mecc alte

POWER FROM WITHIN

DST4602 CONTROLLER

SMARTECH

TECHNICAL MANUAL

Revision	Date	Notes
00	28/03/2014	First review
01	26/11/2012	Controller firmware updated to version 00.15
03	18/04/2014	Controller firmware updated to version 00.39; full review of the manual.
04	20/06/2014	Controller firmware updated to version 00.40 7.5.1, 9.1, 10.8.57, 10.8.106, 10.8.204, 10.8.205, 11.2.3, 11.13, 11.14
05	12/01/2015	Controller firmware updated to version 00.48. 2, 4, 6.4, 6.5.4, 6.5.5, 6.5.7, 6.6, 6.6.3.2, 6.6.3.3, 6.6.3.4,6.6.4.7, 6.6.5.1, 6.6.5.3, 6.6.6.1, 6.6.6.2, 7.3, 7.4, 7.5.1, 8, 8.3, 8.4, 9.7.1, 9.7.3, 10.8.13, 10.8.202
06	10/03/2015	Controller firmware updated to version 00.50. 6.5.1, 6.6.3.19, 6.6.3.20, 6.6.3.21, 6.6.3.22, 10.8.561...10.8.578, 10.8.585...10.8.602
07	23/09/2015	Correction of par. 5.5.6 and 5.5.6.1.
08	03/11/2015	Controller firmware updated to version 00.62. 7.4
09	11/02/2016	Controller firmware updated to version 0.63. 6.6.4.9, 6.6.5.5, 7.5, 7.10, 8.3, 9.5.2, 9.5.4, 9.5.5, 9.6, 9.6.1, 9.6.2, 9.6.3, 9.6.4, 9.6.5, 9.6.6, 10.206
10	04/03/2016	Controller firmware updated to version 0.63. 7.4, 7.5.1, 9.1, 9.4.8.1, 10.1, 10.2, 10.4, 10.207, 11.14
11	28/07/2016	Controller firmware updated to version 0.71. 6.6.4.9, 6.6.4.10, 10.579, 10.580, 10.603, 10.604
12	04/10/2016	Updated to version 0.73 of the controller. 6.6.6.2, 6.6.6.4, 7.10, 9.4.9.2 Fixed the numeration of bits 7.3.4, 7.5.1, 7.8, 8.3, 9.1.1, 9.2.4, 9.3.5, 9.4.11, 9.4.13.5, 9.4.13.6, 9.7.9, 10.5, 10.105, 10.118, 10.132, 10.134, 10.135, 10.136, 10.137, 10.142, 10.144, 10.158, 10.159, 10.160, 10.198, 10.199, 11.2.1, 11.2.2, 11.2.3
13	04/10/2016	Updated to version 0.75 of the controller. 6.6.3.19, 6.6.3.20, 10.563, 10.579, 10.580, 10.581, 10.587, 10.603, 10.604, 10.605.
14	16/02/2017	Updated to version 0.80 of the controller. 5.5.5.1, 5.5.5.2, 5.5.5.3, 6.3, 6.5.1, 6.5.3, 9.4.6.7, 9.4.8.1, 9.4.8.2, 9.4.9, 9.7.4, 9.7.7, 10, 10.6, 10.7, 10-007, 10-901
15	26/07/2017	Updated to version 0.86 of the controller. 5.5.4.2
16	11/09/2017	9.4.5
17	13/11/2017	Updated to version 0.89 of the controller. 6.4, 6.6.3.18, 6.6.3.23, 6.6.4.1, 6.6.5.15, 6.6.5.16, 6.6.6.1, 7.4, 7.5.1, 8.3, 9.1, 9.2, 9.2.2.1, 9.2.3, 9.4.7, 9.4.11, 9.6.5, 9.6.6, 9.6.7, 10.57, 10.202, 10.276, 11.2.1, 11.2.4, 11.11.1
18	27/06/2018	Updated to version 0.98 of the controller. 7.5.1, 9.4.4, 10.8.39, 10.8.40, 10.8.50, 10.8.561...10.8.605
19	06/11/2018	Updated to version 1.02 of the controller. 5.7.1, 6.3, 6.6.3.2, 6.6.3.4, 6.6.5.17, 6.6.5.18, 6.6.5.19, 7.4, 7.5.1, 9.4.15, 10.8.221, 10.8.222, 10.8.223, 10.8.224, 11.1
20	27/03/2019	Updated to version 1.03 of the controller. 6.6.5.17, 7.5.1, 9.4.15, 10.8.221, 10.8.222, 10.8.223
21	19/04/2019	Updated to version 1.04 of the controller. 6.6.5.17, 6.6.5.18, 6.6.5.19, 7.10, 9.4.15.7.5, 9.4.15.9

Revision	Date	Notes
22	06/02/2020	Updated to version 1.10 of the controller. 6.6.3.3, 6.6.4.5, 6.6.5.2, 6.6.5.4, 7.4, 7.5.1, 8.3, 9.1, 9.2, 9.3.2.3.2, 9.4.3.1, 9.4.3.2, 9.5.9, 10.8.01, 10.8.02, 10.8.03, 10.8.48, 10.8.52, 10.8.56, 10.8.58, 10.8.59 Added paragraphs: 9.3.3, 9.8.5 and 11.15
23	13/07/2020	Updated to version 1.15 of the controller. 6.6.3.2, 6.6.4.11, 6.6.4.12, 6.6.5.18, 8.6, 10.8.62, 10.8.198, 10.8.199, 11.11, 11.11.1, 11.11.2
24	25/09/2020	Updated to version 1.15 of the controller. 10.8.204
25	26/05/2021	Updated to version 1.25 of the controller. 1.1, 1.5, 5.7.1, 6.4, 6.6.3.3, 6.6.3.4, 6.6.4.11, 6.6.4.12, 6.6.5.2…6.6.5.15, 7.4, 7.5, 7.7, 7.8, 7.10, 8, 8.2, 8.3, 8.6, 9.5.13.1, 9.5.15.x, 10.8.24, 10.8.97, 10.8.98, 10.8.271, 11.1, 11.2.5, 11.2.6, 11.10, 11.11.1, 11.11.2, 11.12
26	07/09/2021	Updated to version 1.26 of the controller. 5.5.7.1, 6.6.3.18, 6.6.4.8, 7.4, 7.5.1, 8.3, 9.6.6, 10.4, 10.8.96
27	19/01/2022	Updated to version 1.28 of the controller. 6.6.5.17…6.6.5.22, 7.4, 7.5.1, 8.3, 9.5.5, 9.5.16, 9.8.2.5, 10.8.95
28	02/02/2022	Updated to version 1.29 of the controller. 8.3
29	14/03/2022	Updated to version 1.31 of the controller. 10.279
30	24/03/2022	Updated to version 1.32 of the controller. 10.279
31	23/09/2022	Updated to version 1.36 of the controller. 6.6.5.19, 7.4, 7.5.1, 7.10, 11.11.2
32	14/11/2022	Updated to version 1.37 of the controller. 6.3, 6.5.1, 9.5.6.7, 9.5.8.1
33	03/03/2023	Updated to version 1.38 of the controller. 6.2, 6.3, 9.1

SUMMARY

1. Introduction

1.1 Reference documents

[1] Mecc Alte EAAM0380xx – DST4602 Parameters table

[2] Mecc Alte EAAM0396xx – DST4602 User's Manual

[3] Mecc Alte EAAM0199xx – DST46xx/GC500 Parallel Functions Manual

[4] Mecc Alte EAAS0394xx – DST4602 Modbus registers

[5] Mecc Alte EAAS0341xx – Serial Communication

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

[7] CAN open – Cabling and Connector Pin Assignment – CIA Draft Recommendation DR-303-1

[8] Mecc Alte EAAM0136xx – J1939 Interface User's Manual.

[9] Mecc Alte EAAS0117xx – Can Bus communication with motors.

[10] Mecc Alte EAAS0425xx – Can Bus communication with motors

[11] Mecc Alte EAAM0432xx – PLC Editor Manual

[12] Mecc Alte EAAM0412xx – PLC environment description for Mecc Alte equipment

[13] Mecc Alte EAAM046200IT – Ethernet TCP/IP – Quick Installation Guide

[14] Mecc Alte EAAM00458xx – Guide to BoardPrg4

1.2 Safety information

Many accidents are caused by poor knowledge and the non-observance of safety regulations, which must be observed when operating and/or servicing the machine.

To prevent accidents, before using or servicing the machine you should read, understand and observe the precautions and warnings in this manual.

The following words have been used to identify the safety messages contained in this manual.

WARNING! This word refers to the safety messages contained in this manual about potentially dangerous situations that, unless hazards are prevented, can lead to serious or fatal injuries.

These safety messages describe the usual precautions to be taken to avoid hazard situations. Ignoring these precautions can cause serious damage to property and/or injury to persons.

WARNING! This word refers to the safety messages about risks that, unless avoided, can lead to minor or moderate injuries or damage.

The message may also be used for hazards that can cause damage to property and/or injury to persons.

INFORMATION! This term implies the message provides information useful for performing the current operation, or explanations or clarifications for procedures.

1.3 General information

DST4602 is an automatic device for the control of a generator. It can manage and protect both engine and alternator. It integrates all the functionalities needed to manage the parallel of the generator both with other generators and with the mains. It can also be used for simple standby (emergency to mains) or prime-mover (stand-alone production) applications.

1.4 Requirements

The proper use of this manual requires a specific knowledge in genset use and installation and, in case of need, in parallel applications.

In this document there is not a detailed description of all the programming parameters: to this purpose see [1]. The user's manual [2] and the parallel functions manual [3] should be considered an integral part of this manual.

1.5 Notes on the configuration of the device parameters

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

It greatly simplifies the configuration of the device and its use is strongly recommended. It also allows you to save the current configuration of the device on a file and to reuse it on other identical devices,

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

BoardPrg4 [14] can be used on all the Mecc Alte devices; connection to the PC can be realized both directly, via the RS232 serial port, USB, or remotely via modem, RS485 serial port or Ethernet network. To use the program, refer to the related manual.

1.6 Definitions

1.6.1 Anomalies

DST4602 can report and manage all the anomalous conditions occurring during the working of the system. The anomalies are classified into four categories, according to their severity and based on the actions DST4602 performs to manage them:

- **Warning.** This term is used to indicate an anomaly that, under the circumstances, doesn't compromise the working of the generator: the operator should, anyway, take note of it, because sooner or later it could worsen in a more serious anomaly.
- **Unload**. This term is used to indicate an anomaly that requires the stop of generator. There aren't immediate risks either for the generator or for users. The intervention sequence is:
    - If the generator is connected in parallel with another generator or with the mains, DST4602 will gradually reduce to zero the power supplied by the generator.
    - Then, it will open the generator switch (GCB) and, if necessary, close the mains switch (MCB, where provided, if it has not been already closed).
    - The engine is kept running for a configurable time (without load) to allow its cooling cycle.

- In the end, DST4602 stops the engine.

- **Deactivation**. This term is used to indicate an anomaly that requires the stop of generator. There aren't immediate risks for generator, but there are potential risks for users, that, therefore, must be disconnected immediately from generator. The intervention sequence is:
  - DST4602 immediately opens the generator switch (GCB), regardless the power supplied in that moment. If necessary it closes mains switch (MCB, where provided, if not already closed).
  - The motor is left in action for a configurable time (without load), to allow its cooling (cooling cycle).
  - In the end DST4602 stops the engine.

- **Alarm.** This term is used to indicate an anomaly that requires the stop of generator. There are immediate risks for the generator, which therefore should be stopped immediately. The intervention sequence is:
  - DST4602 opens immediately the generator switch (GCB), regardless of the power supplied by the generator. If necessary it closes mains switch (MCB, where provided, if not already closed).
  - DST4602 stops the motor, without executing the cooling cycle.

1.1.1 Acronyms

AIF Identifies a function for configuring analogue inputs (“Analogue Input Function”). The number that follows the wording “AIF.” represents the code to be set in the parameter that configures the function of the desired analogue input.

AOF Identifies a function for configuring analogue outputs (“Analogue Output Function”). The number that follows the wording “AOF.” is the code to be set in the parameter that configures the function of the desired analogue output.

DIF Identifies a function to configure digital inputs (“Digital Input Function”). The number that follows the wording “DIF.” represents the code that should be set in the parameter that configures the function of the desired digital input.

DOF Identifies a function for the configuration of digital outputs (“Digital Output Function”). The number that follows the wording “DOF.” is the code that should be set in the parameter that configures the function of the desired digital output.

DTC Indicates a diagnostic code received from the engine control unit (ECU) via CAN-BUS (“Diagnostic Trouble Code”).

ECU Indicates the engine electronic control unit (“Engine Control Unit”).

EVT Identifies an event stored within the historical records. The number that follows the wording “EVT.” is the event numeric code.

GCB This term identifies the switch that connects the generator to users (or to the parallel bars for systems with more than one generator) (“Generator Circuit Breaker”).

MCB This term identifies the switch that connects mains to users (or to parallel bars if a switch MGCB doesn't exist) (“Mains Circuit Breaker”).

MGCB Indicates the switch that connects the parallel bars of the generator to users (“Master Generators Circuit Breaker”).

MPM	See the description of types of systems (par. [3].
MPtM	See the description of types of systems (par. [3].
MPtM + MSB	See the description of types of systems (par. [3].
MSB	See the description of types of systems (par. [3].
MSB + MSTP	See the description of types of systems (par. [3].
PMCB	Identifies the communication bus (owner of Mecc Alte) through which all devices share information in order to allow the parallel functions described in this document [3] ("Power Management Communication Bus").
SPM	See the description of types of systems (par. [3].
SPtM	See the description of types of systems (par. [3].
SPtM + SSB	See the description of types of systems (par. [3].
SSB	See the description of types of systems (par. [3].
SSB + SSTP	See the description of types of systems (par.[3].

1.7 Conventions

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

1.8 Firmware revisions

Several parts of this manual refer to the controller's firmware revisions. These revisions are marked with the assigned Mecc Alte code (shown on a label on the rear panel of the controller). Software code version has the following format: EB0220179XXYY, where XX is the main revision number and YY is the secondary revision number. Thus, code EB02201790001 refers to the controller's software release 0.01. DST4602 uses two different firmwares.

- EB0220179XXYY: for functional management.
- EB0220104XXYY: for user interface management.

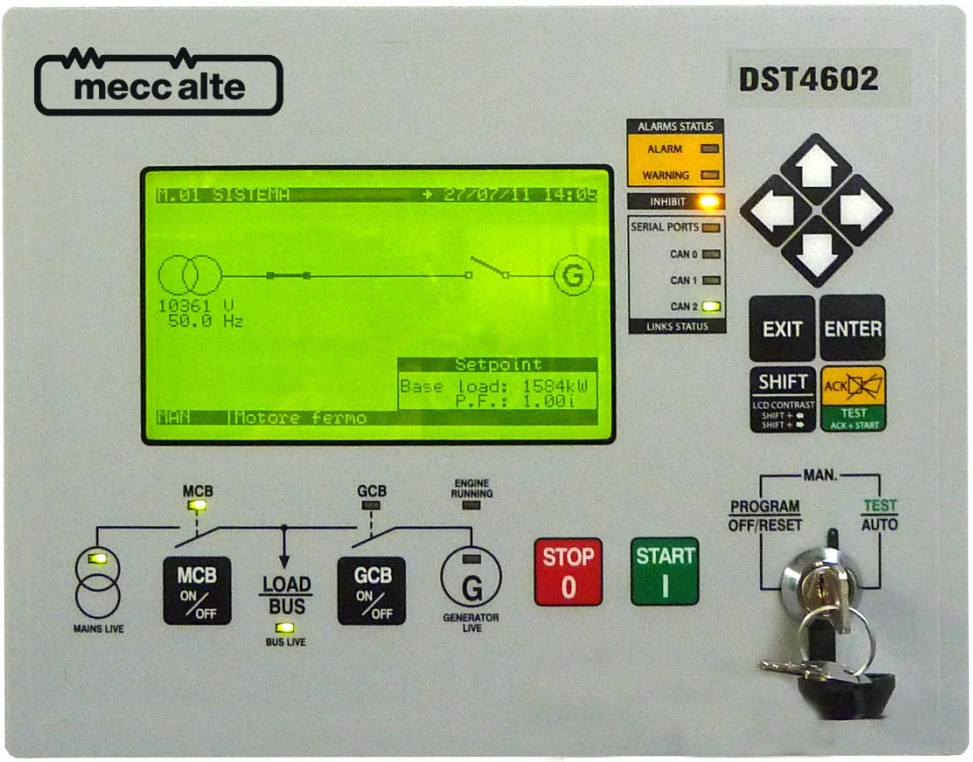
This controller is available in two models:

- A compact controller for panel mounting: **E61021351YYXX** DST4602.
- A two-components controller, with a panel mount command unit and an internal mounting control unit:
    - **EE61021361YYXX** DST4602 HMI (Human Machine Interface).
    - **E61021371YYXX** DST4602 SCM (System Control Module).

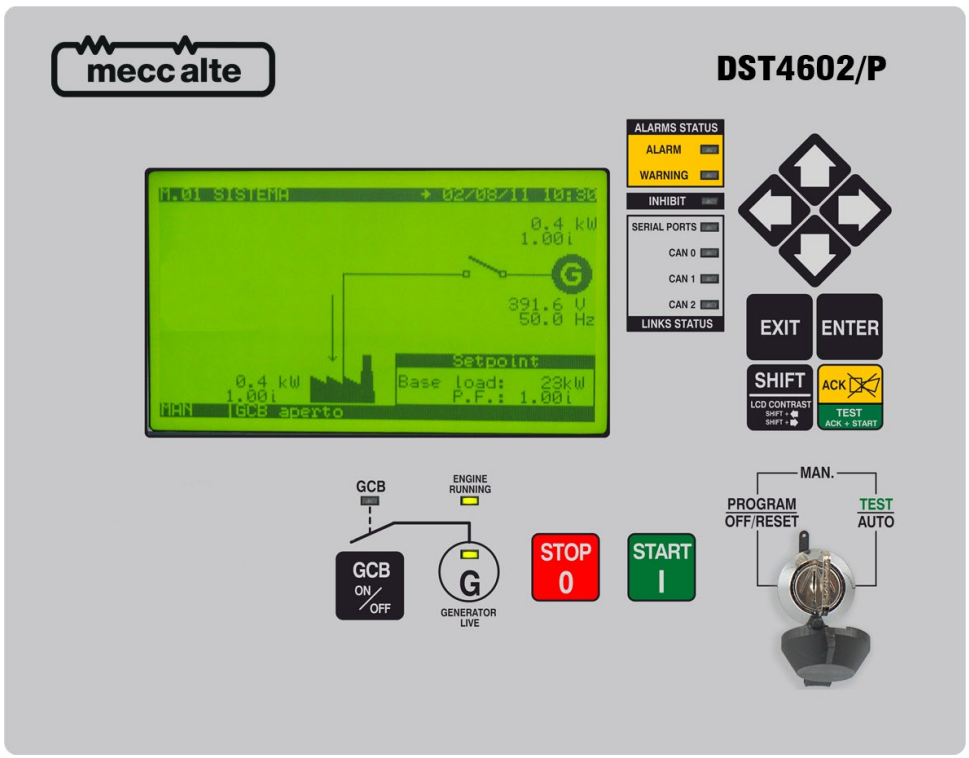
INFORMATION! In the above listed codes, the two YY characters can be replaced by a number showing the version. The last two XX characters can be replaced by a progressive number showing product or option revisions.

2. Views of the device

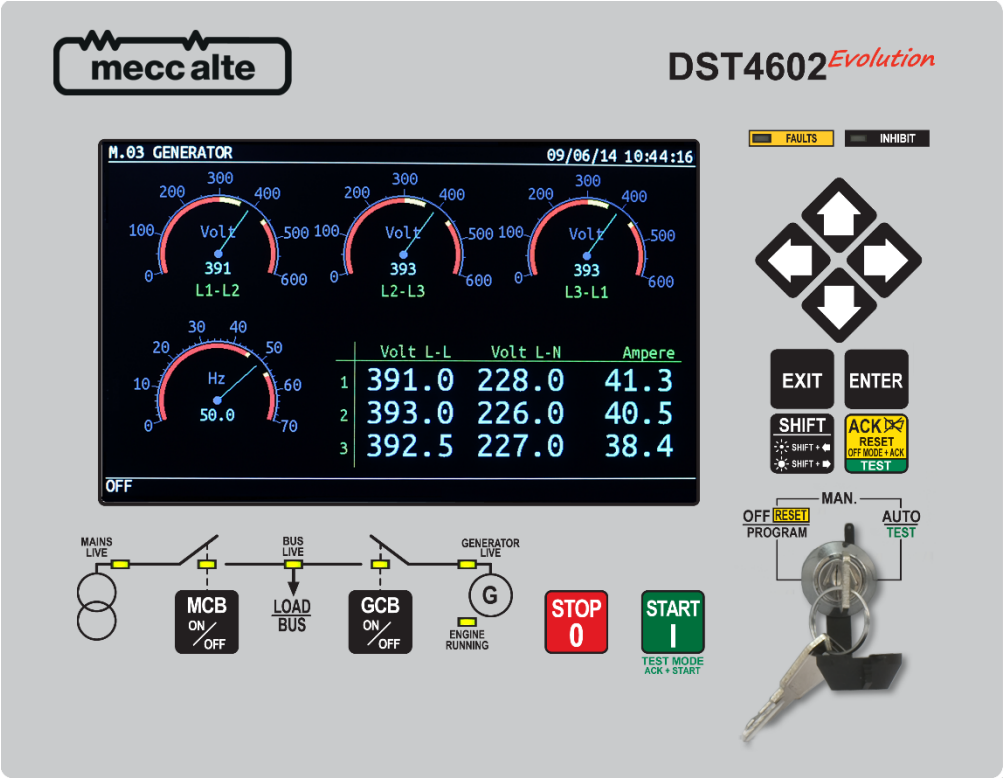
DST4602 and DST4602 HMI Front view:



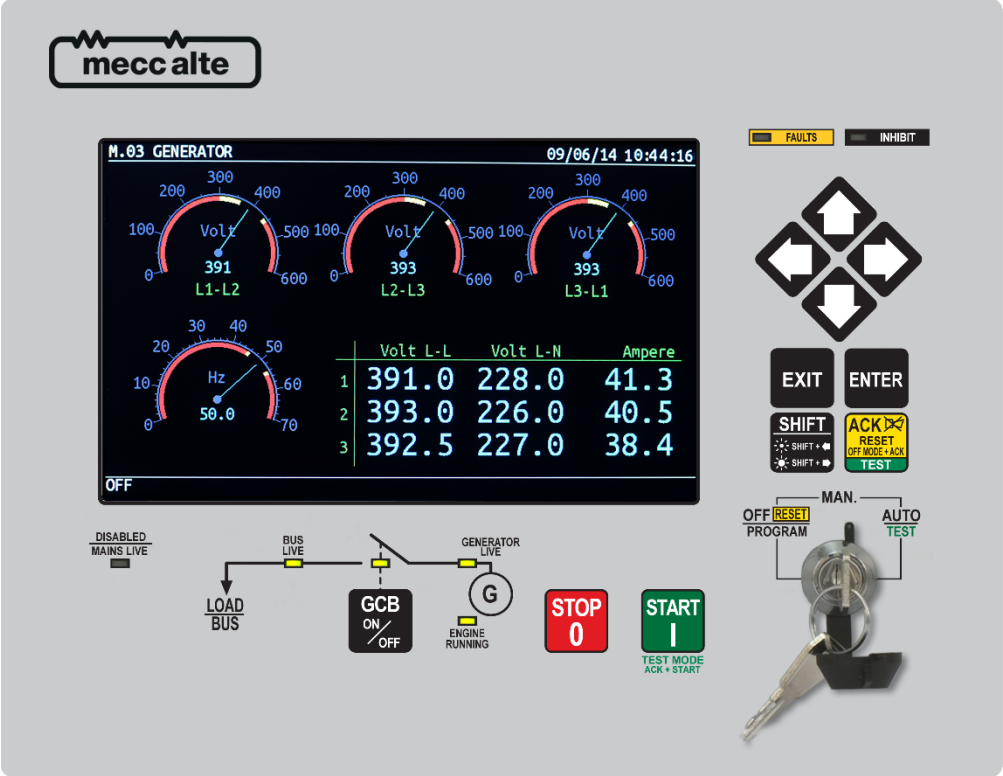
DST4602/P and DST4602/P HMI Front view:



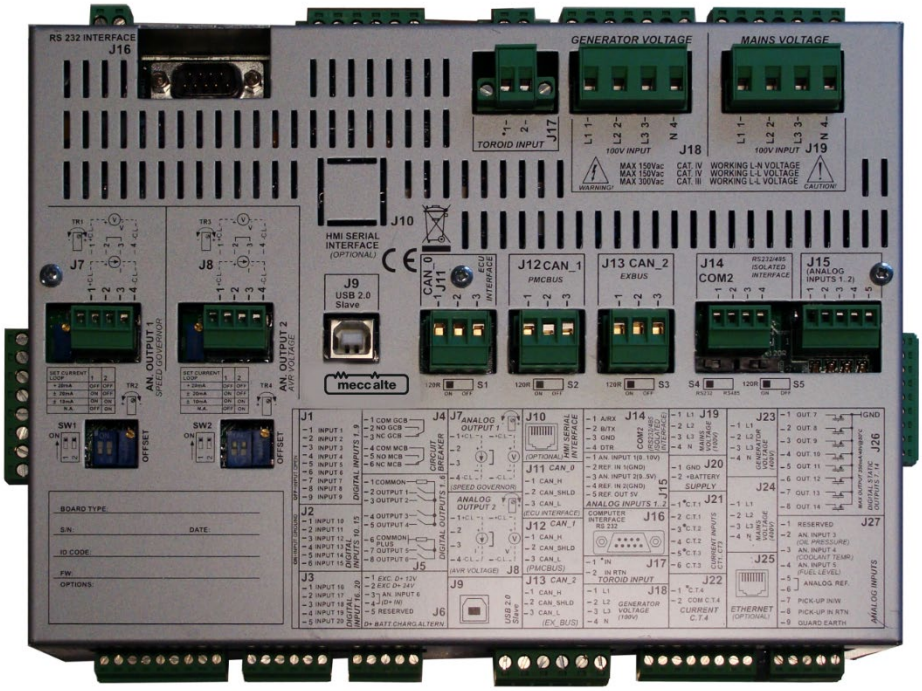
DST4602Evolution and DST4602Evolution HMI Front view:



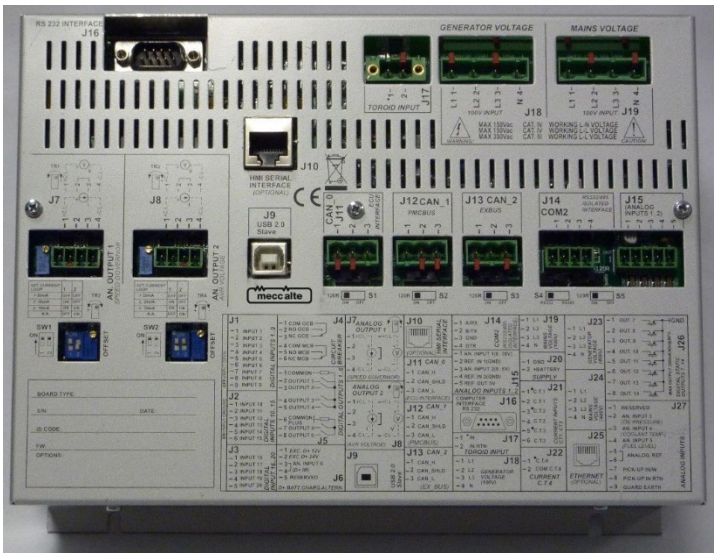
DST4602/P Evolution and DST4602/P Evolution HMI Front view:



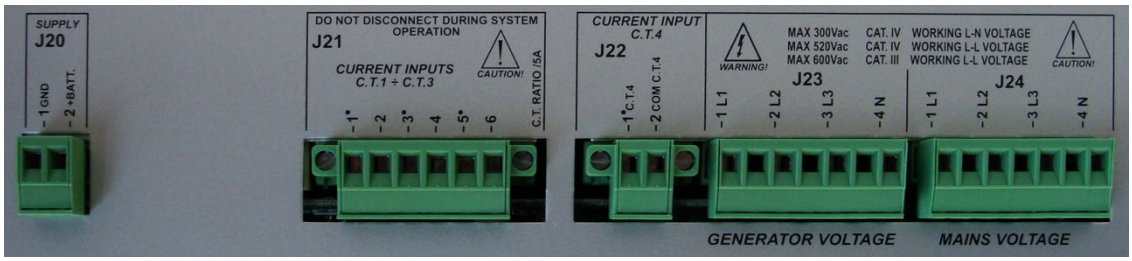
DST4602, DST4602/P, DST4602 Evolution, DST4602/P Evolution Rear view:



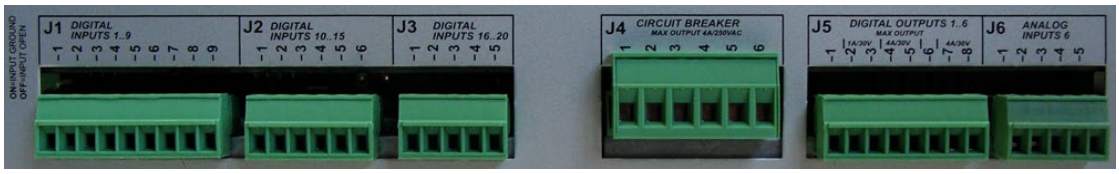
DST4602 SCM, DST4602/P SCM, DST4602 Evolution SCM, DST4602/P Evolution SCM Rear view:



Upper connectors view:



Lower connectors view:



3. Technical features

Supply power voltage Vbatt:	8…33VDC with continuous operation. Protection against polarity reversal with built-in self-resetting fuse. Functioning guaranteed during the starting of the engine, in accordance with the technical specification “ST SGS-THOMSON Microelectronics – Starter motor engagement disturbance”. The device identifies the plant operation at 12 or 24V, to manage its alarms when powered up and whenever OFF/RESET mode is selected. Resolution of the measurement of the battery voltage to 10 bits.
Power consumption in stand-by:	DST4602 or DST4602 SCM + HMI: 500mA @ VBATT = 13.5 VDC display lamp off 270mA @ VBATT = 27.0 VDC display lamp off Only DST 4602 HMI: 40mA @ VBATT = 13.5 VDC display lamp off 485mA @ VBATT = 13.5 VDC display lamp on 24mA @ VBATT = 27.0 VDC display lamp off 227mA @ VBATT = 27.0 VDC display lamp on
Maximum power consumption in operating condition (relays, alarm, LCD lamp and outputs 20mA):	DST4602 or DST4602 SCM + HMI: Max. 1100mA @ 13.5 VDC 585mA @ 27.0 VDC
Electric measurements for mains/generator set voltage and currents:	Analogue/digital conversion at 12bit; sampling frequency 10kHz. True RMS measurements (TRMS). Measurement of the L-N phase voltages and of the L-L concatenated voltages; measurements of the neutral voltages referred to the power supply minus of the device. Input impedance of the voltage measurements: >2,8 MOhm L-L and L-N >1,5 MOhm L-GND and N-GND Measure of three currents with internal CTs and common CT report, plus a fourth independent current with internal CT for Neutral current measurements or differential protection or mains power supply measure. It is required the use of current transformers with a secondary current of 1 to 5A and minimum power of 1VA. Internal amplifiers adaptive gain for measures of currents below 1A.
Maximum mains/generator voltages allowed:	400V nominal inputs: MAX 300Vac in CAT.IV for measures L-N MAX 520Vac in CAT.IV for measures L-L MAX 600Vac in CAT.III for measures L-L 100V nominal inputs: MAX 150Vac in CAT.IV for measures L-N MAX 150Vac in CAT.IV for measures L-L MAX 300Vac in CAT.III for measures L-L
Maximum currents allowed:	5Aac nominal values; possible sinusoidal transient voltage surges up to 20Aac with progressive loss of the measurement accuracy depending on the amplitude of the surge.

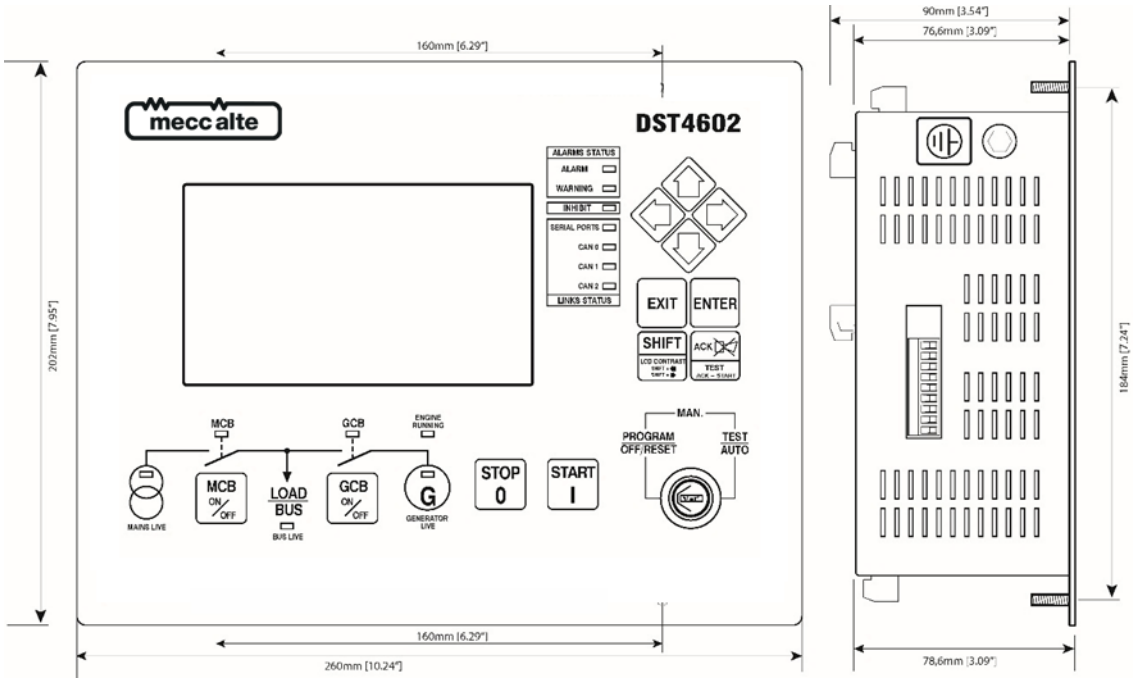
Frequency measurements:	50 or 60Hz nominal frequencies, measured by L1-L2 phase voltages both for the mains and for the generator, by only L1 for single-phase operation. For the generator the sensitivity of measurement is highest at low frequency to optimize the recognition of the started engine and decreases with frequency for higher interference rejection Minimum voltages for frequency detection: Input 100V: 14Vac L1-L2 @ 50Hz mains 15Vac L-N @ 50Hz mains 5Vac L1-L2 @ 50 Hz generator 1Vac L1-L2 @10 Hz generator 6Vac L1-N @ 50 Hz generator 1Vac L1-N @ 10Hz generator Input 400V: 25Vac L1-L2 @ 50Hz mains 50Vac L-N @ 50Hz mains 6Vac L1-L2 @ 50Hz generator 2Vac L1-L2 @10Hz generator 20Vac L-N @ 50Hz mains 2Vac L-N @ 10Hz mains
Digital inputs:	20 optically insulated digital inputs; activation with GND negative supply. When opened, the voltage on the input terminals is Vbatt. Activation/deactivation threshold 2.5VDC Typical current with closed contact: 5mA @ VBATT= 13.5VDC 10mA @ VBATT= 27.0VDC
Relay outputs:	Two relays with positive common input, max 4A @30VDC for starter motor and fuel solenoid valve. Self-restoring fuse and integrated opening power-surge protection diodes. Four relay outputs with a positive or negative common input: • Two with Imax 1A @30VDC • Two with Imax 2.5A@30VDC Two relay outputs with changeover voltage-free contacts to control the commutation of remote-control switches, max.10A @250Vac. All relay outputs are individually reconfigurable via parameter.
SSR outputs:	8 configurable active outputs to GND, each max. 350mA @ 30VDC direct and maximum total current for all outputs of 1.5A at 50°C; integrated thermal protection by overload, short-circuit and over-voltage protection. When not active, the outputs are floating.
Excitation output for recharge alternator +D:	Two dedicated outputs for 12VDC or 24VDC systems. Excitation maximum current: 280mA @ 13.5 VDC 135mA @ 27 VDC

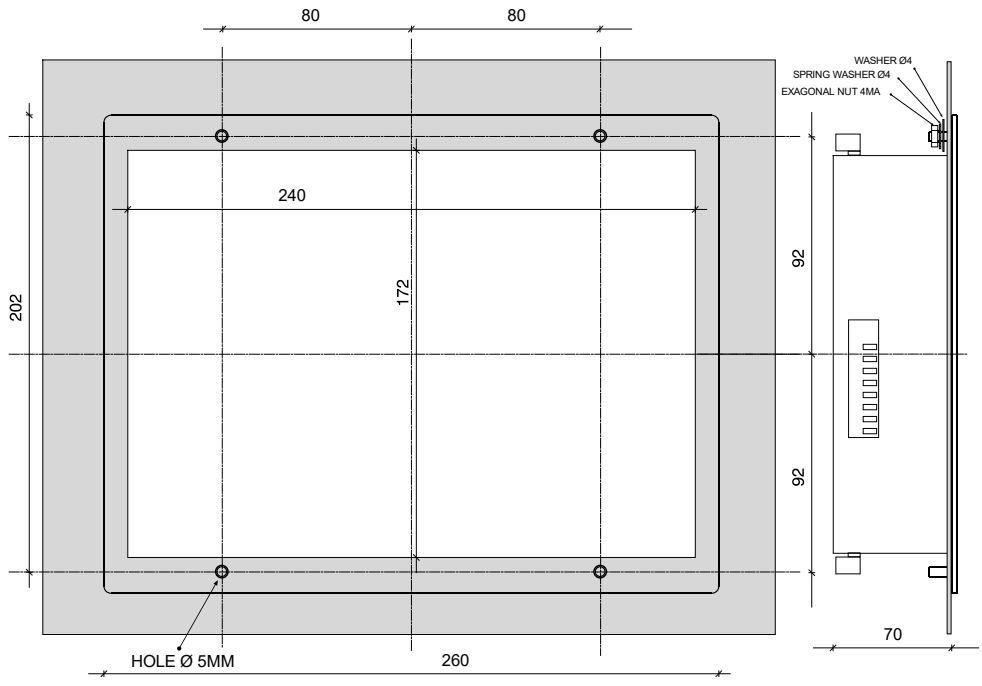
Engine instruments analogue inputs:	Three inputs for resistive sensors plus one input for measuring and compensation of the reference potential of their common minus. Measurement resolution of 10 bits. Resistance measuring range: Oil pressure AN. INPUT 3 max. 300/400ohm Coolant temperature AN INPUT 4 max. 1800/8000ohm Fuel level AN. INPUT 5 max. 400ohm For AN.INPUT 3 and AN.INPUT 4 two different measurement scales can be set. The three measurement inputs can also be used as digital inputs with GND activation. Common voltage compensation range of sensors: -2 / +1.8VDC @ 100ohm
Analogue inputs:	Input 0... 5V Input 0...10V Input impedance: 470kohm Measurement resolution of 10 bits. Both inputs offer the possibility of differential measurement to compensate the differences of negative measurement with reference to GND. Compensation range: Input 0... 5V - 5. /+7VDC Input 0...10V -10 /+9VDC There is a regulated and protected output at 5VDC (J15-5) used as reference for external potentiometers on the two inputs.
Pick-up input or signal W to measure engine speed:	Filtered for DC currents blocking. Minimum voltage 1.3Vac @ 3kHz Maximum voltage 60Vac. The measurement of the signal W requires an additional external filter.
Analogue outputs:	Two outputs with 14-bit resolution for engine speed and independent AVRs and both galvanically isolated and configurable from switches as: ± 20mA + 20mA ± 10mA Arrangement to transform them into voltage outputs via a jumper with values: ± 20V + 20V ± 10V Each configured output voltage has a 1kohm integrated trimmer to reduce maximum output voltage, while preserving the resolution of the signal. Offset adjustment by integrated trimmer
Display:	LCD transflective graphic, LED backlight, 125x72mm size, resolution 240x128
Degree of protection:	EXTERNAL IP 40 without optional gasket and closed key cap EXTERNAL IP 55 with optional gasket and closed key cap INTERNAL IP 20
Operating conditions:	From -25°C to +70°C
Storage Temperature:	From -30°C to +80°C

Size:	260(L)x202(H)x78.6(P)mm
Weight:	1670g DST4602 1285g SCM unit 950g HMI unit

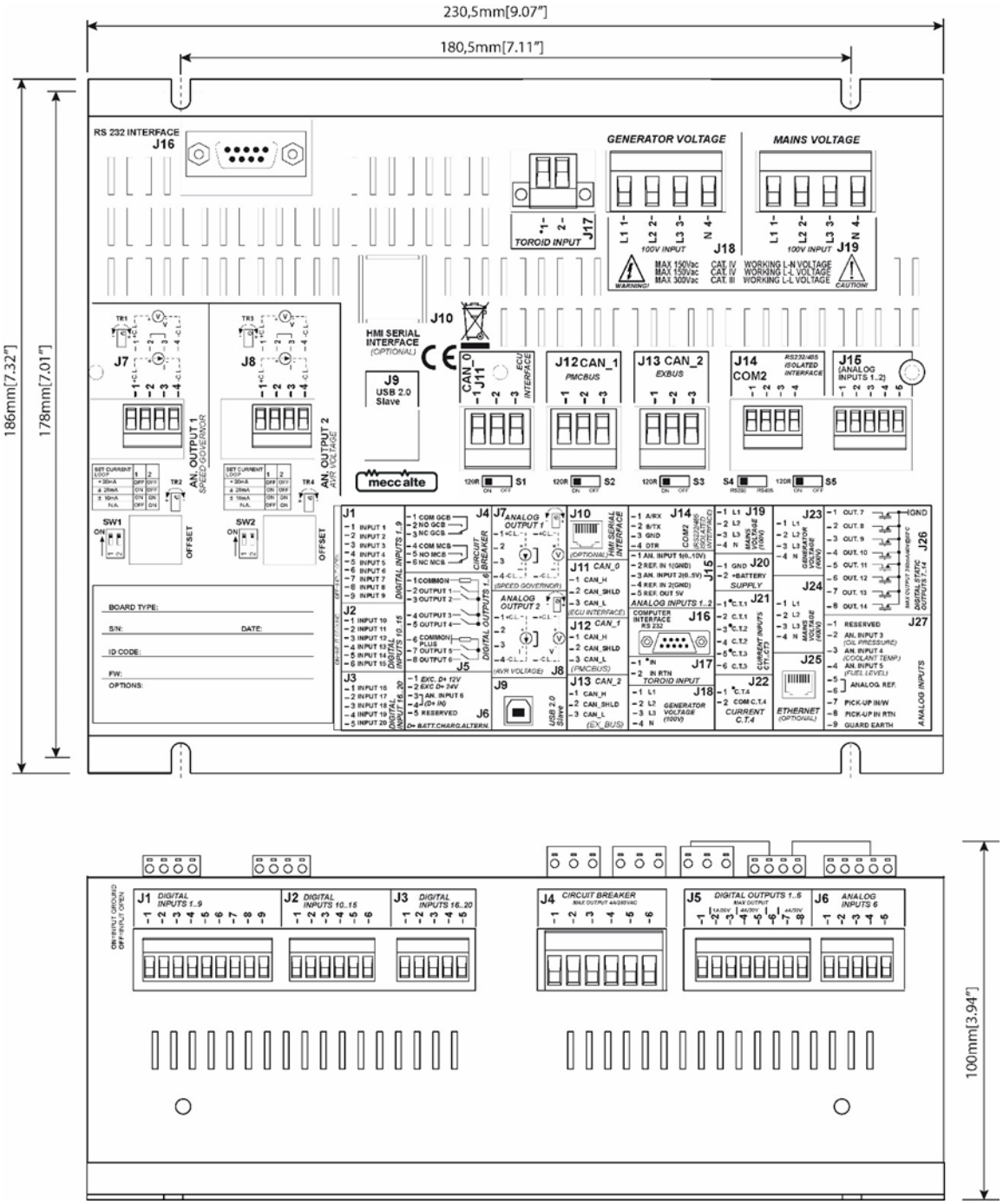
4. Installation

Dimensions and drilling scheme for the installation of the controller DST4602, DST4602/P, DST4602Evolution, DST4602/P Evolution compact model





Dimensions and drilling scheme DST4602 SCM, DST4602/P SCM, DST4602 Evolution SCM, DST4602/P Evolution SCM



5. Connections

WARNING! IT IS MANDATORY TO PERMANENTLY CONNECT THE HOUSING OF THE DEVICE TO EARTH through the suitable screws. The safety connection to earth should be implemented before any other connection.

Mecc Alte should not in any way be held responsible for damages to property or persons due to non-compliance with the requirements of installation and the safety connection to earth of the device.

WARNING! Proper use of the device requires permanent mounting in a panel or cabinet. Accessing device connections shall only be possible by means of specific tools or keys. Device removal shall only be possible by means of tools.

External installation of overcurrent protection is required for any mains/bars and generator phase. The controller input impedance of any mains/bars and genset lines, in normal operating conditions, is greater than 1 MOhm. A 1 A protection threshold is adequate.

The safety ground connection wire must have at least the same (or greater) cross section as the wires used to connect mains/bars and generator. The section of the wire must match the overcurrent protection value used.

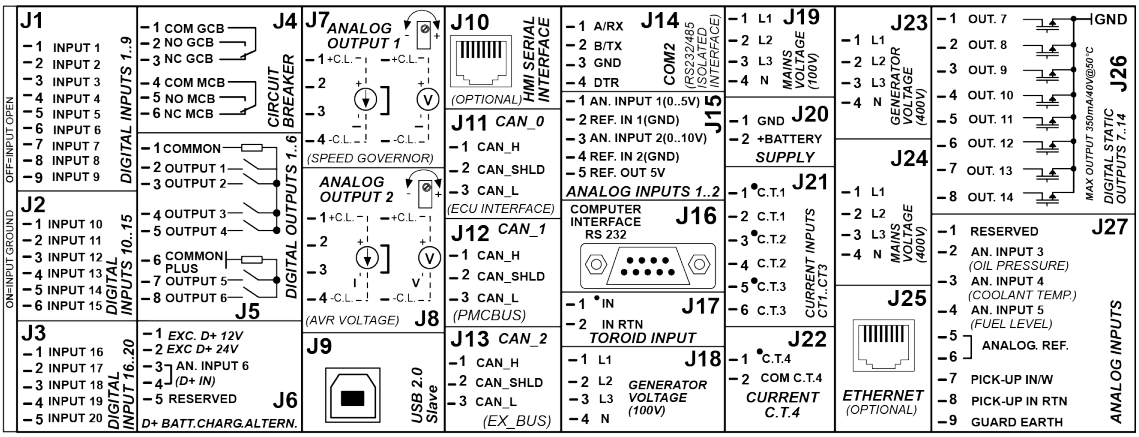
For CAT.IV applications, the auxiliary low voltage negative supply (terminal 1 of connector J20 GND) must be connected to ground. Otherwise, the operation conditions must be requested to S.I.C.E.S.

For CAT.IV applications, the max applicable voltage is 300 Vac (L-N phase-to-neutral) and 520 Vac (L-L phase-to-phase). Maximum voltage to ground is 300 Vac.

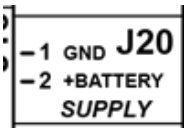
For CAT.III applications, the max applicable voltage is 345 Vac (L-N phase-to-neutral) and 600 Vac (L-L phase-to-phase). Maximum voltage to ground is 600 Vac.

For CAT.IV applications with the GCB contactor powered by generator, use phase L1 to power terminal 1 of connector J4.

Connectors topology



5.1 Device (J20) supply



The J20 connector is the supply connector: connect an uninterruptible power supply (usually the engine starter battery) to the 1-GND terminal (minus) and to the 2-+BATT terminal.

The minus terminal "1-GND" is the reference and the common return of the digital inputs, of the outputs and of the current and voltage measurements. **In principle it should be connected to protection earth.** Systems requiring isolation between battery minus and protective earth are nonetheless usable, but they may generate operating problems and could require special precautions, such as the use of insulating voltage transformers for the Mains and Generator voltage measurements.

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

Through "1- GND negative input" all the current that enters J26 static outputs flows.

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

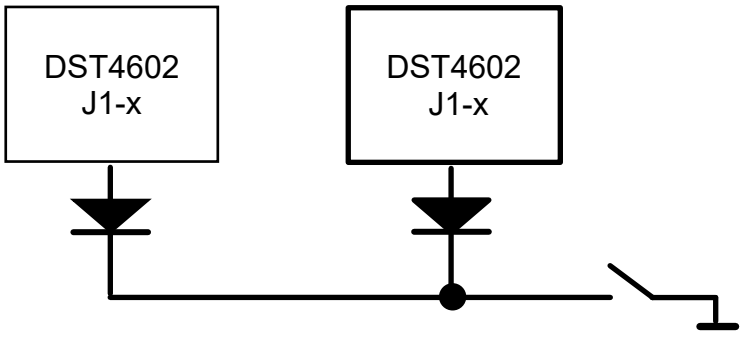
NB: during installation, connect the battery positive as final operation.

5.2 Digital inputs (J1/J2/J3)

DST4602 has a series of twenty optically insulated, fully configurable digital inputs. Connectors J1, J2 and J3 are the terminals of the inputs. The digital inputs are active when connected to the negative power of the board (GND); when not activated when they get to +VBATT.

If not used, it is possible to configure and use also J15 , J27 and J6- 3/4 analogue inputs as digital inputs (see paragraphs 5.5.5 and 5.5.6.2).

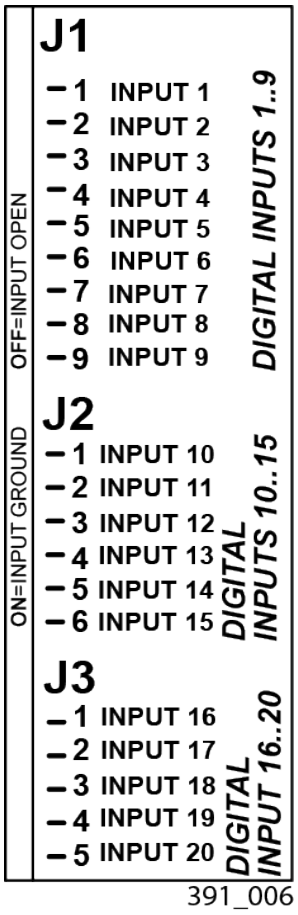
⚠ **Information! We recommend you use input serial diodes in case one or more devices have digital inputs connected in parallel. This expedient prevents false acquisitions of input status when a device is disconnected.**



For a list of assignable functions and for the configuration of the inputs, see paragraph 7.5

The following table shows factory pre-assigned functions to the inputs.

Terminal	Input	Pre-assigned function	
J1 - 1	Input 1	DIF.3001 - GCB switch status.	
J1 - 2	Input 2	DIF.3002 - MCB switch status.	
J1 - 3	Input 3	DIF.4201 - Emergency stop".	
J1 - 4	Input 4	DIF.3102 - Absence of voltage on the parallel bars.	
J1 - 5	Input 5	DIF.2501 - Genset operation inhibit.	
J1 - 6	Input 6	DIF.2031 – TEST mode request.	
J1 - 7	Input 7	DIF.0000 - Not used.	
J1 - 8	Input 8	DIF.0000 - Not used.	
J1 - 9	Input 9	DIF.0000 - Not used.	
J2 - 1	Input 10	DIF.0000 - Not used.	
J2 - 2	Input 11	DIF.0000 - Not used.	
J2 - 3	Input 12	DIF.0000 - Not used.	
J2 - 4	Input 13	DIF.0000 - Not used.	
J2 - 5	Input 14	DIF.0000 - Not used.	
J2 - 6	Input 15	DIF.0000 - Not used.	
J3 - 1	Input 16	DIF.4211 - Minimum fuel level.	
J3 - 2	Input 17	DIF.4212 - Low fuel level.	
J3 - 3	Input 18	DIF.3301 - Fuel level for pump start.	
J3 - 4	Input 19	DIF.3302 - Fuel level for pump stop.	
J3 - 5	Input 20	DIF.4213 - High fuel level.	



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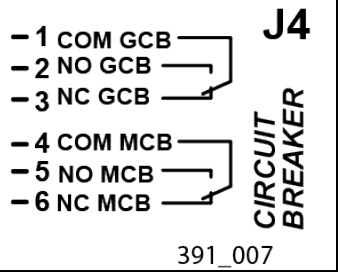
5.3 Digital outputs (J4/J5/J26)

DST4602 is equipped with a series of sixteen digital outputs, all fully configurable.

5.3.1 J4 outputs contactors controls

Changeover voltage-free contact relay outputs, max. **4A/250Vac**.

Terminal	Type	Function	Output	Pre-assigned function	
J4 - 1	Relay, 4 A 250 Vac	COM.	Output 15	DOF.2034 - GCB steady closing command.	
J4 - 2		N.O.			
J4 - 3		N.C.			
J4 - 4	Relay, 4 A 250 Vac	COM.	Output 16	DOF.2004 - MCB steady opening command.	
J4 - 5		N.O.			

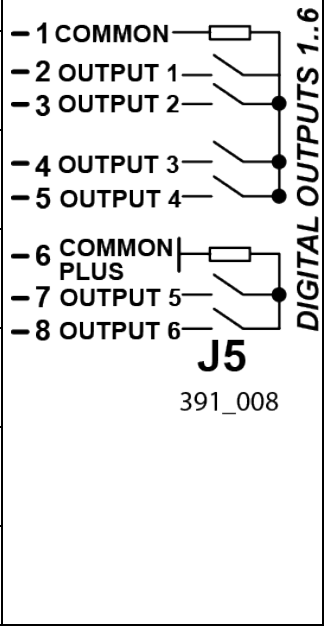
Terminal	Type	Function	Output	Pre-assigned function	
J4 - 6		N.C.			

5.3.2 Outputs J5

J5 outputs are divided into two groups, each with its own common terminal and each internally protected by a self-resetting thermal fuse. The function of each single output is independently configurable.

J5 -1 terminal is the common terminal for 1 ... 4 outputs; it can be connected to a positive voltage included between 0 and 30VDC, or it can be connected to GND.

J5-6 terminal is the common positive for J5-5 and J5-6 outputs (only a positive voltage can be connected to this terminal). Opening power-surge damper diodes are present internally. J5-5 and J5-6 outputs can be used by default for traditional engine start/stop controls.

Terminal	Type	Description	Pre-assigned function	
J5 - 1	Common Positive (max. 30VDC) or Common Negative (GND)	Common for 1 ... 4 outputs.		
J5 - 2	Live relay contact max. 1 A / 30 Vdc, N.O.	Output 1	DOF.1032 -Fuel pump.	
J5 - 3	Live relay contact max. 1 A / 30 Vdc, N.O.	Output 2	DOF.4034 - Fuel anomalies.	
J5 - 4	Live relay contact max. 1 A / 30 Vdc, N.O.	Output 3	DOF.3152 - External horn.	
J5 - 5	Live relay contact max. 1 A / 30 Vdc, N.O.	Output 4	DOF.1006 - Stop command.	
J5 - 6	Common positive (max. 30VDC)	Common for 1 ... 4 outputs (positive only).		
J5 - 7	Live relay contact max. 1 A / 30 Vdc, N.O.	Output 5	DOF.1005 - Engine start-up command.	
J5 - 8	Live relay contact max. 1 A / 30 Vdc, N.O.	Output 6	DOF.1003 – Fuel solenoid valve.	

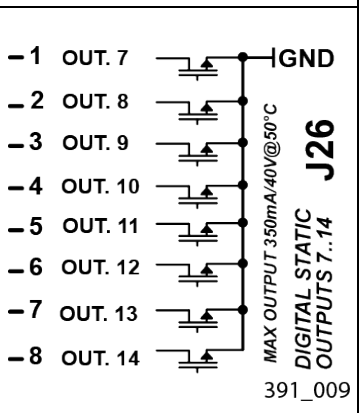
5.3.3 Outputs J26

The following table shows 7 through 14 outputs, available on J26 connector. They are "open drain" outputs, having internal overcurrent protection.

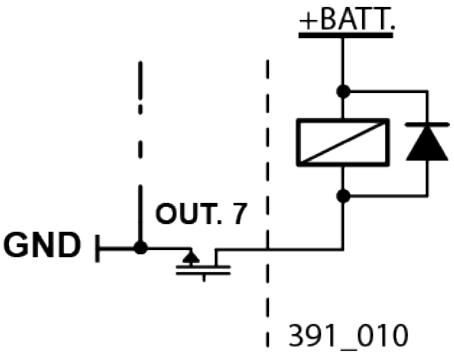
The maximum capacity of each output is 350mA. The overall maximum current for all J26 outputs should not exceed 1.5A.

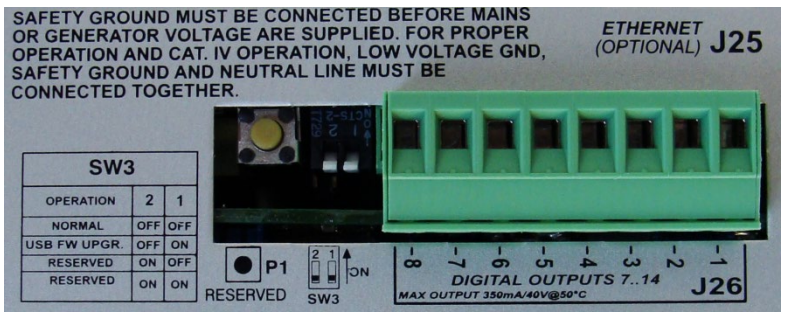
The function of each output is configurable independently.

When the outputs are active they connect the output terminal to the battery negative; if the outputs are not active, the related terminals are floating. The common current returning from the outputs goes through J20-1 terminal (GND).

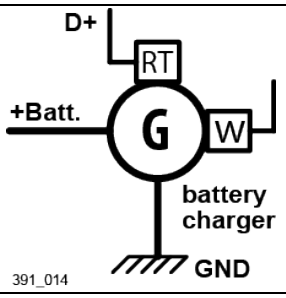
Terminal	Output	Pre-assigned function	
J26 - 1	Output 7	DOF.3061 - Engine running.	
J26 - 2	Output 8	DOF.4001 - Warnings.	
J26 - 3	Output 9	DOF.4005 - Alarms, deactivations and unloads.	
J26 - 4	Output 10	DOF.3011 - Is not in OFF/RESET	
J26 - 5	Output 11	DOF.3012 - One of the automatic modes	
J26 - 6	Output 12	DOF.4031 - Generator anomalies.	
J26 - 7	Output 13	DOF.4033 - Speed controller faults.	
J26 - 8	Output 14	DOF.4032 - Engine anomalies.	

Example of connection to one of 7... 14 outputs:





5.4 Outputs for the excitation of J6 battery-charger alternator

Terminal	Type	Function	
J6 - 1	Output max. 280mA	EXC +D 12V. Excitation output for 12V battery charger.	
J6 - 2	Output max. mA	EXC +D 24V. Excitation output for 24V battery charger.	
J6-3 J6-4	Voltage analogue input	Voltage measurement input +D	

When the controller starts the engine, the J6 terminal supplies the necessary power for energizing the battery recharge alternator.

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

The energizing command is activated on the engine start command.

Through J6- 3 and J6- 4 terminals (internally connected to each other), the board measures the voltage +D of the charging alternator, both during the starting of the engine and during its working. It is displayed in the S.16 page, under item 06.

The voltage measure can be used for two purposes:

- Engine running/stop detection
- Usually the recharge alternator is driven by the drive shaft through a drive belt. Normally, the drive belt also drives other mechanical components of the engine, for example the cooling fan of the radiator. If during engine operation the +D voltage of the recharge alternator drops below 0V or if it does not rise after start, once the P.0349 time is up, it is assumed that the belt is broken or at least that there is a malfunction and the DST4602 activates an anomaly that can be configured with the parameter P.0357 (as warning, unloading, deactivation or lock) to protect the engine from the lack of operation of the mechanical parts driven by the belt.

If not used, the voltage measurement input +D can be used for other functions by configuring it through P.4041 parameter (see paragraph 5.5.6).

5.5 Measure inputs

5.5.1 Generator voltages measure

DST4602 has two different connectors for the connection of generator voltage lines:

- **J23** for voltages up to 520 Vac (phase-to-phase) or 300 Vac (phase). For higher voltages, it is necessary to use voltmeter transformers.

- **J18** for voltages up to 100 Vac (phase-to-phase). This input should be used in case voltmeter transformers with secondary voltage equal to 100V are employed.

J18 and J23 measuring inputs cannot be wired and used simultaneously.

J23 - 1	400 V generator phase input L1
J23 - 2	400 V generator phase input L2
J23 - 3	400 V generator phase input L3
J23 - 4	400 V generator neutral input N

J18 - 1	Generator L1 phase input for 100 V VT
J18 - 2	Generator L2 phase input for 100 V VT
J18 - 3	Generator L3 phase input for 100 V VT
J18 - 4	Generator N neutral input for 100 V VT

The single-phase connection is also possible:

- Connect the phase (L) to terminal 1 of connector J23 or J18
- Connect the neutral (N) to 2 and 4 terminals of J23 or J18 connector.

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

The device, in three-phase connection, can function both with the neutral connection and without it; selection is performed through the P.0128 parameter. If the connection without neutral is selected, the board recreates a virtual neutral internally.

The values of the V1-N, V2-N and V3-N phase voltages and the VN voltage of the neutral in relation to GND for the generator are displayed on page M.03. If the device is configured not to measure neutral voltage, these measures are not displayed.

On both J18 and J23 connectors it is possible to use voltage transformers Aron insertion, which requires the use of only two transformers instead of three (see paragraph 5.5.3). It is necessary to set P.0128 in order not use the neutral connection:

5.5.2 Mains/bars voltages input (J23/J24)

DST4602 has two different connectors for mains or bars voltage lines connection:

- **J24** for voltages up to 520 Vac (phase-to-phase) or 300 Vac (phase). For higher voltages, it is necessary to use voltmeter transformers.
- **J19** for voltages up to 100 Vac (phase-to-phase). This input should be used in case voltmeter transformers with secondary voltage equal to 100V are employed.

J19 and J24 measurement inputs cannot be wired and used simultaneously

J24 - 1	400 V mains/bars phase input L1
J24 - 2	400 V mains/bars phase input L2
J24 - 3	400 V mains/bars phase input L3
J24 - 4	400 V mains/bars neutral input N
J19 - 1	Mains/bars phase input L1 for 100 V TV
J19 - 2	Mains/bars phase input L2 for 100 V TV
J19 - 3	Mains/bars phase input L2 for 100 V TV
J19 - 4	Mains/bars neutral input N for 100 V TV

The single-phase connection is also possible:

- Connect the phase (L) to terminal 1 of connector J24 or J19
- Connect the neutral (N) to 2 and 4 terminals of J24 or J19 connector.

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

The device, in three-phase connection, can function both with the neutral connection and without it; selection is performed through the P.0129 parameter. If the connection without neutral is selected, the board recreates a virtual neutral internally.

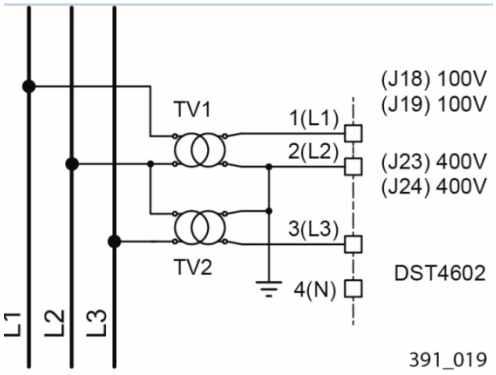
The values of the V1-N, V2-N and V3-N phase voltages and the VN voltage of the neutral in relation to GND for the mains are displayed on page M.02. If the device is configured not to measure neutral voltage, these measures are not displayed.

