1 and terminal JI-2 have relays having switching capabilities of 3A. Terminals JI-3 and JI-4 have relays having switching capabilities of 1A.

The four outputs are fully programmable. The following table lists the predefined configuration. For more details regarding the available function, please refer to par. ☐

HT GC310/HT GC350

Terminal	**Function**
JI-1	**16 – Stop solenoid**
JI-2	**21 – External horn**
JI-3	**00 – Not used**
JI-4	**00 – Not used**

HT GC500/HT GC500*Plus*

Terminal	**Function**
JI-1	**16 – Stop solenoid**
JI-2	**21 – External horn**
JI-3	**00 – Not used**
JI-4	**30 – GCB Minimum voltage coil enable**

By means P.0580, it is possible to individually configure each output to be activated when the function is not active (inversed polarity).

2.1.8 Changeover command outputs

Two 10A relays are used to manage the load changeover. JG connector makes available both the free potential contacts. Both the N.C. and N.O. ones are available with a single COMMON terminal for each relays.

The two relays are named KG and KM for HT GC310/HT GC350. They are named GCB and MCB for HT GC500/ HT GC500*Plus*. In the following they are referred as KG/GCB and KM/MCB.

Terminal	**Function**
JG-1	KG/GCB N.O. contact
JG-2	KG/GCB N.C. contact
JG-3	KG/GCB common terminal
JG-4	KM/MCB N.O. contact
JG-5	KM/MCB N.C. contact
JG-6	KM/MCB common terminal

KG/GCB relays is used to transfer the load to the generator and KM/MCB is used to transfer the load to the MAINS.

Use N.C. contact of KM/MCB to command the MAINS contactor and use N.O. contact of KG/GCB to command the GENERATOR contactor. In this way the load will be connected to the MAINS even if the controller is not supplied.

Three different kinds of changeover can be managed:

- Motorized changeover (like SIRCOVER). The load is transferred by means a single command. Use terminal JG-1 and JG-3 to command the changeover. In this mode, if the controller is not supplied, the load is in any case connected to the MAINS. Terminals JG-4, JG-5 and JG-6 are not used; thus a different function can be assigned to this output. Program parameter P.0220 to a value greater than the time required for the changeover to switch: that prevents the controller from invert the command before the operation is ended. Instead, set to 0 parameter P.0219 since no wait time is required between the KM/MCB and KG/GCB commands.
- Two motorized circuit breaker or contactor. They can be electrically and mechanically interlocked. The command for the generator device (KG/GCB) has to be taken from terminals 1 and 3 of connector JG. For the MAINS device (KM/MCB), the terminals 5 and 6 of JG have to be used. In this way, at rest, the load is connected to the MAINS. Set parameter P.0220 to 0 (no wait time required for the command inversion) and set at least to 2 seconds parameter P.0219 in order to guarantee two seconds of delay time between the opening of one device and the closure of the other.
- A single motorized circuit breaker. Use terminals JG-1 and JG-3 (KG/GCB) to command the C.B. Connector KM/MCB is not used and can be programmed for other auxiliary function. Both parameters P.0220 and P.0219 can be set to 0.

For output configuration, please, refer to par. 4.5.

2.1.9 Serial communication port

Connector JI allows to interface an external RS232 device. For further information, please, refer to the document [2].

The port pin function is the following:

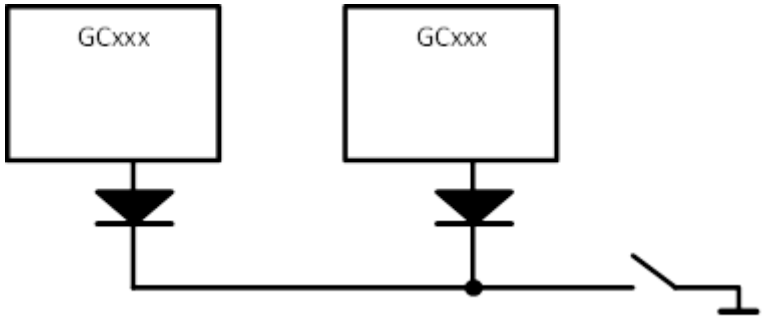
- JA_1: not connected
- JA_2: RXD
- JA_3: TXD
- JA_4: DTR
- JA_5: GND
- JA_6: DSR
- JA_7: RTS
- JA_8: not connected
- JA_9: not connected

2.2 Additional connections for HT GC350/HT GC500/HT GC500*Plus*

Besides the connection available for HT GC310, the HT GC350, HT GC500 and HT GC500*Plus* device are equipped with the following additional connectors.

2.2.1 Additional digital inputs (JV, JU)

It is advisable, whenever two different controller share the same digital input signal, to separate the inputs by means diode as shown in the picture. This solution prevent not wanted input activation in case one of the controller is powered off.



JV connector (HT GC350/HT GC500/HT GC500*Plus*)

This connector provides five additional insulated digital inputs. Terminal JU-6 can be connected to Vbatt for active to ground inputs. Connecting JU-6 to ground, input becomes active if connected to Vbatt.

To the five inputs can be assigned any available digital input functions, refer to par. 4.4. By means P.0531 it is possible to change from active-low to active-high (or float) the functionality of the inputs. The configuration can be made individually for each input.

Terminal	Function
JV-1	INPUT 9
JV-2	INPUT 10
JV-3	INPUT 11
JV-4	INPUT 12
JV-5	INPUT 13
JV-6	COMMON INPUT

JU connector (HT GC350/HT GC500/HT GC500*Plus*)

This connector provides five additional insulated digital inputs. Terminal JV-6 can be connected to Vbatt for active to ground inputs. Connecting JV-6 to ground, input becomes active if connected to Vbatt.

To the five inputs can be assigned any available digital input functions, refer to par. 4.4. By means P.0531 it is possible to change from active-low to active-high (or float) the functionality of the inputs. The configuration can be made individually for each input.

Terminal	Function
JU-1	INPUT 14
JU-2	INPUT 15
JU-3	INPUT 16
JU-4	INPUT 17
JU-5	INPUT 18
JU-6	COMMON INPUT

2.2.2 Additional digital outputs (JT, JS, JR, JSB, JRB)

JT connector (HT GC350/HT GC500)

The six poles JT connector allows wiring six common potential outputs. When the outputs are activated, the related terminal is internal connected to common terminal JT-6 (**JT-**6 must be connected to a positive supply voltage, normally to the positive battery voltage).

All terminals have relays having switching capabilities of 1A.

To all outputs can be assigned any available output functions, refer to par. ☐ It is possible by means P.0589 to configure each output to be activated if the assigned function is not active (inverse polarity).

Terminal	Function
JT-1	N.O. OUTPUT 5
JT-2	N.O. OUTPUT 6
JT-3	N.O. OUTPUT 7
JT-4	N.O. OUTPUT 8
JT-5	N.O. OUTPUT 9
JT-6	COMM. PLUS INPUT

JS connector (HT GC350/HT GC500)

The six poles JS connector allows wiring three free potential outputs. Only normally open contacts are available.

All terminals have relays having switching capabilities of 1A.

To all outputs can be assigned any available output functions, refer to par. ☐ It is possible by means P.0589 to configure each output to be activated if the assigned function is not active (inverse polarity).

Terminal	Function
JS-1	N.O. OUTPUT 10
JS-2	COMM. OUTPUT 10
JS-3	N.O. OUTPUT 11
JS-4	COMM. OUTPUT 11
JS-5	N.O. OUTPUT 12
JS-6	COMM. OUTPUT 12

JR connector (HT GC350/HT GC500)

The six poles JR connector allows to wire two free potential outputs each having two contact outputs (both normally open and normally closed one).

All terminals have relays having switching capabilities of 1A.

To all outputs can be assigned any available output functions, refer to par. ☐ It is possible by means P.0589 to configure each output to be activated if the assigned function is not active (inverse polarity).

Terminal	Function
JR-1	Common terminal OUTPUT 13
JR-2	N.C. OUTPUT 13
JR-3	N.O. OUTPUT 13
JR-4	Common terminal OUTPUT 14
JR-5	N.C. OUTPUT 14
JR-6	N.O. OUTPUT 14

JSB connector (HT GC500*Plus*)

This connector allows to access 5 static digital outputs (open collector) that have negative voltage as common terminal. When active they connect the terminal to negative ground, otherwise they are open. All the five outputs are fully programmable (see par. 4.5). By means parameter P.0589, it is possible, for any single outputs, to reverse the functionality allowing them to be shorted to ground whenever the function is not active.

Any single output is capable to sink a maximum current of 280mA/36V @50°C with a total maximum sink of 1A. Outputs are protected against overcurrent, overvoltage and overtemperature. In case of activation of a protection, output will be disconnected from ground until the fault condition is removed.

Terminal	Function
JSB-1	Open collector output 5
JSB -2	Open collector output 6
JSB -3	Open collector output 7
JSB -4	Open collector output 8
JSB -5	Open collector output 9

JRB connector (HT GC500*Plus*)

This connector allows to access 3 static digital outputs (open collector) and 2 relays that have negative voltage as common terminal. When active they connect the terminal to negative ground, otherwise they are open. All the five outputs are fully programmable (see par. 4.5). By means parameter P.0589, it is possible, for any single outputs, to reverse the functionality allowing them to be shorted to ground whenever the function is not active. Output 10, 11 and 12 can be programmed with the PWM 500Hz function (function usable only on one output). See par. 4.5.1 function OF-49.

Any single output is capable to sink a maximum current of 280mA/36V @50°C with a total maximum sink of 1A. Static outputs are protected against overcurrent, overvoltage and overtemperature. In case of activation of a protection, output will be disconnected from ground until the fault condition is removed.

Terminal	Function
JRB-1	Open collector output 10 (PWM 500Hz function available)
JRB -2	Open collector output 11 (PWM 500Hz function available)
JRB -3	Open collector output 12 (PWM 500Hz function available)
JRB -4	N.O. relay output 13
JRB -5	N.O. relay output 14

2.2.3 JZ - Additional serial communication port

JZ allows to interface to the additional serial communication port.

Terminal	Function
JZ-1	RS232 RX – RS485 A
JZ-2	RS232 TX – RS485 B
JZ-3	GND
JZ-4	N.C.

This port can be used as RS232 or RS485 interface. Selector S5 on the rear panel allows to configure the operating mode.

In case the RS485 mode is selected, switch S4 allows connect/disconnect the 120 ohm resistor for termination. **RS485 interface is not insulated.** For further information, please, refer to the document [2].

2.3 Additional connections for HT GC500/ HT GC500*Plus*

Besides the connection available for HT GC310 and HT GC350, the HT GC500/HT GC500*Plus* device is equipped with the following additional connections.

2.3.1 JP - PMCBUS interface (HT GC500/HT GC500*Plus*)

PMCBUS is used to interface other SICES controllers for LOAD SHARING and POWER MANAGEMENT functions. PMCBUS uses a CAN 2.0B interface working at 250 kbit/s.

The terminal assignment is the same of the CANopen specification, but the protocol is different. **Notice: JP connector has gold plated contacts and terminals, do not exchange it with other connectors.**

Interface is insulated; please do not refer any terminals of this connector to the panel supply potential.

Interface is self-powered, thus terminal JP-1 and JP-5 must be left unconnected.

Use adequate interface cable and proper termination resistor for reliable communication. If required, switch S3 allows to insert the 120 ohm resistor for termination.

2.3.2 JQ – PWM OUTPUTS(HT GC500/HT GC500*Plus*)

By means JQ connector, two PWM outputs, having predefined functions, are made available in order to interface analogue devices.

Terminal	Function
JQ-1	PWM1_NI_SPEED
JQ-2	PWM1_I_SPEED
JQ-3	N.C.
JQ-4	PWM2_NI_SPEED
JQ-5	PWM2_I_SPEED

PWM1 is used to control a speed regulator by means an analogue interface, as alternative to the digital speed control carried out by means Canbus-J1939 interface.

PWM2 can be used in order to interface the alternator AVR in order to control the generator voltage and reactive power (in parallel applications).

Beware: these outputs can't be directly connected to the controlled device. A PWM to current (or to voltage) converter such as SICES E6102117100xx is required.

The converter must be locate inside the same panel of the controller, near as possible, in order to keep shorter as possible the connection shielded cable. Supply the converter with the same supply used for the controller.

Only for HT GC500*Plus*:

this controller is already equipped by two analogue outputs used mainly for SPEED GOVERNOR and AVR interface and thus it does not require the use of this PWM interface.

In case this output is used remember that for HT GC500*Plus* the output command is limited within a minimum value of 4% and a maximum value of 96%.

2.3.3 JW – Analogue inputs (HT GC500)

JW connector offer provision for two analogue inputs connection.

Terminal	Function
JW-1	AN.IN1
JW-2	AN.IN1_RTN
JW-3	AN.IN2
JW-4	AN.IN2_RTN

The two analogue inputs allow signals having a dynamic range of 0...10V.

Inputs are of differential types, so two signals are available for any of them. In any case, beware that they **are not insulated**, thus RTN signals should be connected to a potential near or equal the ground of HT GC500 supply (negative terminal JB-1).

2.3.4 JWB – Analogue inputs (HT GC500*Plus*)

JWB connector offer provision for two analogue inputs connection.

Terminal	Function
JWB-1	+5V output reference reserved for potentiometer supply. Minimum resistor value should be 10kohm.
JWB-2	Ground output reference reserved for potentiometer supply. Minimum resistor value should be 10kohm.
JWB-3	AN.IN1
JWB-4	AN.IN1_RTN
JWB-5	AN.IN2
JWB-6	AN.IN2_RTN

The two analogue inputs allow signals having a dynamic range of 0...10V.

Inputs are of differential types, so two signals are available for any of them. In any case, beware that they **are not insulated**, thus RTN signals should be connected to a potential near or equal the ground of controller supply (negative terminal JB-1).

2.3.5 JY – Analogue output (HT GC500*Plus*) (AO_CONTROLLER_01)

Terminal	Function
JY-1	VOUT1+
JY-2	GND1
JY-3	VOUT1-

By default this output is used to drive a SPEED GOVERNOR unit. The maximum output voltage can be regulated between a minimum of ±1V and a maximum of ±10V by means on

board trimmer TR1. A bipolar output is available between terminals Vout1+ and Vout1-; only positive voltage is available between terminal Vout1+ and GND1.

- Output is insulated from supply ground
- Suggested maximum load is 10kohm

Function of this output can be set by means P.6001: if it is set to '000-Not used', output is switched off reducing the power consumption of the controller.

Output span can be set by means potentiometer TR1. Range can also set by means parameters P.0856 (minimum output value in %) and P.0857 (maximum output value in %).

P. 0831 defines the type of regulation:

- 0 – Normal regulation: an increase of the percentage command causes an increase of the output voltage and vice versa.
- 1 – Inverse regulation: an increase of the percentage command causes a decrease of the output voltage and vice versa.

In case the output is used for SPEED GOVERNOR (standard use), parameter P.0840 defines the output percentage command at rest.

2.3.6 JX – Analogue output (HT GC500*Plus*) (AO_CONTROLLER_02)

Terminal	Function
JX-1	VOUT2+
JX-2	GND2
JX-3	VOUT2-

By default this output is used to drive an AVR unit. The maximum output voltage can be regulated between a minimum of ±1V and a maximum of ±10V by means on board trimmer TR2. A bipolar output is available between terminals Vout2+ and Vout2-; only positive voltage is available between terminal Vout2+ and GND2.

- Output is insulated from supply ground
- Suggested maximum load is 10kohm

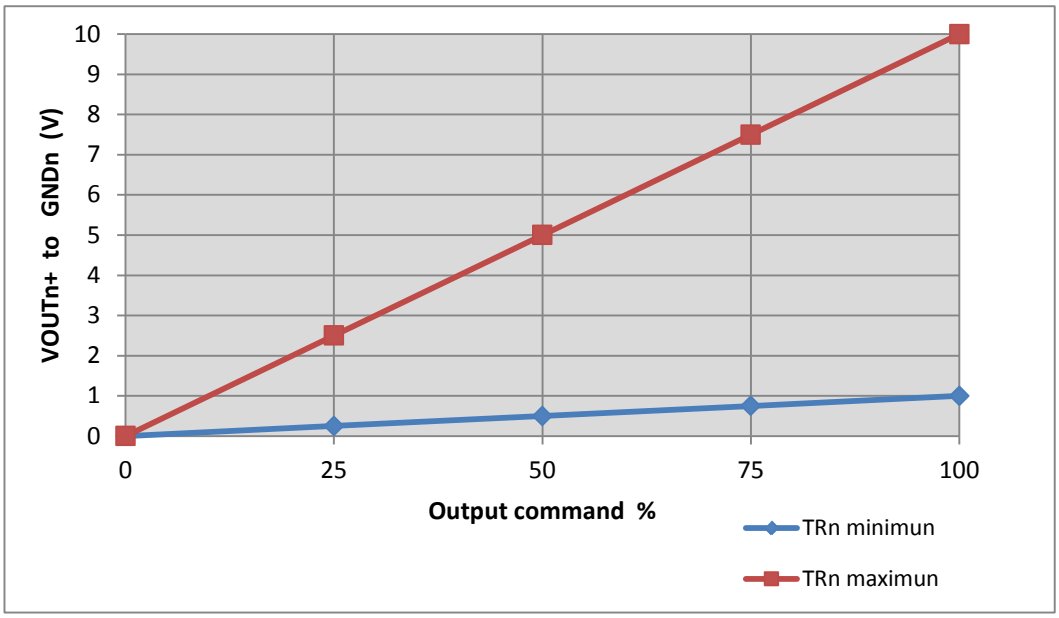
Function of this output can be set by means P.6002: if it is set to '000-Not used', output is switched off reducing the power consumption of the controller.

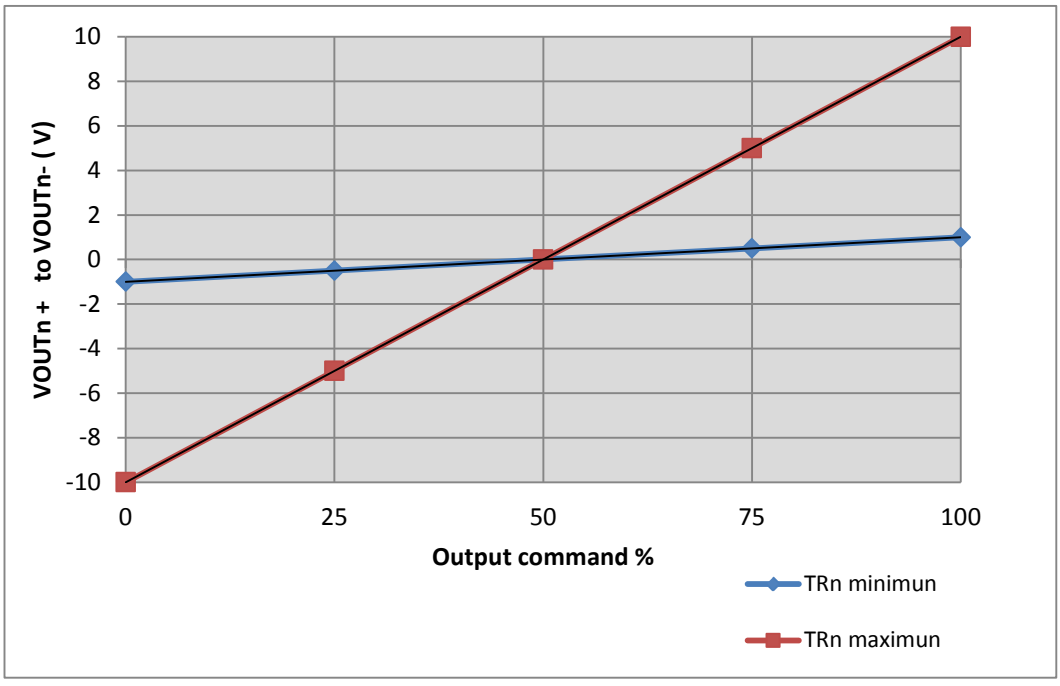
Output span can be set by means potentiometer TR2. Range can also set by means parameters P.0862 (minimum output value in %) and P.0863 (maximum output value in %).

P. 0861 defines the type of regulation:

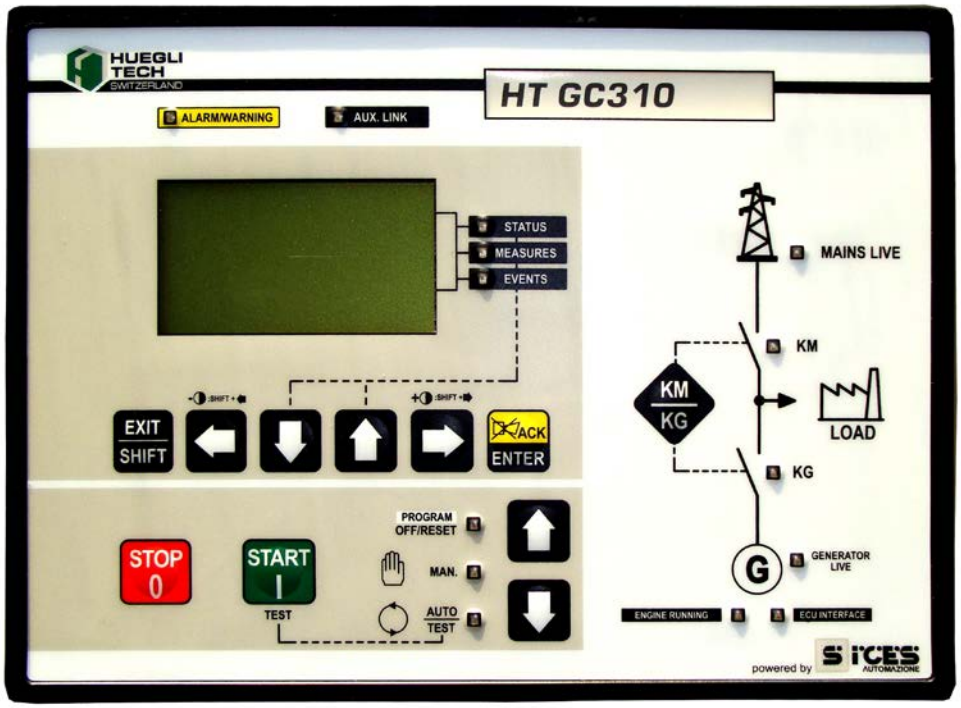
- 0 – Normal regulation: an increase of the percentage command causes an increase of the output voltage and vice versa.
- 1 – Inverse regulation: an increase of the percentage command causes a decrease of the output voltage and vice versa.

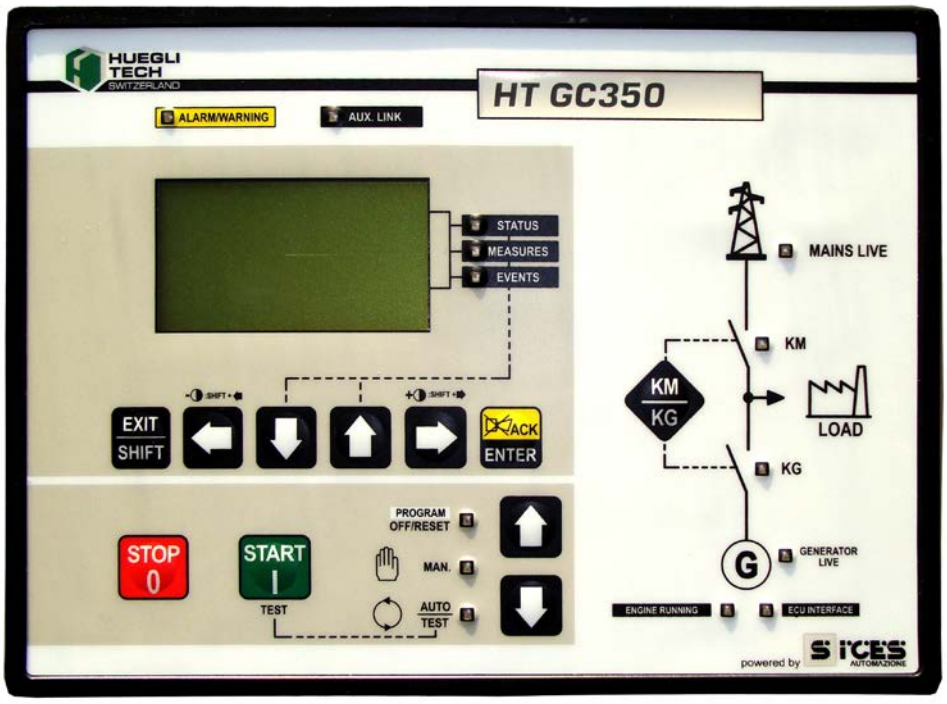
In case the output is used for AVR (standard use), parameter P.0867 defines the output percentage command at rest.


10
9
8
7
6
5
4
3
2
1
0
VOUTn+ to GNDn (V)
0
25
50
75
100
Output command %
TRn minimun
TRn maximun

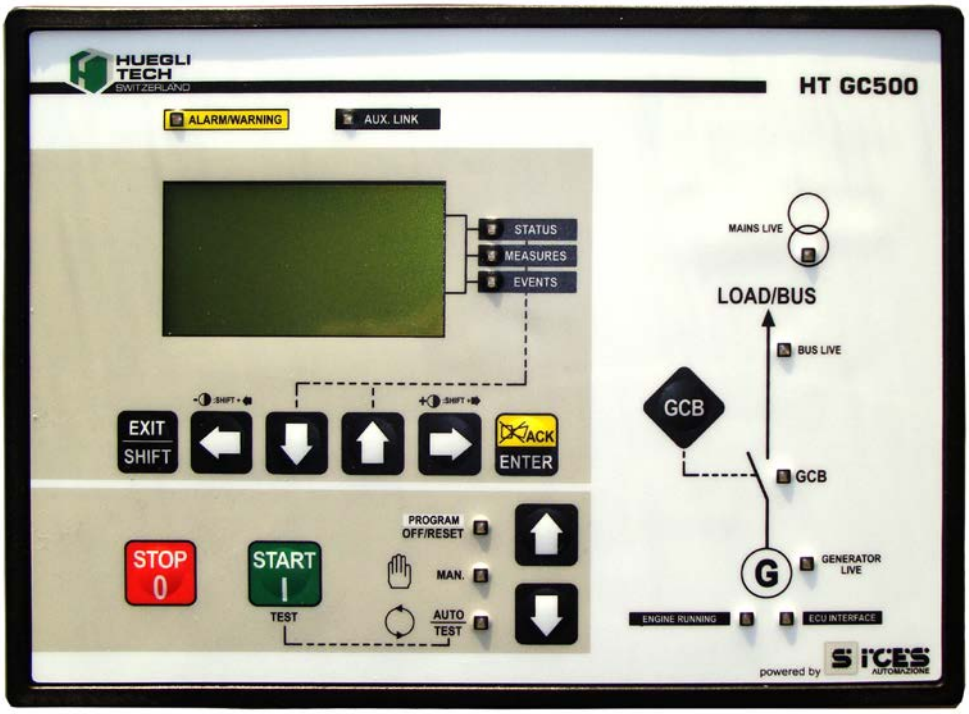

10
8
6
4
2
0
-2
-4
-6
-8
-10
VOUTn + to VOUTn- (V)
0
25
50
75
100
Output command %
TRn minimun
TRn maximun

3. Front panel





HT GC310 and HT GC350 front panel



HT GC500 and HT GC500*Plus* front panel

3.1 Pushbuttons

11 pushbuttons are available for the operator interface. The following table lists their functions.

Pushbutton	Function
STOP	It is used to stop the engine. In AUTO, TEST and REMOTE START mode it is issued a BLOCK. In OFF/RESET mode, the pushbutton drives the LAMP TEST function. Pressed at the same time with the STOP key at the power up, it allows to enter the board special functions.
START	In MAN mode it can be used to start the engine. In AUTO mode enables/disables TEST mode. Pressed at the same time with the STOP key at the power up, it allows to enter the board special functions.
MODE UP MODE DOWN	They allow to change the function mode. OFF_RESET, MAN and AUTO mode can be selected. **In order to change the mode, the pushbutton must be kept pressed for at least half seconds.**
EXIT / SHIFT	Pressed alongside the ◄ or ► pushbuttons, it changes the multifunction display contrast. During programming, pressed alongside the ▲ or ▼ keys, it makes the menu scrolling and the value increase/decrease faster. If used alone, it aborts the current change. During programming or in HISTORY view, it allows to go up the in the previous menu level or to exit the function. If it is kept pressed for at least 2 seconds, the programming mode is leaved retaining the current menu position for further programming access. Depending on the status and the mode, it displays a help message on the bottom row of the display. In OFF_RESET mode, if pressed alongside the ENTER key for at least 5 seconds, it executes a clear task that depend on the shown screen of the multifunction display: default parameters are reloaded, counters are cleared, history data are cleared, peak values are cleared, cancel the BUS-OFF status of CAN-BUS. In some situation, special display mode is exited.
► ◄	They allow to select previous and following pages of the LCD display (except in PROGRAM mode). In Program mode, they are used to move the cursor while editing character strings. Used together with the SHIFT key it modifies the display contrast.
▲ ▼	They allow selecting the multifunction display mode. The following 5 modes are available: PROGRAM, STATUS, MEASURES, ENGINE, and EVENTS (for HT GC500 the PMCB mode is also provided). In addition, in PROGRAM and HISTORY LOGS mode they allow scrolling menus, increase/decrease variables or scroll records. Used in combination with the SHIFT button, in PROGRAM mode, it allows scrolling menu by step of 5 rows or increase/decrease variables in ten units' steps. They allow to scroll alarm or status if this function is active.
ENTER /ACK	It allows to enter the program mode. Selects a menu entry or enables/disables the changing mode of a variable; confirm a new value. It is used to enter also the EVENTS function after selecting the required archive. It enters/ends the changing mode in some measurement pages. It is used to acknowledge an alarm status and activates the status/alarm scroll mode (and some other special display modes). If pressed alongside the EXIT key for at least 5 seconds it executes a clear task (see EXIT key description). It is used also to acknowledge non volatile memory errors at board power up.
KM/KG **(HT GC310 and HT GC350 only)**	It commands the changeover in order to load or unload the generator. It works only in MAN and TEST mode.

Pushbutton	Function
GCB **(HT GC500/HT GC500^{Plus} only)**	It is used to command the closure of the Generator Circuit Breaker with or without synchronization. If it is already close, the activation of the pushbutton forces the GCB opening (with power unload if needed). **In single-generator plants where no digital inputs are used for Mains Circuit Breaker manual commands, it works like "KM/KG" pushbutton of HT GC310/HT GC350.** It works only in MAN and TEST mode.

3.2 Signal lamps

14 LED signal lamps are available. If the "OFF_RESET" mode is active, pressing the STOP pushbutton activates the LAMP test.

Signal	Function
ALARM / WARNING	If ON in fixed mode, it signals that at least a block or deactivation is present. If flashing, there is pending at least a warning. If OFF no anomalies are active.
AUX. LINK	If ON in fixed mode, it signals that a link is established on the serial communication ports. If flashing, it signals that a command received from the remote link is in execution (for example a REMOTE TEST was activated from serial port). If OFF no communication is in progress on the serial ports.
STATUS	If fixed ON, it signals that the current display mode is the STATUS MODE.
MEASURES	If ON, it signals that the current display mode is the MEASURE MODE and electrical or engine measures are actually shown. For HT GC500, it signals also that the PMCB pages are shown.
EVENTS	If fixed ON, it signals that the current display mode is the EVENTS and HISTORY MODE.
OFF_RESET / PROGRAM	If ON in fixed mode, it signals that the current operation mode is OFF_RESET. If flashing it signals that the current display mode is PROGRAMMING.
MAN	If fixed ON, it signals that the operation mode is MAN.
AUTO / TEST	If fixed ON, it signals that the operation mode is AUTO. If flashing with 50% duty, it signals that the board is in the TEST operating mode. If flashing, 90% ON and 10% OFF, it signals that it is active a REMOTE START.
MAINS LIVE	If fixed ON, it signals that the MAINS voltages and frequency are stable inside the operating window. If OFF, it signals that no voltages and frequency are present in any phases. If flashing, 75% ON and 25% OFF, it signals that the MAINS voltages or frequency are above the high limit of the operating window. If flashing, 25% ON and 75% OFF, it signals that the MAINS voltages or frequency are below the low limit of the operating window. It signals also the "voltage unbalance" and the "wrong phase sequence" situations on mains voltages. If flashing, 50% ON and 50% OFF, it signals a transition between the previous status. **Note: this is valid when the internal mains sensor is used, but also when external contacts are used or when an external MC100 device manages the mains (for HT GC500/HT GC500^{Plus} only).** **Only for HT GC500/HT GC500^{Plus}: if more than one MC100 are available (and so more than one mains) and some mains are out of tolerance while some other are in tolerance, for HT GC500 the mains is out of tolerance but it show this situation by blinking this lamp 5% on – 95%.**
KM **(HT GC310 and HT GC350 only)**	If fixed ON, it signals that the KM breaker is closed. OFF if the breaker is open. Flashing, 75% ON and 25% OFF, if KM is closed while the command is to open. Flashing, 25% ON and 75% OFF, if KM is open while the command is to close.

Signal	Function
Bus Live **(HT GC500/HT GC500^{Plus} only)**	If fixed ON, it signals that the bus voltages are stable inside the operating window. If OFF, it signals that no voltage is present in any phases. If flashing, 25% ON and 75% OFF, it signals that the MAINS voltages are below the low limit of the operating window. If flashing, 75% ON and 25% OFF, it signals that the MAINS voltages are above the high limit of the operating window. If flashing, 50% ON and 50% OFF, it signals a transition between the previous status.
KG/GCB	If fixed ON, it signals that the KG/GCB breaker is closed. OFF if the breaker is open. Flashing, 75% ON and 25% OFF, if KG/GCB is closed while the command is to open. Flashing, 25% ON and 75% OFF, if KG/GCB is open while the command is to close.
GENERATOR LIVE	If fixed ON, it signals that the GENERATOR voltages are stable inside the operating window. If OFF, it signals that no voltage is present in any phases. If flashing, 25% ON and 75% OFF, it signals that the GENERATOR voltages are below the low limit of the operating window. If flashing, 75% ON and 25% OFF, it signals that the GENERATOR voltages are above the high limit of the operating window. If flashing, 50% ON and 50% OFF, it signals a transition between the previous status.
ENGINE RUNNING	Fixed ON, it signals the engine running status. Flashing if the engine is cooling down. OFF if engine is stopped.
ECU INTERFACE	Fixed ON if the CAN-BUS connection to the engine is active and communication is working properly. OFF if the CAN-BUS interface is disabled or if no communication is flowing over the bus. Flashing, 25% ON and 75% OFF, it signals the ERROR-PASSIVE status of the CAN-BUS interface. Flashing, 75% ON and 25% OFF, it signals the BUS-OFF status of the CAN-BUS interface. See [3].

3.3 Multifunction display

It is a graphical display that has a resolution of 128x64 pixels.

The backlight lamp is managed by the controller that switches it off after a configurable time (P.0492) if no pushbutton is pressed. To switch it ON again, press any pushbutton. It is possible to disable this function, setting to 0 parameter P.0492. During the engine cranking, it is switched OFF in order to reduce the power consumption of the controller and allowing functionality even with very critical battery condition. If the controller temperature is very low, the lamp is switched in any case ON in order to warm up the controller and the display. On the contrary, in case of elevate temperature, the lamp is switched OFF after a second. Using parameter P.0493 it is possible to force the lamp always ON when the engine is running.