On both J19 and J24 connectors it is possible to use voltage transformers Aron insertion, which requires the use of only two transformers instead of three (see paragraph 5.5.3). It is necessary to set P.0129 in order not use the neutral connection:

5.5.3 Voltmeter transformers Aron insertion o

Both for the generator voltage measurement input and for mains/bars voltage measurement input it is possible to use voltage transformers Aron insertion; this allows using only two transformers instead of three. The connection is possible both on 100Vac and 400Vac inputs.

Aron connection principle scheme is the following:



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

5.5.4 Inputs for measuring currents (J21)

J21 clamp allows the acquisition of the three generator or user phase currents. Inside the board there are three current transformers with a rated current on the primary of maximum 5Aac. On the connector there are both the terminals of each current transformer. It is not necessary that the outputs of the transformers are connected to GND.

Terminal	Function
J21 - 1	Input CT1 (S1) 'hot' pole
J21 - 2	Input CT1 (S2) 'cold' pole
J21 - 3	Input CT2 (S1) 'hot' pole
J21 - 4	Input CT2 (S2) 'cold' pole
J21 - 5	Input CT3 (S1) 'hot' pole
J21 - 6	Input CT3 (S2) 'cold' pole

External current transformers can be connected to these terminals with a 5Aac or 1Aac secondary: the board manages internally an automatic changing of scaling that provides the same accuracy of measure with both types of transformer.

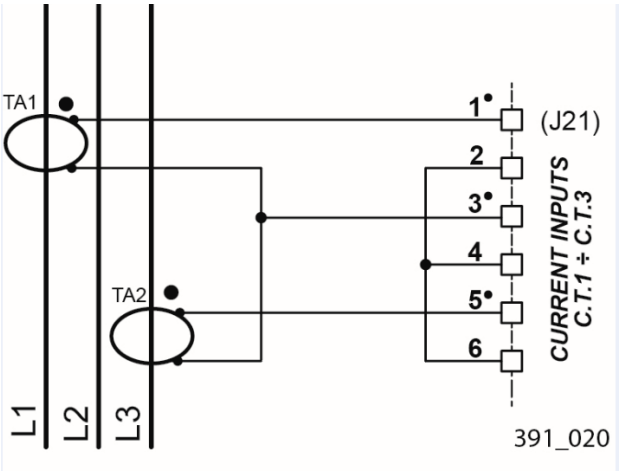
P.0107 and P.0139 parameters allow configuring the transformation ratio of external current transformers. For example, by using 50/5 current transformers, set P.0107= 50 and P.0139= 5.

P.0124 parameter instead allows indicating to DST4602 if the current transformers are connected to the generator lines (value "0") or to the user lines (value "1"). It may be useful, in fact, to connect current transformers to user's lines (instead of to generator lines) to be sure that the board measures load power also when it is connected to the mains. But this is only possible for the types of systems that do not include the parallel: for the only SSB system ("Single Stand By", system composed of a single group that acts as emergency service to the mains and that does not allow parallel with the same mains).

5.5.4.1 Aron insertion for current transformers

It is possible, regardless of the connection of voltmeter transformers, to connect the current transformers configured as Aron insertion. This allows using two current transformers instead of three.

The connection scheme is the following:



5.5.4.2 Inputs for the measurement of the auxiliary current (J22 / J17)

The board can make a fourth measurement of the current (AC). For this purpose, two connectors are provided, but that should be used alternatively. The internal measurement circuit, in fact, is in part in common to the two connectors. Use J22 connector to connect a current transformer to the board; use J17 connector to connect a toroid to the board.

Use P.0109 parameter to indicate to the board which connector has been used:

- P.0109=0. J22 connector (current transformer).

Terminal	Function
J22 - 1	Input CT4 (S1) 'hot' pole
J22 - 2	Input CT4 (S2) 'cold' pole

To these terminals an external current transformer with a 5Aac or 1Aac secondary can be connected: the board manages internally an automatic scaling that ensures the same measurement accuracy with both types of transformers.

P.0108 and P.0140 parameters allow configuring the transformation ratio of the external current transformers. For example, if a 60/5 current transformer is used, set P.0108=60 and P.0140=5.

- P.0109=1. Connector J17 (toroid).

Terminal	Function
J17 - 1	IN Input
J17 - 2	RTN Input

The transformation ratio of the toroid should be configured on the board via P.0108 and P.0140 parameters. For example, if a toroid with a transformation ratio of 700 is used, set P.0108=700 and P.0140=1.

Regardless of the type of used external transformer, it is then necessary to further configure the board to determine how to acquire the measurement and which type of measurement was acquired.

P.0130 parameter allows indicating to the board where the transformer that acquires this measurement of current was placed:

- P.0130 = 0. The transformer is connected in some way to the generator lines. It is the most common case: use this configuration, for example, when it is necessary to measure the current that circulates on the neutral line, or to measure the current between neutral and earth.
- P.0130 = 1. The transformer is connected in some way to user lines. It is a hardly used case, as it applies to SSB systems only (see note in previous paragraph). It could be used, for example, to make a differential protection on the user line instead of on the generator line.
- P.0130 = 2. The transformer is connected in some way to the mains lines. Use this configuration if it is required, for example, which the board can measure the power that circulates on a mains phase.

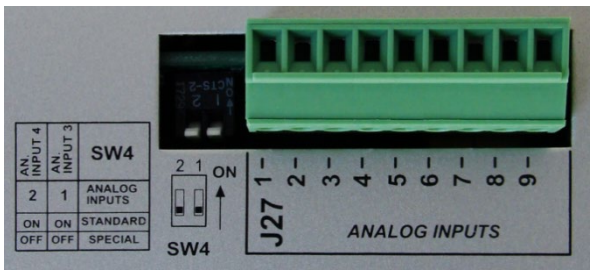
The most important parameter to set is, however, P.0131 parameter, which helps to determine what type of current measurement it is necessary to perform:

- P.0131 = 0 (“Not used”). The board disables the measure of the fourth current, which will then not be displayed.
- P.0131 = 1 (“General use”). The board displays the measurement of current carried out on M.06 page with the wording "Auxiliary current".
- P.0131 = 2 (“Neutral on the generator”). The board displays the measurement of current carried out on M.03 page, by identifying it as “An”. Moreover, if the measurement is acquired by a current transformer (not by a toroid) identical to those used for measuring phase currents (same primary, same secondary and positioned on the same source), the board also calculates the instantaneous sum of the four currents and displays it on M.03 page with the wording "AΣ". Starting from version 00.86, the board calculates the instantaneous sum even if the current transformers are not identical (different primary and/or different secondary).
- P.0131 = 3 (“differential protection”). The board performs the measurement already as a differential current (already as the sum of the four currents of the generator). It displays it on M.03 page with the wording "AΣ".
- P.0131 = 4 (“Power measurement on mains”). The board interprets the measurement as the current circulating on phase L1 of the mains and displays it on "M.06" page with the wording "Mains current". If its three-phase sensor is configured to measure mains voltages, the board also calculates the active power circulating on L1phase of the mains (kW, negative if the power is yield to the mains). Finally, for three-phase systems, it multiplies three times the

calculated power if the load is evenly distributed over the three phases. If it is not the case, it is possible to apply a correction factor (P.0132), which allows increasing the calculated power (if P.0132 > 1) or reducing it (if P.0132 <1) to ensure that it is as close as possible to the actual one. This power measurement on the mains can be used to manage "IMPORT/EXPORT" function (see [3]).

If the measure of the fourth is used (P.0131 > 0), the board allows setting a threshold and a time delay (P.0367 and P.0368) and activating an anomaly in case the measure is too high (A045). Note: if P.0131 is set to "2", the protection does not affect the measured current but the calculated differential current.

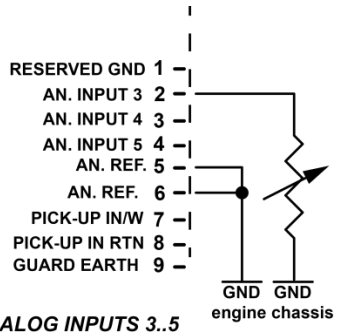
5.5.5 Resistive analogue input (J27-2, J27-3, J27-4, J27-5/6)



Terminal	Type	Function
J27 - 2	Resistive sensor input	OIL PRESSURE / *ANALOGUE INPUT 3.* Input for engine lubrication oil pressure measure (VDO sensors support is standard). By using the "Controller Programming" software, ver. 3.0 or higher", it is possible to create a measure curve, according to sensor's manufacturer specs or customized.
J27 - 3	Resistive sensor input	COOLANT TEMP. / *ANALOGUE INPUT 4.* Input for engine coolant temperature measure (VDO sensors support is standard). By using the "Controller Programming" software, ver. 3.0 or higher", it is possible to create a measure curve, according to sensor's manufacturer specs or customized.
J27 - 4	Resistive sensor input	FUEL LEVEL/*ANALOGUE INPUT 5.* Input for fuel level measure (VDO sensors support is standard). By using the "controller Programming" software, ver. 3.0 or higher", it is possible to create a measure curve, according to sensor's manufacturer specs or customized.
J27 - 5	Voltage measure input	ANALOGUE REF. Input for the measurement of the reference voltage of the engine mass the measuring sensors are connected to, with reference to GND earth of the board used for the measurement.
J27 - 6		Use a conductor, of adequate section, having the same equipotential of the engine chassis to connect sensor reference earthing.

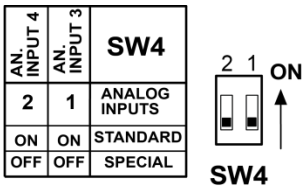
DST4602 has three inputs for resistive sensors, J27-2, J27-3 and J27-4, plus a fourth input for the measurement of the reference potential of the J27-5/6 sensor common (internally connected to each other).

The connection of the sensors is the following:



ANALOG INPUTS 3..5

"ANALOGUE INPUT 3" and “ANALOGUE INPUT 4" inputs have the maximum measurable selectable resistance value. It is necessary to act on SW4 switch and on the configuration parameters of the inputs (see description in the following paragraphs):



391_011A

If not used to acquire the sensors, the three inputs can be configured as additional digital inputs; in this case the input is activated by closing the respective terminal to GND and it is configurable as all other digital inputs (see par. 7.5).

To resistive inputs, in addition to those provided when configured to acquire oil pressure, coolant temperature and fuel level, it is possible to associate additional further thresholds and identifying notices (see par. 7.8).

5.5.5.1 ANALOGUE INPUT 3 J27-2 input (OP Oil Pressure)

The input has a selectable usable resistance measuring range:

- SWITCH SW4_1 ON and P.0136=0 parameter >> full scale =300 Ohm
- SWITCH SW4_1 OFF and P.0136=1 parameter >> full scale =400 Ohm

The typical use of this input is the measure of engine oil pressure; if not used for this purpose, it can be configured via P.4017 parameter as:

- AIF.0000 – “Not used”
- AIF.0100 – “Used as digital input”
- AIF.1000 – “Oil pressure VDO”
- AIF.1001 – "Oi l pressure (generic)"

AIF.1001 function - "Oil Pressure (generic)" implies the use of a conversion curve (see par. 7.7). Starting from version 00.76, this input can be used to acquire any kind of measure (not only the oil pressure). See document [1].

5.5.5.2 ANALOGUE INPUT 4 J27-3 input (CT Coolant Temperature)

The input has a selectable usable resistance measuring range:

- SWITCH SW4_2 ON and P.0137=0 parameter >> full scale =1800 Ohm
- SWITCH SW4_2 OFF and P.0137=1 parameter >> full scale =8000 Ohm

The typical use of this input is the measurement of the engine coolant; if not used for this purpose, it can be configured via P.4025 parameter as:

- AIF.0000 – “Not used”
- AIF.0100 – “Used as digital input”
- AIF.1100 – “Oil temperature (VDO)”
- AIF:1101 – “Oil temperature (generic)”
- AIF.1110 – "Coolant temperature (VDO)"
- AIF.1111 – "Coolant temperature (generic)"

AIF.1101 function - "Oil temperature (generic)" and AIF.1111 function - "Coolant temperature (generic)" imply the use of a conversion curve (see par. 7.7). Starting from version 00.76, this input can be used to acquire any kind of measure (not only the oil/coolant temperature). See document [1].

5.5.5.3 ANALOGUE INPUT 5 J27-4 input (FL Fuel Level)

The input has a full scale of fixed 400 Ohm.

The typical use of this input is the measurement of the fuel level through a float or at least a resistive sensor. If not used for this purpose, the input can be configured via P.4033 parameter:

- AIF.0000 – “Not used”
- AIF.0100 – “Used as digital input”
- AIF.1100 – “Oil temperature (VDO)”
- AIF:1101 – “Oil temperature (generic)”
- AIF.1200 – "Oil level (VDO)"
- AIF.1201 – "Oil level (generic)"
- AIF.1210 – "Coolant level (VDO)"
- AIF.1211 – "Coolant level (generic)"
- AIF.1220 – "Fuel level (VDO)"
- AIF.1221 – “Fuel level (generic)”

AIF.1101 function - "Oil temperature (generic)" - AIF.1201 function - "Oil level (generic)" AIF.1211 function - "Coolant level (generic)" and AIF.1221 function - "Fuel level (generic)" imply the use of conversion curves (see par. 7.7). Starting from version 00.76, this input can be used to acquire any kind of measure (not only the oil/coolant/fuel level). See document [1].

5.5.5.4 J27-5/6 Input (ANALOGUE REFERENCE)

The dual J27-5 and J27-6 "ANALOGUE REFERENCE" input (the two pins are internally connected to each other) is not a true measurement input, but it is used along with three inputs for resistive sensors. Its purpose is to compensate for the lack of equipotentiality between electric earthing of the device (J20-1 GND terminal) and of the electric panel and electric earthing of the genset, usually generated by the voltage drop on the connection cables; particularly, this happens when the connections between electric panel and engine are long and when there is a power flow in the battery minus and earthing connections, for example due to the presence of the battery recharge device inside the electric panel.

The system can efficiently compensate for both positive and negative potentials, ranging between -2 Vdc and +1.8 Vdc, with sensors resistance values of 100 ohm. The range of compensation increases for lower resistance values and decreases for higher values of resistance, being optimized for the resistance values of the sensors in normal operating conditions of the system.

The measurement of voltage with reference to GND terminal is displayed on S.16 page in the first line under the wording “VREF”. The measuring range of the system (and therefore the indicated value) may be higher than the useful one for the compensation indicated above.

The input measures the potential of the common ground point (negative) of the resistive sensors, which for the sensors mounted on the engine is represented directly by the engine itself or the chassis of the genset; the connection can therefore be connected to a grounding system or to a bolt on the engine. If the minus of one or several sensors is isolated from the engine or the genset chassis, for example in the case of floats for fuel level measurement mounted on the plastic tanks or electrically separated from the genset, you need to connect the “ANALOGUE REFERENCE” input to the return of the sensor and also to the negative electric mass of the engine or to the negative limit of the starting battery.

5.5.6 Voltage analogue inputs (J15-1, J15-3 2, J6-3/4)

Terminal	Type	Function
J15 - 1	Measure input	*ANALOGUE INPUT 1 (0...5V):* Analogue measurement input with voltage 0 to 5 Vdc with earthing reference dedicated to terminal 2 of J15.
J15 - 2	Reference J15-1 input	Reference ground input dedicated to ANALOGUE INPUT 1.
J15 - 3	Measure input	*ANALOGUE INPUT 2 (0...10V):* Analogue measurement input with voltage 0 to 10 Vdc with earthing reference dedicated to terminal 4 of J15.
J15 - 4	Reference J15-3 input	Reference ground input dedicated to ANALOGUE INPUT 2.
J15 - 5	Reserved (+5 V)	Output with reference voltage +5 Vdc exclusively reserved to the connection of trimmer/potentiometer reference for ANALOGUE INPUT 1 (0 ... 5V) and ANALOGUE INPUT 2 (0 ... 10V); minimum resistance between +5 V (J6 -5) and GND (J27 -1) = 10kohm. Example: fine adjustment of engine speed or deliverable power **Warning**: Only use for trimmer/potentiometer connection inside the power switchboard.
J27 - 1	Reserved (internal GND)	GND output reserved only for analogue inputs trimmer/potentiometer reference connection - minimum resistance between +5 V (J6-5) and GND (J27-1) = 10kohm Example: fine adjustment of engine speed or deliverable power
J6-3 J6-4	Measure input	ANALOGUE REFERENCE: voltage instrument input +D with reference to J27-5/6 terminals.

DST4602 has three inputs for the measurement of voltage signals.

Two are specific ("ANALOGUE INPUT 1" for signals 0 ... 5 Vdc and "ANALOGUE INPUT 2" for signals 0 ... 10 Vdc), and one ("ANALOGUE INPUT 6") uses the measurement input of the signal +D if it is not used for the excitation of the charge alternator.

"ANALOGUE INPUT 6" uses as earthing reference J27-5/6 "ANALOGUE REFERENCE" terminals, which, for the correct use of the resistive sensors, should be connected to earth (negative) on the engine. If the resistive sensors are not used, connect one of the two J27-5/6 terminals to GND. "ANALOGUE INPUT 6" can be used to measure voltages up to 32 Vdc; its function is configurable with P.4041 parameter.

"ANALOGUE INPUT 1" and "ANALOGUE INPUT 2" provide for the possibility to perform the measurement of the signal in differential, to compensate for any non-equipotentiality of the earthing of the signal source with reference to GND. Maximum common-mode voltages are:

- -10 /+9Vdc for ANALOGUE INPUT 1.
- -5/+7Vdc for ANALOGUE INPUT 2.

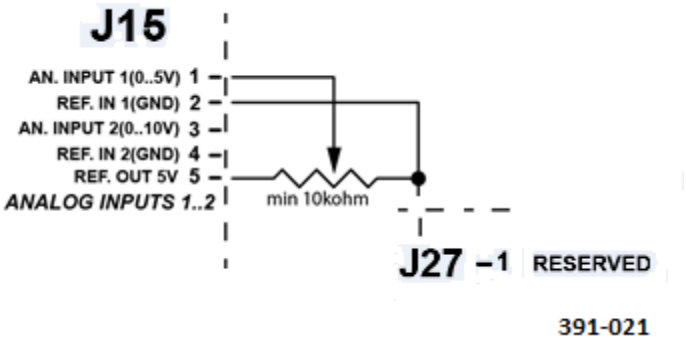
Reference J15-2 and J15-4 terminals are internally connected to GND through 1-kOhm resistors; this allows avoiding their connection to the earthing of voltage signal sources for short connections inside the electrical panel. The functions of the two analogue inputs are configurable by P.4001 and P.4009 parameters.

5.5.6.1 Use with potentiometers

One of the uses of "ANALOGUEUE INPUT 1", "ANALOGUEUE INPUT 2" and "ANALOGUEUE INPUT 6" is to set speeds, power or else by using the potentiometers.

J15-5 terminal can be used, exclusively for this purpose, as regulated source at +5 Vdc to which it is possible to connect one or more adjustment potentiometers; use in this case the J27-1 terminal as reference earthing.

The connection of the potentiometer to "ANALOGUE INPUT 2" by using the internal +5 V reference is as follows:



Note: The minimum resistance between J15-5 (+5 V reference) and J27-1 (internal reference earthing) should not fall below 10kohm.

It is possible to use J15-5 (+5 Vdc) reference also for the potentiometer connected to "ANALOGUE INPUT 2", which has a full scale of 10 Vdc, but in this case the measurement resolution is halved. It is anyway possible to use a conversion curve for this input in order to redefine the full scale for the input +5 Vdc (see par. 7.7). The same applies to "ANALOGUEUE INPUT 6": this input, however, has a full scale of about 32 Vdc, then the measurement resolution is lower.

It is possible to use external reference voltages (5 Vdc or 10 Vdc stabilized); the earthing of the external reference should be connected to the references of used J15-2 and J15-4 inputs; they should be connected to the earth terminal of the potentiometer.

Warning: by using external reference voltages, do not connect the internal reference J27-1 terminal.

5.5.6.2 Use as digital inputs

It is possible to use "ANALOGUE INPUT 1", "ANALOGUE INPUT 2" and "ANALOGUE INPUT 6" as further digital inputs by configuring them as such with the parameters that define their function.

The three inputs are considered active if the measured voltage drops below 1.2 VDC and are deactivated when the voltage rises above 1.8 Vdc.

To provide the deactivation power to "ANALOGUE INPUT 1" and "ANALOGUE INPUT 2" it is possible to use the 10kOhm pull-up resistors connected to J15-5 (+5 Vdc) and the reference J15-1 and J15-3 terminals. In this way, it is enough to connect the input terminal to GND to activate the function.

To provide the deactivation power to "ANALOGUE INPUT 6" it is possible use a 10-kOhm pull-up resistor connected to + VBATT and to the reference J6-3/4 terminal. In this way, it is enough to connect the input terminal to GND to activate the function.

5.5.7 Pick-up input or W signal (J27-7, J27-8)

Terminal	Type	Function
J27 - 7	Measure input	PICK-UP IN/W. Pick-up or W signal input (the latter requires an additional filter).
J27 - 8	Measure input	PICK-UP IN RTN. Pick-up return signal (standard external connection to negative).
J27 - 9	Shielding	GUARD EARTH. Input for pick-up cable shield connection.

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

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

Even if there is no measuring system available, the DST4602 can still calculate and show the rotational speed, from the generator frequency.

5.5.7.1 Magnetic pick-up

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

The signal is sinusoidal; the frequency depends on the rotational speed of the engine and on the number of revolutions of the flywheel. The maximum input voltage with the engine in standard operation is about 3Vac; in case voltage is lower, the signal can be increased by turning the pick-up to bring it closer to the gear wheel, paying the utmost attention not to hit it when turning the flywheel.

Connections:

- J27-7 pick-up signal positive input
- J27-8 pick-up signal negative input

With the one-wire pick-up, only connect the J27-7.

Usually, you can use a single pick-up, connected either to a DST4602 or to another device, such as a speed regulator, but paying attention to the polarity of the connections. Check also that the signal amplitude is sufficient.

For the configuration of the pick-up input, see par. 9.5.3.

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

5.5.7.2 W signal

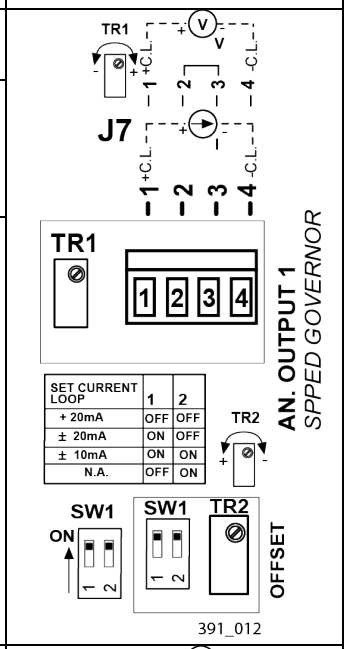
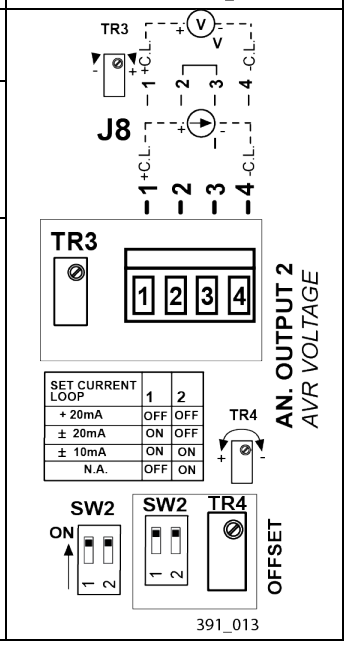
Some battery charger alternators make available a “W” terminal that has an alternate voltage with a frequency proportional to the rotation speed of the battery charger. The W signal is generated inside the engine start battery recharge alternator. It is a square wave, with an amplitude ranging from 0 to +Vbatt and the frequency proportional to the engine speed but depending on how the alternator is built and on the ratio between the diameters of the pulleys onto which the driving belt runs.

To W signal usually overlaps a lot of electrical noise, produced by the same alternator. It is therefore necessary to use an optional external filter, code Mecc Alte SRL E620202710900. The filter has two pairs of wires, an input one connected to W terminal of the alternator and to GND, and an output one, with a wire to be connected to J27-7 and the other to GND.

For the configuration of the W signal see par. 9.5.3.

5.5.8 Analogue outputs (J7/J8)

Two analogue outputs are provided for interfacing the most part of devices requiring current or live input signals. Two parameters are available for defining the function of these outputs: respectively P.6001 for output **J7** and **P.6002** for output **J8**. To know about the functions that are available to be assigned to the parameters, see the document [1].

Terminal	Current	Voltage	
J7 - 1	Positive analogue output in current	Positive polarity analogue live signal	
J7 - 2	Do not connect	Use a jumper only for live outputs and when using trimmer TR1 inside the controller (see paragraph 5.5.12.2)	
J7 - 3			
J7 - 4	Negative analogue output in current	Negative polarity analogue live signal.	
J8 - 1	Positive analogue output in current	Positive polarity analogue live signal	
J8 - 2	Do not connect	Use a jumper only for live outputs and when using trimmer TR1 inside the controller (see paragraph 5.5.12.2)	
J8 - 3			
J8 – 4	Negative analogue output in current	Negative polarity analogue live signal.	

5.5.9 Set “Current loop”:

“Current Loop” adjustments can be selected through the Dipswitches SW1 and SW2. Available configurations:

- From 0 to +20mA
- -10mA to +10mA
- -20mA to +20mA

SET CURRENT LOOP	1	2
+ 20mA	OFF	OFF
± 20mA	ON	OFF
± 10mA	ON	ON
N.A.	OFF	ON

5.5.10 Offset

Trimmers TR2 and/or TR4, respectively for analogue outputs 1 and 2, are factory set for a value centring referred to the current range set.

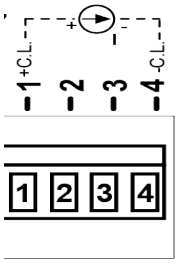
INFORMATION! Modifying the offset trimmers leads to a deviation of the whole current value v/s the range centring.

Correct values:

Range	+20mA	±20mA	±10mA
50% piloting	10mA	0mA	0mA

5.5.11 Current output (“Current loop”)

The output for the device in "current loop" is located between pin +1 for positive and pin -4 for negative.



5.5.12 Live output

A live output can be obtained by using one of the adjustable outputs in current. To obtain a live output, you need to insert an adequately rated resistor/trimmer in parallel with the Current Loop line. Modes are listed in the following paragraphs.

5.5.12.1 Internal trimmer

By bridging pin 2 and pin 3 of connectors J7 and/or J8, the trimmers TR1 and/or TR3 (0...1000 Ohm) are enabled. This allows to obtain a live output with positive (+) pole on pin 1 and negative (-) pole on pin 4 of connectors J7 and/or J8.

5.5.12.2 Trimmer / external resistor

WARNING! Carefully consider the resistor and the dipswitch configuration, as the max. voltage range is ±11 Vdc.

INFORMATION! In case use of an external trimmer or resistor is required, pin 2 and pin 3 of connectors J7 and/or J8 shall be devoid of connections.

To get a live output, it is necessary to insert a resistor or a trimmer resistor in parallel (positive pole (+) pin 1, negative pole (-) pin 4 of J7 and/orJ8 connector) on the "current loop" line.

WARNING! Take all required precautions to avoid contact danger on the Current Loop lines as, depending on the characteristics of the external device, the external resistor or trimmer could reach extremely high operation voltages.

5.5.12.3 Operating procedure:

Below you will find some examples.

Example 1: external resistor

Required voltage: min. – 6 Vdc to max. +6 Vdc.

Select ± 20 mA

The resistance to use is: $$R = \frac{V}{I} = \frac{6V}{0{,}02A} = 300\Omega$$

The dissipation power of the resistor must be at least: $P = V * I = 6V * 0{,}02A = 0{,}12W$

The resistor to be used will be 300 Ohm, 1/4 W

Example 2: external trimmer

Required voltage: min. – -1 Vdc to max. +1 Vdc.

Select ± 10 mA

Trimmer to be used: $R = \frac{V}{I} = \frac{1V}{0{,}01A} = 100\Omega$

Minimum trimmer dissipation power: $P = V * I = 10V * 0{,}01A = 0{,}1W$

The trimmer to be used will be 100 Ohm, 1/4 W

After connecting the trimmer, you may perform full scale and/or centering adjustments; to do so, ensure to use a multimeter with Volt full scale. Measure live output value from pins +1 and 4 of connector J7 and/or trimmer J8 and adjust to the centering value by setting controller setpoint values to 0%, 50% or 100%.

INFORMATION! This procedure requires disconnecting any wire that can affect the value.

Example **3**: internal trimmer

Required voltage: min. – 0 Vdc to max. 3 Vdc.

Select +20mA

The internal trimmer shall be adjusted to a resistive value of: 150 Ohm

To calibrate the trimmer, you must disconnect any wire and/or device that might affect the reading; using a multimeter with full scale in ohm between the pins 1 and 2 of J7 and/or J8, turn the adjustment screw till reading about 150 Ohm.

To verify the full-scale range adjustment and the centering value, use a multimeter with full scale in Volt on pins 1 and 4 of connector J7 and/or J8. With different controller setpoint values set to 0%, 50% or 100% it is possible to adjust the setpoint centring through the trimmer TR2 and/or TR4.

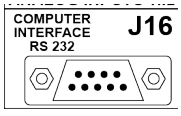
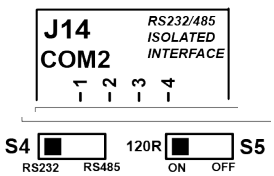
INFORMATION! This procedure requires disconnecting any wire that can affect the value.

5.6 RS232//RS485 (J14/J16) serial communication

The device provides two connectors dedicated to serial communication with other devices.

Connector J16 is the main serial connection for RS232, using one 9 pins male CANON connector. Connector J14 is the secondary serial connection for RS232 or RS485, using one 4 pins connector. J14 configuration, between RS232 or RS 485, is performed through switches close to the connector.

INFORMATION! For the functions and protocols implemented, refer to documents [5] and [4].

J16 – 1st RS232 Serial	J14 – 2nd RS232/RS485 Serial	
1-nc	RS232:	switch S4= RS232 switch S5= OFF
2-RX		1-RX
3-TX		2-TX
4-DTR		3-GND
5-GND		4-DTR
6-DSR	RS485:	switch S5= RS485 switch S5= ON (used for balancing 120 Ohm lines)
7-RTS		1-A
8-nc		2-B
9-nc		3-nc
		4-nc
		

INFORMATION! For correct operation of the 2nd Serial in RS232 mode, ensure that switch S5 is set to OFF.

The serial port J16 can be used in the following two modes that can be selected through parameter P.0451:

- 0: the serial port is set for RS232 and/or RS485 serial communication, using pin 4 (DTR) as a check signal for transmit/receive switching.
- 1: the serial port is set for RS232 and/or Modem serial communication. PSTN and/or GSM modems are supported. The DST4602 provides modem management, initialization, registration on the network, SMS messages and data calls.

This serial port can be configured using parameters P.0451 (Modbus address), P.0453 (Baud rate) and P.0454 (parity, data bits and stop bits), P.0470 (Modbus registers order) and P.0476 (delay before answering, in ms).

The serial port J14 can be used only in one mode that can be selected through parameter P.0471:

- 0: the second serial port works exactly as the first one (refer to document [5]). Exception: it's not possible to connect a modem to the second serial port.

This serial port can be configured using parameters P.0472 (Modbus address), P.0473 (Baud rate) and P.0474 (parity, data bits and stop bits), P.0475 (Modbus registers order) and P.0477 (delay before answering, in ms).

P.0470 and P.0475 parameters specify how the information at 32 is broken down to 16-bit registers provided for by Modbus:

- 0-LSWf: by transferring information at 32-bit, the lowest-index Modbus register will contain the lowest 16 bits of information.
- 1-MSWf: by transferring information at 32-bit, the lowest-index Modbus register will contain the highest 16 bits of information.

P.0476 and P.0477 parameters instead allow inserting a delay (in ms) between the instant at which DST4602 receives a Modbus query to when it begins transmitting the response.

See the document [5] for a description of these parameters.

5.7 CAN-BUS (J11/J12/J13)

This device provides three types of CanBus.

5.7.1 ECU Interface (J11)

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

The protocol uses the CAN 2.0b layer (with 29 bits extended addresses) as a physical and data communication layer. The connector used complies with CAN open [7] specifications.

Warning: the golden contacts connector must not be replaced with other models.

Warning: the pins numbering is inverted with respect to the Mecc Alte standard for compatibility with the CAN open connector.

Terminal	Type	Function
J11 - 1	CAN _H	CAN_H line (high when dominant)
J11 - 2	CAN SH	N.C.
J11 - 3	CAN_L	CAN_L line (low when dominant)

The interface is galvanically isolated.

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

5.7.2 PMCB bus (J12)

The PMCB bus Power Management Communication Bus) connector allows controller connection to the Mecc Alte proprietary CAN-BUS. Through this CAN-BUS, the controller manages many parallel functionalities between multiple gen-sets: load sharing, gen-sets activation/deactivation depending on power demand from the load, etc. The connector used complies with the CAN open specifications[7].

Warning: the golden contacts connector must not be replaced with other models.

Warning: the pins numbering is inverted with respect to the Mecc Alte standard for compatibility with the CAN open connector.

Terminal	Type	Function
J12 - 1	CAN _H	CAN_H line (high when dominant)
J12 - 2	CAN SH	N.C.
J12 - 3	CAN_L	CAN_L line (low when dominant)

The interface is galvanically isolated.

5.7.3 EX_BUS (J13)

The connector EX_BUS (Expansion Bus) allows to connect to DST4602 all the expansion modules using the Mecc Alte EX_BUS proprietary protocol. The modules DITEL, DIGRIN, DITHERM, DIVIT and DANOUT are presently supported.

The connector used complies with CAN open [7] specifications.

Warning: the golden contacts connector must not be replaced with other models.

Warning: the pins numbering is inverted with respect to the Mecc Alte standard for compatibility with the CAN open connector.

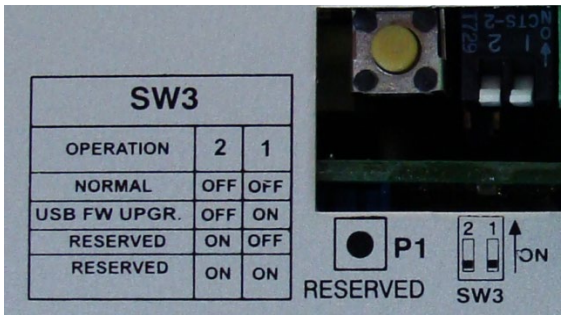
Terminal	Type	Function
J13 - 1	CAN _H	CAN_H line (high when dominant)
J13 - 2	CAN SH	N.C.
J13 - 3	CAN_L	CAN_L line (low when dominant)

The interface is galvanically isolated.

5.8 Other connectors

5.8.1 USB 2.0 Slave(J9)

Connector J9 is a standard USB 2.0 Slave. At present, this connector is only used for updating the device firmware.



Firmware update requires an initial BOOT procedure through the dipswitch SW3 and the button P1.

5.8.2 HMI SERIAL INTERFACE (J10)

J10 connector allows data connection with RS422 differential line between SCM (System Control Module) device and HMI (Human Machine Interface) panel. The connection cable used is an Ethernet standard patch cable with direct EIA/TIA 568A connection. This connection cable is supplied on request; available lengths are 6'8”, 10' and 16'8” max.

5.8.3 ETHERNET (J25)

DST4602 also provides an ETHERNET interface. See the document[13] for the description of the interface. This interface can be used to exchange information with the board with Modbus/TCP protocol: in this case the Modbus address of the device is always "1".

6. Main functions

6.1 Front panel

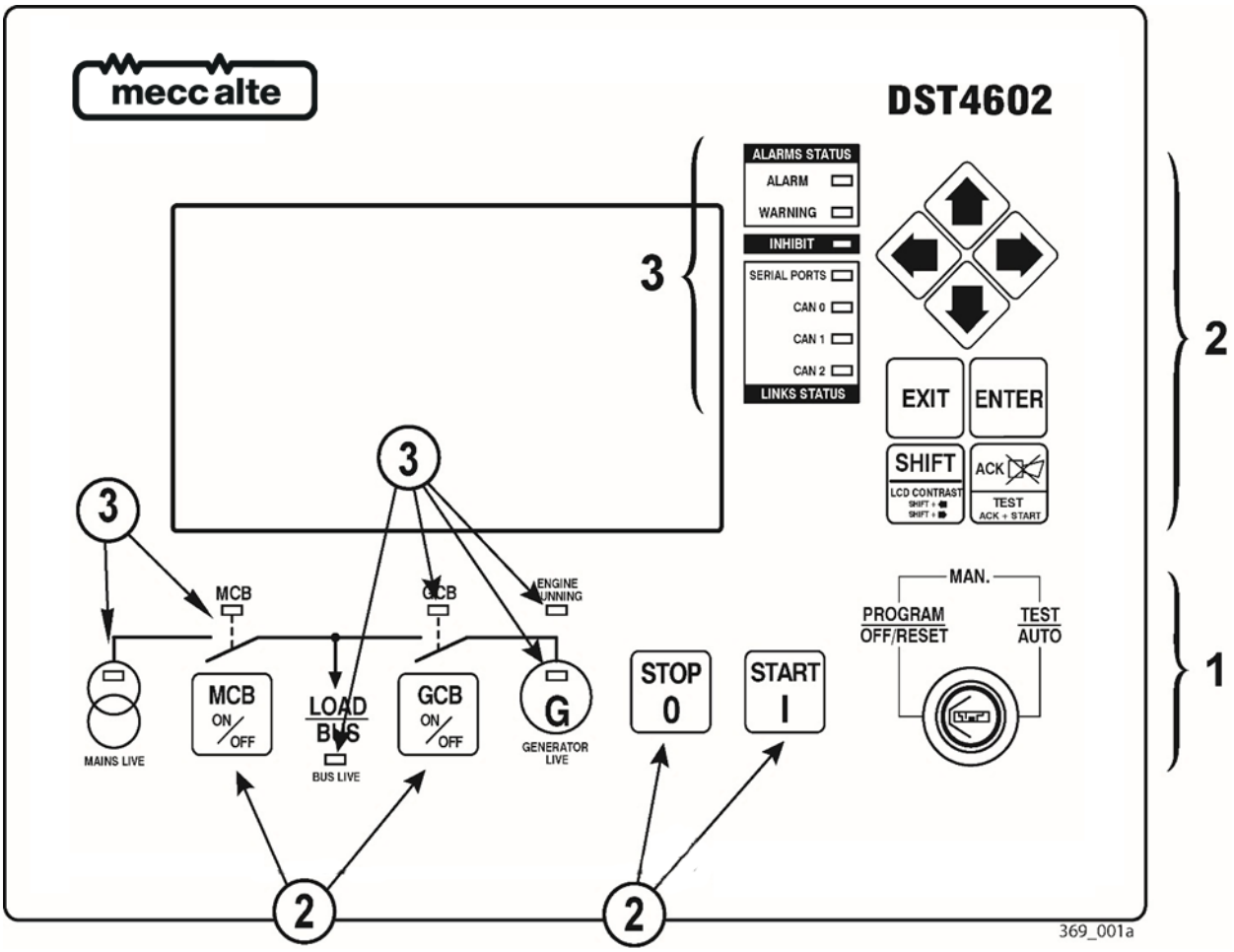


Fig. 1 – DST4602 Front Panel

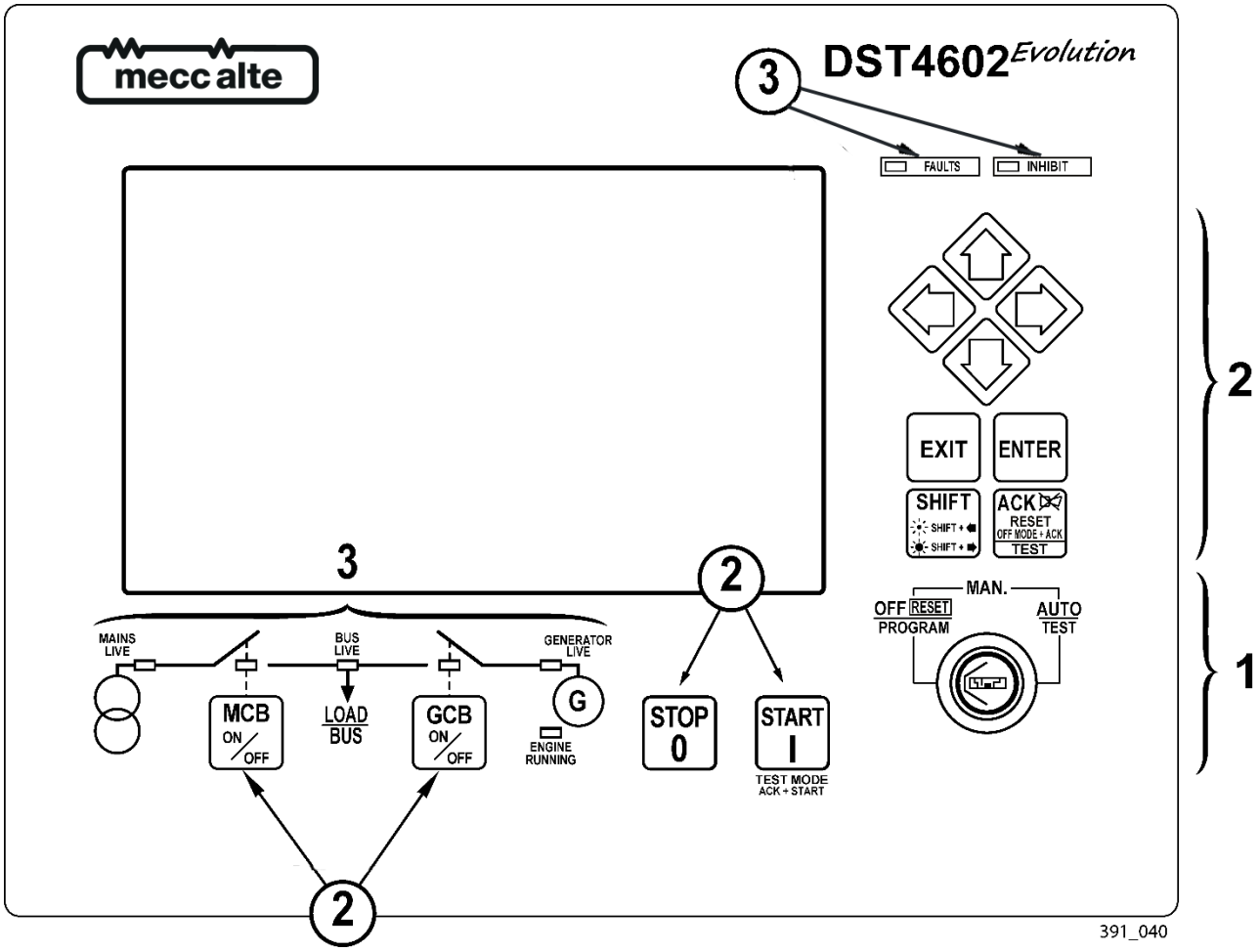


Fig. 2 –DST4602Evolution Front Panel

KEY:

1. Selector
2. Pushbuttons
3. Indicators

The controls consist of a lockable selector (1) and 12 pushbuttons (2).

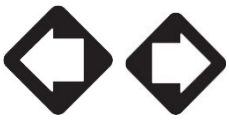
The front panel also has some luminous indicators (3).

6.2 Selector (see fig. 1)

Selector position	Function
OFF/RESET ***PROGRAM***	The engine is OFF. The GCB switch is opened. The MCB (if any) switch is closed. All anomalies are cancelled. You can program the parameters.
MAN	The Gen-set control module is set for manual gen-set control. Press the **START** (START I) button to start the engine. Press the **STOP** (STOP 0) button to stop the engine. For systems consisting of a single generator, the **MCB** (MCB ON/OFF) key can be used to open/close MCB switch (with or without synchronization, if MCB exists and is controlled by DST4602). Note: to open MCB switch with stopped motor, press the key for 5 seconds. The **GCB** (GCB ON/OFF) key can be used to open/close GCB switch (with or without synchronization if GCB is controlled by DST4602).
AUTO ***TEST***	The board sets to the automatic control of the generator. The combination of **ACK/TEST** (ACK TEST ACK + START) and **START** (START I) keys allows activating/deactivating the TEST mode. This feature can be disabled using bit 1 of P.0495 The **STOP** (STOP 0) key is used to stop the generators (with the activation of an alarm). Only in the TEST mode **GCB** (GCB ON/OFF) and **MCB** (MCB ON/OFF) keys allow controlling the switches, as described for the MAN position of the selector.

6.3 Pushbuttons (see fig. 1)

Pushbuttons	Function
SHIFT LCD CONTRAST SHIFT + ◀ SHIFT + ▶ **SHIFT**	Dead key. ○ When pressed in combination with another key, it allows redefining the function (see the description of the other keys). ○ When **HELP** information pages are available on the display, by pressing and holding this key, the **HELP** message will be displayed on the bottom status bar (by quickly pressing this key twice, the **HELP** information is permanently displayed). ○ On some pages of the display, the information is shown in rotation: by pressing and holding this key, the rotation stops on the currently displayed information. ○ It can be used to turn on the display backlight lamp (if it was off).

Pushbuttons	Function
 **LEFT/RIGHT**	Horizontal scrolling buttons. They allow to: ○ Select the previous or the next page of the display within the current mode (in all modes, except PROGRAMMING and RECORDS mode). ○ In **PROGRAMMING** mode, they are used to position the cursor when entering the strings. ○ In the **RECORDS** mode, they are used to scroll through the pages related to a recording. ○ Used in combination with the **SHIFT** SHIFT button they allow adjusting the contrast of the LCD display: • **SHIFT** SHIFT + **LEFT** decreases the contrast. • **SHIFT** SHIFT + **RIGHT** increases the contrast. ○ On some pages of the display, with the **ENTER** ENTER key a selection/editing phase can be activated. When this phase is active, the horizontal scroll keys allow: • Select the size to be adjusted (setpoint). • Change the display mode of PLC resources (symbolic/mnemonic). • Select the counter to be set to zero.
 **UP/DOWN**	Vertical scrolling buttons. They allow to: ○ Select the multifunctional display mode. ○ Once activated the **PROGRAMMING** mode, they allow scrolling through menus and variables. You can increase/decrease the value of the variable to change the settings. Used in combination with the **SHIFT** SHIFT button you can scroll through the menu ten entries at a time or increase/decrease the variables ten units at a time. ○ Once activated the **RECORDS** mode, they allow scrolling through menus and recordings. Used in combination with the **SHIFT** SHIFT key, they allow scrolling through the records, ten items at a time ○ On some pages of the display, with the **ENTER** ENTER key a selection/editing phase can be activated. When this phase is active, the vertical scroll buttons allow: • Changing the value of the size to be adjusted. • Selecting the language. • Selecting one of the active anomalies (by displaying additional details). • Select the counter to be set to zero. • Selecting the PLC block to be displayed.

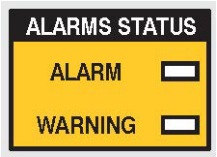
Pushbuttons	Function
ENTER **ENTER**	It allows: ○ "Accepting" any reports of anomalies on the non-volatile memory at powering up. ○ It activates the **PROGRAMMING** function and, within it, allows entering a submenu, starting an editing operation on a variable and confirming the operation. ○ It activates the **RECORDS** function and, within it, allows entering the selected archive. ○ Activates/deactivates the scrolling of the anomalies. ○ It activates the language selection process. ○ It activates/deactivates the selection mode of the counter to be reset. ○ It switches the inputs/outputs display mode (logic status, physical status, by function). ○ It activates/deactivates the selection of the PLC block to be displayed. ○ It activates/deactivates the setting mode of sizes on normal working pages of the display. ○ It modifies the mode for the fuel pump. ○ It selects the "master" generator for load management.
EXIT **EXIT**	It allows: ○ In **PROGRAMMING** mode, it allows aborting the change in the value of a variable, going back to the upper menu, going out from programming. If it is pressed for at least two seconds in any menu, you exit the programming mode retaining the current menu position for further programming access. ○ In **RECORDS** mode, it allows going back to the upper menu and going out from the mode. ○ It "accepts" any reports of anomalies on non-volatile memory at powering up. ○ It cancels the scroll mode of anomalies. ○ It cancels the language selection mode. ○ It cancels the selection mode of a counter. ○ It cancels the selection mode of the PLC block to be displayed. ○ It cancels the setting mode of the sizes on normal working pages of the display. Used with the **SHIFT** SHIFT key, it allows: ○ Manually controlling the fuel pump. Used with the **ACK/TEST** ACK TEST key, it allows: ○ Reloading the default of programming parameters. ○ Resetting the selected counter on the display. ○ Emptying the selected records. ○ Resetting the maximum measured execution of the PLC program.

Pushbuttons	Function
 **GCB**	It is only active in MAN and TEST. It allows controlling the opening and closing of GCB switch. If synchronization is required for closing, by pressing the key, the synchronization sequence will be activated. If pressed during the parallel with other generators or with the mains, it controls the opening of GCB by first carrying out the discharge of the active power of the generator: by holding it for more than a second, the power discharge phase is skipped. Note: the pressing of this key to request the closing of GCB may also involve the opening of the MCB switch (depending on the type of system and the status). It is also used to change the rated speed of Volvo engines with EDC3 control unit.
 **MCB**	It is only active in MAN and TEST. It allows controlling the opening and closing of MCB switch. If synchronization is required for closing, by pressing the key, the synchronization sequence will be activated. When pressed during the parallel with other generators or the mains, it controls the immediate opening of MCB (there is no transfer of load on the generators before the opening of MCB). Note: to open the MCB with the engine off, press the key for 5 seconds. Note: the pressing of this key to request the closing of MCB may also involve the opening of the MCB switch (depending on the type of system and the status).
 **ACK/TEST**	It allows: ○ Disabling the siren, when pressed while the siren is activated. ○ "Recognizing" the presence of anomalies, if pressed while the siren is not active. "Recognized" early warnings will be automatically deleted if the cause is no longer present. ○ Selecting the size to be adjusted (setpoint) in the normal working pages of the display. In conjunction with the **START**  key, with the board in AUTO mode, it allows activating/deactivating the operation mode in TEST. This feature can be disabled using bit 1 of P.0495 Used with the **EXIT**  key, it allows: ○ Reloading the default of programming parameters. ○ Resetting the selected counter on the display. ○ Emptying the selected records. ○ Resetting the maximum measured execution of the PLC program.

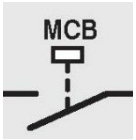
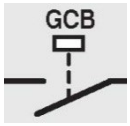
Pushbuttons	Function
 **START**	In MAN mode it can be used to start the engine. The button can be configured in two ways: • P.0252 = 0: fully manual (the starter motor is engaged all the time the button is pressed or until the engine running is detected). • P.0252 > 0: fully automatic (simply press and release the "**START**" button to activate an automatic start sequence of maximum P.0252 tries). If the start is not successful, the fail to start anomaly will be activated. The "**START**" button must be pressed and released again to perform a new start attempt. In AUTO mode, it allows: ○ Used in combination with the ACK/TEST  key, activating/deactivating the TEST mode. This feature can be disabled using bit 1 of P.0495 ○ Temporarily excluding the generators from the "load management", by forcing it to start.
 **STOP**	In OFF/RESET mode, it switches on all the warning lamps, therefore allowing testing their functioning. It is used in MAN to order the engine to stop. Starting from the release 00.80, in **AUTO**, **TEST** or **REMOTE START**, the button can be configured in two ways (bit 0 of P.0495): • Engine stop with activation of a block. • No function. The button press is irrelevant. For previous releases, the controller activates a block.

6.4 Warning lights (see Figure 1)

Led off	LED steady ON	LED flashing
☐	▣	◙

	Signalling		Function
	**ALARM (Not for Evolution)**	▣	Signals at least one lockout or power-off or unload anomaly.
		◙	It indicates the presence of at least an alarm or deactivation or unload not yet recognized with the "**ACK/TEST**" key.
		☐	There are no alarms, deactivations or unloads.
	WARNING (Not for Evolution)	▣	There is at least one active warning.
		◙	Signals at least one warning which has not yet been acknowledged with the "**ACK/TEST**" button.
		☐	No warnings.

	Signalling		Function
	**FAULTS (Only for Evolution)**	■	It indicates there is a block, a deactivation, an unload or a warning.
		⧈	It indicates there is a block, a deactivation, an unload or a warning that has not been acknowledged with the "**ACK/TEST**" button.
		□	There are no blocks, deactivations, unloads or warnings.
	**INHIBIT**	■	It indicates that there is an active request for "inhibition to automatic intervention" of the generator system (see 9.5.15).
		□	It indicates that there is no active request for "inhibition to automatic intervention" of the generator system.
	**SERIAL PORTS (Not for Evolution)**	■	It indicates that a Modbus communication on one of the two serial interfaces or on the Ethernet interface is present.
		□	It indicates that no Modbus communication on the serial interfaces and on the Ethernet interface is present.
	CAN0 (Not for Evolution)	■	Signals that the CAN0 interface is active and in ERROR-ACTIVE mode.
		⧈	Flashing (25% illuminated): it indicates that CAN0 interface is in ERROR-PASSIVE mode, and as a result there are communication problems.
			Flashing (75% illuminated): it indicates that CAN0 interface is in BUS_OFF mode, and as a result there are communication problems.
		□	It indicates that CAN0 interface is disabled, or that it is working and in ERROR-ACTIVE mode, but no external devices are transmitting data.
	CAN1 (Not for Evolution)	■	Signals that the CAN1 (PMCB) interface is active and in ERROR-ACTIVE mode.
		⧈	Flashing (25% illuminated): it indicates that CAN1 interface (PMCB) is in ERROR-PASSIVE mode, and as a result there are communication problems.
			Flashing (75% illuminated): it indicates that CAN1 interface (PMCB) is in BUS_OFF mode, and as a result there are communication problems.
		□	Signals that the CAN1 (PMCB) interface has been disabled.
	CAN2 (Not for Evolution)	■	It indicates that CAN2 interface (EXBUS - expansions) is active, functioning and in ERROR-ACTIVE mode.
		⧈	Flashing (25% illuminated): it indicates that CAN2 interface (EXBUS - expansions) is in ERROR-PASSIVE mode, and as a result there are communication problems.
		□	Flashing (75% illuminated): it indicates that CAN2 interface (EXBUS - expansions) is in BUS_OFF mode, and as a result there are communication problems.
			It indicates that CAN2 interface (EXBUS - expansions) is disabled, or that it is working and in ERROR -ACTIVE mode, but that no expansion module is sending data.
	**BUS LIVE**	■	Indicates the presence of voltage on the parallel bars (or on users if MGCB does not exist or is closed).
		⧈	Flashing (50% illuminated): during the synchronization phase (flashes alternately with the GCB or MCB LED).
		□	It indicates the absence of voltage on the parallel bars (or on users if MGCB does not exist or is closed).
	MAINS LIVE	■	Mains voltages and frequency are "permanently within tolerance".

	Signalling		Function
		▣	Flashing (75% illuminated): the mains is present, but either a voltage or the frequency are above the maximum threshold.
		▣	Flashing (50% illuminated): transition between the "permanently within tolerance" and "absent" statuses.
		▣	Flashing (25% illuminated): the mains is present, but either a voltage or the frequency are below the minimum threshold.
		▣	Flashing (5% illuminated): two MC boards are sending conflicting information about the status of the mains, which is anyway considered out of tolerance.
		☐	Mains voltages and frequency are "absent".
	**GENERATOR LIVE**	■	Generator voltages and frequency are "permanently within tolerance".
		▣	Flashing (75% illuminated): the generator is present, but either a voltage or the frequency are above the maximum threshold.
		▣	Flashing (50% illuminated): transition between the "permanently within tolerance" and "absent" statuses.
		▣	Flashing (25% illuminated): the generator is present, but either a voltage or the frequency are below the minimum threshold.
		☐	Generator voltage and frequency are not present.
	**ENGINE RUNNING**	■	The engine is running
		▣	Flashing (50% illuminated): the engine is running; the cooling cycle is in progress.
		☐	The engine is OFF.
	**MCB**	■	The MCB switch is closed.
		▣	Flashing (25% illuminated): MCB switch is opened at the presence of the closing control.
			Flashing (50% illuminated): in synchronization phase (alternating with the BUS LIVE LED).
			Flashing (75% illuminated): MCB switch is closed at the presence of the opening control.
		☐	The MCB switch is opened.
	**GCB**	■	The GCB switch is closed.
		▣	Flashing (25% illuminated): GCB switch is opened at the presence of the closing control.
			Flashing (50% illuminated): in synchronization phase (alternating with the BUS LIVE LED).
		☐	Flashing (75% illuminated): GCB switch is closed at the presence of the opening control.
			The GCB switch is opened.

In the OFF/RESET mode, by pressing the STOP button, the board turns on all the warning lights, therefore allowing testing their functioning. If an output with DOF.3153 function is configured ("lights test"), also this output is activated: it can be used to turn on any lights outside the board and have a single procedure to test the lights.

6.5 Multifunctional display

6.5.1 Lighting

The backlight lamp is managed by the Genset control module, which switches off the backlight after a programmable time (P.492) if no buttons are pressed in the meantime.

To light it again, simply press any key (use the SHIFT key that, when alone, does not perform any operation). It is possible to disable the automatic shutdown of the lamp by setting P.0492 parameter to 0.

If P.0492 is different from zero, the lamp will be off for most of the time: by using P.0493 parameter, it is possible to force the lamp "always on" when the engine is started (in order to have greater visibility on the measures shown on the display). Starting from release 00.80, using the same parameter it is also possible to force the lamp “on” even during crank attempts.

Note: with DST4602Evolution and DST4602/P Evolution controllers it is suggested to set P.0492 to a quite low value (for example 60 seconds) and never force the lamp to “steady on” when the engine is running: from this point of view, in fact, the colour display is more delicate, and it has to be preserved by reducing the use of the lamp as much as possible.

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

If the controller internal temperature is lower than 10°C, the controller switches on the lamp to warm up itself (not during crank attempts). In the same way, if the internal temperature grows over 55°C, the controller switches off the lamp to cool down itself. In this condition, up to version 00.78 the controller switched off the lamp after 3 seconds from the last button pressed; starting from version 00.79, this time has been increased to 3 minutes, allowing the operator to use the display in a reasonable way when the controller is installed in places where the internal temperature often reaches 55 °C.

6.5.2 Contrast adjustment

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

- Press SHIFT + LEFT keys to decrease the contrast (lighten).
- Press SHIFT + RIGHT keys to increase the contrast (darken).

6.5.3 Mode navigation

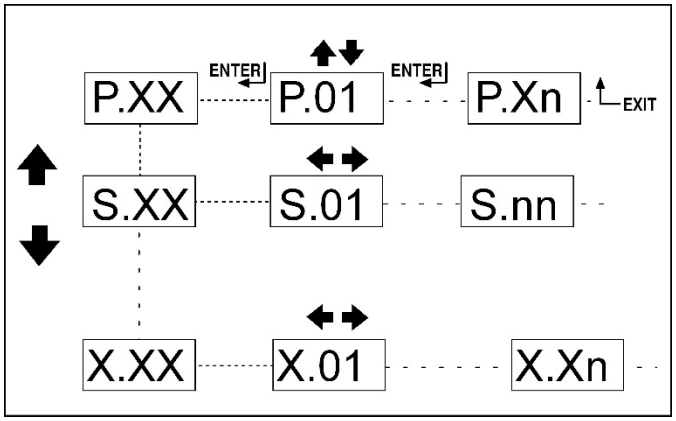


Fig. 2 - Mode navigation

The display has different display modes with various pages.

Mode	Description	Page identifier
PROGRAMMING	Programming	P.XX
PLC	Information about the PLC program	L.XX
STATUS	Status information	S.XX
MEASURES	Electrical measurements	M.XX
ENGINE	Measurements acquired from the engine	E.XX
PMCB	Measurements acquired by CAN2 line (PMCB)	B.XX
HISTORY	History logs	H.XX

Generally, the UP and DOWN buttons are used to navigate between the modes. To view the pages within the mode, LEFT and RIGHT keys should be used.

In some modes (for example P.XX and H.XX mode), to view the pages it is necessary first to press the ENTER key (to activate the mode), and then to use the UP and DOWN keys to navigate through the menus.

If the UP and DOWN keys should be used to manage functions within the displayed page, the pressing of the ENTER key is required to activate these functions, the pressing of the EXIT key to deactivate them.

The controller can automatically hide some pages due to parameters configuration (for example the pages related to the PMCB bus are hidden if the bus is disabled by P.0800).

Starting from version 00.79 the operator can hide some pages using parameters P.0521, P.0522, P.0523, P.0524 e P.0525. They are related respectively to pages “L”, “S”, “M”, “E” and “B”. These parameters can be set using bits; each bit is related to a display page. For example, if you set P.0522 = “0001” (bit 0 activated) the page M.01 will be hidden.

6.5.4 Structure of display areas

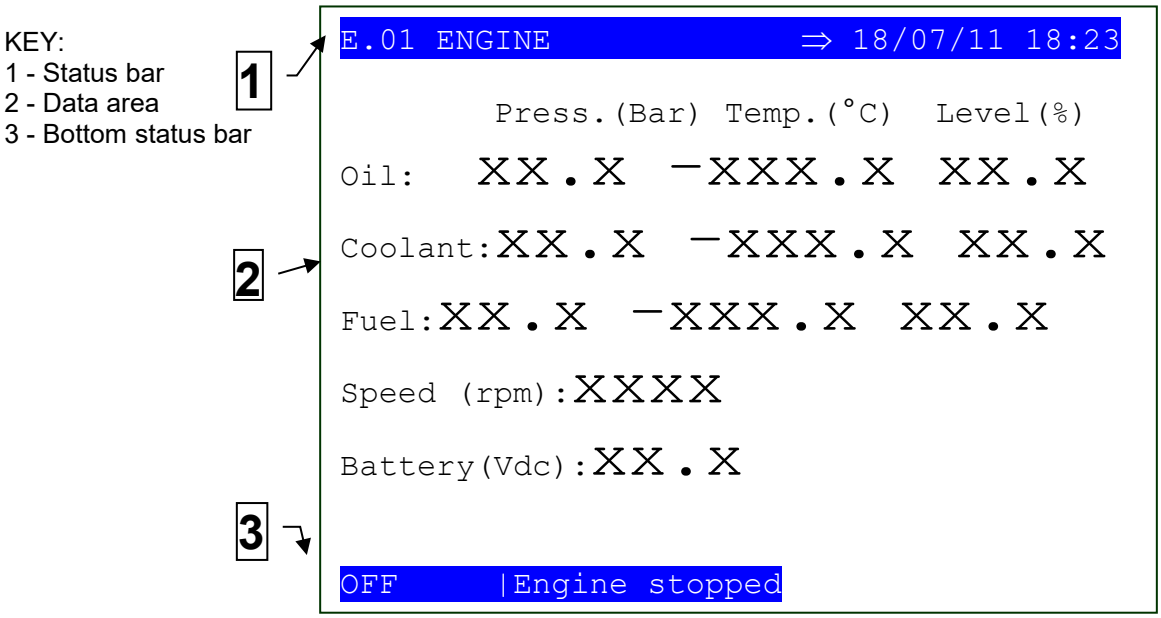
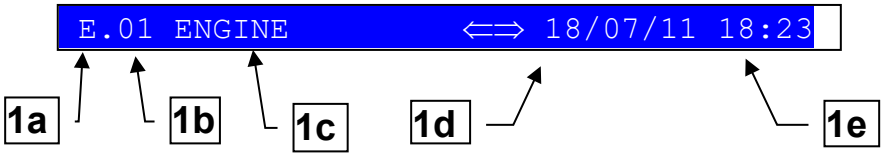


Fig. 3 - Display areas (example for DST4602)

6.5.5 Top status bar



KEY:
1a - Mode identifier
1b - Page identifier
1c - Page title
1d - Pages to the left or right
1e - Date and time

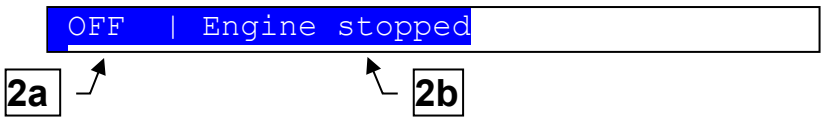
Fig. 4 - Top status bar

The top status bar contains information on navigation and times. The current mode is shown in the related box at the top status bar. The mode identifier (**1a**), and the page identifier (**1b**) identify and refer to the page so there is no chance of error.