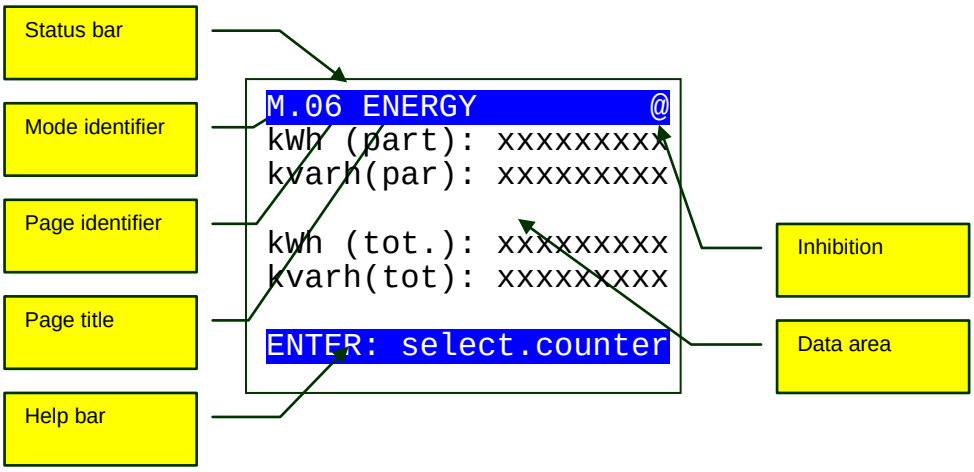
Display contrast can be adjusted pressing at the same time the SHIFT and ◄ (to decrease) or the SHIFT and ► (to increase) pushbuttons.

HT GCxxx uses two different font types that have different dimension. The basic font allows a matrix of 21 characters by 8 rows.

Different display modes are available. Each mode has some pages. Using the ▲▼ pushbuttons, it is possible to select the display mode, while the pages of the selected screen mode can be scrolled using the ◄► pushbuttons. Some screen mode are menu-based; in this case, pressing the ENTER key is request in order to enter the mode. After entering the mode, the menus can be scrolled using the ▲▼ pushbuttons.

As general rule, in case the pushbuttons ▲▼and ◄► have to be used to accomplish task inside the page, it will be necessary to press ENTER to enable the function and EXIT or again ENTER to disable/leave the function.

All the multifunctional display's pages have the same structure.



The status bar, shown in reverse mode, is always present and contains useful information:

- The "Mode identifier" that consist of 5 different letters that identify the screen mode:
    - "P": programming
    - "S": status
    - "M": electrical measure
    - "B": parallel measures (*HT GC500/HT GC500Plus* only).

  - “E”: engine measure
  - “H”: events and history logs

- The “Page identifier” that shows which page is currently shown on the display.
- The “Page title” is a text that describes the current shown page. The title text depends on the selected language. Thus, it will be better to identify the page using also the Mode and Page identifier.
- If some digital inputs are used to select the operating mode of the controller, a small “key” symbol is shown on the far right. See 7.1.
- If any type of inhibition that prevents the generator from start is present, a small lock symbol will be shown on the far right.

Combining Mode and Page identifier allows to have unique identification for every page.

The “Help bar” is available only for some pages, not for all. In some case, it is required to press the “SHIFT” pushbutton to activate it.

3.3.1 Programming

This mode allows to show and modify the programming parameters. See paragraph 4for detailed information regarding programming.

3.3.2 Status

This mode consists of 10 pages.

3.3.2.1 S.01 STATUS

Purpose of this page is to report the general status of the plant. It contains:

- Working status of the generator (stopped, running, supplying, etc.)
- Working mode of the controller (MAN, AUTO, etc.)
- MAINS status (available, not available, etc.)
- If any kind of start inhibition is active
- If any kind of changeover inhibition is active
- If the engine protection override is active

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

3.3.2.2 S.02 ANOMALIES

This page is automatically shown in case a new anomaly arises. For every anomaly, it is shown:

- A letter that identify the type:
  - “A”: Alarm (block)
  - “U”: Unload (HT GC500 only)
  - “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.
- A text message that depends on the selected language and that can be, for some anomalies, customized. For this reason, when report an anomaly, please report also the type identifier and the numeric code.

Every anomaly uses one or two row of the display. The top one is the most recent. If space is not sufficient to show all the pending anomalies, only the most recent ones are shown. In order to see the others, it is required to:

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

For HT GC500 only, for some particular general alarms (for example W273), the last two lines show additional information about the alarm.

This page can also contain diagnostic information received through CAN-BUS interface from the engine ECU. For every diagnostic code it is shown:

- SPN code (SAE J1939 “suspect parameter number” that identify the fault component or part).
- FMI code (SAE J1939 “failure mode indicator” that define the type of failure).
- How many times this code was activated (OC, “occurrence counter”).
- An engine proprietary diagnostic trouble-shooting code or flash-code (if available and managed).
- An explaining text (always in English). For some SPN the text is not available. Thus refer to SAE J1939 or to the engine manufacturer in order to identify the fault.

If one or more of the previous information are not available, they are replaced with dashes or not shown. If more than one diagnostic code is active at the same time, they will be shown in cyclic mode, changing the displayed code every 2 seconds.

3.3.2.3 S.03 PLANT

The digital input of the controller can be configured in order to acquire status information (two categories are available: simple and important). It is also possible to assign a text to the input configured in this way. If one of these inputs is activated, the assigned text will be shown. If the input status is of the type important, this page will pop up.

Every status uses one or two row of the display. If no space is available for all the status, only some of them will be shown. 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

3.3.2.4 S.04 SERIAL COMMUNICATION

This page is used to show the serial communications status. In case of functional problems, please, verify the content of this page.

For the main serial port, it is always shown the type of connection (direct, PSTN modem or GSM modem) and the related status (at rest, communication in progress etc.). In case of GSM modem, information related to the radio signal strength and the provider are shown.

For HT GC350 and HT GC500/HT GC500*Plus* it is also shown the status of the second serial port (connector JZ).

3.3.2.5 S.05 CAN-BUS

This page is used to show the CAN-BUS communication status. In case of functional problems, please, verify the content of this page.

If the CAN-BUS connection is enabled, this page shows the connection status (ERROR-ACTIVE, ERROR-PASSIVE, BUS-OFF) and the transmission and reception error number. When this page is shown, it is possible to clear the error counter and set the ERROR-ACTIVE status (that is the status for correct communication) pressing at the same time the pushbuttons ENTER and EXIT for at least 5 seconds.

For *HT GC500/HT GC500Plus* it is also shown the status of the second CAN-BUS interface (PMCBUS connector JP, used for LOAD-SHARING). Information similar to those of the CAN0 (Engine Interface) are shown.

3.3.2.6 S.06 BOARD

This page is dedicated to the controller itself. It contains:

- The current set operating language.
- Date and Time in extended format (flashing if not valid)
- The internal temperature of the controller
- Internal code used for SICES password (***HT GC500/HT GC500Plus* only**)
- The unique identification number of the controller (ID CODE)
- The Software type and version of the controller (see par. 1.6)
- The Software type and version of the extension (**HT GC350 and *HT GC500/HT GC500Plus* only)**

3.3.2.7 S.07 FUEL PUMP

This page is used to display information related to the fuel pump management. **It is not shown if there isn't any output configured with the "FUEL PUMP" function**.

It shows:

- Fuel pump mode (MAN-OFF, MAN-ON, AUTO).
- Fuel pump status (OFF, ON).

- An indication of the fuel level status referred to the pump management (Start request, stop requested, in hysteresis).

If the fuel pump management uses the analogue level sensor, the board shows by means a bar graph the actual fuel level, signaling at the same time the start/stop thresholds of the pump.

It is possible to change the pump management mode from this page without enter the programming mode.

To do that proceeds in the following way:

- Press the ENTER pushbutton: the square brackets that enclose the pump mode start to flash.
- Use the ▲▼ pushbutton to select the required mode.
- Confirm pressing ENTER or abort by EXIT.

See paragraph 9.1 for a detailed description of the available mode of the controller for the fuel pump management.

3.3.2.8 S.08 DIGITAL INPUT

This page shows the status of all the digital inputs of the controller.

The logic statuses of the inputs are shown. Physical status can be different depending on the configuration of the inputs.

In the page, a “0” associated to an input means that the input is not active. A “1” means that the input is active.

Inputs of both connectors JN and JM are shown. JM inputs are shown with dashes in case they are not configured as digital inputs (by default they are analogue inputs).

For HT GC350 and HT GC500, additional lines are used to report the status of the digital input of connectors JV and JU.

3.3.2.9 S.09 DIGITAL OUT

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

The logical statuses of the outputs are shown.

In the page, a “0” associated to an output means that it is not active. A “1” means that the output is active.

Output status of connectors JI, JH and JG are shown.

For HT GC350, HT GC500 and HT GC500^{Plus}, additional lines are used to report the status of the digital output of connectors JT, JS and JR(HT GC350/HT GC500) or JSB and JRB (HT GC500^{Plus}).

3.3.2.10 S.10 ANALOGUE I/O

Screen S.10 shows all the analogue status of the controller (connector JM). For each input it is shown the voltage value in V; for terminal JM-2, JM-3 and JM-4 it is shown also the resistive value in ohm.

For HT GC500 additional lines are used to report the value of the voltage read by means connector JW.

3.3.2.11 S.11 ANALOGUE OUTPUT (HT GC500/HT GC500Plus)

This screen shows the actual percentage value of the analogue outputs.

Only from SW version 01.13.

3.3.3 Electrical measures

In this mode are shown, by means some pages, the electrical measures carried out from the controller.

3.3.3.1 M.01 MAINS (MAINS/BUS for HT GC500/HT GC500Plus)

The screen shows voltage values (phase-to-phase), frequency and the cyclic sequence of the signals connected to the MAINS three-phase input of the controller.

If the controller is configured for single-phase operation, only one phase-to-neutral voltage value is shown. The cyclic sequence status is no more shown.

At the bottom right a symbol identifies that the values are related to the MAINS measures.

Only for HT GC500: the information shown on this page may refer to the bus-bars and not to the mains, depends on the configuration of parameter P.0126.

3.3.3.2 M.02 GENERATOR

The screen shows voltage values (phase-to-phase), frequency and the cyclic sequence of the signals connected to the GENERATOR three-phase input of the controller.

If the controller is configured for single-phase operation, only one phase-to-neutral voltage value is shown. The cyclic sequence status is no more shown.

At the bottom right a symbol identifies that the values are related to the GENERATOR measures.

3.3.3.3 M.03 CURRENTS

M.03 screen shows the three phase current measures (in single-phase mode only the first one is shown, the others show dashes). If it is configured (P.0190 <>0), it is shown also the fourth current (auxiliary current).

Remark for HT GC310 and HT GC500: usually the current are supplied from the generator. But if the C.T. are connected on the load line (instead of the generator line), when the load is connected to the MAINS, the measured currents are supplied from the MAINS. At the bottom right of the screen a GENERATOR or MAINS symbol identifies the actual current source. P.0124 must be set to 1, otherwise the indication (and the measure) will be fixed on GENERATOR.

3.3.3.4 M.04 POWERS 1

The active powers and power factors are shown, total and phase by phase (dashes only for phase 2 and 3 in single-phase mode). At the bottom right, a symbol identifies the power source (GENERATOR or MAINS), see par. 3.3.3.3. For HT GC500 the source is only GENERATOR.

3.3.3.5 M.05 POWERS 2

The reactive powers and apparent powers are shown, total and phase by phase (dashes only for phase 2 and 3 in single-phase mode). At the bottom right, a symbol identifies the power source (GENERATOR or MAINS), see par. 3.3.3.3. For HT GC500 the source is only GENERATOR.

3.3.3.6 M.06 ENERGY

Page M.06 shows the energy counters (both active and reactive and both total and partial) of the generator. These counters are updated only when the current source is the generator.

Active energy is updated only if positive. Reactive energy is updated without regards the load type (it is increment for both capacity and inductive load).

From this page is possible to clear the partial counters using the following procedure:

- Set the controller mode to OFF-RESET
- Press the ENTER key: one of the partial counter will be shown in reverse
- Use the ▲▼ keys to select the counter to be cleared
- Press at the same time for at least five seconds the ENTER and EXIT keys
- Press the EXIT keys

At the bottom right, a symbol that represents the generator is shown to allow to identify as GENERATOR energy these values.

Starting from SW version 01.13, these counters can be cleared from the front panel interface also if the controller is operating in MAN or AUTO mode.

3.3.3.7 M.07 ENERGY 2

Page M.06 shows the energy counters (both active and reactive and both total and partial) of the MAINS. These counters are updated only when the current source is the MAINS. **These page is shown only if the controller is configured to work with C.T. connected on the load side (P.0124 = 1).**

Active energy is updated only if positive. Reactive energy is updated without regards the load type (it is increment for both capacity and inductive load).

From this page is possible to clear the partial counters using the following procedure:

- Set the controller mode to OFF-RESET
- Press the ENTER key: one of the partial counter will be shown in reverse
- Use the ▲▼ keys to select the counter to be cleared
- Press at the same time for at least five seconds the ENTER and EXIT keys
- Press the EXIT keys

At the bottom right, a symbol that represents the generator is shown to allow to identify as MAINS energy these values.

Starting from SW version 01.13, these counters can be cleared from the front panel interface also if the controller is operating in MAN or AUTO mode.

3.3.3.8 M.08 SYSTEM (HT GC500/HT GC500Plus)

This page is available only for HT GC500. It shows the one-wire diagram of the plant. The following details are shown:

- The mains. The symbol for the mains is fixed when the mains is in tolerance, otherwise it blinks.
- The generator. The symbol for the generator is shown in “reverse” mode when the engine is running and there are voltages on the generator.
- The loads. The symbol for the loads is shown in “reverse” when the loads are supplied by the mains or by the generator.
- The GCB and MCB circuit breakers. The symbol for the circuit breaker shows:
  - The open/close status.
  - A difference between the command and the status (in this case the two terminals of the circuit breaker blink).
  - The possibility to use synchronization for circuit breaker closure. If synchronization is available, the terminals are empty squares, otherwise they are filled squares.
- The power flows, shown by arrows on the three sides of the plant. The arrows show the direction of the power on each side. They blink (to indicate an anomaly) when a negative power is present on the generator or on the loads.
- The active power and the power factor measures. For parallel to the mains applications, if HT GC500 acquires the measure of power on the mains by one of its analogue inputs, it shows the active power measures on all sides of the plant.
- For parallel to the mains application, this page allows changing the setpoint for active power and for power factor.

3.3.4 Parallel measures (HT GC500/HT GC500Plus only)

3.3.4.1 B.01 REGULATIONS

The screen shows value related to the voltage and speed regulation.

It is divided into two parts: the left one shows the three phases voltages and speed of the generator. The second one, those of the BUS.

Two additional lines on the bottom allow to modify the setpoint of Speed reference and of Voltage reference.

3.3.4.2 B.02 SYNCHRONIZATION

The screen shows information related to synchronization.

A bar, acting as synchronoscope, is shown. Underneath the bar, four rectangular buttons indicate the status of voltage, frequency, phase and rotation. If they are black the status is

correct for the closure; if all four are black, the fifth one (OK) will become black and the closure command will be issued.

Two additional lines on the bottom allow to modify the setpoint of Speed reference and of Voltage reference.

Starting from SW version 01.13, if not in reference change mode, keeping pressed the SHIFT key, the controller shows the actual output percentage command (both speed and voltage) instead of their reference.

3.3.4.3 B.03 PARALLEL

The screen shows information related to parallel measures.

Total active and reactive power, the three current values, frequency and engine speed are shown.

Two additional lines on the bottom allow to modify the setpoint of Speed reference and of Voltage reference or the setpoint of power and of power factor (it depends on the function mode).

3.3.4.4 B.04 MC100 DEVICES

This screen is used to report information related to Parallel Management devices (like MC100) if detected over the PMCBus.

Usually it is blank.

3.3.4.5 B.05 PMC-BUS 1

The first lines of this page show the total power, both active and reactive, supplied by all the generators connected on the bus.

The last three lines show the active and reactive power of the generators having address 1, 2 and 3 connected over the bus.

3.3.4.6 B.06 PMC-BUS 2

The seven lines show the active and reactive power of generators having address in the range of 4 to 10 connected over the bus.

3.3.4.7 B.07 PMC-BUS 3

The six lines show the active and reactive power of generators having address in the range of 11 to 16 connected over the bus.

3.3.4.8 B.08 LOAD FUNCTION

Information related to Load management are shown on this page.

The first line reports if the function is enabled; the second one the mode.

Follows a line that identifies the Master genset.

At the bottom a list of the gensets priority is shown.

3.3.4.9 B.09 LOAD FUNCTION 2

Some special measures related to Load Function and Load sharing are shown. In order to understand the shown value, please refer to the par. 1.4.1 of the EAAM019906 (or following) document (Parallel functions handbook).

3.3.5 Engine measures

In this mode, measures related to the engine are shown. The available number of pages depends on the engine type: with ECU (J1939 or MTU MDEC) or without ECU (analogue engines). Some measures are available only for some engine types.

3.3.5.1 E.01 ENGINE 1

It shows:

- Engine Oil pressure
- Coolant temperature
- Engine speed

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

If a CAN-BUS connection to an ECU is active, the type of selected ECU connection is shown.

3.3.5.2 E.02 ENGINE 2

It shows:

- Battery voltage
- Fuel level

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

3.3.5.3 E.03 ENGINE 3

Here are shown counters managed by the controller related to the engine:

- Crank counter (clearable)
- Running hours (clearable)
- Running hours with load (clearable)
- Running hours in OVERRIDE (clearable)
- Running hours Total (not clearable)
- Hours to next maintenance (not clearable).

In order to clear a counter, use the following procedure:

- Set the controller mode to OFF-RESET
- Press the ENTER key: one of the partial counter will be shown in reverse
- Use the ▲▼ keys to select the counter to be cleared

- Press at the same time for at least five seconds the ENTER and EXIT keys
- Press the EXIT keys

3.3.5.4 E.04 CANBUS 1

This page is shown only if CAN-BUS communication to the engine is enabled.

Some engine measures acquired by CAN-BUS are shown in this page. The number and type of available measures depend on the engine type. Not available measures are shown with dashes. This page shows the following measures:

- Engine ECU Temperature (SAE J1939: SPN1136)
- Air Temperature (SAE J1939: SPN171)
- Air Pressure (SAE J1939: SPN108, Barometric Pressure)
- Battery Voltage from ECU (SAE J1939: SPN158)
- Coolant Pressure (SAE J1939: SPN109)
- Coolant Level (SAE J1939: SPN111)
- Total Engine Hours from ECU (SAE J1939: SPN247)

3.3.5.5 E.05 CANBUS 2

This page is shown only if CAN-BUS communication to the engine is enabled.

Some engine measures acquired by CAN-BUS are shown in this page. The number and type of available measures depend on the engine type. Not available measures are shown with dashes. This page shows the following measures:

- Engine Oil Temperature (SAE J1939: SPN175)
- Engine Oil Level percentage (SAE J1939: SPN98)
- Fuel Temperature (SAE J1939: SPN174)
- Fuel Delivery Pressure (SAE J1939: SPN94)
- Common Rail Pressure
- Fuel Rate (SAE J1939: SPN183)
- Total Fuel Used (SAE J1939: SPN250)

3.3.5.6 E.06 CANBUS 3

This page is shown only if CAN-BUS communication to the engine is enabled.

Some engine measures acquired by CAN-BUS are shown in this page. The number and type of available measures depend on the engine type. Not available measures are shown with dashes. This page shows the following measures:

- Boost Temperature (SAE J1939: SPN2629, Turbocharger 1 Compressor outlet temperature)
- Intake Manifold Pressure (SAE J1939: SPN102, Boost Pressure)
- Intake Manifold Temperature (SAE J1939: SPN105, Intake Manifold 1 Temperature)
- Intercooler Temperature (SAE J1939: SPN52, Engine Intercooler Temperature)
- Crankcase Pressure (SAE J1939: SPN101)
- Throttle Position (SAE J1939: SPN51)
- Optimal Speed (SAE J1939: SPN515, Engine's Desired Operating Speed)

3.3.5.7 E.07 CANBUS 4

This page is shown only if CAN-BUS communication to the engine is enabled.

Some engine measures acquired by CAN-BUS are shown in this page. The number and type of available measures depend on the engine type. Not available measures are shown with dashes. This page shows the following measures:

- Required Torque (SAE J1939: SPN91, Accelerator Pedal Position 1)
- Actual Torque (SAE J1939: SPN513, Actual Engine –Percent Torque)
- Lost Torque (SAE J1939: SPN514, Nominal Friction – Percent Torque)
- Load at Current Speed (SAE J1939: SPN92)
- Driver Required Torque (SAE J1939: SPN512)
- Left Bank Gas Temperature (SAE J1939: SPN2434, Left Manifold Gas Temperature)
- Right Bank Gas Temperature (SAE J1939: SPN2433, Right Manifold Gas Temperature)

3.3.5.8 E.08 CANBUS 5

This page is shown only if CAN-BUS communication to the engine is enabled.

Some genset measures acquired by CAN-BUS are shown in this page. The number and type of available measures depend on the engine type. Not available measures are shown with dashes. This page shows the following measures:

- Bearing 1 °C (SAE J1939: SPN1122, Alternator bearing 1 temperature)
- Bearing 2 °C (SAE J1939: SPN1123, Alternator bearing 2 temperature)
- Winding 1 °C (SAE J1939: SPN1124, Alternator Winding 1 temperature)
- Winding 2 °C (SAE J1939: SPN1125, Alternator Winding 2 temperature)
- Winding 3 °C (SAE J1939: SPN1126, Alternator Winding 3 temperature)
- Timing pressure, bar (SAE J1939: SPN156, Injector Timing Rail 1 Pressure)

3.3.5.9 E.09 CANBUS 6

This page is shown only if CAN-BUS communication to the engine is enabled and <u>it is available only from 01.11 version of the software</u>.

Some additional measures, acquired by CAN-BUS interface if available, are shown by means of this page. If a measure is not available, it is shown with dashes.

This page shows the following measures:

- Engine nominal power (rated power)
- Engine nominal speed (rated speed)
- MTU error code
- Clearable average consumption counter (litres/h)
- Clearable consumption counter (litres/h)

3.3.6 History logs

This mode allows to access to the history logs of the controller. Please, see paragraph 5 for deeper information.

4. Programming

The board 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 the specific requirements of the system. This document does not contain the list of the parameters (even if many of they are quoted in the description of the board functions); the list is available from the document [1], where

they're described in detail. Here is described the programming general structure and the operating procedure to read and/or modify the parameters.

4.1 General structure

4.1.1 Organization

Each parameter has associated:

- A description, variable with the selected language
- A numerical code, with three digits (it permits the identification independently of the selected language)
- A level of protection (see next paragraph)

The parameters are grouped in menu, which are organized in a tree structures (a menu can contain others menu). Mixed menu do not exist: a menu cannot contain both parameters and others menu.

To each menu there are associated:

- A description, variable with the selected language
- A one digit numerical code. In case of secondary menu, the code is composed by the one of the main menu, followed by a dot and by its own code.

4.1.2 Protection

The access to the programming can be conditioned by means of three various levels of PASSWORDS, listed in priority order:

1. Manufacturer password (all parameters can be changed)
2. Installer password (all parameters but not manufacturer ones can be changed)
3. End user password (only End User parameters can be changed)

All parameters can be, in any case, viewed.

Each parameter is associated to a proper access level (in document [1] this association is indicated in column "ACC" with letter "C" in order to indicate the manufacturer, "I" for installer and "U" for end user).

A parameter associated to the manufacturer can be modified only from the manufacturer.

A parameter associated to the installer can be modified by manufacturer and installer.

A parameter associated to end user can be modified by manufacturer, installer, and end user.

HT GC500/HT GC500^{Plus} only: An additional password level is available to prevent incorrect and unintentional plant configuration change that can lead to serious system damage. This is named "SICES level"; the parameters that require this password are identified by means a letter "S" in column "ACC" of document [1]. This password can't be assigned. Read more later.

If the operator have to modify a parameter it must input first the proper password in the parameter P.0000 (menu "1-SYSTEM"), so the board can recognize it as "manufacturer", "installer" or "end user".

The access code settings remains memorized for about 10 minutes since the end of programming. When this time is elapsed the code is automatically reset to zero and must be reinserted to access programming again.

Any of these three levels can be enabled/disabled individually, setting a password different/equal to zero for the individual level. The three passwords are themselves three board parameters (identified respectively by codes P.0001, P.0002 and P.0003) and they are configurable by the procedure described later. They are placed in the menu “1-SYSTEM”. The following examples show all the combinations of the password assignment.

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

All users are “manufacturer”, without entering codes in P.0000. 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 is modifiable. When user enters the “uuu” code in P.0000 the board consider it “manufacturer” because there is no password for “installer” and “manufacturer”. After entering code all parameters are modifiable.

Example 3: P.0001=0 P.0002=”iii” P.0003=”uuu”

No parameter is modifiable. When user enters “uuu” in P.0000 it can modify only end user associated parameters. If user enters “iii” the board considers it “manufacturer” because there is no password for “manufacturer”. After entering this code all parameters are modifiable.

Example 4: P.0001=”ccc” P.0002=”iii” P.0003=”uuu”

No parameter is modifiable. When user enters “uuu” in P.0000 it can modify only end user associated parameters. If user enters “iii” it can modify parameters associated to “installer” and “end user”. If user enters “ccc” it can modify all parameters.

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

No passwords are associated to end user and installer. Parameters associated to end user and installer are free programmable, without entering code in P.0000. To modify manufacturer associated parameters you have to enter “ccc” in P.0000.

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

Parameters associated to end user are free programmable, without entering code in P.0000. When user enters “iii” in P.0000 it can modify all parameters because there is no password for “manufacturer”.

Example 7: P.0001=”ccc” P.0002=”iii” P.0003=0

Parameters associated to end user are free programmable, without entering code in P.0000. When user enters “iii” in P.0000 it can modify parameters associated to “installer” and “end user”. If user enters “ccc” it can modify all parameters.

Example 8: P.0001=”ccc” P.0002=000 P.0003=”uuu”

No parameter is modifiable without entering codes in P.0000. When user enters “uuu” it can modify parameters associated to end user and installer. If user enters “ccc” it can modify all parameters.

NOTE: all parameter values are always visible, but the modification is possible only if P.0000 contains a password with superior or equal level to that one required by the parameter.

NOTE: while accessing to programming and setting the password (P.0000), it is possible that parameters P.0001, P.0002 and P.0003 will not be immediately visualized. To enable the visualization, go back to previous menu and subsequently come back.

In case the password code has been forgotten, only knowing the password with higher level it is possible recover the access right. Otherwise (or in the case the manufacturer password was lost), it is necessary to send the board in factory in order to unlock the programming associate functions.

For this reason, it is not advisable to not set up at least the "manufacturer" password (P.0001): if in fact someone else sets up this password or a lower password (even just unaware) without communicate it, it will not be possible to modify any parameter. Instead, knowing the "manufacturer" password, it will be in any case possible to cancel or modify the other passwords.

The general rule imposes that the parameters are modifiable only when the controller is in "OFF/RESET" position. Some parameters make exception and are modifiable with the key in whichever position, also with the engine running. Generally, if a parameter cannot be modified it will be enclosed between < and >, while if it's modifiable it is enclosed between [and]: that is valid also for the restrictions due to password.

4.1.3 SICES password protection (HT GC500/HT GC500*Plus* only)

Some parameters are protected by this special password.

Actually two type of SICES password are available: fixed and temporary.

Fixed password is shipped alongside the controller and it is valid forever. Temporary password can be obtained by means the following procedure.

It's supplied from SICES upon request and depends on the board and a random parameter. After its first use, is possible to continue to use it until two hours of engine operation are elapsed. After this time a new password must be requested to SICES.

At the present moment, it protects the following parameters: P.0802 (Plant type), P.0854 (GCB mode), P.0855 (MCB mode), P.0880 (MAINS parallel operation) and P.0900 (interface device).

Scope of SICES password is to prevent altering parameters whose modification could bring serious damages.

To obtain this password, manufacturer has to request it to SICES, by sending e-mail to techelp@sices.eu. In the e-mail must be reported the Board and panel S/N (if produced by Sices) with the univocal board identification code and the internal code. These last information are obtained from the S.06 status page.

4.2 Operating procedure

This procedure will describe the keyboard and display use.

4.2.1 Enter the programming mode

Programming procedure is accessible in all the working status of the board. To enter in programming mode, it is required to act on ▲ and ▼ keys until the programming screen

appear (P.03). NOTE: if inside a screen mode or function that doesn't allow the use of these pushbuttons to change the mode, press few times EXIT and then try again (this can happen during the visualization of the history logs or during particular operations as, for instance, the setting of the fuel pump command modes).

Press therefore ENTER in order to enter in programming.

At the procedure start, it is automatically shown the menu or the variable selected before the last exit from programming (the first time you enter it is shown the main menu). That is true if programming was exited changing the controller mode to MAN or AUTO or if the SW aborted automatically the programming after the maximum idle time or if the programming was aborted keeping pressed the EXIT key for at least two seconds.

4.2.2 Menu selection

In the first line are always indicated: current menu name, selected menu row, numbers of menu rows. By means the following rows, menu items are visualized (submenus). Selected row is displayed in REVERSE. The ▲ and ▼ keys go up and down in cyclical way (then pressing ▲ from the first item you pass to the last one and vice versa).

To enter the selected menu item press ENTER key. EXIT goes back to previous menu or exit from programming.

4.2.3 Parameters selection

First row shows always the name of the current menu (in the example the "1-SYSTEM" menu), followed by the indication of the selected item and by the number of the menu items. Next rows are all utilized to visualize one single parameter. In details:

- Fourth and fifth rows show the univocal parameter code (three decimal digits) followed by the description in the current language.
- Sixth row shows, aligned to the right side, the variable value, included in square brackets (or between "< >" symbols).
- For some parameters on the eighth it is shown a value in some way related to the parameter current value. In the example, it is shown the plant nominal max current, obtained from nominal genset voltage (P102) and from the nominal power (P.0106 exactly). Often this additional measure is visualized when the parameter is expressed as percentage related to something else, to show its absolute value.

Use the keys ▲ and ▼ to scroll through the menu toward the items having respectively higher and lower index, in a cyclical way (pressing ▲ from the first item it passes the last one and vice versa). Normally the selection moves by an item at once; pressing the SHIFT key together with ▲ and ▼ keys, the selection moves by three items at once. Pressing the ENTER key it will be enabled the parameter modify procedure (see next paragraph); press the EXIT key to exit from the menu (coming back to previous menu).

4.2.4 Parameters modifying

A parameter can be modified if its value is shown enclosed by []. If it is shown enclosed by <>, it can't be modified due to password level or system status.

Once visualized a parameter, to start modifying it, it is necessary to press the ENTER key. The square brackets enclosing the value start to flash, indicating that the modify phase is in progress. Press ENTER key to confirm the new value, press the EXIT key to abort the modifying and come back to the original value. If a variable is shown enclosed in angle brackets instead of square brackets, it can't be modified (that can depend on password level or working mode of the controller).

Existing parameter types are:

- Numerical: the value is modifiable by means of the ▲▼, respectively in order to increase it or to decrease it of one unit (if such keys are pressed alongside the SHIFT key, the value will be increased or decreased of ten units at a time). The modifying is cyclical: trying to increase the value when it is already at its maximum, it is set to the minimum and vice versa.
- Numerical with selection between a predefined list (for example the TA primary values): same as seen for numerical parameters; the ▲▼ permit to select the next/previous value from predefined list (pressing ▲▼ together with the SHIFT key, the next/previous value is ten position ahead/back to the current value).
- Numerical with selection from list of number-string items (for example the oil sensor pressure type); same as the previous type.
- Hour type: same as numerical types, with one exception: the board manages the increase/decrease maintaining valid values (example: increasing from “00.59”, the value goes to “01.00” and not to “00.60”).
- Strings (by example phone numbers): in this case the display shows also a cursor indicating the currently select character in the string. The ▲▼ keys work on the selected character (passing to next/previous character of the ASCII table or jumping by ten positions ahead/back if SHIFT is pressed too), whereas ◄► keys allow selecting the character to modify. NOTE: it is possible to set the ASCII characters from 32 (space) to 127 (escape). It is not possible to set extended ASCII characters (over 127) and the control characters (from zero to 31).
- Hexadecimal strings (by example the digital output bitmaps): same as for the string parameters but the selectable characters are only”0-9” and “A-F” (only capitals).

4.2.5 Set up limits

The operator has not to worry about verifying that the set up value is acceptable for the board since it is not possible to set up not acceptable values. Obviously, this is true only for a single parameter. Nothing forbids, by example, to invert two thresholds values which for their logic function must be the first lower than the second. These controls are however left to the operator. Operator has the responsibility to verify that the programmed value is acceptable for the system: wrong parameter values may lead to generator set damage.

4.2.6 Exit from programming

There are three ways to leave programming mode:

- Press the EXIT key n times to go back until main menu appears and then press it again to exit from programming. Coming a next time into programming, it will be show main menu.
- Keeping pressed the EXIT key for two consecutive seconds from any position: an instantaneous exit from programming will follow and the next programming entry will be exactly in same point.
- Changing the controller mode to AUTO or MAN: next entry will be exactly in same point.

4.2.7 Loading default values

In some situation may be useful to reload parameters factory default values. To do this it is necessary, first at all, entering in the programming mode, then keep the keys ENTER and EXIT pressed simultaneously and consecutively for five seconds. A message on the display will show to the operator the confirm of defaults reload.

NOTE: the default values will be reloaded only for the parameters for which the access rights are granted.

4.3 Additional notes

This paragraph contains notes of general use on the programming.

Three fundamental menus define how the panel (or the plant) is made.

- Menu 1-SYSTEM allows mainly to indicate how the board is connected to the engine and to the generator: single-phase or three-phases connection (P.0101 for generator voltage and P.0119 for mains voltage), the type of C.T. utilized (P.0107), the presence and the type of engine speed sensor (P.0110, P.0111 and P.0127), the presence and the type of oil pressure, coolant temperature and fuel level transducers (P.0112, P.0113 and P.0114), and last, the presence of D+ signal (P.0115). This menu allows moreover to set the nominal characteristics of the electrical measurements: voltage (P.0102 and P.0116), frequency (P105), power (P106 and P.0125) etc. It is fundamental to set correctly these parameters because almost all the thresholds for the activation of protections are made in percentage in respect to them. **Only for HT GC500/HT GC500^{Plus}: this menu allows selecting if the voltages connected to JF connector are the mains or the bus-bars.**
- The configuration of the working sequence is modifiable by means of 2-SEQUENCE menu.
- The protections management is instead accessible from 3-PROTECTION menu. It is important to know that to enable/disable a protection it is sufficient to modify its related time (setting it to 0 to disable), leaving its threshold unchanged. This general rule has however some exception. For more details and for how to disable every single protection, see the chapter about the anomalies or the last table of document [1].
- All what is not concerning the system configuration, the sequence and protections is configurable from 4-AUXILIARY FUNCTIONS menu.
- The 5-I/O menu allows to inform the board how its configurable inputs and outputs are used. NOTE: a wrong configuration of the inputs/outputs functions can lead to serious system damage.
- The menu 7-CAN BUS allows to set how the board has to communicate on the engine can bus to acquire the engine measurements and even to send commands.
- 8- PARALLEL OPERAT menu, allows to set up all the parallel relative parameters, included those related to load function management (HT GC500/HT GC500^{Plus} only).