The presence on the upper status bar of arrows on the left, right or both (1d) indicates the presence of accessible pages with the LEFT and RIGHT keys, respectively.

Only for DST4602Evolution and DST4602/P Evolution, at the right side of the upper status bar two “danger” triangle icons can be displayed to indicate the presence of alarms (yellow icon) and/or blocks, deactivations or unloads (red). These icons flash if the related faults have not been acknowledged by the ACK button.

6.5.6 Bottom status bar



2a - Operating mode
2b - System status

Fig. 5 - Bottom status bar

The bottom status bar displays some information on the system status. The operating mode of the board (2a) reflects the position of the key switch.

System status (2b) displays part of the information on page S.01 (STATUS) which is useful for the operator, as it can be displayed also if other pages are being viewed and in other display modes.

In some pages, pressing the SHIFT button replaces the bottom status bar for the time the button is held down with a HELP message. By consecutively pressing the SHIFT key twice (double click) the message HELP permanently replaces the status bar until the page is changed or the SHIFT key is pressed twice. If the message is not available, the status bar is not displayed.

6.5.7 Notes for DST4602Evolution and DST4602/P Evolution

The Evolution controllers are equipped with a colour display. The assignment of the colours is consistent in all pages:

- GREEN indicates the descriptions
- CYAN indicates measurements and data
- YELLOW indicate setpoints and adjustable measures
- The use of other colours has an aesthetic purpose only, it does not have a specific meaning.

6.6 Display mode

Note: the example pages shown below refer to DST4602 and DST4602/P controllers. For DST4602Evolution and DST4602/P Evolution the data format has slightly changes, but the structure of the pages is the same.

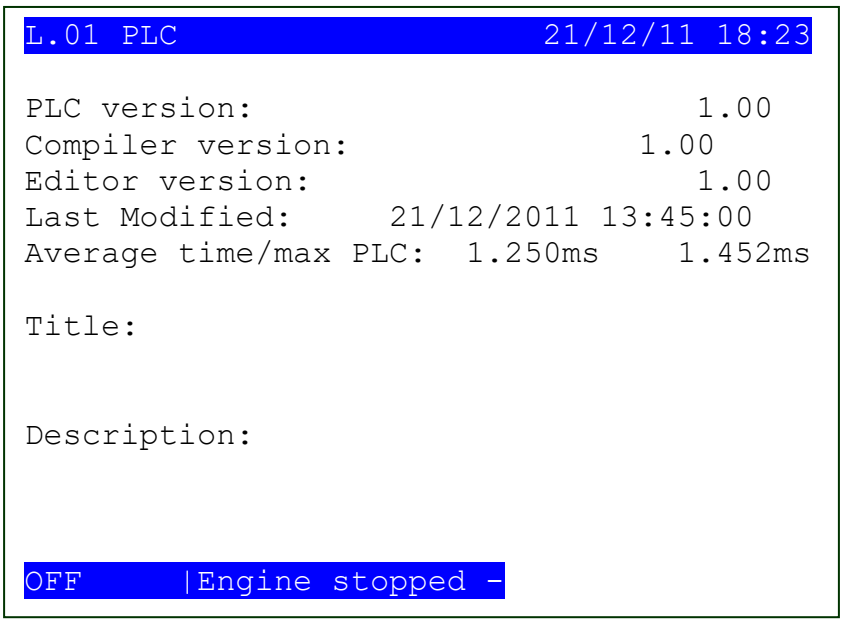
6.6.1 (P.XX) Programming

This mode lets you display and change the programming parameters. See the paragraph 0 for detailed information on programming.

6.6.2 PLC (L.XX)

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

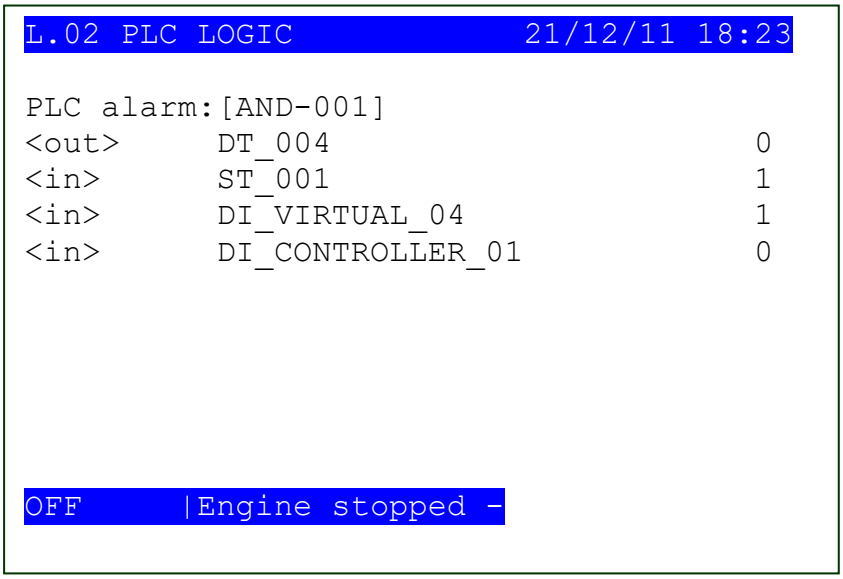
6.6.2.1 L.01 PLC



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

- The title and the description of the PLC program.
- The last modification date.
- The PLC firmware, compiler and editor version.
- The average and maximum execution time. These times are automatically reset when the PLC program is transmitted to the board, or it is possible force the reset by pressing ACK/TEST + EXIT keys for 5 seconds).

6.6.2.2 L.02 PLC LOGIC



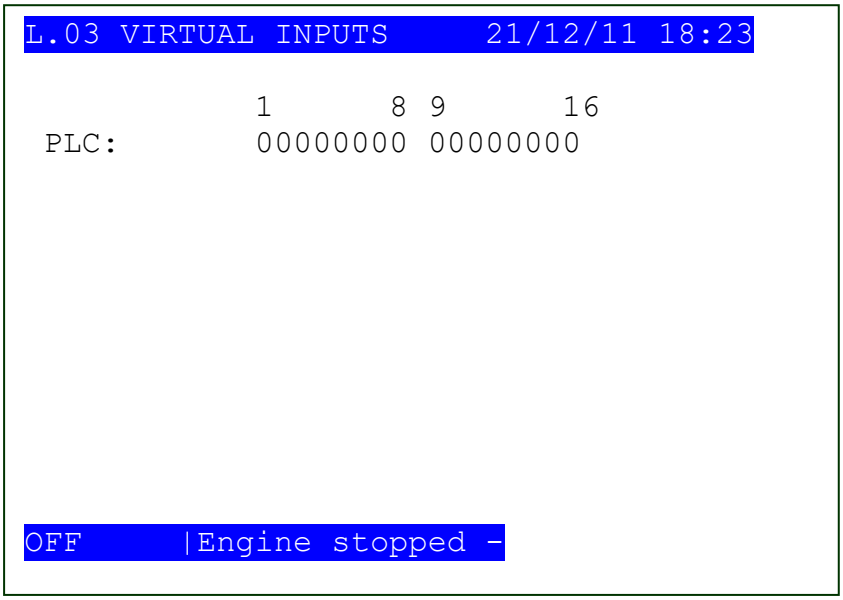
This page shows the information related to a single PLC block.

In the third line (on the right) the selected block, with the "TYPE-NUMBER" format, is shown. To select a block, press the ENTER key, then use the UP and DOWN keys to search the desired block; confirm again with ENTER.

In the next lines all the parameters of the selected block are shown (one line for each parameter):

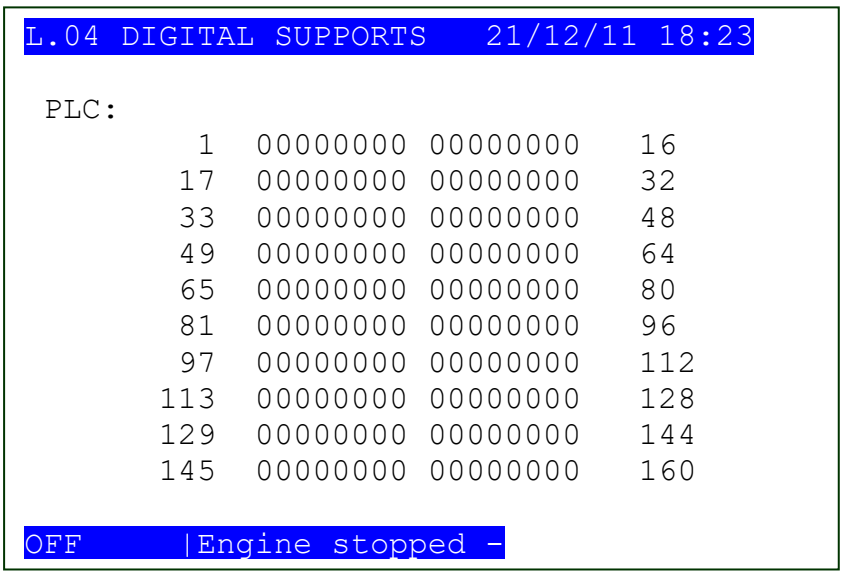
- The first column identifies the type of used parameter (input/output).
- The second column identifies the resource associated to the parameter. Normally, the resources are displayed with Mecc Alte encoding (for example, the digital input 1 is identified as DI_CONTROLLER_01). In the PLC program it is possible to associate symbols ("nickname") to resources. It is possible to display the symbols in the second column, instead of Mecc Alte codes: press the ENTER key (as to select a different block) and press the LEFT or RIGHT key; confirm with the ENTER key. See [12] for the description of Mecc Alte codes for the identification of PLC resources.
- The third column shows the current value of the resource. For digital resources, if the value is displayed in REVERSE, it means that the corresponding parameter is denied.

6.6.2.3 L.03 VIRTUAL INPUTS



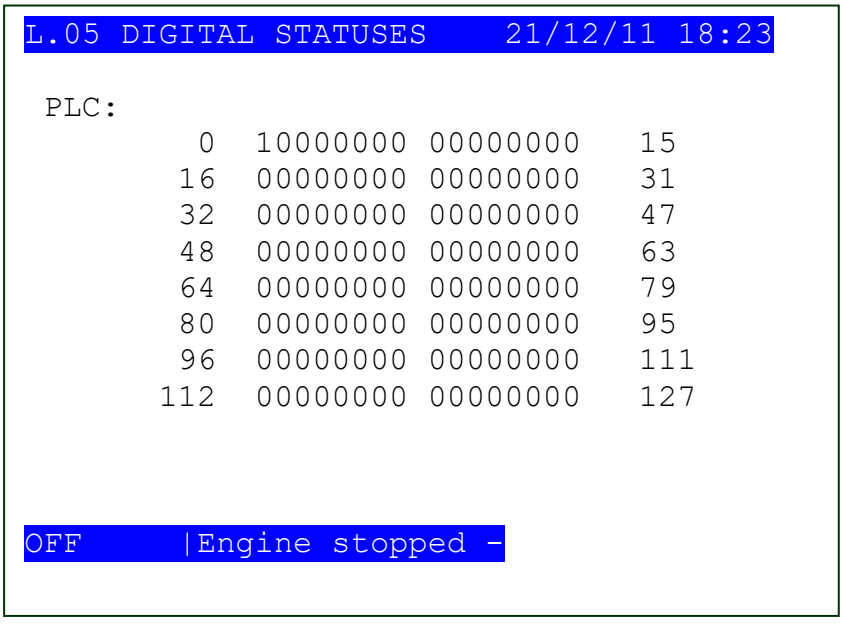
This page displays the status of all virtual digital inputs (i.e. those inputs whose status is not acquired by the hardware but is determined by the PLC program).

6.6.2.4 L.04 DIGITAL SUPPORTS



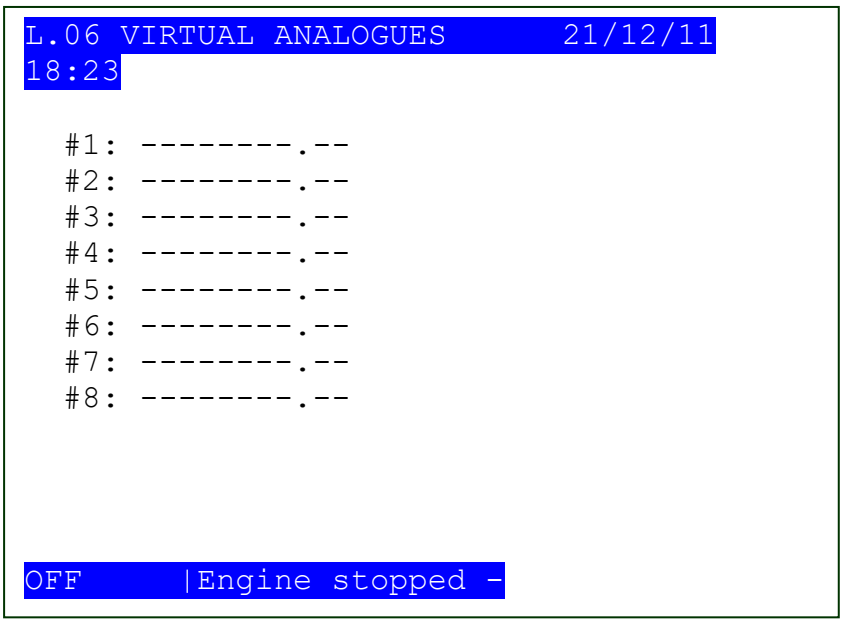
This page shows the status of all digital temporary variables (DT_XXX) available for the PLC program. Several pages that alternate every 2 seconds to display all digital supports are available. By holding down the SHIFT key, the rotation of pages is prevented (therefore keeping the currently displayed page on the display).

6.6.2.5 L.05 DIGITAL STATUSES



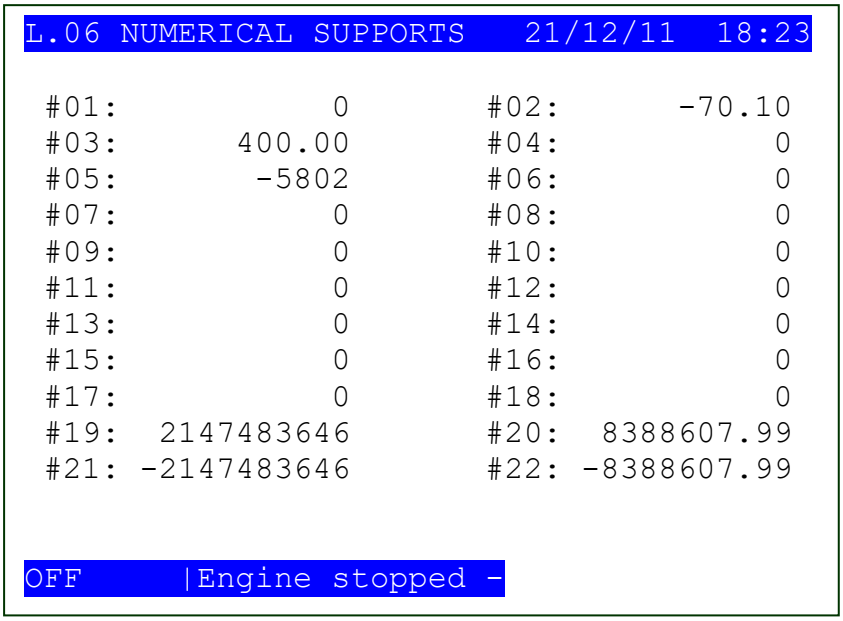
This page shows the value of all internal statutes of the board (ST.XXX) available for the PLC program.

6.6.2.6 L.06 VIRTUAL ANALOGUES



This page shows the value of all the virtual analogue inputs of the board (i.e. those inputs whose value is not acquired by the hardware but is determined by the PLC program).

6.6.2.7 L.07 NUMERICAL SUPPORTS



This page shows the status of all temporary numeric variables (AT_XXX) available for the PLC program. Several pages that alternate every 2 seconds to display all numeric supports are available. By holding down the SHIFT key, the rotation of pages is prevented (therefore keeping the currently displayed page on the display).

6.6.3 Status information (S.XX)

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

6.6.3.1 S.01 STATUS

Page S.01 (STATUS) shows system status information. Part of this information is shown on the bottom status bar. It contains:

- The possible activation of the various protection OVERRIDES (see 10.5).
- The warning (acquired via CAN-BUS) of the "derating" status of the engine, directly activated by the control unit of the engine.
- The warning (acquired via CAN-BUS) that the control unit of the engine has autonomously stopped the engine.
- The warning (acquired via CAN-BUS) that the control unit of the engine has disabled an engine cylinders bank.
- The reporting of any "limitations" of the active power setpoint for the supply in parallel with the mains: these limitations are due to anomalous mains voltage or frequency conditions, or may have been requested from contact (see [3]). If these limitations stop the engine, another message on this page reports it.

For some of this information also a time is displayed; for example, if power setpoint limitations are active, but the conditions of the mains no longer require the limitation, the board shows the seconds remaining to the time when these restrictions will be removed.

6.6.3.2 S.02 ANOMALIES

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

- Only for DST4602Evolution and DST4602/P Evolution: date and time when the anomaly occurred.
- A letter that identify the type.
  - “A”: alarm (block)
  - “D”: deactivation
  - “U”: unload
  - “W”: warning
- A three-digit numeric code that uniquely identify the anomaly. This code flash until it is acknowledged pressing the “ACK/TEST” pushbutton.
- An alphanumeric description, which depends on the language currently selected and which in some cases can be customized using the controller parameters.

Only for DST4602Evolution and DST4602/P Evolution: each anomaly is displayed in yellow if it’s a warning, in red if it’s an unload, a deactivation or a block.

Every fault uses one or two rows of the display LCD (only one line for DST4602Evolution and DST4602/P Evolution). The fault shown in the highest position is the most recent, chronologically. If the space available is not enough to display all the faults, only the most recent will be displayed. To see the other, it is required to:

- Use the ENTER button.
- Use the UP and DOWN keys to scroll the anomalies

- Press EXIT to leave the mode

Some anomalies can show additional diagnostic information. DST4602 Evolution always shows this information. For DST4602, instead, this information is automatically displayed in case of a single active anomaly: if there are several active anomalies, use the procedure described above to select the individual anomalies and display any additional diagnostic information about the selected anomaly. The anomalies that have additional diagnostic information are:

- 273 (“incoherent parameters”). It displays an additional message to help understanding the problem.
- 252 ("missing expansion module"). It displays an additional message that identifies the configured expansion module, but that does not communicate with DST4602.
- 253 ("missing analogue measurement"). It displays an additional message that identifies the acquisition channel and the expansion module from which a measure should be received, that is missing.
- 254 ("address duplicated on EXBUS"). It displays an additional message that identifies the type and address of the expansion module that results as connected twice to DST4602.
- 255 (“connection interrupted with one sensor”). It displays an additional message that identifies the acquisition channel and the expansion module that are transmitting the “broken wire” information.
- 900 ("inconsistent parameters on PLC"). It displays an additional message to help understanding the problem.
- 198 and 199 ("yellow light" and "red light" from CAN-BUS). In this case the controllers shows also the diagnostic codes received from the extern electronic device (Engine Control Unit, Automatic Voltage Regulator, Gas Mixer). For each diagnostic code it is shown:
    - The name of the external device who generated it (only since version 1.15).
    - The SPN code (it is a code defined by the SAE J1939 standard, which identifies the mechanical component that is having the problem) (if available).
    - The FMI code (it is a code defined by the SAE J1939 standard, which identifies the type of problem) (if available).
    - How many times this diagnostic code has been activated (OC) (if available).
    - The alarm code specific for the connected external device (DTC) (if available).
    - An alphanumeric description (the same in English) of the problem (if available).

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

6.6.3.3 S.03 CONTROLLER

This page contains a lot of information related to DST4602 board:

- Date/time in extended format.
- The temperature inside the board.

- The unique serial number of the board.
- The "internal code": this number should be provided to Mecc Alte along with the serial number to get the temporary "Mecc Alte" password for the modification of parameters. This password is valid for 2 hours of engine running: after this time DST4602 generates a new "internal code", which therefore makes the old password void.
- DST4602 main firmware version (EB0240179XXYY for DST4602 and DST4062/P or EB0240245XXYY for DST4602Evolution and DST4602/P Evolution).
- The version of the firmware that manages the DST4602 display (EB0220104XXYY for DST4602 and DST4602/P or EB0240242XXYY for DST4602Evolution and DST4602/P Evolution).
- The version of the Ethernet interface firmware (if present).
- The currently selected language. It is possible to select a different language from this page:
    - Press the ENTER.
    - Use UP and DOWN keys to choose the desired language.
    - Confirm with ENTER.

Note: Standard DST4602 is supplied only with ENGLISH and ITALIAN languages. With BoardPrg4 program it is possible to transfer other languages to the controller.

- The code for software options. This code is usually “00”. If software options have been purchased from Mecc Alte (e.g., CBE "Closure Before Excitation" - see [3]) the displayed value is different from 00.

6.6.3.4 S.04 SERIAL PORTS

This page is dedicated to the status of the two serial ports and of the ETHERNET port. In case of functional problems, please, verify the content of this page.

DST4602 displays the status (idle, ongoing communication, etc.) of each port. By connecting a GSM modem to the main serial port, the controller displays additional information, such as the telephone company and the level of the signal.

Only for serial ports, DST4602 also displays the reception errors counter. It is possible to reset the single counter directly from this page:

- Use the ENTER button.
- Use the vertical UP and DOWN scroll keys to select the desired counter.
- Press and hold ACK/TEST + EXIT keys for a few seconds until the board shows the message "RESET/DEFAULT".
- Use the EXIT button.

For the Ethernet port, the controller shows:

- The MAC address of the network interface.
- The IP address in the local network.
- The subnet mask of the local network.
- The Gateway address of the local network.

- The address of the DNS server.

If DHCP protocol is enabled, the information displayed is that returned by the DHCP server; in addition, it also shows the name under which the controller was registered on the DNS server (P0456).

6.6.3.5 S.05 CAN-BUS

This page is dedicated to the displaying of the status of the three DST4602 CAN-BUS interfaces:

- CAN0: dedicated to communication with engine electronic controls (ECU).
- CAN1: dedicated to communication with the other Mecc Alte boards (PMCB).
- CAN2: dedicated to communication with expansion modules (EXBUS).

For each interface DST4602 shows:

- The status of the interface. Three statuses are possible:
  - ERROR-ACTIVE: normal operations
  - ERROR-PASSIVE: the hardware interface is working, but there are problems in communication.
  - BUS-OFF: Genset has interrupted the connection to the CAN-BUS due to too many errors.
- The present value of the transmission and reception error counters, managed directly by the CAN-BUS interface.
- The maximum value reached by transmission and reception error counters, managed directly by the CAN-BUS interface. It is possible to reset the maximum values with the following procedure:
  - Use the ENTER button.
  - Select the desired CAN-BUS interface with UP and DOWN keys.
  - Press and hold ACK/TEST + EXIT keys for a few seconds until the board shows the message "RESET/DEFAULT".
  - Use the EXIT button.

6.6.3.6 S.06 SYSTEM STATUS

6.6.3.7 S.07 SYSTEM STATUS

6.6.3.8 S.08 SYSTEM STATUS

6.6.3.9 S.09 SYSTEM STATUS

6.6.3.10 S.10 SYSTEM STATUS

6.6.3.11 S.11 SYSTEM STATUS

6.6.3.12 S.12 SYSTEM STATUS

6.6.3.13 S.13 SYSTEM STATUS

These pages are dedicated to the displaying of the status of the digital inputs configured as "generic statuses". The operator has the possibility to acquire the digital status information (1/0, on/off, true/false, etc.) that are not in any way related to the functioning of the board, and shown on the

board display. It can also group them (by any standard), and display them on one of the eight available pages.

The division of the statuses on the different pages is done via the function configured in the digital inputs:

- DIF.3201 and DIF.3202: page S.06.
- DIF.3203 and DIF.3204: page S.07.
- DIF.3205 and DIF.3206: page S.08.
- DIF.3207 and DIF.3208: page S.09.
- DIF.3209 and DIF.3210: page S.10.
- DIF.3211 and DIF.3212: page S.11.
- DIF.3213 and DIF.3214: page S.12.
- DIF.3215 and DIF.3216: page S.13.

As you can see, there are two functions to associate the digital inputs to each page: by using the even function (for example DIF.3202 for S.06 page), DST4602 will force the page displaying when the input is activated.

DST4602 shows one status information per line: it shows the text configured for the digital input (P.2003 for digital input 1), followed by the logic status of the input ("1" or "0"). If more than 14 statuses are associated to one of these pages, DST4602 displays them all, by rotating them on the display every two seconds: hold down the SHIFT key to stop the rotation on the current displaying.

6.6.3.14 S.14 DIGITAL INPUTS

This page displays the status of all board and expansion modules digital inputs (the latter ones displayed only if properly configured with P.0141 parameter).

It is possible to display the inputs in three different ways:

- **Logic status**: DST4602 shows "1" for all inputs that are active from the logical point of view. DST4602 normally considers an input active when the related terminal is connected to the battery negative. It is anyway possible to indicate to DST4602, individually for each input, to consider an input as active when its terminal is floating (reverse polarity, see P.2000 parameter for inputs 1...16 of DST4602, and the equivalents for the other inputs).
- **Physical status**: DST4602 shows "1" for all inputs whose terminal is connected to the battery negative. The display is in REVERSE.
- **By function**: In this mode, DST4602 shows a list of all the functions associated with the digital inputs, and for each function it indicates whether the input that acquires it is active ("1") from the logical point of view. It is therefore possible, for example, to verify whether the feedback of the switch is active, without knowing which board or expansion module input acquires it. DST4602 shows a function for each line. If there are not enough lines for all functions, DST4602 shows them by rotating them every two seconds: hold down the SHIFT key to stop the rotation on the current view.

It is possible to change the display mode of the digital inputs by pressing the ENTER key.

6.6.3.15 S.15 DIGITAL OUTPUTS

This page displays the status of all board and expansion modules digital outputs (the latter ones displayed only if properly configured with P.0141 parameter).

It is possible to view the outputs in three different ways:

- **Logic status**: DST4602 shows "1" for all outputs that are active from the logical point of view, that is, when the function associated with the output requires its activation. Normally, DST4602 activates the internal control relay or transistor when the function associated with the output requires its activation. It is anyway possible to indicate to DST4602, individually for each output, to activate the internal relay or transistor when the function associated with the output does not require its activation (reverse polarity, see P.3000 parameter for output 1 ... 16 of DST4602, and the equivalents for the other outputs).
- **Physical status**: DST4602 shows "1" for all the outputs whose internal relay or transistor is activated. The display is in REVERSE.
- **By function**: In this mode, DST4602 shows a list of all the functions associated to the digital outputs, and for each function it indicates whether the output controlling it is active ("1") from the logical point of view. It is therefore possible, for example, to verify if the control to close a switch is activated, without knowing which board or expansion modules output controls it. DST4602 shows a function for each line. If there are not enough lines for all functions, DST4602 shows them by rotating them every two seconds: hold down the SHIFT key to stop the rotation on the current view.

It is possible to change the displaying mode of the digital outputs by pressing the ENTER key.

6.6.3.16 S.16 ANALOGUE INPUTS

This page displays the status of all board and expansion modules analogue inputs (the latter ones displayed only if properly configured with P.0142 and P.0143 parameters).

- For the analogue inputs of the board, DST4602 shows the value in “Vdc” or in “Ohm”.
- For DITHERM and DIGRIN expansion modules analogue inputs, DST4602 shows the value in “°C” or in “°F” (P.0191 parameter).
- For DIVIT expansion modules analogue inputs, DST4602 shows the value as supplied by the module, by assuming that it is a percentage.

DST4602 also shows the "Vdc" voltage measured on J27-5 terminal (reference for the engine analogues), even if it is not an analogue input used for to the board logics.

If all possible expansion modules are used, there are not enough lines to display all analogue inputs. DST4602 shows them by rotating them every two seconds: hold down the SHIFT key to stop the rotation on the current view.

6.6.3.17 S.17 ANALOGUE OUTPUTS

This page displays the status of all board analogue outputs and expansion modules (the latter ones only displayed if properly configured with P.0144 parameter). Output values are always shown in %.

It is possible to display the analogue outputs in two different ways:

- **Logic status**: DST4602 shows the list of all the board or expansion modules outputs, with their related values.
- **By function:** In this mode, DST4602 shows a list of all the functions associated with analogue outputs, and for each function it indicates the value (%) of the associated output. It is

therefore possible, for example, to verify the speed regulator control, without knowing which board or expansion module analogue output controls it. DST4602 shows a function for each line. If there are not enough lines for all functions, DST4602 shows them by rotating them every two seconds: hold down the SHIFT key to stop the rotation on the current view.

It is possible to change the displaying mode of the analogue outputs by pressing the ENTER key.

6.6.3.18 S.18 MAINS PROTECTIONS

This page is displayed only if the system provides the continuous parallel with the mains (P.0802). It displays the status of all protections for the parallel with the mains, plus some necessary measures to immediately assess the status of the mains.

On the first lines of the page, DST4602 shows a wording for each parallel protection with the configured mains. The wording is displayed in reverse if, at that time, the protection has been triggered. The possible wordings are:

- **DI:** parallel protection of with the external mains, acquired by a digital input configured with DIF.3103 function.
- **27<<**: mains low voltage protection (P.0912 and P.0913 parameters).
- **27<**: mains low voltage protection (P.0916 and P.0917 parameters).
- **27Q:** mains low voltage protection con with directional reactive (27 U< & Q→) (P.1231 ...P.1239 parameters).
- **59>:** mains high voltage protection (P.0918 and P.0919 parameters).
- **59>>:** mains high voltage protection (P.0914 and P.0915 parameters).
- **81<<:** mains low frequency protection (P.0922 and P.0923 parameters).
- **81<:** mains low frequency protection (P.0926 and P.0927 parameters).
- **81>**: mains high frequency protection (P.0928 and P.0929 parameters).
- **81>>**: mains high frequency protection (P.0924 and P.0925 parameters).
- **81R:** Δf/Δt protection (also called ROCOF, P.0931...P.0933 parameters).
- **VJ:** "Vector Jump" protection (also called "Vector Shift" or "Vector Surge", P.0941 and P.0942 parameters).
- **MC:** mains parallel protection activated by a MC board connected to the PMCB CAN-BUS.

See the document [3] for the description of the protections for the parallel with the mains.

The bottom of the page shows some measures related to the mains. Each measure is shown with its unit of measure, but it is also shown as a percentage of the nominal size, viewed as well:

- Frequency.
- Phase-to-phase voltages.
- Positive sequence voltage (also shows the angle of the vector).
- Positive sequence current (also shows the angle of the vector).
- Positive sequence reactive power.

The last three measures are used by “27 U< & Q→” protection.

6.6.3.19 S.19 D-PRO 1

This page is shown only if the controller is configured to communicate via CANBUS with the D-PRO protection relay (parameter P.0145 >=1). It displays all the measurements received from the protection relay:

- D-PRO Digital inputs status
- D-PRO Digital outputs status
- D-PRO Supply voltage
- Measure of the voltages connected to D-PRO:
    - Phase-Neutral voltage.
    - Phase-Negative voltage.
    - Phase-Phase voltage (in case of three-phase system).
    - Phase-Phase medium voltage (in case of three-phase system).
    - Phase rotation sense (in case of three-phase system).
    - Homopolar voltage (59N).
- Measure of the currents connected to D-PRO:
    - Current measurement (side A).
    - Current measurement (side B).
    - Auxiliary current measurement.
    - Current measurement by toroid input.
- Measure of the differential current (if the protection 87G or 87T is enabled).
- Measure of the positive and negative sequence currents (in case of three-phase system).
- Measure of the differential current (if the protection 64 is enabled).
- Measure of the frequency.
- Measure of the active power.
- Measure of the reactive power.

For detailed information on the D-PRO protection relay, see the related technical manual.

6.6.3.20 S.20 D-PRO 1

This page is shown only if the controller is configured to communicate via CANBUS with the D-PRO protection relay (parameter P.0145 >=1). It shows all the relay protections status, displaying the number of the protections configured:

- 27.
- 27T.

- 59.
- 59N.
- 46.
- 47.
- 81U.
- 81O.
- 50.
- 50N.
- 50V.
- 51.
- 51N.
- 51V.
- 87G.
- 87T.
- 32P.
- 32Q.
- 32RP.
- 32RQ/40.
- 64.

For DST4602 and DST4602/P, each number has a caption

- “Disable”: the specific protection is disabled by a D-PRO digital input
- “Enable”: the specific protection is enabled but it has not triggered now
- “Trip”: the specific protection has triggered

For DST4602Evolution and DST4602/P Evolution, the status of each protection is indicated by colours:

- The protection number is in white if the specific protection is disabled by a D-PRO digital input
- The protection number is in cyan if the specific protection is enabled but it has not triggered now
- The protection number is in cyan and in reverse if the specific protection has triggered

6.6.3.21 S.21 D-PRO 1

This page is displayed only if the controller is configured to communicate via CANBUS with two D-PRO protection relays (parameter P.0145 = 2). It displays all the measurements received by the protection relay. See the previous paragraphs.

6.6.3.22 S.22 D-PRO 2

This page is displayed only if the controller is configured to communicate via CANBUS with two D-PRO protection relays (parameter P.0145 = 2). It displays the status of the relay protections. The acronyms of the configured protections are displayed. See the previous paragraphs.

6.6.3.23 S.23 PULSE COUNTERS

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

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

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

This page shows the values of the configured counters.

6.6.4 Electrical measurements (M.XX)

This mode displays all the information on the measurements taken by the Gen-set control module on the electric lines.

6.6.4.1 M.01 SYSTEM

This page shows, in a single-line format, the system scheme. The shown items depend on the type of system (P.0802). The following can be displayed:

- The symbol of the generator (if there is voltage on a dark background).
- GCB switch.
- MGCB switch.
- Users (if powered, on a dark background).
- MCB breaker.
- The mains (flashing if there is no voltage).
- The symbol of a possible transformer (between the generator and GCB switch or between GCB switch and the system).
- The setpoints for the active and reactive power for the supply in parallel with the mains (or the setpoint for the DROOP if this mode is active).

The symbol of the switches also contains an indication of the fact that it is possible to use synchronization to control its closure (empty dots) or not (filled dots). Moreover, the board, autonomously shows the symbol of the interlocks among the switches for the systems that do not include the parallel. It can also display the symbol of a commutator (SIRCOVER) instead of the two switches, if properly configured.

In addition, where possible, DST4602 shows:

- The average voltage, the frequency and the active power of the mains.
- The average voltage, the frequency, the active power and the power factor of the generator.
- The active power and the power factor on the parallel bars (total of generators).
- The active power and the power factor of the users.

Finally, where possible, DST4602 shows some arrows that indicate the direction of the power flow in the various branches of the system.

DST4602 independently determines (based on the configuration of the system) what should be displayed: the operator has however the possibility, by setting P.0494 parameter, to hide some elements or to force the displaying of others. See the document [1] for a detailed description of the parameter.

It is generally possible to modify from this page the setpoints for the power or the DROOP (if displayed), unless these setpoint are acquired from analogue inputs or from any MC board connected on PMCB. To modify the setpoints:

- Press ENTER key: the selected setpoint will be displayed in REVERSE.
- Use UP and DOWN keys (possibly together with the SHIFT key) to change the setpoint value.
- Use the LEFT, RIGHT or ACK/TEST to select another setpoint.
- Press ENTER or EXIT to stop the setpoint modification procedure.

Note: if no keys are pressed for 60 seconds, the procedure to modify the setpoints is automatically terminated.

6.6.4.2 M.02 MAINS/BARS

This page displays the main electrical data acquired by DST4602 mains/bars sensor (J24 or J19 connector). The title of the page is suitable to what configured with P.0126 parameter (0-BARS, 1-MAINS).

The number of displayed information depends on the single phase/three-phase configuration of the system (P.0119). Furthermore, some pieces of information are not shown if the neutral line is not connected to the board (P.0129).

The information that can be displayed is:

- Frequency.
- Phase-to-phase voltages.
- Phase voltages.
- The measured voltage between the neutral and the battery negative.
- The rotation direction of phases (clockwise CW or counter clockwise CCW).

- The three current measurements (if the current transformers are on users and the users are connected to the mains - P.0124).
- Any measurement of neutral current (if the current transformers are on users and the users are connected to the mains, or if it is on the mains - P.0130).
- Any differential current measurement.

6.6.4.3 M.03 GENERATOR

This page shows the main electrical measures acquired DST4602 from the generator (J23 or J18 connector).

The number of displayed information depends on the single phase/three-phase configuration of the system (P.0111). Furthermore, some pieces of information are not shown if the neutral line is not connected to the board (P.0128).

The information that can be displayed is:

- Frequency.
- Phase-to-phase voltages.
- Phase voltages.
- The measured voltage between the neutral and the battery negative.
- The rotation direction of phases (clockwise CW or counter clockwise CCW).
- The three measurements of current (if the current transformers are on the generator, or on users and the users are connected to the generator - P.0124).
- Any measurement of neutral current (if the current transformer is on the generator, or on users and the users are connected to the generator - P.0130).
- Any differential current measurement.

6.6.4.4 M.04 POWERS

Page displays the total and phase power values, the active, reactive and apparent power values, and the power factor. If the current transformers are positioned on users (P.0124 = 1), the board shows (bottom) also the symbol of the generator or of the mains to indicate whether, at that time, the users are connected to the mains or to the generator.

6.6.4.5 M.05 ENERGY COUNTERS

This page displays the energy counters managed by the board. Counters for active energy (partial and total) and reactive energy (partial and total) supplied by the generator are available. Moreover, if the current transformers are positioned on users (P.0124 = 1), there are as many counters for the energy measured on the mains.

It is possible to individually reset partial counters directly from this page:

- Use the ENTER button.
- Use UP, DOWN, LEFT and RIGHT keys to select the counter to be reset: the selected counter will be displayed in REVERSE.
- Press and hold ACK/TEST + EXIT keys for 5 seconds: the board will display a confirmation message and reset the counter.

- Press the ENTER key to finish the reset procedure.

From version 1.09, these counters are protected with the password configured by parameter P.0001 (protection level: user). If a password has been configured in P.0001, to be able to reset the counters, it must first be entered (login) in parameter P.0000 ("access code").

6.6.4.6 M.06 AUXILIARY MEASURES

This page displays some additional voltage and current measures.

On this page the following are displayed:

- The measurement of auxiliary current, when configured as a "General purpose" (P.0131 = 1) or "Power measurement on the mains" (P.0131=4). In the other cases, this measure is shown on M.02 or M.03 pages.
- Positive and negative sequence vectors of currents.
- Positive and negative sequence vectors for generator voltages.

6.6.4.7 M.07 SYNCHRONIZATION

This page shows all the information necessary during the synchronization process. The board shows:

- Voltages, frequency and direction of rotation of the generator.
- Voltages, frequency and direction of rotation of the mains or parallel bars.
- The phase difference between the two three-phases.
- The voltage difference between the two three-phases (only for Evolution controllers).
- The frequency difference between the two three-phases (only for Evolution controllers).
- Engine speed (RPM)

DST4602 also displays a synchronoscope (but only during the actual synchronization procedure). Besides graphically showing the phase difference, the synchronoscope contains four lights:

- The upper left light indicates (when lit) an excessive voltage difference, which prevents closing the switch.
- The upper right light indicates (when lit) an excessive frequency difference, which prevents closing the switch.
- The lower central light indicates (when lit) that the direction of rotation of the two three-phases is different, and therefore the switch cannot be closed.
- The central light, instead, is turned on when DST4602 recognizes the “synchronized” status and controls the closing of the switch.

See the document [3] for the description of the synchronization procedure.

In the lower part of the window, the board shows two couples of values:

- "RIF” column DST4602 shows the present value of speed and voltage references (that can be used for manual sync, see below).
- "CMD" column: they are the current controls for the speed and tension control.

The values in the two columns differ if customized conversion curves or limitations on the analogue outputs used to control speed and voltage regulators are employed (see document [3]).

DST4602 also allows performing the manual synchronization procedure, where the engine speed or the alternator voltages are regulated by the operator and not by the board. This function is available if P.0848 parameter is set to zero. To adjust voltage and frequency, the operator should:

- Use the ENTER button.
- Use the LEFT or RIGHT keys to select the reference to be modified (voltage or frequency). The selected reference is displayed in REVERSE. Note: it is not possible to select a reference if its value is acquired from an analogue input.
- Use the UP and DOWN keys (possibly together with the SHIFT key) to change the selected reference (and consequently the frequency or voltage of the generator).
- Press ENTER or EXIT to finish the modification process.

Note: if no keys are pressed for 60 seconds, the procedure to modify the setpoints is automatically terminated.

The operator should press the GCB key to close the switch: DST4602 will close only if it recognizes the "synchronized" condition.

6.6.4.8 M.08 PARALLEL

This page displays the most useful information to monitor the operations of the generator in parallel with other generators or to the mains. DST4602 displays:

- The average phase-to-phase voltage of the generator.
- The frequency of the generator.
- The three currents of the generator.
- The active and reactive power supplied by the generator.
- The power factor and the cos(ϕ) (this latter one only for applications in parallel with the mains).
- Engine speed (RPM)

The difference between "power factor" and "cos(ϕ)" is in the calculation method. The "power factor" is calculated from the measured active power and apparent power (closing of the triangle): it does not consider any harmonic content of voltage or frequency. The second is calculated starting from the measured active power and reactive power.

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

6.6.4.9 M.09 SETPOINT

This page shows and allows to change (in just one point) all the adjustable setpoints for the plant, related to voltage and speed regulators. It is useful because page M.01 only shows the main setpoints in a specific moment. For example, if a plant can work in both BASE LOAD and DROOP mode, page

M.01 will only show the setpoints related to the current operating mode, while page M.09 will show all of them: in this way, the operator can adjust the setpoints before changing the operating mode. The adjustable setpoints are:

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

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

6.6.4.10 M.10 SETPOINT2

This page (available from version 00.70) shows (in just one point) all the adjustable setpoints for the plant acquired by analogue inputs, related to voltage and speed regulators. It is like page M.02. The adjustable setpoints are:

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

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

6.6.4.11 M.11…M.13 AVR (Evolution)
M.11…M.15 AVR (Standard)

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

- spn 1122 - Engine Alternator Bearing 1 Temperature.
- spn 1123 - Engine Alternator Bearing 2 Temperature.
- spn 1124 - Engine Alternator Winding 1 Temperature.
- spn 1125 - Engine Alternator Winding 2 Temperature.
- spn 1126 - Engine Alternator Winding 3 Temperature.
- spn 2436 – Average frequency
- spn 2437 - Frequency L1
- spn 2438 - Frequency L2
- spn 2439 - Frequency L3
- spn 2440 - Average L-L voltage

- spn 2441 - Voltage L1-L2
- spn 2442 - Voltage L2-L3
- spn 2443 - Voltage L3-L1
- spn 2444 - Average L-N voltage
- spn 2445 - Voltage L1-N
- spn 2446 - Voltage L2-N
- spn 2447 - Voltage L3-N
- spn 2448 – Average current
- spn 2449 - Current L1
- spn 2450 - Current L2
- spn 2451 - Current L3
- spn 2452 - Total active power
- spn 2453 - Active power L1
- spn 2454 - Active power L2
- spn 2455 - Active power L3
- spn 2456 - Total reactive power
- spn 2457 - Reactive power L1
- spn 2458 - Reactive power L2
- spn 2459 - Reactive power L3
- spn 2460 - Total apparent power
- spn 2461 - Apparent power L1
- spn 2462 - Apparent power L2
- spn 2463 - Apparent power L3
- spn 2464 - Total power factor
- spn 2465 - Power factor L1
- spn 2466 - Power factor L2
- spn 2467 - Power factor L3
- spn 2518 - Load type (total) (0=leading, 1=lagging)
- spn 2519 - Load type L1 (0=leading, 1=lagging)
- spn 2520 - Load type L2 (0=leading, 1=lagging)
- spn 2521 - Load type L3 (0=leading, 1=lagging)
- spn 2468 - Exported active energy
- spn 2469 - Imported active energy
- spn 3380 - Excitation voltage
- spn 3381 - Excitation current.

6.6.4.12 M.14…M.19 AVR (Evolution) M.16…M.21 AVR (Standard)

From version 1.15, the controller supports the management of external configuration files that describe the Canbus communication with the automatic voltage regulators. These files may include the definition of one or more pages for the display, dedicated to displaying the specific measures / states of that device (usually when they do not follow the J1939-75 standard).

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

6.6.5 Engine measurements (E.XX)

In this mode, the measurements acquired from the engine are displayed in full.

6.6.5.1 E.01 ENGINE

It is the main page: it displays the main dimensions of the engine detected by the analogue sensors or directly by the engine electronic control unit (ECU) via CAN0 CAN-BUS.

For DST4602 and DST4602/P, this page shows the following measures:

- Lubricating oil pressure, temperature and level.
- Coolant pressure, temperature and level.
- Fuel pressure, temperature and level.
- Engine speed (RPM)
- Battery voltage

If some of the above measures are not available, they are displayed with dashes.

For the Evolution controllers, this page shows:

- Battery voltage
- Engine speed (RPM)
- Oil and coolant liquid temperature
- Oil pressure
- Fuel level

If some of the above measures are not available, they are displayed with grey background.

6.6.5.2 E.02 ENGINE 2

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

- coolant level (AIF.1210 or AIF.1211 functions in the configuration of the analogue inputs).
- oil temperature (AIF.1100 or AIF.1101 functions in the configuration of the analogue inputs).
- oil level (AIF.1200 or AIF.1201 functions in the configuration of the analogue inputs).
- air temperature in the intake duct (AIF.1601 function in the configuration of the analogue inputs).
- turbocharger pressure (AIF.1641 function in the configuration of the analogue inputs).
- exhaust gas temperature (left bank) (AIF.1603 function in the configuration of the analogue inputs).
- exhaust gas temperature (right bank) (AIF.1605 function in the configuration of the analogue inputs).

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

6.6.5.3 E.03 ENGINE COUNTERS

This page shows all the counters related to the engine. Some of these counters are operated by DST4602, others are managed by the engine control unit (ECU).

- Engine starts counter (resettable to zero).
- Hours of engine operation (partial, resettable).
- Hours of engine operation (total).
- Hours of operation of the loaded engine (resettable).
- Hours of engine operation with disabled protections (resettable).
- Hours to maintenance.
- Hours of engine operation (ECU, SPN_247).
- Consumed fuel (ECU, SPN_250, total).
- Consumed fuel (ECU, SPN_182, partial, resettable).

The counters managed by the engine control unit, if not available, are not shown. If the number of hours to maintenance is not set, its counter shows some dashes.

It is possible to reset so counters individually directly from this page (including those managed by ECU):

- Use the ENTER button.
- Use the UP and DOWN keys to select the counter to be reset: the selected counter will be displayed in REVERSE.
- Press and hold ACK/TEST + EXIT keys for 5 seconds: the board will display a confirmation message and reset the counter.
- Press the ENTER key to finish the reset procedure.

From version 1.09, these counters are protected with the password configured by parameter P.0001 (protection level: user). If a password has been configured in P.0001, to be able to reset the counters, it must first be entered (login) in parameter P.0000 ("access code").

6.6.5.4 E.04 FUEL PUMP

This page contains information relating to the fuel pump. It is displayed only if a board output is configured to control the pump (DOF.01032 function). See paragraph 9.5.13dedicated to the fuel pump.

This page shows the status of the pump (off/on) and the request arising from the management logic (starting, stopping, in hysteresis).

If the tank level is acquired via an analogue input, the board shows also a bar that graphically indicates the current level, showing activation/stopping thresholds of the pump as well.

It also shows the control mode (“Manual-OFF”, “Manual-ON” and “Automatic”). It is possible to change the mode from this page, see paragraph 9.5.13.

6.6.5.5 E.05 EXTERNAL MEASURES

6.6.5.6 E.06 EXTERNAL MEASURES

6.6.5.7 E.07 EXTERNAL MEASURES

6.6.5.8 E.08 EXTERNAL MEASURES

6.6.5.9 E.09 EXTERNAL MEASURES

6.6.5.10 E.10 EXTERNAL MEASURES

6.6.5.11 E.11 EXTERNAL MEASURES

6.6.5.12 E.12 EXTERNAL MEASURES

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

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

- AIF.2001: page E.05.
- AIF.2003: page E.06.
- AIF.2005: page E.07.
- AIF.2007: page E.08.
- AIF.2009: page E.09.
- AIF.2011: page E.10.
- AIF.2013: page E.11.
- AIF.2015: page E.12.

DST4602 shows a measure per line: it shows the text configured for the analogue input (P.4002 for the analogue input 1), followed by the measure. If more than 14 measures are associated to one of these pages, DST4602 shows all of them, by rotating them on the display every two seconds: hold down the SHIFT key to stop the rotation on the current view.

6.6.5.13 E.13 HT-AF1000LS/AF2000

This page is dedicated to the information acquired via CAN0 CAN-BUS from a specific customer's control unit. This page is visible only if parameter P.0700 (up to version 00.88) of P.0750 (from version 00.89) is configured with 200 or 201 values. It shows the measures that DST4602 acquires via CAN0 CAN-BUS from these control units.

6.6.5.14 E.14 MAN-DATALOGGER

This page shows a recap of all the measurement acquired from the MAN-DATALOGGER device, connected to a MAN engine:

- Oil pressure A and B (OPA and OPB).
- Oil temperature A and B (OTA and OTB).
- Inlet and outlet coolant temperature (CW and CWO).

- Boost pressure and temperature (BP and BT).
- Exhaust gas temperature (turbine inlet, EXTA and EXTB).

6.6.5.15 E.15 AFR (AIR FUEL RATIO)

This page is dedicated to the management of the AFR, the control of the air/gas mixture for gas engines. The page is displayed only if the management of the AFR is enabled.

It allows to select the manual position for the mixer, and the MAN/AUTO command mode too.

It shows also:

- A table showing the setpoints for regulation (maximum seven points). For each point it shows:
    - The generator power (%).
    - The equivalent value in kW.
    - The corresponding setpoint for the AFR-IN measurement.

  On DST4602, the display is smaller than on DST4602 Evolution: normally, therefore, only the power setpoint in percentage is displayed. Pressing the SHIFT button, you can switch the display from % to kW (and vice versa).
- The power supplied by the generator (as kW and as %). If the generator is working in parallel to the grid, it also shows the final setpoint for the active power (which can be reduced in the case of high temperature of the air/gas mixture - MAT).
- The temperature of the air/gas mixture (MAT, if available).
- The percentage of methane in the gas (CH4, if available).
- The AFR-IN measurement (see the description of the AFR function in chapter 9). It is displayed with the unit of measurement set in the configuration of the analogue input that acquires it. When the generator is supplying a power higher than the threshold P.1333, the controller also shows the setpoint for this value, calculated from the table and the active power supplied (the regulation PID operates on this setpoint).
- The actual position of the mixer (if available), together with its setpoint.
- Any correction of the setpoint for the position of the mixer, calculated with the PLC as a function of an external quantity (temperature or other).
- The position of the actuator controlled by the speed regulator (if it is not available, the command of the controller is displayed).

In the last row, the controller shows abbreviations that allow you to understand under what conditions the system is operating:

- "**2ND**": during engine cranking and in no-load operation the controller uses the alternative position setpoints.
- "**CH4**": the position of the mixer during cranking is determined by the percentage of methane in the gas (P.1311 = 1).
- "**PID**": the regulation loop on the AFR-IN measurement is active.
- "**DB**": the regulation loop on the AFR-IN measurement is suspended because the regulation error is very small (dead band).

- "**UD_DB**": The controller is not activating UP and DOWN commands to adjust the position of the mixer because the position error very small (dead band).
- "**DRT**": a derating of the generator power setpoint is active due to a high temperature of the air/gas mixture (MAT).
- "**CORR**": the setpoint correction for the AFR-IN is active due to temperature of the air / gas mixture (MAT).

6.6.5.16 E.16 DASHBOARD

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

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

SPN 623 ("RED STOP LAMP"). The engine control unit (or the voltage regulator) is signalling on the CANBUS the presence of a diagnostic code (therefore a problem) that prevents its operation
-  Indicates that the regeneration of the diesel particulate filter is inhibited following explicit command. It is usually displayed in solid yellow (it is a state, not an anomaly). If, however the condition remains for a long time and the soot level in the filter becomes extremely high, the ECU activates a diagnostic code with red lamp (icon with a STOP sign shape) and stops the engine: in this case the icon becomes red (fixed or flashing, like red lamp). It is linked to SPN 3697 ("DIESEL PARTICULATE FILTER LAMP COMMAND") or 6915 ("SCR SYSTEM CLEANING LAMP COMMAND"). Only for DST4602 Evolution, if regeneration is in progress it is displayed in green.
-  Indicates that regeneration of the diesel particulate filter is required. It is yellow. It is fixed (not blinking) if the quantity of particulate in the filter is above the "regeneration request" threshold but below the warning threshold. It becomes flashing if it is above the warning threshold. It is related to SPN 3703 ("DIESEL PARTICULATE FILTER ACTIVE REGENERATION INHIBITED DUE TO INHIBIT SWITCH") or 6918 ("SCR SYSTEM CLEANING INHIBITED DUE TO INHIBIT SWITCH").
-  SPN 3698 ("EXHAUST SYSTEM HIGH TEMPERATURE LAMP COMMAND"). It signals a high temperature (real or possible) in the emissions management system (HEST – High Emission System Temperature), probably because regeneration is in progress or about to

start: the ECU could apply a reduction in engine performance (derating). It is yellow, not flashing.

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

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

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

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

6.6.5.17 E.17 Emissions level exceedance

It contains a series of standard information (J1939, DM32) acquired via CAN-BUS from the engine control unit (ECU). It is made up by a maximum of eight diagnostic codes, which indicate why the emissions level allowed by regulation is being exceeded.

If no code is active, DST4602 hides this page. If several codes are active at the same time, it alternates them on the display every two seconds. For each code DST4602 shows:

- The SPN code (which indicates the engine component responsible for exceeding the emission level).
- The FMI code, which indicates the type of failure on the engine component identified by the SPN.
- A textual description.
- The time since which the code is active (expressed in hours, with a resolution of 12 minutes).
- The time the code has been previously active (expressed in hours, with a resolution of 12 minutes).
- The time remaining before the ECU reduces the delivered power (expressed in hours, with the resolution of 15 minutes).

6.6.5.18 E.18…E.23 ECU (Evolution)
E.18…E.25 ECU (Standard)

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

- spn 22: Engine Extended Crankcase Blow-by Pressure
- spn 51: Engine Throttle Position.
- spn 52: Engine Intercooler Temperature.
- spn 81: Aftertreatment 1 Diesel Particulate Filter Intake Pressure
- spn 91: Accelerator Pedal Position 1.

- spn 92: Engine Percent Load At Current Speed.
- spn 94: Engine Fuel Delivery Pressure.
- spn 96: Fuel Level 1
- spn 98: Engine Oil Level.
- spn 100: Engine Oil Pressure.
- spn 101: Engine Crankcase Pressure.
- spn 102: Engine Intake Manifold #1 Pressure.
- spn 105: Engine Intake Manifold #1 Temperature.
- spn 106: Engine Intake Air Pressure
- spn 106: Engine Intake Air Pressure
- spn 107: Engine Air Filter 1 Differential Pressure
- spn 108: Barometric Pressure.
- spn 109: Engine Coolant Pressure.
- spn 110: Engine Coolant Temperature.
- spn 111: Engine Coolant Level.
- spn 132: Engine Intake Air Mass Flow Rate
- spn 156: Engine Injector Timing Rail 1 Pressure.
- spn 157: Engine Injector Metering Rail 1 Pressure.
- spn 158: Key switch Battery Potential.
- spn 166: Engine Rated Power.
- spn 168: Battery Potential / Power Input 1
- spn 171: Ambient Air Temperature.
- spn 172: Engine Intake 1 Air Temperature
- spn 173: Engine Exhaust Gas Temperature
- spn 174: Engine Fuel Temperature 1.
- spn 175: Engine Oil Temperature 1.
- spn 182: Engine Trip Fuel.
- spn 183: Engine Fuel Rate.
- spn 189: Engine Rated Speed.
- spn 190: Engine Speed.
- spn 247: Engine Total Hours of Operation.
- spn 249: Engine Total Revolutions
- spn 250: Engine Total Fuel Used.
- spn 411: Engine Exhaust Gas Recirculation 1 Differential Pressure
- spn 412: Engine Exhaust Gas Recirculation 1 Temperature
- spn 441: auxiliary temperature 1
- spn 442: auxiliary temperature 2
- spn 512: Driver's Demand Engine - Percent Torque.
- spn 513: Actual Engine - Percent Torque.
- spn 514: Nominal Friction - Percent Torque.
- spn 515: Engine's Desired Operating Speed.
- spn 544: Engine Reference Torque
- spn 977: Fan Drive State
- spn 1108: Engine Protection System Timer Override
- spn 1029: Trip Average Fuel Rate.
- spn 1127: Engine Turbocharger 1 Boost Pressure
- spn 1135: Engine Oil Temperature 2.
- spn 1136: Engine ECU Temperature.
- spn 1172: Engine Turbocharger 1 Compressor Intake Temperature
- spn 1180: Engine Turbocharger 1 Turbine Intake Temperature
- spn 1181: Engine Turbocharger 2 Turbine Intake Temperature
- spn 1182: Engine Turbocharger 3 Turbine Intake Temperature
- spn 1183: Engine Turbocharger 4 Turbine Intake Temperature
- spn 1241: Engine Fuel System 1 Gas Mass Flow Rate
- spn 1636: Engine Intake Manifold 1 Temperature (High Resolution)

- spn 1637: Engine Coolant Temperature (High Resolution)
- spn 1639: Fan Speed
- spn 2432: Engine Demand – Percent Torque

6.6.5.19 E.24 DPF REGENERATION (Evolution) E.26 DPF REGENERATION (Standard)

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

- Visualization. A minimum of measurements is required:
  - Percent of soot in the Diesel Particulate Filter (DPF).
  - Percentage of ash in the Diesel Particulate Filter (DPF).
  - Diesel Emissions Fluid (DEF) level.
  - Icons (shown on page E.16)
- Commands. The specification provides two separate commands, to be sent to the ECU, to influence the regeneration of the DPF:
  - Inhibition of regeneration. This command should only be activated when the full power of the generator is required. Regeneration, in fact, involves temperature increases that may require a derating of engine performance. It should be a transient condition: if the level of soot in the filter increases and the ECU cannot regenerate it, at some point the ECU will still apply a derating and eventually it could stop the engine.
  - Forcing of regeneration. It is the opposite command: verifying from the previous lamps the request for regeneration from the ECU, the operator can force it in the moments more favourable to him.

  The controller implements these commands in two ways:
  - Parameter P.0446. This parameter can take three values:
    - 0 - Automatic. It does not send any commands to the ECU, which is therefore free to perform the regeneration whenever it wants.
    - 1 – Forced. It sends the forcing command to the ECU for a maximum of 10 seconds (then the parameter is reset to 0-Automatic). If the ECU can, it carries out a regeneration cycle, which involves overheating the emission treatment system and derating the engine. Following this command, some of the lamps described above can be activated.
    - 2 – Inhibited. It activates the ECU inhibition command, which therefore does not regenerate, even if required.

    The parameter can be modified directly from page E.24.
  - As an alternative to the parameter, it is possible to use two digital inputs configured with the following functions:
    - DIF.2071: inhibits regeneration.
    - DIF.2072: forces regeneration.

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

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

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

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

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

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

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

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

The displayed statuses are:

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

- SPN 3714 (“DIESEL PARTICULATE FILTER ACTIVE REGENERATION INHIBITED DUE TO TEMPORARY SYSTEM LOCKOUT”)
- SPN 3715 (“DIESEL PARTICULATE FILTER ACTIVE REGENERATION INHIBITED DUE TO PERMANENT SYSTEM LOCKOUT”)
- SPN 3716 (“DIESEL PARTICULATE FILTER ACTIVE REGENERATION INHIBITED DUE TO ENGINE NOT WARMED UP”)
- SPN 3750 (“AFTERTREATMENT 1 DIESEL PARTICULATE FILTER CONDITIONS NOT MET FOR ACTIVE REGENERATION”)

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

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

6.6.5.20 E.25…E.26 EXHAUST GAS THREATMENT (Evolution) E.27…E.29 EXHAUST GAS THREATMENT (Standard)

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

- SPN 4765 ("AFTERTREATMENT 1 DIESEL OXIDATION CATALYST INTAKE TEMPERATURE")
- SPN 4766 ("AFTERTREATMENT 1 DIESEL OXIDATION CATALYST OUTLET TEMPERATURE")
- SPN 4781 ("AFTERTREATMENT 1 DIESEL PARTICULATE FILTER SOOT MASS")
- SPN 3719 ("AFTERTREATMENT 1 DIESEL PARTICULATE FILTER SOOT LOAD PERCENT")
- SPN 5466 ("AFTERTREATMENT 1 DIESEL PARTICULATE FILTER SOOT LOAD REGENERATION THRESHOLD")
- SPN 3720 ("AFTERTREATMENT 1 DIESEL PARTICULATE FILTER ASH LOAD PERCENT")
- SPN 3251 ("AFTERTREATMENT 1 DIESEL PARTICULATE FILTER DIFFERENTIAL PRESSURE")
- SPN 3242 ("AFTERTREATMENT 1 DIESEL PARTICULATE FILTER INTAKE TEMPERATURE")
- SPN 81 (" AFTERTREATMENT 1 DIESEL PARTICULATE FILTER INTAKE PRESSURE")
- SPN 3246 ("AFTERTREATMENT 1 DIESEL PARTICULATE FILTER OUTLET TEMPERATURE")
- SPN 3721 ("AFTERTREATMENT 1 DIESEL PARTICULATE FILTER TIME SINCE LAST ACTIVE REGENERATION")

- SPN 1761 ("AFTERTREATMENT 1 DIESEL EXHAUST FLUID TANK VOLUME")
- SPN 3031 ("AFTERTREATMENT 1 DIESEL EXHAUST FLUID TANK TEMPERATURE 1")
- SPN 3515 ("AFTERTREATMENT 1 DIESEL EXHAUST FLUID TEMPERATURE 2")
- SPN 3516 ("AFTERTREATMENT 1 DIESEL EXHAUST FLUID CONCENTRATION")
- SPN 5963 ("AFTERTREATMENT 1 TOTAL DIESEL EXHAUST FLUID USED")
- SPN 6563 ("AFTERTREATMENT TRIP DIESEL EXHAUST FLUID")
- SPN 4360 ("AFTERTREATMENT 1 SCR INTAKE TEMPERATURE")
- SPN 4363 ("AFTERTREATMENT 1 SCR OUTLET TEMPERATURE")
- SPN 4332 ("AFTERTREATMENT 1 SCR SYSTEM 1 STATE")
- SPN 4331 ("AFTERTREATMENT 1 DIESEL EXHAUST FLUID ACTUAL DOSING QUANTITY")
- SPN 4334 ("AFTERTREATMENT 1 DIESEL EXHAUST FLUID DOSER 1 ABSOLUTE PRESSURE")
- SPN 5246 ("AFTERTREATMENT SCR OPERATOR INDUCEMENT SEVERITY")
- SPN 3241 ("AFTERTREATMENT 1 EXHAUST TEMPERATURE 1")
- SPN 3236 ("AFTERTREATMENT 1 EXHAUST GAS MASS FLOW RATE")
- SPN 3237 ("AFTERTREATMENT 1 INTAKE DEW POINT")
- SPN 3238 ("AFTERTREATMENT 1 EXHAUST DEW POINT")
- SPN 3239 ("AFTERTREATMENT 2 INTAKE DEW POINT")
- SPN 3240 ("AFTERTREATMENT 2 EXHAUST DEW POINT")
- SPN 5826 ("EMISSION CONTROL SYSTEM OPERATOR INDUCEMENT SEVERITY")

6.6.5.21 E.27 ADBLUE pump (Evolution)
E.30 ADBLUE pump (standard)

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

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

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

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

- Press the ENTER key: the square brackets that enclose the current pomp operating mode begin to flash.

- Use the UP and DOWN buttons to select the desired mode.
- Confirm with ENTER or cancel the modification with ESC.

See 9.5.16 for a detailed description of the functions offered by the controller for the management of this pump.

6.6.5.22 E.28…E.33 ECU (Evolution) E.31…E.36 ECU (Standard)

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

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

6.6.6 Measures from PMCB CAN-BUS (B.XX)

In this mode, the measures and the statuses acquired by PMCB CAN-BUS, which connects all Mecc Alte devices, are displayed in full.

6.6.6.1 B.01 Boards on PMCB

This page shows a list of all Mecc Alte devices connected to PMCB network.

In the upper part, DST4602 shows the addresses of all MC boards connected to PMCB CAN-BUS. In the lower part, it shows the addresses of all generators control boards (DST4602, DST4601/PX, GC500) connected to PMCB CAN-BUS. Note: MC200 can improve the operating mode: if the improved mode is active, the message “Mains controllers on the PMCB” is shown as reverse.

6.6.6.2 B.02 Generators

This page shows detailed information for all generators control boards connected to PMCB CAN-BUS. DST4602 uses one line for each board. If there are more than 10 boards, DST4602 shows all of them by rotating them every 2 seconds: hold the SHIFT key to stop the rotation on the current view.

For each generator the following are shown (from left to right):

- Column 1: board address
- Column 2:
  - A "*" if the generator is available for the "load management" (see [3]). Starting from version 00.73, the controller shows the configured priority of the genset instead of the “*”.
  - Engine nominal power (MDPs, kW).
  - The supplied active power (kW).
  - The supplied reactive power (kvar).
  - The counter of the active energy produced (kWh, Evolution only)

- The counter of the reactive energy produced (kvarh, Evolution only)
- Engine operation hours.

The information in this column are displayed in REVERSE if they refer to this DST4602.

- Column 3: the status of the generator (idle, running, etc.). The information in this column is displayed in REVERSE if the generators are not available (for example, if there are any active alarms or if it is in OFF/RESET). For the Evolution controllers, the same conditions are in red.

6.6.6.3 B.03 Total on PMCB

This page displays the totals calculated on all generator control boards connected on PMCB CAN-BUS. The following are shown:

- The total rated power of supplying generators (MDPt, kW).
- The total supplied active power (kW).
- The total supplied reactive power (kvar).
- The total active energy (kWh, sum of the energy counters of all generator control boards).
- The total reactive energy (kvarh, sum of the energy counters of all generator control boards).

6.6.6.4 B.04 Load Management

This page is dedicated to the "load management" function (see [3]). The term "load management" refers to the capacity of the system to start/stop the generators to have the strictly necessary running generators to supply the users (with a little margin, but not too much). This page shows all relevant information for this function.

The displayed information is:

- The enabling for this board of the "load management" function.
- The currently selected "load management" mode (determining the criterion by which the generators to be started are chosen).
- The "master" generator (it is the generator with highest priority, the one that should never be stopped). For some "load management" modes this information is not displayed.
- Depending on the selected mode, the board can display in how many hours the system will select a new "master" generator.
- The list of addresses of the generator control boards, ordered by priority (first the generators with higher priority, the ones that will be stopped last). Starting from version 00.73, if the currently selected load function mode is “4-Manual priority” and there are different gensets with the same priority, they are enclosed into round brackets to highlight that they will be started/stopped tighter. For some "load management" modes this information is not displayed.
- The power supplied by the generators (percentage of the maximum power the currently supplying generators can withstand).
- The threshold (%) to be compared with the power calculated in the previous point, beyond which a new generator should be started (or it is necessary to switch to the higher combination of generators at rated power level)

- The power supplied by the generators (percentage of the maximum one) calculated if the generator with lowest priority is stopped (or that the combination of generators having the lowest rated power is stopped).
- The threshold (%) to be compared with the power calculated at the previous point, below which the generators with the lowest priority should be stopped (or it is necessary to switch to the lower combination of generators at a rated power level).

It is possible to manually select the "master" generator directly from this page:

- Use the ENTER button.
- Use UP and DOWN keys to select the address of the required "master" generator.
- Confirm with ENTER key.

6.6.7 (H.XX) Events and history logs.

This mode allows the displaying of all the records managed by the board. See the paragraph 8 for detailed information on records.

7. Programming (P.XX)

The controller manages a high number of parameters that allow the manufacturer, the installer or the final user to configure it to adapt it to specific system requirements. This document does not contain the parameters list (even though many of them are quoted in the description of the controller functions); the list is available in the document:[1] where they're described in detail. In this document the general programming structure and the operating procedure to read and/or modify parameters are described.

WARNING: Assigning an incorrect value to one or more parameters can cause malfunctions, damage to things and/or injury to people. The parameters must only be changed by qualified personnel. Parameters can be password protected (refer to par.7.2).

7.1 Organization

To each programming parameter the following are associated:

- A four-digit numeric code (allowing identification independently of the selected language).
- A description, varying according to the selected language.
- A protection level

Parameters are grouped in menus, organized in a tree structure (a menu can contain more menus). Mixed menus do not exist: a menu cannot contain both parameters and other menus. To each menu are associated:

- A numeric code (allowing identification independently of the selected language). In case of secondary menus, the code consists of the main menu code, plus a dot and its own code.
- A description, varying according to the selected language.

7.2 Protection

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

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

Each parameter of the board is associated with a level of protection (in the document [1] this combination is indicated in the column "ACC" with a letter "S" to indicate Mecc Alte level, "C" for the manufacturer, "I" for the installer and "U" for the end user).

A parameter associated with Mecc Alte level can only be modified by setting Mecc Alte password. A parameter associated with the manufacturer's level can be modified by the same manufacturer (or with Mecc Alte password). A parameter associated with the installer's level can be changed by the manufacturer and the installer (and with Mecc Alte password). A parameter associated with the user's level can be changed by the manufacturer, the installer and the user (and with Mecc Alte password).

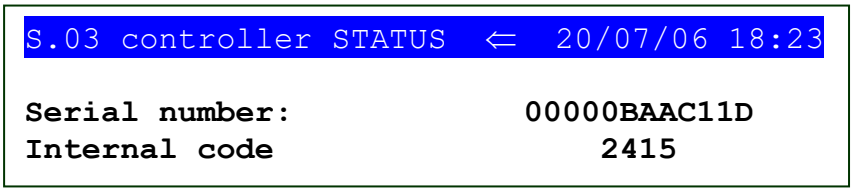
The general rule provides that parameters can only be modified when the controller board is in "OFF/RESET". Some parameters are an exception and can be modified regardless of the status of the

controller board, including with the engine running. As a general rule, if a parameter cannot be modified, it will be enclosed between < and > while, if it can be modified, it is enclosed between [and] : that is, valid also for the restrictions due to password.

If the operator needs to modify a parameter, he/she must input first the proper password in the parameter P.0000 (1.1.1 Authentication"), so that the controller can recognize it as "Manufacturer", "Installer" or "End User". After completing this operation, it will be possible to modify the required parameters. The access code entered remains saved in P.0000 for about 10 minutes since the end of programming. After this time, the code is automatically reset to zero and must be re-entered to access programming again.

It is possible to customize the password by using P.0001 (manufacturer), P.0002 (installer) and P.0003 (user) parameters, available in the "1.1.2 Configuring password" menu. Value "0" for these parameters means no password set. Mecc Alte password, on the other hand, is a special password, pre-assigned at the factory and supplied with the board. The password supplied with the board is always valid. On request, Mecc Alte can supply a second password, however only valid for two hours of engine operations. After this time, a new password must be obtained from Mecc Alte.

To get the password, the operator should request it to Mecc Alte indicating the serial number of the board along with the code inside of the board displayed on S.03 page, as shown below.



If a password gets lost, it is possible to reconfigure it by logging in with the higher-level password. This is the reason why we recommend setting at least the "Manufacturer" password (P.0001): in case someone else sets up this password, or a lower level one (even unwillingly) without providing information, no parameter modification will be possible anymore. On the other hand, knowing the "manufacturer" password will allow to cancel or modify the other passwords. Contact our service centre if the "manufacturer" password is lost.

The following examples show all the combinations for passwords assignment.

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

Any operator is seen as a "manufacturer", with no need of setting anything in P.0000. Therefore, all parameters, excluding critical ones, can be modified by anyone (controller's default mode).

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

No parameter modification is allowed. 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 this code, all parameters, excluding critical ones, can be modified.

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

No parameter modification is allowed. When entering "UUU" in P.0000, the operator is identified as "User" and can modify all parameters associated to the end user. By entering "III", the operator is identified as "installer" but, as no password is associated to the manufacturer, the controller identifies him/her as "manufacturer". After entering this code, all parameters, excluding critical ones, can be modified.

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

No parameter modification is allowed. When entering “UUU” in P.0000, the operator is identified as “User” and can modify all parameters associated to the end user. By entering “III”, the operator is identified as "installer” and can modify all parameters associated to “installer” and “user”. When entering “CCC”, the operator is identified as "manufacturer” and can modify all controller parameters, excluding critical ones.

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

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

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

As no password is associated to user, programming the relevant parameters is allowed without entering anything in P.0000. When entering “III” in P.0000 the operator is identified as “installer” but, as no password is associated to “manufacturer”, the controller identifies him/her as "manufacturer”. After entering this code, all parameters, excluding critical ones, can be modified.

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

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

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

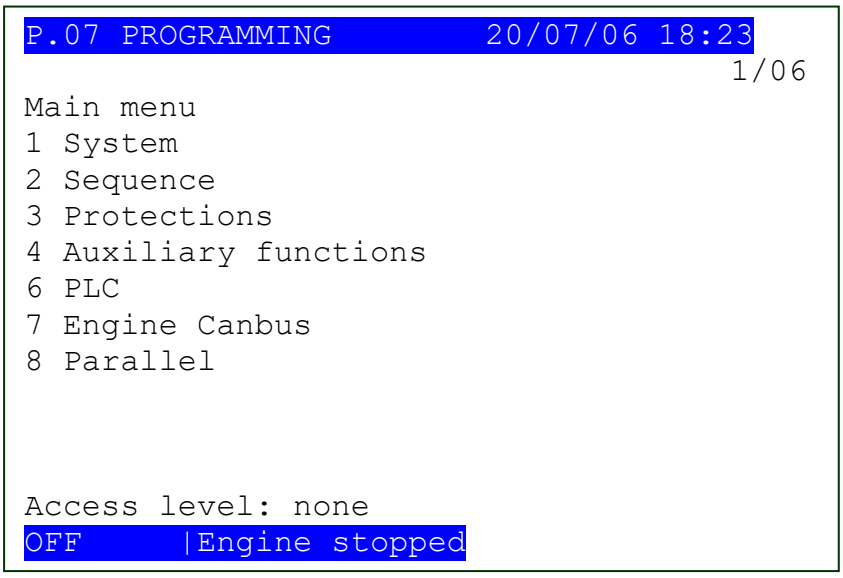
No parameter modification is allowed. When entering the “UUU” in P.0000, the operator is identified as user but, as no password is associated to “installer”, the controller identifies him/her as "installer”. Therefore, he/she can modify all controller parameters associated to installer and user. When entering “III” in P.0000, the operator is identified as “manufacturer” and can modify all parameters, excluding critical ones.

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

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

7.3 Operating procedure

This procedure will describe the keyboard and display use.



Here below is a brief description of the organization of the menus:

- The "1 - SYSTEM" menu allows first to indicate the type of system, and how the board is connected to the engine, to the generator and to the system in general. In this menu it is possible to set the nominal values of all variables: it is essential to set these parameters correctly, because almost all the thresholds to activate the protections are expressed as a percentage of them. In this menu it is also possible to individually configure each input and output channel, both digital and analogue, of the board and its expansions.
- Working sequence configuration can be modified through the menu "2–SEQUENCE". In this menu it is possible to set thresholds, acquisition times and enable/disable functions related to operation sequences.
- Protections management is accessible through the menu "3-PROTECTION". As to this, it is important to know that, to enable/disable a protection, you may simply modify the associated time, leaving the threshold unchanged: by setting the time to zero, the protection is disabled. However, this general rule provides some exceptions. For a description of individual disable modes, refer to the chapter about anomalies.
- All operations not related to system, sequence and protections configuration, can be performed through the menu "4-AUXILIARY FUNCTIONS". This menu contains other menus used for configuring engine's auxiliary functions, history logs and serial communication.
- The "6 -PLC" menu allows modifying the setpoint values defined in the PLC program. It is displayed only if a valid PLC program is installed on the board, which uses at least one setpoint.
- The "7 -CAN- BUS" menu is dedicated to the CAN-BUS communication with the electronic controls of engines. It allows configuring how the board should communicate on the CAN-BUS to acquire measurements from the engine and possibly to send controls.
- The "8- PARALLEL" menu allows setting all the parameters related to the operations in parallel (see the document [3]).

7.3.1 Access to programming

Programming is accessible in any controller operation status. The modification of the parameters is generally only possible with the board in OFF/RESET mode. Only some parameters can be modified even during system operation. To enter programming mode, use the UP and DOWN buttons till the base PROGRAMMING mode (P.03) screen is displayed. Inside a mode that restricts the use of the vertical scroll keys, it could be necessary to press one or more times the EXIT key before being able to use these keys to select P.03 page (this situation may arise during the displaying of the records or during special operations such as, for example, the setting of the fuel pump control mode).

Then, press ENTER to access programming

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

7.3.2 Menu selection

The second line of the display always shows the name of the current menu, followed by the number of the selected menu item and the number of items in the menu. Menu items (submenus) are displayed in the following lines. The selected item is displayed in REVERSE. Use the UP and DOWN buttons to scroll through the menu to the lower and upper index items (pressing the UP button allows to directly cycle from the first item to the last one).

The next-to-last line of the display shows the level of protection (Mecc Alte, manufacturer, installer or user) accredited to the operator.

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

7.3.3 Parameters selection

The second line of the display always shows the name of the current menu, followed by the number of the selected menu item and the number of items in the menu. The following lines are used to display single parameters. In detail:

- The third line shows the unique code of the parameter (four decimal digits) followed by the description in the current language.
- The fourth line shows, right-aligned, the value of the variable, in square brackets (or between the symbols "<" and ">" if the modification of the value is not allowed). For some parameters, the next line shows a value in some way linked to the current value of the parameter. For example, if the nominal power of the generator (P.0106) is being set, on the next line the rated current of the system is displayed, obtained from the rated power and the rated voltage of the generator. Sometimes, this additional measure can be displayed for showing its absolute value, when the parameter is a percentage of other values.

The next-to-last line of the display shows the level of protection (Mecc Alte, manufacturer, installer or user) accredited to the operator.

Use the UP and DOWN buttons to scroll through the menu to the lower and upper index items (pressing the UP button allows to directly cycle from the first item to the last one). Press the ENTER button to enable the parameter modification procedure (see following paragraph). Press the EXIT button to leave the menu (back to the previous menu).

7.3.4 Modify a parameter

You may only modify parameters displayed between square brackets "[" e "]". A parameter between (major/minor) symbols "<" e ">" cannot be modified. In this case, you may require resetting an appropriate password and/or switch the key to OFF/RESET mode.

In case modifying the displayed parameter is allowed, press the ENTER button; the square brackets enclosing the value will blink to signal that the modification is in progress. Press again the ENTER button to confirm the new value; press the EXIT button to abort and return to the original value.

Parameter types are the following:

- **Numeric**: the value can be modified by pressing the UP and/or DOWN buttons, to increase or decrease one unit from the most rightwards decimal digit (if you press the above buttons plus SHIFT, the figure will be increased or decreased by ten units at a time). The change is cyclical: increasing over the maximum value when will lead to the minimum one and vice versa.

- **Numeric with selection from a predefined list** (for example, P.0453 parameter, which selects the baud rate for the serial port): what indicated above for the numerical parameters is valid, by considering that UP and DOWN keys allow switching to the next/previous value in the predefined list (with the SHIFT key it is possible to shift to the value ten positions before/after the current one).

- **Numeric with selection from the list of number-string couples** (for example, P.0802 parameter, which configures the type of system): same as for the previous point.

- **Time parameters**: same as numerical parameters, with one exception: the controller manages the increment/decrement maintaining valid values (example: increasing from "00.59", the value goes to "01.00" and not to "00.60").

- **Strings** (e.g. telephone numbers): in this case the display shows also a cursor indicating the currently selected character in the string. The UP and/or DOWN buttons work on the selected character (passing to the one after/before in the ASCII table. If you press the above buttons plus SHIFT, you will move to the one 10 units before/after). The LEFT and RIGHT buttons allow to select the character to be modified. You can only set the ASCII characters from 32 (Space) to 127 (Escape). It is not possible to set extended ASCII characters (over 127) and the control ones (from zero to 31).

- **Bits**: Some parameters are managed with bits. Each bit set to 1 enables a function and each bit set to 0 disables a function. They can be used up to 16 bits. A hexadecimal value is assigned to each bit. The parameter should be set with the result of the sum of the hexadecimal values associated with functions that should be enabled. The setting is carried out as described for the strings, with the exception that it is possible to select only hexadecimal characters (0...9, A....F).

  The description of these parameters is shown in a table like the one below:

Bit	Value	Description
0	0001	Enable function 1
1	0002	Enable function 2
2	0004	Enable function 3
3	0008	Enable function 4
4	0010	Enable function 5
5	0020	Enable function 6
6	0040	Enable function 7
7	0080	Enable function 8

8	0100	Enable function 9
9	0200	Enable function 10
10	0400	Enable function 11
11	0800	Enable function 12
12	1000	Enable function 13
13	2000	Enable function 14
14	4000	Enable function 15
15	8000	Enable function 16

In case the operator wants:

- To disable all functions: he/she must set to 0000 the relevant parameter.
- Enable 1 to 8 functions: the value to be set is given by the hexadecimal sum 0001+0002+0004+0008+0010+0020+0040+0080 = 00FF.
- Enable, for example, the functions 3, 4, 6 and 8: the value to be set is the sum 0004+0008+0020+0080 = 00AC.

7.3.5 Set up limits

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

Obviously, this is only true for individual parameters. However, it is possible to set two or more parameters in incongruent or incompatible ways. It is up to the operator to prevent this from occurring.

7.3.6 Exit from programming

There are three ways to exit programming mode:

- Press the EXIT button 'n' times to scroll back to the main menu, then press it again to exit programming. The main menu will be displayed on the next access to programming.
- Press and hold the EXIT key for two seconds from any menu: the programming will be left immediately, and at the next entering, you will be in the same point.
- Change the operation mode to AUTO or MAN: and at the next entering, you will be in the same point.

7.3.7 Loading default values

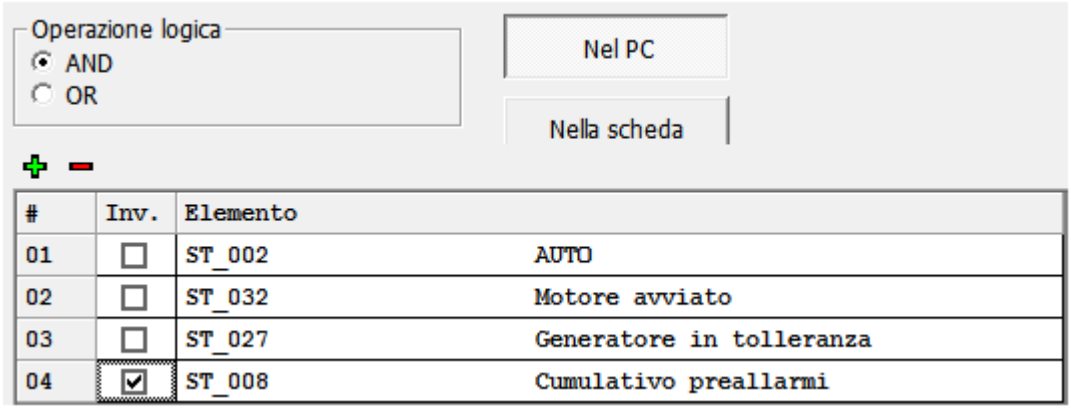
WARNING: This procedure permanently recharges the parameters with the factory default (depending on access rights).

Sometimes, it may be useful to reload parameters factory values. To do so, first access programming, then press and hold the ACK/TEST and EXIT buttons simultaneously for five seconds. A message on the display will confirm the reload of the factory values.

Factory values are reloaded only for parameters for which you are granted access rights.

7.4 Logics AND/OR

The AND/OR logics are, basically, a list of boolean conditions (true/false, on/off, 1/0), which can be configured by the operator (programming), which the controller evaluates and the result of which can be assigned to a digital output. For using the AND/OR logics with a digital output, use the DOF.0103 function. **NB: the AND/OR logics cannot be configured directly from the panel of the controller, but through a PC equipped with the BoardPrg4 software [14].**



The operator must first decide if the list of conditions must be evaluated as AND (all must be checked) or as OR (it is enough that one condition is met). It is not possible to have AND/OR mixed logics.

You can add up to 30 conditions. Each condition can be individually denied: in the previous figure, for example, the board will check that there are no active early warnings. The following conditions can be added:

- DI_XXX: logic states of all the digital inputs (physical or virtual).
- DO_XXX: logic states of all the digital outputs.
- AL_XXX: warnings/locks present.
- ST_XXX: internal states of the controller.
- AT_XXX: states concerning the thresholds on analogue measures (see paragraph7.8).

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

Status	Description
ST.000	OFF/RESET
ST.001	MAN
ST.002	AUTO
ST.003	TEST
ST.004	REMOTE START
ST.006	Faults acknowledgement
ST.007	Faults reset
ST.008	Warnings cumulative
ST.009	Unloads cumulative
ST.010	Deactivations cumulative
ST.011	Locks cumulative
ST.012	Unacknowledged warnings cumulative
ST.013	Unacknowledged unloads cumulative
ST.014	Unacknowledged deactivations cumulative

ST.015	Unacknowledged locks cumulative
ST.016	Mains voltage/frequency present.
ST.017	Mains out of tolerance or absent
ST.018	Delay for mains within tolerance.
ST.019	Mains in tolerance
ST.020	Delay for mains out of tolerance or absent
ST.024	Generator voltage/frequency present
ST.025	Generator out of tolerance or absent
ST.026	Delay for generator within tolerance.
ST.027	Generator in tolerance
ST.028	Delay for generator out of tolerance or absent
ST.032	Engine started
ST.033	Oil protections enabled
ST.035	Engine sequence: standby
ST.036	Engine sequence: starting
ST.037	Engine sequence: low speed
ST.038	Engine sequence: delay before power delivery
ST.039	Engine sequence: ready to deliver
ST.040	Engine sequence: cooling
ST.041	Engine sequence: arrest
ST.048	Presence of bar voltages
ST.051	Active 27Q protection
ST.052	Active mains parallel protections (no mains)
ST.053	Active 27 protection (U<<, 1st threshold)
ST.054	Active 59 protection (U>>, 1st threshold)
ST.055	< Active 81 protection (f<<, 1st threshold)
ST.056	> Active 81 protection (f>>, 1st threshold)
ST.057	Active ROCOF protection
ST.058	Active VECTOR JUMP protection
ST.059	Active 27 protection (U<, 2nd threshold)
ST.060	Active 59 protection (U>, 2nd threshold)
ST.061	< Active 81 protection (f<, 2nd threshold)
ST.062	> Active 81 protection (f>, 2nd threshold)
ST.064	GCB status
ST.065	MCB status
ST.066	MGCB status
ST.068	Impulse closing command for GCB
ST.069	Impulse closing command for MCB
ST.070	GCB under voltage coil command
ST.071	Impulse open command for GCB
ST.072	Impulse closing command for GCB
ST.073	GCB under voltage coil command
ST.074	Impulse open command for MCB
ST.075	Impulse closing command for MCB
ST.080	Inhibition of the start from contact
ST.081	Inhibition of the start from clock/calendar
ST.082	Starting inhibition from load function
ST.083	Starting inhibition because it is not possible to deliver stand alone and there are no mains
ST.084	Starting inhibition because another generator has GCB not open
ST.088	Inhibition of the GCB closing from contact
ST.089	GCB closing inhibition because it is not possible to deliver stand alone and there are no mains

ST.090	Inhibition of the GCB closing from serial port
ST.091	GCB closing inhibition because another generator has GCB not open
ST.092	GCB closing inhibition because a returning synchronization is ongoing
ST.093	GCB closing inhibition from MC board
ST.096	Ready to deliver
ST.097	Input synchronization
ST.098	Returning synchronization
ST.099	Synchronized
ST.100	Loading phase.
ST.101	Unloading phase.
ST.102	Production in parallel with mains.
ST.103	Supplying in parallel among generators
ST.104	Stand-alone supplying
ST.108	(Emergency system)
ST.109	(Mains parallel plants)
ST.110	Parallel system with other generators
ST.111	No MC on PMCB CAN-BUS
ST.112	Synchronism each second
ST.113	Synchronism each minute
ST.114	Synchronism each hour
ST.127	Daylight Save Time
ST.128	Glow plugs pre-heating control
ST.129	Engine enabling control
ST.130	Fuel solenoid valve control
ST.131	Gas valve control
ST.132	Command for the starter
ST.133	Command of arrest when energized
ST.134	Idle speed command (IDLE)
ST.135	Cooling liquid pre-heating control
ST.136	Pre-lubrication control
ST.137	Inhibit DPF regeneration
ST.138	Force DPF regeneration
ST.139	AdBlue pump command
ST.140	AdBlue solenoid command
ST.144	GCB closed on genset 01
ST.145	GCB closed on genset 02
ST.146	GCB closed on genset 03
ST.147	GCB closed on genset 04
ST.148	GCB closed on genset 05
ST.149	GCB closed on genset 06
ST.150	GCB closed on genset 07
ST.151	GCB closed on genset 08
ST.152	GCB closed on genset 09
ST.153	GCB closed on genset 10
ST.154	GCB closed on genset 11
ST.155	GCB closed on genset 12
ST.156	GCB closed on genset 13
ST.157	GCB closed on genset 14
ST.158	GCB closed on genset 15
ST.159	GCB closed on genset 16
ST.160	GCB closed on genset 17
ST.161	GCB closed on genset 18
ST.162	GCB closed on genset 19

ST.163	GCB closed on genset 20
ST.164	GCB closed on genset 21
ST.165	GCB closed on genset 22
ST.166	GCB closed on genset 23
ST.167	GCB closed on genset 24
ST.176	Master genset for load function
ST.192	Power unload on genset 01
ST.193	Power unload on genset 02
ST.194	Power unload on genset 03
ST.195	Power unload on genset 04
ST.196	Power unload on genset 05
ST.197	Power unload on genset 06
ST.198	Power unload on genset 07
ST.199	Power unload on genset 08
ST.200	Power unload on genset 09
ST.201	Power unload on genset 10
ST.202	Power unload on genset 11
ST.203	Power unload on genset 12
ST.204	Power unload on genset 13
ST.205	Power unload on genset 14
ST.206	Power unload on genset 15
ST.207	Power unload on genset 16
ST.208	Power unload on genset 17
ST.209	Power unload on genset 18
ST.210	Power unload on genset 19
ST.211	Power unload on genset 20
ST.212	Power unload on genset 21
ST.213	Power unload on genset 22
ST.214	Power unload on genset 23
ST.215	Power unload on genset 24
ST.224	Calendar 1.
ST.225	Calendar 2.
ST.226	Calendar 3.
ST.227	Calendar 4.
ST.228	Calendar 5.
ST.229	Calendar 6.
ST.230	Calendar 7.
ST.231	Calendar 8.
ST.232	Calendar 9.
ST.233	Calendar 10.
ST.234	Calendar 11.
ST.235	Calendar 12.
ST.236	Calendar 13.
ST.237	Calendar 14.
ST.238	Calendar 15.
ST.239	Calendar 16.
ST.240	Timer 1
ST.241	Timer 2
ST.242	Timer 3
ST.243	Timer 4
ST.256	CAN 0 BUS-OFF
ST.257	CAN 0 ERR-PASSIVE
ST.258	CAN 0 ERR-ACTIVE

ST.259	No communication on CAN 0
ST.260	CAN 1 BUS-OFF
ST.261	CAN 1 ERR-PASSIVE
ST.262	CAN 1 ERR-ACTIVE
ST.263	No communication on CAN 1
ST.264	CAN 2 BUS-OFF
ST.265	CAN 2 ERR-PASSIVE
ST.266	CAN 2 ERR-ACTIVE
ST.267	No communication on CAN 2
ST.304	START button
ST.305	STOP button
ST.306	GCB button
ST.307	MCB button
ST.308	MODE UP button
ST.309	MODE DOWN button
ST.310	UP button
ST.311	DOWN button
ST.312	LEFT button
ST.313	RIGHT button
ST.314	ENTER button
ST.315	EXIT button
ST.316	SHIFT button
ST.317	ACK button
ST.320	Status #01 from engine management by file
ST.321	Status #02 from engine management by file
ST.322	Status #03 from engine management by file
ST.323	Status #04 from engine management by file
ST.324	Status #05 from engine management by file
ST.325	Status #06 from engine management by file
ST.326	Status #07 from engine management by file
ST.327	Status #08 from engine management by file
ST.328	Status #09 from engine management by file
ST.329	Status #10 from engine management by file
ST.330	Status #11 from engine management by file
ST.331	Status #12 from engine management by file
ST.332	Status #13 from engine management by file
ST.333	Status #14 from engine management by file
ST.334	Status #15 from engine management by file
ST.335	Status #16 from engine management by file
ST.336	Application type: SPM
ST.337	Application type: SSB
ST.338	Application type: SSB+SSTP
ST.339	Application type: SPTM
ST.340	Application type: SPTM+SSB
ST.341	Application type: MPM
ST.342	Application type: MSB
ST.343	Application type: MSB+MSTP
ST.344	Application type: MPTM
ST.345	Application type: MPTM+MSB
ST.352	Maximum deliverable power limited for low mains frequency
ST.353	Delivered active power limited for high mains frequency
ST.354	Delivered active power limited for high mains voltage
ST.355	Delivered active power limited by external command

ST.367	Enable protections 27 for low mains voltage.
ST.368	Active regeneration status: not active (spn3700=0)
ST.369	Active regeneration status: active (spn3700=1)
ST.370	Active regeneration status: will start soon (spn3700=2)
ST.371	DPF status: regeneration not required (spn3701=0)
ST.372	DPF status: regeneration needed - lowest level (spn3701=1)
ST.373	DPF status: regeneration needed - moderate level (spn3701=2)
ST.374	DPF status: regeneration needed - highest level (spn3701=3)
ST.997	PLC first scan
ST.998	Always on
ST.999	Always off

7.5 Digital input configuration

Information: although it is possible to program the digital inputs by directly acting on the device, it is strongly recommended to use BoardPrg4 [14] program, which greatly simplifies configuration operations.

The board has twenty physical digital inputs and sixteen virtual digital inputs as standard. It may also use the six analogue inputs as if they were digital (if not used as analogue). Finally, it handles up to ten DITEL expansion modules, with sixteen digital inputs each. The board can therefore handle up to 202 digital inputs. For the virtual digital inputs see 7.5.2. Use P.0141 parameter to specify the number of DITEL modules to be managed. 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 reverse this convention (individually for each input), by using the appropriate parameters:

Parameter	**Inputs**
P.2000	01...16
P.2050	17...20
P.2100	Analogue inputs used as digital ones
P.2200	DITEL #01
P.2250	DITEL #02
P.2300	DITEL #03
P.2350	DITEL #04
P.2400	DITEL #05
P.2450	DITEL #06
P.2500	DITEL #07
P.2550	DITEL #08
P.2600	DITEL #09
P.2650	DITEL #10

As you can see, there is no parameter to "reverse the polarity" of virtual digital inputs (it is not possible). By using theBoardPrg4 program, the logic status of each input can be inverted with reference to its physical status simply checking the "Reversed polarity" box on the input configuration page. The box appears only if the selected function is different from DIF.0000.

The above parameters have a bit for each input:

- A bit set to zero means that the related input is “active” when it is connected to the negative supply of the controller.
- A bit set to one means that the related input is considered “active” when it is left open (connecting the input to ground will change to “not active” the status).

As default, all the bits are set to 0.

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

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

See document [1] for the parameters list.

Information: in BoardPrg4 the parameters for the configuration of the delay and the message will only appear if the function associated with the input is different from DIF.0000.

The parameters which configure the delay and the message for an input are used by the controller only for certain features of the inputs (see the table below).

7.5.1 Digital input functions

The following table indicates the functions that can be associated with each digital input and highlights when the parameters for the configuration of the delay and the message are used:

Code	Function	Delay	Message	Description
DIF.0000	Not used.			The input is not used.
DIF.0101	Used by the PLC			It matches the digital input to the PLC function internal to the device; the input will be used exclusively for the functions programmed in the PLC sequence.
DIF.1001	GCB close command.			Only acts in MAN and in TEST, and is equivalent to pressing the GCB button to change-over the loads to the generator. If there is no input with the function DIF.1002, it acts as “toggle”: it controls the opening of the breaker when the same is closed and vice versa
DIF.1002	GCB open command.			Only acts in MAN and in TEST, and is equivalent to pressing the GCB button to change-over the loads to the mains.
DIF.1003	GCB controlled externally.			It indicates to the board that the switch will be temporarily controlled by external logics: the board will acknowledge the situation without triggering anomalies.
DIF.1004	Synchronization request for GCB.			Used when GCB is controlled by external devices: the external device activates this input if it wants the board to perform synchronization and to provide the "synchronized" contact.
DIF.1031	MCB close command.			Only acts in MAN and in TEST, used to control the manual closure of the MCB breaker. If there is no input configured with the function DIF.1032, this input works in reality as toggle: it commands the closure of the breaker when the same is open and commands the opening when the same is closed.
DIF.1032	MCB open command.			Only acts in MAN and in TEST, used to control the manual opening of the MCB breaker.

DIF.1033	MCB controlled externally.			It indicates to the board that the switch will be temporarily controlled by external logics: the board will acknowledge the situation without triggering anomalies.
DIF.1034	Synchronization request for MCB.			Used when MCB is controlled by external devices: the external device activates this input if it wants the board to perform synchronization and to provide the "synchronized" contact.
DIF.2001	Alarms reset command.			When the input becomes active, the controller executes a reset of all anomalies. That is equivalent to change the controller mode to OFF/RESET and back again to the working mode.
DIF.2002	Alarms acknowledgement command.			When the input becomes active, the controller carries out an acknowledgement of all faults and silence the acoustic horn. This operation is equivalent to press the ACK key on the controller
DIF.2029	Request for the test mode without load (impulse).			When the input becomes active with the controller in AUTO, the controller carries out a test start of the engine without load for the time configured in P.0420. If the input activates again during the test, it immediately stops.
DIF.2030	Request for the test mode with load (impulse).			When the input becomes active with the controller in AUTO, the controller carries out a test start of the engine with load for the time configured in P.0420. If the input activates again during the test, it immediately stops.
DIF.2031	Request for TEST mode.			When the input is "active", the mode of the board switches from AUTO to TEST (the input does nothing if the board is not in AUTO or if the automatic intervention of the generator is required). When it becomes inactive, the status changes back to AUTO.
DIF.2032	Request for REMOTE START.	Yes		If the input is “active”, the controller operating mode changes from AUTO to REMOTE START (the input does nothing if the controller is in OFF/RESET or MAN mode). When it becomes inactive, the status changes back to AUTO.
DIF.2033	Manual start control.			When the input become “active” (only in mode MAN) the controller makes a start attempt (only one) the same way an automatic start is performed, i.e. it controls the starter motor until starting is accomplished or failed.
DIF.2034	Manual stop control.			When the input become activated (in MAN mode) the controller stops the engine. This is equivalent to pressing the STOP button.
DIF.2061	Request for IDLE reduced speed.			When this input is "active", the board controls the reduced rotation speed to the engine and disables the generator minimum frequency and minimum voltage protections, because it assumes that the engine is rotating at a lower speed than the rated one. The controller also prevents the change-over of the loads to the generator.
DIF.2062	Engine protections override.			When the input is “active”, all the protections for the engine, which normally act as alarm, unload or deactivation elements, become mere warnings
DIF.2063	Complete protections override.			When the input is activated, all the protections (except for few, see [1]) which involve interlocks or deactivations become warnings.
DIF.2064	Override generator’s protections.			When the input is “active”, all the protections for the genset, which normally act as alarm, unload or deactivation, become mere warnings.

DIF.2071	Inhibit DPF regeneration.			Inhibition of regeneration. This command should only be activated when the full power of the generator is required. Regeneration, in fact, involves temperature increases that may require a derating of engine performance.
DIF.2072	Force DPF regeneration.			Forcing of regeneration. Checking the request for regeneration (from the ECU) on the controller's display, the operator can force it in the moments more favourable to him.
DIF.2073	Consent for DPF regeneration.			If this input exists, the controller authorizes the regeneration of the particulate filter only when the input is active. If it does not exist, the controller authorizes regeneration when GCB is open.
DIF.2091	Select DROOP mode for AVR			When the input is active, the controller activates the DROOP mode for the control of the round and voltage regulators.
DIF.2092	According to power setpoint.			When the input is activated, the power setpoint during the parallel with the mains is P.0902 parameter instead of P.0884 parameter.
DIF.2093	Selects the import-export mode.			When the input is activated, the board switches to the "import/export" mode in parallel with the mains, regardless of the mode configured in P.0880.
DIF.2094	It selects the DROOP mode.			When the input is activated, the board shifts to the DROOP mode to control speed and voltage regulators.
DIF.2095	It disables the control of kW.			When the input is activated, the board disables all PI controllers for the management of active and reactive power.
DIF.2096	Transfer to the generators.			When the input is activated, the board transfers the load from the mains to the generator, then it opens MCB switch.
DIF.2097	Limitation of active power setpoint 1.			When the input is active, during the parallel with the mains the board limits the power setpoint to the value set with P.0954 parameter.
DIF.2098	Limitation of active power setpoint 2.			When the input is active, during the parallel with the mains the board limits the power setpoint to the value set with P.0955 parameter.
DIF.2099	Local BASE LOAD.			When the input is active, the controllers runs in BASE LOAD mode, even if the parameter P.0880 is set in SYSTEM BASE LOAD mode.
DIF.2121	Selection of master generator.			Used in the "load management". See document [3].
DIF.2151	Select configuration 1.			When the input becomes "active", parameters of alternative configuration set 1 are copied in the working configuration.
DIF.2152	Select configuration 2.			When the input becomes "active", parameters of alternative configuration set 2 are copied in the working configuration.
DIF.2153	Select configuration 3.			When the input becomes "active", parameters of alternative configuration set 3 are copied in the working configuration.
DIF.2154	Select configuration 4.			When the input becomes "active", parameters of alternative configuration set 4 are copied in the working configuration.
DIF.2161	Selects the application SPM.			When the input becomes "active", if the parameters P.0802 is set to "10", the relevant SPM plant type is selected.
DIF.2162	Selects the application SSB.			
DIF.2163	Selects the application SSB+SSTP.			
DIF.2164	Selects the application SPTM.			

DIF.2165	Selects the application SPTM+SSB.			
DIF.2166	Selects the application MPM.			
DIF.2167	Selects the application MSB.			
DIF.2168	Selects the application MSB+MSTP.			
DIF.2169	Selects the application MPTM.			
DIF.2181	Immediate supply.			Used for systems composed of multiple generators: if the input is active, the switching of the users between mains and generators is performed after the closing of the first GCB switch.
DIF.2211	Enabling of load distribution.			Used if the distribution of the active power is controlled by an internal device: the board uses the signal from this device only if this input is active.
DIF.2241	Fuel pump in MAN-OFF mode.			When the input is active, the mode of the fuel pump is forced into “Manual-OFF”.
DIF.2242	Fuel pump in MAN-ON mode.			When the input is active, the mode of the fuel pump is forced into “Manual-ON”.
DIF.2243	Fuel pump in AUTO mode.			When the input is active, the mode of the fuel pump is forced into “Automatic”.
DIF.2271	OFF by remote control.			When this input is active, the operation mode of the controller is forced into OFF/RESET and you cannot use the buttons on the panel to change it. NB: When this input is turned off, if there are no inputs configured with 2272 and 2273 functions, the operating mode comes back to the one it was before the activation of the input.
DIF.2272	MAN by remote control:			When this input is active, the operation mode of the controller is forced into MAN and you cannot use the buttons on the panel to change it.
DIF.2273	AUTO by remote control.			When this input is active, the operation mode of the controller is forced into AUTO and you cannot use the buttons on the panel to change it.
DIF.2301	Selection of mixer alternative protection for AF2000			Function for specific use
DIF.2302	It selects zeppelin alternate position for AF2000			Function for specific use
DIF.2330	It selects the maximum power reserve for the load function			Used in the "load management". See document [3].
DIF.2331	It selects the power reserve # 1 for the load function			Used in the "load management". See document [3].
DIF.2332	It selects the power reserve # 2 for the load function			Used in the "load management". See document [3].

DIF.2333	It selects the power reserve # 3 for the load function			Used in the "load management". See document [3].
DIF.2341	Request #1 for engine derating			When the input is active, the board requires the derating (1) of the engine based on parameters P.1281 ... P.1284
DIF.2342	Request #2 for engine derating			When the input is active, the board requires the derating (2) of the engine based on parameters P.1285 ... P.1288
DIF.2343	Request #3 for engine derating			When the input is active, the board requires the derating (3) of the engine based on parameters P.1289 ... P.1292
DIF.2344	Request #4 for engine derating			When the input is active, the board requires the derating (4) of the engine based on parameters P.1283 ... P.1296
DIF.2391	AFR - Mixer in MAN mode			It selects the mixer control mode for the AFR function between manual (1) and automatic (0).
DIF.2392	AFR - Gas type selection			It selects different setpoints to manage the mixer for the AFR function when the engine is started
DIF.2401	Input for pulse counter #1			The controller increments the pulse counter #1 when this input **becomes** active.
DIF.2402	Input for pulse counter #2			The controller increments the pulse counter #2 when this input **becomes** active.
DIF.2403	Input for pulse counter #3			The controller increments the pulse counter #3 when this input **becomes** active.
DIF.2404	Input for pulse counter #4			The controller increments the pulse counter #4 when this input **becomes** active.
DIF.2405	Input for pulse counter #5			The controller increments the pulse counter #5 when this input **becomes** active.
DIF.2406	Input for pulse counter #6			The controller increments the pulse counter #6 when this input **becomes** active.
DIF.2407	Input for pulse counter #7			The controller increments the pulse counter #7 when this input **becomes** active.
DIF.2408	Input for pulse counter #8			The controller increments the pulse counter #8 when this input **becomes** active.
DIF.2417	Reset for pulse counter #1			The controller clears the pulse counter #1 when this input **is** active.
DIF.2418	Reset for pulse counter #2			The controller clears the pulse counter #2 when this input **is** active.
DIF.2419	Reset for pulse counter #3			The controller clears the pulse counter #3 when this input **is** active.
DIF.2420	Reset for pulse counter #4			The controller clears the pulse counter #4 when this input **is** active.
DIF.2421	Reset for pulse counter #5			The controller clears the pulse counter #5 when this input **is** active.
DIF.2422	Reset for pulse counter #6			The controller clears the pulse counter #6 when this input **is** active.
DIF.2423	Reset for pulse counter #7			The controller clears the pulse counter #7 when this input **is** active.
DIF.2424	Reset for pulse counter #8			The controller clears the pulse counter #8 when this input **is** active.
DIF.2501	Genset operation inhibit.			When the input is “active”, the automatic start of the engine is inhibited. "TEST" and "REMOTE START" modes are not affected by this function

DIF.2502	Inhibition to taking of load			In automatic mode, when the input is "active", the board opens GCB switch (and, where applicable, closes MCB switch).
DIF.2503	MCB closure inhibition			If this input is active, the controller keeps the MCB circuit breaker open (in automatic modes).
DIF.2701	Enable REMOTE START request.			If this function is defined for one input, “REMOTE START” function is inhibited if the input is not active.
DIF.2702	It enables the load function.			Used in the "load management". See document [3].
DIF.2703	Enable the load thresholds.			If the input is not active, the management of load thresholds (described in 11.8) is disabled
DIF.2704	Disable the protections on the 4th current.			When this input is “active” the auxiliary current protection (normally used for differential protection) is disabled.
DIF.2705	Disable the protections on the analogue measures.			When this input is “activated”, the thresholds set on analogue measures having bit 13 ON in the third configuration parameter (see par. 7.8) do not trigger the relevant protections.
DIF.2706	It enables controls from serial ports.			If this input is not active, the controls sent via Modbus HOLDING REGISTER 101 and 102 are not accepted.
DIF.2707	It enables fast parallel.			It enables CBE function. See document [3].
DIF.2708	It enables the restrictive thresholds ("1") for PPR.			If this input exists but is not active, the protections for the parallel with the mains configured with P.0922 and P.0924 parameters are disabled. See document [3].
DIF.2709	Consent to starting			In case of a request for automatic starting, the board activates its internal sequence to start the engine, but it does not activate any actual control until this input (if it exists) is activated (it can be used, for example, to manage pre-ventilation).
DIF.2710	It enables the acquisition of the setpoint for the BASE LOAD from analogue input			If this input exists and is active, the power setpoints for the parallel with the mains is acquired by a suitably configured analogue input. If it exists and is not active, the setpoint is P.0884 parameter.
DIF.2711	It enables the acquisition of the speed reference from analogue input			If this input exists and is active, the speed offset is acquired from an analogue input properly configured. If it exists and it is not active, the setpoint is the P.0840 parameter.
DIF.2712	It enables the function 27T			If this input exists and is not active, the function which disables the generator and interface protections 27 for low mains voltage is disabled.
DIF.2713	It enables 27Q (PPR) protection			If this input exists and is not active, "27 U< & Q→" protection for the parallel with the mains is disabled.
DIF.2714	It enables the acquisition of the frequency reference for the analogue input DROOP			If this input exists and is active, the frequency setpoint for the DROOP is acquired by an analogue input properly configured. If it exists and it is not active, the setpoint is the P.0974 parameter.
DIF.2715	It enables the load function in DROOP mode			If this input exists and it is active, the load function runs on the DROOP controllers instead of the ISOCHRONOUS ones.
DIF.2716	It enables the load function in SYSTEM BASE LOAD mode			If this input exists and it is active, the load function runs on the SYSTEM BASE LOAD controllers instead of the ISOCHRONOUS ones.

DIF.2723	Enables the limitation of the active power setpoint for high grid voltage			It is combined with the function which, in parallel with the mains, reduces the active power supplied if the mains voltage rises above a configured threshold. If there is no input configured with this code, the power reduction is always enabled. If there is an input configured with this code, the power reduction is enabled if the input is active.
DIF.3001	GCB breaker status.	Yes		An input configured in this way is used to activate the early warnings/alarms in the event of a discrepancy between the controls to the switch given by the board and the status of the same switch.
DIF.3002	MCB breaker status.	Yes		An input configured in this way is used to activate early warnings in the event of a discrepancy between the controls to the switch given by the board and the status of the same switch. Warning can be also issued in this case or, even, depending on the configuration, the gen-set can be started in case of MCB closure failure. It is also used to detect the status of the circuit breaker when it is commanded by external devices.
DIF.3003	MGCB breaker status.			It acquires the status of general input connecting the parallel bars of the generator to the users (and in case also to the mains). It is used to recognize the status of "parallel with the mains" and to disable the "load management" if the users are not connected to the generators.
DIF.3004	GCB status of other generators.			Use this input if the generator must work in parallel with other sets controlled by "non- Mecc Alt" boards: it indicates to DST4602 that at least one other generator has its own GCB closed.
DIF.3005	Status of the neutral earthing remote-control switch (NECB).			It acquires the status of the remote-control switch for the earthing of the neutral of the generator.
DIF.3101	External mains sensor.			When the input is “active” the mains is “in tolerance” (see 9.3.2.2).
DIF.3102	Absence of voltage on the parallel bars.			Used in parallel systems, where the board cannot directly measure voltage on parallel bars. The active input indicates that there is no voltage on the bars.
DIF.3103	Exterior protections for parallel with mains.			Connect this input to the external device that manages the protections of parallel with the mains. The input should be active when no protection has been triggered.
DIF.3201	Generic status (page 1).		Yes	If the related input is active, the controller will show the text defined by the related text parameter on page S.06 of the display.
DIF.3202	Important generic status (page 1).		Yes	If this input is “active”, the controller displays the text set in the related parameters associated to the input on page S.06, which is displayed immediately
DIF.3203	Generic status (page 2).		Yes	If the related input is active, the controller will show the text defined by the related text parameter on page S.07 of the display.
DIF.3204	Important generic status (page 2).		Yes	If this input is “active”, the controller displays the text set in the related parameters associated to the input on page S.07, which is displayed immediately
DIF.3205	Generic status (page 3).		Yes	If the related input is active, the controller will show the text defined by the related text parameter on page S.08 of the display.

DIF.3206	Important generic status (page 3).		Yes	If this input is “active”, the controller displays the text set in the related parameters associated to the input on page S.08, which is displayed immediately
DIF.3207	Generic status (page 4).		Yes	If the related input is active, the controller will show the text defined by the related text parameter on page S.09 of the display.
DIF.3208	Important generic status (page 4).		Yes	If this input is “active”, the controller displays the text set in the related parameters associated to the input on page S.09, which is displayed immediately
DIF.3209	Generic status (page 5).		Yes	If the related input is active, the controller will show the text defined by the related text parameter on page S.10 of the display.
DIF.3210	Important generic status (page 5).		Yes	If this input is “active”, the controller displays the text set in the related parameters associated to the input on page S.10, which is displayed immediately
DIF.3211	Generic status (page 6).		Yes	If the related input is active, the controller will show the text defined by the related text parameter on page S.11 of the display.
DIF.3212	Important generic status (page 6).		Yes	If this input is “active”, the controller displays the text set in the related parameters associated to the input on page S.11, which is displayed immediately
DIF.3213	Generic status (page 7).		Yes	If the related input is active, the controller will show the text defined by the related text parameter on page S.12 of the display.
DIF.3214	Important generic status (page 7).		Yes	When this input is "active", the board displays the text set in the parameters associated with the input on S.12 page, that is displayed immediately.
DIF.3215	Generic status (page 8).		Yes	If the related input is active, the controller will show the text defined by the related text parameter on page S.13 of the display.
DIF.3216	Important generic status (page 8).		Yes	When this input is "active", the board displays the text set in the parameters associated with the input on S.13 page, which is displayed immediately
DIF.3301	Fuel level for pump start.		Yes	If the input is active, the fuel pump is started.
DIF.3302	Fuel level for pump stop.			If the input is active, the fuel pump is stopped.
DIF.3311	Level for starting AdBlue pump			See 9.5.16.
DIF.3312	Level for stopping AdBlue pump			See 9.5.16.
DIF.4001	Generic early warning.	Yes	Yes	If the input is active, a warning is issued: the message shown is the one set by means the related “text” parameter.
DIF.4002	Generic unload.	Yes	Yes	When the input is "active", an unload is triggered: the displayed text is the one set in the parameters associated with the input.
DIF.4003	Generic deactivation.	Yes	Yes	If the input is “active”, a deactivation command is issued: the message shown is the one set by means of the related parameters.
DIF.4004	Generic alarm	Yes	Yes	If the input is active, an alarm (block) is issued: the message shown is the one set by means the related “text” parameter.

DIF.4011	Warning (after oil delay).	Yes	Yes	If the input is active, an alarm (block) is issued if the time set by means P.0216 is elapsed from the engine running detection. The message shown is the one set by means the related “text” parameter.
DIF.4012	Unload (after oil delay).	Yes	Yes	If the input is active, an alarm (block) is issued if the time set by means P.0216 is elapsed from the engine running detection. The message shown is the one set by means the related “text” parameter.
DIF.4013	De-activation (after oil delay)”.	Yes	Yes	When the input is "active", if the time set with P.0216 parameter from the starting of the engine has elapsed, a deactivation is triggered: the displayed text is the one set in the parameters associated with the input.
DIF.4014	Alarm (after oil delay)”.	Yes	Yes	If the input is active, an alarm (block) is issued if the time set by means P.0216 is elapsed from the engine running detection. The message shown is the one set by means the related “text” parameter.
DIF.4021	Early warning (if GCB is closed).	Yes	Yes	If the input is "active" and the output command for the function GCB, is active, a warning is issued. The message shown is the one set by means the related text parameter.
DIF.4022	Unload (if GCB is closed).	Yes	Yes	When the input is "active", if the GCB control is active, an unload is triggered: the displayed text is the one set in the parameters associated with the input.
DIF.4023	Deactivation (if GCB is closed).	Yes	Yes	When the input is "active", if the GCB control is active, a deactivation is triggered: the displayed text is the one set in the parameters associated with the input.
DIF.4024	Interlock (if GCB is closed).	Yes	Yes	If the input is "active" and the command for the GCB is also active, an interlock is activated. The message shown is the one set by means of the related parameters.
DIF.4031	Warning (if FUEL is enabled).	Yes	Yes	If the input is active and the output command for the fuel solenoid is active, a warning is issued. The message shown is the one set by means the related “text” parameter.
DIF.4032	Unload (if FUEL is enabled)	Yes	Yes	When the input is "active", if the fuel solenoid valve control is active, an unload is triggered: the displayed text is the one set in the parameters associated with the input.
DIF.4033	Deactivation (if FUEL is enabled).	Yes	Yes	When the input is "active", if the fuel solenoid valve control is active, a deactivation is triggered: the displayed text is the one set in the parameters associated with the input.
DIF.4034	Interlock (if FUEL is enabled).	Yes	Yes	When the input is "active", if the fuel solenoid valve control is active, an alarm is triggered: the displayed text is the one set in the parameters associated with the input.
DIF.4041	Warning (if GAS is enabled).	Yes	Yes	When the input is "active", if the GAS solenoid valve control is active as well, an early warning is triggered: the displayed text is the one set in the parameters associated with the input.
DIF.4042	Unload (if GAS is enabled).	Yes	Yes	When the input is "active", if the GAS solenoid valve control is active as well, an unload is triggered: the displayed text is the one set in the parameters associated with the input.
DIF.4043	Deactivation (if GAS is enabled).	Yes	Yes	When the input is "active", if the GAS solenoid valve control is active as well, a deactivation is triggered: the displayed text is the one set in the parameters associated with the input.
DIF.4044	Interlock (if GAS is enabled).	Yes	Yes	When the input is "active", if the GAS solenoid valve control is active as well, an alarm is triggered: the displayed text is the one set in the parameters associated with the input.

DIF.4051	Warning (turns off the fuel pump)	Yes	Yes	If the input is active, a warning is issued: the message shown is the one set by means the related “text” parameter. The controller blocks the fuel pump if this input is “active”
DIF.4052	Unload (turns off the fuel pump)	Yes	Yes	When the input is "active", an unload is triggered: the displayed text is the one set in the parameters associated with the input. The controller blocks the fuel pump if this input is “active”
DIF.4053	Deactivation (turns off the fuel pump)	Yes	Yes	If the input is active a deactivation is issued: the message shown is the one set by means the related “text” parameter. The controller blocks the fuel pump if this input is “active”
DIF.4054	Alarm (turns off the fuel pump)	Yes	Yes	If the input is active, an alarm (block) is issued: the message shown is the one set by means the related “text” parameter. The controller blocks the fuel pump if this input is “active”
DIF.4062	Unload (subject to OVERRIDE)”.	Yes	Yes	When the input is "active", an unload is generally triggered. If the “OVERRIDE engine protections” function is enabled, a warning is issued. The message shown is the one set by means of the related parameters.
DIF.4063	Deactivation (subject to OVERRIDE)”.	Yes	Yes	When the input is "active", a deactivation is generally triggered. If the “OVERRIDE engine protections” function is enabled, a warning is issued. The message shown is the one set by means of the related parameters.
DIF.4064	Alarm (subject to OVERRIDE)”.	Yes	Yes	If the input is “active”, normally an interlock is activated. If the “OVERRIDE engine protections” function is enabled, a warning is issued. The message shown is the one set by means of the related parameters.
DIF.4201	Emergency stop	Yes		When the input is "not active", the board triggers an "emergency" alarm.
DIF.4211	Minimum fuel level	Yes		If the input is “active”, an interlock with a fixed description (language-dependant) is activated. This function can be also used for the “Fuel pump management” (see par. 9.5.13).
DIF.4212	Low fuel level	Yes		If the input is “active”, a warning with a fixed description (language-dependant) is activated. This function can be also used for the “Fuel pump management” (see par. 9.5.13).
DIF.4213	High fuel level	Yes		If the input is “active”, a warning with a fixed description (language-dependant) is activated. This function can be also used for the “Fuel pump management” (see par. 9.5.13).
DIF.4221	Minimum oil pressure	Yes		When the input is “active”, if the time set by means of the P.0216 parameter from engine start has elapsed, a fixed description (language-dependant) interlock is activated.
DIF.4222	Low oil pressure	Yes		When the input is “active”, if the time set by means of the P.0216 parameter from engine start has elapsed, a fixed description (language-dependant) warning is activated.
DIF.4231	High coolant temperature	Yes		When the input is “active”, if the time set by means of the P.0216 parameter from engine start has elapsed, a fixed description (language-dependant) warning is activated.
DIF.4232	Maximum coolant temperature	Yes		When the input is “active”, if the time set by means of the P.0216 parameter from engine start has elapsed, a fixed description (language-dependant) warning is activated.
DIF.4241	Overload	Yes		Normally, the “tripped” contact of the machine protection breaker is connected to this input. If the input is “active”, an interlock with a fixed description (language-dependant) is activated.

DIF.4251	Overspeed	Yes		If the input is “active”, an interlock with a fixed description (language-dependant) is activated.
DIF.4261	Auto production line open.	Yes		When the input is "active" the board assumes it is no longer in parallel with the mains and stops the group with an alarm.

For further details and/or clarifications regarding the functions of the inputs, refer to [1].

The following function, not directly linked to the board functioning sequence, can be selected for any digital input:

- DIF.0101 - “Used by the PLC”. It is possible to use some digital inputs of the board only for PLC logics, without that the normal sequence of operations should use them. In these cases, it is possible to leave the inputs configured with DIF.0000 function ("Not used"). There is however the risk of reusing the input for other purposes, as it seems to be free: for this reason, DIF.0101 function exists (to indicate that the input is used, even if not directly by the board).

7.5.2 Virtual digital inputs

The board, in addition to physical digital inputs, also manages 16 digital virtual inputs. The same are operated by the controller just as if they were physical inputs (with no limitation), but the status of the virtual inputs is not acquired from the hardware, but it is determined through the software PLC.

For example, it is possible to associate a virtual digital input with DIF.2501 function ("inhibition to automatic intervention of the generator"). When this virtual digital input is active, DST4602 stops the engine. The operator can then create a complex PLC program and decide on its basis under which conditions the generator should work or not: by writing the result of the logics of the virtual digital input, it will be able to control the automatic starting of the generator.

7.6 Digital outputs configuration

The board has sixteen physical digital outputs as standard and manages up to ten DITEL expansion modules, with sixteen digital outputs each. In total, therefore, the board can manage up to 176 digital outputs, all fully configurable. Use P.0141 parameter to specify the number of DITEL modules to be managed.

By default, internal relays/transistors associated with all digital outputs are activated when its related logic function requires their activation. It is however possible to reverse this convention (individually for each output), by using the appropriate parameters:

Parameter	Outputs
P.3000	01...16
P.3200	DITEL #01
P.3250	DITEL #02
P.3300	DITEL #03
P.3350	DITEL #04
P.3400	DITEL #05
P.3450	DITEL #06
P.3500	DITEL #07
P.3550	DITEL #08
P.3600	DITEL #09

P.3650	DITEL #10

Said parameters have a bit for each output:

- A bit at zero means that the relay/transistor is activated when the corresponding function requires its activation.
- A bit at one means that the relay/transistor is deactivated when the corresponding function requires its activation.

By default, all the bits are set to 0.

Each output is associated with a parameter that configures its function (P.3001 for output 1). See document [1] for the parameters list.

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

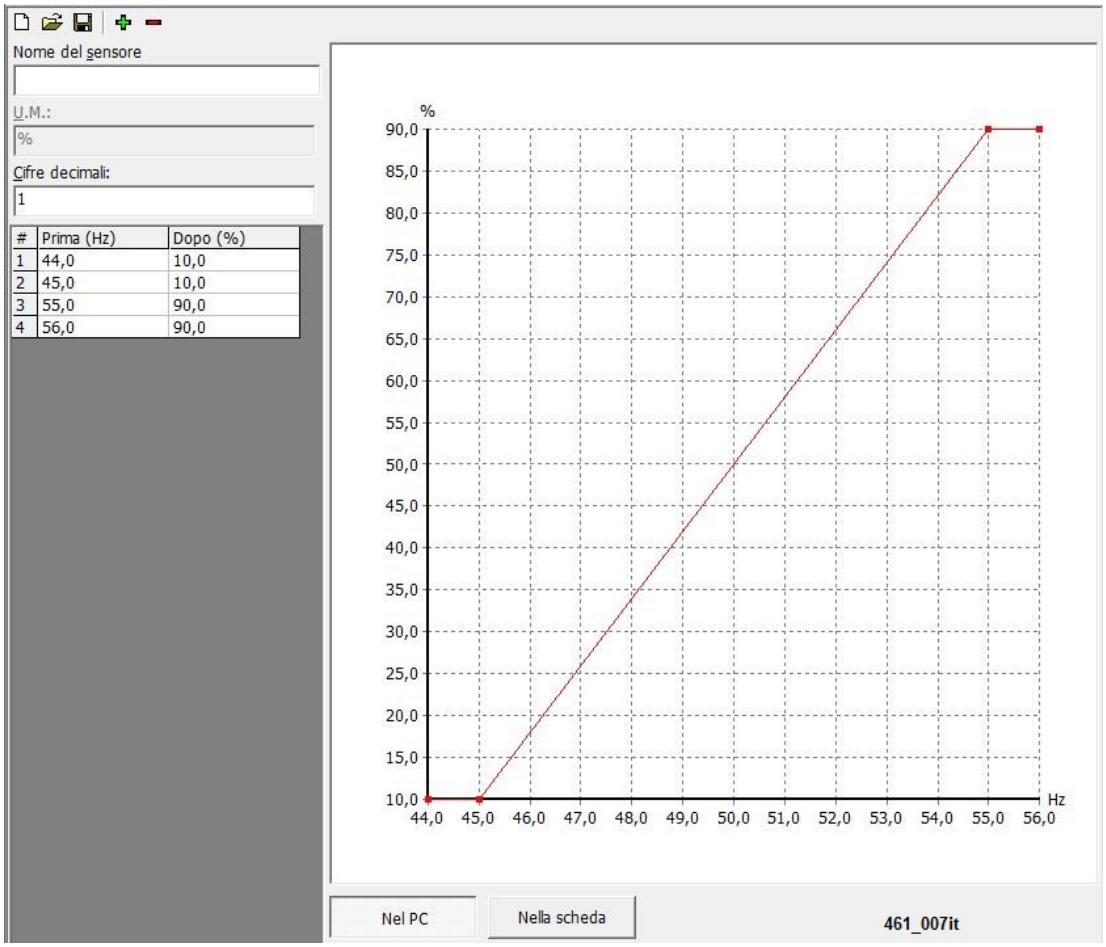
- DOF.0101 - “Used by the PLC”. This function combines the digital output to the PLC program internal to the device: in this way, it is the PLC logic that controls the output, and not the normal operating logics of the board. Note: if the PLC program uses some outputs, but these outputs are not configured with DOF.0101 function, the outputs will not be controlled.
- DOF.0102 - “Controlled by the serial ports”. The board does not control the output with its own internal logics, but with the controls it receives through the serial ports.
- DOF.0103 - “Logics AND/OR”. See 7.4.