4.4 Digital input configuration

HT GC310 is equipped with eight digital inputs that are fully configurable (connector JN, terminals 1 to 8). HT GC350 and HT GC500/HT GC500^{Plus} are equipped with ten additional fully configurable inputs (connectors JV and JU). In case more inputs are required, it is

possible to use as digital input the terminal 2, 3 and 4 of the connector JM in case not used for analogue measurement. In order to change the function of these input from analogue to digital, please, set to “99 – Digital Input” one or more of these parameters, depending on the required input:

- P.0112 for terminal JM-3.
- P.0113 for terminal JM-4.
- P.0114 for terminal JM-2.

For the connection of the digital input, please, refer to par. 2.1.6.

All the inputs are fully configurable.

As default, all the inputs are “active” only when the related terminal is connected to the negative of the supply voltage of the board; they are considered “not active” when the terminal is left open. It is possible to change this assumption (input by input), using parameters P.0501 (for connector JN), P.0531 (for connectors JV and JU) and P.0570 (for connector JM). Each input is identified by one bit in the related parameter (eight bit for P.0501, ten bits for P.0531 and three for P.0570):

- 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.

For each input, there are associated three parameters:

- One parameter configures the function.
- One parameter configures the delay time.
- One parameter allows to define a text message to display.

The following table shows for each input the related parameter

Input	Terminal	Function	Delay	Text	Remarks
INPUT1	JN-1	P.0507	P.0508	P.0509	
INPUT2	JN-2	P.0510	P.0511	P.0512	
INPUT3	JN-3	P.0513	P.0514	P.0515	
INPUT4	JN-4	P.0516	P.0517	P.0518	
INPUT5	JN-5	P.0519	P.0520	P.0521	
INPUT6	JN-6	P.0522	P.0523	P.0524	
INPUT7	JN-7	P.0525	P.0526	P.0527	
INPUT8	JN-8	P.0528	P.0529	P.0530	
	JM-3	P.0571	P.0572	P.0573	
	JM-4	P.0574	P.0575	P.0576	
	JM-2	P.0577	P.0578	P.0579	

Input	Terminal	Function	Delay	Text	Remarks
INPUT9	JV-1	P.0532	P.0533	P.0534	HT GC350/HT GC500 only
INPUT10	JV-2	P.0535	P.0536	P.0537	HT GC350/HT GC500 only
INPUT11	JV-3	P.0538	P.0539	P.0540	HT GC350/HT GC500 only
INPUT12	JV-4	P.0541	P.0542	P.0543	HT GC350/HT GC500 only
INPUT13	JV-5	P.0544	P.0545	P.0546	HT GC350/HT GC500 only
INPUT14	JU-1	P.0547	P.0548	P.0549	HT GC350/HT GC500 only
INPUT15	JU-2	P.0550	P.0551	P.0552	HT GC350/HT GC500 only
INPUT16	JU-3	P.0553	P.0554	P.0555	HT GC350/HT GC500 only
INPUT17	JU-4	P.0556	P.0557	P.0558	HT GC350/HT GC500 only
INPUT18	JU-5	P.0559	P.0560	P.0561	HT GC350/HT GC500 only

4.4.1 Digital input functions

The available functions are the following (for an updated list of the functions, please refer to document [1]).

- IF_00 - “0 – Not used”.
- IF_01 - “1 – Warning”. If the input is active, a warning is issued: the message shown is the one set by means the related “text” parameter.
- IF_02 - “2 – Deactivation”. If the input is active a deactivation is issued: the message shown is the one set by means the related “text” parameter.
- IF_03 - “3 – Alarm”. If the input is active, an alarm (block) is issued: the message shown is the one set by means the related “text” parameter.
- IF_04 - “4 – Alarm masked by oil mask time”. 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 “59 – Override engine protections” function (IF_59) is activated, a warning is issued instead of an alarm.
- IF_05 - “5 – 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. **This function is an edge activated one**.
- IF_06 - “6 – Mains circuit breaker (KM/MCB) status”. It is used to detect the actual status of the KM/MCB circuit breaker. In case of discordance between status and command, a signaling will outline it. Warning can be also issued in this case or, even, depending on the configuration, the gen-set can be started in case of KM/MCB closure failure. For HT GC500 controller, this status is used for the logic related to the parallel. It is also used to detect the status of the circuit breaker when it is commanded by external devices.
- IF_07 - “7 – Generator circuit breaker (KG/GCB) status”. It is used to detect the actual status of the GCB circuit breaker. In case of discordance between status and command, a signaling will outline it. Warning can be also issued in this case.

- IF_08 - “8 – Minimum fuel level”. An alarm will result from the activation of this input. This function can be also used for the “Fuel pump management” (see par. 9.1).
- IF_09 - “9 – Low fuel level”. A warning will result from the activation of this input. This function can be also used for the “Fuel pump management” (see par. 9.1).
- IF_10 - “10 – Fuel level for pump start”. If the input is active, the fuel pump is started (see par. 9.1).
- IF_11 - “11 – Fuel level for pump stop”. If the input is active, the fuel pump is stopped (see par. 9.1).
- IF_12 - “12 – High fuel level”. A warning will result from the activation of this input. This function can be also used for the “Fuel pump management” (see par. 9.1).
- IF_13 - “13 – Minimum oil pressure”. 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.
- IF_14 - “14 – Low oil pressure”. If the input is active, a warning is issued if the time set by means P.0216 is elapsed from the engine running detection.
- IF_15 - “15 – High coolant temperature”. If the input is active, a warning is issued if the time set by means P.0216 is elapsed from the engine running detection.
- IF_16 - “16 – Maximum coolant temperature”. 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.
- IF_17 - “17 – Overload”. If the input is active, an alarm (block) is issued. Usually the trip status of the circuit breaker is connected to this input.
- IF_18 - “18 – Over speed”. If the input is active, an alarm (block) is issued.
- IF_19 - “19 – Warning masked by oil mask time”. If the input is active, a warning 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_21 - “21 – Gas solenoid masked warning”. If the input is active and the output command for the function “14 – Gas solenoid” (OF_14) is active, a warning is issued. The message shown is the one set by means the related “text” parameter.
- IF_22 - “22 – Gas solenoid masked alarm”. If the input is active and the output command for the function “14 – Gas solenoid” (OF_14) is active, an alarm (block) is issued. The message shown is the one set by means the related “text” parameter.
- IF_23 - “23 – Fuel solenoid masked warning”. If the input is active and the output command for the fuel solenoid is active (JH_3), a warning is issued. The message shown is the one set by means the related “text” parameter.
- IF_24 - “24 – Fuel solenoid masked alarm”. If the input is active and the output command for the fuel solenoid is active (JH_3), an alarm (block) is issued. The message shown is the one set by means the related “text” parameter.
- IF_26 - “26 – Remote test request”. 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.
- IF_27 - “27 – Remote start request”. 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.
- IF_28 - “28 – Emergency stop”. This input is used to signal to the control an EMERGENCY STOP. An alarm (block) is issued. SAFETY EMERGENCY STOP CAN’T

BE CARRIED OUT BY THE CONTROLLER: be sure that external electromechanical or mechanical parts fulfill the safety requirements.

- IF_29 - “29 – Remote start enable”. If this function is defined for one input, “Remote start” function is inhibited if the input is not active.
- IF_30 - “30 – Changeover sequence inhibition”. If an input configured with this function is active, the controller will not transfer the load to generator; if the load is already connected to the generator, it’ll be transferred back to the mains.
- IF_31 - “31 – KG/GCB masked warning”. If the related input is active and the load is connected to the generator, a warning will be issued. The message shown is the one set by means the related “text” parameter.
- IF_32 - “32 – KG/GCB masked alarm”. If the related input is active and the load is connected to the generator, an alarm (block) will be issued. The message shown is the one set by means the related “text” parameter.
- IF_33 - “33 – Load Function Enable”. It is used to enable/disable the “load function” when the generator works in parallel with other generators. **Available only with HT GC500 /HT GC500*Plus***
- IF_34 - “34 – Fuel pump warning”. If active, a warning is issued. Moreover, the fuel pump is switched OFF until the input becomes inactive.
- IF_35 - “35 – Idle speed request”. If the input is active, minimum voltage and frequency protections are disabled and it is prevented the load connection to the generator. Controller assumes that the engine is rotating at low speed. If a CAN-BUS connection to ECU is configured, an IDLE command is sent to engine (if supported by it).
- IF_36 - “36 – General generator breaker status”. Status of external MGCB circuit breaker (this is the breaker that connects the generators bus-bars to the loads or to the mains): active if closed. **Available only with HT GC500 /HT GC500*Plus*.**
- IF_37 - “37 – Generic status”. If the related input is active, the controller will show the text defined by the related text parameter on page S.03 of the display.
- IF_38 - “38 – Import/Export mode selection”. When working in parallel to the mains in “BASE LOAD” mode, the activation of this input switches the power management mode to “IMPORT/EXPORT” (the difference is that in “BASE LOAD” mode you select the power the generator has to produce, while in “IMPORT/EXPORT” mode you select the power that has to be imported/exported to the mains). . **Available only with HT GC500 /HT GC500*Plus*.**
- IF_39 - “39 – PPR status”. Allows connecting the contact of an external protection that detects the “loss of mains” while the generator is in parallel to the mains itself. The input must be active when the mains is present. . **Available only with HT GC500 /HT GC500*Plus*.**
- IF_40 - “40 – Inhibition”. If the related input is active, the function prevents the automatic start of the generator. Remote Start is not affected by this function.
- IF_41 - “41 – Unloading and deactivation”. If input becomes active, generator is unloaded (if in parallel mode) and deactivation is issued. The message shown is the one set by means the related “text” parameter. **Available only with HT GC500 /HT GC500*Plus*.**
- IF_42 - “42 – Deactivation masked by oil mask time”. If the input is active, a deactivation 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 “59 – Override engine protections” function (IF_59) is activated, a warning is issued instead of an alarm.

- IF_43 - “43 – Unloading and deactivation masked by oil mask time”. If input becomes active and the time set by means P.0216 is elapsed from the engine running detection, generator is unloaded (if in parallel mode) and deactivation is issued. The message shown is the one set by means the related “text” parameter. If the “59 – Override engine protections” function (IF_59) is activated, a warning is issued instead of an alarm. **Available only with HT GC500 /HT GC500Plus.**

- IF_44 - “44 – Deactivation masked by gas solenoid”. If the input is active, a deactivation is issued when the output command for the function “14 – Gas solenoid” (OF_14) is active. The message shown is the one set by means the related “text” parameter.

- IF_45 - “45 – Unloading and deactivation masked by gas solenoid”. If input becomes active and the output command for the function “14 – Gas solenoid” (OF_14) is active, generator is unloaded (if in parallel mode) and deactivation is issued. The message shown is the one set by means the related “text” parameter. **Available only with HT GC500 /HT GC500Plus.**

- IF_46 - “46 – Fuel solenoid masked deactivation”. If the input is active and the output command for the fuel solenoid is active (JH_3), a deactivation is issued. The message shown is the one set by means the related “text” parameter.

- IF_47 - “47 – Unloading and deactivation masked by fuel solenoid”. If input becomes active and the output command for the “fuel solenoid” is active (JH_3), generator is unloaded (if in parallel mode) and deactivation is issued. The message shown is the one set by means the related “text” parameter. **Available only with HT GC500 /HT GC500Plus.**

- IF_48 - “48 – KG/GCB masked deactivation”. If the input is active, a deactivation is issued if the load is connected to the generator. The message shown is the one set by means the related “text” parameter.

- IF_49 - “49 – Unloading and deactivation masked by GCB”. If input becomes active and GCB is closed, generator is unloaded (if in parallel mode) and deactivation is issued. The message shown is the one set by means the related “text” parameter. **Available only with HT GC500 /HT GC500Plus.**

- IF_50 - “50 – Dead Bus”. If active, it signals that there is no voltage on the bus-bars. **Available only with HT GC500 /HT GC500Plus.**

- IF_51 - “51 – Production line open”. Function is used to signal that an external circuit breaker is opened, disconnecting the mains from the generators. Used in parallel to the mains applications. **Available only with HT GC500 /HT GC500Plus.**

- IF_52 - “52 – External reverse synchronization request”. This function is used in parallel to the mains applications where the MCB is not commanded by HT GC500, but the internal synchronizer of HT GC500 must be used to close this breaker. If the input is active, HT GC500 starts the synchronization. **Available only with HT GC500 /HT GC500Plus.**

- IF_53 - “53 – External Load Sharing request”. This function is used in multiple gensets applications where an external load sharing unit must be used, and HT GC500 is not able to detect when other gensets are in parallel with it. If this input is active, HT GC500 assumes to be in parallel with other generators: the signal from the external load sharing

unit is used to manage the speed of the engine. **Available only with HT GC500 /HT GC500Plus.**

- IF_54 - "54 – External KG/GCB closure request". It works only in MAN and TEST mode. Activating an input configured with this function, is like pressing the KG/KM (or GCB) pushbutton to transfer the load to the generator. If no inputs are configured with function "55" (IF_55), this input works as toggles: it is used to close the circuit breaker if it is open and vice versa.
- IF_55 - "55 – External KG/GCB open request". It works only in MAN and TEST mode. Activating an input configured with this function, is like pressing the KG/KM (or GCB) pushbutton to transfer the load to the MAINS.
- IF_56 - "56 – Other gensets GCB status" (must be active if at least one GCB closed). Used to signal to the controller that at least one generator is closed to the bar. It can be used as additional safety function or when no PMCBus connection is available (remote droop operation). **Available only with HT GC500 /HT GC500Plus.**
- IF_58 - "58 – Disable Power Regulation". Used to disable LOAD-SHARING or POWER REGULATION, mainly if these functions are carried out by an external device. **Available only with HT GC500 /HT GC500Plus.**
- IF_59 - "59 – Override engine protections". If the related input is active, all the engine protections become warnings, preventing the engine shutdown. THIS FUNCTION CAN LEAD TO ENGINE DAMAGE. USE IT AT YOUR OWN RISK.
- IF_60 - "60 – External mains sensor". If the input is active, MAINS is considered to be in working window (see 7.2).
- IF_61 - "61 – DROOP request". It activates the active power DROOP mode, once the generator is in parallel. In DROOP mode the controller manage the speed of the engine in a way opposite to active power: typically the generator will run at 52 Hz with no load and at 48 Hz at full load. **Available only with HT GC500 /HT GC500Plus.**
- IF_62 - "62 – Set master genset". Activating this function will allow to set the generator as "master" for the load function: this generator will never be stopped, whatever is the load request. **Available only with HT GC500 /HT GC500Plus.**
- IF_63 - "63 – Select 1800 rpm". It can be used only for some CAN-BUS engine: it allows switching the speed from 1500 to 1800.
- IF_64 - "64 – Select configuration 1". When the input becomes active, parameters of alternative configuration 1 are copied into the working parameters. **This function is an edge activated one**.
- IF_65 - "65 – Select configuration 2". When the input becomes active, parameters of alternative configuration 2 are copied into the working parameters. **This function is an edge activated one**.
- IF_66 - "66 – Select configuration 3". When the input becomes active, parameters of alternative configuration 3 are copied into the working parameters. **This function is an edge activated one**.
- IF_67 - "67 – Select configuration 4". When the input becomes active, parameters of alternative configuration 4 are copied into the working parameters. **This function is an edge activated one**.

- IF_68 - “68 – Relevant status”. If active, the controller shows the programmed text (text parameter) on the page S.03. The display is also forced to show this page.
- IF_69 - “69 – Auxiliary current protection disable”. If the related input is active, the auxiliary current protection (usually used for differential protection) is disabled.
- IF_70 - “70 - Immediate supply”. This function is used together with two outputs, for the management of an external changeover, in multiple gensets applications. Normally the generators are connected to the loads when enough power is available: if this input is active, the generators are connected to the load as soon as on GCB is closed. **Available only with HT GC500 /HT GC500Plus.**
- IF_71 - “71 – External MCB closure request”. It works only in MAN and TEST modes. It is used to manually close the MCB circuit breaker. If no inputs are configured with function "72" (IF_72), this input works as toggle: it is used to close the circuit breaker if it is open and vice versa. **Available only with HT GC500 /HT GC500Plus.**
- IF_72 - “72 – External MCB open request”. It works only in MAN and TEST modes. It is used to manually open the MCB circuit breaker. **Available only with HT GC500 /HT GC500Plus.**
- IF_73 - “73 – Alarm (managed with override)”. If the input is active, an alarm (block) is issued. The message shown is the one set by means the related “text” parameter. If the “override engine protection” function is activated, a warning is issued instead of an alarm.
- IF_75 - “75 – Load thresholds enable”. If active, the load thresholds function is enabled (see par. 9.4).
- IF_77 - “77 – Second power setpoint”. Used only in parallel to the mains applications where the “BASE LOAD” regulation mode is selected. Normally the power setpoint is P.0884. When this input is active, the power setpoint switches to P.0902 (the controller moves the power between the set points with the configured ramp). **Available only with HT GC500 /HT GC500Plus.**
- IF_78 – “78 – Remote OFF-RESET”. When this input is active, the operating mode of the controller is forced to OFF-RESET, and it is not possible to use the pushbuttons on the front panel to change it. See 7.1. **Note: when this input become “not active”, if no inputs are configured with functions 79 and 80, the operating mode is forced to the one set before the input activation..**
- IF_79 – “79 – Remote MAN”. When this input is active, the operating mode of the controller is forced to MAN, and it is not possible to use the pushbuttons on the front panel to change it. See 7.1.
- IF_80 – “80 – Remote AUTO”. When this input is active, the operating mode of the controller is forced to AUTO, and it is not possible to use the pushbuttons on the front panel to change it. See 7.1.

4.5 Digital output configuration

HT GC310 controllers have six digital outputs (relays) fully configurable in addition to other two fixed function outputs. HT GC350 and HT GC500 controllers have ten additional fully configurable outputs. Please see par. 2.1.7 for the list of the available outputs and their connections.

As default, all the relays pick-up when the associated function is active. It is possible to invert the function mode in order to let relays works until the function becomes activate, then drop.

This can be done by means parameters P.0580 and P.0589. This parameter has one bit for associated to each configurable output (sixteen bits).

- Bit set to zero means that the output is normally at rest, it pick-ups when the associated function is active
- Bit set to one means that the output is normally working, it drops whenever the associated function is active.

As default parameter is set to 0 (all bits to 0).

Any available digital output function can be assigned to these outputs.

To each output are associated 4 parameters.

- A parameter that allows to select an output function among a list of predefined functions
- Three parameters that define the OR logic among controller status to associate to the output, alternative to the predefined output functions (Output Mapping)

The following table lists the associations between outputs and parameters.

Output	Terminal	Function	Map 1	Map 2	Map 3	Remarks
Output1	JI-1	P.0581	P.0601	P.0602	P.0603	
Output2	JI-2	P.0582	P.0604	P.0605	P.0606	
Output3	JI-3	P.0583	P.0607	P.0608	P.0609	
Output4	JI-4	P.0584	P.0610	P.0611	P.0612	
START	JH-1	P.0585	P.0613	P.0614	P.0615	
KM/MCB	JG-4...6	P.0586	P.0616	P.0617	P.0618	
Output5	JT-1	P.0590	P.0619	P.0620	P.0621	HT GC350/HT GC500 only
Output6	JT-2	P.0591	P.0622	P.0623	P.0624	HT GC350/HT GC500 only
Output7	JT-3	P.0592	P.0625	P.0626	P.0627	HT GC350/HT GC500 only
Output8	JT-4	P.0593	P.0628	P.0629	P.0630	HT GC350/HT GC500 only
Output9	JT-5	P.0594	P.0631	P.0632	P.0633	HT GC350/HT GC500 only
Output10	JS-1...2	P.0595	P.0634	P.0635	P.0636	HT GC350/HT GC500 only
Output11	JS-3...4	P.0596	P.0637	P.0638	P.0639	HT GC350/HT GC500 only
Output12	JS-5...6	P.0597	P.0640	P.0641	P.0642	HT GC350/HT GC500 only
Output13	JR-1...3	P.0598	P.0643	P.0644	P.0645	HT GC350/HT GC500 only
Output14	JR-4...6	P.0599	P.0646	P.0647	P.0648	HT GC350/HT GC500 only

4.5.1 Digital Output functions

Below, a list of available functions for the controller's output.

- OF_00 - "0 – Not used".
- OF_01 - "1 – Reset pulse". When the controller starts a reset cycle (usually changing the operator mode to OFF/RESET), the output is activated for one second. It allows, for example, to reset external device.

- OF_02 - “2 – Glow-plugs preheat”. It is activated before the cranking command allowing a fuel preheating. Time is configurable by means P.0209.
- OF_03 - “3 – Fuel pump”. Function used to manage a pump used to fill the local fuel tank from an external one. See par. 9.1.
- OF_04 - “4 – Load thresholds status”. Function used to connect/disconnect loads based on the supplied power of the generator. See par. 9.4.
- OF_05 - “5 – Test running”. This function signals the status of TEST mode.
- OF_06 - “6 – Mains in thresholds”. Function is active when the mains is considered “in tolerance” (see 7.2).
- OF_07 - “7 – Generator in thresholds”. Function is active when both voltage and frequency values are inside the operating window defined by the threshold parameters.
- OF_08 - “8 – Engine running”. Active if the engine running status is detected from the controller.
- OF_09 - “9 – Generator alarms”. Active if any generator anomaly is present.
- OF_10 - “10 – Engine alarms”. Active if any engine anomaly is present.
- OF_11 - “11 – Speed alarms”. Active if any anomaly due to engine speed problem is present.
- OF_12 - “12 – Fuel alarms”. Active if any fuel anomaly is present.
- OF_13 - “13 – Changeover alarms”. Active if any anomaly related to KG/GCB and/or KM/MCB is present.
- OF_14 - “14 – Gas solenoid”. Used for application with gas supplied engine. Using this command, the controller automatically carries out the flush cycle.
- OF_16 - “16 – Stop solenoid”. This function is to be used when a pick-up stop command is required. Usually the “FUEL SOLENOID” output is to be used. See par. 7.5.2.
- OF_17 - “17 – OR warnings”. If at least one warning is present, this function is active.
- OF_18 - “18 – OR alarms”. If at least one alarm (block, unload or deactivation) is present, this function is active.
- OF_19 - “19 – MAN + AUTO”. Function is **not active** if controller is in OFF/RESET mode.
- OF_20 - “20 – AUTO”. Function is **not active** if controller is in OFF/RESET or MAN mode.
- OF_21 - “21 – External horn”. This output function allows to connect an external horn (or a lamp) that will be driven in parallel to the internal alarm horn.
- OF_22 - “22 - Bit mapped”. Setting the output with this function, allows to define an OR function of one or more status among a maximum of 192 status.
- OF_23 - “23 – Idle speed command”. Function is active to command a low-speed mode to the engine. It is to be connected to the IDLE command of the engine or of the speed regulator (IDLE in some case can be activated by CAN interface).

- OF_24 - “24 – Coolant heating command”. This function allows to the controller to manage the coolant heating system of the engine (see par. 9.2).

- OF_25 - “25 – Engine enable command”. This function can be used to supply the speed governor of the engine. It can be used instead or alongside the “FUEL SOLENOID” output (see par.7.5.2).

- OF_26 - “26 – Synchronization in progress”. The output is activated when an automatic synchronization procedure is running on the controller (both direct and reverse synchronization). It can be used to supply/enable an external synchronizer. **Available only with HT GC500 /HT GC500Plus.**

- OF_28 - “28 – Reverse synchronization in progress”. The output is activated when an automatic reverse synchronization procedure is running on the controller. It can be used to switch voltage references on an external synchronizer that must be used both for direct and reverse synchronization. **Available only with HT GC500 /HT GC500Plus.**

- OF_29 - “29 – MCB voltage release coil disable”. This function works with a negative logic: the output is activated to remove power supply from the voltage release coil. In this way, when HT GC500 is not supplied, the output is not active, the voltage release coil is supplied, and so the circuit breaker can be closed. **Available only with HT GC500 /HT GC500Plus.**

- OF_30 - “30 – GCB voltage release coil enable”. This function works with a positive logic: the output is activated to supply the voltage release coil. In this way, when HT GC500 is not supplied, the output is not active, the voltage release coil is not supplied, and so the circuit breaker cannot be closed (it is forced open). **Available only with HT GC500 /HT GC500Plus.**

- OF_31 - “31 – External transfer switch closure command on gensets”. This function can be used when the generator works in parallel with other generators. Its purpose is to manage an external switch that connects the loads to the generators or to the mains. Each generator has one closure command (function “31” – OF_31) and one opening command (function “32” – OF_32) for this purpose; an external AND/OR logic is required to manage the external switch.. **Available only with HT GC500 /HT GC500Plus.**

- OF_32 - “32 – External transfer switch opening command from mains”. This function can be used when the generator works in parallel with other generators. See the description of function “31” (OF_31). **Available only with HT GC500 /HT GC500Plus.**

- OF_33 - “33 – Neutral contactor command”. This function is used only in parallel to the mains application. It is used to command a contactor (TLN) that connects the neutral to the earth. This contactor is always closed, except when the generator is in parallel with mains. Normally this contactor is supplied with the generator voltages: for this reason the contactor is open when the engine is stopped (or stopping). **Available only with HT GC500 /HT GC500Plus.**

- OF_34 - “34 – Engine start”. Used to crank the engine (see par. 7.5.2).

- OF_35 - “35 – MCB/KM command”. Used to command the Mains Circuit Breaker. It works with a negative logic: the output is activated to open the circuit breaker. In this way, when HT GC500 is not supplied, the output is not active and the circuit breaker is forced open.

- OF_36 - “36 – Synchro-check”. This function is used only in parallel applications. The output is activated only during synchronizations procedure (automatic or manual) when the conditions required to close the circuit breaker are met. It can be used to use the internal synchronizer of HT GC500 for externally managed circuit breakers (MCB). **Available only with HT GC500 /HT GC500Plus.**

- OF_37 - “37 – Voltage on bus-bars”. The output is activated when voltages are present on the bus-bars. **Available only with HT GC500 /HT GC500Plus.**

- OF_38 - “38 – Select Battery 1”. Output can be used to select Battery 1 set to cranking the engine, in system with 2 battery set.

- OF_39 - “39 – Select Battery 2”. Output can be used to select Battery 2 set to cranking the engine, in system with 2 battery set.

- OF_40 – “40 – Mains present (from loss of mains protection)”. This output is activated when the “loss of mains” protections (internal or external” say that mains is present. **Available only with HT GC500 /HT GC500Plus.**

- OF_41 – “41 – Device fault”. It is possible to configure with this function only the outputs from 5 to 14 (so this function is not available for HT GC310). The output is always activated: it is not activated only for an internal fault of the controller. It can be used to signal the fault of the controller. See 9.18.

- OF_49 – “49 – PWM 500 Hz”. This function is available only for digital output 10, 11 and 12. This function should associated to only one output at time. In any case only the first configured one will be used. This function generate a 500Hz PWM signal that reflect the speed governor output signal command. It is suitable for CATERPILLAR and PERKINS engine and others. **Available only for HT GC500Plus**.

5. EVENT LOG archive

During his working the board effects some periodical or on-event recordings; they are partially configurable with programming parameters. The board manages five types of archive:

- **Events**: when an event (previously configured) occurs, the board adds a record in this archive. The full capacity is of 99 records. If the archive is full and a new event occurs, the less recent is overwritten (so there are always the last 99 events). For each event, besides a numerical code that identifies it, the following data are recorded: the date/time when the event occurred, the key-lock switch status, the status of engine, generator, mains and of changeover in that moment. If the event is an anomaly, some analogue measurements are recorded too linked to the event. The settings of what event must be recorded is possible by means of P.0441 parameter:

P.0441 VALUE	FW release	Cause of recording
0	00.00	Blocks, disables, warnings, new start up and clock settings.
1	00.00	As “0” and moreover generator status variations
2	00.00	As “1” and moreover change-over status variations
3	00.00	As “2” and moreover engine status variations
4	00.00	As “3” and moreover mains status variations
99	00.00	All events

The following is a table with the codes of all possible events:

Code	Rel.	Registering cause
1001	1.00	Board in OFF/RESET
1002	1.00	Board in MAN
1003	1.00	Board in AUTO
1004	1.00	Board in TEST
1005	1.00	Board in REMOTE START
1010	1.00	Mains voltage absent
1011	1.00	Mains voltage present
1012	1.00	Mains voltage in tolerance
1013	1.00	Inhibition activated (from configurable input)
1014	1.00	Inhibition not activated (from configurable input)
1020	1.00	Generator voltage absent
1021	1.00	Generator voltage present
1022	1.00	Generator voltage in tolerance
1030	1.00	Closing KG/GCB command
1031	1.00	Opening KG/GCB command
1032	1.00	KG/GCB closed (from digital input)

1033	1.00	KG/GCB open (from digital input)
1035	1.00	Closing KM/MCB command
1036	1.00	Opening KM/MCB command
1037	1.00	KM/MCB closed (from digital input)
1038	1.00	KM/MCB open (from digital input)
1040	1.00	Engine stopped
1041	1.00	Starting cycle
1042	1.00	Engine running
1043	1.00	Cooling cycle
1044	1.00	Stopping cycle
1045	1.00	IDLE cycle
1050	1.00	Manual start request
1051	1.00	Manual stop request
1052	1.00	Auto start request
1053	1.00	Auto stop request
1054	1.00	Digital input start request JA-06 (TEST)
1055	1.00	Digital input stop request JA-06 (TEST)
1056	1.00	SW start request (RS232) (TEST)
1057	1.00	SW stop request (RS232) (TEST)
1058	1.00	Periodical start request (clock/calendar) (TEST)
1059	1.00	Periodical stop request (clock/calendar) (TEST)
1060	1.00	SMS start request (TEST)
1061	1.00	SMS stop request (TEST)
1062	1.00	Start request for MCB closure failure
1063	1.09	Start request by remote controller over PMCBus (**HT GC500 /HT GC500*Plus* only**)
1070	1.00	Fuel pump on
1071	1.00	Fuel pump off
1074	1.09	Reset
1075	1.00	Real Time Clock invalid
1076	1.00	Date/time modified
1077	1.00	New power on (of the board)
1078	1.00	Parameters set to default values (**HT GC500 /HT GC500*Plus* only**).
1080	1.00	Changeover inhibition activation.
1081	1.00	Changeover inhibition deactivation.
1082	1.00	Engine protection override activation
1083	1.00	Engine protection override de-activation
1091	1.09	Loss of mains protection “27” tripped (**HT GC500 /HT GC500*Plus* only**).
1092	1.09	Loss of mains protection “59” tripped (**HT GC500 /HT GC500*Plus* only**).
1093	1.09	Loss of mains protection “81<” tripped (**HT GC500 /HT GC500*Plus* only**).
1094	1.09	Loss of mains protection “81>” tripped (**HT GC500 /HT GC500*Plus* only**).

1095	1.09	Loss of mains protection “Df/Dt” tripped (**HT GC500 /HT GC500Plus only**).
1096	1.09	Loss of mains protection “Vector Jump” tripped (**HT GC500 /HT GC500Plus only**).
1097	1.09	Loss of mains protection (from MC100) tripped (**HT GC500 /HT GC500Plus only**).
1098	1.09	Loss of mains protection (from digital input) tripped (**HT GC500 /HT GC500Plus only**).
1099	1.09	Loss of mains protections restored (**HT GC500 /HT GC500Plus only**).

All the anomalies are recorded using the own failure code.

- **Fast trend**: with a configurable frequency by means of parameter P442 (time step increment in seconds), the board records the following analogue measurements:
    - Mains (or bus-bars for HT GC500) phase-to-phase voltages and frequency.
    - Generator phase-to-phase voltages and frequency.
    - Generator currents
    - Active, reactive and apparent powers, the power factor and the type of the plant total load.
    - Starting battery voltage, engine rotation speed, coolant temperature, oil pressure and engine fuel level.

  Each record has date/time associated. The measurements not acquired (because the board was not set to acquire them) are substituted by dashes. This archive has a capacity of 30 records that, with the predefined time step increment (60 seconds) covers a period of half an hour.

- **Slow trend**: with a time step increment configurable by means of P.0443 (minutes) the board records the same measurements seen at previous point. Each record has associated its date/time. This archive has a capacity of 48 recordings that, with the predefined time step increment (30 minutes) covers a period of one day.

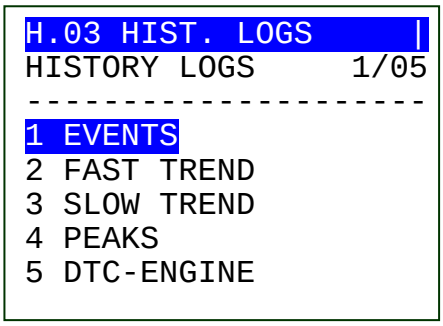
- **Peaks**: the board effects a series of recordings of the maximum and minimum peaks for some significant measurements:
    - Total active power: it is recorded the maximum peak, with its associated date/time and the measurement of the engine coolant temperature (if available)
    - Currents: for each current it is recorded the maximum peak value, with its date/hour
    - Coolant temperature: the maximum value alongside data and time
    - Board temperature: the maximum peak of the internal temperature is recorded with its time/date

- ECU diagnostic (DTC): diagnostic codes received from the engine by means CAN connection are stored in this archive. It is able to store up to 16 records. After that, the most recent record overwrites the oldest one.

5.1 Entering the archives

These archives can be accessed in any function mode and status of the controller. In order to select the function, use the buttons ▲ and ▼ under the display in order to show the HISTORY ARCHIVE (H.01) base page. REMARKS: if inside a display mode the controller doesn't allow to change the display mode, press EXIT pushbutton one or more time in order to leave the mode (for example if inside PROGRAMMING).

Once the page H.01 is shown, press ENTER in order to activate the mode, page H.03 will be shown, containing a select menu for all the archives type.



5.2 Exit from archives visualization

There are two ways to exit from archive visualization:

- Press the EXIT key n times to come back until page H.01
- Changing the operation mode of the controller

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

5.3 Archive selection

First row shows always the numerical indication of the selected entry and the number of available entries in the menu.

Subsequent rows are used to show the list of available archive types. Selected entry is shown in reverse. Using the pushbuttons ▲ and ▼, it is possible to scroll the menu in cyclic mode (once reached the last or the first one, the scroll continues with the first or the last one). Then, pressing ENTER the archive is accessed; from this page, press EXIT to go back to page H.01.

5.4 Events page

Second row identifies which event in the whole list of records is shown. REMARK: the most recent one has the higher identify number.

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

Each event is shown by means at least three pages; if the event is one of the last 15 ones, they are shown by means seven pages. It is possible to scroll among the pages by means the ◄► pushbuttons.

Fourth row of all event pages shows recording date and time. On the right, left and right arrows (or only one of them) are shown to indicate that other pages can be accessed for this record.

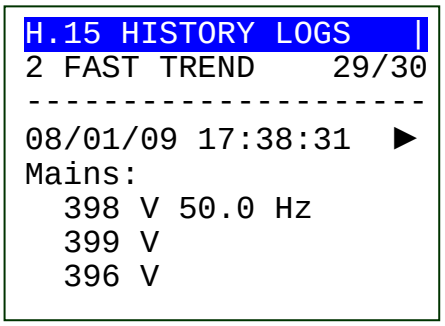
Other rows show information depending on the shown page:

- On the first page, it is shown a numeric code of the event and its description.
- On the second page, it is shown the function mode of the controller in addition to the engine, generator and mains status.
- On the third page, KG/GCB and KM/MCB status are shown.
- For page 4, 5, 6 and 7, please refer to next paragraph.

5.5 Pages for fast/slow analogue records

Second row shows which record is displayed respect to the total number of records. REMARK: the most recent one has the higher identify number.

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



Fourth row of all event pages shows recording date and time. On the right, left and right arrows (or only one of them) are shown to indicate that other pages can be accessed for this record.

Other rows show information depending on the shown page:

- On the first page, phase to phase voltages and frequency related to the mains (or to the bus-bars for HT GC500) are shown.
- On the second page, phase to phase voltages and frequency related to the generator are shown.
- On the third page are shown measures related to current, powers (kW, kvar and KVA), the power factor and load type.
- On the fourth page are shown measures related to the coolant temperature, oil pressure, fuel level, speed rotation and battery voltage.

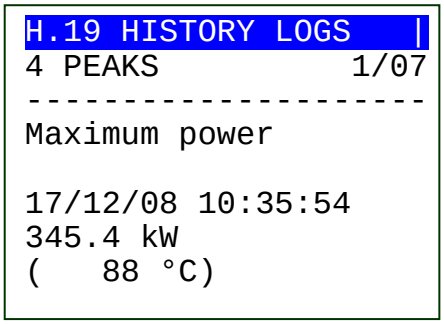
If any measure was not available at record time, dashes are shown instead.

5.6 Peak pages

Second row shows which record is displayed respect to the total number of records. The available records are 7.

Only one page is used to show the records, thus use the ▲ and ▼ pushbuttons to scan the records.

Fourth row shows a description of the peak record shown:



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

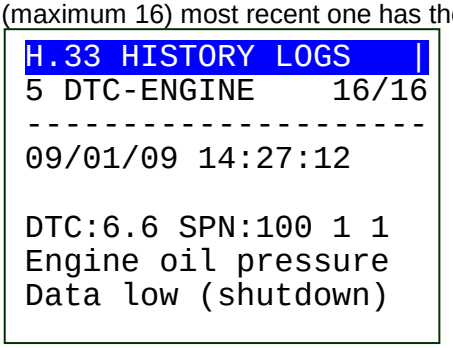
On the sixth row date and time of record are shown. On the seventh row it is shown the recorded measure (power, current etc.). On the eighth row can be shown a meaningful reference measure:

- Together the maximum power, it is recorded the coolant temperature
- Together the maximum currents, are recorded the power factor values.

If any measure was not available at record time, dashes are shown instead.

5.7 Pages for Diagnostic Trouble Code (DTC)

Second row shows which record is displayed respect to the total number of records (maximum 16) most recent one has the higher identify number.



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

Only one page is used.

Fourth row shows date and time of recording.

Fifth row shows the diagnostic code. It contains:

- DTC: it is the proprietary diagnostic code of the engine. Each engine type has proper DTC. Check the operating manual of the engine. If this code is not available, it is replaced with dashes.
- SPN (Suspect Parameter Number): it is a numeric code that identifies the fault engine part, component or function. This code is available only for J1939 diagnostic.
- FMI (Failure Mode Identifier): it is a numeric code between 0 and 31 that identifies the type of problem (for example, 1 means a too low value that requires engine shutdown). It is available only for J1939 diagnostic.

On the seventh and eighth rows a plain text message explaining the failure is shown (if available).

6. Special procedures

Besides to the normal working sequence, HT GCxxx includes special procedures which must to be activated in a particular way. Some of them are reserved to S.I.C.E.S. s.r.l. and then are not described in this document. Some other instead can be used also by the installer or by the end user.

While these special procedures are in execution, the normal working sequence is not executed and the genset is not available. It is then appropriate executing these special procedures in phase of plant installing or starts up. If these procedures have to be executed in a second time, be sure to supply the loads from another source before starting.

Here the list of special procedures implemented by HT GCxxx. The ones in italics and underlined are reserved to S.I.C.E.S. s.r.l.

- *"RESERVED"*
- *"TEST": board self test*
- *"CALIBRAT.": measurements inputs calibration.*
- **"FUEL LEV": calibration of the fuel level sensor**.
- **"LANGUAGE": language selection**

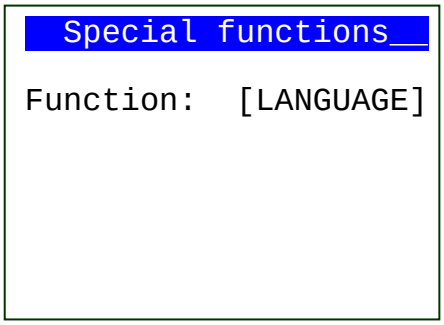
The required operations to activate the special procedures are common for all, and are described forward. REMARK: all special operations are protected with password. In this document, the passwords are disclosed only for the procedures available to the operator. It is not possible to modify these passwords: avoid then to disclose them to operators not interested to special operations.

Before activate one of the special procedure, be sure that the generator can't be started.

6.1 Special procedure activation

During this phase all the outputs are deactivated and load is transferred to the mains.

It is required to follow these steps:



1) Disconnect the supply from the board (remove JB connector or open the fuse in the panel)
2) Wait for 5 seconds or more.
3) Now supply the board, keeping pressed together the START and STOP keys. In this phase, the multifunctional display shows question marks. The two keys must be kept pressed until the display will appear as in the previous screen example. NOTE: if the

keys are released too soon, the board will start to work with its normal working sequence.

4) On third row appears in square brackets the name of a special procedure. Release the START and STOP keys and press ENTER: the square brackets start to flash.

5) Select the request procedure using ▲ and ▼ keys (until its name appears into the brackets). Then confirm with ENTER key. The square brackets stop to flash.

6) In the fifth row, it is now necessary to set a password. This password is different for each special procedure (see next paragraphs). Press ENTER to start the password setting (brackets start to flash).

7) Use the ▲ and ▼ keys to increase or decrease the number into the squares (NOTE: pressing the SHIFT key together to ▲ or ▼ makes the numbers increase or decrease faster).

8) When into the brackets there is the desired number, confirm it by pressing ENTER key. If the password is correct the selected special procedure starts (described later on), otherwise the board shows an error message and automatically comes back to step 1.

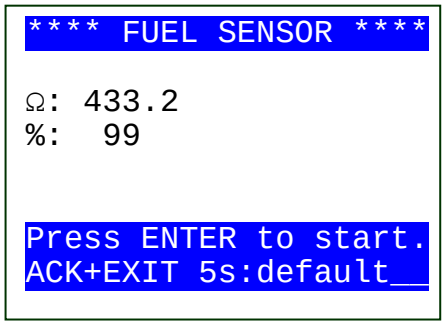
NOTE: it is possible to abort this procedure in every moment, by removing the supply from the board. In each case, at the special procedure end, it is necessary removing and providing again the supply to the board to come back to the normal working sequence.

6.2 "FUEL LEV.": fuel level sensor calibration.

It is possible to connect to HT GCxxx an analogue sensor level to measure the fuel quantity in the tank. This measure can be also used to manage a pump for automatic filling of the tank aboard the genset. It can moreover utilized to activate anomalies if the tank is empty of overfilled. The board manages resistive sensors that change their resistance between 0 and 400 ohms. This allows working with the most common sensors. Each sensor type has however its own well-defined resistive range and each one is different from the other. Moreover, also with same sensors, different tanks have different shapes and probably the sensor cannot have (for mechanical reasons) its full resistance excursion. For these reasons, the calibration procedure was implemented: it allows to the operator, in the phase of installation or plant set up, to define the resistance values corresponding to empty and to full tank.

To execute this calibration, follow at first the procedure to activate the special procedure, using the password **"135"** to access the function. The board records calibration values in a not-volatile memory. Usually this procedure is executed only one time when configuring the genset. The screen of fuel sensor is shown above.

Both the resistive value of the sensor and the associated percentage are shown.



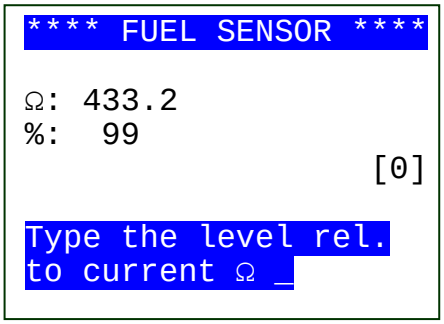
In order to proceed with the calibration, follow these steps:

1) Press the ENTER pushbutton

2) Text on the last two rows becomes: MOVE SENSOR TO EMPTY POS. THEN PRESS ENTER. Move then the sensor until the empty position. Wait few seconds to stabilize the ohm measurement, and then press ENTER.

3) Now the page is like this one.

   Now set the numerical value to be associated to the present float position. Typically with empty tank the value to visualize should be 0%, but it is possible to associate any value



   (by example, if manually it is not possible to carry the float completely in the empty position, it is possible to estimate the current level and set this value). To set the level, press ENTER (square brackets start flashing), use ▲ and ▼ keys to change the value and confirm new value with ENTER. NOTE: even if the desired value is “0”, you must however to set it (by pressing two times the ENTER key).

4) The text on the last two rows change in: MOVE SENSOR TO FULL POS. THEN PRESS ENTER. The tank must to be filled to its maximum, or you must to move manually the sensor float up to the level corresponding to full tank. Wait some seconds, until the measurements shown in the second row are stable, then press the ENTER key.

5) Display is now similar to the one shown on point 3). Now set the numerical value to associate to the present float position. Typically, with full tank, the value should be 100%, but it is possible to associate any value (if, by example, manually it is not possible to reach the full tank position with the float, it can be estimate the level reached and use this value). To set the level, press ENTER (square brackets start flashing), use ▲ and ▼ keys to change the value and confirm new value with ENTER. NOTE: even if the desired value is “100”, you have however to set it (by pressing two times the ENTER key).

Now the procedure is complete and it restarts from step 1 allowing its repetition if needed: on the last row, it will be shown the level value recalculated with new calibration. It is so possible to move the float, verifying the proper level visualization.

When the procedure is at step 1, pressing together for five seconds the MODE and EXIT keys it is reloaded the default calibration. This calibration is suitable for “VEGLIA” sensor and corresponds to 360 ohms for empty tank and 10 ohms to full tank.

Starting from SW revision 01.13 of the software, it is possible to use a generic sensor 0-400ohm for which a transfer function curve can be specified by means the programming software BoardPrg3. In this case it is advisable to not use this procedure. In order to enable the curve, set P.0114 to 20.

6.3 “LANGUAGE”: language selection

HT GCxxx allows to select the language to use for any text of the multifunctional display. At the present three languages are supported: Italian, English and French (default language is English). To select the desired language, follow at first the procedure described in 6.1, using **“1”** as password. The board records the selected language in a non-volatile memory. Normally, then, this procedure has to be executed only one time. At the end of the procedure described in 6.1, the display shows this window (text changes with selected language):

To modify the language:

1) Press ENTER key. Square brackets start to flash.

2) Select the desired language (in the square brackets) using ▲ and ▼ keys. NOTE: the text in the first three rows adapts itself to the selected language.

3) Confirm with ENTER key: brackets stop flashing.

Now it is possible to remove and give back the supply to the board and work with new language.

Starting from SW version 01.13, it is possible to change the operating language directly from page S.06 even with the generator running without entering this special procedure.

7. Working sequences

7.1 Board modes

HT GCxxx operating modes are five:

- OFF/RESET: genset is not working (or it is stopping), anomalies are all reset and it is possible to enter to the programming to modify parameters. KG/GCB and KM/MCB are at rest allowing load connection to the MAINS.
- MAN: genset starting and load changeover to the generator are made by operator (the board does not manage them automatically). The genset stopping and the load changeover to the mains are normally made by the operator; since protections are active, the board may in all cases changeover the load to the mains if the generator is not in tolerance and in the same way can stop the engine if an anomaly requiring it occurs. It is allowed the access to programming but only few parameters can be changed.
- AUTO: the genset starting and stopping and the load changeover are managed by the board (the operator cannot intervene). All the protections are enabled. It is allowed to access to programming but only few parameters can be changed.
- TEST: this working mode is almost identical to AUTO mode. It differs by the fact that the engine is in all the cases started (automatically) also with mains present. With parameter P.0222, it is possible to choose if the board has or has not to do the load changeover to generator. However, the operator can do the changeover manually pressing KM/KG (or GCB). The board will pass automatically from TEST to AUTO if the conditions for an automatic genset intervention are verified. It is allowed the access to programming but only few parameters can be changed.
- REM (REMOTE START): this working mode is almost identical to AUTO. It differs by the fact that the engine is in every case (automatically) started also with mains and inhibits input presence, and the load is then changed-over to genset. This mode has priority to TEST mode (it can interrupt TEST or substitute itself to the periodical test). The operator cannot changeover the load manually. The board will pass automatically from REMOTE START to AUTO if the conditions for an automatic genset intervention are verified. It is allowed the access to programming but only few parameters can be changed.

First three modes can be selected by using the UP/DOWN pushbutton on the front panel. Alternatively, it is possible to use three digital inputs of the controller configured with the following functions:

- 78 “Remote OFF” (IF_78).
- 79 “Remote MAN” (IF_79).
- 80 “Remote AUTO” (IF_80).

When one of these inputs is active, the operating mode is forced, and it is no more possible to use the pushbuttons to change it (the first row of the display shows a “key” symbol to warn the operator about this situation). When no one of these inputs is active, it is again possible to use the pushbuttons to change the operating mode. If more than one input is active at the same time, the input configured to force the OFF-RESET mode has high priority, followed by the one which forces the MAN mode and last by the input which forces the AUTO mode. It is also possible to use only one or two inputs. For example, It’s possible to use only one input to force the AUTO mode: when the input is active, the controller is forced in AUTO mode, when the input is not active the controller remains in AUTO, but the pushbuttons can be used to select a different mode. **If it is used only one input to force the OFF-RESET mode, the**

controller acts in a different way: when the input is active the controller is forced in OFF-RESET, when the input become not active the operating mode goes back to the mode active before the input activation.

In order to activate the TEST mode, the operating mode must be in advance set to AUTO. If no start requests are pending, it is possible to start the TEST mode in one of the following ways:

- Pressing the START key. The mode change is immediate. To return to AUTO mode, press again the START pushbutton.
- Set properly parameters P.0418, P419 and P420 (PERIODICAL TEST). They permit to program weekly time slots during which the engine has to run in TEST mode (to maintain it efficient). In this case, the passage to TEST is automatic in the scheduled days and hour. The board comes back to AUTO mode at the end of the configured TEST time interval.
- Through an adequate SMS command message (see the document describing the use of RS232 port). To utilize this possibility it is necessary that parameter P420 is different from zero (it is the TEST duration). In this case the board passes to TEST mode as soon as received the SMS message and comes back to AUTO mode after the time P.0420
- By means of a command from a PC connected to RS232 board serial port. The board passes to TEST as soon as received the command from serial port, comes back when receive the opposite command or when it consider loose the serial connection (60 seconds without messages).
- Activating a digital input configured with the REMOTE TEST function (function 26 – IF_26). Controller switch from AUTO to TEST activating this input and switch back to AUTO deactivating it.

If in test mode, the AUTO/TEST indicator flashes at a duty of 50%.

To active the REMOTE START mode, the board must be in AUTO or in TEST mode. If a digital input is configure as “REMOTE START ENABLE” (function 29 – IF_29), this input must be active in order to allow entering REMOTE START mode.

This mode can be activated in one of the following modes:

- By means a digital input configured with the REMOTE START function (function 27 – IF_27). If input is active, the REMOTE START mode is entered and it is leaved deactivating the input.
- By means a SMS. In this case, the controller switch to REMOTE START as soon it receives the message and switch back to AUTO receiving a message with the opposite command.
- By means command sent from a remote PC connected to the serial port. It switches to REMOTE START upon reception of the command and switch back to AUTO after receiving the opposite command (**it remains in REMOTE START in case of communication failure**).

7.2 Mains

HT GCxxx controllers must know the status of the mains for many reasons.

In emergency applications (HT GC310, HT GC350 and some configurations of HT GC500), the controller starts the generator (and connects the loads to it) when the mains is “out of tolerance”; it connects the loads to the mains and stops the generator when the mains is “in tolerance”.

In parallel to the mains applications HT GC500/HT GC500*Plus* only), the controller stops the generator when the mains is “out of tolerance”, and starts it when the mains is “in tolerance”.

The status of the mains can be detected in many ways:

- From the JF connector of the controller.

  For HT GC310 and HT GC350, this connector is provided only for the mains.

  For HT GC500/HT GC500*Plus*, instead, JF connector is provided both for mains (P.0126 = 1) and bus-bars (P.0126 = 1) connections. Obviously, if it is used for bus-bars connections, the controller is not able to directly measure voltages and frequency from the mains.

  See paragraph 2.1.1 for wiring notes about JF connector.

  In any cases, HT GCxxx can directly measure voltages and frequency of the mains from JF connector **only** if the nominal voltage for the mains is different from zero (P.0116).

- By a digital input configured as “60 – External mains sensor” (IF_60). When this input is active, mains is considered “in tolerance”; when the input is not active, mains is “out of tolerance”. **Note: if this digital input is active, the mains is “in tolerance” even if the measures from JF connector say that mains is “out of tolerance”.**

- **Only for HT GC500/HT GC500*Plus***: if the controller cannot use the two previous ways, it can use (if exists) the status of the “loss of mains protections” as mains status. The status of the “loss of mains protections” can be detected from a digital input (function “39 – PPR Status” – IF_39), from JF connector if wired to the mains (P.0126=1) or from MC100 controllers.

- **Only for HT GC500/HT GC500*Plus***: from one or more MC100 controllers, connected over the PMCB bus. In this case, all previous checks are discarded and only the status sent by MC100 is used as mains status. **Note: if more than one MC100 is available, mains is “out of tolerance” if at least one MC100 says “out of tolerance”.** If two (or more) MC100 controllers send different mains statuses, for HT GC500 the mains is “out of tolerance” but this condition in signaled by a fast blink (5% on) of the “MAINS LIVE” lamp.

7.2.1 Internal sensor

If JF connector is assigned to the mains (P.0126=1 for HT GC500) and enabled (P.0116 <> 0), there are many parameters used to configure the management of the mains:

- P.0119: set it to 3 if mains is three-phases and 1 if single-phase
- P.0116: nominal mains voltage. Its value must be the nominal phase-to-phase voltage for three-phase systems and phase–to–neutral voltage for single-phase systems. Thresholds are expressed in percentage respect to P116. Setting it is set to zero, mains voltages are always considered not present, even if physically

connected. NOTE: even if P.0116 is set to zero, mains voltages is always computed and visualized.

- P.0117: if voltage transformers are connected to JF inputs, this is their primary voltage value (in volts).
- P.0118: as P117 but for voltage transformers secondary voltage value (volts).
- P.0105: generator nominal frequency. It is used also as mains nominal frequency. All frequency-related thresholds are expressed in percentage respect to P105.
- P.0201: hysteresis applied to all the thresholds related to main voltages and frequency. It is a percentage value respect to P116 and P.0105.
- P.0203: low mains voltage threshold (percentage respect to P.0116); under this value mains is considered anomalous.
- P.0204: high mains voltage threshold (percentage respect to P.0116); over this value mains is considered anomalous.
- P.0236: low mains frequency threshold (percentage respect to P.0105); under this value mains is considered anomalous.
- P.0237: high mains frequency threshold (percentage respect to P.0105); over this value mains is considered anomalous.
- P.0238: mains voltage unbalance threshold (percentage respect to P.0116); over this value mains is considered anomalous. This parameter can be used only for three-phase systems.
- P.0239: phases sequence required for mains. This parameter can be used only for three-phase systems.

To detect the status of the mains, the controller can perform up to four different checks (it is possible to disable them one by one). The following paragraphs describe all them, even with some examples. Remember, however, that voltages and frequency checks cannot be both disabled (in this case mains is “out of tolerance”)).

7.2.1.1 Check of frequency

To disable this control, at least one of the following conditions must be true:

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

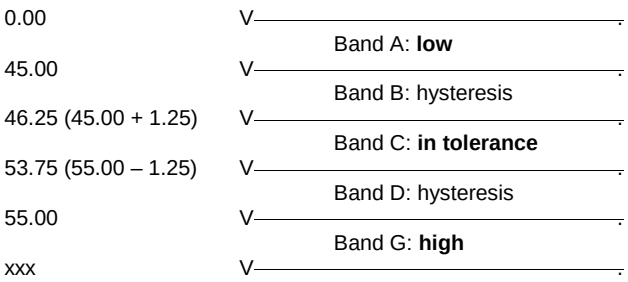
Let us see a practical example upon how thresholds work, with default values for the parameters we have seen:

Parameter	**Description**	**Default value**	**frequency (Hz)**
P.0105	Nominal 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 is calculated as half the difference of P.0237 and P.0236. It is limited, however, to the value set in parameter P.0201. The hysteresis is applied:

- To the minimum frequency threshold, in high direction (so between 45.00 Hz and 46.25 Hz).
- To the maximum frequency threshold, in low direction (so between 53.75 Hz and 55.00 Hz).

With these values, we can identify the following bands:



If the mains frequency is in the “B”, “D” bands, board maintains its previous status (hysteresis). For example, if mains was in “C” band and now is in “D” band, it is considered in any case “in tolerance”. If instead mains was in “A” band and now is in “B” band, it is considered “low”.

7.2.1.2 Check of voltages

To disable this control, at least one of the following conditions must be true:

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

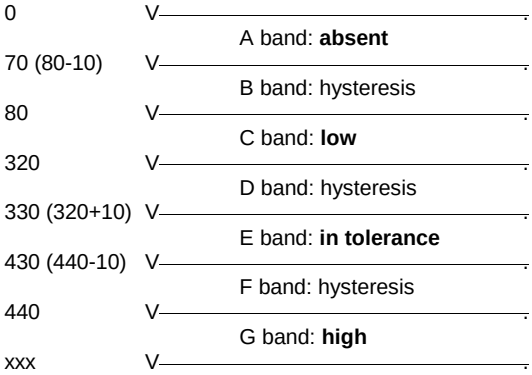
Let us see a practical example upon how thresholds work, with default values for the parameters we have seen:

Parameter	**Description**	**Default value**	**Voltage (V)**
P.0116	Nominal 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 is calculated as half the difference of P.0204 and P.0203. It is limited, however, to the value set in parameter P.0201. The hysteresis is applied:

- To the mains presence thresholds, in low direction (in the example between 70 V and 80 V).
- To the minimum voltage threshold, in high direction (so between 320 V and 330 V).
- To the maximum voltage threshold, in low direction (so between 430 V and 440 V).

With these values, we can identify the following bands:



If the mains voltages are in the “B”, “D”, “F” bands, board maintains its previous status (hysteresis). For example, if mains was in “E” band and now is in “D” band, it is considered in any case “in tolerance”. If instead mains was in “C” band and now is in “D” band, it is considered “low”.

These controls are made on each phase.

7.2.1.3 Check for voltages unbalance

On three-phase systems, it is possible to force HT GC500/HT GC500^{Plus} to consider mains as “out of tolerance” if there are some differences between any phase-to-phase voltages greater than the configured threshold.

To disable this control, set parameter P.0238 to zero.

Let us see a practical example upon how thresholds work, with default values for the parameters we have seen:

Parameter	Description	Default value	Voltage (V)
P.0116	Nominal voltage	400 V	400
P.0238	Mains voltage unbalance threshold	10.0 %	40

In this example, if the difference (absolute value) between to phase-to-phase voltages is higher than 40V, mains is “out of tolerance” (MAINS LIVE lamp blinks 25% on). If all differences are below 40 V, mains is “in tolerance”. No hysteresis is managed for this check.

7.2.1.4 Check for phases sequence

On thee-phase systems, it is possible to force HT GC500/HT GC500^{Plus} to consider mains as “out of tolerance” if the actual phase sequence is different from the one configured with parameter P.0239.

To disable this control, set parameter P.0239 to zero.

If you need a “clockwise” phases sequence, set parameter P.0239 to “1”; if the real phases sequence is “counterclockwise” mains is considered “out of tolerance” (MAINS LIVE lamp blinks 25% on).

If you need a “counterclockwise” phases sequence, set parameter P.0239 to “2”; if the real phases sequence is “clockwise” mains is considered “out of tolerance” (MAINS LIVE lamp blinks 25% on).

7.2.1.5 Internal sensor global status

To detect the global status of the mains by the internal sensor, the following algorithms are utilized, shown in their computing order:

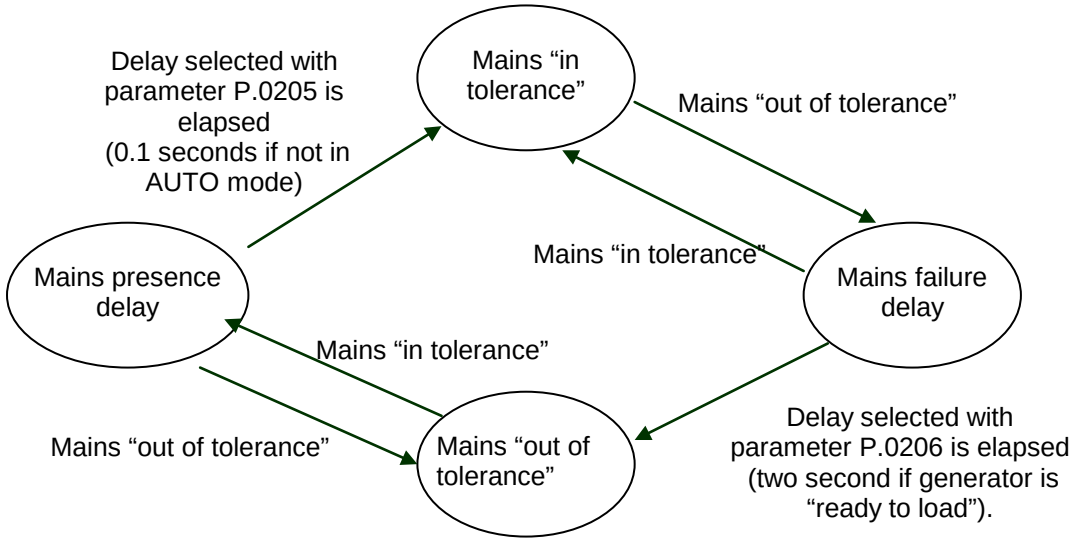
- If **all** the existing voltages **and** the frequency are in "Absent" status, also global status is "Absent".
- If **all** the existing voltages **and** the frequency are in "In tolerance" status, also global status is "In tolerance".
- If at least **one** of the existing voltage **or** the frequency are in "High" status, also global status is "High"
- If all the previous conditions are not met, the global status is "Low".

If the previous tests say that the mains is "in tolerance", the following two tests are evaluated:

- If the is a "voltage unbalance" condition, the global status is "Low".
- If the real phases sequence is different from the configured one, the global status is "Low".

7.2.2 Mains global status

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



7.3 Generator

HT GCxxx measures generator (single or three-phase) voltage and frequency in order to protect the loads and the generator itself from malfunctioning outside its tolerance thresholds.

For information about connection of the generator, please refer to par. 2.1.2

7.3.1 Frequency

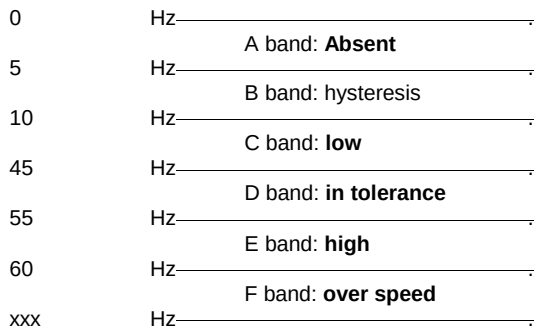
Many parameters related to the frequency measurements:

- P.0105: nominal generator frequency. The thresholds are expressed in percentage in respect to it.
- P.0228: threshold (absolute in Hz) under which the generator is considered stopped.
- P.0229: threshold (absolute in Hz) over which the generator is considered working.
- P.0305: low frequency threshold (percentage in respect to P.0105); under this threshold, the generator cannot be loaded.
- P.0307: high frequency threshold (percentage in respect to P.0105); over this threshold the generator cannot be loaded.
- P.0331: over speed (maximum frequency threshold as percentage in respect to P.0105); over this threshold, the genset must be stopped because it is possible to damage both the engine and the alternator.

Let us see a practical example about thresholds, with default values for the parameters.

Parameter	Description	Default value	Frequency (Hz)
P.0105	Nominal frequency	50 Hz	50
P.0228	Engine stopped threshold (from frequency)	10.0 %	5
P.0229	Engine running threshold (from frequency)	20.0 %	10
P.0305	Minimum frequency threshold	90.0 %	45
P.0307	Maximum frequency threshold	110.0 %	55
P.0331	Over speed threshold (from frequency)	120.0 %	60

With these values, we can identify the following bands:



The only managed hysteresis band is to diagnose the status for engine spotted or engine running. From generator's viewpoint, the "E" and "F" bands are the same; they are separated only to implement an over speed protection for the engine in the case his speed cannot be detected in other ways (pick-up, "W" signal, etc.).

P.0305, P.0307 and P.0331 thresholds are utilized also to manage the engine/generator frequency protections. These protections can be individually disabled setting to zero the parameter specifying the delay (respectively P.0306, P.0308, and P.0332). However, if protections are disabled, thresholds are utilized to determine the frequency status; this allows to not changeover the loads on generator if its electrical measurements are not in the tolerance band (useful for asynchronous engines).

7.3.2 Voltages

Some parameters are used to manage generator voltages measurements:

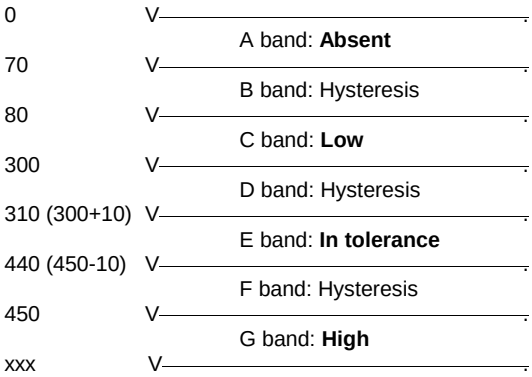
- P.0101: set it to 3 if generator is three-phases and to 1 if single-phase.
- P.0102: phase-to-phase nominal generator voltage. For three-phase generator this value is the phase-to-phase voltage, for single-phase it is line to neutral voltage. Thresholds are expressed in percentage in respect to it.
- P.0103: if voltage transformers are used, connected to JN inputs, this is their primary voltage value (in volts)
- P.0104: as P103 but for voltage transformers secondary voltage value (volts).
- P.0202: hysteresis applied to all the thresholds related to generator voltage. It is a percentage value respect to P102.
- P.0226: threshold (absolute in volts) under which the generator is considered disabled
- P.0227: threshold (absolute in volts) over which the generator is considered working
- P.0301: low generator voltage threshold (percentage respect to P.0102); under this value loads cannot be changed-over to genset
- P.0303: high generator voltage threshold (percentage respect to P.0102); over this value loads cannot be changed-over to genset

Let us see a practical example upon how thresholds work, with default values for the parameters.

Parameter	Description	Default value	Voltage
P.0102	Nominal voltage	400 V	400
P.0226	Engine stopped threshold (from voltages)	17.5 %	70
P.0227	Engine running threshold (from voltages)	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 is applied to the two configurable thresholds (P.0301 and P.0303) fully in the direction for the threshold entry. This means that generator voltage is out of the tolerance if external to 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.

With these values, we can identify the following bands:



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

Such statuses are managed for each phase. With a three-phase system, in order to diagnose the generator “global” status, the following algorithms are utilized, shown in the order they are computed:

- If all the three phases are in “Absent” status, also global status is “Absent”.
- If all the three phases are in “In tolerance” status, also global status is “In tolerance”.
- If at least one phase is in “High” status, also global status is “High”
- If no one of the previous conditions is verified, the global status is “Low”.

P.0301 and P.0303 thresholds are utilized also to manage the generator protections on voltages. These protections can be singularly disabled setting to zero their related parameter specifying the delay (respectively P.0302 and P.0304). Thresholds are however utilized in order to identify the voltage status: this allows to non-changeover the load to genset if its electrical measurements are not in the tolerance band, also if protections are disabled (this is useful for asynchronous engines).

7.3.3 Overview

To the general management, the generator behavior can be described in three phases:

a) Steady out of tolerance: the generator voltages and/or frequency status was different from “In tolerance” consecutively for two seconds. The LED “GENERATOR LIVE” is switched off if voltages and frequency are in “Absent” status, otherwise it flashes.

b) Steady present: the generator voltages and frequency status must be “In tolerance” consecutively for 0.5 seconds “GENERATOR LIVE” LED is switched on.

c) Transitory: between the passage from “a” phase to “b” phase” or vice-versa. The LED “GENERATOR LIVE” flashes.

Generator status is shown by means the signal lamp GENERATOR LIVE (see par. 3.2)

7.4 Inhibition of automatic start of generator

In automatic mode, whatever is the status of the mains, the automatic start of the generator can be inhibited in many ways, described in the following paragraphs.

Inhibition status is shown by a PADLOCK icon on the top bar of the LCD display.

This function can be used only in AUTO mode; TEST and REMOTE START modes are not affected by it.

7.4.1 Inhibition from digital input

The board can use a digital input programmed with the function “40 – Inhibition” (IF_40). If the input is active, it prevents the automatic start of the generator.

Parameter P.0207 is used to set a delay between the physical activation of the input and the logical activation of the function (Inhibition activation delay). This delay is applied only if the controller is working in AUTO mode.

Parameter P.0208 is used to set a delay between the physical deactivation of the input and the logical deactivation of the function (Inhibition deactivation delay). In case the generator is running, this time is fixed to 2 seconds.

7.4.2 Inhibition by internal real time clock

With parameters P.0421, P.0422, P.0423 it is possible to define weekly time bands in which the genset is enabled to work. In particular, by means of parameter P.0421 you can select in which days of the week the genset can work. By the others it is selected a time band, same for all the selected days. The time band start (P.0422) is referred to the days selected with P.0421, and the time band end (P.0423) is referred to the same day if it has value higher than P.0422, to the next day if lower (across midnight). Moreover, setting P.0422 equal to P.0423, it is defined a band covering the whole day.

7.4.3 Inhibition by load function (HT GC500/HT GC500*Plus* only)

In application with many gensets working in parallel, it is possible to use the “load function”. This function starts the generators required to supply the power actually requested by the loads; all other generators are stopped (even if, for example, it is an emergency application and mains is “out of thresholds”).

7.4.4 Inhibition for “mains out of tolerance” (HT GC500/HT GC500*Plus* only)

In parallel to the mains applications, when there are no local loads to supply, the generator can only work in parallel to the mains. When the mains is “out of tolerance”, the generator must be disconnected from the mains: in this case there is no need to keep the generator running. After a configurable delay (P.0899), HT GC500 stops the generators and waits for the mains coming back “in tolerance”.