7.7 Conversion curves

As you can easily understand from the name, the conversion curves are a tool that allows converting a numeric value into another numeric value. They can be used for two purposes:

- To convert the value acquired from a (physical) analogue input into the real units of measurement of the sensor.
- Convert an internal measure of the controller board into a percentage value, prior to “writing” it on an analogue output.

NB: the conversion curves cannot be configured directly from the panel of the controller board, but through a PC equipped with the BoardPrg4 [14] software.



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

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

The BoardPrg4 [14] software allows you (by means of the first buttons on top left) to save the curve on file to be able to use it again in other applications. So, you can create an archive of the conversions associated to the sensors used.

7.8 Analogue inputs configuration

The board has six physical analogue inputs and eight virtual analogue inputs as standard. It also manages up to sixteen DIGRIN/DITHERM expansion modules (for a total of 48 temperatures) and up

to sixteen DIVIT modules (for a total of 64 measurements). Therefore, it manages up to 126 analogue inputs, all fully configurable.

For the virtual analogue inputs, see par. 7.8.1.

Use P.0142 parameter to specify the number of DIGRIN/DITHERM modules to be managed. Use P.0143 parameter to specify the number of DIVIT modules to be managed.

It is possible to apply a conversion curve to all analogue inputs.

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

- One parameter which configures its function (P.4001 for input 1).
- One parameter allows to define a text message to display. (P.4002 for input 1).
- Two thresholds consisting of three parameters each:
    - One parameter which configures the threshold value (P.4003 and P.4206 for input 1).
    - One parameter which configures the delay for managing the “out of threshold” (P.4004 and P.4007 for input 1).
    - One parameter which configures the checking options and the actions in case of “out of threshold” (P.4005 and P.4008 for input 1).

See document [1] for the parameters list.

The parameter that configures the message for an analogue input (P.4002 for input 1) is used by the board every time the thresholds are used to trigger early warnings and/or alarms (see below); is also used for the following functions of the analogue inputs:

- AIF.2001
- AIF.2003
- AIF.2005
- AIF.2007
- AIF.2009
- AIF.2011
- AIF.2013
- AIF.2015

The previous functions configure the input as "Generic sensor". In this case, the acquired measurement will be displayed on the pages E.05 through E.12, preceded by the configured message. **NOTE: You can also use the AIF.2051 function instead of the previous three.** in this case, the measure acquired will not be displayed on pages E.05...E.12; however, you can still use it with the thresholds to manage digital outputs and activate warnings/locks.

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

- Bit 0: allows configuring the "out of threshold" condition:

- 0: the "out of threshold" condition occurs when the measurement is higher than the threshold.
- 1: the "out of threshold" condition occurs when the measurement is lower than the threshold.

- Bit 1: allows managing the internal status linked to the thresholds on a measurement (see below).
- Bit 4...7: allow indicating the typology of anomaly:
  - Bit 4: early warning.
  - Bit 5: unload.
  - Bit 6: deactivation.
  - Bit 7: lock.

  Note: If none of these bits is selected, the threshold does not trigger early warnings, but it can still be used to manage the internal status (see below). Only one of these four bits should be enabled: if two or more are active, the board uses the one that requires the most severe anomaly.
- Bit 8...12: allow determining the conditions under which the "out of threshold" condition can be assessed. They are not linked to anomalies, then they act even if the thresholds are used to drive the internal status (see below) and not to activate anomalies.
  - Bit 8: the "out of threshold" condition is assessed only if the engine is running.
  - Bit 9: the "out of threshold" condition is assessed only if the engine has been running since at least the time set with P.0216 parameter ("engine protection masking time").
  - Bit 10: the "out of threshold" condition is assessed only if GCB switch is closed.
  - Bit 11: the "out of threshold" condition is assessed only if the fuel solenoid valve is open (FUEL, see 9.5.6.6).
  - Bit 12: the "out of threshold" condition is assessed only if the GAS solenoid valve is open (GAS, see 0).

  It is possible to activate any combination of these bits: the "out of threshold" condition is assessed only if all the selected conditions are met.
- Bit 13. This bit is only linked to anomalies. If selected, it subjects the activation of anomalies to the status of a digital input configured with DIF.2705 function ("disable protections on analogue measurements"): if this input exists and is active, the board does not trigger this anomaly.
- Bit 14. This bit is only linked to anomalies. If this bit is selected, DST4602 will stop the fuel pump (see 9.5.13.5) when the anomaly is active.
- Bit 15. This bit is only linked to anomalies. If this bit is selected, DST4602 will "transform" the anomaly into an early warning if the engine protection OVERRIDE or the complete OVERRIDE is activated (see 10.5).

You can set any combination of these bit.

Internal status linked to thresholds on analogue measurements. DST4602 can use both thresholds on the analogue measurements to activate/deactivate an internal status: the internal status is then accessible by AND/OR logics, and it is possible to use it to control the digital outputs of the board.

Intrinsically, the board uses the "out of threshold" condition of one of the two thresholds to activate the internal status, the "out of threshold" condition of the other threshold to deactivate it (therefore managing a band of hysteresis).

The configuration is performed by using the bit 1 of the configuration parameter of both thresholds (P.4005 and P.4008 for input 1). Set to "1" the bit 1 in the configuration parameter related to the threshold that should activate the internal status; set it to "0" in the configuration parameter of the other threshold.

Let's take an example: let's suppose that the analogue input 1 acquires a temperature and that the board should manage a heating system to keep the temperature at 50°C. Let's suppose then that you want to activate the external heating system when the temperature falls below 45°C and to turn it off when the temperature rises above 52°C. The parameters can be configured in the following way (example referred to analogue input 1):

- P.4003: 45.0 °C
- P.4004: 5.0 s
- P.4005: 0003 (bit 0 on, bit 1 on)
- P.4006: 52.0 °C
- P.4007: 3.0 s
- P.4008: 0000 (bit 0 off, bit 1 off)

The first threshold is used to activate the internal status (but the opposite could be done). With the first three parameters, the board is configured to activate the internal status (bit 1 of P.4005 on) when the temperature measurement is lower (bit 0 of P.4005 on) than the 45°C threshold for 5 consecutive seconds. The board is configured to deactivate the internal status (bit 1 of P.4008 off) if the temperature measurement is higher (bit 0 of P.4005 off) than the 52 C° threshold for 3 consecutive seconds.

Use of analogue inputs as digital ones. The analogue inputs of the board (01 ... 06, not those of the expansion modules) can be individually used as digital inputs. To do this, configure the input (P.4001 or equivalent) with AIF.0100 function (used as digital input). For the wiring of inputs (when used as digital inputs) see paragraph 5.

7.8.1 Virtual digital inputs

In addition to the physical analogue inputs, the controller also operates 8 virtual analogue inputs. They are managed by the board exactly as if they were physical inputs (without limitations); the value of the virtual inputs is not acquired by the hardware but determined by the PLC program.

Example: if you configure a virtual analogue input with AIF.2301 function ("power setpoint in BASE LOAD"), the board will indeed use the value of the virtual analogue input as reference power to be supplied when the generator is in parallel with the mains. Through the PLC program, the operator can generate a complex logic (which can consider temperatures, pressures, etc.) to determine the power that the generator should supply, and finally write the result of the logic into the virtual analogue input.

7.9 Configuration of the analogue outputs

The standard board has two analogue outputs as standard and manages up to eight DANOUT expansion modules (four outputs per module, for a total of 32 additional outputs). In total, therefore, the board manages up to 34 analogue outputs, all fully configurable.

Use P.0144 parameter to specify the number of DANOUT modules to be managed.

One parameter which configures its function (P.6001 for output 1). See document [1] for the parameters list.

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

The following function, not directly related to the operation sequences of the board, can be selected for any analogue output:

- AOF.0101 - “Used by the PLC”. This function combines the analogue output to the PLC program inside the device: in this way, it is the PLC logic that controls the output and not the normal operating logics of the board. Note: if the PLC program uses some outputs, but these outputs are not configured with DOF.0101 function, the outputs will not be controlled.
- AOF.0102 - “Controlled by the serial ports”. The board does not control the output with its own internal logics, but with the controls it receives through the serial ports.

7.10 Alternative parameters configuration

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

Alternative configurations can be programmed only using the BoardPrg4. You cannot program or modify the configurations from the controller.

The parameters present in each alternative group are the following:

- P.0101: Generator number of phases.
- P.0102: Generator nominal voltage
- P.0103: Primary of generator voltmeter transformers.
- P.0104: Secondary generator voltmeter transformers.
- P.0105: Rated frequency
- P.0106: Generator nominal power (kVA).
- P.0107: Primary of the generator/user current transformer.
- P.0108: Primary of the current transformer or toroid ratio for auxiliary power.
- P.0109: Type of transformer for auxiliary power.
- P.0116: Mains/bars nominal voltage
- P.0117: Primary of mains/bars voltmeter transformers.
- P.0118: Secondary of mains/bars voltmeter transformers.

- P.0119: Mains/bars number of phases.
- P.0124: Connection of generator/user current transformers
- P.0125: Engine nominal power (kW).
- P.0126: Use of mains/bars sensor.
- P.0128: Is the neutral of the generator connected to the board?
- P.0129: Is the neutral of mains/bars connected to the board?
- P.0130: Auxiliary current connection.
- P.0131: Auxiliary current use.
- P.0133: Nominal engine speed (@ 50Hz).
- P.0134: Nominal engine speed (@ 60Hz).
- P.0139: Secondary of generator/user current transformer.
- P.0140: Secondary of the current transformer or toroid ratio for auxiliary power
- P.0713: Speed at 0% command
- P.0714: Speed at 100% command
- P.1604 (since version 1.04): Setpoint for the frequency.
- P.1654 (since version 1.04): Setpoint for the voltage.
- P.1703 (since version 1.25): Voltage corresponding to 0%.
- P.1704 (since version 1.25): Voltage corresponding to 100%.
- P.1708 (since version 1.36): Rated voltage for AVR.

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

- DIF.2151 – “Select configuration 1”. When the input becomes "active", parameters of alternative configuration set 1 are copied in the working configuration.
- DIF.2152 – “Select configuration 2”. When the input becomes "active", parameters of alternative configuration set 2 are copied in the working configuration.
- DIF.2153 – “Select configuration 3”. When the input becomes "active", parameters of alternative configuration set 3 are copied in the working configuration.
- DIF.2154 – “Select configuration 4”. When the input becomes "active", parameters of alternative configuration set 4 are copied in the working configuration.

Caution: when an alternative configuration is copied in the operating parameters, the previous values of the operating parameters are lost. The only way to restore them is to have them stored in another alternative configuration and recall it.

This function is usually used with multiple-voltage and/or multiple-frequency panels: wiring the cams of a selector to the panel on the inputs of the controller, you can manually switch voltages and frequency without having to use the parameters of the controller.

NOTE: parameter change occurs only with engine shut off and with the controller in OFF/RESET mode.

8. History logs (H.XX)

During operations, if it is not in the OFF/RESET, the board makes periodic records of a single event, partially configurable with programming parameters.

The controller manages three types of archive:

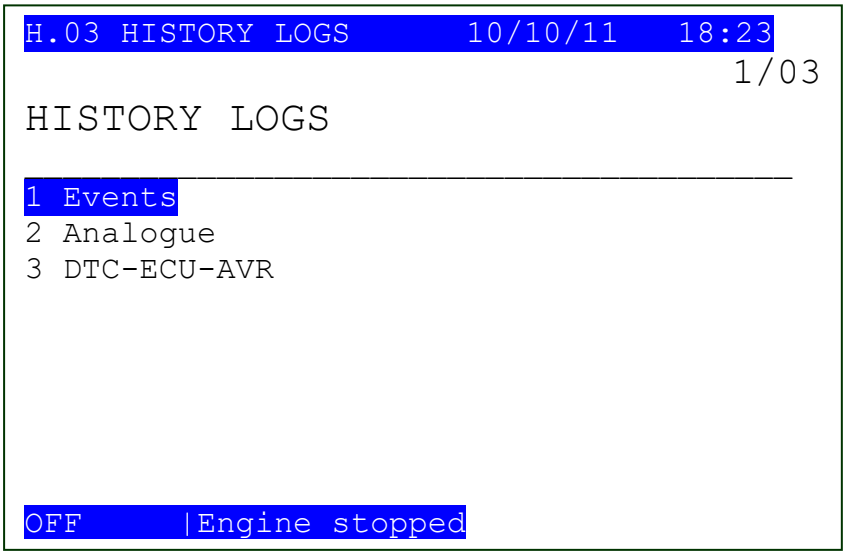
- Events
- Analogue archive
- Diagnostic codes (DTC – “Diagnostic Trouble Code”).

8.1 How to visualize the archives

The history logs can be accessed in any controller operating status. To access the archive visualization, press the UP and DOWN buttons till the HISTORY LOGS (H.01) page is displayed. If you are in a mode the limits the use of the vertical scroll buttons, you may be required to press the EXIT button repeatedly.

Then, press ENTER to view the records: it shifts to "H.03" page, which allows the selection of the desired archive.

8.2 Log selection



The second line always shows the numerical indication of the selected archive and the number of archives in the menu. The next lines of the display are used to display the archives that could be selected. The selected item is highlighted in reverse REVERSE. Use the UP and DOWN buttons to scroll through the menu to the lower and upper index items (pressing the UP button allows to directly cycle from the first item to the last one).

By pressing the ENTER key, the selected archive will be entered, press the EXIT key to return to "H.01" page.

8.3 Events pages

When previously configured events occur, the controller adds a record in this archive. The record always contains date and time, the numeric code that identifies the event and the status of the controller. By means of the BoardPrg4 program, it is possible to select which information must be recorded for every event. It is possible to add 44 information max. The capacity of the archive depends on the information recorded on event: however, with the default configuration the full capacity is 860 records. If the archive is full and a new event occurs, the oldest is overwritten.

P.0441 parameter allows selecting which events should be recorded. It is a configurable parameter in bits (for the configuration of parameters in bits see 7.3.4):

Bit	Hexadecimal value	Firmware version	Description.
0	01	00.00	Controller modes.
1	02	00.00	Mains status.
2	04	00.00	Generator status.
3	08	00.00	Engine status.
4	10	00.00	Switches status.
5	20	00.00	Switches controls.
6	40	00.00	Start/stop requests.
7	80	00.00	Fuel pump controls.
8	100	00.63	Diagnostic

Below you will find a table showing the codes of all possible events.

Code	Firmware version	Although blocked	Description
EVT.1001	00.00	Yes	Controller in OFF/RESET mode
EVT.1002	00.00	Yes	Controller in MAN mode
EVT.1003	00.00	Yes	Controller in AUTO mode
EVT.1004	00.00	Yes	Controller in TEST mode
EVT.1005	00.00	Yes	Controller in REMOTE START mode
EVT.1010	00.00		Mains failure
EVT.1011	00.00		Mains on
EVT.1012	00.00		Mains in tolerance
EVT.1013	00.00		"Inhibition to automatic intervention" is active (from configurable input).
EVT.1014	00.00		"Inhibition to automatic intervention" is not active (from configurable input).
EVT.1020	00.00		Generator failure
EVT.1021	00.00		Generator on
EVT.1022	00.00		Generator in tolerance
EVT.1030	00.00		GCB Close command
EVT.1031	00.00		GCB Open command
EVT.1032	00.00		GCB closed.
EVT.1033	00.00		GCB open.
EVT.1035	00.00		MCB Close command
EVT.1036	00.00		MCB Open command
EVT.1037	00.00		MCB closed

EVT.1038	00.00		MCB open.
EVT.1040	00.00		Engine stopped
EVT.1041	00.00		Starting cycle
EVT.1042	00.00		Engine running.
EVT.1043	00.00		Cooling cycle
EVT.1044	00.00		Stopping cycle
EVT.1045	00.00		Idle speed cycle
EVT.1050	00.00		Manual start-up command
EVT.1051	00.00		Manual stop command
EVT.1052	00.00		Auto start command
EVT.1053	00.00		Auto stop command
EVT.1054	00.00		Start-up command from digital input (automatically)
EVT.1055	00.00		Stop command from digital input (automatically)
EVT.1056	00.00		Start-up command from serial port (automatically)
EVT.1057	00.00		Stop command from serial port (automatically)
EVT.1058	00.00		Start-up command from clock/calendar (automatically)
EVT.1059	00.00		Stop command from clock/calendar (automatically)
EVT.1060	00.00		Start-up command from SMS (automatically)
EVT.1061	00.00		Stop command from SMS (automatically)
EVT.1062	00.00		Start-up command for not closed MCB
EVT.1063	00.00		Start-up command from MC
EVT.1070	00.00	Yes	Fuel pump on
EVT.1071	00.00		Fuel pump off
EVT.1072	01.28		AdBlue pump on
EVT.1073	01.28		AdBlue pump off
EVT.1074	00.00	Yes	Reset
EVT.1075	00.00		Clock/Calendar not valid (but used by some functions)
EVT.1076	00.00	Yes	Date/time update
EVT.1077	00.00		New controller power-on
EVT.1078	00.00	Yes	Factory parameters configuration restored
EVT.1080	00.00		Inhibition to the taking of load (by digital input) active
EVT.1081	00.00		Inhibition to power load is not active.
EVT.1082	00.00		Engine protections override on
EVT.1083	00.00		Engine protections override off
EVT.1086	00.89	Yes	Daylight Save Time activated.
EVT.1087	00.89	Yes	Daylight Save Time deactivated.
EVT.1091	00.00		Mains "27 U<<" loss protection activated
EVT.1092	00.00		Mains "59 U>>" loss protection activated
EVT.1093	00.00		Mains "81 f<<" loss protection activated
EVT.1094	00.00		Mains "81 f>>" loss protection activated
EVT.1095	00.00		Mains "81R" (Δf/Δt) loss protection activated
EVT.1096	00.00		Mains “Vector Jump” loss protection activated
EVT.1097	00.00		Mains loss protection (from MC) activated
EVT.1098	00.00		Mains loss protection (from contact) activated
EVT.1099	00.00		Mains loss protection restored
EVT.1100	00.07		Mains "27 U<" loss protection activated

EVT.1101	00.07		Mains "59 U>" loss protection activated
EVT.1102	00.07		Mains "81 f<" loss protection activated
EVT.1103	00.07		Mains "81 f>" loss protection activated
EVT.1104	00.32		Protections 27 enabled.
EVT.1105	00.32		Mains"27 U< & Q→"loss protection activated
EVT.1121	00.07		Power limitation for high mains frequency activated.
EVT.1122	00.07		Power limitation for high mains frequency deactivated.
EVT.1123	00.07		Power limit from contact # 1 activated.
EVT.1124	00.07		Power limit from contact # 1 deactivated.
EVT.1125	00.07		Power limit from contact # 2 activated.
EVT.1126	00.07		Power limit from contact # 2 deactivated.
EVT.1127	00.07		Power limitation for mains low frequency activated.
EVT.1128	00.07		Power limitation for mains low frequency deactivated.
EVT.1131	00.07		~~Engine stopped due to excessive power limitation activated.~~
EVT.1132	00.07		~~Engine stopped due to excessive power limitation deactivated.~~
EVT.1133	01.27		Power setpoint limitation for high voltage enabled
EVT.1134	01.27		Power setpoint limitation for high voltage disabled
EVT.1135	01.27		Start of power setpoint limitation for high voltage
EVT.1136	01.27		End of power setpoint limitation for high voltage
EVT.1137	01.27		Start of power setpoint limitation by ext. command
EVT.1138	01.27		End of power setpoint limitation by ext. command
EVT.1151	00.32		Mains "27 U<<" loss protection restored
EVT.1152	00.32		Mains "59 U>>" loss protection restored
EVT.1153	00.32		Mains "81 f<<" loss protection restored
EVT.1154	00.32		Mains "81 f>>" loss protection restored
EVT.1155	00.32		Mains "81R" (Δf/Δt) loss protection restored
EVT.1156	00.32		Mains “Vector Jump” loss protection restored
EVT.1157	00.32		Mains loss protection (from MC) restored
EVT.1158	00.32		Mains loss protection (from contact) restored
EVT.1160	00.32		Mains "27 U<" loss protection restored
EVT.1161	00.32		Mains “59 U>" loss protection restored
EVT.1162	00.32		Mains "81 f<" loss protection restored
EVT.1163	00.32		Mains "81 f>" loss protection restored
EVT.1164	00.32		Protections 27 disabled.
EVT.1165	00.32		Mains "27 U< & Q→" loss protection restored
EVT.1191	01.27		The parallel with the mains is allowed
EVT.1192	01.27		The parallel with the mains is not allowed
EVT.1201	00.63		Inhibition to the taking of load (by mains out of tolerance) active
EVT.1202	00.63		Inhibition of the taking of load (by Modbus) active.

EVT.1203	00.63		Inhibition of the taking of load (for some GCB not opened) active.
EVT.1204	00.63		Inhibition of the taking of load (for synchronisation on MCB) active.
EVT.1205	00.63		Inhibition of the taking of load (for command by MC) active.
EVT.1221	00.63		Inhibition to the automatic intervention (by clock/calendar) not active.
EVT.1222	00.63		Inhibition to the automatic intervention (by clock/calendar) active.
EVT.1223	00.63		Inhibition to the automatic intervention (for mains out of tolerance in SPtM and MPtM plants) active.
EVT.1224	00.63		Inhibition to the automatic intervention (for mains out of tolerance in SPtM and MPtM plants) not active.
EVT.1225	00.63		Inhibition to the automatic intervention active (for GCB not open).
EVT.1226	00.63		Inhibition to the automatic intervention not active (for GCB not open).
EVT.1241	00.63		Taking of load function disabled (by parameter)
EVT.1242	00.63		Taking of load function disabled (by digital input)
EVT.1243	00.63		Taking of load function disabled (for the supply mode)
EVT.1244	00.63		Taking of load function disabled (by MC controller)
EVT.1245	00.63		Taking of load function disabled (for mains in tolerance)
EVT.1246	00.63		Taking of load function disabled (for inhibitions to start)
EVT.1247	00.63		Taking of load function disabled (for MGCB open)
EVT.1248	00.63		Taking of load function disabled (because the exit from parallel is required for other reasons)
EVT.1249	00.63		Taking of load function disabled (controller not in AUTO)
EVT.1250	00.63		Taking of load function disabled (there are warnings)
EVT.1261	00.63		Start requested by load function (because disabled)
EVT.1262	00.63		Start requested by load function (load function just enabled)
EVT.1263	00.63		Start requested by load function (no GCB closed)
EVT.1264	00.63		Start requested by load function (START button pressed)
EVT.1265	00.63		Start requested by load function (initial delay)
EVT.1266	00.63		Start requested by load function (priority list not valid)
EVT.1267	00.63		Start requested by load function (genset selected)
EVT.1268	00.63		Start requested by load function (for min. number of gensets supplying)
EVT.1269	00.63		Start requested by load function (because it is the master genset)
EVT.1270	00.63		Start requested by load function (for load threshold)
EVT.1271	00.63		Start requested by load function (for load reserve)
EVT.1272	00.63		Start requested by load function (for priority order)
EVT.1273	00.63		Start requested by load function (for priority order)
EVT.1281	00.63		Start requested by load function (for genset not selected)
EVT.1282	00.63		Start requested by load function (for load threshold and reserve)
EVT.1291	00.63		New master genset
EVT.1292	00.63		The supplying mode for the load function is ISOCHRONOUS
EVT.1293	00.63		The supplying mode for the load function is SYSTEM BASE LOAD
EVT.1294	00.63		The supplying mode for the load function is DROOP

EVT.1321	00.63		The number of gensets connected to the PMCB bus has changed
EVT.1801	01.29		AFR enabled
EVT.1802	01.29		AFR disabled
EVT.1803	01.29		Error in AFR MAN/AUTO mode
EVT.1804	01.29		AFR in AUTO mode
EVT.1805	01.29		AFR in MAN mode
EVT.1806	01.29		first set of parameters for AFR
EVT.1807	01.29		second set of parameters for AFR
EVT.1808	01.29		mixer position in AUTO: engine stopped
EVT.1809	01.29		mixer position in AUTO: delay before cranking
EVT.1810	01.29		mixer position in AUTO: cranking
EVT.1811	01.29		mixer position in AUTO: running with GCB open
EVT.1812	01.29		mixer position in AUTO: running with GCB closed - low power
EVT.1813	01.29		mixer position in AUTO: running with GCB closed - high power
EVT.1814	01.29		mixer position in AUTO: stopping
EVT.1815	01.29		Error in mixer position in AUTO mode

The column "even if blocked" indicates which events are anyway recorded even if the records are blocked (see 8.5)

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

- 2000: if the anomaly is an early warning.
- 3000: if the anomaly is an unload.
- 4000: if the anomaly is a deactivation.
- 5000: if the anomaly is an alarm.

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

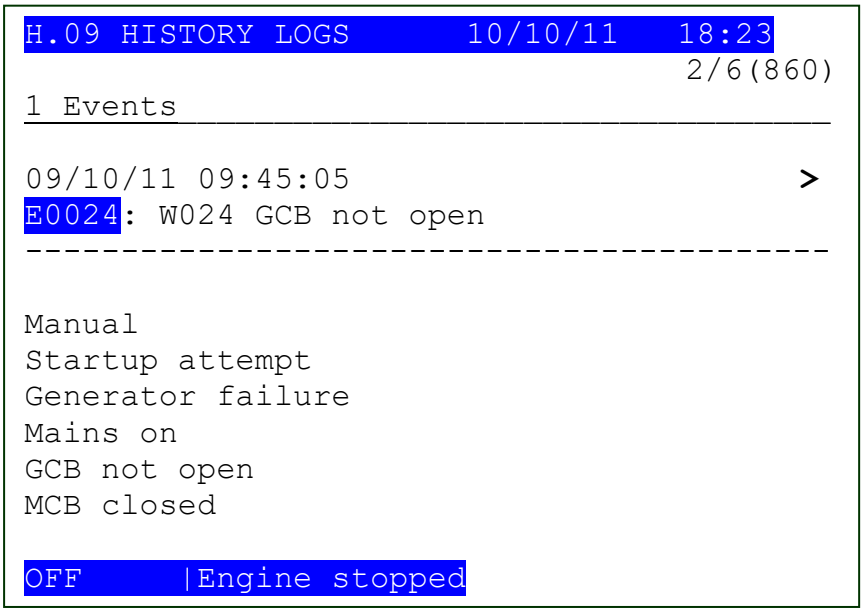
With the default configuration, each time that an event is recorded, the board also records the following info (this list can be modified by means of the BoardPrg4 program):

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

- Mains/Busbar phase-to-phase voltages and frequency.
- Genset phase-to-phase voltages and frequency.
- The three phase currents.
- The total (apparent, active and reactive) powers and the total power factor.
- The battery voltage.
- Engine rotation speed, lubricant pressure, coolant temperature and fuel level.

Use the UP and DOWN buttons to scroll cyclically trough all recordings. Each event has four information pages. Pressing the LEFT and RIGHT buttons allows you to scroll through the four pages related to the event.

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



The common part (above the dotted line) contains:

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

The content below the dashed line depends on the information configured for the record; with the default configuration, 4 pages are used:

Page 1. It shows the statutes of the system at the time when the event was recorded: board operation mode and statutes of engine, generator, mains and switches.

Page 2. It shows mains and generator frequency and voltages.

Page 3. It shows the L3- L1 phase-to-phase voltage of the generator, phase currents and total powers (kVA, kW, kvar).

Page 4. It shows total power factor, battery voltage, engine rotation speed, lubricant pressure, coolant temperature and fuel level.

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

8.4 Pages for analogues

DST4602 records a series of analogue measurements and statuses at regular intervals. The recording interval is configurable, and different intervals for when the engine is running and when the engine is stopped can be configured:

- P.0442: interval (in seconds) for the recording into the archive of analogue measurements, used when the engine is running.
- P.0443: interval (in seconds) for the recording into the archive of analogue measurements, used when the engine is stopped.

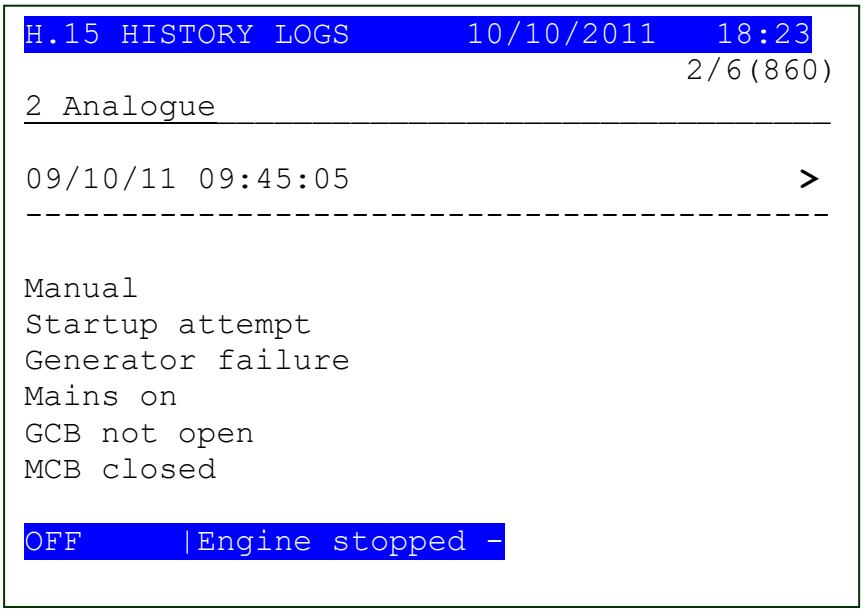
Each record always contains the date/time and the status of the controller. By means of the BoardPrg4 program, it is possible to select which information must be recorded. It is possible to add 44 information max. The capacity of the archive depends on the information recorded on event: however, with the default configuration the full capacity is 860 records. If the archive is full and a new event occurs, the oldest is overwritten.

Full capacity is 860 records. If the archive is full and a new event occurs, the less recent is overwritten (so always the last 860 events are stored). Recorded values are:

- Date/Time
- Operating mode of the controller.
- Engine status.
- Genset status.
- Mains status.
- GCB, MCB and MGCB circuit breakers status.
- GCB and MCB circuit breakers current command.
- Mains/Busbar phase-to-phase voltages and frequency.
- Genset phase-to-phase voltages and frequency.
- The three phase currents.
- The total (apparent, active and reactive) powers and the total power factor.
- The battery voltage.
- Engine rotation speed, lubricant pressure, coolant temperature and fuel level.

Use the UP and DOWN buttons to scroll cyclically trough all recordings. Each record has four pages available for information. By pressing LEFT and RIGHT keys it is possible to navigate on the four pages related to recording.

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



The common part (above the dotted line) contains:

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

The content below the dashed line depends on the information configured for the record; with the default configuration, 4 pages are used:

Page 1. It shows the statutes of the system at the time when the event was recorded: board operation mode and statutes of engine, generator, mains and switches.

Page 2. It shows mains and generator frequency and voltage, and the current L1.

Page 3. It displays current L2 and L3, total powers (kVA, kW, kvar), total power factor, battery voltage, engine rotation speed and lubricant pressure.

Page 4. It shows coolant temperature and fuel level.

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

8.5 Locked recordings

The board does not perform recordings in the archive of analogues and in the archive of events if it is in OFF/RESET mode and when an alarm, a deactivation or an unload have been activated. Exceptions are some event codes (highlighted by the wording "Yes" in the column "even if blocked" of the table in 8.3) and all anomalies. Recordings are locked; all the windows of the History logs display an

intermittent “Locked” message. To unlock the recordings, it is necessary cancel all anomalies and set the board in MAN or AUTO.

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

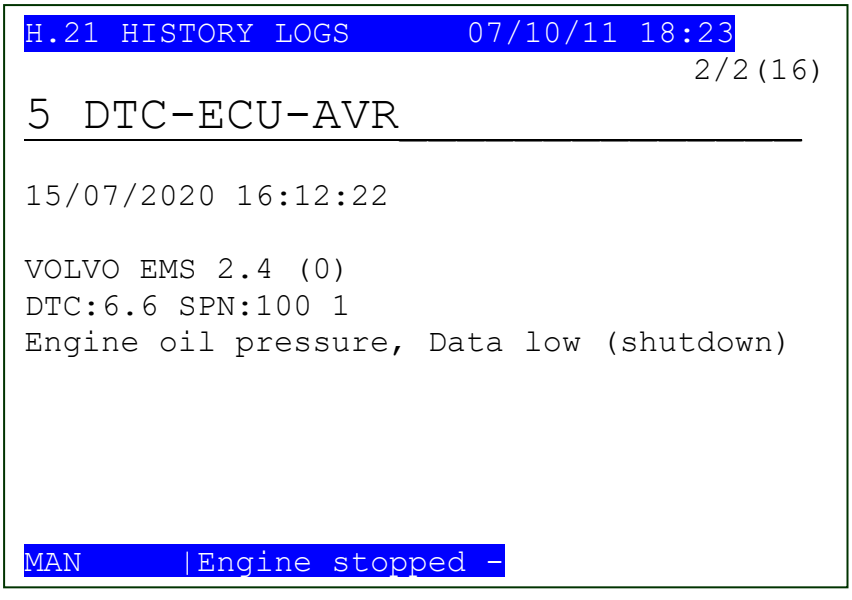
The controller stores the DTCs sent over the CAN-BUS CAN0 line by external devices (the engine control unit, the voltage regulator, the gas mixer).

For each diagnostic code, the controller stores:

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

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

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



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

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

8.7 Exit from archives visualization

There are two ways to exit from archive visualization:

- Press the EXIT button 'n' times to scroll back to page H.01
- Change the operating mode of the controller.

In both cases, page H.01 will display; you may move to other display modes using the UP and DOWN buttons.

8.8 Deleting of an archive

It is possible to fully delete (empty) an archive with the following procedure:

- Display a recording of the concerned archive (see above).
- Press and hold ACK/TEST + EXIT keys for 5 seconds: at the end the board will display a confirmation message and delete the archive.

9. Working sequence

9.1 Operating modes

The active work mode is always displayed in the status bar (bottom right). DST4602 provides for three main working modes:

- **OFF/RESET**: DST4602 controls the opening of GCB switch and stops the engine. Where provided, it also controls the closing of MCB switch. The anomalies are all cancelled, and you can access the programming to modify the parameters.
- **MAN:** the starting and stopping of the generator will be executed by the operator. GCB switch (and, where applicable, MCB switch) opening/closing as well will be executed by the operator: DST4602 always allows the opening of the switches (to open MCB when the engine is stopped, press the MCB key for 5 seconds); it allows closing GCB only if the engine is started and if generator voltages and frequency are within tolerance. DST4602 automatically activates the synchronization procedure (if required) following to the closing control of a switch by the operator. If the operator puts the generator in parallel with the mains or with another group, all parallel functions are managed automatically (see [3]). Protections are active: DST4602 is therefore always able to open GCB switch and stop the engine. Accessing programming is allowed, though only some parameters can be modified.
- **AUTO:** the starting and stopping of the generator and the management of GCB and MCB switches (where applicable) are executed by the board (the operator cannot intervene). All protections are enabled. Accessing programming is allowed, though only some parameters can be modified.

The operating mode can be selected in three different ways:

- By using the key selector on the board panel. The board, if you wish, may be purchased without the operator's panel (code E61021371yyxx): in this case it is necessary to act in one of the following ways.
- Using one or several digital inputs configured with the following functions:
    - DIF.2271 - “OFF/RESET by remote control”.
    - DIF.2272 - “MAN by remote control”.
    - DIF.2273 - “AUTO by remote control”.

    When one of these inputs is active, the mode of the board is forced, and the key selector and even the controls from the serial ports to change it can no longer be used.

    When none of these inputs is active, it is again possible to use the key selector or the controls from the serial ports to change the operation mode.

    If there are multiple active inputs at the same time, priority is given to the input that forces the OFF / RESET mode, followed by the one that forces MAN mode and finally the one that forces AUTO mode.

    You needn't use all three inputs. For example, it is possible to use only one input to force the status of AUTO: when the input is active, the board is always in AUTO, when the input deactivates, the board returns to the mode selected with the key selector.
- Using the commands from the serial ports. These controls are valid only if the board does not have the operator's panel (and therefore there is no key selector). To use these controls, no input configured with the functions described in the previous paragraph should be active.

These controls can be enabled by a digital input configured with DIF.2706 function - "Enable controls from the serial ports": if this input exists, it should be active. To change the working mode, it is necessary to write (within 5 seconds) the following Modbus registers in sequence:

- HOLDING REGISTER 101: enter the password configured with the parameter P.0004.
- HOLDING REGISTER 102: "1" to force OFF/RESET, "2" to force MAN, "3" to force AUTO.

When the main working mode of **DST4602** is AUTO, it is possible to activate two additional modes (remember that the board is still in AUTO, then what said above is valid):

- **TEST:** this operation mode differs from AUTO in the fact that the engine is anyway started (automatically), although the conditions of the system require or not the automatic intervention of the generator (the "inhibitions to automatic intervention" are ignored in this mode). With P.0222 parameter ("Enable generator supply on TEST") it is possible to indicate to the board if it should automatically close GCB switch as a result the starting of the engine (if the conditions of the system allow the closure of the switch). In any case, the operator has the faculty of command the MCB and GCB circuit breakers as in MAN (if enabled by bit #3 of parameter P.0249). When the controller goes back to AUTO (at the end of the test), the loads are automatically switched in the mains (if included) and the engine is stopped with normal procedure. The controller automatically passes from TEST to AUTO if the conditions for an automatic intervention of the genset happen. The access to programming is allowed, but only some parameters can be modified.

  To switch to TEST mode, the board should be in AUTO, there should be no alarms, deactivations and unloads, there should be no REMOTE START requests (see below) and there should be no requests for automatic intervention (see engine sequence description).

  Note: the request for the switching to TEST is lost if the automatic intervention of the generator is required (for example, if there is no mains): when the automatic intervention is no longer required, the board will not return to TEST. The request of the TEST mode from digital input is an exception: when the automatic intervention is no longer required, if the input is still active, the board will return to TEST.

  You can shift to TEST mode as follows:

  - By simultaneously pressing the START + ACK/TEST buttons on the controller panel (this feature can be disabled using bit 1 of P.0495). The shift to TEST mode is immediate. Press again these same buttons to return to AUTO mode. From version 00.64, if the test duration (P.0420) is configured (the value must be different from zero), this stops automatically stops after the indicated time.
  - By using a digital input configured with DIF.2031 function ("Request of test mode"): the controller switches into TEST when this input is activated and returns to AUTO when it is deactivated.
  - By using a digital input configured with the function DIF.2029 (“Request for the test mode without load - impulse”). The controller evaluates the input activation moment (impulse): the controller switches to TEST when it activates this input and goes back to AUTO at the end of the time configured in P.0420 (if P.0420 is set to zero, the test is not carried out). If there is second activation of the input during the test, the test is immediately stopped. During this test, the controller doesn’t close the GCB circuit breaker, independently from the value configured in P.0222.
  - By using a digital input configured with the function DIF.2030 (“Request for the test mode with load - impulse”). The controller evaluates the input activation moment (impulse): the controller switches to TEST when it activates this input and goes back

to AUTO at the end of the time configured in P.0420 (if P.0420 is set to zero, the test is not carried out). If there is second activation of the input during the test, the test is immediately stopped. During this test, the controller closes the GCB circuit breaker, independently from the value configured in P.0222.

- By properly configuring the parameters:
  - P.0418 (“Weekly test calendar”).
  - P.0419 (“Test start time”).
  - P.0420 (“Test starting duration”).

  They allow selecting the days of the week and a time slot within which the working mode switches from AUTO to TEST. The controller returns to AUTO when the TEST time interval ends.
- By means of a proper command via SMS (refer to document [5]. To use this feature, the parameter P.0420 Test starting duration shall not be set to zero. In this case, the controller shifts from TEST after receiving the SMS and returns to AUTO after the time P.0420.
- Through a control from the serial ports.
  - HOLDING REGISTER 20Modbus register: writing the value "6", the board switches to TEST, writing the value "7" the board comes back to AUTO.
  - HOLDING REGISTER Modbus registers 101 and 102. These two registers should be written within 5 seconds one from the other (otherwise the control will not work). These controls can be enabled by a digital input configured with DIF.2706 function - "Enable controls from the serial ports": if this input exists, it should be active.
    - Write the password configured with P.0004 parameter in the register 101.
    - Write the value "12" in the register 102 to switch to TEST, the value "21" to return to AUTO.

  The TEST control from the serial ports is cancelled if the board considers the communication interrupted (60 seconds without a message).

- **REMOTE START:** this operation mode differs from AUTO in the fact that the engine is anyway started (automatically), although the conditions of the system require or not the automatic intervention of the generator (the "inhibitions to automatic intervention" are ignored in this mode). If there are no requests for "inhibition to power load", DST4602 will automatically close GCB switch (with synchronization, if required). The operator cannot manually control the switches. When the REMOTE START mode is disabled, the board returns to AUTO and, if the automatic intervention of the generator is no longer required, the board opens GCB switch (with power discharge, if required) and stops the engine. Accessing programming is allowed, though only some parameters can be modified.

  To switch to REMOTE START mode, the board should be in AUTO or TEST and there should be no alarms, deactivations and unloads. Moreover, it is possible to configure an input with DIF.2701 function ("enable remote start request"): if the input exists, it should be active.

  You can shift to REMOTE START mode as follows:

  - Through a control sent from MC boards on PMCB CAN-BUS.

- By means of the digital input configured with the feature DIF.2032 (“remote start request”). In this case, it is necessary pay attention to the delay that is configured for the selected input: the board switches to REMOTE START when the input is active since the configured time, it comes back to MAN as soon as the input is deactivated.
- By properly configuring the parameters:
  - P.0426 (“Intervention forcing calendar”).
  - P.0427 (“Intervention forcing start time”).
  - P.0428 (“Intervention forcing end time”).

  These parameters are available from the review 00.40 of the board. They allow selecting the days of the week and a time slot within which the working mode switches from AUTO to REMOTE START. The controller returns to AUTO when interval ends.
- By means of a proper command via SMS (refer to document [5]. In this case, the controller shifts to REMOTE START as soon as it receives the SMS and returns to AUTO when it receives the opposite command.
- Through a control from the serial ports.
  - HOLDING REGISTER Modbus register 20: writing the value "18", the board switches to REMOTE START, writing the value "19" the board comes back to AUTO.
  - HOLDING REGISTER Modbus registers 101 and 102. These two registers should be written within 5 seconds one from the other (otherwise the control will not work). These controls can be enabled by a digital input configured with DIF.2706 function - "Enable controls from the serial ports": if this input exists, it should be active.
    - Write the password configured with P.0004 parameter in the register 101.
    - Write the value "13" in the register 102 to switch to REMOTE START, the value "21" to return to AUTO.

9.1.1 Events

The board records the following events if the working mode changes (if enabled with bit 0 of P.0441 parameter):

- EVT.1001: the new mode is “OFF/RESET”.
- EVT.1002: the new mode is “MAN”.
- EVT.1003: the new mode is “AUTO”.
- EVT.1004: the new mode is “TEST”.
- EVT.1005: the new mode is “REMOTE START”.

9.1.2 Signalling

The following functions for the configuration of the digital outputs are related to the operation mode of the board:

- DOF.3001: the output is activated if the board is in OFF/RESET.
- DOF.3002: the output is activated if the board is in MAN.
- DOF.3003: the output is activated if the board is in AUTO.
- DOF.3004: the output is activated if the board is in TEST.
- DOF.3005: the output is activated if the board is in REMOTE START.
- DOF.3011: the output is activated if the board is not in OFF/RESET.
- DOF.3012: the output is activated if the board is in AUTO, TEST or REMOTE START.
- DOF.0103 (Logics AND/OR)
    - ST.000: the output is activated if the board is in OFF/RESET.
    - ST.001: the output is activated if the board is in MAN.
    - ST.002: the output is activated if the board is in AUTO.
    - ST.003: the output is activated if the board is in TEST.
    - ST.004: the output is activated if the board is in REMOTE START.

9.2 Plant types

The controller is able to manage ten different plant types:

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

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

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

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

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

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

- **SPtM** and **MPtM (Parallel to Mains)**: they are pure production plants in parallel to the public grid. The gensets are normally started automatically only if the grid is permanently present

and in tolerance; in case of anomalies on the grid, the generators are disconnected from it (and from the loads), and eventually stopped.

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

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

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

The selection is made using parameter P.0802

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

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

To select the plant type with digital inputs:

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

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

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

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

To select a different plant, you must:

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

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

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

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

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

9.3 Mains sensor / parallel bars

DST4602 has a three-phase sensor that can be used to acquire the mains or parallel bars voltage of the system. This sensor is available on J24 connector for a 400Vac input and on J19 for a 100Vac input. For the connection, see paragraph 5.

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

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

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

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

- P.0105: rated frequency (Hz).
- P.0116: mains/bars nominal voltage Phase-to-phase rated voltage shall be set for three-phase systems; single-phase, for single phase systems.
- P.0119: indicates a three-phase mains/bars (3) or a single-phase one (1).
- P.0129: indicates if the neutral line is connected to the board (1) or not (0). On single-phase systems the parameter shall be set to 1.
- P.0117: value of the primary (Vac) of any voltage transformers linked to J19 (100Vac) or J24 (400Vac) connector.
- P.0118: value of the secondary (Vac) of any voltage transformers linked to J19 (100Vac) or J24 (400Vac) connector.

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

Note: if it is indicated that that the neutral is not connected to the board, **DST4602** will not display phase voltages and Neutral-Earth voltage.

9.3.1 Sensor for the parallel bars

Definition:

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

DST4602 needs to verify the presence of voltage on the parallel bars, to verify if a switch (GC, but also MCB) can be closed without synchronization.

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

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

9.3.1.1 Signalling

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

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

9.3.2 Mains sensor

Depending on the type of system, **DST4602** may need to determine the status of the mains, for two reasons:

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

See the document [3] for a description of the use of the mains sensor for the parallel with the mains. This chapter instead describes the use of the mains sensor for the emergency service.

DST4602 can determine the status of the mains in three ways, described below.

9.3.2.1 Status of the mains acquired by a MC board

If one or more MC boards are connected to the PMCB CAN-BUS, **DST4602** uses as status of the mains the one transmitted by these boards. MC boards can only be used on systems composed of multiple generators, where, as a rule, the generators do not directly measure the mains. If different MC transmit the status of their mains, **DST4602** creates a "global" status with the following logics (assessed in the order in which they are described):

- If at least a MC board indicates that the mains is steadily "present but out of tolerance", then for **DST4602** the mains is steadily "present but out of tolerance".
- If at least a MC board indicates that the mains is steadily "not present", then for **DST4602** the mains is steadily "not present".
- If at least a MC board indicates that the delay due to "mains out of tolerance" is in process, then for **DST4602** the delay due to "mains out of tolerance" is in process.
- If at least a MC board indicates that the delay due to "mains within tolerance" is in process, then for **DST4602** the delay due to "mains within tolerance" is in process.
- For **DST4602** the mains is steadily "within tolerance".

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

If **DST4602** receives the status from the mains, it ignores its internal sensor and any external sensors connected to its digital inputs.

9.3.2.2 Mains status acquired by a digital input

It is possible to configure a digital input with DIF.3101 function ("External mains sensor"): **DST4602** considers the mains "present and within tolerance" if the digital input is active. The delays configured with P.0205 and P.0206 parameters apply in this case (see 9.3.3).

If there is a digital input configured with DIF.3101 function, it is also used if the internal sensor is enabled (see next paragraph): in this case **DST4602** considers the mains "present and within tolerance" if the digital input is active (whatever the voltage connected to the internal sensor is); but if the digital input is not active, **DST4602** uses the mains status acquired by the internal sensor.

If there is no digital input configured with DIF.3101 function, and if the board cannot use the internal sensor to acquire the status of the mains, it is possible to use the digital input (if any) dedicated to the protections for the parallel with the mains (see document [3]) also to determine the status of the

mains for the emergency service. This input is configured with DIF.3103 function ("External protections for the parallel with the mains"). The mains is considered to be "present and within tolerance" if the digital input is active (the delays configured with P.0205 and P.0206 parameters apply in this case - see 9.3.3).

9.3.2.3 Mains status acquired by the internal sensor

To use the mains/bars sensor to acquire the status of the mains, P.0126 parameter should be set to "1-mains". Refer to 9.2 the parameters that configure the mains/bars sensor.

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

9.3.2.3.1 Frequency check

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

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

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

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

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

These values define the following bands:

0.00
A band: **low**
45.00
B band: hysteresis
46.25
C band: **in tolerance**
53.75
D band: hysteresis
55.00
G band: **high**
XXX

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

9.3.2.3.2 Voltages check

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

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

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

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

- Downwards towards mains presence threshold (i.e., with the default values of the parameters, between 70 Vac and 80 Vac).
- Upward towards low voltage threshold (i.e., with the default values of the parameters, between 320 Vac and 330 Vac).
- Downwards towards high voltage threshold (i.e., with the default values of the parameters, between 430 Vac and 440 Vac).

These values define the following bands:

0
A band: **absent**
70
B band: hysteresis
80
C band: **low**
320
D band: hysteresis
330
E band: **in tolerance**
430
F band: hysteresis
440
G band: **high**
XXX

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

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

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

9.3.2.3.3 Unbalance check

Parameter	Description	Default value	Voltage in Volts
P.0116	Rated voltage	400 Vac	400
P.0238	Mains unbalance threshold	10.0 %	40

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

Note: **DST4602** makes no verification on the displacement angle of the three phases, but only on the amplitude of phase-to-phase voltages.

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

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

9.3.2.3.4 Rotation direction check

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

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

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

With P.0239 parameter it is possible to select the direction of rotation required for the mains: "1-clockwise" or "2-anticlockwise". The mains is considered "out of tolerance" if the actual direction of rotation differs from the configured one.

9.3.2.3.5 Internal sensor status

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

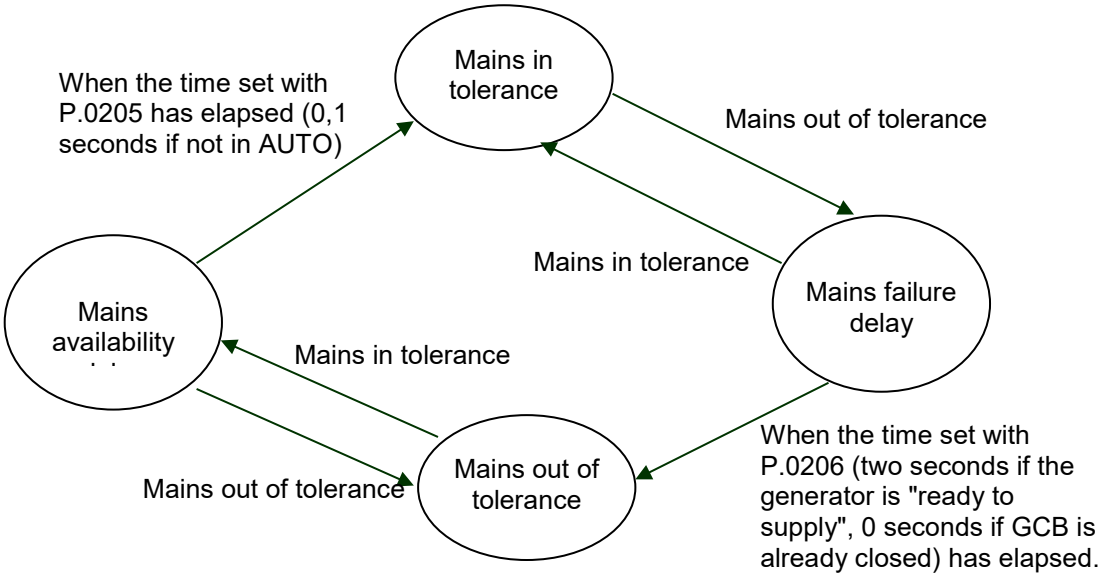
- If **all** voltages **and** frequency are in a status of "Not present", also the global status is "Not present".
- If **all** voltages **and** frequency are in a status of "Within tolerance", also the global status is "Within tolerance". In this case, if the control of the direction of rotation or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

- In case none of the previous conditions occurs, global status is “Low”.

9.3.3 Mains global status

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

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



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

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

Generator not supplying the loads and bit 1 of P.0250 is “0”: the duration of the “mains presence delay” is 0 seconds.

9.3.4 Events

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

- EVT.1010: the new status of the mains is steadily "not present or out of tolerance".
- EVT.1011: the new status of the mains is “present out of tolerance”.
- EVT.1012: the new status of the mains is steadily “within tolerance”.

9.3.5 Signalling

The MAINS LIVE light indicates the status of the mains (see description in 6.4).

The following functions for the configuration of the digital outputs are linked to the status of the mains:

- DOF.3033 (“Mains within tolerance”): the output is activated if the mains is steadily within tolerance and during the delay due to "mains out of tolerance".
- DOF.0103 (“Logics AND/OR”):
  - ST.016: the output is activated if there is voltage on the mains (even if it is out of tolerance).
  - ST.017: the output is activated if the mains is steadily "out of tolerance" (or not present).
  - ST.018: the output is activated when the mains is instantly within tolerance, and the delay due to "mains within tolerance" is ongoing.
  - ST.019: the output is activated if the mains is steadily "within tolerance".
  - ST.020: the output is activated when the mains is instantly out of tolerance (or not present), and the delay due to "mains out of tolerance" is ongoing.

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

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

9.4 Genset

DST4602 acquires generator (single or three-phase) voltage and frequency to protect the loads and the generator itself from operating outside its tolerance thresholds.

For connecting the generator to the **DST4602**, see paragraph 5.

DST4602 manages two types of generators: synchronous generators and asynchronous generators. Use P.0100 parameter to select the type of generator.

9.4.1 Nominal sizes

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

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

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

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

9.4.2 Asynchronous generator

This type of generator can only be used for power generation in parallel with the mains. Its particularity, in fact, is not to generate any voltage if it is not in parallel with the mains. The type of system should therefore be SPtM or MPTM and GCB switch should be "not synchronized" (P.0854 parameter, see document [3])

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

- The engine is started only if the mains is present and the parallel with the mains is allowed.
- **DST4602** can recognize "started engine" and "engine at operating speed" conditions only through the engine rotation speed. **DST4602** should therefore acquire this a measure, through its measurement inputs or via CAN0 CAN-BUS line (see 9.5.1).
- Before closing GCB switch, **DST4602** verifies whether there is voltage on the parallel bars: the closing of GCB is however performed without synchronization, because until the GCB is closed, the generator does not generate any tension.

9.4.2.1 "Engine at operating speed" verification.

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

Generator minimum and maximum frequency thresholds are used: as they are percentage values, in this case they are referred to rated speed (see 9.5.2), instead to rated frequency. The hysteresis on the various thresholds is set with P.0201 parameter. The hysteresis applies to:

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

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

These values define the following bands:

0.0 ——————————.
A band: **absent**
105.0 ——————————.
B band: hysteresis
300.0 ——————————.
C band: **low**
1350.0 ——————————.
D band: hysteresis
1385.7 ——————————.
E band: **in tolerance**
1612.5 ——————————.
F band: hysteresis
1650 ——————————.
G band: **high**
XXX ——————————.

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

For asynchronous generators, the condition of "engine at operating speed" corresponds to the "generator within tolerance" condition. What described in 9.4.4 is then valid.

9.4.2.2 Magnetization resistances.

In the management of asynchronous generators, it is customary to use resistances to allow the magnetization of the generator. These resistances are inserted **one** second before the closing of GCB switch: they connect the mains to the generator (bypassing GCB switch), allowing a (limited) circulation of current in the generator. This current is therefore used for the magnetisation of the generator.

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

DST4602 provides for DOF.2121 function ("Magnetization of the asynchronous generator") for the configuration of the digital output that should control the remote-control switch that connects/disconnects magnetization resistances: the board activates the output when it wants to insert the resistances.

GCB closing sequence is therefore:

- Activation of DOF.2121 output and subsequent insertion of the resistances.
- Waiting for **one** second to allow the magnetization of the generator.
- Activation of the control for the closing of GCB switch.
- If GCB closes, the board disconnects the resistances and the procedure ends.

- If GCB cannot be closed within **three** seconds, the board removes the control to close GCB, disconnects the resistances and waits P.0257 seconds. Then the sequence restarts from the beginning.

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

9.4.2.3 Power-factor capacitors

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

DST4602 provides for DOF.2122 function ("Power-factor capacitors") to configure the digital output that should control the remote-control switch that connects/disconnects the capacitors.

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

9.4.3 Synchronous generator

To determine the status of the generator, the board controls both voltage and frequency of the generator.

9.4.3.1 Frequency

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

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

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

These values define the following bands:

0.00 ——————
A band: **absent**
5.00 ——————
B band: hysteresis
10.00 ——————
C band: **low**
45.00 ——————
D band: hysteresis
46.25 ——————
E band: **in tolerance**

53.75 ——————————.
F band: hysteresis
55.00 ——————————.
G band: **high**
XXX ——————————.

If frequency is in "B", "D" or "F" brackets, it keeps the status it had before (hysteresis). For example, if the voltage was in the “E” band and now it is in “D” band, it is considered however “In tolerance”. On the other hand, in case the frequency was within the “C” band, and now is within “D” band, it is considered “Absent”.

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

9.4.3.2 Voltages

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

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

- Upwards towards the minimum voltage threshold (thus, with the default values of the parameters, between 300 Vac and 310 Vac).
- Downwards towards maximum voltage threshold (i.e., with the default values of the parameters, between 440 Vac and 450 Vac).

These values define the following bands:

0 ——————————.
A band: **absent**
70 ——————————.
B band: hysteresis
80 ——————————.
C band: **low**
300 ——————————
D band: hysteresis
310 ——————————.
E band: **in tolerance**
440 ——————————.
F band: hysteresis
450 ——————————.
G band: **high**
XXX ——————————.

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

These controls are managed at a single-phase level. In three-phase systems phase-to-phase voltages are used, phase voltage in single-phase systems. Set parameter P.0328 to “1”, the same checks are also made on the phase voltages (nominal voltage calculated by dividing the phase-to-phase nominal P.0102 by 1.73 - squared root of 3).

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

9.4.3.3 Overview

To diagnose the "global" status of the synchronous generator, the following algorithms are used, computed in the order they are presented:

- If **all** voltages **and** frequency are in a status of "Not present", also the global status is "Not present".
- If **all** voltages **and** frequency are in a status of "Within tolerance", also the global status is "Within tolerance".
- In case the status of at **least** one voltage or the frequency is “High”, also the global status is “High”.
- In case none of the previous conditions occurs, global status is “Low”.

9.4.4 Genset status

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

- **Permanently out of tolerance:** the status of voltages and/or frequency of the generator (or of the rotation speed for asynchronous generators) should be different from "Within tolerance" consecutively for two seconds.
- **Steady present:** generator's voltages and frequency status must be fully “in tolerance” for at least 0.5 seconds.
- **Transitory**: during the transition between the two previous statuses.

9.4.5 Events

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

- EVT.1020: the new status of the generator is steadily "not present or out of tolerance".
- EVT.1021: the new status of the generator is "present out of tolerance".
- EVT.1022: the new status of the generator is steadily "within tolerance".

9.4.6 Signalling

The GENERATOR LIVE light indicates the status of the generator (see description in 6.4).

The following functions for the configuration of the digital outputs are related to the status of the generator:

- DOF.3032 (“Generator within tolerance”): the output is activated if the generator is steadily within tolerance, or in the delay before stating it "out of tolerance".
- DOF.0103 (“Logics AND/OR”):
    - ST.024: the output is activated if there is voltage on the generator (even if it is out of tolerance).
    - ST.025: the output is activated if the generator is steadily "out of tolerance" (or absent).
    - ST.026: the output is activated when the generator is instantly within tolerance, and the delay due to "generator within tolerance" is in progress.
    - ST.027: the output is activated if the generator is steadily "within tolerance".
    - ST.028: the output is activated when the generator is instantly out of tolerance (or absent), and the delay due to "generator out of tolerance" is in progress.

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

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

9.5 Engine

DST4602 can start, stop and protect the engine by means of a series of thresholds on the acquired measures (oil pressure, coolant temperature, speed etc.).

9.5.1 Nominal power

DST4602 allows specifying the rated power of the engine (P.0125 parameter, in kW). It is important to set this figure, because the thresholds for some protections are expressed as its percentage.

Moreover, all PI controllers that manage the active power during delivery in parallel with other generators or with the mains, work with percentages of power values referred to this parameter: the modification of this parameter may require a new calibration of PI controllers (see document [3]).

9.5.2 Rated engine speed

The generators are usually designed to work with both the most common frequencies (50Hz and 60Hz). Obviously, at different frequencies, the rated rotation speed of the engine varies. Because some thresholds are expressed as a percentage of rated speed, **DST4602** should know the present rated speed.

DST4602 allows setting two nominal rotation speeds for the engine via P.0133 and P.0134 parameters (both expressed in kW): it uses the one specified in P.0133 ("Primary engine rated speed") if the nominal frequency (P.0105) is lower than 55 Hz, otherwise it uses P.0134 parameter ("Secondary engine rated speed").

9.5.3 Engine speed (RPM)

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

DST4602 can acquire this measure in different ways, listed in the order in which they are assessed:

- The measure can be acquired by a pick-up on the engine. See initial chapters for the connection of the signal. To enable this measure, in P.0110 parameter the number of teeth of the rim on which the pick-up works should be set. This is a known value and, anyway, easily computed If P.0110 is set to a nonzero value, the following points are ignored.
- The measure can be acquired by the signal W of the engine battery charging alternator. See initial chapters for the connection of the signal. To enable this measure, it is necessary to set the ratio between the frequency of the signal W and the rotation speed in P.0111 parameter (expressed in revolutions/second) of the engine, and P.0110 parameter should be set to zero. This ratio depends on many factors and it is not easy to calculate. If a frequency meter is available, simply start the engine (it will run at is rated and known speed, i.e. 1,500 rpm) and measure the W signal frequency, and then calculate the ratio. If a frequency meter is not available, the following method can be used:
    - Set a random value for P.0111 (e.g. 15).
    - Start the engine and, when at operating speed, note the rpm value shown by the controller.
    - Calculate the ratio between the displayed speed and the actual engine speed (displayed/actual).
    - Multiply the value previously set in P.0111 by this ratio and set the new value.
    - Restarting the engine, the speed measure should be close to the actual speed. Then, manually adjust the value P.0111 until you get the right display, considering that, for the same true speed, the value displayed by the controller decreases when increasing P.0111. If P.0111 is set to a nonzero value, the following points are ignored.
- To determine the engine speed, the generator frequency can also be used. In this case, it is necessary to set the known ratio between engine rotation speed and the frequency of the generator in P.0127 parameter, and P.0110 and P.0111 parameters should set to zero. For example, a normal generator works at 1500 rpm to deliver 50Hz: set P.0127 to 30 (1500/50). If P.0127 is set to a nonzero value, the following points are ignored.
- The board can also read the engine rotation speed directly from the electronic control unit (ECU) of the engine itself through the CAN0 CAN-BUS. To do this, it is simply necessary to enable the CAN-BUS (P.0700 different from zero), and P.0110, P.0111 and P.0127 parameters should be set to zero.

9.5.4 Acquiring of analogue measurements

DST4602 can acquire a great number of analogue measurements from the engine. For electronic engines, these measures are usually read directly from the ECU of the engine through the CAN-BUS connection.