7.4.5 Inhibition for “GCB circuit breaker not open” (HT GC500/HT GC500*Plus* only)

In application with many gensets working in parallel, it may be possible that a generator who needs to stop is not able to open its GCB circuit breaker. This is a dangerous condition, because the voltages of all other generators keep this generator running (and so also the engine is moved by its generator). This condition is very dangerous if there are some kinds of important services (oil pump or similar), because these services are normally stopped when HT GC500 stops the generator: if the engine is still running after HT GC500 has stopped it, it runs without these services and this could lead to damage.

When HT GC500 detects over the PMCB bus a “GCB not open” condition, it can be configured to avoid the closure of its GCB (or even it can be configured to open its GCB): in this situation HT GC500 stops the generators, waiting for a solution of the problem.

7.5 Engine

HT GCxxx is able to start, stop and protect the engine with a series of thresholds upon the acquired measurements (oil pressure, coolant temperature, speed etc.). Before to describe the engine management sequences, it is necessary to define in which way the board determines the engine running status.

7.5.1 Engine running/stopped status acknowledgement

There are six possible ways to determine if the engine is running:

- The engine speed is higher than P.0225 threshold. This control is not used if this or P.0224 threshold is set to zero or the measurement is not available (P.0110, P.0111 and P.0127 parameters set to zero and CAN BUS not used).
- The D+ signal voltage (terminal 4 or 5 of JH) is higher than the threshold configured with parameter P.0230. This control is not used if parameter P.0115 set to 0 or 2.
- If the low/minimum oil pressure inputs are not active. In fact, when the engine is stopped, the oil pressure goes down near to zero, and these contacts should activate. This control is not used if the parameter P.0232 is zero (that is if it explicitly was chosen to not use it) or no digital input is configured to acquire low and minimum oil pressure signals.
- If the voltage measured **on at least** one generator phase is higher than P.0227 threshold. This control is not used if this or P.0226 thresholds are set to zero.
- If the frequency measured on generator is higher than P.0229 threshold. This control is not used if this or P.0228 thresholds are set to zero.
- If the engine signals the running status on CAN BUS (only if parameter P.0700 is set to a value greater than 0 and if a CAN connection to the engine is established).

To acknowledge the engine running status, to HT GCxxx it is sufficient that **at least one** of the previous conditions is verified consecutively for 0.2 seconds. The board disables the starter signal (and prevent others activations) if it diagnoses that engine is running.

In the same way the conditions to acknowledge the engine-stopped status are:

- The engine speed is lower than P.0224 threshold. This control is not used if this or P.0225 threshold are set to zero or if the measurement is not available (P.0110, P.0111 and P.0127 parameters set to zero and CAN bus connection is not used).
- Signal D+ voltage is lower than P.0231 threshold. This control is not used if parameter P.0115 set to 0 or 2.
- If the low/minimum oil pressure inputs are active. This control is not used if parameter P.0232 is set to zero (that is if it explicitly was chosen to not use it) or if no digital input is configured to acquire low and minimum oil pressure signals.
- If the voltage measured **on all** the phases of the generator are lower than P.0226 threshold. This control is not used if this or P.0227 thresholds are set to zero.
- If the frequency measured on the generator is lower than P.0226 threshold. This control is not used if this or P.0229 threshold are set to zero.
- If the engine signals the stopped status on CAN BUS (only if parameter P.0700 is set to a value greater than 0 and if a CAN connection to the engine is established).

The engine is considered stopped if **all** the previous conditions are verified (all that are not disabled) consecutively for five seconds.

7.5.2 Engine commands

The board can manage seven separated commands for the engine management:

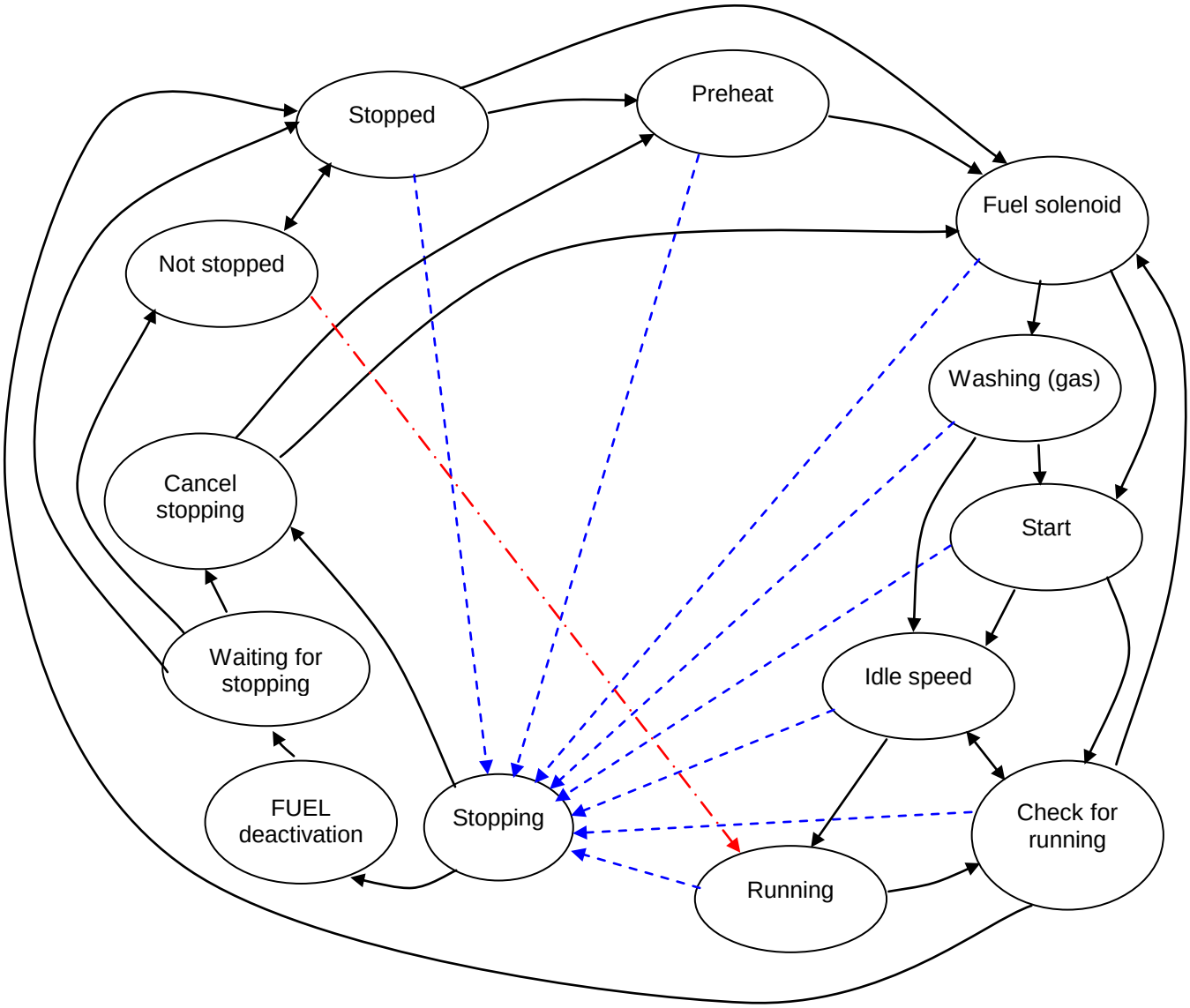
- START: command for the starter
- FUEL: command for the fuel solenoid (engines having drop-down shutdown system)
- STOP: command for the stop solenoid (engines having excitation shutdown system).
- PREHEAT: command for the glow-plugs heater
- GAS: command for the gas valve (for gas engines)
- IDLE: command to active engine idle speed
- ENGINE ENABLE: this is always activated when the FUEL command is activated, but it can deactivate before FUEL in order to leave the engine stop without empty the fuel pipes.

Controller has a dedicated output for the FUEL command, terminal 3 of JH connector. It is a 3A relays that, when active, supply the voltage connected to terminal 2 of the same connector.

All other outputs are configurable and thus it is possible to assign the engine commands to any outputs.

As default, the functions “2-Glow-plugs heater” (OF_02), “14-Gas solenoid” (OF_14), “23-Idle Speed Command” (OF_23) and “25-Engine Enable Command” (OF_25) are not assigned. The “16-Stop solenoid” (OF_16) function is assigned to terminal 1 of JI. The “34-Engine Start Command” (OF_34) is assigned to terminal 1 of connector JH.

7.5.3 Manual control sequence



The manual engine management presents the statuses shown in the previous diagram. The rest status are **stopped** and **not stopped**. For both statuses, the board has deactivated all the engine commands. The **not stopped** status means that the engine has been started by some other device or the engine did not stop after a stop cycle (this is possible only with engines having excitation shutdown system or with defective fuel solenoid). By the board viewpoint, these two statuses are the same because the generator and engine protections were never activated since the board considers that another device started and controls the engine.

7.5.3.1 Manual start

From rest status, pressing the “START” pushbutton on the frontal panel, manual start cycle begins. If the engine was **not stopped**, the starter is not activated and the next status is **running**. If the engine was **stopped**, the cycle begins whit **preheat** (if configured) or with the activation of the **fuel solenoid**.

All statuses are subject to the following rules:

- If a stop request arises then next status is **stopping**.
- If the START button is released, next status is **check for running**.
- If the engine running status is diagnosed, next status will be **idle speed** (if configured) or **running**.

Preheat (glow-plugs heater) status is executed only if parameter P.0209 (preheat duration in seconds) is different from zero and no output is configured for the GAS engine washing (gas valve): In fact the parameter P.0209 is shared with preheat cycle and washing cycle (so they are executed in alternative). It is not compulsory to set an output as preheat command; this is useful if there is a need to introduce a delay between FUEL and START commands. When this phase is ended the engine will be ready to start. In this status the FUEL, ENGINE ENABLE and PREHEAT are activated.

The status **fuel solenoid** is executed in alternative to **preheat** or after that cycle and is used to introduce a minimum delay of 0.2 seconds between FUEL and START commands. This is made because some fuel solenoids have a mechanical problem and cannot be opened while there is a fuel de-pressure. At the end of this status, the next will be **start** or, if configured, the **washing** cycle. In this status, FUEL, ENGINE ENABLE and IDLE (if requested) commands are active.

The **washing** cycle is useful only for gas engines. It consists in the activation of the starter motor keeping closed the GAS valve. In this way a depression is created, which extracts the residuum gases before the engine start. The cycle is executed if at least one output is configured as GAS output and the duration is configured by parameter P.0209 (shared with the preheat cycle). When the configured time is ended, the engine starts cranking. In this status FUEL, ENGINE ENABLE, IDLE (if requested) and START are active.

During **start** status, FUEL, GAS, ENGINE ENABLE, IDLE (if requested) and START commands are active. This phase lasts until the acknowledgement of engine running status or until the “START” button is released. The engine running status is watched continuously (see previous paragraphs) to release as soon as possible the starter motor. The cycle ends when the “START” button is released or when the engine starts up (see notes at the beginning).

The **check for running** status is entered if the “START” button is released before the board has acknowledged the engine running. Really, the given command should be sufficient to the engine, which should so start regularly. In this status the engine is checked for a maximum time of 10 seconds, to verify if it is running. “FUEL” and “GAS” commands are active (to help the engine to start). If the engine is really running, it follows the **running** status, otherwise at the end of the 10 seconds the board comes back to **stopped** status. Pressing the “START” button in this phase the start procedure is repeated, bypassing the preheat status (from **fuel solenoid** status). Commands FUEL, GAS, ENGINE ENABLE and IDLE (if requested) are active.

The **idle speed** status is executed if the parameter P.0233 is different from zero or if an input configured as “35-Idle speed request” (IF_35) is active. In this status the commands FUEL, ENGINE_ENABLE, IDLE and GAS are active. If the board is connected with CAN BUS to the engine, the idle speed command is managed directly over the bus. Otherwise it is necessary to configure one output to give this command (OF_23). The cycle ends when the configured time is over or when the digital input is no more active. If the board acquires the coolant temperature (with CAN BUS or from sensor), it is also possible to set a minimum temperature threshold (P.0223) to end the cycle: if the coolant temperature is higher than this threshold for two consecutively seconds, the idle cycle is ended. Next status is **running**.

In **running** status, FUEL, ENGINE ENABLE and GAS commands are active.

Remark: in MAN mode, crank will always use battery 1, even if two sets of batteries are configured (see note on automatic start description).

7.5.3.2 Manual stop

From **running** status (but also from any other status described in the previous paragraph) the board passes to **stopping** status in the following cases:

- Pressing the “STOP” button on the board frontal panel.
- With a command from serial port (also via SMS).
- When an alarm, an unload or a deactivation occurs.

NOTE: the stopping phase can be executed also with engine stopped.

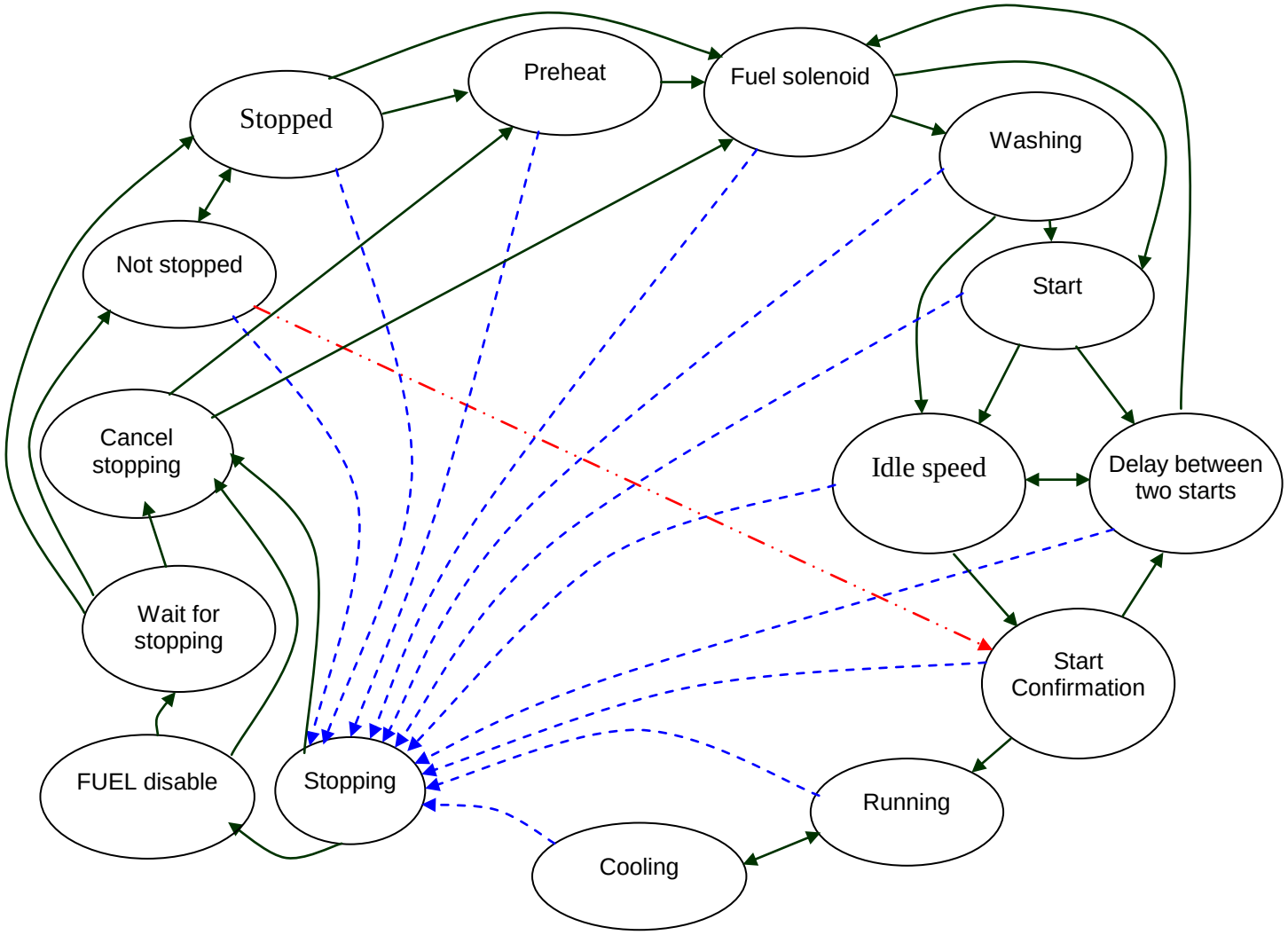
During the **stopping** phase, the ENGINE ENABLE, GAS, START and PREHEAT commands are disabled and it is instead activated the STOP command. FUEL command is disabled after the time P.0234. The length of this phase is configurable with the parameter P.0213 (stop pulse duration). At the end, the board passes to the **waiting for stopping** phase.

During **waiting for stopping** phase all engine commands are disabled (except FUEL command if the time configured with P.0234 is not elapsed) and the board waits for the stop of the engine. The length of this phase is configurable with parameter P.0214 (stop cycle duration, from which it is subtracted the time configured with P.0213). At the end of this phase, if the engine is not stopped the board passes in the **not stopped** phase. If the engine stops, the board returns to the **sopped** status. The entire **waiting for stopping** phase can however be disabled setting parameter P.0214 to zero.

If during these last two phases all the stop requests cease and the “START” button is newly pressed, the board passes to the **cancel stopping** status also if the engine has not been already diagnosed stopped. It is in fact possible to end one stop cycle if the board is in MAN mode.

The phase **cancel stopping** is useful only to allow a little delay between the deactivation of the eventual “STOP” command and the activation of the “FUEL” command. This delay is of 0.2 seconds, at the end of which the board comes back to the **stopped** status, from which the board will carry on with the engine start being there the conditions.

7.5.4 Automatic command sequence



The automatic engine management is used with AUTO, TEST and REMOTE START modes. There are no differences in the sequence between the three modes: differences are in the protections and load change over management.

In automatic mode, the board manages the engine by means the status shown in the diagram. Before describe the diagram it is necessary to define when the engine has to be started or stopped automatically.

The engine is automatically started if there are not alarms, unloads and deactivations and if at least one of these conditions is verified:

- The TEST mode is activated (see the paragraph describing the board working modalities)
- The REMOTE START mode is activated (see the paragraph describing the board working modalities)

- If an automatic start is required and no start inhibitions are pending. Start requirement depends from plant configurations:
    - Emergency applications:
        - The mains voltage is “out of tolerance”.
        - Mains is “in tolerance” but MCB circuit breaker is not closed (this function is active only if P.0221 is different from 0).
    - Parallel to the mains applications (without loads):
        - The mains voltage is “in tolerance”.
    - Applications where the genset has to work in parallel with mains but also as emergency:
        - The automatic start request is always present.

In automatic mode, the engine can be stopped in two ways:

a) With normal procedure. This procedure consists of doing an engine cooling cycle (only if the loads have been connected to the generator), keep it running with loads connected to the mains. This procedure is applied if:
    - No more automatic start request is pending (see before).
    - An anomaly, qualified as “deactivation” or “unload” has occurred (it is an anomaly typically dangerous for loads but not for the genset).

b) With an emergency procedure. This procedure requires the immediate engine stop, without engine cooling cycle. It is applied if:
    - The operating mode is switched to OFF/RESET
    - An anomaly qualified as “alarm” has occurred and the engine is in a status different from **stopped** or **not stopped** (see after). NOTE: in automatic the stop commands from the panel (STOP button), from serial ports and from SMS are included among this category since they active the A007 alarm (stop key pressed while in auto).

To describe the diagram, let us think as starting point the **stopped** and **not stopped** status. In both the cases, all the engine commands are disabled. The **not stopped** status means then that engine has been started by some other device or it is not stopped after a stop cycle (this is possible only with engines having excitation shutdown system or with defective fuel solenoid). For the board view point the two status are the same, since the protections of the engine and alternator were never been activated because the board considers that some other devices is managing the genset. It is possible to exit from this status only if an automatic start or stop request arises.

7.5.4.1 Automatic start

From the rest status, if a request (see before) arises, the start procedure is activated, doing the **preheat** cycle (if programmed) or activating the FUEL and ENGINE ENABLE command and subsequently the START command. If the start request is activated with the engine in a **not stopped** condition, the board passes directly in the **start confirmation** status.

All statuses are subject to the following rules:

- If a stop request occurs, board passes to **stopping** status.
- If the start request ends, board passes to **stopping** status.
- If the “engine running” status is diagnosed, the board goes on with i**dle speed** status (if configured) or with **running** status

For **preheat**, **fuel solenoid**, **washing**, **start** and **idle speed** see what described for manual starting procedure. As unique difference, the **starting** status has a maximum length configurable with parameter P.0210.

Compared to manual start, two new statuses are introduced.

The **start confirmation** status is executed when the **idle speed** cycle has ended or after the engine was acknowledged running. This status is used to wait until the generator reaches its working conditions. The engine in fact could stop itself (the board could have acknowledged it running just because the starter has enough speed). In these cases, the board has to try again to start the engine, until the end of the configured attempts. From this status the board passes to **running** status if the generator reaches its working conditions (in this case the start was successful and a subsequently stop of the engine is symptomatic of a serious anomaly on genset); board continues with the **delay between two starts** status if the engine stop itself and to the **stopping** status if the engine didn’t stop but the generator didn’t reach its operating condition within the time configured with parameter P.0217 (the alarm A008 - “operating conditions failure” is activated). In this status, the FUEL, ENGINE ENABLE and GAS command are active.

The status **delay between two starts** is executed each time the engine does not start after an automatic start attempt. The length of this status is configured with the parameter P.0212. At the end the board goes on with the **start** status: this status is executed P.0211 times: if after all the configured attempts the engine did not start, the board actives the alarm A022- “Overcrank” and goes on with the **stop** status. In this status FUEL, ENGINE ENABLE and PREHEAT are active, in order to use itself for the preheater of Diesel engines.

The starting procedure ends with the **running** status. In this phase, the changeover is enabled.

7.5.4.2 Cranking with two alternate battery sets

The controller is able to manage the start of the engine using two battery sets, alternating them to ensure a safe start of the engine. To use this procedure, the following output functions are provided:

- “38 - Select battery 1” (OF_38).
- “39 - Select battery 2” (OF_39).

In order to use this function, at least one output must be configured with function “39”. In this case the start sequence becomes:

- "Select battery 1" output **activated**, "Select battery 2" output **deactivated**.
- Wait for two seconds (it can be increased adding pre-glow time).
- First crank attempt.
- Pause.
- ....

- Last crank attempt.
- Wait for two seconds
- "Select battery 1" output **deactivated**, "Select battery 2" output **deactivated**.
- Wait for two seconds
- "Select battery 1" output **deactivated**, "Select battery 2" output **activated**.
- Wait for two seconds (it can be increases by the wait time between two crank attempts).
- First crank attempt with battery 2.
- Pause.
- ....
- Last crank attempt with battery 2.
- Over-crank alarm.
- Wait for two seconds.
- "Select battery 1" output **deactivated**, "Select battery 2" output **deactivated**.

Sequence ends before “over crank” alarm if the engine starts. The output related to the battery used for cranking remains active for two seconds after the engine running detection. If no function “39” was configured, the crank sequence remains the standard one. If, in this case, function “38” is assigned to an output, crank sequence is started activating in any case this output.

7.5.4.3 Automatic standard stop

The standard stop procedure is preceded by a **cooling** cycle (during which the board changes-over the loads on mains) for the engine. This cycle is done only if during the **running** status the loads were changed-over on generator. During this cycle, the FUEL, ENGINE ENABLE and GAS commands are active. The length of the cycle is configurable with parameter P.0215. From this status it is possible to come back to the **running** status if the requests to stop end and it is present at least one start request (for instance the board was in this status after the return of mains, but during the **cooling** the mains fault again). The cycle can be interrupted also if an emergency stop request rises up (an alarm or the operating mode switched to OFF). In this case, or in any case when the time P.0215 ends, the emergency stop cycle follows.

7.5.4.4 Automatic emergency stop

The emergency stop procedure consists in stopping the engine without the cooling cycle. This procedure is common also in the standard stop, after exactly the cooling cycle. During the **stopping** phase the commands FUEL, ENGINE ENABLE, GAS, START and PREHEAT are disabled and instead the STOP command is active. The length of this phase is set with parameter P.0213 (stop pulse duration). When this time is over, the board passes in the **waiting for stopping** status. If during this phase all stop requests cease and at least one start request is present, the board passes to **cancel stopping** status but only and uniquely if the engine was acknowledged stopped. It is not in fact possible interrupt an automatic stop cycle, because situations in which the engine may be difficult to restart if not previously stopped can happen.

During the **waiting for stopping** phase, all engine commands are disabled and board waits exactly the engine stop. The length of this phase is configurable with parameter P.0214 (stop cycle duration, to which it is subtracted the time set by P.0213). At the end of this phase, if the engine is still running, it is activated the A021 alarm – "over crank" and the board passes to the **not stopped** status. The entire **waiting for stopping** phase (and so the alarm too) can be in any case disabled setting to zero the P.0214 parameter. If the engine stops, the board comes back to the **stopped** status. This phase cannot be interrupted to effect further starts.

The phase **cancel stopping** is used only to allow a little delay between the deactivation of the eventual STOP command and the activation of the FUEL command. This delay is set to 0.2 seconds, at the end of which the board comes back to the **stopped** status, and goes immediately on with the start having the right conditions (and restarting from zero the start attempts count).

7.6 Circuit breakers management

7.6.1 Digital outputs

Four different commands are available for circuit breakers management:

- The closure command for KG/GCB is not configurable. It is always available on terminals 1… 3 of JG connector. The controller activates this output to **close** the circuit breaker: the **normally open** contact must be used. In this way when the controller is not supplied, the circuit breaker is opened.

- Function "35 – KM/MCB command" (OF_35). There isn't a digital output dedicated to this function: each digital output can be used. On HT GC310 and HT GC350, this function is associated (as default) to terminals 4… 6 of JG connector. On HT GC500, no outputs is associated to this function (as default), because the controller is pre-configured for multiple genset applications. The controller activates this output to **open** the circuit breaker: a **normally closed** contact must be used**.** In this way when the controller is not supplied, the circuit breaker closes.

- **HT GC500/HT GC500*Plus* only**. Function "30 – GCB voltage release solenoid enable" (OF_30). HT GC500 can manage an output to supply the voltage release coil of the circuit breaker. When this coil is not supplied, the circuit breaker opens and cannot be closed. When the coil is supplied, the circuit breaker can be closed (but a separate closure command is needed). The controller activates this output to **supply** the coil: a **normally open** contact must be used. In this way, when the controller is not supplied, also the voltage release coil is not supplied, and the circuit breaker opens.

- **HT GC500/HT GC500*Plus* only**. Function "29 – MCB voltage release solenoid disable" (OF_29). See the description for voltage release coils on previous paragraph. The controller activates this output to **remove the supply** from the coil: a **normally closed** contact must be used. In this way, when the controller is not supplied, the voltage release coil is supplied and the circuit breaker can be closed.

When the voltage release coil commands are used (HT GC500 only), the controller works in the following way:

- When it has to close a circuit breaker, first supplies the voltage release coil, then waits for at least 0.5 seconds, and last activates the closure command.

- When it has to open a circuit breaker, it removes supply from the voltage release coil and removes the closure command at the same time.

Note: HT GC500/HT GC500Plus can work with externally managed MCB circuit breaker. In this case, no outputs should be configured with functions "35" and "29".

NB: if you want to use a single switch (not two separate breakers) for change over (not for parallel plants), no outputs must be configured with function "35".

7.6.2 Digital inputs

The digital inputs of the controller can be used for many purposes, related to circuit breakers management.

7.6.2.1 Circuit breaker statuses

Three functions are provided for this purpose:

- **HT GC500/HT GC500Plus only**. Function "36 – MGCB status" (IF_36). This function is used only in multiple-gensets applications; often (but not always) a general circuit breaker is provided to connect the bus-bars of the generators to the loads or to the mains. If no inputs are configured with this function, the MGCB circuit breaker is considered always closed. HT GC500 needs to know the status of MGCB for many reasons:
  - In emergency plants, the "load function" must be disabled when MGCB is open. In this case, in fact, no loads are connected to generators: the "load function", if not disabled, could switch off the generators.
  - In parallel to the mains applications, the statuses of MCB, GCB and MGCB are important to understand if the generator is in parallel to the mains or not. The controller, in fact, manages speed and voltage regulators in different ways (in parallel to the mains it performs power modulation and power factor control, in parallel between generators it manages active and reactive power sharing). **To simplify the logics, if MGCB is opened HT GC500 considers also MCB opened.**
- Function "06 –KM/MCB status" (IF_06). In parallel to the mains applications, this status must be acquired, in all other kinds of applications it is optional. The controller uses this status for many purposes:
  - The KM lamp shows the real status of the circuit breaker, and can also show a difference between command and status by blinking it. The same for the one-wire diagram shown on page M.08.
  - If a delay different from zero is set for this input, the controller rises some warnings (that can become alarms in parallel applications) when the command is different from the status (after this delay is elapsed from the command). **Note: no alarms/warnings are activated if the status is different from the command but the mains is out of tolerance (because normally the KM/MCB is supplied by the mains).**
  - For emergency applications, the controller can start the engine and supply the loads when the KM/MCB circuit breaker is "not closed" and the mains is in tolerance.
  - **HT GC500/HT GC500Plus only**: HT GC500 can work with externally managed MCB. In this case it is very important to know the status of the circuit breaker.

- **HT GC500/HT GC500^{Plus} only**: in parallel to the mains applications, the statuses of MCB, GCB and MGCB are important to understand if the generator is in parallel to the mains or not (see the description of MGCB).

- Function “07 –KG/GCB status” (IF_07). In parallel applications (to the mains or between generators) this status must be acquired, in all other kinds of applications it is optional. The controller uses this status for many purposes:
  - The “KG” or “GCB” lamp shows the real status of the circuit breaker, and can also show a difference between command and status by blinking it. The same for the one-wire diagram shown on page M.08.
  - If a delay different from zero is set for this input, the controller rises some warnings (that can become alarms in parallel applications) when the command is different from status (after this delay is elapsed from the command).
  - **HT GC500/HT GC500^{Plus} only**: In parallel to the mains applications, the statuses of MCB, GCB and MGCB are important to understand if the generator is in parallel to the mains or not (see the description of MGCB).
  - **HT GC500/HT GC500^{Plus} only**: in multiple-gensets applications, this status allows detecting a “GCB not closed condition”; in this situation all other generators can take some actions (avoid closing their GCB or opening it).

7.6.2.2 Manual commands for circuit breakers

The controller allows using its digital inputs for connecting external pushbuttons, used for manually open and/or close the circuit breakers. Two functions are provided for each circuit breaker:

- Function “54 – External manual KG/GCB closure command” (IF_54).
- Function “55 – External manual KG/GCB opening command” (IF_55).
- **HT GC500/HT GC500^{Plus} only**: Function “71 – External manual MCB closure command” (IF_71).
- **HT GC500/HT GC500^{Plus} only**: Function “72 – External manual MCB opening command” (IF_72).

These commands are available only in MAN and TEST modes.

All these commands are edge activated.

For each circuit breaker, it is possible to use both commands or only the “closure” command (or none). If only the closure command is used, it works as toggle: it opens the circuit breaker when closed and vice versa.

HT GC310 / HT GC350.

If you configure only the function “54”, using this input is the same as using the “KM/KG” pushbutton. If both functions “54” and “55” are used, the input configured as “54” works only when KG/GCB is opened, while input configured as “55” works only when KG/GCB is closed.

HT GC500/HT GC500^{Plus} – Only one genset without parallel to the mains (P.0802 < 2).

See the description for HT GC310/HT GC350. If you use two separate circuit breakers for the change-over (not a single switch), it is possible (but not useful) to use also the functions “71”

and “72”. For this kind of applications, in fact, the controller doesn’t allow both circuit breakers opened: thus, opening MCB is the same as closing GCB, and vice versa.

HT GC500/HT GC500*Plus* – Multiple gensets applications (P.0802 >= 5).

The only commanded circuit breaker is GCB. Using an input configured as “54” is the same as using the “GCB” pushbutton. If both “54” and “55” functions are used, the input configured as “54” can be used to enable manual synchronization, to close the circuit breaker and to abort the unloading of the generator; the input configured as “55” can be used to unload the generator and to open the circuit breaker. Functions “71” and “72” are not used.

HT GC500/HT GC500*Plus* – Only one genset working in parallel to the mains.

If MCB is externally managed, you can see the description at previous point.

On HT GC500/HT GC500*Plus* front panel, no pushbuttons are actually provided for the manual command of MCB. The only way to manually command MCB is to use inputs configured with functions “71” and “72”. Let’s see all the possibilities:

- MCB closed, GCB opened.

  Using input configured as “54” or pressing “GCB” pushbutton, the controller tries to close the GCB with synchronization; if this cannot be done, first it opens the MCB and then it closes the GCB. Commands are not managed if GCB cannot be closed for any reason.

  The input configured as “55” is not used.

  - o There is an input with function “72”.

    Input configured as “71” is not used.

    If the input configured as “72” is active, the controller opens MCB (and then tries to close GCB because both breakers opened are not allowed).

  - o There isn’t an input with function “72”.

    If the input configured as “71” is active, the controller opens MCB (and then tries to close GCB because both breakers opened are not allowed).

- MCB opened, GCB closed.

  Input configured as “72” is not used.

  If the input configured as “71” is active, the controller tries to close MCB with synchronization; if this cannot be done, first it opens the GCB and then it closes the MCB.

  If there is an input configured as “71”, when the operator push the “GCB” pushbutton the controller opens the GCB and then closes the MCB (both breakers opened are not allowed).

  Instead, if no inputs are configured as “71”, when the operator push the “GCB” pushbutton the controller tries to close MCB with synchronization; if this cannot be done, first it opens the GCB and then it closes the MCB.

  - o There is an input with function “55”.

    Input configured as “54” is not used.

If the input configured as “55” is active, the controller opens the GCB and then it closes the MCB (both breakers opened are not allowed).

- o There isn’t an input with function “55”.

  If the input configured as “54” is active, the controller opens the GCB and then it closes the MCB (both breakers opened are not allowed).

- MCB closed, GCB closed.

  Pushing the “GCB” pushbutton, the controller unloads the generator and then opens the GCB.

  - o There is an input with function “55”.

    Input configured as “54” is not used.

    If the input configured as “55” is active, the controller unloads the generator and then opens the GCB.

  - o There isn’t an input with function “55”.

    If the input configured as “54” is active, the controller unloads the generator and then opens the GCB.

  - o There is an input with function “72”.

    Input configured as “71” is not used.

    If the input configured as “72” is active, the controller opens the MCB.

  - o There isn’t an input with function “72”.

    If the input configured as “71” is active, the controller opens the MCB.

7.6.3 Change-over logic

KG/GCB circuit breaker can be closed only if **all** the following conditions are met:

- o Generator voltages and frequency are in the tolerance band from a proper time (see the generator sequence description).
- o The engine has been started by the board (the fuel solenoid command must be active).
- o No alarms or unloads or deactivations are present.
- o If the closure of this circuit breaker is required and no load inhibitions are activated.

In **OFF_RESET** mode, KG/GCB is always opened, while KM/MCB is always closed; loads are always supplied by the mains (in some plant configurations of HT GC500 KM/MCB can be not present).

In **MAN** mode, normally KG/GCB is open and KM/MCB is closed. Manual commands are available (see previous paragraphs). **Note: it is not possible to open both circuit breakers, it is only possible to switch the loads from the mains to the generator and vice versa. Only with HT GC500, if configured, the circuit breakers can be both closed (parallel to the mains).**

In **AUTO** mode, the KG/GCB is automatically closed (with respect of the proper conditions) when the logic of the plant requires it:

- Emergency applications: only when the mains is out of thresholds. As soon as the mains comes back in tolerance (with proper times, see mains sequence), loads are connected again to the mains. The only exception is the presence of the “KM/MCB not closed warning”: if properly configured, the board changes-over to genset also with mains present.

- **HT GC500/HT GC500^{Plus} only**. In parallel to the mains applications, only when the mains is in tolerance. If the mains is “out of tolerance” the controller opens the GCB circuit breaker and, after a configured timeout (P.0899) it stops the engine. As soon as the mains comes back “in tolerance” the controller starts the engine and closes the GCB.

- **HT GC500/HT GC500^{Plus} only**. In applications where the generator can work either with or without the mains, the GCB circuit breaker is always closed. Normally, if the mains goes “out of tolerance” the controller opens the MCB circuit breaker: if MCB is externally managed, the controller opens GCB, wait for MCB opening (by external devices), and then closes GCB to supply the loads. If MCB is commanded by HT GC500, when the mains comes back “in tolerance”, the controller closes again the GCB circuit breaker with synchronization.

Passing from any other working modes to AUTO, loads are forced as described, driving a changeover if needed.

This status uses another timing: to close the loads on genset it must be passed the P.0218 time since engine started, or, more precisely, since the genset voltages and frequency are internal to its tolerance bands.

In the **TEST** mode, normally KG/GCB is open and KM/MCB is closed. Using the parameter P.0222, it is possible to enable the “LOAD ON TEST” mode that activates the load transfer to the generator. Manual commands are available.

It has to remember that the board passes automatically in AUTO (aborting TEST mode) if its automatic intervention is required.

In the **REMOTE START** mode, loads are always transferred to the genset (in the conditions previously seen), also with mains presence. All timings of AUTO mode are valid.

7.6.4 Timings

The controller ensures the respect of some minimum timing (configurable) in the management of the circuit breakers:

- P.0219. The controller never closes a circuit breaker if the other one is opened and the time configured with this parameter is not elapsed. This function is useful in non-parallel plants, where two different breakers are used. This minimum time is a safety to avoid the closure of both breakers (external electrical and mechanical interlocks must always be provided).

- P.0220. The controller doesn’t allow to open/close a circuit breaker if the time configured by this parameter is not elapsed from the previous command of the same circuit breaker. For example, if an opening command has been issued, a closure command cannot be accepted before P.0220 seconds. This function is useful in non-parallel plants, where often a switch is used instead of two separate circuit breakers (SIRCOVER): this switch may fault if its command is changed before the complete changeover has been done (and it will need a manual restore operation).

7.6.5 Inhibition of automatic supply of generator

In all the automatic working modes of the controller, the KG/GCB circuit breaker can be forced open for many reasons, even when the plant logic requires its closure. Next paragraphs describe all these reasons:

- It is possible to configure a digital input as “30 – Changeover sequence inhibition” (IF_30). When this input is active, the controller opens the KG/GCB (and tries to close KM/MCB if possible). See also the description for the EJP function.
- It is possible to use a command from the serial ports. This command is temporary (it lasts 30 seconds): if you need to keep the KG/GCB opened, you have to send this command periodically.
- **HT GC500/HT GC500*Plus* only**. There are some kinds of applications where the generator can only supply in parallel with the mains, because without the mains there are too many loads to supply. In these situations, when the mains is out of tolerance a “changeover inhibition” is activated (and so the GCB is opened). The controller keeps the engine running for the time configured with P.0899, waiting for the mains coming back in tolerance: after this time also a “start inhibition” is activate, to stop the engine.
- **HT GC500/HT GC500*Plus* only**. In multiple-gensets applications, when a generator is not able to open its GCB circuit breaker during its stopping cycle, it is kept “moving” by the other generators in parallel with it, instead of by its engine. This is a dangerous situation, which can result in damages on the engine and on the generator. In these cases, HT GC500 can be configured to activate a “changeover inhibition”. In this way, all the generators will open their GCB circuit breakers, saving the engine/generator with the not opened GCB. This is a configurable behavior: there are cases when it is preferable to damage an engine instead of leaving the loads unsupplied. Alternatively HT GC500 can be configured to avoid GCB closure, but not to open the already closed GCB.
- **HT GC500/HT GC500*Plus* only**. In multiple- genset applications, working between each other but also in parallel to the mains, the GCB closure is inhibited during the reverse synchronization (MCB). The multiple-genset reverse synchronization, in fact, is a more difficult operation than a direct synchronization; the controller avoids closing the GCB because this closure will introduce some changes in speed that may result in an even more difficult reverse synchronization.

7.7 Parallel applications (HT GC500/HT GC500*Plus* only)

HT GC500 is mainly aimed to parallel applications. For more information related to parallel applications, please refer to the documents [6], [7] and [8].

The followings plant types are managed:

0. SPM (Single Prime Mover).
1. SSB (Single Stand By).
2. SSB + SSTP (Single Stand By + Single Short Time Parallel).
3. SPtM (Single Parallel To Mains).
4. SPtM + SSB (Single Parallel To Mains + Single Stand By).
5. MPM (Multiple Prime Mover).

6. MSB (Multiple Stand By).
7. MSB + MSTP (Multiple Stand By + Multiple Short Time Parallel).
8. MPtM (Multiple Parallel To Mains).
9. MPtM + MSB (Multiple Parallel To Mains + Multiple Stand By).

7.7.1 Single genset applications

Codes 0… 4 identify applications with only one genset. There is no need for external devices in such applications; all functions are included in the controller. The only two functions not available in the device are related to “parallel to the mains” applications:

- “Dead bus” detection. In “parallel to the mains” applications, normally JF is connected to the mains and JE is connected to the generator. The controller has no way to detect the presence of voltages on the loads. Normally, the controller assumes that there are voltages on the bus if the mains is present and MCB is closed or if the generator is running and GCB is closed. If you prefer, you can configure a digital input with function “50 – Dead bus” (IF_50). When this input is active, the controller assumes that no voltages are present on the loads.
- To manage the “Import/Export” function while in parallel to the mains, an external device must be used to measure the power flow on the mains. This device should be connected to an analogue input (0… 10 V) of the controller.

7.7.2 Multiple genset applications

Codes 5… 9 identify multiple gensets applications. In this case, the JF connector of HT GC500/HT GC500^{Plus} is connected to the bus-bars, so HT GC500/HT GC500^{Plus} is not able to directly measure the mains. Also, it is no able to command the MCB circuit breaker. For simple plants these functions can be implemented even by wired hardware logic. For more complex system, a control device connected over the PMCBus, such as MC100, should be used. Plant of up to 16 generators can be easily implemented.

Synchronization over common bus bar and over the mains and power regulation (or load-sharing) is directly managed without the aids of external devices. Power regulation can be accomplished in isochronous mode or in droop mode. Load management function is available in order to start/stop generators depending on the load request.

All the communication required is made through a single CAN line, PMCBUS, which allows to exchange information related to load-sharing and system management.

It is possible and straightforward to setup plant that mix DST4601/PX and HT GC500/HT GC500^{Plus} controller.

8. Anomalies

This chapter describes all the anomalies managed by the controller. Some of these act as protections for the loads, for the generator or for the engine. There is also signaling of particular events in the management of the plant. Before describing them in details, it is opportune to give some definitions.

We define four typologies of anomaly:

- Warnings: these anomalies don't require the arrest of the engine. 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.

- Unloads (**HT GC500/HT GC500^{Plus} only**): these anomalies require the arrest of the engine. They are not dangerous (at the moment) for the loads or for the engine. For this reason the controller first unloads the generator (if possible), then opens the GCB circuit breaker, and last stops the engine with the standard procedure (with the cooling cycle). However, it is not possible to restart the engine until someone takes care of the anomaly.

- Deactivations: these anomalies require the arrest of the engine. They are dangerous for the loads but not immediately for the engine. For this reason the GCB circuit breaker is immediately opened (without unloading the generator) and the engine is stopped with the standard procedure (with the cooling cycle). However, it is not possible to restart the engine until someone takes care of the anomaly.

- Alarms: these anomalies require the arrest of the engine. They are dangerous for the loads and/or for the engine and for the generator. For this reason the GCB circuit breaker is immediately opened (without unloading the generator), and the engine is stopped immediately, without the cooling cycle. It is not possible to restart the engine until someone takes care of the anomaly.

When an anomaly is activated, the controller performs the following actions:

a) It activates the internal horn and, if configured, also the external one. For this purpose, it is possible to configure a digital output with the function "21 – External horn" (OF_21).

b) It forces the multifunction display on the S.02 page. This page shows the fault numeric code and the current language text related to the anomaly.

c) If the anomaly is a **warning**, the "ALARM/WARNING" lamp starts blinking; in case of **unloads**, **deactivations** or **alarms** the lamp is switched fixed ON.

d) If the anomaly is an **unload**, a **deactivation** or an **alarm**, the loads will be disconnected from the generator (with or without unloading it) and the engine will be stopped (with or without the cooling cycle).

The operator can take two actions about an anomaly:

a) Acknowledge: this indicates to the board that the operator has token care about the situation.

b) Reset: it tells to the controller that the anomaly is not yet active.

The operator can acknowledge the anomaly (ISA2C sequence) by pressing the ACK key. This operation also stops the internal and the external horns. The horn management is however related to the P.0491 parameter:

- 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 when the operator press the MODE key.

- If set to any value between 1 and 998, the horn will be activated when a new anomaly arises, and will be stopped both for pressing the ACK key and after P.0491 seconds from activation.

The multifunction display shows the anomaly up to when the operator doesn't acknowledge it, even if its cause is not still present.

The board automatically resets all the acknowledged **warnings** when their cause is not still active. In order to reset the **unloads**, the **deactivations** and the **alarms**, the operator must change the operating mode to “OFF/RESET” (obviously it must be changed back to MAN or AUTO in order to use the genset again). With this procedure, it is also possible to reset externally managed anomalies. In fact, you can configure one of the digital outputs of the controller (function “01 – Reset pulse” OF_01) to activate for one second when the internal reset procedure is performed. Remember that this one second pulse is generated only for the reset procedure, not for the acknowledge one. A digital input can be configured with function “05 -Reset Command” (IF_05), and can be used to remotely reset the alarms.

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). An **alarm** can be activated if some **unloads**, **deactivations** or **warnings** are active.

A **deactivation** can be activated only if no **alarms** and **deactivations** are already active. Instead, some **unloads** or **warnings** can be active.

An unload can be activated only if no **alarms**, **deactivations** and **unloads** are already active. Instead, some **warnings** can be active.

A **warning** can be activated only if no **alarms**, **deactivations** and **unloads** are already active. Instead, some **warnings** can be active.

Here follows a detailed description of each anomaly. The word “enable” will be used to describe the minimum conditions needed by the board in order to check the anomaly. The word “activation” will be used to describe the condition needed by the board to activate the anomaly, after it has been “enabled”.

Note: normally all engine’s and generator’s protections are “enabled” if the engine is started by the controller, thus if the fuel solenoid control is active. If not, the only way to “enable” the protections is to force the controller to start the engine again (by pressing the START key in MAN, by example): the cranking motor will not be activated, but the fuel solenoid control will be set and so all the protections will be “enabled”.

01 – Minimum generator voltage

Type:	**Deactivation**
Category:	**Load protection**
Related parameters:	**P.0101 P.0102 P.0202 P.0301 P.0302**
To disable:	**P.0302=0**
Enabled if:	**AUTO, TEST, REMOTE START**
	MAN (only if GCB is closed)

This protection is enabled only if the engine was started by the board (fuel solenoid command activated), and is disabled during the engine starting and stopping cycle. It is enabled when the generator voltages and frequency firstly enter inside the band of tolerance (from the engine start moment, see the engine sequence description). It is activated if, in the previously conditions, at least one generator voltage falls under the P.0301 threshold, continuously for the P.0302 time.

02 – Maximum generator voltage

Type:	**Alarm**
Category:	**Load/generator protection**
Related parameters:	**P.0101 P.0102 P.0202 P.0303 P.0304**
To disable:	**P.0304=0**
Enabled if:	**MAN, AUTO, TEST, REMOTE START**

This protection is enabled only if the engine was started by the board (fuel solenoid command activated), and is disabled during the engine starting and stopping cycle. It is activated if, in the previously conditions, at least one generator voltage becomes greater than the P.0303 threshold, continuously for the P.0304 time.

03 – Minimum generator frequency

Type:	**Deactivation**
Category:	**Load protection**
Related parameters:	**P.0105 P.0305 P.0306**
To disable:	**P.0306=0**
Enabled if:	**AUTO, TEST, REMOTE START**
	MAN (only if GCB is closed)

This protection is enabled only if the engine was started by the board (fuel solenoid command activated), and is disabled during the engine starting and stopping cycle. It is enabled when the generator voltages and frequency firstly enter inside the band of tolerance (from the engine start moment, see the engine sequence description). It is activated if, in the previously conditions, the generator frequency falls under the P.0305 threshold, continuously for the P.0306 time.

04 – Maximum generator frequency

Type:	**Alarm**
Category:	**Load/generator protection**
Related parameters:	**P.0105 P.0307 P.0308**
To disable:	**P.0308=0**
Enabled if:	**MAN, AUTO, TEST, REMOTE START**

This protection is enabled only if the engine was started by the board (fuel solenoid command activated), and is disabled during the engine starting and stopping cycle. It is activated if, in the previously conditions, the generator frequency becomes greater than the P.0307 threshold, continuously for the P.0308 time.

05 – Belt break

Type:	**Warning / Alarm**
Category:	**Engine protection**
Related parameters:	**P.0115 P.0349**
To disable:	**P.0349=0**
Enabled if:	**MAN, AUTO, TEST, REMOTE START**

This protection is enabled only if the board is configured to use the D+ signal (P.0115 >= 2) and if this signal is physically connected to the JH connector. The protection is enabled only if the engine was started by the board (fuel solenoid control activated). It is activated if the D+ signal potential is lower than the internal fixed threshold continuously for the P.0349 time. **If engine's protections override is activated, this protection becomes a WARNING.**

06 – Maximum current

Type:	**Configurable**
Category:	**Generator protection**
Related parameters:	**P.0101 P.0102 P.0106 P.0309 P.0310**
To disable:	**P.0310=0**
Enabled if:	**MAN, AUTO, TEST, REMOTE START**

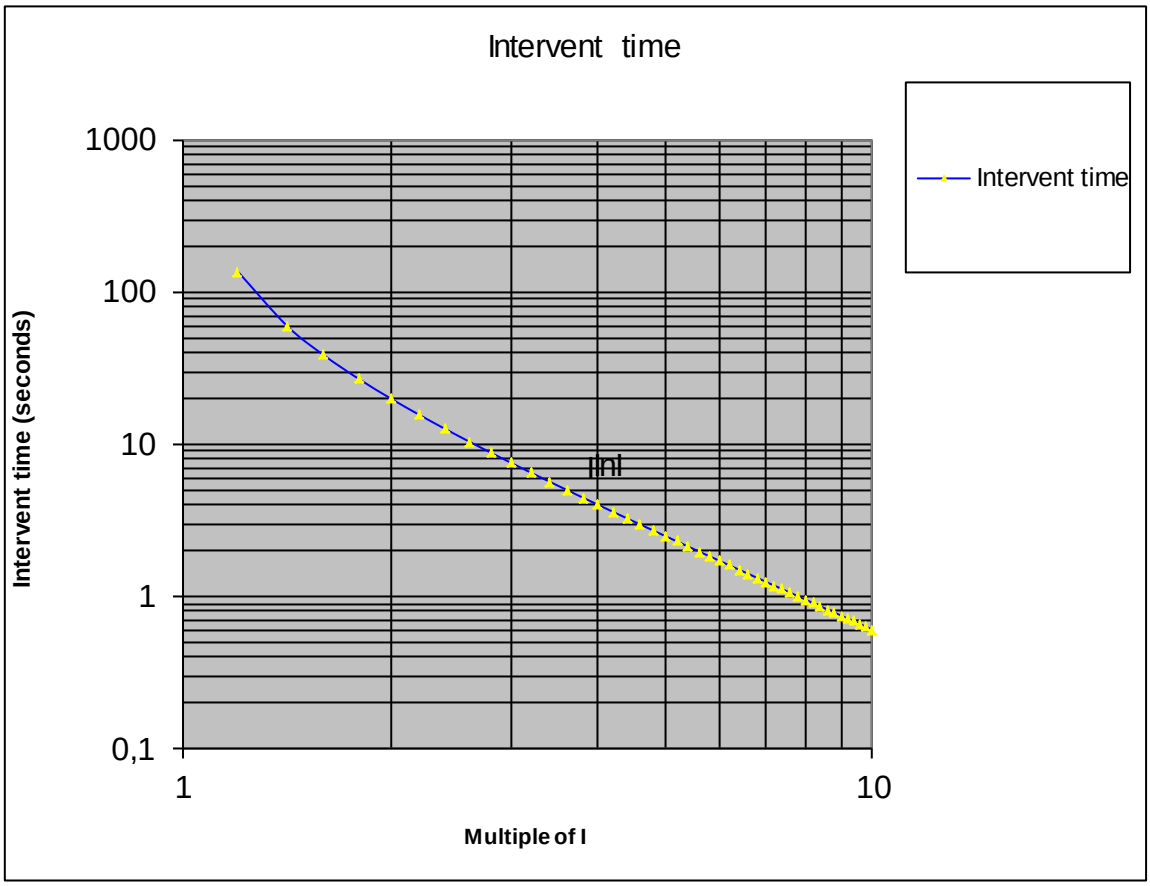
HT GCxxx implements a time-related maximum current protection (it activates so much more quickly how much higher is the overload). The used curve is named EXTREMELY INVERSE, and implements an I^2t function. It is a generator protection (not an engine protection) because it limits the thermal accumulation of the generator, during the generation phase. For the engine, the maximum power protection must be used, that is independent from the load typology.

We define a maximum current threshold, and the maximum time the generator can work with this current. If the current is lower than the defined threshold, the protection is not activated. If the current become greater than the threshold, the protection is activated with a time inversely proportional with the entity of the over current. In order to correctly set the thresholds, follow the following steps:

- You must know the nominal current of the system. You can obtain it from the nominal power (P.0106) and the nominal voltage (P.0102):Single-phase system: $I_{nom} = \frac{P.106}{P.102}$
- Three-phases system: $I_{nom} = \frac{\left(P.106 / 3\right)}{\left(P.102 / \sqrt{3}\right)}$

For example, in a three-phases system with 400 V voltage and 200 kVA nominal power, the nominal current is around 289 A. Note: if you configure first the P.0101 e P.0102 parameters, and then the P.0106 parameter, the last row of the display shows the nominal current.

- Configure the maximum current threshold by the P.0309 parameter, as a percentage of the nominal current. In the previous example, if you want to set a 350 A threshold, you have to configure 121 (%) for the P.0309 parameter.
- Configure the intervention time for the protection in the P.0310 parameter: the protection will be activated exactly after the time you've configured if the current is constantly equals to the P.0309 threshold multiplied by $\sqrt{2}$. In the previous example, if you set 10 s in P.0310, the protection will be activated after 10 seconds with around 495 A of constant load, in a fewer time if the current is higher, in a longer time if the current is lower and never if the current is less than 350 A.



In order to calculate the intervention time for a preferred current, please use the following formula:

$$t_I = \frac{P.310}{\left(\frac{I}{P.309}\right)^2 - 1}$$

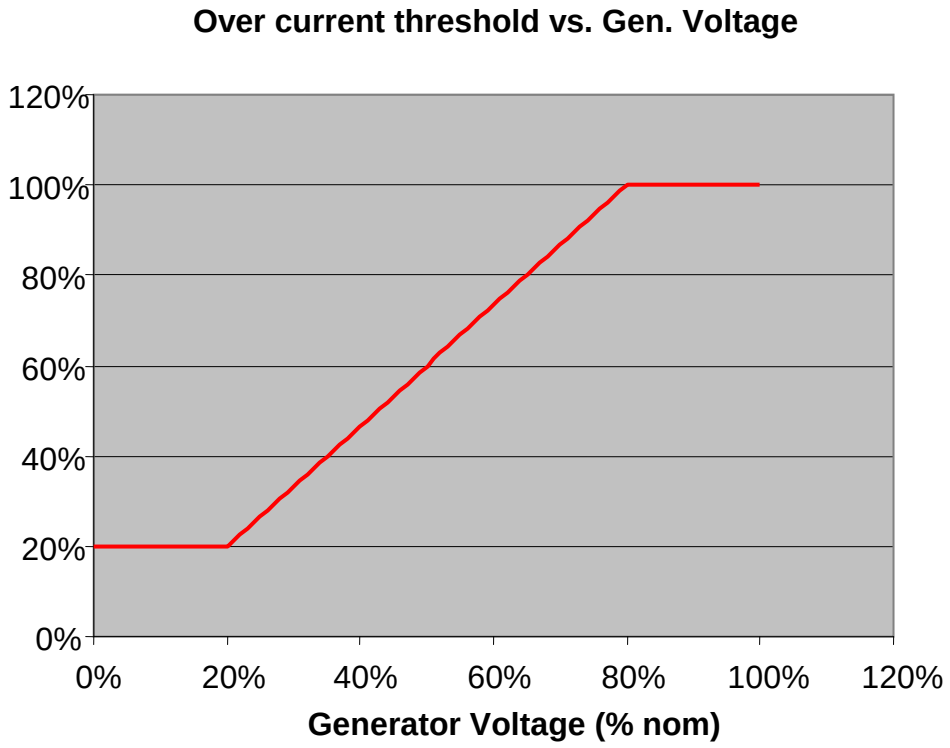
I is the current in the circuit.ou must keep in mind that the board calculates the integral value of the current in the time, so all the current samples over the threshold concur to determine the intervention time, with their instantaneous weight as defined in the previous formula. The only way to verify exactly this formula is thus to switch instantaneously from a normal load situation to an over load situation.

The following graph shows the used curve, with P.0310 set to 60 seconds (I is the maximum current): This protection is enabled only if the engine was started by the board (fuel solenoid control activated), and is disabled during the engine starting and stopping cycle.

The protection type can be configured by means P.0323 as **unload**, **deactivation** or **alarm**.

By means parameter P.0324, it is possible to change the function of this protection from “51” to “51V” protection. The difference is that the “51V”s reduces the current threshold as the voltage decreases:

- If the generator voltage is greater than the 80% of the nominal, threshold is the configured one.
- If the generator voltage is lower or equal to the 20% of the nominal voltage, threshold is set to the 20% of the configured one.
- If the generator voltage is between the 20% and the 80% of the nominal, threshold is proportionally decreased.



In order to change the behavior to “51V”, set parameter P.0324 to 2 or 3.

07 – STOP key pressed while in AUTO

Type:	**Alarm**
Category:	**Generic**
Related parameters:	**-**
To disable:	**-**
Enabled if:	**AUTO, TEST, REMOTE START**

This protection is always enabled and cannot be disabled. It is activated when, in AUTO, TEST or REMOTE START the operator presses the STOP key or if a stop command is received from the serial ports or by an SMS.

08 – Operating conditions failure

Type: **Alarm**
Category: **Generic**
Related parameters: **P.0217**
To disable: **P.0217=0**
Enabled if: **AUTO, TEST, REMOTE START**

This protection is always enabled and cannot be disabled. It is activated if the generator voltages and frequency are not firmly inside the band of tolerance within P.0217 seconds from the recognition of the engine running status (or from the end of the engine's idle cycle, if enabled).

11 – Power reverse

Type: **Alarm**
Category: **Generator protection**
Related parameters: **P.0106, P.0313, P.0314**
To disable: **P.0314=0**
Enabled if: **MAN, AUTO, TEST, REMOTE START**

This protection is enabled only if the engine was started by the board (fuel solenoid control activated), and is disabled during the engine starting and stopping cycle. It is activated if, in the previously conditions, the system total active power is negative and has an absolute value greater than the P.0313 threshold, consecutively for P.0314 seconds. NB: P.0313 is expressed as a percentage of P.0106. **Remark: protection is not active if the controller is measuring power with the load connected to the MAINS.**

12 – Genset locked

Type: **Alarm**
Category: **Generic**
Related parameters: **-**
To disable: **-**
Enabled if: **MAN, AUTO, TEST, REMOTE START**

This protection is always enabled and cannot be disabled. It is activated when the board receives the lock command from the serial ports or by an SMS. It is deactivated only when the board receives the unlock command from the serial ports or by an SMS. Disconnecting the board from the battery cannot disable the protection.

13 – Mains control breaker (KM/MCB) not closed

Type: **Warning**
Category: **Generic, load protection**
Related parameters: **P.0221, P.0507 P.0508 (for input 1, or equivalent)**
To disable: **P.0508=0 (or equivalent)**
Enabled if: **AUTO, TEST, REMOTE START**

This protection is enabled only if one of the digital inputs of the board is configured to acquire the KM/MCB status (function "06 – Mains circuit breaker status" – IF_06 – for P.0507 parameters, or equivalent for other inputs), and if a delay different from zero has been set for this input (P.0508 or equivalent for other inputs). It is activated only when the board closes the KM/MCB (relay on idle) but the acquired status is not active (open) continuously for the

configured time. For emergency applications, when this anomaly is activated, you can also force the engine to start and the connection of the loads to the genset by using the parameter P.0221. **Note: in parallel applications with HT GC500, in some cases this anomaly can be activated even if the delay set for the input is zero. In this case, it cannot be disabled.**

14 – Genset control breaker (KG/GCB) not closed

Type:	**Warning / deactivation / alarm**
Category:	**Generic**
Related parameters:	**P.0507 P.0508 (for input 1, or equivalent)**
To disable:	**P.0508=0 (or equivalent)**
Enabled if:	**AUTO, TEST, REMOTE START**

This protection is enabled only if one of the digital inputs of the board is configured to acquire the KG/GCB status (function "07 – Genset circuit breaker status" – IF_07 – for P.0507 parameters, or equivalent for other inputs), and if a delay different from zero has been set for this input (P.0508 or equivalent for other inputs). It is activated only when the board closes the KG/GCB (relay at work) but the acquired status is not active (open) continuously for the configured time. For HT GC310 and HT GC350 it is always a warning. For HT GC500 it can be a warning, a deactivation or an alarm, depending on conditions and plant type.

Note: in parallel applications with HT GC500, in some cases this anomaly can be activated even if the delay set for the input is zero. In this case, it cannot be disabled.

15 – Over load (from contact)

Type:	**Alarm**
Category:	**Generator protection**
Related parameters:	**P.0507 P.0508 (for input 1, or equivalent)**
To disable:	**P.0508=0 (or equivalent)**
Enabled if:	**MAN, AUTO, TEST, REMOTE START**

This protection is enabled only if one of the digital inputs of the board is configured to acquire the external over load contact (function "17 – Over load" – IF_17 – for P.0507 parameters, or equivalent for other inputs), and if a delay different from zero has been set for this input (P.0508 or equivalent for other inputs). It is enabled only if the engine was started by the board (fuel solenoid control activated), and is disabled during the engine starting and stopping cycle. It is enabled only if the loads are connected to the generator. It is activated if the configured input is active continuously for the related time.

16 – Short circuit on the generator

Type:	**Alarm**
Category:	**Generator protection**
Related parameters:	**P.0101 P.0102 P.0106 P.0311 P.0312 P.0323 P.0324**
To disable:	**P.0312=0**
Enabled if:	**MAN, AUTO, TEST, REMOTE START**

HT GCxxx implements a short circuit protection, in addition to the over current protection. This is in order to act as much faster as possible and to be untied with the timing described for the over current protection. The protection is configured by setting a threshold (P.0311) expressed as a percentage of the nominal current (see the maximum current protection for how to calculate the nominal current from the parameters P.0101, P.0102 e P.0106). It is

enabled only if the engine was started by the board (fuel solenoid control activated), and is disabled during the engine starting and stopping cycle. It is activated when at least one phase's current is higher than the threshold P.0311 continuously for P.0312 seconds.

By means parameter P.0324, it is possible to change the function of this protection from "51" to "51V" protection. The difference is that the "51V" reduce the current threshold as the voltage decreases (refer to alarm code 06)

In order to activate the "51V" mode, set P.0324 to 1 or 3.

The protection type can be configured by means P.0323 as **unload**, **deactivation** or **alarm**.

17 – Over speed (from contact)

Type:	**Alarm**
Category:	**Engine protection**
Related parameters:	**P.0507 P.0508 (for input 1, or equivalent)**
To disable:	**P.0508=0 (or equivalent)**
Enabled if:	**MAN, AUTO, TEST, REMOTE START**

This protection is enabled only if one of the digital inputs of the board is configured to acquire the external over speed contact (function "18 – Over speed" – IF_18 – for P.0507 parameters, or equivalent for other inputs), and if a delay different from zero has been set for this input (P.0508 or equivalent for other inputs). It is enabled only if the engine was started by the board (fuel solenoid control activated), and is disabled during the engine starting and stopping cycle. It is activated if the configured input is active continuously for the related time.

18 – Over speed (from engine speed measure)

Type:	**Alarm**
Category:	**Engine protection**
Related parameters:	**P.0110 P.0111 P.0127 P.0333 P.0334 P.0700**
To disable:	**P.0334=0**
Enabled if:	**MAN, AUTO, TEST, REMOTE START**

This protection is enabled only if the board acquires the engine speed measure. It can be acquired by the pick-up input (JL_01, P.0110 different from zero) or by the W input (JL_03, P.0111 different from zero), by the generator frequency (P.0127 different from zero) or by the CAN BUS (P.0700 different from zero). It is enabled only if the engine was started by the board (fuel solenoid control activated), and is disabled during the engine starting and stopping cycle. It is activated when the acquired speed is higher than the P.0333 threshold continuously for P.0334 seconds.

19 – Over speed (from generator frequency)

Type:	**Alarm**
Category:	**Engine protection**
Related parameters:	**P.0105 P.0331 P.0332**
To disable:	**P.0332=0**
Enabled if:	**MAN, AUTO, TEST, REMOTE START**

This protection is enabled only if the engine was started by the board (fuel solenoid control activated), and is disabled during the engine starting and stopping. It is activated when the generator frequency is higher than the P.0331 threshold continuously for P.0332 seconds. Note: P.0331 is expressed as a percentage of P.0105.

21 – Engine not stopped

Type: **Alarm**
Category: **Generic**
Related parameters: **P.0214**
To disable: **P.0214=0**
Enabled if: **AUTO, TEST, REMOTE START**

This protection is activated if the engine does not stop itself before P.0214 seconds from the stop command. Note: this alarm can be activated even if another alarm is still active.

22 – Over crank

Type: **Alarm**
Category: **Battery protection**
Related parameters: **P.0211**
To disable: **-**
Enabled if: **AUTO, TEST, REMOTE START**

This protection is activated after P.0211 attempts of starting the engine without results. It cannot be disabled.

23 – Mains control breaker (KM/MCB) not open

Type: **Warning / deactivation**
Category: **Generic**
Related parameters: **P.0507 P.0508 (for input 1, or equivalent)**
To disable: **P.0508=0 (or equivalent)**
Enabled if: **AUTO, TEST, REMOTE START**

This protection is enabled only if one of the digital inputs of the board is configured to acquire the KM/MCB status (function "06 – Mains circuit breaker status" – IF_06 – for P.0507 parameters, or equivalent for other inputs), and if a delay different from zero has been set for this input (P.0508 or equivalent for other inputs). It is activated only when the board opens the KM/MCB (relay on work) but the acquired status is active (closed) continuously for the configured time. For HT GC310 and HT GC350 it is always a warning. For HT GC500/HT GC500*Plus* it can be a warning or a deactivation, depending on conditions and plant type.

Note: in parallel applications with HT GC500/HT GC500*Plus*, in some cases this anomaly can be activated even if the delay set for the input is zero. In this case, it cannot be disabled.

24 – Genset control breaker (KG/GCB) not open

Type: **Warning / alarm**
Category: **Generic**
Related parameters: **P.0507 P.0508 (for input 1, or equivalent)**
To disable: **P.0508=0 (or equivalent)**
Enabled if: **AUTO, TEST, REMOTE START**

This protection is enabled only if one of the digital inputs of the board is configured to acquire the KG/GCB status (function "07 – Genset circuit breaker status" – IF_07 – for P.0507 parameters, or equivalent for other inputs), and if a delay different from zero has been set for

this input (P.0508 or equivalent for other inputs). It is activated only when the board opens the KG/GCB (relay on idle) but the acquired status is active (closed) continuously for the configured time. For HT GC310 and HT GC350 it is always a warning. For HT GC500 it can be a warning or an alarm, depending on conditions and plant type.

Note: in parallel applications with HT GC500/*HT GC500^{Plus}, in some cases this anomaly can be activated even if the delay set for the input is zero. In this case, it cannot be disabled.

25 – Minimum fuel level (from contact)

Type:	**Warning / alarm**
Category:	**Generic**
Related parameters:	**P.0507 P.0508 (for input 1, or equivalent)**
To disable:	**P.0508=0 (or equivalent)**
Enabled if:	**MAN, AUTO, TEST, REMOTE START**

This protection is enabled only if one of the digital inputs of the board is configured to acquire the minimum fuel level contact (function "08 – Minimum fuel level" – IF_08 – for P.0507 parameters, or equivalent for other inputs), and if a delay different from zero has been set for this input (P.0508 or equivalent for other inputs). It is activated if the configured input is active continuously for the related time. **Remark: if engine's protections override function is enabled, this anomaly becomes a warning.**

26 – Minimum fuel level (from analog measure)

Type:	**Warning / alarm**
Category:	**Generic**
Related parameters:	**P.0114 P.0347 P.0348**
To disable:	**P.0348=0**
Enabled if:	**MAN, AUTO, TEST, REMOTE START**

This protection is enabled if the board is configured to use the analog fuel level sensor (P.0114 different from zero), and if this sensor is connected to the JM connector. It is activated when the fuel level is lower than or equal to the P.0347 threshold continuously for P.0348 seconds. **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.0507 P.0508 (for input 1, or equivalent)**
To disable:	P**.0508=0 (or equivalent)**
Enabled if:	**MAN, AUTO, TEST, REMOTE START**

This protection is enabled only if one of the digital inputs of the board is configured to acquire the low fuel level contact (function "09 – Low fuel level" – IF_09 – for P.0507 parameters, or equivalent for other inputs), and if a delay different from zero has been set for this input (P.0508 or equivalent for other inputs). It is activated if the configured input is active continuously for the related time.

28 – Low fuel level (from analog measure)

Type: **Warning**
Category: **Generic**
Related parameters: **P.0114 P.0345 P.0346**
To disable: **P.0346=0**
Enabled if: **MAN, AUTO, TEST, REMOTE START**

This protection is enabled if the board is configured to use the analog fuel level sensor (P.0114 different from zero), and if this sensor is connected to the JM connector. It is activated when the fuel level is lower than or equal to the P.0345 threshold continuously for P.0346 seconds.

29 – High fuel level (from contact)

Type: **Warning**
Category: **Generic**
Related parameters: **P.0507 P.0508 (for input 1, or equivalent)**
To disable: **P.0508=0 (or equivalent)**
Enabled if: **MAN, AUTO, TEST, REMOTE START**

This protection is enabled only if one of the digital inputs of the board is configured to acquire the high fuel level contact (function "12 – High fuel level" – IF_12 – for P.0507 parameters, or equivalent for other inputs), and if a delay different from zero has been set for this input (P.0508 or equivalent for other inputs). It is activated if the configured input is active continuously for the related time.