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

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

- AIF.1000 (“oil pressure – VDO”). This function can only be used for analogue input 3. **DST4602** automatically uses the characteristic curve of 0-10 bar VDO sensor (10 Ohm 0 bar, 180 Ohm 10 bar).
- AIF.1001 (“oil pressure – generic”). Use a conversion curve to configure the sensor.
- AIF.1100 (“oil temperature – VDO”). This function can only be used for analogue inputs 4 and 5. **DST4602** automatically uses the characteristic curve of 0-120 °C VDO sensor (290 Ohm 40 °C, 10 Ohm 150 °C).
- AIF.1101 (“oil temperature – generic”). Use a conversion curve to configure the sensor.
- AIF.1110 (“coolant temperature – VDO”). This function can only be used for analogue inputs 4 and 5. **DST4602** automatically uses the characteristic curve of 0-120 °C VDO sensor (290 Ohm 40 °C, 10 Ohm 150 °C).
- AIF.1111 (“coolant temperature – generic”). Use a conversion curve to configure the sensor.
- AIF.1200 (“oil level – VDO”). This function can only be used for analogue input 5. **DST4602** automatically uses the characteristic curve of VDO sensor (10 Ohm 100%, 180 Ohm 0%).
- AIF.1201 (“oil level – generic”). Use a conversion curve to configure the sensor.
- AIF.1210 (“coolant level – VDO”). This function can only be used for analogue input 5. **DST4602** automatically uses the characteristic curve of VDO sensor (10 Ohm 100%, 180 Ohm 0%).
- AIF.1211 (“coolant level – generic”). Use a conversion curve to configure the sensor.
- AIF.1220 (“fuel level – VDO”). This function can only be used for analogue input 5. **DST4602** automatically uses the characteristic curve of VDO sensor (10 Ohm 100%, 180 Ohm 0%).
- AIF.1221 (“fuel level – generic”). Use a conversion curve to configure the sensor.
- AIF.1231 (“fuel level in litres (lt) – generic”). Use a conversion curve to configure the sensor.
- AIF.1601 - "air temperature in the intake pipe" Use a conversion curve to configure the sensor.
- AIF.1603 (“exhaust gas temperature – left bank”). Use a conversion curve to configure the sensor.
- AIF.1605 (“exhaust gas temperature – right bank”). Use a conversion curve to configure the sensor.
- AIF.1641 (“pressure of air coming out from the turbocharger”). Use a conversion curve to configure the sensor.

9.5.5 Engine running/stopped status acknowledgement

There are six possible ways to define whether the engine is running or not:

- Directly from the electronic control unit (ECU) of the engine (if connected via CAN0 CAN-BUS, P.0700 <> 0).

- Engine speed (RPM) The engine is considered to be in motion if the rotation speed is above P.0225 threshold ("Started engine threshold (rpm)"; it is considered stopped if the rotation speed is below P.0224 threshold ("Stopped engine threshold (rpm)"). This control is not used if:
    - The rotation speed is not available (see above).
    - P.0224=0.
    - P.0225=0.
    - P.0224 > P.0225.
- From the voltage of the signal D + of the engine battery charger alternator. The engine is considered to be in motion if the tension +D is above P.0231 threshold ("Started engine threshold (+D)"; it is considered stopped if the rotation speed is below P.0230 threshold ("Stopped engine threshold (+D)"). This control is not used if:
    - The measurement of voltage +D is not available (P.4041 set with a different function from DIF.1300 "Signal +D").
    - P.0230=0.
    - P.0231=0.
    - P.0230 > P.0231.
- From oil pressure. This control is enabled if parameter P.0232 is different from zero and if digital inputs are configured to acquire the status of the oil pressure switches (DIF.4221 and/or DIF.4222), or if the pressure measurement is available (from analogue input or Can Bus). The instantaneous state of the engine is:
    - **Stopped** if the oil pressure is below the minimum threshold (with the engine stopped, in fact, the oil pressure drops, and these contacts should activate).
    - **In movement** if the oil pressure is above the minimum threshold, from the time configured with P.0232.
- From generator voltage. The engine is considered to be in motion if the tension is above P.0227 threshold ("Started engine threshold (V)"; it is considered stopped if the tension is below P.0226 threshold ("Stopped engine threshold (V)"). This control is not used if:
    - P.0226=0.
    - P.0227=0.
    - P.0226 > P.0227.
- From generator frequency. The engine is considered to be in motion if the frequency is above P.0229 threshold ("Started engine threshold (Hz)"; it is considered stopped if the frequency is below P.0228 threshold ("Stopped engine threshold (Hz)"). This control is not used if:
    - P.0228=0.
    - P.0229=0.
    - P.0228 > P.0229.

To acknowledge engine running status, at least one of the previous conditions must be continuously present for at least **0.2** seconds. The board will immediately disable the starter motor control (and will prevent a new starting) if it diagnostics a running engine.

The engine is considered stopped if all the previous conditions are met (all the enabled ones) continuously for **five** seconds**.**

9.5.6 Engine commands

The board can handle many digital outputs to control the engine. As follows, there is the list of functions for the configuration of digital outputs, with an acronym used below and a description:

Function	Acronym	Description
DOF.1001	**GLOW_PLUGS**	Command for Diesel engines glow-plugs preheating.
DOF.1002	**ECU_ENABLE**	Enabling control for the engine control unit. It is activated along with the FUEL control but may be deactivated after the FUEL control (useful to stop electronic engines, without causing vacuums in the fuel pipes).
DOF.1003	**FUEL**	Fuel solenoid valve control.
DOF.1004	**GAS**	Gas solenoid valve control (gas engines only).
DOF.1005	**START**	Starter motor control.
DOF.1006	**STOP**	Solenoid control for the stopping of the engine.
DOF.1007	**IDLE**	Control to activate engine reduced speed (IDLE).
DOF.1008	**BATT1**	Control used to manage the dual battery.
DOF.1009	**BATT2**	Control used to manage the dual battery.
DOF.1031	**PREHEAT**	Engine preheating control.
DOF.1033	**PRELUBE**	Engine pre-lubrication control.

All digital outputs of the board are configurable, it is therefore possible to associate in all ways the controls of the engine to the outputs of the board (use P.3001 parameters and following ones, with the functions listed in the table). With the factory configuration of parameters, some controls are pre-assigned:

- STOP: output 4 (J5-5).
- START: output 5 (J5-7).
- FUEL: output 6 (J5-8).

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

- ST.128 (GLOW_PLUGS).
- ST.129 (ECU_ENABLE).
- ST.130 (FUEL).
- ST.131 (GAS).
- ST.132 (START).
- ST.133 (STOP).
- ST.134 (IDLE).
- ST.135 (PREHEAT).
- ST.136 (PRELUBE).

As follows, the controls are described individually.

Note: for electronic engines connected via CAN0 CAN-BUS to **DST4602**, many of these controls are managed directly through the CAN-BUS connection, and therefore it is not necessary to configure the outputs. If the outputs are configured, the board controls them, although the engine is connected in CAN-BUS.

9.5.6.1 Engine preheating control (PREHEAT)

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

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

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

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

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

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

9.5.6.2 Engine pre-lubrication control (PRELUBE)

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

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

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

The board considers that the lubricating oil is under pressure if at least one of the following conditions is met:

- If the board acquires the measurement of the lubricant pressure (from the engine control unit via CAN0 CAN-BUS, or via the analogue inputs, AIF.1000 or AIF.1001 functions):
    - If the lubricant low-pressure threshold is set (P.0339 <> 0), when the measured pressure is higher than the threshold.
    - If the lubricant low-pressure threshold is not configured, but minimum pressure threshold is configured (P.0341 <> 0), when the measured pressure is higher than the threshold.
- If the board does not acquire the measurement of lubricant pressure, or if both P.0339 and P.0341 thresholds are set to zero:

- If the digital input is configured to acquire "oil low pressure" (DIF.4222) when this input is not active.
- If no digital input is configured to acquire "oil low pressure", but the digital input to acquire the "oil low pressure" (DIF.4221) is configured, when this input is not active.

When the pre-lubrication cycle is ended, the starting sequence goes on (with the starter motor): The pre-lubrication controls remains anyway active until the engine starts or until the starting sequence is interrupted. In case of repeated attempts to start, the pre-lubrication control persists: the time configured with P.0242 is counted, but only during the first attempt.

9.5.6.3 Glow plugs pre-heating control (GLOW_PLUGS)

This control is intended for the old diesel engines, for which it was necessary to heat glow plugs before starting the engine. It can still be used to insert a delay between the opening of the fuel solenoid valve and the starter motor control: sometimes, as a matter of fact, if the two controls are activated together, the vacuum in the fuel ducts caused by the starter motor does not allow the correct opening of the valve (it gets stuck).

To enable this function, it is necessary to set P.0209 parameter ("Pre-heating cycle maximum duration") to a value other than zero.

The controller activates the glow plugs pre-heating command at the beginning of the starting cycle, along with the opening of the fuel solenoid valve. The output remains active throughout the glow plugs pre-heating cycle: it ends after P.0209 seconds.

When the cycle ends, the starting sequence goes on (with the starter motor control): the glow plugs pre-heating control remains active until the engine starts or until the starting sequence is interrupted. In case of repeated attempts to start, the glow plugs pre-heating control goes on: the time configured with P.0209 is counted, but only during the first attempt.

Warning: the glow plugs pre-heating cycle is performed simultaneously with the pre-lubrication cycle. If P.0242 parameter is set to a value higher than P.0209, the glow plugs pre-heating cycle will last P.0242 seconds as well.

9.5.6.4 Using two battery sets (BATT1 e BATT2)

The controller can control engine start-ups alternately managing two battery sets to ensure engine start-ups. To use this function requires at least one output configured with function DOF.1008 (BATT1).

If only BATT1 output is configured, then the controller activates this output to select battery #1, it disables this output to select battery #2.

If both BATT1 and BATT2 outputs are configured, then the active board activates BATT1 output to select battery #1 and BATT2 output to select battery #2. It also guarantees a minimum time of **two** seconds with both outputs off during the shift between battery #1 and battery #2.

Finally, **DST4602** guarantees a minimum delay of **two** seconds between the selection of a battery and the starter motor control.

In automatic, the board performs on battery #1 the number of starting attempts configured with P.0211 parameter. If the engine does not start, it switches on battery # 2 and performs again the same number of starting attempts. If the engine has not been started yet, it activates A022 alarm ("failure to start").

In manual mode, the board always performs only one starting attempt, and then it always performs it on battery #1.

The automatic starting sequence is:

- BATT1 output **enabled**, BATT2 output **disabled**.
- 2-second wait (note 1).
- First start-up attempt.
- Pause
- ……
- Last start-up attempt.
- 2 seconds delay
- BATT1 output **disabled**, BATT2 output **disabled**.
- 2 seconds delay
- Only if BATT2 output exists: BATT1 output **disabled**, BATT2 output **enabled**.
- Only if BATT2 output exists: 2-second wait (note 2).
- First start-up attempt with the second battery.
- Pause
- ……
- Last start-up attempt with the second battery.
- Failed start-up alarm.
- 2 seconds delay.
- BATT1 output **disabled**, BATT2 output **disabled**.

Note 1: the **two**-second initial delay between the selection of battery #1 and the starter motor control is performed at the same time of the pre-lubrication cycle and the glow plugs pre-heating cycle, and it could be extended to the longer time between those configured in P.0242 and P.0209.

If the engine starts up, the sequence ends. The output BATT1 or BATT2 active in that moment is disabled after a **2** seconds delay after detecting started engine.

9.5.6.5 Control to enable the engine control unit (ECU_ENABLE)

9.5.6.6 Fuel solenoid valve control (FUEL)

These two controls are activated simultaneously at the beginning of the starting sequence. Both remain active even with started engine, until the starting of the shutdown sequence:

The ECU_ENABLE control is removed immediately at the beginning of the shutdown sequence.

The FUEL control is removed after P.0234 seconds ("delay between STOP and FUEL controls") from the starting of the stopping cycle.

The FUEL control should be used to control the solenoid valve placed on the fuel line. At the beginning of the starting sequence, the board opens the valve, thus allowing the fuel to get to the engine. At the beginning of the stopping sequence, the board closes the solenoid valve: the engine receives no more fuel and then it stops.

The ECU_ENABLE control should be used to give a consent to the starting of electronic control units of the engines. Lacking this consent, it is reflected in the shutdown of the fuel injection system: therefore, without this consent then the engine cannot start, but instead it will be stopped if it was running.

If ECU_ENABLE (not present) or STOP (present) controls are used to stop the engine, but a solenoid valve is anyway present on the fuel line, it is possible that the vacuum in the fuel circuit caused by the engine that is stopping may prevent the correct movement of the solenoid valve. In these cases, by using P.0234 parameter, it is possible to delay the closing control of the fuel solenoid valve with reference to the stop control (ECU_ENABLE or STOP) of the engine: the engine is stopped through its own stopping system and, when the engine is stopped, the fuel solenoid valve can be closed.

9.5.6.7 Command for the starter (START)

This control should be used for the direct control of the starter motor. The board enables the START output to start the engine and shall remove it immediately when it detects a "started engine" status (see 9.5.5). In this way, it ensures the immediate release of the starter motor ring gear, therefore avoiding that the starter motor is dragged by the engine. In case of failure to start, the board deactivates the START output at the end of the starting attempt.

The duration of each starting attempt is automatically determined by the P.0210 parameter ("Duration of the starting control"). This duration may be increased for gas engines (see below).

The duration of the manual start cycle depends on the parameter P.0252:

- 0: the duration of the start attempt is established by the operator; the attempt interrupts when the operator releases the START button.
- >0: the duration of the start attempt is selected by parameter P.0210.

For start cycles controlled through the serial port, the instructions for the automatic are valid.

9.5.6.8 Gas solenoid valve control (GAS)

This control only makes sense for GAS engines. The aim is to perform the washing cycle of the engine. When a GAS engine is turned off, in the feeding circuit unburned gas is still present. If it is not disposed of before the next starting, it could be dangerous because it could explode unrestrainedly. Therefore, each time the engine is started, the washing cycle to remove this unburned gas is performed. The cycle consists in making the engine run, through the starting motor, without opening the GAS valve: the vacuum caused by the engine is enough to remove the unburned gas.

This function is enabled by setting P.0241 parameter to a value higher than zero. The GAS solenoid valve is opened after P.0241 seconds from the time the starter motor was activated (START): for this reason, if the duration of the starting cycle (P.0210) is lower than P.0241 parameter, it is automatically lengthened to a second more than P.0241.

If the starting attempt ends without that the engine has started, the board closes the GAS valve, and, at the next starting attempt, the washing cycle will be repeated.

9.5.6.9 Engine stop command when energized (STOP)

This control is used in systems where it is preferred to give priority to the supply by the generator. When the FUEL control is used, as a matter of fact, a failure of the solenoid valve control system results in its closure, and the resultant stop of engine.

The STOP control is instead active only during the stopping cycle. Its purpose is to block the flow of fuel to the engine only during the stopping phase: when the engine has been stopped, the output is disabled, so allowing the reopening of the fuel pipeline. In this case, it is always possible to start the engine, even at the presence of a fault on the STOP control: at the limit it will not be possible to stop the engine.

The STOP control is activated at the beginning of the stopping cycle, at the same time when the ECU_ENABLE control is removed. The STOP control will remain active for the time set with P.0213 parameter ("Duration of the stop control").

Note: If the engine stops in a shorter time, and a restarting of the engine is required, the STOP control is disabled before.

9.5.6.10 Idle speed command (IDLE)

This control is used to activate the reduced rotation speed, directly on the rpm regulator of the engine.

The output is active during the entire IDLE cycle. Note: if there is a request for IDLE before starting the engine, the control will be already active from the beginning of the starting sequence. Similarly, if the IDLE request is active during the stopping cycle, the control is active as well.

The IDLE cycle can be requested in two ways:

- By setting a nonzero delay in P.0233 parameter ("Low speed cycle duration"). The board performs an IDLE cycle at each stating of the engine (both manual and automatic). The maximum duration of the IDLE cycle is the one set with P.0233 parameter. It is however possible to link the duration of the cycle to the temperature of the coolant. By setting a nonzero value in P.0223 parameter ("Minimum temperature for the consent to supply"), the board monitors the temperature of the coolant and, as soon as it is above P.0223 threshold, it stops the IDLE cycle.
- With a digital input configured with DIF.2061 function ("Request for reduced speed"). When the input is active, the board runs the IDLE cycle.

During the IDLE cycle, minimum frequency and minimum voltage protections of the generator are disabled. At the end of the IDLE cycle, before enabling the protections, the board requires that voltages and frequency are within tolerance: if it is not the case, the board activates A008 alarm ("no steady status").

During the IDLE cycle the board does not allow the closing of GCB switch. If the IDLE cycle is requested (with the digital input) while GCB is closed, the board opens GCB switch first (in case by discharging power if the generator is parallel to anything), and then activates the IDLE control.

9.5.7 Consent to starting

DST4602 provides for DIF.2709 function ("Consent to starting") for the configuration of the digital inputs.

The board uses this input as consent to start: if the starting of the engine is required and there is an input configured with this function, **DST4602** waits until the input is active before performing the starting cycle. When the starting is initiated, the input is not more checked (it can also be deactivated). The purpose of this input is to manage external sequences, such as, for example, the pre-ventilation of the room where the generator is installed. Example of use:

- When the board receives a request to start, its internal management mode shifts to "start", but if the digital input is not active, the actual starting procedure will not be performed.
- The internal "start" status can activate a digital output (DOF.0103 function "AND/OR logics" with ST.036 status). This output can activate the external pre-ventilation sequence.
- When the external sequence is finished, it will have to activate the digital input configured as DIF.2709: at this point, **DST4602** goes on with the starting of the engine.

This function is particularly useful when **DST4602** should work with a MC board. In this case, in fact, it is not possible to use the "inhibition to automatic intervention" function to prevent the starting of the

engine during the pre-ventilation phase (or others): MC, in fact, when it wants to start a generator, switches the related **DST4602** to REMOTE START, where the requests for "inhibition to automatic intervention" are ignored.

It is also useful if the external sequences should be performed also in MAN (because in MAN the requests of "inhibition to automatic intervention" are ignored).

9.5.8 Manual control sequence

9.5.8.1 Manual start

There are two possible manual start sequences:

- P.0252 ("Number of crank attempts in manual") equal to zero. The duration of the starting attempt is established by the operator: the attempt stops when the operator releases the START key. If the operator releases the START button when the engine has not yet started, the controller leaves the fuel circuit (including the GAS) open for ten seconds (to check if the engine starts): then eventually commands an automatic stop cycle. From version 00.64, the GAS valve is closed immediately when the START button is released (if the engine has not started).
- P.0252 > 0. The duration of the crank attempt is instead selected with parameter P.0210.

If P.0252 is greater than 0, the controller carries out P.0252 starting attempts, activating the "fail to start" anomaly if the engine does not start. During manual cranking, the controller automatically carries out the pre-lubrication, glow plug pre-heating and washing cycles. Starting is always done with battery #1 (if two batteries are configured).

With the controller in MAN mode, it is possible to request engine starting in three ways:

- With the START key of the panel.
- With a digital input configured with DIF.2033 function ("Manual starting control"). This input is managed exactly as the START key: same as said above.
- It is possible to control the starting of the engine manually with a control through the serial ports. These controls can be enabled by a digital input configured with DIF.2706 function - "Enable controls from the serial ports": if this input exists, it should be active. To start the engine manually, it is necessary to write (within 5 seconds) the Modbus registers in sequence:
  - HOLDING REGISTER 101: enter the password configured with the parameter P.0004.
  - HOLDING REGISTER 102: enter the value “11”.

  Following this command, the controller behaves as if P.0252 was greater than zero (if it is equal to zero, it makes a single start attempt).

Note: if the starting is requested in MAN when the engine is already running (but it was not started by the board), **DST4602** acknowledges the situation: it activates all engine controls as if it had started it, except for the starter motor, that is not activated.

9.5.8.2 Manual stop

With the board in MAN, it is possible to request the stopping of the engine in four ways:

- With the STOP key on the board panel of the card.
- With a digital input configured with DIF.2034 function ("Manual stop control"). This input is managed exactly as the STOP key: same as said above.

- With a command from serial port. By writing a value "3" in the HOLDING REGISTER 20 Modbus register.
- It is possible to control the stopping of the engine manually with a control through the serial ports. These controls can be enabled by a digital input configured with DIF.2706 function - "Enable controls from the serial ports": if this input exists, it should be active. To start the engine manually, it is necessary to write (within 5 seconds) the Modbus registers in sequence:
    - HOLDING REGISTER 101: enter the password configured with the parameter P.0004.
    - HOLDING REGISTER 102: enter the value “21” or “22”.

In all cases, **DST4602** performs an emergency automatic stop cycle. Starting from the release 00.80, **DST4602** provides the bit 1 of parameter P.0249 allowing to select whether to perform (in MAN mode) the emergency (0) or standard (1) automatic stop cycle. If the standard automatic stop cycle is selected, the operator can stop the cooling cycle (switching to the emergency stop cycle) by giving a second MAN stop command.

Note: the stop cycle can also be performed with already stopped engine.

9.5.9 Automatic command sequence

Before describing automatic start/stop procedures, it is necessary to define when the engine should be started and stopped automatically.

The engine is started automatically if there are no alarms, unloads and deactivations and if at least one of these conditions is present:

- If the TEST is activated (see 9.1).
- If the REMOTE START is activated (9.1).
- If there is no active "inhibition to automatic intervention" of the generator (see 9.5.15) and the automatic intervention of the generator is required. This request depends on the type of system (see [3]):
    - Stand-alone production systems. The request for intervention is always active.
    - Emergency system to the mains. The request for intervention is active if the mains is out of tolerance or if MCB switch is not closed (if configured).
    - System for the production in parallel with the mains only. The request for intervention is active when the mains is present and if voltage and frequency measures authorize the parallel.

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

- With normal procedure. After opening the GCB switch (possibly after discharging power), the board performs a cooling cycle of the engine (only if previously the load was connected to the generator), by keeping it running without load. This procedure applies if:
    - No automatic start-up request is pending (see above)
    - It triggers an "inhibition to automatic intervention", with the board in AUTO.
    - An anomaly qualified as “deactivation” or “unload” occurred (it is an anomaly typically dangerous for loads but not for the engine).

  If the Bit 1 of parameter P.0249 is set to "1" the controller enable the cooling cycle also in **manual** mode.

This cycle is performed (if the GCB switch has been closed at least once since the engine was started and / or if the coolant temperature is higher than the threshold P.0271) in the following cases:

- The operator presses the STOP key on the keypad (or the stop command is sent to the MAN from the communication ports).
- An "unload" or "deactivation" anomaly is activated.

In both cases, the operator can stop the cooling cycle by giving a second MAN stop command (or with a new command from the communication ports).

- With an emergency procedure. This procedure requires immediate engine stop, without engine cooling cycle. It applies if:
  - The key switch is turned on OFF/RESET
  - Any anomaly described as an "alarm" is activated. In automatic mode, the stop commands from panel (STOP button, if not disabled by bit 0 of parameter P.0495, available since release 00.80), from serial port and from SMS are included in this category since they activate the alarm A07 (manual stop in auto mode).

9.5.9.1 Automatic start-up

The board automatically executes the number of starting attempts configured with P.0211 parameter ("Number of starting attempts") for each battery set. At the end, if the engine is not started, it activates A022 alarm - "Failure to start".

Each starting attempt has the maximum duration configured with P.0210 parameter ("Duration of the starting control"). It however ends if the condition of started engine is detected. Within the starting procedure, **DST4602** automatically manages pre-lubrication, glow plugs pre-heating and cleaning cycles.

Between a starting attempt and the next one, the board makes a pause with a duration configured with P.0212 parameter ("Delay between two starts"). This pause may be longer when the selected battery set is changed.

If, during a starting attempt, the board recognizes the started engine condition, it waits for the maximum time configured with P.0217 parameter ("Maximum time for steady statuses") until voltages and frequency of the generator are within tolerance:

- If during the pause the engine stops, the board will go on with the next starting attempts.
- If generator voltages and frequency are "within tolerance", the starting procedure is ended: from this time on, also minimum voltage and minimum frequency protections are active.
- If, at the end of the pause, voltages or frequency are not "within tolerance", the board activates A008 alarm "no steady status".

If the low speed cycle is required, the previous pause will be performed after it is finished.

At the end of the automatic starting procedure, the board manages a further delay that allows the generator to stabilize/warm up before being connected to the load. This delay can be configured with P.0218 parameter ("delay before delivery"): it does not work in MAN.

9.5.9.2 Standard automatic stop

This procedure starts after the board has opened GCB switch (or at least after the board has made an attempt to open). Any power discharge of the generator has already been done.

If during the automatic operations the board closed GCB switch, it considers that the generator was heated by the load, and that it therefore needs to cool down before being stopped. Then a cooling cycle is performed. It simply consists in keeping the engine started without load for the time set with P.0215 parameter ("Duration of the cooling cycle"). Starting from version 00.73, the cooling cycle can be aborted before the time set with P.0215 if the coolant temperature becomes lower than the threshold set with P.0271 parameter (if this threshold is different from zero).

Often the generators have a whole range of auxiliary services (pumps, fans and so on) that are essential for the proper functioning of the generator. These auxiliary services are normally powered from an AC voltage: if this voltage is not available, the generator cannot stay in motion. It often happens that, for example in generators that only produce in parallel with the mains, these services are powered by mains voltage, and therefore the generator should be stopped as soon as the mains fails.

DST4602 allows configuring the source from which these services are supplied, via P.0240 parameter ("The engine services are supplied by:"):

- 0: generator voltage.
- 1: voltage on the parallel bars.
- 2: voltage on users.
- 3: mains voltage.

If **DST4602** realizes that there is no voltage on the selected source, the cooling cycle is stopped immediately (this function works only on the cooling cycle, not in all the other management phases of the engine). By setting P.0240 to "0", the board can always run the cooling cycle.

9.5.9.3 Automatic emergency stop

The emergency stop procedure consists in stopping the engine without performing the cooling cycle. This procedure is common also in the standard stop, after the cooling cycle.

During the stopping cycle, the board removes ECU_ENABLE and FUEL controls (the second with P.0234 seconds of delay) and activates the STOP control for P.0213 seconds. The board waits until the engine stops. The maximum duration of the shutdown cycle is configurable with P.0214 parameter ("Duration of the stopping cycle"): if at the end of this phase the engine has not stopped, A021 alarm is activated - "Failure to stop".

Note: normally the stopping cycle lasts P.0214 seconds even if the engine stops in a shorter time. If during the stopping cycle a new automatic intervention of the generator is required, the same stopping cycle will be arrested only when the engine is completely stopped. In this case **DST4602** ensures that the STOP and FUEL controls do not overlap.

9.5.10 Masking of oil protections

DST4602 provides a parameter that allows configuring a delay (from the moment when the "started engine" condition is recognized) within which the oil pressure protections are disabled. This is to allow time for the pump to pressurize oil and prevent false alarms. The delay is configurable with P.0216 parameter ("Engine protection masking time").

9.5.11 Events

The controller records the following events if the status of the engine varies (if enabled by the bit 3 of P.0441 parameter):

- EVT.1040: if the motor is idle.

- EVT.1041: starting cycle in progress.
- EVT.1042: the engine is running.
- EVT.1043: cooling cycle in progress.
- EVT.1044: stopping cycle in progress.
- EVT.1045: low speed cycle in progress.

Moreover, the controller records the following events at the changing of start/stop requests (if enabled by the bit 6 of P.0441 parameter):

- EVT.1050: manual start request.
- EVT.1050: manual arrest command.
- EVT.1052: starting automatic request.
- EVT.1053: stopping automatic request.
- EVT.1054: starting automatic request (from contact).
- EVT.1055: stopping automatic request (from contact).
- EVT.1056: starting automatic request (from serial port).
- EVT.1057: stopping automatic request (from serial port).
- EVT.1058: starting automatic request (from clock/calendar).
- EVT.1059: stopping automatic request (from clock/calendar).
- EVT.1060: starting automatic request (from SMS).
- EVT.1061: stopping automatic request (from SMS).
- EVT.1062: starting automatic request (for non-closed MCB).
- EVT.1063: starting automatic request (from MC board).

9.5.12 Signalling

The following functions for the configuration of the digital inputs are linked to engine management (besides those described for engine direct controls):

- DOF.3061: the output will be activated if the engine is in motion.
- DOF.3062 the output will be activated if the engine is in motion and if the “delay before supplying” (P.0218) has been performed.
- DOF.0103 (Logics AND/OR)
    - ST.032: the output will be activated if the engine is in motion.
    - ST.033: the output will be activated if the engine is in motion and if the “oil protection masking” time span has elapsed (P.0216).
    - ST.035: engine stopped.
    - ST.036: starting cycle ongoing.

- ST.037: low speed cycle ongoing.
- ST.038: delay before supplying ongoing.
- ST.039: engine: ready for power delivery.
- ST.040: cooling cycle ongoing.
- ST.041: stopping cycle ongoing.

The following functions, for the configuration of analogue outputs, are linked to engine management. The outputs are managed based on an engine analogue value. Use the "conversion curves" to adapt the single value to the output (0-100%):

- AOF.3001 (“engine speed”).
- AOF.3011 (“oil pressure”).
- AOF.3013 (“oil temperature”).
- AOF.3015 (“oil level”).
- AOF.3023 (“coolant temperature”).
- AOF.3025 (“coolant level”).
- AOF.3035 (“fuel level”).

9.5.13 Fuel pump

The genset implements the full management of the fuel pump, to pump the fuel from the storage tank to the tank on the generator. For the management of the pump, **DST4602** must acquire the fuel tank level on board of the generator: for this purpose, a float with contacts or an analogue level sensor can be used (that can be selected through P.0401 parameter “type of sensor for fuel pump”).

9.5.13.1 Functioning mode

Three functioning modes of the fuel pump are provided:

- **MANUAL-OFF:** the pump is deactivated.
- **MANUAL-ON:** the pump is activated in any case, and it is deactivated only with the maximum level of the tank on board the generator.
- **AUTOMATIC:** the pump is activated and deactivated automatically based on the tank level on board the generator.

The functioning mode can be selected in five different ways:

- Through the digital inputs configured through the functions:
  - DIF.2241: forces the pump in MANUAL-OFF mode.
  - DIF.2242: forces the pump in MANUAL-ON mode.
  - DIF.2243: forces the pump in AUTOMATIC mode.

  If at least one of these inputs is active, the pump functioning mode is forced and cannot be changed with the other methods described below. In case more than one input is active simultaneously, higher priority is assigned to MANUAL-OFF, followed by MANUAL-ON and then AUTOMATIC.

- By changing P.0400 parameter (“fuel pump mode”).
- “E.04” page of **DST4602** display is dedicated to the fuel pump. From this page it is possible to change the pump functioning mode:
    - Use the ENTER button.
    - Use UP and DOWN keys to select the required mode.
    - Press ENTER to confirm or EXIT to abort.

    Note: if no keys are pressed for 60 seconds, the modification procedure is automatically terminated.
- Alternatively, **DST4602** supplies a quick way to change the pump functioning mode: by simultaneously pressing SHIFT + EXIT keys, the mode will be alternated between “Manual-OFF” and “Manual-ON”. **DST4602** forces the display on E.04 page.
- With a command from serial port. It is necessary to write Modbus HOLDING REGISTER 20:
    - By writing the value “13”, the functioning mode turns into MANUAL-OFF.
    - By writing the value “14”, the functioning mode turns into MANUAL-ON.
    - By writing the value “15”, the functioning mode turns into AUTOMATIC.

9.5.13.2 Use with an analogue level transducer

To use this function:

- The level analogue transducer should be connected to one of the analogue inputs of **DST4602** or to DIVIT expansion modules. The utilized analogue input should be configured through AIF.1220 functions (dedicated to VDO sensor, 0%-180 Ohm, 100%-0 Ohm) or through AIF.1221 function (configurable).
- Set the thresholds to activate/deactivate the pump (parameters P.0402 and P.0403).
- In case they are configured, also minimum, low and high fuel level are used (P.0347, P.0345, P.0343 parameters): they are used even if the relevant intervention times are set to zero (to disable anomalies).

Very important is the thresholds setting which should be ranked by level (from down up), as follows: minimum, low, start, stop, high. As already explained, the controller operates even if thresholds are not in this order; all you need is the first three ones lower than the last two ones (within each of the two groups they can be swapped, but it is not recommended).

9.5.13.3 To use this function requires:

To use this function, it is necessary to connect the contacts of the float to the analogue inputs of the board, by using the functions:

- DIF.4211 (“Minimum fuel level”): input activated if the level is under minimum level threshold.
- DIF.4212 (“Low fuel level"): input activated if the level is under low level threshold.
- DIF.3301 (“Level for the fuel pump starting”): input activated if the level is under pump starting threshold.
- DIF.3302 (“Level for the fuel pump stop”): input activated if the level is **under** pump stopping threshold.

- DIF.4213 (“High fuel level”): Input active if the level is **above** high-level threshold.

The inputs configured through DIF.3301 and DIF.3302 functions are mandatory, the other three are optional. If they are present, they will be used even if the delay for the relevant input has been set to “0” to disable the anomaly.

9.5.13.4 Level evaluation

The controller assigns the actual fuel level by calculating in the order all the following evaluations:

- If the level is lower than the pump start threshold, the controller assigns the “start” position.
- If a low-level threshold exists, and the level is lower than threshold, the controller assigns the “low” position.
- If a minimum level threshold exists, and the level is lower than the threshold, the controller assigns the “minimum” position.
- If the level is higher than the stop threshold, the controller assigns the “stop” position.
- If a maximum level threshold exists, and the level is higher than the threshold, the controller assigns the “maximum” position.
- If none of the previous condition is met, the controller assigns the “hysteresis” position.

9.5.13.5 Pump control

DST4602 uses two controls to manage the fuel pump, that can be associated to any digital output (P.3001 parameter and subsequent ones) with the functions:

- DOF.1032 (“Fuel pump”).
- DOF.1034 (“Fuel pump solenoid”).

The output for the pump control is mandatory (otherwise this function is disabled).

The output for the electromagnetic valve is optional. When it is used, it is necessary to configure a delay in P.0405 parameter (“delay between solenoid valve and fuel pump”): **DST4602** guarantees the opening of the solenoid valve P.0405 seconds **before** activating the pump, and the opening of the solenoid valve P.0405 seconds **after** closing the pump. All that to avoid that the vacuum caused by the pump within the fuel circuit could bring about some malfunctioning of the solenoid valve (it could get stuck).

DST4602 controls the pump based on the fuel level and based on the working mode:

- AUTOMATIC. Referring to the position evaluated in the previous paragraph, the pump:
  - Activates if the level is “start”, “low” or “minimum”.
  - Deactivates if the level is “stop” or “maximum”.
  - Retains the actual command if in “hysteresis”.
- MANUAL-ON. Pump can be activated and deactivated according to operator needs. However, the controller prevents the start if the level (see previous paragraphs) is “stop” or “maximum”.
- MANUAL-OFF. The pump is deactivated

DST4602 can anyway stop the pump (even if the previous logic would require its start) when the following conditions are present:

- In case anomalies activated by the digital inputs configured through the functions are active:
  - DIF.4051 “warning (turns off the fuel pump))”.
  - DIF.4052 “unload (turns off the fuel pump))”.
  - DIF.4053 “Deactivation (turns off the fuel pump))”.
  - DIF.4054 “Lock (turns off the fuel pump))”.

  Warning: it is the anomaly that stops the pump, not the activation of the input.
- In case anomalies activated by thresholds on analogue inputs are active (P.4003...P.4008 parameters for analogue input 1). This happens only if the anomaly has been specifically configured to stop the pump, through the bit 14 of the threshold configuration parameter (P.4005 for the first threshold on the first analogue input). Warning: it is the anomaly that stops the pump, not the activation of the input.
- Moreover, you can set the maximum fuel pump activation time with parameter P.0404. This parameter should be used to set the time needed for the pump to fill the equipment tank, in the worst conditions: empty tank and engine started at maximum power. If the pump stays in motion (both from manual and automatic control) for a longer time span, the board activates W064 early warning: in fact, it is likely the presence of a failure of the pump or, anyway, that the pump is not drawing from the storage tank. The pump is stopped until W064 early warning is activated: when the operator “cancels” it, the pump restarts with another cycle.
- **DST4602** allows configuring the electric source that supplies the pump, through P.0406 parameter (“Supplying of the fuel pump”):
  - 0: generator voltage.
  - 1: voltage on the parallel bars.
  - 2: voltage on users.
  - 3: mains voltage.
  - 4: from an always present voltage.

  If **DST4602** detects that there isn't voltage on the selected source uninterruptedly for five seconds, it will stop the pump (set P.0406 on “4” to disable this control).
- The pump is disabled in OFF/RESET, but only if this mode persists consecutively for five seconds.

9.5.13.6 Events

The board will record the following events, if the fuel pump status changes (if enabled with the bit 7 of P.0441 parameter):

- EVT.1070: the pump is started.
- EVT.1071: the pump is stopped.

9.5.14 Maintenance

The board can automatically communicate to the operator the request to carry out engine periodic maintenance. This function is configurable with parameters P.0424 and P.0425. With P.0424, it is possible to set extra operation hours for maintenance service. In P.0425, on the contrary, the type of anomaly to be activated at the end of the period is configured:

- 1: early warning (W039).
- 2: unload (U039).
- 4: deactivation (D039).
- 8: alarm (A039).

The function is enabled if the parameter P.0424 contains a value other than zero. The count starts in the moment this parameter is set. When the configured (working) hours have elapsed, the board records, on its non-volatile memory, the maintenance request. In this way, also cutting off the supply to the board, the piece of information doesn't get lost and, above all, the anomaly cannot be cancelled. If an alarm has been selected withy P.0425, then the generator cannot be used again. This function allows to manage rental contracts “by hour number”.

To cancel the maintenance request (and the relevant signal) requires setting again the parameter P.0424: to disable the function, set the parameter to zero; to set the next maintenance after the same period as the previous one, simply confirm the existing parameter; or set a new interval. To modify these parameters requires installer level password.

9.5.15 AFR (Air Fuel Ratio)

This function is dedicated to gas engines. It manages a motorized valve (gas mixer) that regulates the percentages of air and gas introduced into the engine's cylinders.

You can use this function for:

- Adjust the "lambda" value of the exhaust gases directly.
- Indirectly adjust the "lambda" value of the exhaust gases, monitoring the pressure of the air/gas mixture (MAP - "Manifold Air Pressure").
- Adjust the exhaust gas temperature.
- Adjust the cylinders temperature.
- ...

In all cases, a sensor capable of measuring the value to be adjusted (lambda, MAP, temperature ...) must be connected to an analogue input on the controller. In the controller's terminology, the value to be adjusted is identified as "**AFR-IN**". The analogue input of the controller that acquires this sensor must be configured with the AIF.1681 function.

In defining the sensor (curve), you can indicate a name (for example "**MAP**"), the unit of measurement (for example "mbar") and the number of decimal digits you want. This information will be used to display the measurement on the controller's display.

It is also important to configure the "complete" curve of the sensor (specifying the maximum measurable value). This "maximum value" is used to convert the AFR-IN measurement in percentage, required by the regulation PID.

Optionally, the controller can also acquire the temperature of the air/gas mixture (**MAT**) via an analogue input configured with the AIF.1683 function. This measure can be used for:

- Activate anomalies.
- Reduce the power setpoint for the engine in case of high temperature.
- Correct the "power ←→AFR-IN" conversion table, to adapt it to the actual working temperature (the table is normally created at the rated working temperature).

9.5.15.1 Operation

Basically, using the parameters of the controller, a default position is defined for the gas mixer for each engine's operating condition (engine stopped, cranking, stopping, no-load operation, low power operation). In these conditions the controller will simply "request" this position to an external adjustment system.

If instead the power supplied by the generator exceeds the threshold P.1333, the controller uses a regulation PID that acts on the mixer position, to bring the actual AFR-IN value close to its setpoint (extracted via interpolation from the set points table and by the active power supplied by the generator). The system can act in two ways:

- In the points table, it is possible to specify the "basic" position of the mixer for each engine's power setpoint. The controller will calculate the "basic" position relative to the currently supplied active power (by interpolation); the regulation PID will then only provide a small correction with respect to the "basic" position (the maximum correction is established by the parameter P.1357).

- If, on the other hand, the parameters that set the “basic” positions of the mixer are all left at zero, the adjustment PID will never be limited and will therefore be free to select any position of the mixer, to obtain the required AFR-IN value (in this case the parameter P.1357 is ignored).

9.5.15.2 Correction of the mixer position

From version 1.25, the AIF.1691 function has been added for configuring virtual analogue inputs. If such an input exists, the controller uses its value (with sign) to apply a correction to the mixer position, in all phases where the regulating PID is not active (i.e., as long as the power delivered by the generator remains lower than the threshold P.1333). It is therefore possible to use the DST4602 PLC function to assign a value to the virtual analogue input, for example as a function of the ambient temperature, or the temperature of the intake air, etc. The current correction value is displayed on page E.15.

9.5.15.3 Mixer position

The controller can acquire (and display) the real position of the mixer, using an analogue input configured with the AIF.1687 function. The acquisition of the feedback is not normally mandatory but may be useful during commissioning. It becomes mandatory if the mixer is controlled by two digital outputs OPEN/CLOSE.

9.5.15.4 Actuator position

In the engine control system, the mixer only determines the amount of gas to be sent to the carburation system. Downstream of it, however, a further valve will regulate the quantity of mixture sent to the cylinders (actuator). The two adjustments affect each other; it is therefore convenient to view the position of both valves. The controller can acquire the actuator position using an analogue input configured with the AIF.1689 function.

9.5.15.5 Mixer command

The controller can use two different control systems:

- An analogue output (use the AOF.1021 function for the output configuration). DST4602 has two analogue outputs. In a gas engine operating in parallel to the grid, however, typically three outputs are needed (speed regulator, voltage regulator and gas mixer): for this reason, it is also possible to use the outputs of a DANOUT expansion module.

  Using the conversion curve, it is possible to adapt the real command signal (Vdc, mA etc.) to the mixer, to make the command percentage values coincide with the real position of the mixer (in this phase it may be useful to acquire the position feedback of the mixer).

- Digital outputs OPEN/CLOSE (use functions DOF.1041 and DOF.1042 to configure the controller's digital outputs). In this case, it is mandatory to acquire the feedback of the mixer, because through the OPEN/CLOSE outputs DST4602 will try to bring the real position of the mixer close to the setpoint resulting from its internal calculations. Furthermore, the parameter P.1358 establishes the minimum difference between the requested position and the actual position, below which neither OPENING nor CLOSURE are controlled.

The controller then provides two modes (MAN/AUTO) for the mixer control (note: it is independent from the controller's MAN/AUTO mode; the controller can be in AUTO with the gas mixer in MAN). The selection between MAN and AUTO is made with parameter P.1301, also accessible outside programming in the dedicated display page (E.15). It is also possible to use a digital input configured with function DIF.2391 for selecting MAN/AUTO (in this case parameter P.1301 is no longer used).

9.5.15.6 Ramps

In all working conditions with a supplied active power lower than the P.1333 threshold, the controller responds to changes in the mixer position setpoints by means of a ramp, to never command too violent movements. Two ramps are available:

- P.1303: used with the mixer in MAN.
- P.1305: used with the mixer in AUTO.

The ramps are set in "%/s".

They are also used when switching from an active power higher than P.1333 (where the position of the mixer depends on the AFR-IN value) to a lower power (where instead the position is determined by a fixed setpoint - P.1331 or P.1332). They are not used with the engine stopped.

9.5.15.7 Mixer manual control

When the mixer is in MAN mode, its position is determined by the parameter P.1302, directly accessible from the dedicated display page (E.15). Attention: before switching the mixer from AUTO to MAN, set the correct value in parameter P.1302.

In MAN mode, it is possible to move the mixer even when the engine is stopped.

9.5.15.8 Mixer automatic control

When the mixer is in AUTO mode, the "required" position of the mixer is determined with different algorithms based on the operating conditions. These algorithms will be described below.

During the start-up, while running with no-load (GCB open) and while supplying low active power (GCB closed but kW<P.1333), the controller allows you to select two different setpoint groups:

Description	Set 1	Set 2
Mixer position - start # (%)	P.1314	P.1317
Mixer increase - start # (%)	P.1315	P.1318
Mixer position - engine running (%)	P.1316	P.1319
Mixer position - low power engine (%)	P.1331	P.1332

It is possible to use a digital input configured with function DIF.2392 to select which set of parameters to use (if the input is OFF or if it does not exist, set 1 is used).

9.5.15.8.1 Engine stopped or during stopping cycle

Note: during this phase, any correction to the mixer position described in 9.5.15.2 **is not applied.**

In these phases, normally there is an additional valve that closes the gas pipe; it is therefore not necessary to move the mixer to the "0" position. The controller, however, provides you setpoints:

- When the engine stopped, it moves the mixer to the position specified by parameter P.1306.
- During the stopping cycle, it moves the mixer to the position specified for cranking (P.1314 or P.1317).

9.5.15.8.2 Starting the engine

Note: during this phase, any correction to the mixer position described in 9.5.15.2 is applied.

This phase ends when the controller recognizes the engine running condition. During this phase, the "required" position of the mixer can be determined in two different ways:

- Fixed value. The position of the mixer is determined by the setpoints P.1314 or P.1317. The controller uses this working method if P.1311=0. Using parameters P.1315 or P.1318, it is possible to add a fixed offset to the previous setpoints **for each cranking attempt after the first one** (to increase the quantity of gas).
- Regulation based on the percentage of methane (CH4). The controller can optionally acquire a signal indicating the percentage of methane in the gas, using an analogue input configured with the AIF.1685 function. It is therefore possible to set the "required" position for the mixer for two predefined methane percentage values (40% and 60%, parameters P.1312 and P.1313): the controller will calculate the position of the mixer relative to the real percentage of methane (limiting the calculated value between P.1312 and P.1313). The controller uses this working method if P.1311 is different from 0.

It is possible to configure a delay (P.1304) to be applied at the beginning of this phase: during this delay the position of the mixer will not be changed.

9.5.15.8.3 Engine running without load (GCB open)

Note: during this phase, any correction to the mixer position described in 9.5.15.2 is applied.

This phase ends when the GCB is closed, or a stopping cycle is commanded. In this phase, the "required" position for the mixer is determined by the parameters P.1316 or P.1319.

9.5.15.8.4 Engine running at low load (GCB closed, kW < P.1317)

Note: during this phase, any correction to the mixer position described in 9.5.15.2 is applied.

This phase ends when GCB is opened or if the active power exceeds the threshold P.1333. In this phase, the "required" position for the mixer is determined by the parameters P.1331 or P.1332.

9.5.15.8.5 Engine running at high load (GCB closed, kW > P.1317)

Note: during this phase, any correction to the mixer position described in 9.5.15.2 **is not applied.**

This phase ends when the GCB is opened or if the active power falls below the threshold P.1333.

The controller's parameters establish first up to seven power values (%) for the engine (parameters P.1333, P.1334, P.1335, P.1336, P.1337, P.1338 and P.1339). For example, 30%, 45%, 60%, 70%, 80%, 90%, 100%. **Note: the seven parameters must be set in ascending order. You can use fewer points, leaving unused points to zero**.

Each of these power values corresponds to a setpoint for the AFR-IN quantity (parameters P.1340, P.1341, P.1342, P.1343, P.1344, P.1345 and P.1346).

Based on the table determined by the previous points, the controller calculates by interpolation the setpoint for the AFR-IN measurement corresponding to the power supplied by the generator. This setpoint can then be slightly changed if the MAT temperature is different from the threshold set with parameter P.1391 (see 9.5.15.10). The regulation PID will then act on the mixer position to bring the AFR-IN measurement to the calculated setpoint.

To stabilize the mixer setting as much as possible, the following precautions are used:

- The controller uses the average value for the active power instead of the instantaneous value. If the power measurement is more stable, the setpoint for AFR-IN extracted from the table is also more stable.
- The setpoint for AFR-IN extracted from the table is then averaged in a period of one second. This is done to make it even more stable across the variations in average power.

- It is then possible to set a filter on the AFR-IN sensor. With parameter P.1371 it is possible to set a period (in seconds), within which the average of the AFR-IN sensor will be calculated, which will then be used in the logics.

During the regulation, in fact, the variation of the mixer position affects the supplied power (as well as the AFR-IN measurement), which in turn causes a different setpoint for the AFR-IN measurement. By slowing down the control loop with averages, the speed regulator can manage to compensate the power error introduced by the mixer variation, before correcting the mixer again. The regulation loop acts every 100 milliseconds.

To each of the power values in the table it is then possible (but not mandatory) to associate "basic" positions for the mixer (parameters P.1347, P.1348, P.1349, P.1350, P.1351, P.1352 and P.1353). In this phase, the controller can operate in two ways:

- If the parameters from P.1347 to P.1353 contain values other than zero, the controller first establishes the "basic" position for the mixer at the current power (interpolation between the points in the table). Then it applies a PID regulation loop, which modifies (only partially) the "base" position, to bring the AFR-IN measurement close to the relative setpoint. Parameter P.1357 establishes the maximum correction applied by the PID with respect to the "base" position. This system only works well with high quality and constant GAS.

- If, on the other hand, the parameters from P.1347 to P.1353 are all zero, the regulation PID is free to move the mixer to any position. Parameter P.1357 is ignored.

Example:

Suppose we must respect a “maximum NOX” limit value for exhaust gases (to comply with emission regulations).

If we only have one MAP sensor available (air/gas mixture pressure), the relative set points are not directly supplied by the engine manufacturer but must be derived empirically. It can be done with the following manual procedure:

- You need an instrument that measures the "NOX" value of the exhaust gases.
- From the documentation, obtain the "NOX" value prescribed by the engine manufacturer or by the emissions regulations (for example 500).
- Put the mixer in MAN mode and set P.1302 to a position that is good for starting.
- Start the engine, close the GCB and bring the generator to the power configured with P.1333 (via a dummy load or via a setpoint for the BASE LOAD if operating in parallel to the grid).
- Act manually on the mixer position (P.1302) until the external instrument shows a "NOX" value close to the prescribed one.
- Set the current MAP pressure in P.1340 (or following).
- Set the current mixer position to P.1347 (or following) (or leave it at zero if you only want to regulate with the PID, for example if the quality of the GAS is very variable).
- Repeat the procedure for the other six power setpoints.

At the end of the procedure there will be three "curves" of seven points, one for the engine power, one for the relative MAP pressure and the last for the mixer default position to obtain that MAP pressure at that specific engine power (the latter only if requested).

The operations performed during the adjustment are:

- DST4602 takes the measurement from the AFR-IN sensor and averages it with the period specified by P.1371.
- DST4602 measures the power supplied by the engine; it calculates the average and expresses it in percentage.
- By interpolation on the previous "curves", it calculates the setpoint for the AFR-IN value. Then DST4602 averages it on a 1 second period.
- Optionally, it corrects the previously calculated setpoint if the MAT working temperature is different from the P.1391 threshold.
- If requested, by interpolation DST4602 obtains the "basic" position for the mixer from the previous "curves". If not required, the "basic" position is the one specified by parameters P.1331 or P.1332.
- The regulation PID modifies the "basic" position of the mixer to bring the AFR-IN measurement close to the calculated setpoint. The gains of the regulation PID can be configured with parameters P.1354 (P), P.1355 (I) and P.1356 (D).
- Parameter P.1357 establishes the maximum percentage correction that the PID can apply to the "base" position of the mixer: it is used only if the parameters from P.1347 to P.1353 are different from zero.
- Finally, it is possible to set a "dead band" threshold (P.1373) on the difference between the setpoint and the actual value of AFR-IN, to avoid correcting the position of the mixer due to irrelevant differences. The "dead band" situation is shown on the display with "DB" written on page E.15; it can be signalled externally with a digital output configured with the DOF.1043 function. Parameter P.1373 applies a hysteresis configured with P.1372.

9.5.15.9 AFR-IN protection

As mentioned, the controller tries to adjust the AFR-IN value to bring it close to the setpoint obtained from the set curves. Protections are provided if this adjustment is not successful.

The parameter P.1374 establishes the maximum acceptable difference between the setpoint and the AFR-IN value. Instead, parameter P.1375 establishes a delay: if the difference between the setpoint and the AFR-IN values remains higher than P.1374 for P.1375 seconds, the controller activates an anomaly (222). The type of the anomaly (waring, unload, deactivation, alarm) is established with parameter P.1376.

Parameter P.1374 applies a hysteresis configured with P.1732.

9.5.15.10 MAT temperature management

It is very important to keep the temperature of the air/gas mixture (MAT) under control, because too high temperatures entering the cylinders can cause faults. The controller allows the use of an analogue input configured with the AIF.1683 function to acquire this temperature.

Protections.

Two different protections are provided:

- First threshold:
  - P.1382: threshold (° C).
  - P.1383: delay (s).
  - P.1384: type of anomaly.

- Second threshold:
    - P.1385: threshold (° C).
    - P.1386: delay (s).
    - P.1387: type of anomaly.

The hysteresis configured with P.1381 is applied to the thresholds (P.1382 and P.1386).

The first threshold can be used as a warning (P.1382 different from zero and P.1384 set to "1-warning"); it can also be used for derating the engine and to correct the AFR-IN setpoint (see below).

The second threshold is used to stop the generator (P.1386 different from zero). Parameter P.1387 is used to select the type of anomaly (unload, deactivation, alarm).

Derating.

If the MAT temperature rises, it means that the cooling system (AFTERCOOLER) cannot dissipate the excess of heat. If this happens, there is usually a problem: if it is not too serious, the problem can be overcome by reducing the power supplied by the generator.

To use this function, parameter P.1388 must be different from zero. If the generator is working in parallel to the grid and the MAT temperature exceeds the threshold P.1382 for P.1386 seconds, the controller applies the reduction specified from P.1388 (for example 70%) **to the power supplied at that moment by the generator** and uses the calculated value as a new power setpoint. If the temperature drops (below the P.1382 minus the hysteresis), the controller reactivates the original power setpoint.

The "derating" condition is highlighted by the word "DRT" at the bottom of page E.15.

The derating is active (if P.1388 is different from zero) even if the high temperature protection is disabled (P.1382 or P.1386 are at zero).

Table correction based on temperature.

With the parameters from P.1333 to P.1353 you can configure the table that establishes the operating parameters of the system. This table is normally calibrated to the rated working temperature of the air/gas mixture (MAT), parameter P.1391. If the real MAT temperature is different from the rated one, it is possible to "adapt" the table by adding or subtracting an offset to the AFR-IN setpoint extracted from it. Parameter P.1389 establishes the offset (with sign) to be added to the setpoint extracted from the table, for each degree of difference between the MAT temperature and the threshold P.1391.

The correction is active if P.1389 is different from zero. The correction applied by this function can be limited using parameter P.1390, which establishes its maximum value.

The "correction" condition is indicated by the word "CORR" at the bottom of page E.15.

9.5.15.11 Incoherent parameters

The controller signals any discrepancies in the configuration of the AFR parameters by activating anomaly 224 (for example, there is an analogue output for mixer control, but the AFR-IN value is not available).

9.5.16 AdBlue fluid pump

The controller implements a complete management of the pump for refilling the AdBlue fluid daily tank from the external storage tank. Pump management includes automatic operation and manual controls, accessible from the front panel.

Three pump operating modes are available:

- AUTO: the pump is started/stopped by the controller according to the level of the AdBlue fluid in the daily tank, with a hysteresis band that prevents continuous starts/stops.
- MAN-ON: the pump is stopped only with the daily tank full. No hysteresis band is managed: as soon as the tank is no longer full, the pump starts.
- MAN-OFF: the pump is always off, even when the daily tank is empty.

The operating mode can be selected in two ways:

- By modifying parameter P.1490 (“AdBlue pump mode”).
- From page E.27 (E.30 for DST4602 standard) (which is only visible if a digital output is configured for the pump control) it is possible to use the normal setting procedure (ENTER to begin, ▲ and ▼ to modify and ENTER to confirm) to select the control mode of the pump.

Using parameter P.1496 it is possible to select which is the power source of the pump between:

0 – Generator.

1 – Generators’ busbars.

2 – Loads.

3 – Mains.

4 – Always supplied (power supply is always present).

The controller keeps the pump off if the selected power source is not available (while maintaining the selected operating mode). With the controller in OFF_RESET mode, the pump is always stopped.

The controller can work both with a contact level detection system and with an analogue level measurement.

This function is enabled if at least one of the configurable digital outputs of the controller is set with function DOF.1037 - “Pump for AdBlue”.

It is also possible to configure a digital output to control an interception solenoid valve on the pump line (DOF.1038 - “Solenoid valve for the AdBlue pump”).

In BoardPrg4 there is menu 4.2.5 for the configuration of the pump. However, it is possible to set the individual parameters by acting directly on the controller.

Parameter P.1495 configures the delay between the activation of the solenoid valve command and the pump start command.

9.5.16.1 Use with an analogue level measurement

To use this function, it is necessary that:

- The level measurement is acquired via CanBus by the engine control unit (SPN 1761 - SAE J1939). The ECU must therefore provide this measure.
- The contacts for the level must not be configured (see next paragraph), otherwise the controller uses those.
- At least the thresholds for activating and deactivating the pump are configured (parameters P.1492 and P.1493).

Check that the activation threshold (P.1492) is lower than the deactivation threshold (P.1493).

9.5.16.2 Use with a contact level transducer

To use this function, you need to:

- That the contact level transducer exists.
- That the start and stop contacts are connected to two configurable inputs of the controller.

Contacts must respect the following convention:

- Start contact (input with function DIF.3311): closed when the level is below the starting threshold of the pump.
- Stop contact (input with function DIF.3312): closed if the level is below the pump stop threshold.

9.5.16.3 Evaluation of the level

The controller assigns the current position of the AdBlue fluid level by evaluating all of the following conditions in order:

- If the level is below the pump start threshold, it assigns the "start" position.
- If the level is higher than the pump stop threshold, it assigns the "stop" position.
- If none of the above conditions are true, assign the position "Hysteresis".

9.5.16.4 Automatic management of the pump

With reference to the position evaluated in the previous paragraph, the pump is:

- Activated if the level position is “start”.
- Disabled if the position is “stop”.
- Keeps the current command if the position is “hysteresis”.

9.5.16.5 Manual management of the pump

The pump can be activated and deactivated as required by the operator. However, the controller prevents starting if the level position (see previous paragraphs) is "stop".

9.5.16.6 Protections

With parameter P.1494 it is possible to set the maximum activation duration of the pump. The time necessary for the pump to fill the daily tank, in the worst conditions, should be set in this parameter. If the pump remains running (both by manual and automatic control) for longer than this time, the controller stops it (without changing the control mode) and activates the warning W095: probably there is a fault in the pump or however the pump is not drawing from the storage tank. As soon as the alarm is acknowledged by the operator, the pump restarts.

9.5.16.7 Signalling

The controller makes available the internal commands for the pump and the solenoid valve in two internal statuses (usable in AND/OR logics):

- ST.139: pump control.
- ST.140: solenoid valve control.

In addition, the activation and deactivation of the pump are recorded in the event log (if bit 7 of parameter P.0441 is active):

- EVT.1072: pump activation.
- EVT.1073: pump deactivation.

9.6 Inhibition to automatic intervention

In automatic mode, **DST4602** determines, based on the type of system and the current conditions, whether to start the generator. In these conditions, it is possible to force the stopping of the generator by using the "inhibition to automatic intervention" function of the generator.

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

It is possible to activate this function in different ways, described in the following paragraphs. The “INHIBIT” lamp turns On when an inhibition is active.

9.6.1 Inhibition from contact

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

Use parameter P.0207 to set a delay between input's physical activation and this function's logic activation: Use parameter P.0208 to set a delay between input's physical de-activation and this function's logic de-activation: in case the generator is already running, the delay is two seconds (firm). The value set in the parameter that configures the delay of the used digital input (P.2002 for digital input 1) is ignored.

The board records any changes of this specific inhibition:

- EVT.1013: inhibition activated.
- EVT.1014: inhibition deactivated.

9.6.2 Inhibition from clock

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

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

Starting from version 00.63, the controller records every variation of this specific inhibition:

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

9.6.3 Inhibition to load management

In systems in parallel among more generators it is possible to use the "load management" (see document [3]). This function only activates the generators needed to meet the power required by loads in specific times. That is, exceeding generators are stopped even though, for example, it is an emergency plant and mains is Off. The “load management” uses the “inhibition to automatic intervention” function to stop generators.

9.6.4 Inhibition due to mains failure

In systems that provide only the supplying in parallel with the mains (see [3]), should the mains fail, DST4602 would force the opening of GCB switch and, after a configurable waiting time (P.0899), it would activate the “inhibition to automatic intervention” to stop the generator until the mains is again "within tolerance".

Starting from version 00.63, the controller records every variation of this specific inhibition:

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

9.6.5 Inhibition due to “GCB switch not open”

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

Starting from version 00.63, the controller records every variation of this specific inhibition:

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

9.6.6 Signalling

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

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

9.7 Inhibition to taking of load

In automatic mode, once the generator has been started, **DST4602** normally always tries to close GCB switch. In these conditions, it is possible to force the opening of GCB switch by using the “inhibition to power load” function.

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

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

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

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

- EVT.1081: inhibition deactivated.

9.7.1 Inhibition from contact

It is possible to configure a digital input through DIF.2502 function (“inhibition to power load”). When this input is active, the inhibition to power load is active.

Starting from version 00.63, the controller records an event when this inhibition is activated:

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

In the previous versions, this event was recorded no matter what the reason of the inhibition was.

9.7.2 Control from serial ports

There are two possibilities:

- HOLDING REGISTER Modbus register 20. By writing the value "20" into the register, the inhibition to power load is activated, by writing the value "21" it is disabled.
- HOLDING REGISTER Modbus registers 101 and 102. These controls can be enabled by a digital input configured with DIF.2706 function - "Enable controls from the serial ports": if this input exists, it should be active. It is first of all necessary to write the value configured with P.0004 parameter in register 101 (password): within 5 seconds; by writing the value "31" or "32" into the register 102 the inhibition to power load will be activated, by writing the value "33" it will be deactivated.

The control remains active for 30 seconds from the time it is received by **DST4602**: it is therefore necessary to repeat it about every 25 seconds until the inhibition to power load should be kept active.

Starting from version 00.63, the controller records an event when this inhibition is activated:

- EVT.1202: inhibition activated.

9.7.3 Due to failure of the mains

In systems that provide the supply in parallel with the mains only (see [3]), if the mains fail, **DST4602** will force the immediate opening of GCB switch, and will activate the “inhibition to power load” in order to stop its closure. The inhibition will be cancelled when the mains is "within tolerance" again.

Starting from version 00.63, the controller records an event when this inhibition is activated:

- EVT.1201: inhibition activated.

9.7.4 Inhibition due to “GCB switch not open”

In multiple generator parallel plants, a generator's GCB switch might not open when the generator is stopped. This is a hazardous situation, as the voltage from the other running generators 'drags' the alternator of the gen-set with “not open GCB”. In this condition, notwithstanding the stop command, the engine would keep running with all external services unpowered (oil pumps and the like). In these conditions it is possible to stop the closure of the GCBs of the other generators (P.0804), and also to force their opening in case they are already closed: the board activates the “inhibition to power load” to stop the closure (or force the opening) of GCB.

Starting from version 00.63, the controller records an event when this inhibition is activated:

- EVT.1203: inhibition activated.

9.7.5 Inhibition from MC board

If **DST4602** is “controlled” by MC (see document [3]), MC can activate the “inhibition to power load” to force the opening of GCB switches of all generators.

Starting from version 00.63, the controller records an event when this inhibition is activated:

- EVT.1205: inhibition activated.

9.7.6 Inhibition to synchronization on MCB ongoing.

In a system composed of more than one generator, that can supply both stand alone and in parallel with the mains (MSB + MSTP or MPtM + MSB), some external logics (among which MC) can intervene on supplying generators voltage and frequency to synchronize the generator bar to the mains to close MCB or MGCB switch. At this stage, **DST4602** activates the inhibition to power load if its own GCB is open: in this way it stops its closure, in order not to disturb the ongoing synchronization.

Starting from version 00.63, the controller records an event when this inhibition is activated:

- EVT.1201: inhibition activated.

9.7.7 Signalling

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

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

9.8 Circuit breakers management

DST4602 can control GCB switch. For systems composed of a single generator (P.0802 <= 4), it is also able to control MCB switch.

On the contrary, it can't control MGCB switch, if any.

Anyway, DST4602 accepts that these switches could be controlled by external logics (steadily or temporarily).