30 – High fuel level (from analog measure)

Type: **Warning**
Category: **Generic**
Related parameters: **P.0114 P.0343 P.0344**
To disable: **P.0344=0**
Enabled if: **MAN, AUTO, TEST, REMOTE START**

This protection is enabled if the board is configured to use the analog fuel level sensor (P.0114 different from zero), and if this sensor is connected to the JM connector. It is activated when the fuel level is greater than or equal to the P.0343 threshold continuously for P.0344 seconds.

31 – High coolant temperature (from contact)

Type: **Warning**
Category: **Engine protection**
Related parameters: **P.0507 P.0508 (for input 1, or equivalent)**
To disable: **P.0508=0 (or equivalent)**
Enabled if: **MAN, AUTO, TEST, REMOTE START**

This protection is enabled only if one of the digital inputs of the board is configured to acquire the high coolant temperature contact (function "15 – High coolant temperature" – IF_15 – for P.0507 parameters, or equivalent for other inputs), and if a delay different from zero has been set for this input (P.0508 or equivalent for other inputs). It is enabled only if the engine was started by the board (fuel solenoid control activated), and is disabled during the engine starting and stopping cycle. It is activated when the configured input is active continuously for

the related time, but only after P.0216 seconds was elapsed from the engine start (oil mask time). This is useful to avoid false anomalies when the engine starts immediately after a previous emergency stop; in this situation, in fact, the engine has the tendency to warm up itself.

32 – High coolant temperature (from analog measure)

Type: **Warning**
Category: **Engine protection**
Related parameters: **P.0113 P.0335 P.0336 P.0700**
To disable: **P.0336=0**
Enabled if: **MAN, AUTO, TEST, REMOTE START**

This protection is enabled only if the board acquires the engine coolant temperature measure. It can be acquired by the board input (JM-04, P.0113 different from zero) or by the CAN BUS (P.0700 different from zero). It is enabled only if the engine was started by the board (fuel solenoid control activated), and is disabled during the engine starting and stopping cycle. It is activated when the acquired temperature is higher than or equal to the P.0335 threshold continuously for P.0336 seconds, but only after P.0216 seconds was elapsed from the engine start (oil mask time). See previous paragraph note.

33 – Maximum coolant temperature (from contact)

Type: **Alarm**
Category: **Engine protection**
Related parameters: **P.0507 P.0508 (for input 1, or equivalent)**
To disable: **P.0508=0 (or equivalent)**
Enabled if: **MAN, AUTO, TEST, REMOTE START**

This protection is enabled only if one of the digital inputs of the board is configured to acquire the maximum coolant temperature contact (function “16 – Maximum coolant temperature” – IF_16 – for P.0507 parameters, or equivalent for other inputs), and if a delay different from zero has been set for this input (P.0508 or equivalent for other inputs). It is enabled only if the engine was started by the board (fuel solenoid control activated), and is disabled during the engine starting and stopping cycle. It is activated when the configured input is active continuously for the related time, but only after P.0216 seconds was elapsed from the engine start (oil mask time). See previous paragraph note. **Remark: if engine’s protections override function is enabled, this anomaly becomes a warning.**

34 – Maximum coolant temperature (from analog measure)

Type: **Alarm**
Category: **Engine protection**
Related parameters: **P.0113 P.0337 P.0338 P.0700**
To disable: **P.0338=0**
Enabled if: **MAN. AUTO, TEST, REMOTE START**

This protection is enabled only if the board acquires the engine coolant temperature measure. It can be acquired by the board input (JM-04, P.0113 different from zero) or by the CAN BUS (P.0700 different from zero). It is enabled only if the engine was started by the board (fuel solenoid control activated), and is disabled during the engine starting and stopping cycle. It is activated when the acquired temperature is higher than or equal to the P.0337 threshold continuously for P.0338 seconds, but only after P.0216 seconds was elapsed from the engine start (oil mask time). **Remark: if engine’s protections override function is enabled, this anomaly becomes a warning.**

37 – Low battery voltage

Type: **Warning**
Category: **Battery protection**
Related parameters: **P.0362 P.0363**
To disable: **P.0363=0**
Enabled if: **MAN, AUTO, TEST, REMOTE START**

It is always enabled except when the cranking motor is activated. It is activated when the battery voltage is lower than the P.0362 threshold continuously for P.0363 seconds. Note: P.0362 is expressed as a percentage of the nominal battery voltage, which is not configurable but is automatically selected by the board between 12 e 24 Vdc. The nominal battery voltage is selected each time the board is powered and each time the operating mode is switched to OFF/RESET. The nominal battery voltage is set to 12 V if in the previous conditions the battery voltage is not greater than 17 V, otherwise is set to 24 V.

38 – High battery voltage

Type: **Warning**
Category: **Battery protection**
Related parameters: **P.0364 P.0365**
To disable: **P.0365=0**
Enabled if: **MAN AUTO, TEST, REMOTE START**

It is always enabled except when the cranking motor is activated. It is activated when the battery voltage is greater than the P.0364 threshold continuously for P.0365 seconds. Note: P.0364 is expressed as a percentage of the nominal battery voltage (see previous paragraph).

39 – Service required

Type: **Configurable**
Category: **Generic**
Related parameters: **P.0424 P.0425**
To disable: **P.0424=0**
Enabled if: **MAN, AUTO, TEST, REMOTE START**

It is activated after P.0424 engine working hours since the last time P.0424 was changed. Note: the working hours are counted also if other devices start the engine. When activated, it acts as warning, unload, deactivation or alarm as configured in P.0425. Disconnecting the board from the battery does not disable it. Only typing a new value in P.0424 can disable it: you can configure zero to disable this function, or you can set a new value (even the same value). Note that P.0424 and P.0425 require the “installer” access level for program function: this can be used for genset rent in order to lock the genset when the established hours are elapsed. **Remark: 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.0216, P.0507 P.0508 (for input 1, or equivalent)**
To disable: **P.0508=0 (or equivalent)**
Enabled if: **MAN, AUTO, TEST, REMOTE START**

This protection is enabled only if one of the digital inputs of the board is configured to acquire the minimum oil pressure contact (function "13 – Minimum oil pressure" – IF_13 – for P.0507 parameters, or equivalent for other inputs), and if a delay different from zero has been set for this input (P.0508 or equivalent for other inputs). It is enabled only if the engine was started by the board (fuel solenoid control activated), and is disabled during the engine starting and stopping cycle. It is activated when the configured input is active continuously for the related time, but only after P.0216 seconds was elapsed from the engine start (this delay is needed to ignore the normal low pressure state when the engine starts up). **Remark: if engine's protections override function is enabled, this anomaly becomes a warning.**

42 – Minimum oil pressure (from analog measure)

Type: **Warning / alarm**
Category: **Engine protection**
Related parameters: **P.0112 P.0216 P.0341 P.0342 P.0700**
To disable: **P.0342=0**
Enabled if: **MAN, AUTO, TEST, REMOTE START**

This protection is enabled only if the board acquires the engine oil pressure measure. It can be acquired by the board input (JM-03, P.0112 different from zero) or by the CAN BUS (P.0700 different from zero). It is enabled only if the engine was started by the board (fuel solenoid control activated), and is disabled during the engine starting and stopping cycle. It is activated when the acquired pressure is lower than or equal to the P.0341 threshold continuously for P.0342 seconds, but only after P.0216 seconds was elapsed from the engine start (oil mask time). See previous paragraph note. **Remark: 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.0216, P.0507 P.0508 (for input 1, or equivalent)**
To disable: **P.0508=0 (or equivalent)**
Enabled if: **MAN, AUTO, TEST, REMOTE START**

This protection is enabled only if one of the digital inputs of the board is configured to acquire the low oil pressure contact (function "14 – Low oil pressure" – IF_14 – for P.0507 parameter, or equivalent for other inputs), and if a delay different from zero has been set for this input (P.0508 or equivalent for other inputs). It is enabled only if the engine was started by the board (fuel solenoid control activated), and is disabled during the engine starting and stopping cycle. It is activated when the configured input is active continuously for the related time, but only after P.0216 seconds was elapsed from the engine start (oil mask time). See previous paragraph note.

44 – Low oil pressure (from analog measure)

Type: **Warning**
Category: **Engine protection**
Related parameters: **P.0112 P.0216 P.0339 P.0340 P.0700**
To disable: **P.0340=0**
Enabled if: **MAN, AUTO, TEST, REMOTE START**

This protection is enabled only if the board acquires the engine oil pressure measure. It can be acquired by the board input (JM-03, P.0112 different from zero) or by the CAN BUS (P.0700 different from zero). It is enabled only if the engine was started by the board (fuel solenoid control activated), and is disabled during the engine starting and stopping cycle. It is activated when the acquired pressure is lower than or equal to the P.0339 threshold continuously for P.0340 seconds, but only after P.0216 seconds was elapsed from the engine start (oil mask time). See previous paragraph note.

45 – Maximum auxiliary current

Type:	**Alarm**
Category:	**Generic**
Related parameters:	**P.0108, P.0109, P.0367, P.0368**
To disable:	**P.0368=0**
Enabled if:	**MAN, AUTO, TEST, REMOTE START**

This protection is enabled only if the board is configured to use the auxiliary current input (P.0108 e P.0109 different from zero). It is enabled only if the engine was started by the board (fuel solenoid control activated), and is disabled during the engine starting and stopping cycles. It is activated when the auxiliary current measure is higher than P.0367 threshold continuously for P.0368 seconds. It is possible to disable this protection without modifying any parameters but activating a digital input configured as "69 – Auxiliary current protections disable" - IF_69. **Remark: protection is not enabled when the load is connected to the mains.**

48 – Emergency stop

Type:	**Alarm**
Category:	**Generic**
Related parameters:	**P.0361, P.0507 P.0508 (for input 1, or equivalent)**
To disable:	**-**
Enabled if:	**MAN, AUTO, TEST, REMOTE START**

This protection is always enabled and cannot be disabled. It is activated if the input configured as "28 – Emergency stop" (IF_28) is not activated continuously for P.0361 seconds (note: when the emergency push-button is pressed, the related contact is open).

49 – High power

Type:	**Configurable**
Category:	**Engine protection**
Related parameters:	**P.0125 P.0350 P.0351 P.0352**
To disable:	**P.0351=0**
Enabled if:	**MAN, AUTO, TEST, REMOTE START**

It is activated only if the engine was started from the controller and it is disabled during the shutdown sequence. It is activated when the system total active power is positive and greater than the P.0350 threshold continuously for P.0351 seconds. With parameter P.0352 it is possible to choose the protection to be activated (warning, unload, deactivation, alarm). Remark: parameter P.0350 is a percentage value of P.0125.

Remark: protection is not enabled if the load is connected to the mains.

Remark: if engine's protections override function is enabled, this anomaly becomes a warning.

51 – High board temperature

Type:	**Warning**
Category:	**Board protection**
Related parameters:	**P.0366**
To disable:	**P.0366=max**
Enabled if:	**MAN, AUTO, TEST, REMOTE START**

It is activated when the internal board temperature is higher than the P.0366 threshold, even for a small time.

52 – Generator voltage asymmetry

Type:	**Alarm**
Category:	**Generator protection**
Related parameters:	**P.0101, P.0102, P.0315, P.0316**
To disable:	**P.0316=0**
Enabled if:	**MAN, AUTO, TEST, REMOTE START**

It is enabled only in three-phase systems (P.0101=3) and only if the engine was started by the board (fuel solenoid control activated), and is disabled during the engine's starting and stopping cycle. The generator voltages and frequency must be inside the band of tolerance. The threshold P.0315 is expressed as a percentage of the nominal voltage of the system. This threshold is the maximum absolute acceptable difference between any two phase-to-phase voltages. The protection is activated when the difference between any two phase-to-phase voltages is greater than the P.0315 threshold (ignore the sign of the difference) continuously for P.0316 seconds.

53 – Generator current asymmetry

Type:	**Alarm**
Category:	**Generator protection**
Related parameters:	**P.0101, P.0102, P.0106, P.0317, P.0318**
To disable:	**P.0318=0**
Enabled if:	**MAN, AUTO, TEST, REMOTE START**

It is enabled only in three-phase systems (P.0101=3) and only if the engine was started by the board (fuel solenoid control activated), and is disabled during the engine's starting and stopping cycle. The generator voltages and frequency must be inside the band of tolerance and the loads must be connected to the generator. The threshold P.0317 is expressed as a percentage of the nominal current of the system (see the maximum current protection). This threshold is the maximum absolute acceptable difference between any two-phase currents. The protection is activated when the difference between any two-phase currents is greater than the P.0317 threshold (ignore the sign of the difference) continuously for P.0318 seconds. **Remark: protection is not enabled if the load is connected to the mains.**

55 – Wrong phases sequence

Type:	**Configurable**
Category:	**Generator protection**
Related parameters:	**P.0319, P.0320**
To disable:	**P.0319=0**
Enabled if:	**MAN, AUTO, TEST, REMOTE START**

It is enabled only in three-phase systems (P.0101=3) and only if the engine was started by the board (fuel solenoid control activated), and is disabled during the engine's starting and stopping cycles. The generator voltages and frequency must be inside the band of tolerance and the loads must be connected to the mains (because the protection prevents the loads to be connected to the generator). You can set the required phases sequence by using the P.0319 parameter (0=disable, 1=CW, 2=CCW, 3=as the MAINS). The protection is activated when the generator phases sequence is different from the configured one continuously for 0.5 seconds. When activated, it acts as warning, unload, deactivation or alarm as configured with the P.0320 parameter.

57 – Clock not valid

Type:	**Warning**
Category:	**Generic**
Related parameters:	**P.0418 P.0420 P.0421 P.0422 P.0423**
To disable:	-
Enabled if:	**MAN, AUTO, TEST, REMOTE START**

It is always enabled. It is activated if the board acquires the not valid status from the clock and is configured at least one function that needs the clock, such as the periodic engine test (P.0418 e P.0420) or the working enabled time periods (P.0421, P.0422, P.0423). If you set the clock, the protection is deactivated.

61 – Excitation lost

Type:	**Alarm**
Category:	**Generator protection**
Related parameters:	**P.0321 P.0322**
To disable:	**P.0322**
Enabled if:	**MAN, AUTO, TEST, REMOTE START**

It is enabled only if the engine was started by the board (fuel solenoid control activated), and is disabled during the engine starting and stopping cycles. It is activated if the reactive power is negative in sign and is greater than the threshold P.0321, continuously for P.0322 seconds.
Remark: protection is not enabled if the load is connected to the mains.

62 – Engine's CAN BUS link fault

Type:	**Configurable**
Category:	**Generic**
Related parameters:	**P.0700 P.0703 P.0709**
To disable:	**-**
Enabled if:	**MAN, AUTO, TEST, REMOTE START**

It is enabled only if engine's CAN BUS option is present and configured (p.0700 <> 0). It is activated if internal CAN controller drops in the BUS-OFF status because of communication errors on bus. By means P.0709 it is possible to select the protection type (warning, deactivation, alarm).

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, P.0581**
To disable:	**P.0404 = 0**
Enabled if:	**MAN, AUTO, TEST, REMOTE START**

It is enabled only if an output is configured for fuel pump command (code "03 – Fuel pump" – OF_03). It is activated if the fuel pump remains at work consecutively for at least P.0404: it switch off the pump. Note: the controller doesn't switch the pump to the "MAN-OFF" mode; as soon as the operator acknowledges this warning, the pump starts again.

65 – Low coolant temperature (from analogue sensor)

Type:	**Warning**
Category:	**Generic**
Related parameters:	**P.0113 P.0353 P.0354 P.0700**
To disable:	**P.0354 = 0**
Enabled if:	**MAN, AUTO, TEST, REMOTE START**

This protection is enabled only if the controller acquires the coolant temperature. It can be acquired by analogue input (Terminal 4 of JM properly configured) or by CAN-BUS (P.0700 different from 0). It is activated if the coolant temperature remains below the threshold P.0353 consecutively for the time P.0354. Using terminal 4 of JM for the measurement, the minimum temperature that can be measured is 40°C.

67 – Generic anomaly from input 1 (JN-1).

68 – Generic anomaly from input 2 (JN-2).

69 – Generic anomaly from input 3 (JN-3).

70 – Generic anomaly from input 4 (JN-4).

71 – Generic anomaly from input 5 (JN-5).

72 – Generic anomaly from input 6 (JN-6).

73 – Generic anomaly from input 7 (JN-7).

74 – Generic anomaly from input 8 (JN-8).

75 – Generic anomaly from input 9 (JV-1, HT GC350/HT GC500/HT GC500*Plus*).

76 – Generic anomaly from input 10 (JV-2, HT GC350/HT GC500/HT GC500*Plus*).

77 – Generic anomaly from input 11 (JV-3, HT GC350/HT GC500/HT GC500*Plus*).

78 – Generic anomaly from input 12 (JV-4, HT GC350/HT GC500/HT GC500*Plus*).

79 – Generic anomaly from input 13 (JV-5, HT GC350/HT GC500/HT GC500*Plus*).

80 – Generic anomaly from input 14 (JU-1, HT GC350/HT GC500/HT GC500*Plus*).

63 – Generic anomaly from input 15 (JU-2, HT GC350/HT GC500/HT GC500*Plus*).

66 – Generic anomaly from input 16 (JU-3, HT GC350/HT GC500/HT GC500*Plus*).

46 – Generic anomaly from input 17 (JU-4, HT GC350/HT GC500/HT GC500*Plus*).

47 – Generic anomaly from input 18 (JU-5, HT GC350/HT GC500/HT GC500*Plus*).

101 – Generic anomaly from input JM-3.

102 – Generic anomaly from input JM-4.

103 – Generic anomaly from input JM-2.

All these anomalies are identical; they differ only since activated from different digital inputs. Description is equal for all of them. A reference will be made only to parameters P.0507, P.0508 and P.0509 that are related to input 1 (JN_1). For other inputs consider the same function parameters associated to those inputs.

Type:	**Configurable**
Category:	**Generic**
Related parameters:	**P.0507 P.0508 P.0509 P.0216**
To disable:	**P.0507<> 1, 2, 3, 4, 19, 21, 22, 23, 24, 31, 32, 34, 41, 42, 43, 44, 45, 46, 47, 48, 49, 73**
Enabled if:	**MAN, AUTO, TEST, REMOTE START**

By means the P.0507 parameter, you can configure the type of protection you want. The anomaly is activated when the input is grounded (in the respect of the specific conditions of each function) continuously for the time configured for that input (P.0508). You must configure the text related to the anomaly with the parameter P.0509 because no text is provided by the board for those generic anomalies (but the numeric code is fixed).

The following codes are available:

- “01 – Warning” (IF_01). Generic external warning. It is always enabled.
- “02 – Deactivation” (IF_02). Generic external deactivation. It is always enabled.
- “03 – Alarm” (IF_03). Generic external alarm. It is always enabled.
- “04 - Alarm masked by oil mask time” (IF_04). Generic external engine alarm, masked by P.0216 parameter. It is enabled only after P.0216 seconds from the engine starting time. **Remark: if engine’s protections override function is enabled, this anomaly becomes a warning.**
- “19 - Warning masked by oil mask time” (IF_19). Generic external engine warning, masked by P.0216 parameter. It is enabled only after P.0216 seconds from the engine starting time.
- “21 - Gas solenoid masked warning” (IF_21). Generic external warning, masked by gas valve control. It is enabled only when this control is active.

- “22 - Gas solenoid masked alarm” (IF_22). Generic external alarm, masked by gas valve control. It is enabled only when this control is active.
- “23 - Fuel solenoid masked warning” (IF_23). Generic external warning, masked by fuel solenoid control. It is enabled only when this control is active.
- “24 - Fuel solenoid masked alarm” (IF_24). Generic external alarm, masked by fuel solenoid control. It is enabled only when this control is active
- “31 – KG/GCB masked warning” (IF_31). External warning subjected to KG/GCB closing. It is enabled only with KG/GCB closed.
- “32 - GCB masked alarm” (IF_32). External alarm subjected to GCB closing. It is enabled only with GCB closed.
- “34 - Fuel pump warning” (IF_34). If the input is active, an alarm is issued. The fuel pump is switched OFF at least until the input is active. Note: the pump is switched off, not moved to “MAN-OFF” operating mode.
- “41 - Unloading and deactivation” (IF_41). If the input is active, an unload is issued. **HT GC500/HT GC500*Plus* only**.
- “42 - Deactivation masked by oil mask time” (IF_42). If the input is active and the time set by parameter P.0216 is elapsed, a deactivation is issued. **Remark: if engine’s protections override function is enabled, this anomaly becomes a warning.**
- “43 - Unloading and deactivation masked by oil mask time” (IF_43) If the input is active and the time set by parameter P.0216 is elapsed, an unloading is issued. **Remark: if engine’s protections override function is enabled, this anomaly becomes a warning. HT GC500/HT GC500*Plus* only**.
- “44 - Gas solenoid masked deactivation” (IF_44). If the input is active and the GAS command is active, a deactivation is issued.
- “45 - Unloading and deactivation masked by gas solenoid” (IF_45). If the input is active and the GAS command is active, an unloading is issued. **HT GC500/HT GC500*Plus* only**.
- “46 - Fuel solenoid masked deactivation” (IF_46). If the input is active and the FUEL command is active, a deactivation is issued.
- “47 - Unloading and deactivation masked by fuel solenoid” (IF_47). If the input is active and the FUEL command is active, an unloading is issued. **HT GC500/HT GC500*Plus* only**.
- “48 – KG/GCB masked deactivation” (IF_48). If the input is active and KG/GCB command is active (load connected to the generator), a deactivation is issued.
- “49 - Unloading and deactivation masked by GCB” (IF_49). If the input is active and the GCB command is active, an unloading is issued. **HT GC500/HT GC500*Plus* only**.
- “73 – Alarm (managed with override)” (IF_73). Generic external alarm. It is always enabled. . **Remark: if engine’s protections override function is enabled, this anomaly becomes a warning.**

98 – Engine communication failure

Type:	**Configurable**
Category:	**Generic**
Related parameters:	**P.0700 P.0709 P.0711**
To disable:	**P.0709 = 0 (not for MTU MDEC engines)**
Enabled if:	**MAN, AUTO, TEST, REMOTE START**

This protection is enabled only if CANBUS communication is enabled (P.0700 not set to 0). For MTU MDEC engines, the anomaly is activated if the NMT ALIVE PDU message is not received for a fixed predefined time. For other engines (J1939 protocol), it is activated if no messages are received for a time greater than the value set by P.0711. By means P.0709, it is possible to configure this protection as warning, unload, deactivation or alarm (shutdown). **Remark: if engine's protections override function is enabled, this anomaly becomes a warning.**

105 – Belt break from CAN-BUS

Type:	**Warning**
Category:	**Engine protection**
Related parameters:	**P.0700 P.0704**
To disable:	**bit 11 of P.0704 on**
Enabled if:	**MAN, AUTO, TEST, REMOTE START**

This protection is enabled only if CANBUS communication with the engine is enabled (P.0700 not set to 0). It is activated if a belt break status is received from CAN-BUS.

118 – Over speed from CAN BUS

Type:	**Alarm**
Category:	**Engine protection**
Related parameters:	**P.0700 P.0704**
To disable:	**bit 10 of P.0704 on**
Enabled if:	**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 over speed state over the CAN BUS.

132 – High coolant temperature from CAN BUS

Type:	**Warning**
Category:	**Engine protection**
Related parameters:	**P.0700 P.0704**
To disable:	**bit 4 of P.0704 on**
Enabled if:	**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 coolant temperature state over the CAN BUS.

134 – Maximum coolant temperature from CAN BUS

Type: **Alarm**
Category: **Engine protection**
Related parameters: **P.0700 P.0704**
To disable: **bit 5 of P.0704 on**
Enabled if: **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 coolant 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: **Alarm**
Category: **Engine protection**
Related parameters: **P.0700 P.0704**
To disable: **bit 7 of P.0704 on**
Enabled if: **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 P.0704
To disable: **bit 6 of P.0704 on**
Enabled if: **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 P.0704**
To disable: **bit 9 of P.0704 on**
Enabled if: **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: **Alarm**

Category: **Engine protection**
Related parameters: **P.0700 P.0704**
To disable: **bit 1 of P.0704 on**
Enabled if: **MAN, AUTO, TEST, REMOTE START**

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 P.0704**
To disable: **bit 0 of P.0704 on**
Enabled if: **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 P.0704**
To disable: **bit 2 of P.0704 on**
Enabled if: **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: **Alarm**
Category: **Engine protection**
Related parameters: **P.0700 P.0704**
To disable: **bit 3 of P.0704 on**
Enabled if: **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. **Remark: 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 P.0704**
To disable: **bit 8 of P.0704 on**
Enabled if: **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 from CAN BUS (cumulative)

Type: **Warning**
Category: **Engine protection**
Related parameters: **P.0700**
To disable: **bit 14 of P.0704 on**
Enabled if: **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 from CAN BUS (cumulative)

Type: **Configurable**
Category: **Engine protection**
Related parameters: **P.0700**
To disable: **bit 15 of P.0704 on**
Enabled if: **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 – (HT GC500/HT GC500*Plus* only) PMCB bus link fault

Type: **Warning**
Category: **Generic**
Related parameters: **P.0800**
To disable: -
Enabled if: **MAN, AUTO, TEST, REMOTE START**

It's enabled only if PMCB bus is installed and enabled (P.0800 different from 0). It's activated when the internal CAN controller switch to BUS-OFF status because of bus communication errors.

201 – (HT GC500/HT GC500*Plus* only) Duplicated address on PMCB bus

Type: **Warning**
Category: **Generic**
Related parameters: **P.0800 P.0452**

To disable: -
Enabled if: **MAN, AUTO, TEST, REMOTE START**

It's enabled only if PMCB bus is installed and enabled (P.0800 different from 0). It's activated when two or more controllers connected on the same PMCB have the same address (P.0452).

202 – (HT GC500/HT GC500*Plus* only) Wrong number of gen. over the PMCB BUS

Type: **Warning**
Category: **Generic**
Related parameters: **P.0803**
To disable: **P.0803 = 0**
Enabled if: **MAN, AUTO, TEST, REMOTE START**

It's enabled only if PMCB bus is installed and enabled (P.0800 different from 0). It's activated when the board detects a number of boards different from what specified in P.0803.

271 – (HT GC500/HT GC500*Plus* only) GCB Parallel failure

Type: **Alarm**
Category: **Generic**
Related parameters: **P.0802 P.0852 P.0854**
To disable: **-**
Enabled if: **AUTO, TEST, REMOTE START**

This protection is enabled only if plant configuration (P.0802, P.0854) allows the synchronization on GCB circuit breaker. It's activated when the GCB circuit breaker does not close itself within the time configured with P.0852 from the start of the synchronization.

272 – (HT GC500/HT GC500*Plus* only) MCB parallel failure (reverse parallel)

Type: **Warning**
Category: **Generic**
Related parameters: **P.0802 P.0853 P.0855**
To disable: **P.0851 = 0**
Enabled if: **AUTO, TEST, REMOTE START**

This protection is enabled only if plant configuration (P.0802, P.0855) allows the synchronization on MCB circuit breaker. It's activated when the MCB circuit breaker does not close itself within the time configured with P.0853 from the start of the synchronization.

273 – (HT GC500/HT GC500*Plus* only) Incoherent or not set parameters

Type: **Warning / alarm**
Category: **Generic**
Related parameters: -

To disable: **-**

Enabled if: **MAN, AUTO, TEST, REMOTE START**

This protection is always enabled and is activated when plant configuration parameters are non consistent. For example, if you set up a plant as Mains parallel, for sure you have to set up the input to acquire GCB, MCB and PPR status. Moreover a synchronization module must be connected to the board. If these conditions are not verified this alarm starts.

This alarm starts also when (for any reason) the board loads all default parameters: in this case to deactivate the alarm you have to set up at least one of parameters that require the SICES special password (see paragraph 4.1.3).

An explanation is provided on the page S.02 of the display to better understand what the problem is.

274 – (HT GC500/HT GC500*Plus* only) Production line open

Type: **Deactivation**

Category: **Generic**

Related parameters: **P.0507 P.0508 (for input 1, or equivalent)**

To disable: **P.0508=0 (or equivalent)**

Enabled if: **MAN, AUTO, TEST, REMOTE START**

If an external circuit breaker disconnects the mains while the generator is supplying in parallel with it, the genset will be disconnected and stopped after cooling down. A digital input can be configured to detect this condition (function “51 – Production line open” – IF_51). It is activated only if operating in parallel to the mains.

275 – (HT GC500/HT GC500*Plus* only) Interface device not open

Type: **Alarm**

Category: **Generic**

Related parameters: **P.0900**

To disable: **P.0900 = 0**

Enabled if: **MAN, AUTO, TEST, REMOTE START**

In parallel to mains application, if the interface device doesn’t open in 0.5 seconds from the “loss of mains” detection, a shutdown is issued.

276 – (HT GC500/HT GC500*Plus* only) Alarm from master device

Type: **Alarm**

Category: **Generic**

Related parameters: **-**

To disable: **-**

Enabled if: **MAN, AUTO, TEST, REMOTE START**

This alarm is issued when an external master device (MC100) requires it over the PMCB bus. MC100 uses this function to force the opening of all GCB circuit breakers without any unload operation.

277 – (HT GC500/HT GC500^{Plus} only) GCB cannot be closed

Type: **Warning**
Category: **Generic**
Related parameters: **-**
To disable: **-**
Enabled if: **MAN, AUTO, TEST, REMOTE START**

This warning is issued when the GCB circuit breaker has to be closed, but actually it cannot be closed due to an external non consistent condition (for example when the mains is in tolerance, the MCB is closed but there are no voltages on the bus-bars). An explanation is provided on the page S.02 of the display to better understand what the problem is.

278 – (HT GC500/HT GC500^{Plus} only) MCB cannot be closed

Type: **Warning**
Category: **Generic**
Related parameters: **-**
To disable: **-**
Enabled if: **MAN, AUTO, TEST, REMOTE START**

This warning is issued when the MCB circuit breaker has to be closed, but actually it cannot be closed due to an external non consistent condition (for example when all GCB circuit breakers are opened but still there are voltages on the bus-bars). An explanation is provided on the page S.02 of the display to better understand what the problem is.

279 – (HT GC500/HT GC500^{Plus} only) Incoherent bus-bars voltages

Type: **Warning**
Category: **Generic**
Related parameters: **-**
To disable: **-**
Enabled if: **MAN, AUTO, TEST, REMOTE START**

This warning is issued when the voltage detection on the bus-bars is not coherent with the status of the circuit breakers (for example, all circuit breakers opened but voltages present on the bus-bars).

9. Other functions

9.1 Fuel pump

HT GCxxx implements a fuel pump full management, for the loading of the local tank on genset from the storage tank. The pump management is inclusive of automatic working and manual controls, accessible from the frontal panel. You must first force the multifunctional display on page S.07. Here it is possible to use the standard setting procedure (ENTER to begin, ▲ and ▼ to modify and ENTER to confirm) to select the pump control mode. **Remark: the pump control mode is a standard parameter (P.0400) of the controller and thus can be modified also from the programming screens.** The available modes are:

- AUTO: pump is started / stopped by the controller depending on the fuel level in the tank. A hysteresis is applied to avoid repeated start / stop.
- MAN-ON (pump activated): pump is stopped only if the tank is full. As soon level decreases under the full value, the pump is started again.
- MAN-OFF (pump deactivated): pump is always stopped, even with an empty tank.

Usually the pump is supplied by the generator; for this reason the controller always keep the pump off if the engine is dead (the control mode is retained). Thus in OFF-RESET mode is always stopped.

The pump can work either with a detecting system with contacts or with an analogical instrument.

The minimum condition in order to use this function is that one of the board configurable outputs is associated to the pump: this configuration is done setting the code “03 – Fuel pump” (OF_03) in parameter P.0581 (or in its equivalents for other outputs).

9.1.1 Usage with an analogue level transducer

To use this function it is required:

- The analogue transducer must exist and be connected between terminals 2 and 1 of JM connector.
- The board must be configured to acquire the measurement from the transducer (P.0114 different from zero)
- The board must be configured to command the pump according with this transducer (parameter P.0401 set to zero)
- At least the thresholds for the activation and deactivation of the pump (P.0402 and P.0403) must be configured.
- If configured, also minimum, low and high fuel level thresholds are used (parameters P.0347, P.0345, P.0343).

Attention: if the first three conditions are verified, the board manages in any case the pump, whatever threshold values are programmed. In particular, thresholds defined in the last condition (minimum, low etc.) are used also if their related delay times are set to zero (to disable the anomalies). The configuration of the thresholds is very important; thresholds have to be put in scale (from lower to higher values) in this order: minimum, low, start, stop, high. For what we said before, the board works also if the thresholds aren’t in this order; it is enough that the first three are lower than the last two (internal to the two groups they can be exchanged, but this is not recommended).

9.1.2 Usage with a level transducer with contacts

To use this function it is required:

- The level transducer with steps signaled by contacts must exist.
- The board must to be configured to command the pump according to that transducer (parameter P.0401 set to 1)
- At least the pump start and stop contacts must be connected respectively to two configurable inputs of the board.
- If connected, also minimum, low and high fuel level contacts are use.

Attention: if the first two conditions are verified, the board manages in any case the pump, whatever are the connected contacts. In particular, the contacts indicated in the last condition are used also if their related acting times are set to zero (to disable the anomalies). At least, the contacts must respect the following convention:

- Minimum level (function “08” - IF_08): closed if level is lower than minimum level threshold
- Low level (function “09” - IF_09): closed if level is lower than low level threshold
- Start level (function “10” - IF_10): closed if level lower than pump start threshold
- Stop level (function “11” - IF_11): closed if level lower than pump stop threshold
- High level (function “12” - IF_12): closed if level **higher** than maximum level threshold.

9.1.3 Level evaluation

The board assigns the real fuel level present position by doing in the order all the following valuations:

- If the level is lower than the pump start threshold, the board assigns the “start” position.
- If a low level threshold exists, and the level is lower than threshold, the board assigns the “low” position.
- If a minimum level threshold exists, and the level is lower than the threshold, the board assigns the “minimum” position.
- If the level is higher than stop threshold, the board assigns the “stop” position.
- If a maximum level threshold exists, and the level is higher than the threshold, the board assigns the “maximum” position.
- If no one of the previous condition is verified, the board assigns the “hysteresis” position.

9.1.4 Automatic pump control

Referring to the position evaluated in the previous paragraph, the pump:

- Is activated if the level position is “start”, “low” or “minimum”.
- Is deactivated if the level position is ”stop” or “maximum”

- Retains the present control if in “hysteresis”.

9.1.5 Manual pump control

Pump can be activated and deactivated as the operator likes. However, the board prevents the start if the level position (see previous paragraphs) is “stop” or “maximum”

9.1.6 Fuel pump protections

Using parameter P.0404, it is possible to set a maximum activation time for the fuel pump. This parameter should be set to a value that allows filling the tank with a proper spare time. If the pump remains active for a time greater than the set value, controller shutdowns the pump (retaining the pump control mode) and activates the warning W064: possible cause of problem are pump failure or external empty tank. As soon as the operator acknowledges the warning, the pump is started again.