Through the P.0854 parameter it is possible to configure the way DST4602 should manage the GCB switch:

- 0: the switch is controlled by DST4602, and DST4602 cannot use synchronization to close it.
- 1: the switch is controlled by DST4602, and DST4602 can use synchronization to close it
- 2: the switch is controlled by an external device, and DST4602 cannot use synchronization to close it.
- 3: the switch is controlled by an external device, and DST4602 can use synchronization to close it.

At the same way, through P.0855 parameter, it is possible to configure the way DST4602 should manage MCB switch (see previous description).

9.8.1 Digital outputs

Four different commands can be used to manage MCB breakers:

- DOF.2001 - "MCB (NC) Under-voltage coil". This feature can be used to supply with power the under-voltage coil (if any) of the breaker. The board activates this output when it wants to open the switch, it deactivates the output when it wants to close the switch: the actual closing control will be activated with at least 0.5-second delay from the deactivation of this output. As a rule, a usually closed contact should be used, so that with non- supplied board, the under-voltage coil is excited and MCB switch can close.
- DOF.2002 - "MCB opening coil". The controller enables this output when it must open the breaker: the output goes back on standby once the breaker feedback shows that it is open (or when the opening time-out expires).
- DOF.2003 - "MCB closing coil". The board activates this input when it wants to close the switch (by assuring that DOF.2001 function, if any, isn't active for at least 0.5 seconds): the output is again at rest as soon as the switch feedback indicates that it is closed (or when the closure time-out lapses, or if the synchronism condition is no more present).
- DOF.2004 - "MCB (NC) steady opening command". The board activates this output when it wants to open the switch: the output remains active also with open switch. The board deactivates this output when it wants to close the switch (by assuring that the possible DOF.2001 function isn't active for, at least, 0.5 seconds): the output remains deactivated with closed switch, too. As a rule, a usually closed contact should be used, so that with non-supplied board MCB switch closes. Use this output with the remote-control switches, not with the motorized breakers.

Four different commands can be used to manage GCB breakers:

- DOF.2031 - "GCB Under voltage coil". This feature can be used to supply with power the under-voltage coil (if any) of the breaker. The controller disables this output when it must

open the breaker and enables it when it must close the breaker: the real closing command will be activated with at least 0.5 seconds after the enabling of this output. As a rule, a usually open contact should be used, so that with non-supplied board the under-voltage coil is de-energized and GCB switch opens.

- DOF.2032 - “GCB opening coil”. The controller enables this output when it must open the breaker: the output goes back on standby once the breaker feedback shows that it is open (or when the opening time-out expires).
- DOF.2033 - “GCB closing coil”. The controller enables this output when it must close the breaker (ensuring that the feature DOF.2031 «if available» has been active for at least 0.5 seconds): the output goes back on standby once the breaker shows that it is closed (or when the closing time-out expires, or if the synchronism condition is no longer met).
- DOF.2034 - “GCB steady closing command”. The controller enables this output when it must close the breaker (ensuring that the DOF.2031 feature «if available» has been active for at least 0.5 seconds): the output stays active even with the breaker closed. The controller disables this output when it must open the breaker: the output remains enabled even with the breaker open. As a rule, a usually open contact should be used, so that with non-supplied board GCB switch opens. Use this output with the remote-control switches, not with the motorized breakers.

9.8.2 Digital inputs

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

9.8.2.1 Acquiring breakers status

Three functions are available to get the feedback of the switch:

- DIF.3001 - "GCB switch status". Utilize this function to get the feedback of the switch (active input when the switch is closed).
- DIF.3002 - “MCB switch status”. Utilize this function to get the feedback of the switch (active input when the switch is closed).
- DIF.3003 - “MCB switch status”. Utilize this function to get the feedback of the switch (active input when the switch is closed).

It isn't always mandatory to connect the feedback of the switches to the board: it depends on the type of system (see the document [3]). If DST4602 gets feedbacks, it will use them to:

- Issuing failed opening or failed closing warnings (MCB and GCB).
- For its own operating sequence.
- It is also used to detect the status of the circuit breaker when it is commanded by external devices.
- To show the status of the circuit breakers on the front panel LEDs.

The delay associated to the input is used as maximum time for opening or closing the breaker (MCB and GCB).

9.8.2.2 Temporary override of switch controls

It is possible to use some digital inputs to communicate to DST4602 that the control of one or both switches is temporarily managed by an external device (even if P.0854 and P.0855 parameters indicate that the switch is controlled by the board):

- DIF.1003 - “GCB controlled externally”.
- DIF.1033 - “MCB controlled externally”.

Until the input is active, the board never tries either to open or close the switch: but, if the switch in motion (due to external controls), DST4602 will adapt its own control to the new status of the switch, in order not to cause any unwanted opening/closure when the input is deactivated.

9.8.2.3 Manual controls for the switches

It is possible to connect some external keys to open/close the switches to the digital inputs of the board. DST4602 will use these inputs (only in MAN) exactly in the same way as the MCB and GCB keys present on the panel.

- DIF.1001 - “GCB close command”.
- DIF.1002 - “GCB open command”.
- DIF.1031 - “MCB close command”.
- DIF.1032 - “MCB open command”.

Please refer to the paragraph 9.8.4 for a description of the use of these controls.

9.8.2.4 Request for synchronization

If a switch isn't controlled by DST4602, it will be anyway possible to take advantage of the internal synchronization function of DST4602 (see document [3]). When the external logic wants to close a switch and synchronization is required, it will have to ask DST4602 for the synchronization, by activating a digital input. The following functions are available to configure the digital input:

- DIF.1004 - “Request for synchronization for GCB”.
- DIF.1034 - “Request for synchronization for MCB”.

For more details refer to the document [3].

9.8.2.5 Forcing MCB to open

A digital input can be configured with the DIF.2503 function (“MCB closure inhibition”). If the controller is in AUTO, TEST or REMOTE START mode, and an input configured with this function is activated, the controller opens the mains circuit breaker (MCB) and keeps it open, **even if the mains is present**.

9.8.3 OFF/RESET management logic

In this mode, DST4602 always controls GCB when opening. If MCB is controlled by DST4602, it will be controlled when closing. Note: if MCB is configured as “supplied by mains” (P.0847 different from zero) and the mains fails, DST4602 never tries to control the closing of MCB, not even in OFF/RESET mode.

9.8.4 Management logic in MAN and in TEST

The document [3] details logics through which DST4602 allows opening/closing the switches manually (anyway the logics depend on the type of system).

On the contrary, in this paragraph, the way to send manual controls, for opening/closing switches, to the board is described.

- Using the controller buttons.

  By means of MCB button, the operator can open/close MCB switch. It is always possible to open MCB (if the engine is stopped, it is necessary to hold the key for 5 seconds). It is always possible to close MCB: if GCB is closed, DST4602 will activate synchronization. If it is not possible to use the synchronization, then the operation depends on the bit 2 of parameter P.0495 (this parameter is available since release 00.80; for previous releases consider the bit = 0):

  - Bit 2 = 1: the controller proceeds to open GCB before closing MCB.
  - Bit 2 = 0: the controller does not do anything; the operator must open GCB first, then close MCB.

  Through the GCB key, the operator can open/close GCB switch. It is always possible to open GCB. The switch, on the contrary, can be closed only if the engine is started and if generator voltages and frequency are "within tolerance": if MCB is closed, DST4602 will activate synchronization. If it is not possible to use the synchronization, then the operation depends on the bit 2 of parameter P.0495 (this parameter is available since release 00.80; for earlier releases consider the bit = 0):

  - Bit 2 = 1: the controller proceeds to open MCB before closing GCB.
  - Bit 2 = 0: the controller does not do anything; the operator must open MCB first, then close GCB.

- Using the digital inputs of the controller (to connect external buttons to allow for manual opening/closing of the breakers) See paragraph 9.8.2.3 for the list of available functions.

  These commands act on shifting the input from “not active” to “active”, not on the steady “active” state. For each switch, it is possible to use either opening/closing commands or only the closing one. If only the closing command is used, it acts as “toggle”: it commands the breaker opening if it is closed, or it’s closing if it is open. It is true what described for MCB and GCB keys at the previous point.

- Using the commands received from the serial ports.

  - Only in TEST it is possible to use the Modbus HOLDING REGISTER 20: by writing the value “4”, DST4602 opens MCB and closes GCB. By writing the value “5”, the board opens GCB and closes MCB”
  - Only in MAN it is possible to use the Modbus HOLDING REGISTER 101 and 102. These controls can be enabled by a digital input configured with DIF.2706 function - "Enable controls from the serial ports": if this input exists, it should be active. First, it is necessary to write the value configured with P.0004 parameter in 101 register (password): within 5 seconds, write in 102 register the values:
    - “31” or “32” to open the GCB circuit breaker.
    - “33” to close the GCB circuit breaker.
    - “41” to open the MCB circuit breaker.
    - “43” to close the MCB circuit breaker.

For a detailed sequence relevant to any single type of system, please refer to the document [3].

Warning: The P.0235 parameter determines what happens on the GCB circuit breaker when the operating mode turns from an automatic mode (AUTO, TEST or REMOTE START) to MAN:

- P.0235=0: GCB holds its status.
- P.0235=1: GCB is opened immediately and without performing power discharge.

9.8.5 Management logic in TEST

Starting from version 1.10, the manual control of the circuit breakers is disabled by default in TEST mode (the circuit breakers are therefore managed as described in the next paragraph). To enable them, set bit #3 of parameter P.0249 to “1”.

9.8.6 Switching logic in AUTO mode

The document [3] details the logics by means DST4602 manages the switches in AUTO, TEST and REMOTE START (anyway logics depend on the kind of system).

9.8.7 Changeover switch

Only for the SSB type of system (single generator in emergency to mains), the board can control a commutator instead of a switch. To do this, it is enough not to configure any output for the control of MCB (but to configure it as "internally controlled through P.0855 parameter"). Use the “Steadily GCB closure control” (DOF.2034) to control the commutator.

Moreover, it is possible to configure a minimum time span before which it isn't possible (either manually or automatically) to reverse the commutator control (P.0220 “Contactors control holding time”). This is useful because if the command is inverted during the movement phase, with some type of power switches it is possible that they lock themselves, and a manual action will be required to unlock them.

9.8.8 Commutation management

In the event that DST4602 controls both MCB and GCB switches, but it cannot use synchronization to close a switch (for any reason), it can always use commutation (from release 00.80 only if enabled with the bit 2 of parameter P.0495): open the other switch and then close the needed switch. In this case, it is possible to configure the duration of the pause with both switches open, by means of P.0219 parameter (“contactors controls exchange time”).

9.8.9 Signalling

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

- ST.064 - "GCB status"
- ST.065 - "MCB status"
- ST.066 - "MGCB status"
- ST.068 - “GCB steady closing command”.
- ST.069 - “MCB steady closing command”.
- ST.070 - "GCB under voltage coil command"

- ST.071 - "Impulse open command for GCB”
- ST.072 - "Impulse close command for GCB”
- ST.073 - "MCB under voltage coil command"
- ST.074 - "Impulse open command for MCB”
- ST.075 - "Impulse close command for MCB”

9.8.10 Events

The board will record any variation of the control and of the status of the switch in the event archive, if it is enabled respectively through the bits 4 and 5 of P.0441 parameter:

- EVT.1030: GCB close command
- EVT.1031: GCB open command
- EVT.1032: GCB closed.
- EVT.1033: GCB open.
- EVT.1035: MCB close command
- EVT.1036: MCB open command
- EVT.1037: MCB closed
- EVT.1038: MCB open.

10. Anomalies

This chapter describes all the anomalies managed by the controller. Some of these act as protections for the loads, for the generator or for the engine. There is also signalling of specific events in the plant management. Before describing them in detail, some definitions are required.

Four types of anomalies are:

- **Warnings**: these anomalies do not require shutting the engine down. They point out to situations that are not dangerous now, but the operator must take some action because, if ignored, they could degenerate in one of the following categories.
- **Unloads:** these anomalies have features like deactivations (see below). As they do not create problems for the loads and the genset, in parallel operations opening of the power connection is preferably performed after power unloading. This is performed by fast unloading ramp. However, it is not possible to restart the engine until the anomaly has not been acknowledged.
- **Deactivations**: these anomalies require shutting the engine down. They create hazards for the loads but not immediately for the engine. For this reason, GCB switch is open immediately (without power discharge) and the engine can be stopped through the standard procedure; that is, by means of the cooling cycle. However, it is not possible to restart the engine until the anomaly has not been acknowledged.
- **Alarms**: these anomalies require shutting the engine down. They create hazards for the loads and/or for the engine and the generator. For this reason, GCB switch is open immediately (without power discharge) and the engine is stopped immediately, without the cooling cycle. It is not possible to restart the engine until the anomaly is acknowledged.

Up to version 00.78 (but even with higher versions if bit 0 of P.0249 is **not** activated), the controller follows these rules:

- An alarm can be activated only if no other alarms are already active (there are some exceptions to this rule and will be underlined in the rest of the paragraph). Unloads, deactivations and early warnings can be present.
- A deactivation can be activated only if no alarms and deactivations are already active. Whereas, other early warnings and other unloads can be present.
- For activating unloads, alarms, deactivations, or other unloads should not be present. Some other warnings can be active.
- For activating an early warning alarms, deactivations or unloads should not be present. Some other warnings can be active.

Starting from version 00.79, if you set the bit 0 of P.0249, the controller doesn't follow the previous rules; thus, any alarm can always be activated (no matter if other alarms are still activated).

When an anomaly activates, the controller performs the following:

- It activates the internal horn and, if configured, also the external one.
- Prompts the page S.02 ANOMALIES on the multifunction display. This page shows the numeric code and the current language text related to all active anomalies. The numeric code flashes to indicate that the anomaly hasn't been recognized by the operator yet.
- It will activate the flashing of the "WARNING" light, if the anomaly belongs to the early warning category, or the "ALARM" light. The light flashing indicates the presence of an anomaly, of the relevant category, not yet recognized.
- If the anomaly isn't an early warning, it will disconnect the generator from users or from parallel bars (with or without power discharge) and it will stop the engine (with or without cooling cycle).

The following operations can be carried out on an anomaly:

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

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

10.1 Silence the horn

The hooter can be suppressed in two ways:

- By pressing the ACK/TEST key on the board panel. **This operation doesn't recognize the anomaly that, therefore, goes on flashing on the display.**
- By a digital input configured with the function DIF.2002 (“Alarm acknowledgement command”). The acoustic horn is silenced when the input switches from “not active” to “active”.
- Using the commands from the serial ports. These controls can be enabled by a digital input configured with DIF.2706 function - "Enable controls from the serial ports": if this input exists, it should be active. To change the operation mode, it is necessary to write the Modbus registers in sequence (within 5 seconds):
    - HOLDING REGISTER 101: enter the password configured with the parameter P.0004.
    - HOLDING REGISTER 102: enter the value “51”.

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

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

10.2 Acknowledge the anomaly

The anomaly can be identified in three ways:

- By pressing the ACK/TEST key on the board panel. **If you push this key when the hooter is on, it stops the hooter:** it should be pressed a second time to “recognize” the anomaly.
- By a digital input configured with the function DIF.2002 (“Alarm acknowledgement command”). The acoustic horn is silenced when the input switches from “not active” to “active”.
- Using the commands from the serial ports. There are two possibilities:
    - HOLDING REGISTER Modbus register 20. Write the value “2” in this register to identify anomalies. NB: this control also cancels the hooter in case it is active.
    - HOLDING REGISTER Modbus registers 101 and 102. These controls can be enabled by a digital input configured with DIF.2706 function - "Enable controls from the serial ports": if this input exists, it should be active. To change the working mode, it is necessary to enter in sequence (within 5 seconds):
        - HOLDING REGISTER 101: enter the password configured with the parameter P.0004.
        - HOLDING REGISTER 102: enter the value “52”. NB: this control also cancels the hooter in case it is active.

The previous operations “identify” all active anomalies. The relevant numeric codes on the display stop flashing. WARNING and ALARM lights stop flashing, too.

10.3 Cancel the anomaly

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

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

On the contrary, to cancel unloads, deactivations and alarms, it is necessary to follow one of the below procedures:

- By moving the key switch on OFF/RESET position.
- Using a digital input configured with the feature DIF.2001 - “Alarm reset command”. Anomalies are cancelled when the input from "inactive" turns into "active".
- Using the commands from the serial ports. There are two possibilities:
    - HOLDING REGISTER Modbus register 20. Write the value “1” in this register to cancel anomalies.
    - HOLDING REGISTER Modbus registers 101 and 102. These controls can be enabled by a digital input configured with DIF.2706 function - "Enable controls from the serial ports": if this input exists, it should be active. To change the working mode, it is necessary to enter in sequence (within 5 seconds):
        - HOLDING REGISTER 101: enter the password configured with the parameter P.0004.
        - HOLDING REGISTER 102: enter the value “53”.
- By using an “SMS” control (see document [5]).

10.4 Signalling

The following functions for the configuration of digital outputs are linked to anomalies:

- DOF.3151 (“reset of anomalies”). The board activates this output for **one** second when the internal sequence for the cancellation of anomalies is carried out. With this procedure, it is also possible to reset externally managed anomalies.
- DOF.3152 (“external horn”). This output is activated and deactivated along with the internal hooter. It can be used to control a more powerful hooter and/or a lamp.
- DOF.3154 (“faults acknowledgement”). The controller activates this output for **one** second when the internal sequence of faults acknowledgement is carried out. This procedure can be used to acknowledge also some possible faults managed by other devices externally.
- DOF.4001: the output will be activated if at least an early warning is active.
- DOF.4002: the output will be activated if at least an unload is active.
- DOF.4003: the output will be activated if at least a deactivation is active.
- DOF.4004: the output will be activated if at least an alarm is active.

- DOF.4005: the output will be activated if at least an early warning, a deactivation or an unload are active.
- DOF.4031: the output will be activated if at least an anomaly linked to the generator is active. As follows is the list of anomalies that activate this output:
    - 008 (“Operating conditions failure”).
    - 099 (“Minimum speed for asynchronous generators”).
    - 003 (“Minimum generator frequency”).
    - 058 (“Low generator frequency”).
    - 060 (“High generator frequency”).
    - 004 (“Maximum generator frequency”).
    - 001 (“Minimum generator voltage”).
    - 056 (“Low generator voltage”).
    - 059 (“High generator voltage”).
    - 002 (“Maximum generator voltage”).
    - 052 (“Generator voltages unbalance”).
    - 055 (“Wrong phases sequence”).
    - 053 (“Current unbalance rate”).
    - 061 (“Lost excitation”).
    - 015 (“Maximum current (from contact)”).
    - 006 (“Maximum current (from measure)”).
    - 016 (“Short-circuit”).
- DOF.4032: the output will be activated if at least an anomaly linked to the engine is active. As follows is the list of anomalies that activate this output:
    - 022 (“Over crank”).
    - 021 (“Engine not stopped”).
    - 005 (“Battery-charger failure (from D+)”).
    - 105 (“Battery-charger failure (from CAN-BUS)”).
    - 065 (“Low coolant temperature”).
    - 031 (“High coolant temperature (from contact)”).
    - 032 (“High coolant temperature (from measure)”).
    - 132 (“High coolant temperature (from CAN-BUS)”).
    - 033 (“Maximum coolant temperature (from contact)”).
    - 034 (“Maximum coolant temperature (from measure)”).

- 134 (“Maximum coolant temperature (from CAN-BUS)”).
- 135 (“Minimum coolant level (from CAN-BUS)”).
- 136 (“Low coolant level (from CAN-BUS)”).
- 043 (“Low oil pressure (from contact)”).
- 044 (“Low oil pressure (from measure)”).
- 144 (“Low oil pressure (CAN-BUS)”).
- 041 (“Minimum oil pressure (from contact)”).
- 042 (“Minimum oil pressure (from measure)”).
- 142 (“Minimum oil pressure (from CAN-BUS)”).
- 054 (“High oil temperature (from measure)”).
- 158 (“High oil temperature (from CAN-BUS)”).
- 035 (“Maximum oil temperature (from measure)”).
- 159 (“Maximum oil temperature (from CAN-BUS)”).
- 025 (“Minimum fuel level (from contact)”).
- 026 (“Minimum fuel level (from measure)”).
- 027 (“Low fuel level (from contact)”).
- 028 (“Low fuel level (from measure)”).
- 029 (“High fuel level (from contact)”).
- 030 (“High fuel level (from measure)”).
- 160 (“Water in fuel from CAN BUS)”).
- 037 (“Low battery voltage - 1st threshold (from measure)”).
- 036 (“Low battery voltage - 2nd threshold (from measure)”).
- 137 (“Low battery voltage from CAN BUS”).
- 038 (“High battery voltage - 1st threshold (from measure)”).
- 020 (“High battery voltage - 2nd threshold (from measure)”).
- 198 (“Warnings - Yellow lamp (from CAN-BUS)”).
- 199 (“Alarms/Blocks - Red lamp (from CAN-BUS)”).
- 062 (“CAN-BUS 0 (engine): BUS-OFF.
- 098 (“CAN-BUS 0 (engine): maximum time w/o data”).
- 039 (“Needed maintenance”).
- 049 (“Maximum power”).

- 096: Magnetic pickup failure

- DOF.4033: the output will be activated if at least an anomaly linked to the speed control is active. As follows is the list of anomalies that activate this output:
  - 018 (“Maximum speed (from measure)”).
  - 019 (“Maximum speed (from Hz)”).
  - 118 (“Maximum speed (from CAN-BUS)”).
  - 099 (“Minimum speed for asynchronous generators”).
  - 003 (“Minimum generator frequency”).
  - 058 (“Low generator frequency”).
  - 060 (“High generator frequency”).
  - 004 (“Maximum generator frequency”).
  - 011 (“Power reverse”).
  - DOF.4034: the output will be activated if at least an anomaly linked to the fuel is active. As follows is the list of anomalies that activate this output:
  - 025 (“Minimum fuel level (from contact)”).
  - 026 (“Minimum fuel level (from measure)”).
  - 027 (“Low fuel level (from contact)”).
  - 028 (“Low fuel level (from measure)”).
  - 029 (“High fuel level (from contact)”).
  - 030 (“High fuel level (from measure)”).
  - 160 (“Water in fuel from CAN BUS)”).
- DOF.4035: the output will be activated if at least an anomaly linked to switches is active. As follows is the list of anomalies that activate this output:
  - 013 (“MCB not closed”).
  - 014 (“GCB not closed”).
  - 023 (“MCB not open”).
  - 024 (“GCB not open”).
- DOF.0103 (Logics AND/OR)
  - ST.006: the output will be activated for a second after a command of faults acknowledgement.
  - ST.007: the output will be activated for a second after a command of faults reset.
  - ST.008: the output will be activated if at least an early warning is active.
  - ST.009: the output will be activated if at least an unload is active.

- ST.010: the output will be activated if at least a deactivation is active.
- ST.011: the output will be activated if at least an alarm is active.
- ST.012: the output will be activated if at least a non-identified early warning is active.
- ST.013: the output will be activated if at least a non-identified unload is active.
- ST.014: the output will be activated if at least a non-identified deactivation is active.
- ST.015: the output will be activated if at least a non-identified alarm is active.

10.5 OVERRIDE of protections

WARNING: the use of these functions can cause serious damages to the engine. Mecc Alte cannot be considered anyway liable due to malfunctioning and damages to things and/or people occurred because of the utilization of the OVERRIDE function.

This term defines the capacity of DST4602 of temporarily disabling (in particular conditions and on specific request) a series of protections. The OVERRIDE function, when is activated, turns a set of alarms, deactivations and unloads into simple “early warnings”: in this way, the board indicates, anyway, the presence of problems, but doesn't reduce the supplying capacity of the generator. In some situations, in fact, supply to users is put before the preservation of the engine. You should consider, for example, hospitals: there are situations in which it is preferable to damage the engine, and supply power for the longest period possible, rather than safeguarding the engine, but leaving operating rooms without light.

DST4602 manages three different OVERRIDE requests for protections; all of them can be activated through digital inputs. Use the following functions to configure the digital inputs:

- DIF.2062 (“Engine protections override”).
- DIF.2063 (“Full protections Override”).
- DIF.2064 (“Override of generator protections”).

Each OVERRIDE function turns a specific set of alarms/deactivations/unloads into "early warnings". The document [1] has a table indicating all DST4602 board anomalies: the column “OVER” indicates, for each anomaly, the OVERRIDE functions it is subject. The column includes:

- Letter “F” if the anomaly is subject to total OVERRIDE.
- Letter “E” if the anomaly is subject to engine protections OVERRIDE.
- Letter “G” if the anomaly is subject to generator protections OVERRIDE.

Besides what indicated in the table, the OVERRIDE function also affects "generic" anomalies connected to analogue and digital inputs. The following functions for the configuration of digital inputs activate anomalies that are subject to engine protections OVERRIDE and to total OVERRIDE, too:

- DIF.4012 - “unload (after oil delay)”.
- DIF.4013 – “deactivation (after oil delay)”.
- DIF.4013 – “alarm (after oil delay)”.

- DIF.4064 – “unload (subject to OVERRIDE)”.
- DIF.4063 - “deactivation (subject to OVERRIDE)”.
- DIF.4064 – “alarm (subject to override)”.

As to protections activated through thresholds on analogue measures, it is possible to subject these anomalies to engine protections OVERRIDE (and to total OVERRIDE, too) through the bit 15 of the threshold configuration parameter (P.4005 for the first threshold on the first analogue input).

The board will show a message on “S.01” page when one of these OVERRIDE functions is activated. Warning: engine electronic control units can manage directly OVERRIDE requests. In this case, ECUs do not stop the engine in case of anomalies. They usually indicate the active OVERRIDE status on CAN0CAN-BUS: DST4602 also displays this OVERRIDE status S.01 page.

The board records an event every time that an OVERRIDE request is activated (EVT.1082). Moreover, it records an event among the records, whenever all OVERRIDE requests cease (EVT.1083).

The DST4602 manages a separate operating time counter when this OVERRIDE mode is active.

10.6 Anomalies connected to digital inputs

DST4602 manages a significant number of digital input, by taking also the expansion modules (DITEL) that it can manage into account. Every input can be used to activate anomalies. These anomalies are divided into two kinds:

- **Specific.** They are configured by means of DIF.4201 function and following ones. DST4602 knows the modes through which these anomalies should be managed, and already has some default error messages (that cannot be configured) connected to each anomaly.
- **Generic.** They are configured through DIF.4001 through DIF.4064 functions. As to these anomalies, the operator should configure the message that will be shown on the display. Moreover, by using the appropriate functions, DST4602 will be instructed regarding the way it will have to manage the anomaly.

Specific anomalies will be described in the following paragraphs: in the description the parameters relevant to the digital input #1 of DST4602 (P.2001, P.2002 and P.2003) will be always referred to. The document [1] has a table that shows the parameters to be used for every digital input of DST4602 and of the expansion modules.

What stated above is true also for generic anomalies. They will not be described in the following paragraphs, because they will be infinite repetitions of the same description for each input. On the contrary, they are described here, by indicating parameters for input #1 of DST4602.

DST4602 assigns numeric codes 685 through 886 to generic anomalies linked to digital inputs (the document [1] has a table that shows the code for each input). By utilizing the parameter that configures the function (P.2001), it is possible to select the type of anomaly (early warning, unload, deactivation or alarm) and to define the conditions for the anomaly management. Warning: by setting the delay to “0”, the anomaly is disabled. In the list below, the functions for the configuration of digital inputs, used to manage generic anomalies, are indicated. They are grouped four by four: the four functions for each group define the type of anomaly (see document [1] for the list of functions).

- DIF.4001, DIF.4002, DIF.4003, DIF.4004. The board will activate this anomaly if the digital input is uninterruptedly active for the configured (P.2002) time span.
- DIF.4011, DIF.4012, DIF.4013, DIF.4014. The anomaly can be activated only if the engine has been started by DST4602, and if it is in motion from, at least, the time span configured in

P.0216 (“engine protection masking time”). The board will activate these anomalies if the digital input is uninterruptedly active for the configured (P.2002) time span. The anomaly is subject to the engine protections OVERRIDE and to total OVERRIDE, too (see 10.5).

- DIF.4021, DIF.4022, DIF.4023, DIF.4024. The anomaly can be activated only if GCB switch is closed. The board will activate this anomaly if the digital input is uninterruptedly active for the configured (P.2002) time span.
- DIF.4031, DIF.4032, DIF.4033, DIF.4034. The anomaly can be activated only if the fuel electromagnetic valve is open (FUEL, see 9.5.6.6). The board will activate this anomaly if the digital input is uninterruptedly active for the configured (P.2002) time span.
- DIF.4041, DIF.4042, DIF.4043, DIF.4044. The anomaly can be activated only if the GAS electromagnetic valve is open (GAS, see 0). The board will activate this anomaly if the digital input is uninterruptedly active for the configured (P.2002) time span.
- DIF.4051, DIF.4052, DIF.4053, DIF.4054. The board will activate this anomaly if the digital input is uninterruptedly active for the configured (P.2002) time span. The anomaly activation causes the stopping of the fuel pump (see 9.5.13.5).
- DIF.4062, DIF.4063, DIF.4064. The board will activate this anomaly if the digital input is uninterruptedly active for the configured (P.2002) time span. The anomaly is subject to the engine protections OVERRIDE and to total OVERRIDE, too (see 10.5).

Starting from version 00.79, these alarms can be activated if other alarms are still activated (see paragraph 10).

10.7 Anomalies connected to analogue inputs

DST4602 can manage a high number of analogue inputs, also considering those acquired by DIGRIN, DITHERM and DIVIT expansion modules.

For each analogue input, DST4602 allows setting two thresholds on the acquired measure, and each threshold can activate an anomaly. These are generic anomalies, since DST4602 doesn't know how to manage them and hasn't default warning messages. They will not be described in the following paragraphs, because they will be infinite repetitions of the same description for each analogue input. On the contrary, they are described here, by indicating parameters for input 1 of DST4602.

DST4602 assigns numeric codes 301 through 552 to generic anomalies linked to analogue inputs (the document [1] has a table that shows the code of each input).

First, the operator should configure the error message that will be shown on the board display when the anomaly is activated. It must use P.4002 parameter, the only one for the two thresholds. DST4602 will add an initial wording to the configured message:

- “High value:” if the anomaly is activated when the measure is higher than the threshold.
- “Low value:” if the anomaly is activated when the measure is lower than the threshold.

For each analogue input, there are six parameters available for the management of thresholds, three for each threshold (P.4003, P.4004 and P.4005 for the first threshold of the first analogue input; P.4006, P.4007 and P.4008 for the second threshold of the first analogue input).

Besides the threshold value (P.4003 or P.4006) and the delay to be managed (P.4004 or P.4007), the operator has to configure the operations connected to the threshold (P.4005 or P.4008). The parameter that configures the actions is managed through bits (every bit enables/disables a function connected to the threshold). A description for these parameters follows 7.8

Beware: by setting the delay to “0”, the anomaly **isn't disabled**.

Starting from version 00.79, these alarms can be activated if other alarms are still activated (see paragraph 10).

10.8 Faults list

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

- Enabling an anomaly refers to the minimum conditions required for the controller to detect the relevant cause.
- Activation of an anomaly refers to the cause after enabling.

01 – Minimum generator voltage

Type:	**Deactivation**
Related parameters:	**P.0101** Number of phases of the generator **P.0102** Generator rated voltage **P.0301** Minimum voltage threshold **P.0302** Minimum voltage delay
To disable:	**P.0302=0**
Enabled in:	**MAN, AUTO, TEST, REMOTE START**

The protection is enabled only with the engine in motion (active FUEL control) and, after that generator voltage and frequency have been considered “within tolerance". It is disabled during the starting and stopping phase of the engine. In MAN is enabled only when GCB switch is closed.

It will be enabled if at least one of generator voltages go below P.0301 threshold (percentage of P.0102) uninterruptedly for P.0302 time span.

For three-phase systems, the protection normally works on the phase-to-phase voltages: setting P.0328 to 1 the protection considers also the phase voltages.

* In **MAN** it is only enabled if the GCB breaker is closed or if the bit 2 of parameter P.0249 is set to "1".

02 – Maximum generator voltage

Type:	**Alarm**
Related parameters:	**P.0101** Number of phases of the generator **P.0102** Generator rated voltage **P.0303** Maximum voltage threshold **P.0304** Maximum voltage delay
To disable:	**P.0304=0**
Enabled in:	**MAN, AUTO, TEST, REMOTE START**

The protection is enabled only with started engine (active FUEL control). It is disabled during the starting and stopping phase of the engine.

It will be activated if at least one of the generator voltages go over P.0303 threshold (percentage of P.0102) uninterruptedly for P.0304 time span.

For three-phase systems, the protection normally works on the phase-to-phase voltages: setting P.0328 to 1 the protection considers also the phase voltages.

03 – Minimum generator frequency

Type:	**Deactivation**

Related parameters: **P.0105** Rated frequency
P.0305 Minimum frequency threshold
P.0306 Minimum frequency delay
To disable: **P.0306=0**
Enabled in: **MAN, AUTO, TEST, REMOTE START**

The protection is enabled only with the engine in motion (active FUEL control) and, after that generator voltage and frequency have been considered “within tolerance". It is disabled during the starting and stopping phase of the engine. In MAN is enabled only when GCB switch is closed.

It will be activated if generator frequency goes below P.0305 threshold (percentage of P.0105) uninterruptedly for P.0306 time span.

It will be activated if generator frequency goes below P.0305 threshold (percentage of P.0105) uninterruptedly for P.0306 time span.

* In **MAN** it is only enabled if the GCB breaker is closed or if the bit 2 of parameter P.0249 is set to "1".

04 – Maximum generator frequency

Type: **Alarm**
Related parameters: **P.0105** Rated frequency
P.0307 Maximum frequency threshold
P.0308 Maximum frequency delay
To disable: **P.0308=0**
Enabled in: **MAN, AUTO, TEST, REMOTE START**

The protection is enabled only with started engine (active FUEL control). It is disabled during the starting and stopping phase of the engine.

It will be activated if the generator frequency exceeds P.0307 threshold (percentage of P.0105) uninterruptedly for P.0308 time span.

05 – Belt break (D+ battery-charger failure)

Type: **Configurable**
Related parameters: **P.4041** Function of the analogue input 6 (+D)
P.0230 Threshold for stopped engine (+D)
P.0230 Threshold for running engine (+D)
P.0349 Delay for belt break
P.0357 Action for belt break
To disable: **P.0349=0**
Enabled in: **MAN, AUTO, TEST, REMOTE START**

The protection is enabled only with started engine (active FUEL control). It is disabled during the starting and stopping phase of the engine. It is enabled only if the analogue input 6 is used to receive the signal +D (AIF.1300 function in P.4041 parameter) and if both P.0230 and P.0231 thresholds are different from zero (the identification of started engine is enabled by the signal +D).

It will be activated if the voltage of the signal +D remains lower than P.0230 threshold, uninterruptedly for P.0349 time span. The type of anomaly can be configured through P.0357 parameter.

06 – Maximum current (51)

Type: **Configurable**

Related parameters: **P.0101** Number of generator phases
P.0102 Generator rated voltage
P.0106 Generator rated output
P.0309 Maximum current threshold
P.0310 Maximum current delay
P.0323 Action on maximum current / short circuit
P.0324 Protections enabling 50V-51V

To disable: **P.0310=0**

Enabled in: **MAN, AUTO, TEST, REMOTE START**

Current protection is time dependent (reaction time is faster when the overload increases). The used curve is named **EXTREMELY INVERSE** and implements a I2t function. It is a generator protection as it limits the thermal accumulation of the generator during the supply phase. As engine protection, the maximum power protection must be used, that is independent from the load type.

A maximum current threshold and the maximum time the generator can work with this current are defined. If the current is lower than the defined threshold, the protection does not activate. If the current rises above the threshold, the protection activates with a time inversely proportional to the overcurrent. To correctly set the thresholds, perform the following steps:

- Define the system rated current (see9.4.1).
- Set the maximum current threshold with the parameter P.0309, as a percentage of the rated current.
- Set the action time in the parameter P.0310: the protection will be activated within time set if the current is constantly equal to the threshold P.0309 multiplied by $\sqrt{2}$. It will be activated more quickly when the current is higher and more slowly when the current is lower.

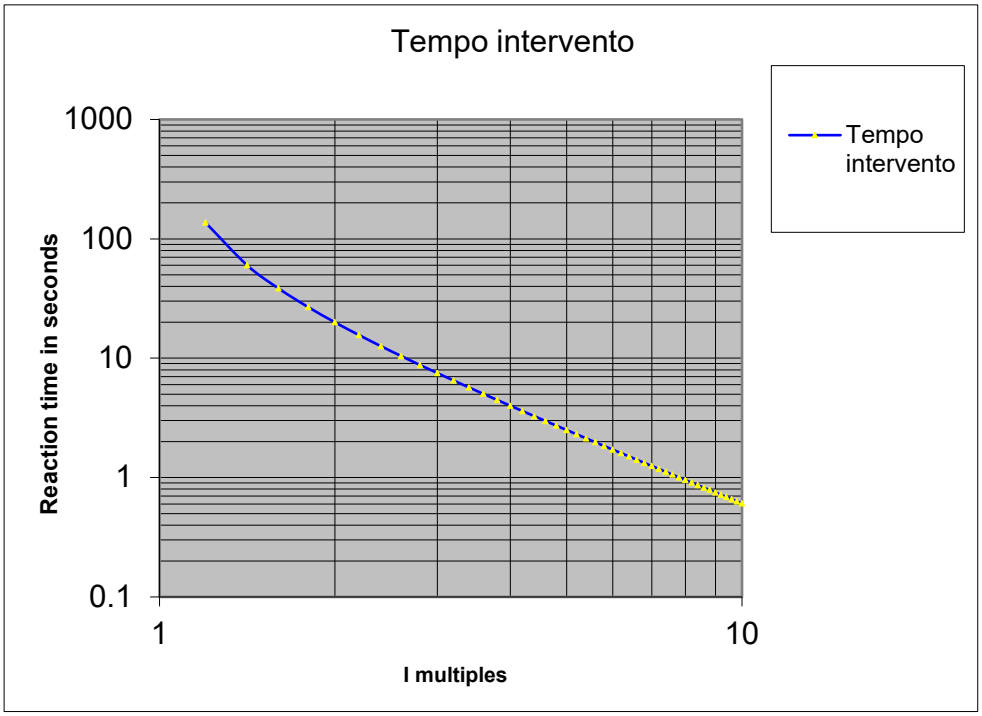
To calculate the intervention time for a set current, please use the following formula:

$$t_I = \frac{P.0310}{\left(\frac{I}{P.0309}\right)^2 - 1}$$

Where *I* is the current in the circuit.

Please remember that the protection is performed by performing the integral of the current value during time; therefore, current values above the rated threshold all concur to define the intervention time, with their instant weight resulting from the above formula. Thus, only way to experimentally verify this formula is to switch instantaneously from a normal load situation to an overload situation.

The following graph shows the curve used for enabling protection, with a value of P.0310 set to 60 seconds (I is the maximum current):



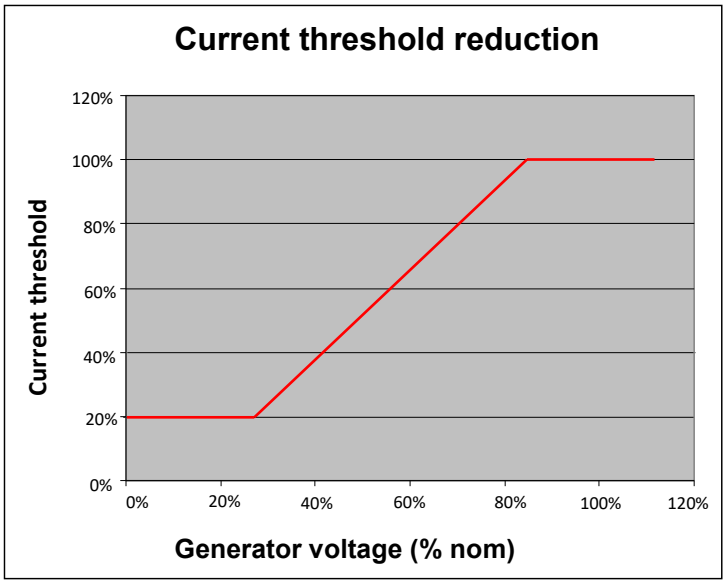
The protection is enabled only with started engine (active FUEL control). It is disabled during the starting and stopping phase of the engine.

The type can be configured through P.0323 parameter.

By utilizing P.0324 parameter, it is possible to convert this protection into **51V** protection (values 2 or 3 in P.0324). The 51V protection differs from 51 “normal” protection for the fact that the threshold set with P.0309 is automatically reduced when the generator voltage decreases. In detail:

- If the generator voltage is higher than 80% the rated, the current threshold remains the one set.
- If the generator voltage is less or equal to 20% of the rated, the current threshold becomes 20% of the one set.

- If the generator voltage is between 20% and 80% of the rated, the current threshold is reduced in percentage.



07 – Manual stop while in AUTO

Type: **Alarm**
Related parameters: **P.0495** Keyboard options (since release 00.80)
To disable: **Bit 0 of P.0495=1**
Enabled in: **AUTO, TEST, REMOTE START**

The protection is enabled if bit 0 of parameter P.0495 is set to 0 (this parameter is available since release 00.80; for previous releases, the protection is always enabled). It will be activated if, in AUTO, TEST and REMOTE START modes the operator presses the STOP key on the panel or if DST4602 receives the stop control from the serial ports or through the SMS control.

08 – Operating conditions failure

Type: **Alarm**
Related parameters: **P.0217** Maximum time for operating conditions
To disable: **P.0217=0**
Enabled in: **AUTO, TEST, REMOTE START**

It is activated when the generator voltages and frequency are not steady within tolerance range within time P.0217 from the engine running acknowledgement (or from the end of the engine's idle cycle, if enabled).

11 – Power reverse

Type: **Alarm**
Related parameters: **P.0125** Engine rated output
P.0313 Power reverse threshold
P.0314 Power reverse delay

To disable: **P.0314=0**
Enabled in: **MAN, AUTO, TEST, REMOTE START**

The protection is enabled only with started engine (active FUEL control). It is disabled during the starting and stopping phase of the engine. It is disabled if currents aren't associated to the generator (current transformers on users and GCB switch open).

It will be activated if, according to the previous conditions, the total active power of the system has a negative sign and is higher (in absolute value) than P.0313 threshold (percentage of P.0125), uninterruptedly for the P.0314 time span.

12 – Genset not available

Type: **Alarm**
Related parameters: -
To disable: -
Enabled in: **MAN, AUTO, TEST, REMOTE START**

The protection is always enabled.

It will start when DST4602 receives the shutdown controls from the serial ports (or via SMS); it will be deactivated when it receives the opposite control. Disconnecting the controller from the battery cannot disable the protection. This lock is used for: time rental, lack of maintenance, economic litigation, etc.

13 – Mains circuit breaker (MCB) not closed

Type: **Warning**
Related parameters: **P.2001** Feature of the input 1 or equivalent for the other inputs.
P.2002 Feature of the input 1 or equivalent for the other inputs.
To disable: **P.2002=0**
Enabled in: **MAN, AUTO, TEST, REMOTE START**

The protection will be enabled if the board receives the feedback from MCB switch (DIF.3002 function in P.2001 parameter or equivalent) and if the delay associated to the input is different from 0 (P.2002 or equivalent). Note: for the systems in parallel with the mains it is mandatory that the board receives the feedback of the switch; in these cases, it isn't possible to disable the early warning by setting the delay to zero (the board uses a 2-second delay when set to “0”).

DST4602 activates the protection when it controls the closing of GCB switch, but it doesn't close within the time associated to the input (in AUTO, the board performs three closing attempts of the switch before activating the anomaly). Refer to document [3] for the description of the function that allows starting the generator when this anomaly is activated (function linked to the value of P.0221 parameter).

Note: this anomaly can be activated also with an already active alarm.

14 – Generator switch (GCB) not closed

Type: **Deactivation/Warning**
Related parameters: **P.2001** Feature of the input 1 or equivalent for the other inputs.
P.2002 Feature of the input 1 or equivalent for the other inputs.
To disable: **P.2002=0**
Enabled in: **MAN, AUTO, TEST, REMOTE START**

The protection will be enabled if the board receives the feedback from GCB switch (DIF.3001 function in P.2001 parameter or equivalent) and if the delay associated to the input is different from 0 (P.2002 or equivalent). Note: for parallel systems it is mandatory that the board receives the feedback of the switch; in these cases, it isn't possible to disable the anomaly by setting the delay to zero (the board uses a 2-second delay when set to “0”).

DST4602 activates the protection when it controls the closing of GCB switch, but it doesn't close within the time associated to the input (in AUTO, the board performs three closing attempts of the switch before activating the anomaly). In MAN, the board activates an early warning, in the other modes it activates a deactivation.

Note: this anomaly can be activated also with an already active alarm.

15 – Maximum current (from contact)

Type: **Alarm**

Related parameters: **P.2001** Feature of the input 1 or equivalent for the other inputs.
P.2002 Feature of the input 1 or equivalent for the other inputs.

To disable: **P.2002=0**

Enabled in: **MAN, AUTO, TEST, REMOTE START**

The protection is always enabled. It will be activated if the input that receives the external contact (DIF.4241 function in P.2001 parameter or equivalent) remains active uninterruptedly for the configured time span (P.2002 or equivalent).

16 – Short circuit on the generator (50)

Type: **Configurable**

Related parameters: **P.0101** Number of generator phases
P.0102 Generator rated voltage
P.0106 Generator rated output
P.0311 Short circuit threshold
P.0312 Short circuit delay
P.0323 Action on maximum current/short circuit
P.0324 Protections enabling 50V-51V

To disable: **P.0312=0**

Enabled in: **MAN, AUTO, TEST, REMOTE START**

This protection intervenes as quickly as possible and it doesn't depend on timings of the curve represented for maximum current protection. The protection is configured by setting P.0311 threshold, indicated as percentage of the system rated current (see 9.4.1 for the determination of the rated current from P.0101, P.0102 and P.0106 parameters).

The protection is enabled only with started engine (active FUEL control). It is disabled during the starting and stopping phase of the engine.

It will be activated if at least one current remains above P.0311 threshold uninterruptedly for P.0312 time span.

The type can be configured through P.0323 parameter.

By utilizing P.0324 parameter, it is possible to convert this protection into **50V** protection (values 1 or 3 in P.0324). The 50V protection differs from the 50 “normal” protection for the fact that the threshold set with P.0311 is automatically reduced when the generator voltage decreases. In detail:

- If the generator voltage is higher than 80% the rated, the current threshold remains the one set.

- If the generator voltage is less or equal to 20% of the rated, the current threshold becomes 20% of the one set.
- If the generator voltage is between 20% and 80% of the rated, the current threshold is reduced in percentage.

Please see the graphic in the anomaly description “06 – Maximum current (51)”.

17 – Maximum speed from (from contact)

Type: **Alarm**
Related parameters: **P.2001** Feature of the input 1 or equivalent for the other inputs.
P.2002 Feature of the input 1 or equivalent for the other inputs.
To disable: **P.2002=0**
Enabled in: **MAN, AUTO, TEST, REMOTE START**

The protection is always enabled. It is disabled during the starting phase of the engine.

It will be activated if the input that receives the external contact (DIF.4251 function in P.2001 parameter or equivalent) remains active uninterruptedly for the configured time span (P.2002 or equivalent).

Note: this anomaly can be activated also with an already active alarm.

18 – Maximum speed (from rotation speed)

Type: **Alarm**
Related parameters: **P.0110** Number of teeth of the Pick-up wheel
P.0111 Rpm/W ratio
P.0127 Rpm/Hz ratio
P.0133 Engine rating (@ 50Hz)
P.0134 Engine rating (@ 60Hz)
P.0333 Maximum speed threshold (Pick-up/W) **(%)**
P.0334 Maximum speed delay (Pick-up/W).
P.0700 Engine type
To disable: **P.0334=0**
Enabled in: **MAN, AUTO, TEST, REMOTE START**

The protection will be enabled if the board gets the rotation speed of the engine (see 9.5.3). The protection is disabled during the starting phase of the engine.

It will be activated if the acquired speed is higher than P.0333 threshold (percentage of P.0133 or P.0134 rated speed, see 9.5.2) uninterruptedly for P.0334 time span.

Note: this anomaly can be activated also with an already active alarm.

19 – Maximum speed (from generator frequency)

Type: **Alarm**
Related parameters: **P.0105** Rated frequency (Hz)
P.0331 Maximum speed threshold (frequency) (expressed in %)
P.0332 Maximum speed delay (frequency)
To disable: **P.0332=0**
Enabled in: **MAN, AUTO, TEST, REMOTE START**

The protection is always enabled. It is disabled during the starting phase of the engine.

It will be activated if the measured frequency stays above P.0331 threshold (percentage of P.0105) uninterruptedly for P.0332 time span.

Note: this anomaly can be activated also with an already active alarm.

20 – High battery voltage - 2nd threshold (from measure)

Type: **Warning**
Related parameters: **P.0371** Second threshold for battery high voltage (%)
P.0372 Delay for second threshold for battery high voltage
To disable: **P.0372=0**
Enabled in: **MAN, AUTO, TEST, REMOTE START**

The protection is always enabled. It is disabled when the control for the starter motor is activated.

It activates if the battery voltage is continuously above threshold P.0371 for time P.0372. The threshold is expressed as a percentage of the rated battery voltage which is not settable but is automatically selected by the controller between 12 e 24 Vdc. Selection is made when the controller is powered and every time the key is switched to OFF/RESET. If the controller previously sensed a value lower than, or equal to, 17V, it considers to be powered by a 12 V battery, otherwise it will consider a 24V rated voltage.

21 – Engine not stopped.

Type: **Alarm**
Related parameters: **P.0214** Duration of stopping cycle(s)
To disable: **P.0214=0**
Enabled in: **AUTO, TEST, REMOTE START**

The protection is always enabled.

It be activated if, following to a stop control, the engine doesn't stop within the time span configured in P.0214 (from the stop control).

Note: this anomaly can be activated also with an already active alarm.

22 – Over crank

Type: **Alarm**
Related parameters: **P.0211** Number of start-up attempts
To disable: **-**
Enabled in: **AUTO, TEST, REMOTE START**

The protection is always enabled.

It will be activated if, following to a request for starting, the engine hasn't started after P.0211 consecutive starting attempts (for every battery set).

23 – Mains circuit breaker (MCB) not open

Type: **Deactivation/Warning**
Related parameters: **P.2001** Feature of the input 1 or equivalent for the other inputs.
P.2002 Feature of the input 1 or equivalent for the other inputs.
To disable: **P.2002=0**
Enabled in: **MAN, AUTO, TEST, REMOTE START**

The protection will be enabled if the board receives the feedback from MCB switch (DIF.3002 function in P.2001 parameter or equivalent) and if the delay associated to the input is different from 0 (P.2002 or equivalent). Note: for the systems in parallel with the mains it is mandatory that the board receives the feedback of the switch; in these cases, it isn't possible to disable the early warning by setting the delay to zero (the board uses a 2-second delay when set to “0”).

DST4602 activates the protection when it controls the opening of MCB switch, but it doesn't open within the time associated to the input (in AUTO, the board performs three attempts to open the switch before activating the anomaly).

Usually DST4602 activates an early warning; in the following conditions it activates a deactivation:

- When the stable command for MCB closing is used (function 2004 in one of the digital outputs).
- For the systems that not provide for the continuative parallel with the mains (see document [3]).

Note: this anomaly can be activated also with an already active alarm.

24 – Genset circuit breaker (GCB) not open

Type:	**Alarm/Warning**
Related parameters:	**P.2001** Feature of the input 1 or equivalent for the other inputs. **P.2002** Feature of the input 1 or equivalent for the other inputs.
To disable:	**P.2002=0**
Enabled in:	**MAN, AUTO, TEST, REMOTE START**

The protection will be enabled if the board receives the feedback from GCB switch (DIF.3001 function in P.2001 parameter or equivalent) and if the delay associated to the input is different from 0 (P.2002 or equivalent). Note: for parallel systems it is mandatory that the board receives the feedback of the switch; in these cases, it isn't possible to disable the anomaly by setting the delay to zero (the board uses a 2-second delay when set to “0”).

DST4602 activates the protection when it controls the opening of GCB switch, but it doesn't open within the time associated to the input (in AUTO, the board performs three attempts to open the switch before activating the anomaly).

Usually DST4602 activates an early warning; in the following conditions it activates an alarm:

- When the stable command for MCB closing is used (function 2034 in one of the digital outputs).

Note: this anomaly can be activated also with an already active alarm.

Note: parameter P.0243 (“enable supplying due to failure to open GCB”) allows to keep the generator in motion (with GCB switch closed) when this early warning is activated (P.0243=1). It should be avoided, stopping the generator because:

- If it were in parallel with another electric source, it would be dragged by this source.
- If it were supplying stand alone on a charge, stopping it with closed GCB would mean to supply the charge with out-of-tolerance voltages/frequency.

It is possible to keep the generation in motion only if there aren't alarms, deactivations or unloads.

Note: parameter P.0251 ("Enable the opening of MCB for GCB closed and engine not running") allows you to enable or disable the opening of the MCB circuit breaker if the GCB circuit breaker is not opened

and the engine must be stopped (alarms/deactivations/unloads, controller in OFF/RESET mode, etc.). Obviously, it makes sense for systems that support parallel to the grid (even transitory).

- 0: with this value the loads are safeguarded. If the GCB fails to open due to alarms (therefore with the engine stopping/stopped), the **engine will be dragged by the mains**. This is the default value for the parameter.
- 1: with this value the generator is safeguarded. If the GCB fails to open due to alarms (therefore with the engine stopping/stopped), the controller opens MCB, preventing the mains from dragging the engine. **The loads, however, are not supplied**.

25 – Minimum fuel level (from contact)

Type: **Alarm**
Related parameters: **P.2001** Feature of the input 1 or equivalent for the other inputs.
P.2002 Feature of the input 1 or equivalent for the other inputs.
To disable: **P.2002=0**
Enabled in: **MAN, AUTO, TEST, REMOTE START**

The protection is always enabled.

It will be activated if the input that receives the external contact (DIF.4211 function in P.2001 parameter or equivalent) remains active uninterruptedly for the configured time span (P.2002 or equivalent).

26 – Minimum fuel level (from analogue sensor)

Type: **Alarm**
Related parameters: **P.0347** Fuel minimum level threshold (%)
P.0348 Fuel level minimum delay
To disable: **P.0348=0**
Enabled in: **MAN, AUTO, TEST, REMOTE START**

The protection will be enabled if the board gets the fuel level measure (AIF.1220 or AIF.1221 functions in P.4001 parameter or equivalent ones).

It will be activated if the received measure stays below P.0347 threshold, uninterruptedly for P.0348 time span.

27 – Low fuel level (from contact)

Type: **Warning**
Related parameters: **P.2001** Feature of the input 1 or equivalent for the other inputs.
P.2002 Feature of the input 1 or equivalent for the other inputs.
To disable: **P.2002=0**
Enabled in: **MAN, AUTO, TEST, REMOTE START**

The protection is always enabled.

It will be activated if the input that receives the external contact (DIF.4212 function in P.2001 parameter or equivalent) remains active uninterruptedly for the configured time span (P.2002 or equivalent).

28 – Low fuel level (from analogue sensor)

Type: **Warning**
Related parameters: **P.0345** Fuel minimum level threshold (%)
P.0346 Fuel level minimum delay
To disable: **P.0346=0**
Enabled in: **MAN, AUTO, TEST, REMOTE START**

The protection will be enabled if the board gets the fuel level measure (AIF.1220 or AIF.1221 functions in P.4001 parameter or equivalent ones).

It will be activated if the received measure stays below P.0345 threshold, uninterruptedly for P.0346 time span.

29 – High fuel level (from contact)

Type: **Warning**
Related parameters: **P.2001** Feature of the input 1 or equivalent for the other inputs.
P.2002 Feature of the input 1 or equivalent for the other inputs.
To disable: **P.2002=0**
Enabled in: **MAN, AUTO, TEST, REMOTE START**

The protection is always enabled.

It will be activated if the input that receives the external contact (DIF.4213 function in P.2001 parameter or equivalent) remains active uninterruptedly for the configured time span (P.2002 or equivalent).

30 – High fuel level (from analogue sensor)

Type: **Warning**
Related parameters: **P.0343** Fuel minimum level threshold (%)
P.0344 Fuel level minimum delay
To disable: **P.0344=0**
Enabled in: **MAN, AUTO, TEST, REMOTE START**

The protection will be enabled if the board gets the fuel level measure (AIF.1220 or AIF.1221 functions in P.4001 parameter or equivalent ones).

It will be activated if the received measure stays above P.0343 threshold, uninterruptedly for P.0344 time span.

31 – High coolant temperature (from contact)

Type: **Warning**
Related parameters: **P.2001** Feature of the input 1 or equivalent for the other inputs.
P.2002 Feature of the input 1 or equivalent for the other inputs.
P.0216 Engine protections mask time
To disable: **P.2002=0**
Enabled in: **MAN, AUTO, TEST, REMOTE START**

The protection is enabled after P.0216 ("engine protection masking time") from the starting of the engine. This protection is disabled in the engine start/arrest phases.

It will be enabled if, according to the previous conditions, the input that acquires the external contact (DIF.4231 function in P.2001 parameter or equivalent ones) remains active, uninterruptedly for the configured time span (P.2002 or equivalent ones).

32 – High coolant temperature (analogue sensor)

Type: **Warning**
Related parameters: **P.4001** Feature of the input 1 or equivalent for the other inputs.
P.0216 Engine protections mask time
P.0335 High coolant temperature threshold
P.0336 High coolant temperature delay
P.0700 Engine type
To disable: **P.0336=0**
Enabled in: **MAN, AUTO, TEST, REMOTE START**

The protection will be enabled only if the board acquires the coolant temperature measure (see 9.5.4). The protection is enabled after P.0216 ("engine protection masking time") from the starting of the engine. This protection is disabled in the engine start/arrest phases.

It will be enabled if, according to the previous conditions, the temperature measure stays above P.0335 threshold uninterruptedly for P.0336 time span.

33 – Maximum coolant temperature (from contact)

Type: **Alarm**
Related parameters: **P.2001** Feature of the input 1 or equivalent for the other inputs.
P.2002 Feature of the input 1 or equivalent for the other inputs.
P.0216 Engine protections mask time
To disable: **P.2002=0**
Enabled in: **MAN, AUTO, TEST, REMOTE START**

The protection is enabled after P.0216 ("engine protection masking time") from the starting of the engine. This protection is disabled in the engine start/arrest phases.

It will be enabled if, according to the previous conditions, the input that acquires the external contact (DIF.4232 function in P.2001 parameter or equivalent ones) remains active, uninterruptedly for the configured time span (P.2002 or equivalent ones).

34 – Maximum coolant temperature (analogue sensor)

Type: **Alarm**
Related parameters: **P.4001** Feature of the input 1 or equivalent for the other inputs.
P.0216 Engine protections mask time
P.0337 Maximum coolant temperature threshold
P.0338 Maximum coolant temperature delay
P.0700 Engine type
To disable: **P.0338=0**
Enabled in: **MAN, AUTO, TEST, REMOTE START**

The protection will be enabled only if the board acquires the coolant temperature measure (see 9.5.4). The protection is enabled after P.0216 ("engine protection masking time") from the starting of the engine. This protection is disabled in the engine start/arrest phases.

It will be enabled if, according to the previous conditions, the temperature measure stays above P.0337 threshold uninterruptedly for P.0338 time span.

35 – Maximum oil temperature (from measure)

Type: **Alarm**

Related parameters: **P.4001** Feature of the input 1 or equivalent for the other inputs.
P.0216 Engine protection mask time
P.0375 Maximum oil temperature threshold
P.0376 Maximum oil temperature delay
P.0700 Engine type

To disable: **P.0376=0**

Enabled in: **MAN, AUTO, TEST, REMOTE START**

The protection will be enabled if the board acquires the lubricating oil temperature measure (see 9.5.4). The protection is enabled after P.0216 ("engine protection masking time") from the starting of the engine. This protection is disabled in the engine start/arrest phases.

It will be activated if, according to the previous conditions, the lubricating oil temperature measure stays above P.0375 threshold uninterruptedly for P.0376 time span.

36 – Low battery voltage - 2nd threshold (from measure)

Type: **Warning**

Related parameters: **P.0369** Second threshold for battery low voltage (%)
P.0370 Delay for second threshold for battery low voltage

To disable: **P.370=0**

Enabled in: **MAN, AUTO, TEST, REMOTE START**

The protection is always enabled. It is disabled when the control for the starter motor is activated.

It activates if the battery voltage is continuously lower than the threshold P.0369 for time P.0370. The threshold is expressed as a percentage of the rated battery voltage which is not settable but is automatically selected by the controller between 12 e 24 Vdc. Selection is made when the controller is powered and every time the key is switched to OFF/RESET. If the controller previously sensed a value lower than, or equal to, 17V, it considers to be powered by a 12 V battery, otherwise it will consider a 24V rated voltage.

37 – Low battery voltage – 1st threshold (from measure)

Type: **Warning**

Related parameters: **P.0362** Second threshold for battery low voltage (%)
P.0363 Delay for second threshold for battery low voltage

To disable: **P.363=0**

Enabled in: **MAN, AUTO, TEST, REMOTE START**

Protection is always enabled. It is disabled when the control for the starter motor is activated.

It activates if the battery voltage is continuously lower than the threshold P.0362 for time P.0363. The threshold is expressed as a percentage of the rated battery voltage which is not settable but is automatically selected by the controller between 12 e 24 Vdc. Selection is made when the controller is powered and every time the key is switched to OFF/RESET. If the controller previously sensed a value lower than, or equal to, 17V, it considers to be powered by a 12 V battery, otherwise it will consider a 24V rated voltage.

38 – High battery voltage – 1st threshold (from measure)

Type: **Warning**
Related parameters: **P.0364** Second threshold for battery high voltage (%)
P.0365 Delay for second threshold for battery high voltage
To disable: **P.365=0**
Enabled in: **MAN, AUTO, TEST, REMOTE START**

The protection is always enabled. It is disabled when the control for the starter motor is activated.

It activates if the battery voltage is continuously above threshold P.0364 for time P.0365. The threshold is expressed as a percentage of the rated battery voltage which is not settable but is automatically selected by the controller between 12 e 24 Vdc. Selection is made when the controller is powered and every time the key is switched to OFF/RESET. If the controller previously sensed a value lower than, or equal to, 17V, it considers to be powered by a 12 V battery, otherwise it will consider a 24V rated voltage.

39 – Service required (first counter)

Type: **Configurable**
Related parameters: **P.0424** Pause for maintenance (working hours)
P.0425 Type of action for maintenance
To disable: **P.0424**=0
Enabled in: **MAN, AUTO, TEST, REMOTE START**

The protection is always enabled.

It activates after P.0424 engine running hours since last parameter P.0424 setting. Note: engine operating hours are counted even when engine is not started by the controller. It isn't possible to reset the anomaly by cutting off the supply to the board.

To deactivate it, it is necessary to set P.0424 parameter again, by setting it to zero for disabling the function or by confirming the present value or by setting a different one. P.0424 and P.0425 parameters need the “installer's” access level for their programming: so, this function can be used by freighter of generators when entering into contract by the hour, to be able to stop the engine when agreed hours have elapsed. Cycle duration can be set with parameter P.0425.

40 – Service required (second counter)

Type: **Configurable**
Related parameters: **P.0436** Pause for maintenance (working hours)
P.0437 Type of action for maintenance
To disable: **P.0436**=0
Enabled in: **MAN, AUTO, TEST, REMOTE START**

The protection is always enabled.

It activates after P.0436 engine running hours since last parameter P.0436 setting. Note: engine operating hours are counted even when engine is not started by the controller. It isn't possible to reset the anomaly by cutting off the supply to the board.

To deactivate it, it is necessary to set P.0436 parameter again, by setting it to zero for disabling the function or by confirming the present value or by setting a different one. P.0436 and P.0437 parameters need the “installer's” access level for their programming: so, this function can be used by

freighter of generators when entering into contract by the hour, to be able to stop the engine when agreed hours have elapsed. Cycle duration can be set with parameter P.0436.