It is also available a special input function for the fuel pump management; this function shutdowns the pump and issues a warning (“34 – Fuel pump warning” – IF_34). It is possible to define a custom text message for the warning. If, for example, an input is to be used in order to stop the pump in case of external tank is empty, configure one digital input with the function “34”, define a proper time delay for the input and, if you need, specify a text like “Ext. tank empty”.

9.2 Coolant pre-heating

Controller is able to monitor the coolant temperature of the engine and thus it can manage a pre-heating system for low ambient temperature.

In order to use this function, set one digital output with the function “24 - Coolant heating command” (OF_24). This output will be used to command the heater. The controller must acquire the coolant temperature using its analogue input and one of the supported sensor, or by means the CAN-BUS connection.

By means parameter P.0355 and P.0356 configure the working threshold:

- P.0355: temperature (in °C) below which the heater is activated.
- P.0356: temperature (in °C) over which the heater is deactivated.

Threshold P.0356 must be set to a value greater than the one used for P.0355: two different thresholds are used in order to have a hysteresis that prevents continuous start and stop of the heater.

Heater will start if the temperature drop below the P.0355 value for at least one second and will be stopped if it rise above P.0356 for at least one second.

9.3 Protection against MCB (KM/MCB) failure

For stand-by application, MCB must be usually closed in order to connect the load to the MAINS. In case of breaker, switch or power relay failure, and subsequent opening, the load can be remains unsupplied. Using this function is possible to automatically start the generator and supply the load in case of MCB failure.

In order to use this function, carry out following configuration:

- MCB status feedback must be connected to a digital input of the controller configured with the function 06 (Mains breaker status).
- Delay time of the input must be different from 0.

- Set parameter P.0221 (Enable generator supply on KM/MCB fault) to 1.

With such configuration, MCB status is continuously monitored, when MAINS is present. When MCB is command close but remains open for more time than the one programmed, the following actions are carried out:

- Warning W013 is issued.
- If engine is dead, it is started.
- As soon the generator is in operating window, GCB is closed (MCB is command open)

At this point, load will remains indefinitely connected to the generator. In order to restore the normal operating condition, proceed in the following way:

- Set the operating mode to MAN.
- Command the changeover to MAINS.
- Set again the mode to AUTO

If the load is successfully transferred to the MAINS, W013 will be reset and cooling cycle will be started; otherwise W013 will be again issued and the load transferred again to the generator.

In MAN mode or with inhibition active the function is disabled.

For HT GC500/HT GC500*Plus* working in parallel to mains mode with reverse synchronization, the behavior is slightly different.

- Three different function modes are available:

1. **P.0221 = 0-No (Protection disabled)**

   In this case, if the controller is transferring the load to the mains and MCB feedback remains open after the closure command and the programmed delay, the following sequence starts:

   - **W272 – No reverse parallel** is issued
   - GCB is opened
   - A three attempts MCB closing procedure is started
   - If the problem persists the warning **W013 – Mains breaker not closed is issued**.
   - Generator will be then stopped with the standard procedure. Remain part of sequence is similar to the non-parallel one.

2. **P.0221 = 1-Yes (allows black-out on loads)**

   In this case, if the controller is transferring the load to the mains and MCB feedback remains open after the closure command and the programmed delay, the following sequence starts:

   - **W272 – No reverse parallel** is issued
   - GCB is opened
   - A three attempts MCB closing procedure is started

- If the problem persists the warning **W013 – Mains breaker not closed is issued**.
- Generator is kept running and GCB is reclosed supplying the load as in no parallel application.

3. **P.0221 = 2-Yes (doesn't allow black.out)**

   In this case, if the controller is transferring the load to the mains and MCB feedback remains open after the closure command and the programmed delay, the following sequence starts:

   - **W272 – No reverse parallel** is issued
   - GCB is kept closed
   - A three attempts MCB closing procedure is started
   - If the problem persists the warning **W013 – Mains breaker not closed is issued**.
   - Generator is kept running supplying the load; the remain part of sequence is similar as in no parallel application.

(in these cases, MCB closure attempt is carried out by means a synchronization procedure).

9.4 Load thresholds

This function is different from the "load function" available for "parallel plants" with HT GC500/HT GC500^{Plus} (the "load function" is described on the "Parallel Function Handbook").

This function allows to monitoring 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.

Parameter P.0481 allows selecting the condition to be monitored: zero selects the survey of the low load condition; one selects the control of the high load condition.

In some cases it is required to disable the function by means an external command. Set a digital input to function "75 – Load thresholds enable" (IF_75). If any input is configured with this function, the "Load thresholds" function will be active only when the input is active.

9.4.1 Low load

The purpose of this function is to diagnose a low load condition, in a scenario with more genset working in parallel, in order to disable the ones not required. For the gensets enabling/disabling it is used one of the configurable digital outputs, for which the function "04 - Load thresholds status" (OF_04) is configured in parameter P.0581 (or followings). If no output is configured in this way, this function is not available.

The board surveys the total active power supplied, confronting it with two thresholds (which set a hysteresis band): the output is activated (signaling a low load status) if the power stays below than the lower threshold for the configured time. The output is deactivated if the power stays above than the higher threshold for the configured time. These thresholds and delays are set with following parameters:

- P.0483: lower threshold (percentage in respect to the nominal power P.0125).
- P.0484: delay related to the lower threshold (in seconds).
- P.0485: higher threshold (percentage in respect to the nominal power P.0125):
- P.0486: delay related to the higher threshold (in seconds).

If the thresholds P.0483 and P.0485 are set to zero (or inconsistent), the function is disabled.

Starting from the moment that "Load thresholds enable" input is activated, a time delay, set by parameter P.0482, must be waited before the function actually becomes active (thus, during this time, the output is held inactive with no care respect to the load amount). This function is useful during system startup.

9.4.2 High load

Purpose of this function is to diagnose a high load status in order to disconnect a part of the less important loads. For the loads connecting/disconnecting it is used one of the configurable outputs of the board, for which it has been configured the code "04 - Load thresholds status" (OF_04) in the parameter P.0581 (or followings). If no output is configured in this way, the function will work in any case.

The description for the "low load" condition is still valid; remember only that the output is activated when the power is above the higher threshold and is deactivated when is below the lower one.

The output is activated in a maximum power situation, and can so be used directly as control for the disconnecting of loads. Beware of the thresholds: when a part of the loads is disconnected, the power will drop low. If the lower threshold is higher than this condition, the output will be deactivated, and this could make the load to be reconnected and so on.

9.5 Remote commands

If the controller is in AUTO mode, some function can be controlled from remote, using some digital input configured as required. Available functions are the followings:

- "05 – Reset command" (IF_05). When this input becomes active, the controller executes a complete reset of all anomalies. This operation has the same effect of changing the operator mode of the controller to OFF-RESET and back again to AUTO.
- "26 – Remote test request" (IF_26). If the input is active, the controller mode change from AUTO to TEST (in OFF-RESET and MAN the input doesn't affect the functionality). When the input is deactivated, controller returns to AUTO.
- "27 – Remote start request" (IF_27). If the input is active, the controller mode change from AUTO to REMOTE START (in OFF-RESET and MAN the input doesn't affect the functionality). When the input is deactivated, the controller returns to AUTO. In REMOTE START mode, the controller always starts the engine, and tries to close the KG/GCB circuit breaker, whatever is the status of the mains, unless the "Changeover sequence inhibition" is active (see in the following).
- "30 – Changeover sequence inhibition" (IF_30). In AUTO, TEST and REMOTE START mode, when this input is active, the controller always opens the KG/GCB circuit breaker.
- "33 – Load function enable" (IF_33). If the input is not active, the "load function" for parallel plants is disabled (see the parallel function handbook).

- "35 – Idle speed request" (IF_35). If this input is active, the controller disables the minimum frequency and voltages protections in order to allow low speed operation that will be set by means a dedicated output ("23 – Idle speed command" - OF_23) or by CAN.

- "38 – Import/export mode selection" (IF_38) (**HT GC500/HT GC500*Plus* only**). This input allows selecting the power control mode between "BASE LOAD" (not active" and "IMPORT/EXPORT" (active). See the parallel function handbook.

- "40 – Inhibition" (IF_40). If the input is active, the automatic operation of the genset is prevented for any reason (except for the REMOTE START and the TEST mode).

- "52 – External reverse synchronization request" (IF_52) (**HT GC500/HT GC500*Plus* only**). This function is used in parallel to mains applications, where the MCB circuit breaker is commanded by an external device, to use the HT GC500 internal synchronizer to close this circuit breaker.

- "58 – Disable power management" (IF_58) (**HT GC500/HT GC500*Plus* only**). When this input is active, the controller disables all internal algorithms related to active and reactive power management (because external devices are provided to manage powers).

- "59 – Engine's protections override" (IF_59). When this input is active, all protections related to the engine acts as "warning". Use this function in plants where it is preferable to damage the engine instead of leaving the loads unsupplied.

- "61 – DROOP request" (IF_61) (**HT GC500/HT GC500*Plus* only**). This input allows switching the speed control mode from "ISOCHROOUS" (not active) to "DROOP" (active). See the parallel function handbook.

- "62 – Select master genset" (IF_62) (**HT GC500/HT GC500*Plus* only**). When this input is active, this generator becomes the "master" for the "load function" purposes. See the parallel function handbook.

- "77 – Second power setpoint" (IF_77) (**HT GC500/HT GC500*Plus* only**). This input allows switching between two different power set points when working in parallel to the mains. See the parallel function handbook.

If the controller is in MAN mode, four digital inputs can be used in order to manage the circuit breakers (see 7.6.2.2).

9.6 Alternative configuration sets

It is possible to use some digital inputs, properly configured, to allow changing system configurations without directly changing programming parameters. HT GCxxx manages four alternative parameter sets that can be copied in the working parameter set. Copying is activated by digital input. Only a subset of the parameters is changed, the other remains unmodified.

Parameters modified by the alternative set are the followings:

- P.0101: Generator number of phases.
- 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: Generator/load CT ratio.
- P.0108: Auxiliary current CT ratio.
- P.0116: Mains nominal voltage.
- P.0117: Mains VT primary voltage.
- P.0118: Mains VT secondary voltage.
- P.0119: Mains number of phases.
- P.0125: Engine nominal power (kW).
- P.0701: Nominal engine speed.

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

- "64 – Select configuration 1" (IF_64). When the input becomes active, parameters of alternative configuration set 1 are copied in the working configuration.
- "65 – Select configuration 2" (IF_65). When the input becomes active, parameters of alternative configuration set 2 are copied in the working configuration.
- "66 – Select configuration 3" (IF_66). When the input becomes active, parameters of alternative configuration set 3 are copied in the working configuration.
- "67 – Select configuration 4" (IF_67). When the input becomes active, parameters of alternative configuration set 4 are copied in the working configuration.

Remark: copying an alternative set in working configuration causes a lost of the previous loaded parameters. The only way to restore them without manual reprogramming is to save them in another alternative set.

This function is useful for multi voltage/frequency systems, allowing a fast configuration change without direct reprogramming the controller.

Remark: the load of an alternative set are enabled only if the engine is dead and the controller is in OFF-RESET mode.

Among the various parameters that can be modified by means alternative sets, there is also P.0701 that allows setting the nominal speed of the engine. This is mainly used for some CAN interfaced engines. Please refer to document [3] about speed change: in some cases this operation requires a little more complex operation than simple new value assignment.

As alternative, for the speed change, it is possible to use the digital input function "63 - Select 1800 rpm" (IF_63). In this case P.0701 must be set to 1500 also in the alternative set, allowing the speed change only when the digital input switches to active status (the change must be carried out when engine is dead).

9.7 EJP function

Note: HT GCxxx board is not able to detect EJP signals on the mains. In order to use this function, an external device detector should be used. The detector should provide two output signals consistent with the HT GCxxx EJP functionality.

The EJP function allows starting the engine and warming it before mains faults, so when it will happen, loads can be immediately changed-over to genset, reducing to the minimum the

time the loads stay unsupplied. EJP is used also to signal the beginning of more expansive fare band for the energy; some users prefer to generate the energy by ourselves during that band. EJP is a French specification and regulation.

The system uses two signal provided by the MAINS supplier:

A. A signal activated well in advance with respect to the mains fault or fare change.

B. A signal activated just before mains fault or fare change.

What is desired is to start the engine in some advance (configurable) in respect to B signal; load however is changed-over only when B is activated. The board can do this, but the following rules have to be followed:

- A and B signals must stay active until mains comes back (or high fare ends).
- Both signals must be connected with relays with exchanging contacts.
- The time between A and B signals activation must be known.

To use this function the board has to be configured in the following way:

- Configure one digital input with function “27 – Remote start request” (IF_27) (by parameter P.0507 or equivalent for other inputs). Moreover, for this input it has to be configured the desired delay between A signal activation and the engine start (in seconds, in parameter 508 or equivalents). If, for example, we want to warm the engine for five minutes and A signal will be activated 30 minutes before B, the P.0508 delay will be 1500 seconds, which is 25 minutes (it is possible to set delays up to 4000 seconds, which is 66 minutes).
- Configure one digital input with function “30 - Changeover sequence inhibition” (IF_30) (by parameter P.0507 or equivalent for other inputs).

Then connect the **N.O**. contact of the relay on A signal to first configured input and **N.C.** contact of B signal relay to second input. **REMARK: the “Changeover sequence inhibition” function prevents to connect the load also if the generator is automatically started for other reasons such as AMF. To avoid this problem, use a logic that prevents to activate this function if the generator is not started by REMOTE START function.**

When both signals are inactive, the board has not the remote start request and so stays at rest in AUTO mode. The “Changeover sequence inhibition” command is ignored.

When A signal is activated, both board inputs will be active. The board will not pass immediately to REMOTE START mode, but will do it only after the time configured in P.0508 (or equivalents). So in this phase, too the “Changeover sequence inhibition” is ignored. In this phase, window S.01 shows the remaining time before cranking.

After the configured time from A signal activation, the board passes in REMOTE START mode and proceeds to start the engine. In this phase, the “Changeover sequence inhibition” is no more ignored, and being it active (connected on N.C. relay contact), it will prevent the loads changeover on genset.

When B signal is activated, the “Changeover sequence inhibition” input is deactivated, allowing so the load changeover on genset.

When the function ends, both A and B signals are deactivated. Therefore, the board comes back in AUTO mode, and being mains present, it provides to stop the engine (with cooling cycle).

9.8 OVERRIDE of the engine protection

In some types of application, it is required that, also if engine anomalies are present, the engine will not shut down.

HT GCxxx is able to deactivate some engine protection in order to allow to work without care of engine failure. Since this operation mode can lead to serious engine damage, it can be never used as default operation mode. The switch to this operation mode must be made by means activation of a digital input configured with the function “59 – Engine protections override” (IF_59). If this function is active, it is shown in the screen S.01 of the display and the following alarms (blocks) are changed in warnings

- 005: belt break.
- 025: minimum fuel level (from contact).
- 026: minimum fuel level (from analogue measure).
- 033: maximum coolant temperature (from contact).
- 034: maximum coolant temperature (from analogue measure).
- 039: service request.
- 041: minimum oil pressure (from contact).
- 042: minimum oil pressure (from analogue measure).
- 049: high power.
- 062: Engine’s CAN-BUS link failure.
- 098: communication lost with the engine.
- 134: maximum coolant temperature from CAN-BUS.
- 135: minimum coolant level from CAN-BUS.
- 142: minimum oil pressure from CAN-BUS.
- 159: maximum oil temperature from CAN-BUS.
- 199: CAN-BUS cumulative alarms (red lamp).

Also the following generic alarms (associated to digital inputs) become warnings when the “override” input is activated:

- “04 – Alarm masked by oil mask time” (IF_04).
- “42 – Deactivation masked by oil mask time” (IF_42).
- “43 – Unloading and deactivation masked by oil mask time” (IF_43).
- “73 – Alarm (managed with override)” (IF_73).

In this way a warning will be issued to the operator but the generator will continue to work.

A dedicated counter keeps tracks of the working time with the OVERRIDE active.

Electrical protections are not affected from the OVERRIDE.

Starting from SW version 01.13, if OVERRIDE is set directly to the engine interface and the status is reported by CAN BUS (if available), the OVERRIDE status is any case shown by the controller display even if it is not set by the controller itself.

CAUTION: using this function can lead to severe engine damages. SICES can't be considered responsible in any way for damages occurred using OVERRIDE function.

9.9 Maintenance

The board can automatically signal to the operator the periodical service request. This function is configurable through the parameters P.0424 and P.0425. In particular, with P.0424 it is configured the running hours beyond which it is request a service. By means P.0425 it is configured what kind of signaling has to be activated at the expiry: a warning, an unload, a deactivation or an alarm (the anomaly code is W39 or U39 or D39 or A39).

The function is enabled if the parameter P.0424 contains a value different from zero. The count starts in the moment this parameter is set. When the time configured is elapsed, the board stores in the non-volatile memory the status of the service request. In this way, also removing supply to the board, this signaling cannot be lost and it cannot be reset. Besides, if with P.0425 it is selected the signaling by means of an alarm, then the genset will not be anymore used. This function allows managing rental contracts "by hour number".

To cancel the service request (and also the related signaling) it needs to set again the parameter P.0424; it can be set to zero to disable the function, it can be simply confirmed to require that next service will be after the same hours number, or it can be set with a new value.

Note that these parameters require the installer password.

9.10 CAN BUS

The controller is always equipped with the CAN BUS interface; thus, it is able to interact with the engine by the bus itself, reducing the needed wiring in the panel and between panel and engine. For a complete description of the functions available with CAN BUS, see document [3].

9.11 Status Signals

HT GCxxx's digital outputs can be configured (see paragraph 4.5) in order to signal status of the controller.

The following output functions can be used:

- "05 – Test running" (OF_05). Active if the controller is in TEST mode
- "06 – Mains in thresholds" (OF_06). Active when the mains is "in tolerance" (see 7.2).
- "07 – Generator in thresholds" (OF_07). Active when the generator is "in tolerance (see 7.3).
- "08 – Engine running" (OF_08). Active when the engine running status is detected (see 7.5.1).
- "09 – Generator alarms" (OF_09). It is active when any generator anomalies is active
  - 001: Minimum generator voltage.
  - 002: Maximum generator voltage.
  - 006: Maximum current.

- 008: Operating condition failure.
- 015: Overload (from digital input).
- 016: Short circuit.
- 052: Voltage unbalance.
- 053: Current unbalance.
- 055: Wrong phase sequence.
- 061: Loss of excitation.

- "10 – Engine alarms" (OF_10). It is active when any engine anomalies is active
  - 005: Belt break (engine's battery-charger failure).
  - 021: Engine not stopped.
  - 022: Over-crank.
  - 031: High coolant temperature (digital input).
  - 032: High coolant temperature (analogue measure).
  - 033: Maximum coolant temperature (digital input).
  - 034: Maximum coolant temperature (analogue measure).
  - 037: Low battery voltage.
  - 038: High battery voltage.
  - 039: Service request.
  - 041: Minimum oil pressure (digital input).
  - 042: Minimum oil pressure (analogue measure).
  - 043: Low oil pressure (digital input).
  - 044: Low oil pressure (analogue measure).
  - 049: High power.
  - 062: CAN-BUS link failure.
  - 065: Low coolant temperature (analogue measure).
  - 098: Engine communication lost.
  - 105: Belt-break from Can-Bus.
  - 132: High coolant temperature from Can-Bus.
  - 134: Maximum coolant temperature from Can-Bus.
  - 135: Minimum coolant level from Can-Bus.
  - 136: Low coolant level 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.
  - 160: Water in fuel from Can-Bus.
  - 198: Can-Bus cumulative warnings.
  - 199: Can-Bus cumulative alarms.
- "11 – Speed alarms" (OF_11). It is active when any speed/frequency anomalies is active
  - 003: Minimum generator frequency.
  - 004: Maximum generator frequency.
  - 011: Reverse power.
  - 017: Over speed (digital input).
  - 018: Over speed (pick-up).
  - 019: Over speed (frequency).
  - 118: Over speed (Can-Bus).
- "12 – Fuel alarms" (OF_12). It is active when any fuel anomalies is active
  - 025: Minimum fuel level (digital input).
  - 026: Minimum fuel level (analogue measure).
  - 027: Low fuel level (digital input).
  - 028: Low fuel level (analogue measure).
  - 029: High fuel level (digital input).
  - 030: High fuel level (analogue measure).
  - 064: Fuel pump failure.
  - Any digital input configured as "34 – Fuel pump warning" (IF_34).
- "13 – Changeover alarms" (OF_13). It is active when any changeover anomalies is active
  - 013: MCB not closed.
  - 014: GCB not closed.
  - 023: MCB not open.
  - 024: GCB not open.
  - 271: No parallel (**HT GC500/HT GC500*Plus* only**).
  - 272: No reverse parallel (**HT GC500/HT GC500*Plus* only**).
- "17 – Cumulative warning" (OF_17). Active if any warning is active.
- "18 – Cumulative alarm (block)" (OF_18). Active if any alarm, unload or deactivation is active.

- "19 – MAN+AUTO" (OF_19). Function **is not** active if controller is in OFF-RESET mode.
- "20 – AUTO" (OF_20). Function **is not** active if controller is in OFF-RESET or MAN mode.
- "26 – Synchronization in progress" (OF_26). The output is activated during synchronizations (manual or automatic, on GCB or MCB). **HT GC500/HT GC500^{Plus} only.**
- "28 – Reverse synchronization in progress" (OF_28). The output is activated during reverse synchronizations (on MCB), manual or automatic. **HT GC500/HT GC500^{Plus} only.**
- "36 – Synchro-check" (OF_36). The output is activated only during synchronizations, when the genset is synchronized to the mains or to the bus-bars. **HT GC500/HT GC500^{Plus} only.**
- "37 – Voltages on bars" (OF_37). The output is activated when voltages are present on the bus-bars. **HT GC500/HT GC500^{Plus} only.**
- "40 – Mains present (from loss of mains protections)" (OF_40). The output is activated when the "loss of mains" protection detects that the mains is "in tolerance". **HT GC500/HT GC500^{Plus} only.**

9.12 Output mapping

By means output function "22 – Bit mapped" (OF_22) is possible to configure a digital output to be activated when at least one of selected status (among a list of 196) is active. Thus this function implement a logical OR operation on all the selected statuses (it is possible select up to 196 status). The statuses are split in three blocks of 64 each. Each block is described by a parameter that consists of a hexadecimal string of 16 characters. Each character represent 4 binary digit (thus 4x16 = 64 bits). Each output has thus 3 parameters for output mapping. Setting to one a bit will include the related status in the check for that output. If any of the status that has the related bit set to one becomes active, the output becomes active.

- First 128 statuses are associated mainly to controller anomalies. **Remark: output is activated when the selected status is activated, not when the related input is active (in OFF-RESET, inputs can be all active but no anomalies are activated and neither the mapped outputs associated).**
- Last 64 statuses are general status of the controller, engine, generator etc.

9.13 Counters

The board manages internally the following counters:

4. Active power (kWh), clearable: it counts only the supplied power, it does not count in case of power reverse. It works only if the load is connected to the generator.
5. Active power (kWh), total: it counts only the supplied power, it does not count in case of power reverse. It works only if the load is connected to the generator.
6. Reactive power (kvarh), clearable; it counts the absolute value. It works only if the load is connected to the generator.

7. Reactive power (kvarh), total; it counts the absolute value. It works only if the load is connected to the generator.

8. Mains Active power (kWh), clearable: it counts only the supplied power, it does not count in case of power reverse. It works only if the load is connected to the mains and the CT are connected on the load side.

9. Mains Active power (kWh), total: it counts only the supplied power, it does not count in case of power reverse. It works only if the load is connected to the mains and the CT are connected on the load side.

10. Mains Reactive power (kvarh), clearable; it counts the absolute value. It works only if the load is connected to the mains and the CT are connected on the load side.

11. Mains Reactive power (kvarh), total; it counts the absolute value. It works only if the load is connected to the mains and the CT are connected on the load side.

12. Engine starts counter, clearable.

13. Engine running hours, clearable.

14. Absolute engine running hours.

15. Time to next service (hours).

16. Working hour counter with KG/GCB closed, clearable.

17. Working hour counter with OVERRIDE active, clearable.

18. Board absolute supply time (hours).

Almost all these counters are visualized on board frontal panel (only the board absolute supply time is not visible). All are however readable by means of serial port (with the Modbus protocol). Some of these counters can be reset from operator by a proper procedure or by means of the serial port; in no way can be reset the time to next service counter, the absolute engine running hours counter and the board absolute supply time counter. All these counters are saved in a non-volatile memory and so they maintain their value also removing supply from the board. Since non-volatile memories “consume” themselves writing in them, it is necessary to reduce at the minimum the number of writings. For this reason, a counter is not immediately saved as its value changes, and it is then important to know when values are saved and how to be sure that they are saved before removing supply from the board.

Counters are saved (all together and in the same time) in the following conditions:

- Immediately after each engine start (with engine running, not after each start attempt).
- Immediately after each engine stop (when board acknowledges the engine stopped status, not when stop is request).
- After each engine running hour counter increase, which is for each full hour, (total, also if the engine has been started for instance six times for ten minutes each time).
- After each absolute engine running hour counter increase, which is for each full hour, (total, also if the engine has been started for instance six times for ten minutes each time).
- After each increase of the engine running hour with GCB closed counter (total, also if the engine has been started for instance six times for ten minutes each time).
- After each increase of the engine running hour in OVERRIDE mode counter (total, also if the engine has been started for instance six times for ten minutes each time).

- Each time the key switch is switched on OFF/RESET.
- For each board supply hour.
- When parameter P.0424 (time to next service) is changed.

Furthermore, counters are saved when they are reset (singularly or globally) from frontal panel or serial port. Beware that some counters have a decimal part (example the minutes-counters associated to hours-counters), which is saved in non-volatile memory too. Removing supply to the board in an uncontrolled way, there is the risk to loose just this decimal part. It is however sufficient switch the key to OFF/RESET to force the board to save data, before removing the supply.

9.13.1 Counter reset

Counter reset is achieved by means a standard procedure that acts only on some counters depending on the page shown on the display. See page descriptions in par. 3.3; there are descript also the clearing procedure.

9.14 Clock

The board is provided with a hardware clock. The date/time is shown in the S.05 page of the multifunction display. Time and date are programmable through the menu 4.2 of the program function or trough the serial port. Clock is used for many functions:

- History logs recordings.
- Weekly planning of the start of the engine for TEST.
- Weekly planning of time intervals in which the genset must not automatically starts.

The first function is widely explained in the paragraph 5, now will be explained the other two functions.

9.14.1 Engine TEST weekly planning.

The planning for the TEST of the engine is made weekly. Thus it is possible to select in which days the engine must be started for TEST. Attention: the periodic TEST is not related in any way with the manual or automatic use of the engine. It is possible that the engine has been used only a few minutes before, but the planned TEST will be performed any way. It is also possible to select a time interval (start and end hours) for the test. This time interval is common to all the days selected.The parameters related to this function are:

- **P.0418**: lets you specify in which days of week to perform the engine TEST. It is a bit-configurable parameter; each bit of the parameter corresponds to a day of week. The value you must set for the parameter is the sum of the value field of the following table for the days needed.

Bit	Value	Day of week
0	1	Sunday
1	2	Monday
2	4	Tuesday
3	8	Wednesday
4	16	Thursday

5	32	Friday
6	64	Saturday

For example, if you want to perform the TEST only on Monday and Thursday, you must set 18 (16+2).

- **P.0419**: lets you set start time for the TEST (Hours and minutes).
- **P.0420**: lets you configured the TEST duration (in minutes).

By P.0420 you configure duration instead of a time for the end of TEST. This is because the same parameter is used also for the TEST activated by an SMS command

9.14.2 Weekly planning for working 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 engine can start automatically. The planning is made weekly: it is so possible as many days of week as required, and also one time interval for enabling automatic intervention of the engine; this time interval will be the same for all selected days.

The parameters related to this function are:

- **P.0421**: lets you 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 week. The value you must set for the parameter is the sum of the value field of the following table for the days needed.

Bit	**Value**	**Day of week**
0	1	Sunday
1	2	Monday
2	4	Tuesday
3	8	Wednesday
4	16	Thursday
5	32	Friday
6	64	Saturday

- **P.0422**: lets you configure the start of the time interval into which the engine can start automatically (by hours and minutes).
- **P.0423**: lets you configure the end of the time interval into which the engine can start automatically (by hours and minutes).

Normally P.0422 will be set to a lower value than P.0423. Instead, if it contains a greater value, the board interprets that the time interval is configured across midnight: in this case, the time set by P.0422 is referred to the days selected by P.0421, while the time set by P.0423 is referred to the next days.

By example, if you want that engine can automatically start only on Monday and Friday, between 08:00 and 18:00, you must set:

P.0421=62 (2+4+8+16+32)

P.0422 = 08:00

P.0424 = 18:00

9.15 Thermometer

The board is provided with thermometer used to measure the internal temperature. The measure is shown on S.05 page of the multifunction display. It is used for many functions:

- The display becomes slower in showing information at very low temperatures. By using the thermometer, when the temperature falls under a very low threshold, the board switches on the backlight lamp of the display, and this contributes to warm it up and to improve its performances.
- The electronic components inside the board have an extended working temperature range. Despite this, it is possible in critical ambient conditions that temperature goes out of this range. The board uses the thermometer to activate a warning if the ambient temperature becomes greater than a configurable threshold. This is useful for alerting the operator, but is also possible to use one board configurable output for activate an external cooling system (by using the bit-mapping function you can configure one output to follow the state of the high internal temperature warning).
- For diagnosis purpose, the board stores in its history logs the most high and low temperature measured, by using also the internal clock. With this function, it is possible to examine in a second time the board working conditions, checking if it is necessary to install external warming/cooling systems, in order to improve the operating conditions.

9.16 Genset lock

By means remote communication (data or SMS) it is possible to send to the controller a command that inhibit the operation of the generator. Once locked, generator functionality can be restored only by means a special command issued from remote (data or SMS communication); the genset functionality cannot be restored removing supply to the controller. In this status the controller issues the alarm A012 to signal the lock status.

9.17 Non volatile memory

Controller has inside a non volatile memory, used to store various information, such as parameters, counters, etc. Memory is divided in some areas. At power up, the controller verifies the stored data in each area; in case at least one area has corrupted data, a message is shown on the display. This message contains a numeric code (hexadecimal value); each bit of this code represents a memory area. If the bit is set to 1 the area is not valid.

Area	Vers.	Bit	Value	Description
1	1.00	0	1 (0001)	Calibration values for controller measures.
2	1.00	1	2 (0002)	Various configuration information (language, display contrast etc.)
3	1.00	2	4 (0004)	Counters
4	1.00	3	8 (0008)	DTC from CAN-BUS archive.
5	1.00	4	16 (0010)	Fuel sensor calibration values.
6	1.00	5	32 (0020)	Peak values archive.
7	1.00	6	64 (0040)	Alternative programming parameter sets.
8	1.00	7	128 (0080)	Programming parameters

9	1.09	8	256 (0100)	“Loss of mains” protection trips and resets.

If, for example, the failure message at start-up shows 0004, that means the Counters was not valid but the other configuration are preserved. In case the value is 0081, that means that parameter area and various configuration area are not valid.

If any error is present, the power-up sequence is suspended until the operator acknowledges the error pressing the “ENTER + EXIT” pushbuttons. Pressing “ENTER + EXIT”, the controller will load the default values for the fault areas and then the power-up sequence will be resumed up to the normal operation (in this case, take in mind that some configurations or parameters are no longer valid and that generator functionality must be checked before operate).

If instead pressing “ENTER + EXIT”, the controller is powered off, no default values will be reloaded and at next power-up the same error will be detected.

9.18 Fault signaling

It is possible to configure the outputs from 5 to 14 with the function “41 – Device fault” (OF_41). The output is always activated: it can be not active only due to an internal fault of the controller. It can be use to signal a fault of the controller.

10. Installation

For a proper use of the device, it must be mounted in a fixed way onto a panel or cabinet. The rear panel of the device must not be accessible without using tools or keys. Must be impossible to remove the controller without tools.

DUE TO THE HIGH VOLTAGE CONNECTED TO THE MEASURE INPUTS, ALL THE CONDUCTIVE PARTS OF THE CABINET MUST BE CONNECTED TO SAFETY GROUND.

Protection ground must be permanently connected where required.

The external installation of over current protection is required for each mains and generator phase. The board input impedance of each mains and genset lines, in normal operating conditions, is greater then 1 Mohm. Over current protection of 1A threshold is suitable.

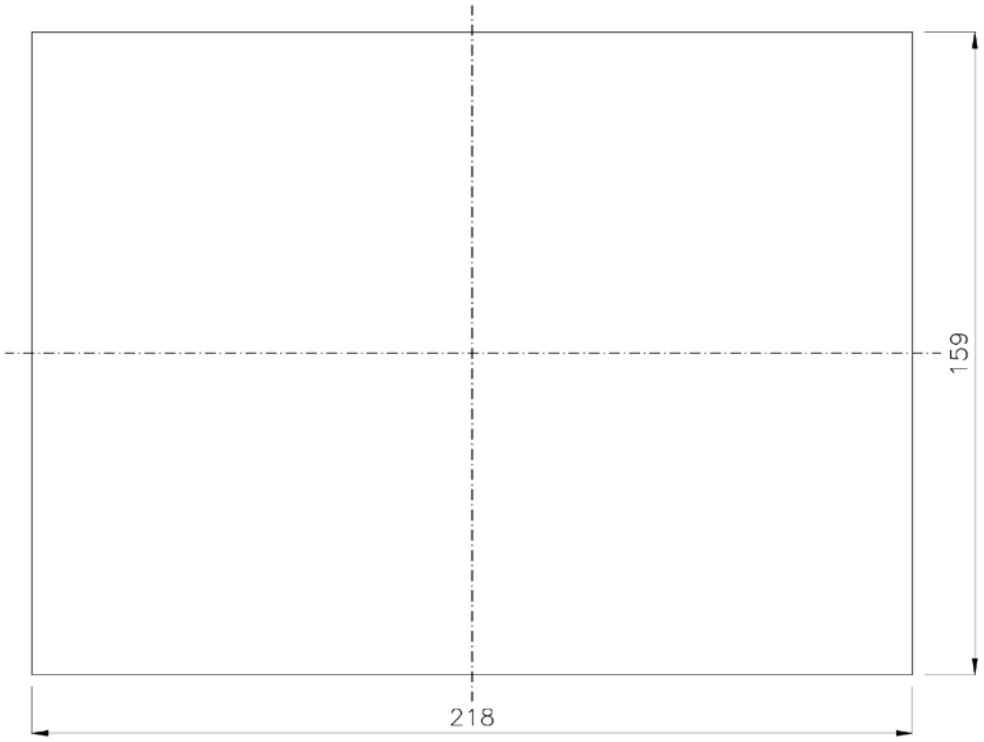
The safety heart connection wire, where used, must be at least equal in section as the wires used to cable the mains and generator voltage line to the board. The section of the wire must be conform to the over current protection value used.

For CAT.IV application, the max applicable voltage is 300Vac (phase-to-neutral) and 520Vac (phase-to-phase). The maximum voltage relative to safety ground is 300 Vac.

For CAT.III application, the max applicable voltage is 345Vac (phase-to-neutral) and 600Vac (phase-to-phase). The maximum voltage relative to safety ground is 600 Vac.

Controller can operate in CAT.IV and CATIII condition if the negative supply of the controller and generator’s neutral line are connected to the safety ground. In other cases, please, check with SICES the actual operating conditions.

10.1 Panel cut-out



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