41 – Minimum oil pressure (from contact)

Type: **Alarm**

Related parameters: **P.2001** Feature of the input 1 or equivalent for the other inputs.
P.2002 Feature of the input 1 or equivalent for the other inputs.
P.0216 Engine protections mask time

To disable: **P.2002=0**

Enabled in: **MAN, AUTO, TEST, REMOTE START**

The protection is enabled after P.0216 ("engine protection masking time") from the starting of the engine. This protection is disabled in the engine start/arrest phases.

It will be enabled if, according to the previous conditions, the input that acquires the external contact (DIF.4221 function in P.2001 parameter or equivalent ones) remains active, uninterruptedly for the configured time span (P.2002 or equivalent ones).

42 – Minimum oil pressure (from measure)

Type: **Alarm**

Related parameters: **P.4001** Feature of the input 1 or equivalent for the other inputs.
P.0216 Engine protections mask time
P.0341 High coolant temperature threshold
P.0342 High coolant temperature delay
P.0700 Engine type

To disable: **P.0342=0**

Enabled in: **MAN, AUTO, TEST, REMOTE START**

The protection will be enabled if the board acquires the lubricating oil pressure measure (see 9.5.4). The protection is enabled after P.0216 ("engine protection masking time") from the starting of the engine. This protection is disabled in the engine start/arrest phases.

It will be enabled if, according to the previous conditions, the measure of pressure stays under P.0341 threshold uninterruptedly for P.0342 time span.

43 – Low oil pressure (from contact)

Type: **Warning**

Related parameters: **P.2001** Feature of the input 1 or equivalent for the other inputs.
P.2002 Feature of the input 1 or equivalent for the other inputs.
P.0216 Engine protections mask time

To disable: **P.2002=0**

Enabled in: **MAN, AUTO, TEST, REMOTE START**

The protection is enabled after P.0216 ("engine protection masking time") from the starting of the engine. This protection is disabled in the engine start/arrest phases.

It will be enabled if, according to the previous conditions, the input that acquires the external contact (DIF.4222 function in P.2001 parameter or equivalent ones) remains active, uninterruptedly for the configured time span (P.2002 or equivalent ones).

44 – Low oil pressure (from measure)

Type: **Warning**

Related parameters: **P.4001** Feature of the input 1 or equivalent for the other inputs.
P.0216 Engine protections mask time
P.0339 High coolant temperature threshold
P.0340 High coolant temperature delay
P.0700 Engine type

To disable: **P.0340=0**

Enabled in: **MAN, AUTO, TEST, REMOTE START**

The protection will be enabled if the board acquires the lubricating oil pressure measure (see 9.5.4). The protection is enabled after P.0216 ("engine protection masking time") from the starting of the engine. This protection is disabled in the engine start/arrest phases.

It will be enabled if, according to the previous conditions, the measure of pressure stays under P.0339 threshold uninterruptedly for P.0340 time span.

45 – Maximum auxiliary current

Type: **Alarm**

Related parameters: **P.0109** Transformer type.
P.0130 Connection of transformer or toroid.
P.0108 Primary of transformer or of toroid.
P.0140 Secondary of transformer or of toroid.
P.0131 Auxiliary current use.
P.0367 Threshold for auxiliary/differential current
P.0368 Delay for auxiliary/differential current

To disable: **P.0368=0**

Enabled in: **MAN, AUTO, TEST, REMOTE START**

The protection will be enabled if a valid current measure is configured. Both P.0108 and P.0109 should be different from zero, and P.0131 should be different from zero and different from four. Moreover, the protection can be disabled through a digital input configured through DIF.2704 function (“disable protections on the fourth current”): if the digital input exists and is activated, the protection will be disabled.

The protection will be activated if, according to the previous conditions, the measure of current stays above P.0367 threshold uninterruptedly for P.0368 time span.

Note: by configuring P.0131 with the value “2 – Generator neutral”, DST4602 calculates the differential current as the instant sum of the three phase currents and of the neutral current. Only in this case, the protection acts on the differential current, not on the fourth current.

48 – Emergency stop

Type: **Alarm**

Related parameters: **P.2001** Feature of the input 1 or equivalent for the other inputs.
P.2002 Feature of the input 1 or equivalent for the other inputs.

To disable: **P.2002=0**

Enabled in: **MAN, AUTO, TEST, REMOTE START**

The protection is always enabled.

It will be activated if, according to the previous conditions, the input that acquires the external contact (DIF.4232 function in P.2001 parameter or equivalent ones) **remains idle**, uninterruptedly for the configured time span (P.2002 or equivalent).

It is possible to force the emergency stop alarm manually with a control through the serial ports. These commands can be enabled by a digital input configured with function DIF.2706 "Enable controls from the serial ports": if this input exists, it should be active. To activate the emergency stop alarm, it is necessary to write (within 5 seconds) the Modbus registers in sequence:

- HOLDING REGISTER 101: write the password configured with the parameter P.0004.
- HOLDING REGISTER 102: enter the value “99”.

Note: this anomaly can be activated also with an already active alarm.

49 – Maximum power

Type: **Configurable**
Related parameters: **P.0125** Engine nominal power
P.0350 Maximum power threshold
P.0351 Maximum power delay
P.0352 Maximum power action
To disable: **P.0351=0**
Enabled in: **MAN, AUTO, TEST, REMOTE START**

The protection is enabled only with started engine (active FUEL control). It is disabled during the starting and stopping phase of the engine.

It will be activated if the measure of currents is connected to the generator (current transformer on the generator, or on users, but with closed GCB switch), and if the total active power has positive sign and is higher than P.0350 threshold (percentage of P.0125) uninterruptedly for P.0351 time span. Cycle duration can be set with parameter P.0352

50 – Service required (days counter)

Type: **Warning**
Category: **Generic**
Related parameters: **P.0438 = 0**
Enabled in: **MAN, AUTO, TEST, REMOTE START**

A warning is activated at 8:00 in the morning after P.0438 days have left since the P.0438 parameter has been set for the last time. It cannot be cancelled even if removing the power source controller. It can be cancelled only by confirming the current value or by setting a different one.

The days are counted even if the engine is stopped.

The P.0438 parameter requires the “installer” access level for the programming.

51 – High controller temperature

Type: **Warning**
Related parameters: **P.0366 Controller high temperature threshold**
To disable: **P.0366=255 (maximum value)**
Enabled in: **MAN, AUTO, TEST, REMOTE START**

The protection is always enabled.

It activates if the internal controller temperature is over the threshold P.0366, even for an instant.

52 – Generator voltages unbalance

Type: **Alarm**
Related parameters: **P.0101** Generator number of phases
P.0102: Rated generator voltage.
P.0315 Voltages unbalance threshold (% rated phase voltage)
P.0316 Voltages unbalance delay
To disable: **P.0316=0**
Enabled in: **MAN, AUTO, TEST, REMOTE START**

The protection is enabled only with started engine (active FUEL control). It is disabled during the starting and stopping phase of the engine. It is enabled only for three-phase systems (P.0101 = 3) and only if generator voltages and frequency are within tolerance (immediately).

It will be activated when the difference between two whatever phase-to-phase voltages exceeds, in absolute value, P.0315 threshold (percentage of P.0102) uninterruptedly for P.0316 time span.

By setting P.0328 to 1, the protection considers also the unbalance of the phase voltages.

53 – Generator current unbalance

Type: **Alarm**
Related parameters: **P.0101** Generator number of phases
P.0102: Rated generator voltage.
P.0106 Generator rated output
P.0317 Current unbalance threshold (% rated current)
P.0318 Current unbalance delay
To disable: **P.0318=0**
Enabled in: **MAN, AUTO, TEST, REMOTE START**

The protection is enabled only with started engine (active FUEL control). It is disabled during the starting and stopping phase of the engine. It is enabled only for three-phase systems (P.0101 = 3) and only if the currents are associated to the generator (current transformer on the generator, or on users, but with closed GCB switch).

It activates if the difference between any of two currents (absolute value) is continuously over the threshold P.0317 for time P.0318. P.0317 threshold is expressed in percentage with reference to rated current: see 9.4.1 for the determination of rated current from P.0101, P.0102 and P.0106 parameters.

54 – High oil temperature (from measure)

Type: **Warning**
Related parameters: **P.4001** Feature of the input 1 or equivalent for the other inputs.
P.0216 Engine protections mask time
P.0373 High oil temperature threshold
P.0374 High oil temperature delay
P.0700 Engine type
To disable: **P.0374=0**
Enabled in: **MAN, AUTO, TEST, REMOTE START**

The protection will be enabled if the board acquires the lubricating oil temperature measure (see 9.5.4). The protection is enabled after P.0216 ("engine protection masking time") from the starting of the engine. This protection is disabled in the engine start/arrest phases.

It will be activated if, according to the previous conditions, the measure of temperature stays above P.0373 threshold uninterruptedly for P.0374 time span.

55 – Wrong phases sequence

Type: **Configurable**

Related parameters: **P.0101** Number of generator phases
P.0319 Generator phases sequence (required)
P.0320 Wrong generator phases sequence action

To disable: **P.0319=0**

Enabled in: **MAN, AUTO, TEST, REMOTE START**

The protection is enabled only with started engine (active FUEL control). It is disabled during the starting and stopping phase of the engine. It is enabled only for three-phase systems (P.0101 = 3) and only if generator voltages and frequency are within tolerance. It is enabled only if GCB switch is open.

It starts when the direction of rotation of generator phases doesn't match with the one configured in P.0319 parameter (0=disables the function, 1=clockwise rotation, 2=counter clockwise rotation, 3=as mains/bars), with a filter time of 0.5 seconds.

56 – Low generator voltage

Type: **Warning**

Related parameters: **P.0101** Number of phases of the generator
P.0102 Generator rated voltage
P.0391 Low voltage threshold
P.0392 Low battery voltage delay

To disable: **P.0392=0**

Enabled in: **MAN, AUTO, TEST, REMOTE START**

The protection is enabled only with the engine in motion (active FUEL control) and, after that generator voltage and frequency have been considered “within tolerance". It is disabled during the starting and stopping phase of the engine. In MAN is enabled only when GCB switch is closed.

It will be enabled if at least one of generator voltages go below P.0391 threshold (percentage of P.0102) uninterruptedly for P.0392 time span.

For three-phase systems, the protection normally works on the phase-to-phase voltages: setting P.0328 to 1 the protection considers also the phase voltages.

* In **MAN** it is only enabled if the GCB breaker is closed or if the bit 2 of parameter P.0249 is set to "1".

57 – Clock not valid

Type: **Warning**

Related parameters: **P.0418** Weekly test schedule
P.0420 Test duration
P.0421 Weekly operation schedule
P.0422 Operation start time
P.0423 Operation end time
P.0426 Intervention forcing calendar

To disable: **Set the clock.**
Enabled in: **MAN, AUTO, TEST, REMOTE START**

The protection is always enabled.

It is activated if the controller recognizes the clock status as not valid and the functions related to the clock, such as the weekly test (P.0418 and.0420), the time to enable operations (P.0421, P.0422, P.0423), the time to force intervention (P.0426, P.0427 and.0428) or configurable calendars *P.1900…P.1964(have been configured.

58 – Low generator frequency

Type: **Warning**
Related parameters: **P.0105** Rated frequency
P.0395 Low frequency threshold
P.0396 Low frequency delay
To disable: **P.0396=0**
Enabled in: **MAN, AUTO, TEST, REMOTE START**

The protection is enabled only with the engine in motion (active FUEL control) and, after that generator voltage and frequency have been considered “within tolerance". It is disabled during the starting and stopping phase of the engine. In MAN is enabled only when GCB switch is closed.

It will be activated if generator frequency goes below P.0395 threshold (percentage of P.0105) uninterruptedly for P.0396 time span.

It will be activated if generator frequency goes below P.0395 threshold (percentage of P.0105) uninterruptedly for P.0396 time span.

* In **MAN** it is only enabled if the GCB breaker is closed or if the bit 2 of parameter P.0249 is set to "1".

59 – High generator voltage

Type: **Warning**
Related parameters: **P.0101** Number of phases of the generator
P.0102 Generator rated voltage
P.0395 High voltage threshold
P.0394 High voltage delay
To disable: **P.0394=0**
Enabled in: **MAN, AUTO, TEST, REMOTE START**

The protection is enabled only with started engine (active FUEL control). It is disabled during the starting and stopping phase of the engine.

It will be activated if at least one of the generator voltages go over P.0393 threshold (percentage of P.0102) uninterruptedly for P.0394 time span.

For three-phase systems, the protection normally works on the phase-to-phase voltages: setting P.0328 to 1 the protection considers also the phase voltages.

60 – High generator frequency

Type: **Warning**
Related parameters: **P.0105** Nominal frequency
P.0397 High frequency threshold
P.0398 High voltage delay

To disable: **P.0398=0**

Enabled in: **MAN, AUTO, TEST, REMOTE START**

The protection is enabled only with started engine (active FUEL control). It is disabled during the starting and stopping phase of the engine.

It will be activated if frequency goes over P.0397 threshold (percentage of P.0105) uninterruptedly for P.0398 time span.

61 – Loss of excitation

Type: **Alarm**

Related parameters: **P.0321** Excitation loss threshold
P.0322 Excitation loss delay

To disable: **P.0322 = 0**

Enabled in: **MAN, AUTO, TEST, REMOTE START**

The protection is enabled only with started engine (active FUEL control). It is disabled during the starting and stopping phase of the engine.

It starts if the measure of currents is connected to the generator (current transformers on the generator, or on users, but with closed GCB switch), and if the total reactive power has a negative sign and is higher, as to the module, than P.0321 threshold, uninterruptedly for P.0322 time span.

62 – Faulty CAN-BUS 0 link

Type: **Configurable**

Related parameters: **P.0700** Engine type
P.1700 Voltage regulator (AVR) type
P.0750 GAS control device model
P.0709 Can-Bus fault signal

To disable: **-**

Enabled in: **MAN, AUTO, TEST, REMOTE START**

The protection is enabled if the CAN-BUS is activated (P.0700, P.1700 or P.0750).

It activates if the internal CAN controller switches to BUS-OFF status due to bus communication errors.

Cycle duration can be set with parameter P.0709.

64 – Fuel pump failure

Type: **Warning**

Related parameters: **P.0404** Fuel pump start maximum duration

To disable: **P.0404 = 0**

Enabled in: **MAN, AUTO, TEST, REMOTE START**

The protection is always enabled.

It activates if the pump keeps running for the time P.0404.

65 – Low coolant temperature (from analogue sensor)

Type: **Warning**

Related parameters: **P.4001** Feature of the input 1 or equivalent for the other inputs.
P.0353 Coolant low temperature threshold
P.0354 Coolant low temperature delay
P.0700 Type of engine

To disable: **P.0354 = 0**

Enabled in: **MAN, AUTO, TEST, REMOTE START**

The protection is enabled if the board acquires the measure of the coolant temperature (see 9.5.4). The protection is always enabled.

It will be activated if the temperature measurement stays lower than P.0353 threshold, uninterruptedly for P.0354 time span.

95 – AdBlue fluid pump failure

Type: **Warning**

Category: **AdBlue fluid pump protection**

Related parameters: **P.1494** Pump maximum activation duration
P.3001 Feature of output 1 or equivalent for the other outputs
P.3201 Equivalent feature for DITEL outputs

To disable: **P.1494 = 0**

Enabled in: **MAN, AUTO, TEST, REMOTE START**

This protection is only enabled if there is an output configured to control the AdBlue fluid pump (feature DOF.1037 – "AdBlue pump" in parameter P.3001 or equivalent for the other outputs) and if a time other than zero has been set in parameter P.1494. It activates if the pump operates continuously for the time set. The activation of this warning does not change the pump's operating mode (it turns off the pump, which restarts as soon as the warning is acknowledged).

96 – Magnetic pickup failure

Type: **Configurable (warning/unload/deactivation/alarm)**

Category: **Engine protection**

Related parameters: **P.0110** Number of teeth of the pick-up wheel
P.0387 Number of teeth of the pick-up wheel
P.0388 Action for magnetic pickup failure

To disable: **P.0387 = 0**

Enabled in: **MAN, AUTO, TEST, REMOTE START**

This protection is enabled only if the controller acquires the engine speed with its input dedicated to the magnetic pick-up (P.0110 different from zero).

It is activated if the controller detects the "engine running "condition, but the measured speed is "0". This condition must persist for the time configured with P.0387 (the protection is disabled if this time is "0"). With P.0388 the protection is configured as warning, unload, deactivation or alarm.

Remark: if engine's protections override function is enabled, this anomaly becomes a warning.

97 – Communication failure with the ECU

Type: **Configurable (Warning/Alarm/Unload/Deactivation)**

Category: **Generic**

Related parameters: **P.1700** Voltage regulator (AVR) type
P.1706 Communication timeout with AVR (s)
P.1707 Action for communication failure with AVR

To disable: **P.1706 = 0**

Enabled in: **MAN, AUTO, TEST, REMOTE START**

It's enabled only if the CAN-BUS connection to the automatic voltage regulator is configured (P.1700). It is activated if the controller does not continuously receive messages from the voltage regulator for time P.1706. With P.1707 the protection is configured as warning, unload, deactivation or alarm.

Remark: if engine's protections override function is enabled, this anomaly becomes a warning.

98 – Communication failure with the ECU

Type: **Configurable**

Related parameters: **P.0700** Engine type
P.0709 CAN-BUS fault signal
P.0711 Maximum time without messages from engine

To disable: **P.0711 = 0 (not for MTU-MDEC engines)**

Enabled in: **MAN, AUTO, TEST, REMOTE START**

The protection is enabled if the CAN-BUS is activated (P.0700).

It will be activated if the board doesn't acquire communications from the engine uninterruptedly for P.0711 time span. By setting P.0700 with values 140 to 143, it is activated, according to MTU specification, when the board doesn't receive the NMT ALIVE PDU message from ECU uninterruptedly for the specified time span.

99 – Minimum speed for asynchronous generators (from measure)

Type: **Deactivation**

Related parameters: **P.0110** Number of teeth of the Pick-up wheel
P.0111 Rpm/W ratio
P.0127 Rpm/Hz ratio
P.0133 Engine rating (@ 50Hz)
P.0134 Engine rating (@ 60Hz)
P.0305 Minimum speed threshold (Pick-up/W) **(%)**
P.0306 Minimum speed delay (Pick-up/W).
P.0700 Engine type

To disable: **P.0306=0**

Enabled in: **MAN, AUTO, TEST, REMOTE START**

The protection will be enabled if the board gets the rotation speed of the engine (see 9.5.3). The protection is enabled only with the engine in motion (active FUEL control) and, after that generator voltage and frequency have been considered "within tolerance". It is disabled during the starting and stopping phase of the engine. In MAN is enabled only when GCB switch is closed.

It activates if the acquired speed measure exceeds threshold P.0305 continuously, for time P.0306. P.0305 threshold is expressed in percentage: this percentage is applied, in this case, to the rated rotation speed of the engine (P.0133 or P.0134, see 9.5.2), rather than to the rated frequency.

105 – Battery-charger failure (from CAN-BUS).

Type: **Warning**

Related parameters: **P.0700** Engine type
P.0704 Can-Bus anomalies disable mask
To disable: **bit 11 of P.0704 on**
Enabled in: **MAN, AUTO, TEST, REMOTE START**

The protection is enabled if the CAN-BUS is activated (P.0700).

It will be activated when the electronic control unit of the engine reports the anomaly on the CAN-BUS.

106 – Maximum exported reactive power

Type: **Alarm**
Related parameters: **P.0379 P.0380**
To disable: **P.0380 = 0**
Enabled in: **MAN, AUTO, TEST, REMOTE START**

The protection is available from the review 00.40. It is only enabled if the controller has been started by the controller (if the command for the fuel solenoid is activated) and is disabled in the engine start/stop phases. It is activated if the reactive power is positive and is higher than P.0379 threshold, consecutively for P.0380 time.

WARNING! The protection doesn't work when current transformers are connected to users and when users are supplied by mains or other generators (see 5.5.4).

118 Maximum speed (from CAN-BUS 0)

Type: **Alarm**
Related parameters: **P.0700** Engine type
P.0704 Can-Bus anomalies disable mask
To disable: **bit 10 of P.0704 on**
Enabled in: **MAN, AUTO, TEST, REMOTE START**

The protection is enabled if the CAN-BUS is activated (P.0700).

It will be activated when the electronic control unit of the engine reports the anomaly on the CAN-BUS.

Note: this anomaly can be activated also with an already active alarm.

132 – High coolant temperature from CAN-BUS 0)

Type: **Warning**
Related parameters: **P.0700** Engine type
P.0704 Can-Bus anomalies disable mask
To disable: **bit 4 of P.0704 on**
Enabled in: **MAN, AUTO, TEST, REMOTE START**

The protection is enabled if the CAN-BUS is activated (P.0700).

It will be activated when the electronic control unit of the engine reports the anomaly on the CAN-BUS. Only for SCANIA engine: the board accepts this warning, via CAN-BUS, only after P.0216 (“engine protection masking time) from engine starting.

134 – Maximum coolant temperature (from CAN-BUS 0)

Type: **Alarm**
Related parameters: **P.0700** Engine type
P.0704 Can-Bus anomalies disable mask
To disable: **bit 5 of P.704 on**
Enabled in: **MAN, AUTO, TEST, REMOTE START**

The protection is enabled if the CAN-BUS is activated (P.0700).

It will be activated when the electronic control unit of the engine reports the anomaly on the CAN-BUS. Only for SCANIA engine: the board accepts this warning, via CAN-BUS, only after P.0216 (“engine protection masking time) from engine starting.

135 – Coolant liquid minimum level (from CAN-BUS 0)

Type: **Alarm**
Related parameters: **P.0700** Engine type
P.0704 Can-Bus anomalies disable mask
To disable: **bit 7 of P.0704 on**
Enabled in: **MAN, AUTO, TEST, REMOTE START**

The protection is enabled if the CAN-BUS is activated (P.0700).

It will be activated when the electronic control unit of the engine reports the anomaly on the CAN-BUS.

136 – Low coolant level (from CAN-BUS 0)

Type: **Warning**
Related parameters: **P.0700** Engine type
P.0704 Can-Bus anomalies disable mask
To disable: **bit 6 of P.0704 on**
Enabled in: **MAN, AUTO, TEST, REMOTE START**

The protection is enabled if the CAN-BUS is activated (P.0700).

It will be activated when the electronic control unit of the engine reports the anomaly on the CAN-BUS.

137 – Low battery voltage (from CAN-BUS 0)

Type: **Warning**
Related parameters: **P.0700** Engine type
P.0704 Can-Bus anomalies disable mask
To disable: **bit 9 of P.0704 on**
Enabled in: **MAN, AUTO, TEST, REMOTE START**

The protection is enabled if the CAN-BUS is activated (P.0700).

It will be activated when the electronic control unit of the engine reports the anomaly on the CAN-BUS.

142 – Minimum oil pressure (from CAN-BUS 0)

Type: **Alarm**
Related parameters: **P.0700** Engine type
P.0704 Can-Bus anomalies disable mask
To disable: **bit 1 of P.0704 on**
Enabled in: **MAN, AUTO, TEST, REMOTE START**

The protection is enabled if the CAN-BUS is activated (P.0700).

It will be activated when the electronic control unit of the engine reports the anomaly on the CAN-BUS. Only for SCANIA engine: the board accepts this warning, via CAN-BUS, only after P.0216 (“engine protection masking time) from engine starting.

144 – Low oil pressure (from CAN-BUS 0)

Type: **Warning**
Related parameters: **P.0700** Engine type
P.0704 Can-Bus anomalies disable mask
To disable: **bit 0 of P.0704 on**
Enabled in: **MAN, AUTO, TEST, REMOTE START**

The protection is enabled if the CAN-BUS is activated (P.0700).

It will be activated when the electronic control unit of the engine reports the anomaly on the CAN-BUS. Only for SCANIA engine: the board accepts this warning, via CAN-BUS, only after P.0216 (“engine protection masking time) from engine starting.

158 – High oil temperature (from CAN-BUS 0)

Type: **Warning**
Related parameters: **P.0700** Engine type
P.0704 Can-Bus anomalies disable mask
To disable: **bit 2 of P.0704 on**
Enabled in: **MAN, AUTO, TEST, REMOTE START**

The protection is enabled if the CAN-BUS is activated (P.0700).

It will be activated when the electronic control unit of the engine reports the anomaly on the CAN-BUS.

159 – Maximum oil temperature (from CAN-BUS 0)

Type: **Alarm**
Related parameters: **P.0700** Engine type
P.0704 Can-Bus anomalies disable mask
To disable: **bit 3 of P.0704 on**
Enabled in: **MAN, AUTO, TEST, REMOTE START**

The protection is enabled if the CAN-BUS is activated (P.0700).

It will be activated when the electronic control unit of the engine reports the anomaly on the CAN-BUS.

160 – Water in fuel (from CAN-BUS 0)

Type: **Warning**
Related parameters: **P.0700** Engine type
P.0704 Can-Bus anomalies disable mask
To disable: **bit 8 of P.0704 on**
Enabled in: **MAN, AUTO, TEST, REMOTE START**

The protection is enabled if the CAN-BUS is activated (P.0700).

It will be activated when the electronic control unit of the engine reports the anomaly on the CAN-BUS.

198 –Warnings from CAN-BUS 0 (cumulative)

Type: **Warning**
Related parameters: **P.0700** Engine type
P.1700 Voltage regulator (AVR) type
P.0750 GAS control device model
P.0704 Can-Bus anomalies disable mask
To disable: **bit 14 of P.0704 on**
Enabled in: **MAN, AUTO, TEST, REMOTE START**

The protection is enabled if the CAN-BUS is activated (P.0700, P.1700 or P.0750).

It will be activated when the electronic control unit of the engine, the voltage regulator or the gas mixer reports over the CAN-BUS the presence of at least one warning.

199 – Alarms from CAN-BUS 0 (cumulative)

Type: **Configurable**
Related parameters: **P.0700** Engine type
P.1700 Voltage regulator (AVR) type
P.0750 GAS control device model
P.0704 Can-Bus anomalies disable mask
To disable: **bit 15 of P.0704 on**
Enabled in: **MAN, AUTO, TEST, REMOTE START**

The protection is enabled if the CAN-BUS is activated (P.0700, P.1700 or P.0750).

It will be activated when the electronic control unit of the engine, the voltage regulator or the gas mixer reports over the CAN-BUS the presence of at least one alarm. The type of anomaly can be configured with the bit 13 of P.0704 parameter: if the bit is OFF, the anomaly is an alarm; if the bit is ON, the anomaly is a warning.

200 – Faulty CANBUS 1 (PMCB) connection

Type: **Warning**
Related parameters: **P.0800** PMCB bus mode
To disable: **-**
Enabled in: **MAN, AUTO, TEST, REMOTE START**

The protection is enabled if the CAN-BUS is activated (P.0800).

It activates if the internal CAN controller switches to BUS-OFF status due to bus communication errors.

201 – CAN-BUS 1 (PMCB) addresses conflict

Type: **Warning**
Related parameters: **P.0800** PMCB bus mode
P.0452 Modbus address (1)
To disable: -
Enabled in: **MAN, AUTO, TEST, REMOTE START**

The protection is enabled if the CAN-BUS is activated (P.0800).

It will be activated when two or more generator control boards connected on PMCB have the same address (configured in P.0452).

202 – Wrong number of generators on bus CAN-BUS 1 (PMCB)

Type: **Warning**
Related parameters: **P.0800** PMCB bus mode
P.0803 Number of genset over **PMCB** bus
To disable: **P.0803=0**
Enabled in: **MAN, AUTO, TEST, REMOTE START**

The protection is enabled if the CAN-BUS is activated (P.0800).

It will be activated when in the bus there are a number of generator control boards (not MC or BTB100) different from what specified by P.0803

203 – Negative sequence

Type: **Deactivation**
Related parameters: **P.0101** Generator number of phases
P.0106 Generator rated output
P.0325 Negative sequence I2 threshold (%)
P.0326 Negative sequence delay
P.0327 Nominal phase sequence
To disable: **P.0326=0**
Enabled in: **MAN, AUTO, TEST, REMOTE START**

The protection is enabled only with started engine (active FUEL control). It is disabled during the starting and stopping phase of the engine. It is enabled only for three-phase systems (P.0101 = 3) and only if the measure of currents is linked to the generator (current transformers on the generator, or on users but with closed GCB switch).

“I2” negative sequence current is calculated as 1/3 of the module of the vector sum of the three phase currents, by putting out of phase of 120° in a direction the current of L2 phase and of 120° in the other direction the current of L3 phase (it depends on the rotation direction). If the load on the three phases is balanced and of equal cos (ϕ), the “I2” current is 0. Practically, it represents an index of load imbalance, which considers also angles of current vectors and not only of modules.

P.0327 parameter (“rated phase sequence for the calculation of the direct/reverse sequence)” affects the calculation of the negative sequence current:

- P.0327 = 2. In this case, the default phase sequence is the counter clockwise one. For the calculation of the negative sequence, a 240° angle is added to L2 phase vector, a 120° angle is added to L3 phase vector.
- P.0327 = 1. In this case, the default phase sequence is the clockwise one. For the calculation of the negative sequence, a 120° angle is added to L2 phase vector, a 240° angle is added to L3 phase vector.
- P.0327 = 0. The default phase sequence is the present voltage one. Based on the fact that it is clockwise or counter clockwise, what stated at the two previous points is true.

It will be activated when "I2" current remains higher than P.0325 threshold uninterruptedly for P.0326 time span. P.0325 threshold is expressed in percentage with reference to rated current: see 9.4.1 for the determination of rated current from P.0101, P.0102 and P.0106 parameters.

204 – Failure to close NECB switch

Type: **Configurable**

Related parameters: **P.0161** Action for the neutral-earth circuit breaker (NECB) failure to close
P.3001 Feature of output 1 or equivalent for the other outputs
P.4001 P.4002 Function and delay of input 1 or equivalent for the other inputs.

To disable: -

Enabled in: **AUTO, TEST, REMOTE START**

This anomaly is available from the review 00.40. Is enabled only if the board controls NECB switch for the earthing of the neutral of the generator (DOF.2061 function in P.3001 parameter for output 1 or equivalent for the other outputs), and if it acquires its feedback (DIF.3005 function in P.4001 parameter for input 1 or equivalent for the other inputs). It is activated if the switch remains open for the time associated with the feedback input, at the presence of the closing control.

205 – Failure to open NECB switch

Type: **Warning**

Related parameters: **P.3001** Feature of output 1 or equivalent for the other outputs
P.4001 P.4002 Function and delay of input 1 or equivalent for the other inputs.

To disable: -

Enabled in: **AUTO, TEST, REMOTE START**

This anomaly is available from the review 00.40. Is enabled only if the board controls NECB switch for the earthing of the neutral of the generator (DOF.2061 function in P.3001 parameter for output 1 or equivalent for the other outputs), and if it acquires its feedback (DIF.3005 function in P.4001 parameter for input 1 or equivalent for the other inputs). It is activated when the switch remains closed for the time associated with the feedback input, at the presence of the opening control.

206 – Maximum error of active power

Type: **Adjustable**

Related parameters: **P.0381** Threshold for active power maximum error
P.0382 Delay for active power maximum error
P.0383 Action for active power maximum error

To disable: **P.0382=0**

Enabled in: **MAN, AUTO, TEST, REMOTE START**

This anomaly is available from the review 00.63. It is enabled only if the genset is running in parallel with other gensets (also during the multiple back-synchronization) or if the genset is in parallel with the mains. It activates if the difference between the power supplied and the current power setpoint is consecutively higher than the P.0381 threshold for 5 seconds (not adjustable). With parameter P.0383, you can configure the anomaly as warning, unload, deactivation or alarm. The anomaly is subject to the override of the genset protections (and to the total override).

207 – Maximum time in parallel to the grid

Type:	**Warning**
Related parameters:	**P.0890** Maximum time in parallel with the mains
	P.0897 Permission for the MCB opening for maximum time in parallel with the mains
To disable:	**P.0890=0**
Enabled in:	**MAN, AUTO, TEST, REMOTE START**

This anomaly activates if the duration of the parallel with the mains has been set to a limit (P.0890 different from zero) and the parallel has lasted more than the time set. The controller forces the GCB opening and impedes its reclosing until the operator acknowledges the warning. This warning can be activated also in case the “genset switch” function is active, if at the end of the time set, the power has not been switched to the genset yet (because the nominal power of the genset is not enough to supply the load): in this case, if the power absorbed by the load decreases, the controller will automatically close GCB even in case of warning.

To maintain the compatibility with the previous version (which at the end of the time set forced the MCB opening), the P.0897 parameter has been added. It is a bit parameter that allows to select in which conditions the MCB opening must be allowed in case the time set for the parallel with the mains is exceeded:

- Bit 0: MAN mode.
- Bit 1: AUTO mode.
- Bit 2: TEST mode.
- Bit 3: REMOTE START mode.
- Bit 7: in case of “MGCB opening failure”.

Note: the parameter is aimed just to allow the operation of old plants in case of a firmware update. In new plants, it should be left at zero.

221 – AFR: maximum temperature for MAT

Type:	**Configurable**
Related parameters:	**P.1381** Hysteresis on MAT temperature
	P.1385 Maximum MAT temperature threshold
	P.1386 Maximum MAT temperature delay
	P.1387 Maximum MAT temperature alarm type
To disable:	**P.1386 = 0**
Enabled in:	**MAN, AUTO, TEST, REMOTE START**

The protection is enabled if the P.1386 delay is non-zero.

It is activated if the temperature of the air/gas mixture remains above the threshold P.1385 for the time P.1386. Parameter P.1387 configures the anomaly as unload, deactivation or alarm. Parameter P.1381 configures the hysteresis applied to the threshold P.1385.

222 – AFR: regulation error

Type:	**Configurable**
Related parameters:	**P.1372** Hysteresis on regulation/protection thresholds for AFR-IN **P.1374** Max AFR-IN regulation error threshold **P.1375** Max AFR-IN regulation error delay (alarm) **P.1376** Max AFR-IN regulation error alarm type
To disable:	**P.1375 = 0**
Enabled in:	**MAN, AUTO, TEST, REMOTE START**

The purpose is to recognize a situation in which the control loop cannot bring the AFR-IN measurement close to its setpoint.

The protection is enabled if the delay P.1375 is different from zero.

It is activated if the regulation error (setpoint - measurement, without sign) remains above the threshold P.1374 for the time P.1375. Parameter P.1376 configures the anomaly as a warning, unload, deactivation or alarm. Parameter P.1372 configures the hysteresis applied to the threshold P.1374.

223 – AFR: high temperature for MAT

Type:	**Configurable**
Related parameters:	**P.1381** Hysteresis on MAT temperature **P.1382** High MAT temperature threshold **P.1383** High MAT temperature delay **P.1384** High MAT temperature alarm type
To disable:	**P.1383 = 0**
Enabled in:	**MAN, AUTO, TEST, REMOTE START**

The protection is enabled if delay P.1383 is non-zero.

It is activated if the temperature of the air/gas mixture remains above the threshold P.1382 for the time P.1383. With parameter P.1384 the anomaly is configured as a warning, or it is disabled. Parameter P.1381 configures the hysteresis applied to the threshold P.1385.

If the anomaly is disabled, the threshold can still be used to activate a power derating on the engine.

224 – AFR: incoherent parameters

Type:	**Warning**
Related parameters:	-
To disable:	-
Enabled in:	**MAN, AUTO, TEST, REMOTE START**

The protection is always enabled.

It is activated if the configuration parameters of the AFR function are not coherent with each other. On page S.02, selecting this anomaly, the controller shows a description of the problem:

- AFR-IN measurement is not acquired.
- The position of the mixer is not acquired (mandatory with digital commands OPEN/CLOSE).

- The methane percentage measurement is not available (but is required).
- The thresholds relative to the position of the mixer with respect to the percentage of methane are inverted.
- The air/gas mixture temperature measurement is not available (but is required).

251 – Faulty CANBUS 2 (EXBUS) connection

Type: **Warning**
Related parameters: **P.0141** Number of DITEL modules
P.0142 Number of DITEMP modules
P.0143 Number of DIVIT modules
P.0144 Number of DANOUT modules
To disable: -
Enabled in: **MAN, AUTO, TEST, REMOTE START**

The protection is enabled if the CAN-BUS is activated (P.0141 or P.0142 or P.0143 or P.0144 different from zero).

It activates if the internal CAN controller switches to BUS-OFF status due to bus communication errors.

252 – CAN-BUS 2 (EXBUS) expansion modules missing

Type: **Warning**
Related parameters: **P.0141** Number of DITEL modules
P.0142 Number of DITEMP modules
P.0143 Number of DIVIT modules
P.0144 Number of DANOUT modules
To disable: -
Enabled in: **MAN, AUTO, TEST, REMOTE START**

The protection is enabled if the CAN-BUS is activated (P.0141 or P.0142 or P.0143 or P.0144 different from zero).

It will be activated when one or more boards configured with the previous parameters isn't communicating on the CAN-BUS. On page S.02, by selecting this early warning, the board shows which module isn't communicating.

253 – CAN-BUS 2 (EXBUS) missing measure

Type: **Warning**
Related parameters: **P.0142** Number of DITEMP modules
P.0143 Number of DIVIT modules
To disable: -
Enabled in: **MAN, AUTO, TEST, REMOTE START**

The protection is enabled if the CAN-BUS is activated (P.0141 or P.0142 or P.0143 or P.0144 different from zero).

It will be activated when DST4602 doesn't receive an analogue measure from the CAN-BUS. The board verifies the sole presence of the utilized analogue measures (those that have a function different from zero in P.4131 parameter or equivalent ones for the other analogue inputs). On S.02 page, by selecting this early warning, the board indicates which channel of which module isn't carrying out the measurement.

254 – CAN-BUS 2 (EXBUS) duplicate address

Type: **Warning**

Related parameters: **P.0141** Number of DITEL modules
P.0142 Number of DITEMP modules
P.0143 Number of DIVIT modules
P.0144 Number of DANOUT modules

To disable: -

Enabled in: **MAN, AUTO, TEST, REMOTE START**

The protection is enabled if the CAN-BUS is activated (P.0141 or P.0142 or P.0143 or P.0144 different from zero).

It will be activated if two or more expansion modules are configured with the same address. On S.02 page, by selecting this early warning, the board indicates which module has the duplicated address.

255 – Disconnected CAN-BUS 2 sensor (EXBUS)

Type: **Warning**

Related parameters: **P.0142** Number of DITEMP modules
P.0143 Number of DIVIT modules

To disable: -

Enabled in: **MAN, AUTO, TEST, REMOTE START**

The protection is enabled if the CAN-BUS is activated (P.0141 or P.0142 or P.0143 or P.0144 different from zero).

It will be activated when a DIGRIN, DITHERM or DIVIT module reports the status of “disconnected sector”. On S.02 page, by selecting this early warning, the board indicates which channel of which module has a disconnected sensor.

271 – GCB parallel failure (direct parallel)

Type: **Warning/Alarm**

Related parameters: **P.0802** Plant type
P.0854 GCB use
P.0852 Synchronization Maximum Time (GCB)

To disable: **P.0852 = 0**

Enabled in: **AUTO, TEST, REMOTE START**

This protection is enabled only if plant configuration (P.0802, P.0854) allows the GCB breaker synchronization.

It activates when the GCB breaker does not close within the time set with P.0852 since synchronization start. It is always an alarm: it becomes an early warning only if the switch is controlled externally (P.0854).

272 – MCB parallel failure (reverse parallel)

Type: **Warning**

Related parameters: **P.0802** Plant type
P.0855 MCB use
P.0853 MCB maximum synchronization time

To disable: **P.0853 = 0**

Enabled in: **AUTO, TEST, REMOTE START**

This protection is enabled only if plant configuration (P.0802, P.0855) allows the MCB breaker synchronization.

It activates when the MCB breaker does not close within the time set with P.0853 since synchronization start.

273 – Incoherent parameters

Type: **Warning/Alarm**
To disable: **-**
Enabled in: **MAN, AUTO, TEST, REMOTE START**

The protection is always enabled.

It activates if plant configuration parameters are not coherent and/or all parameters default have been reloaded. On S.02 page, by selecting this anomaly, the board shows a description of the problem. It is almost always an early warning: it is an alarm only for continuative parallel systems with the mains in case the interface switch isn't selected.

274 – Self-production line selected

Type: **Deactivation**
Related parameters: **P.2001** Feature of the input 1 or equivalent for the other inputs.
P.2002 Feature of the input 1 or equivalent for the other inputs.
To disable: **P.2002=0**
Enabled in: **MAN, AUTO, TEST, REMOTE START**

The protection is always enabled.

It will be activated if the input that receives the external contact (DIF.4261 function in P.2001 parameter or equivalent) remains active uninterruptedly for the configured time span (P.2002 or equivalent). Purpose of this protection is to indicate to the board that there is an open switch on the line that connects the generator to the public mains, which in fact doesn't allow the supply in parallel with the mains.

275 – Interface device not open

Type: **Alarm**
Related parameters: **P.0802**: plant type
P.0900: interface device
To disable: **-**
Enabled in: **MAN, AUTO, TEST, REMOTE START**

In case of mains failure during parallel, in mains parallel plants, the generator/s must be isolated from mains by opening a breaker switch (interface breaker). If the breaker does not open within 0.5 sec. since mains failure, the controller sets this anomaly. Either MCB or GCB can act as interface breaker.

276 – Alarm from master controller CAN-BUS 1 (PMCB)

Type: **Warning/Alarm**
Related parameters: **P.0800** PMCB bus mode
P.0802: plant type
To disable: **-**

Enabled in: **MAN, AUTO, TEST, REMOTE START**

This anomaly is forced by the controller MC when an anomaly must be signalled also to the generators control controllers (the MC controller display will show the actual anomaly).

279 – Inconsistent bar voltage

Type: **Warning/Deactivation**
Related parameters: **P.0807** Options for the parallel
To disable: **bit 7 of P.0807 on**
Enabled in: **MAN, AUTO, TEST, REMOTE START**

The board will activate this warning before closing GCB, if it notices a divergence between the effective presence of voltage on parallel bars and what it expects based on the status of switches, mains and any other generator control boards connected on PMCB. The anomaly is activated only if there isn't voltage on bars when, on the contrary, it should be present. For example, if at least another generator has closed GCB, there should be voltage on parallel bars: if the board doesn't detect it (through the three-phase sensor or through a contact), after two seconds the signalling is activated. Usually, the signal is an early warning, it becomes a deactivation (only in case of automatic procedures) after 60 seconds if the board needs to close the GCB.

280 – System error #001

Type: **Early warning/Unload**
Related parameters: -
To disable: -
Enabled in: **MAN, AUTO, TEST, REMOTE START**

DST4602 will activate this early warning if it hasn't a valid serial number (indication of cloning). The early warning will become an unload if the situation continues for two days.

561 – Minimum voltage (27) by D-PRO relay #1

Type: **Configurable as Alarm (bit 0 of P.0604=1), Deactivation (bit 0 of P.0603=1), Unload (bit 0 of P.0602=1), Warning (bit 0 of P.0604=1)**
Related parameters: **P.0145** Number of D-PRO modules
To disable: **Act on D-PRO relay or set bit 0 of all parameters P.0601, P.0602, P.0603, P.0604 to zero**
Enabled in: **MAN, AUTO, TEST, REMOTE START**

The protection is always enabled. See the technical manual of the D-PRO protection relay.

562 – Minimum voltage (27T) by D-PRO relay #1

Type: **Configurable as Alarm (bit 1 of P.0604=1), Deactivation (bit 1 of P.0603=1), Unload (bit 1 of P.0602=1), Warning (bit 1 of P.0604=1)**
Related parameters: **P.0145** Number of D-PRO modules
To disable: **Act on D-PRO relay or set bit 1 of all parameters P.0601, P.0602, P.0603, P.0604 to zero**
Enabled in: **MAN, AUTO, TEST, REMOTE START**

The protection is always enabled. See the technical manual of the D-PRO protection relay.

563 – Maximum active power (32P) by D-PRO relay #1

Type: **Configurable as Alarm (bit 2 of P.0604=1), Deactivation (bit 2 of P.0603=1), Unload (bit 2 of P.0602=1), Warning (bit 2 of P.0604=1)**

Related parameters: **P.0145** Number of D-PRO modules

To disable: **Act on D-PRO relay or set bit 2 of all parameters P.0601, P.0602, P.0603, P.0604 to zero**

Enabled in: **MAN, AUTO, TEST, REMOTE START**

The protection is always enabled. See the technical manual of the D-PRO protection relay.

564 – Maximum reactive power (32Q) by D-PRO relay #1

Type: **Configurable as Alarm (bit 3 of P.0604=1), Deactivation (bit 3 of P.0603=1), Unload (bit 3 of P.0602=1), Warning (bit 3 of P.0604=1)**

Related parameters: **P.0145** Number of D-PRO modules

To disable: **Act on D-PRO relay or set bit 3 of all parameters P.0601, P.0602, P.0603, P.0604 to zero**

Enabled in: **MAN, AUTO, TEST, REMOTE START**

The protection is always enabled. See the technical manual of the D-PRO protection relay.

565 – Negative sequence (46) by D-PRO relay #1

Type: **Configurable as Alarm (bit 4 of P.0604=1), Deactivation (bit 4 of P.0603=1), Unload (bit 4 of P.0602=1), Warning (bit 4 of P.0604=1)**

Related parameters: **P.0145** Number of D-PRO modules

To disable: **Act on D-PRO relay or set bit 4 of all parameters P.0601, P.0602, P.0603, P.0604 to zero**

Enabled in: **MAN, AUTO, TEST, REMOTE START**

The protection is always enabled. See the technical manual of the D-PRO protection relay.

566 – Wrong phase sequence (47) by D-PRO relay #1

Type: **Configurable as Alarm (bit 5 of P.0604=1), Deactivation (bit 5 of P.0603=1), Unload (bit 5 of P.0602=1), Warning (bit 5 of P.0604=1)**

Related parameters: **P.0145** Number of D-PRO modules

To disable: **Act on D-PRO relay or set bit 5 of all parameters P.0601, P.0602, P.0603, P.0604 to zero**

Enabled in: **MAN, AUTO, TEST, REMOTE START**

The protection is always enabled. See the technical manual of the D-PRO protection relay.

567 – Short circuit (50) by D-PRO relay #1

Type: **Configurable as Alarm (bit 6 of P.0604=1), Deactivation (bit 6 of P.0603=1), Unload (bit 6 of P.0602=1), Warning (bit 6 of P.0604=1)**

Related parameters: **P.0145** Number of D-PRO modules

To disable: **Act on D-PRO relay or set bit 6 of all parameters P.0601, P.0602, P.0603, P.0604 to zero**

Enabled in: **MAN, AUTO, TEST, REMOTE START**

The protection is always enabled. See the technical manual of the D-PRO protection relay.

568 – Short circuit on neutral (50N) by D-PRO relay #1

Type: **Configurable as Alarm (bit 7 of P.0604=1), Deactivation (bit 7 of P.0603=1), Unload (bit 7 of P.0602=1), Warning (bit 7 of P.0604=1)**

Related parameters: **P.0145** Number of D-PRO modules

To disable: **Act on D-PRO relay or set bit 7 of all parameters P.0601, P.0602, P.0603, P.0604 to zero**

Enabled in: **MAN, AUTO, TEST, REMOTE START**

The protection is always enabled. See the technical manual of the D-PRO protection relay.

569 – Short circuit (50V) by D-PRO relay #1

Type: **Configurable as Alarm (bit 8 of P.0604=1), Deactivation (bit 8 of P.0603=1), Unload (bit 8 of P.0602=1), Warning (bit 8 of P.0604=1)**

Related parameters: **P.0145** Number of D-PRO modules

To disable: **Act on D-PRO relay or set bit 8 of all parameters P.0601, P.0602, P.0603, P.0604 to zero**

Enabled in: **MAN, AUTO, TEST, REMOTE START**

The protection is always enabled. See the technical manual of the D-PRO protection relay.

570 – Maximum current (51) by D-PRO relay #1

Type: **Configurable as Alarm (bit 9 of P.0604=1), Deactivation (bit 9 of P.0603=1), Unload (bit 9 of P.0602=1), Warning (bit 9 of P.0604=1)**

Related parameters: **P.0145** Number of D-PRO modules

To disable: **Act on D-PRO relay or set bit 9 of all parameters P.0601, P.0602, P.0603, P.0604 to zero**

Enabled in: **MAN, AUTO, TEST, REMOTE START**

The protection is always enabled. See the technical manual of the D-PRO protection relay.

571 – Maximum current on neutral (51N) by D-PRO relay #1

Type: **Configurable as Alarm (bit 10 of P.0604=1), Deactivation (bit 10 of P.0603=1), Unload (bit 10 of P.0602=1), Warning (bit 10 of P.0604=1)**

Related parameters: **P.0145** Number of D-PRO modules

To disable: **Act on D-PRO relay or set bit 10 of all parameters P.0601, P.0602, P.0603, P.0604 to zero**

Enabled in: **MAN, AUTO, TEST, REMOTE START**

The protection is always enabled. See the technical manual of the D-PRO protection relay.

572 – Maximum current (51V) by D-PRO relay #1

Type: **Configurable as Alarm (bit 11 of P.0604=1), Deactivation (bit 11 of P.0603=1), Unload (bit 11 of P.0602=1), Warning (bit 11 of P.0604=1)**

Related parameters: **P.0145** Number of D-PRO modules

To disable: **Act on D-PRO relay or set bit 11 of all parameters P.0601, P.0602, P.0603, P.0604 to zero**

Enabled in: **MAN, AUTO, TEST, REMOTE START**

The protection is always enabled. See the technical manual of the D-PRO protection relay.

573 – Maximum current (59) by D-PRO relay #1

Type: **Configurable as Alarm (bit 12 of P.0604=1), Deactivation (bit 12 of P.0603=1), Unload (bit 12 of P.0602=1), Warning (bit 12 of P.0604=1)**

Related parameters: **P.0145** Number of D-PRO modules

To disable: **Act on D-PRO relay or set bit 12 of all parameters P.0601, P.0602, P.0603, P.0604 to zero**

Enabled in: **MAN, AUTO, TEST, REMOTE START**

The protection is always enabled. See the technical manual of the D-PRO protection relay.

574 – Maximum single-pole voltage (59N) by D-PRO relay #1

Type: **Configurable as Alarm (bit 13 of P.0604=1), Deactivation (bit 13 of P.0603=1), Unload (bit 13 of P.0602=1), Warning (bit 13 of P.0604=1)**

Related parameters: **P.0145** Number of D-PRO modules

To disable: **Act on D-PRO relay or set bit 13 of all parameters P.0601, P.0602, P.0603, P.0604 to zero**

Enabled in: **MAN, AUTO, TEST, REMOTE START**

The protection is always enabled. See the technical manual of the D-PRO protection relay.

575 – Minimum frequency (81U) by D-PRO relay #1

Type: **Configurable as Alarm (bit 14 of P.0604=1), Deactivation (bit 14 of P.0603=1), Unload (bit 14 of P.0602=1), Warning (bit 14 of P.0604=1)**

Related parameters: **P.0145** Number of D-PRO modules

To disable: **Act on D-PRO relay or set bit 14 of all parameters P.0601, P.0602, P.0603, P.0604 to zero**

Enabled in: **MAN, AUTO, TEST, REMOTE START**

The protection is always enabled. See the technical manual of the D-PRO protection relay.

576 – Maximum frequency (81O) by D-PRO relay #1

Type: **Configurable as Alarm (bit 15 of P.0604=1), Deactivation (bit 15 of P.0603=1), Unload (bit 15 of P.0602=1), Warning (bit 15 of P.0604=1)**

Related parameters: **P.0145** Number of D-PRO modules

To disable: **Act on D-PRO relay or set bit 15 of all parameters P.0601, P.0602, P.0603, P.0604 to zero**

Enabled in: **MAN, AUTO, TEST, REMOTE START**

The protection is always enabled. See the technical manual of the D-PRO protection relay.

577 – Maximum genset differential current (87G) by D-PRO relay #1

Type: **Configurable as Alarm (bit 16 of P.0604=1), Deactivation (bit 16 of P.0603=1), Unload (bit 16 of P.0602=1), Warning (bit 16 of P.0604=1)**

Related parameters: **P.0145** Number of D-PRO modules

To disable: **Act on D-PRO relay or set bit 16 of all parameters P.0601, P.0602, P.0603, P.0604 to zero**

Enabled in: **MAN, AUTO, TEST, REMOTE START**

The protection is always enabled. See the technical manual of the D-PRO protection relay.

578 – Maximum transformer differential current (87T) by D-PRO relay #1

Type: **Configurable as Alarm (bit 17 of P.0604=1), Deactivation (bit 17 of P.0603=1), Unload (bit 17 of P.0602=1), Warning (bit 17 of P.0604=1)**

Related parameters: **P.0145** Number of D-PRO modules

To disable: **Act on D-PRO relay or set bit 17 of all parameters P.0601, P.0602, P.0603, P.0604 to zero**

Enabled in: **MAN, AUTO, TEST, REMOTE START**

The protection is always enabled. See the technical manual of the D-PRO protection relay.

579 – Active power reverse (32RP) by D-PRO relay #1

Type: **Configurable as Alarm (bit 18 of P.0604=1), Deactivation (bit 18 of P.0603=1), Unload (bit 18 of P.0602=1), Warning (bit 18 of P.0604=1)**

Related parameters: **P.0145** Number of D-PRO modules

To disable: **Act on D-PRO relay or set bit 18 of all parameters P.0601, P.0602, P.0603, P.0604 to zero**

Enabled in: **MAN, AUTO, TEST, REMOTE START**

The protection is always enabled. See the technical manual of the D-PRO protection relay.

580 – Reactive power reverse / Loss of excitation (32RQ/40) by D-PRO relay #1

Type: **Configurable as Alarm (bit 19 of P.0604=1), Deactivation (bit 19 of P.0603=1), Unload (bit 19 of P.0602=1), Warning (bit 19 of P.0604=1)**

Related parameters: **P.0145** Number of D-PRO modules

To disable: **Act on D-PRO relay or set bit 19 of all parameters P.0601, P.0602, P.0603, P.0604 to zero**

Enabled in: **MAN, AUTO, TEST, REMOTE START**

The protection is always enabled. See the technical manual of the D-PRO protection relay.

581 – Restricted earth fault / Maximum differential current (64) by D-PRO relay #1

Type: **Configurable as Alarm (bit 20 of P.0604=1), Deactivation (bit 20 of P.0603=1), Unload (bit 20 of P.0602=1), Warning (bit 20 of P.0604=1)**

Related parameters: **P.0145** Number of D-PRO modules

To disable: **Act on D-PRO relay or set bit 20 of all parameters P.0601, P.0602, P.0603, P.0604 to zero**

Enabled in: **MAN, AUTO, TEST, REMOTE START**

The protection is always enabled. See the technical manual of the D-PRO protection relay.

585 – Minimum voltage (27) by D-PRO relay #2

Type: **Configurable as Alarm (bit 0 of P.0608=1), Deactivation (bit 0 of P.0607=1), Unload (bit 0 of P.0606=1), Warning (bit 0 of P.0605=1)**

Related parameters: **P.0145** Number of D-PRO modules

To disable: **Act on D-PRO relay or set bit 0 of all parameters P.0605, P.0606, P.0607, P.0608 to zero**

Enabled in: **MAN, AUTO, TEST, REMOTE START**

The protection is always enabled. See the technical manual of the D-PRO protection relay.

586 – Minimum voltage (27T) by D-PRO relay #2

Type: **Configurable as Alarm (bit 1 of P.0608=1), Deactivation (bit 1 of P.0607=1), Unload (bit 1 of P.0606=1), Warning (bit 1 of P.0605=1)**

Related parameters: **P.0145** Number of D-PRO modules

To disable: **Act on D-PRO relay or set bit 1 of all parameters P.0605, P.0606, P.0607, P.0608 to zero**

Enabled in: **MAN, AUTO, TEST, REMOTE START**

The protection is always enabled. See the technical manual of the D-PRO protection relay.

587 – Maximum active power (32P) by D-PRO relay #2

Type: **Configurable as Alarm (bit 2 of P.0608=1), Deactivation (bit 2 of P.0607=1), Unload (bit 2 of P.0606=1), Warning (bit 2 of P.0605=1)**

Related parameters: **P.0145** Number of D-PRO modules

To disable: **Act on D-PRO relay or set bit 2 of all parameters P.0605, P.0606, P.0607, P.0608 to zero**

Enabled in: **MAN, AUTO, TEST, REMOTE START**

The protection is always enabled. See the technical manual of the D-PRO protection relay.

588 – Maximum reactive power (32Q) by D-PRO relay #2

Type: **Configurable as Alarm (bit 3 of P.0608=1), Deactivation (bit 3 of P.0607=1), Unload (bit 3 of P.0606=1), Warning (bit 3 of P.0605=1)**

Related parameters: **P.0145** Number of D-PRO modules

To disable: **Act on D-PRO relay or set bit 3 of all parameters P.0605, P.0606, P.0607, P.0608 to zero**

Enabled in: **MAN, AUTO, TEST, REMOTE START**

The protection is always enabled. See the technical manual of the D-PRO protection relay.

589 – Negative sequence (46) by D-PRO relay #2

Type: **Configurable as Alarm (bit 4 of P.0608=1), Deactivation (bit 4 of P.0607=1), Unload (bit 4 of P.0606=1), Warning (bit 4 of P.0605=1)**

Related parameters: **P.0145** Number of D-PRO modules

To disable: **Act on D-PRO relay or set bit 4 of all parameters P.0605, P.0606, P.0607, P.0608 to zero**

Enabled in: **MAN, AUTO, TEST, REMOTE START**

The protection is always enabled. See the technical manual of the D-PRO protection relay.

590 – Wrong phase sequence (47) by D-PRO relay #2

Type: **Configurable as Alarm (bit 5 of P.0608=1), Deactivation (bit 5 of P.0607=1), Unload (bit 5 of P.0606=1), Warning (bit 5 of P.0605=1)**

Related parameters: **P.0145** Number of D-PRO modules

To disable: **Act on D-PRO relay or set bit 5 of all parameters P.0605, P.0606, P.0607, P.0608 to zero**

Enabled in: **MAN, AUTO, TEST, REMOTE START**

The protection is always enabled. See the technical manual of the D-PRO protection relay.

591 – Short circuit (50) by D-PRO relay #2

Type: **Configurable as Alarm (bit 6 of P.0608=1), Deactivation (bit 6 of P.0607=1), Unload (bit 6 of P.0606=1), Warning (bit 6 of P.0605=1)**

Related parameters: **P.0145** Number of D-PRO modules

To disable: **Act on D-PRO relay or set bit 6 of all parameters P.0605, P.0606, P.0607, P.0608 to zero**

Enabled in: **MAN, AUTO, TEST, REMOTE START**

The protection is always enabled. See the technical manual of the D-PRO protection relay.

592 – Short circuit on neutral (50N) by D-PRO relay #2

Type: **Configurable as Alarm (bit 7 of P.0608=1), Deactivation (bit 7 of P.0607=1), Unload (bit 7 of P.0606=1), Warning (bit 7 of P.0605=1)**

Related parameters: **P.0145** Number of D-PRO modules

To disable: **Act on D-PRO relay or set bit 7 of all parameters P.0605, P.0606, P.0607, P.0608 to zero**

Enabled in: **MAN, AUTO, TEST, REMOTE START**

The protection is always enabled. See the technical manual of the D-PRO protection relay.

593 – Short circuit (50V) by D-PRO relay #2

Type: **Configurable as Alarm (bit 8 of P.0608=1), Deactivation (bit 8 of P.0607=1), Unload (bit 8 of P.0606=1), Warning (bit 8 of P.0605=1)**

Related parameters: **P.0145** Number of D-PRO modules

To disable: **Act on D-PRO relay or set bit 8 of all parameters P.0605, P.0606, P.0607, P.0608 to zero**

Enabled in: **MAN, AUTO, TEST, REMOTE START**

The protection is always enabled. See the technical manual of the D-PRO protection relay.

594 – Maximum current (51) by D-PRO relay #2

Type: **Configurable as Alarm (bit 9 of P.0608=1), Deactivation (bit 9 of P.0607=1), Unload (bit 9 of P.0606=1), Warning (bit 9 of P.0605=1)**

Related parameters: **P.0145** Number of D-PRO modules

To disable: **Act on D-PRO relay or set bit 9 of all parameters P.0605, P.0606, P.0607, P.0608 to zero**

Enabled in: **MAN, AUTO, TEST, REMOTE START**

The protection is always enabled. See the technical manual of the D-PRO protection relay.

595 – Maximum current on neutral (51N) by D-PRO relay #2

Type: **Configurable as Alarm (bit 10 of P.0608=1), Deactivation (bit 10 of P.0607=1), Unload (bit 10 of P.0606=1), Warning (bit 10 of P.0605=1)**

Related parameters: **P.0145** Number of D-PRO modules

To disable: **Act on D-PRO relay or set bit 10 of all parameters P.0605, P.0606, P.0607, P.0608 to zero**

Enabled in: **MAN, AUTO, TEST, REMOTE START**

The protection is always enabled. See the technical manual of the D-PRO protection relay.

596 – Maximum current (51V) by D-PRO relay #2

Type: **Configurable as Alarm (bit 11 of P.0608=1), Deactivation (bit 11 of P.0607=1), Unload (bit 11 of P.0606=1), Warning (bit 11 of P.0605=1)**

Related parameters: **P.0145** Number of D-PRO modules

To disable: **Act on D-PRO relay or set bit 11 of all parameters P.0605, P.0606, P.0607, P.0608 to zero**

Enabled in: **MAN, AUTO, TEST, REMOTE START**

The protection is always enabled. See the technical manual of the D-PRO protection relay.

597 – Maximum current (59) by D-PRO relay #2

Type: **Configurable as Alarm (bit 12 of P.0608=1), Deactivation (bit 12 of P.0607=1), Unload (bit 12 of P.0606=1), Warning (bit 12 of P.0605=1)**

Related parameters: **P.0145** Number of D-PRO modules

To disable: **Act on D-PRO relay or set bit 12 of all parameters P.0605, P.0606, P.0607, P.0608 to zero**

Enabled in: **MAN, AUTO, TEST, REMOTE START**

The protection is always enabled. See the technical manual of the D-PRO protection relay.

598 – Maximum single-pole voltage (59N) by D-PRO relay #2

Type: **Configurable as Alarm (bit 13 of P.0608=1), Deactivation (bit 13 of P.0607=1), Unload (bit 13 of P.0606=1), Warning (bit 13 of P.0605=1)**

Related parameters: **P.0145** Number of D-PRO modules

To disable: **Act on D-PRO relay or set bit 13 of all parameters P.0605, P.0606, P.0607, P.0608 to zero**

Enabled in: **MAN, AUTO, TEST, REMOTE START**

The protection is always enabled. See the technical manual of the D-PRO protection relay.

599 – Minimum frequency (81U) by D-PRO relay #2

Type: **Configurable as Alarm (bit 14 of P.0608=1), Deactivation (bit 14 of P.0607=1), Unload (bit 14 of P.0606=1), Warning (bit 14 of P.0605=1)**

Related parameters: **P.0145** Number of D-PRO modules

To disable: **Act on D-PRO relay or set bit 14 of all parameters P.0605, P.0606, P.0607, P.0608 to zero**

Enabled in: **MAN, AUTO, TEST, REMOTE START**

The protection is always enabled. See the technical manual of the D-PRO protection relay.

600 – Maximum frequency (81O) by D-PRO relay #2

Type: **Configurable as Alarm (bit 15 of P.0608=1), Deactivation (bit 15 of P.0607=1), Unload (bit 15 of P.0606=1), Warning (bit 15 of P.0605=1)**

Related parameters: **P.0145** Number of D-PRO modules

To disable: **Act on D-PRO relay or set bit 15 of all parameters P.0605, P.0606, P.0607, P.0608 to zero**

Enabled in: **MAN, AUTO, TEST, REMOTE START**

The protection is always enabled. See the technical manual of the D-PRO protection relay.

601 – Maximum genset differential current (87G) by D-PRO relay #2

Type: **Configurable as Alarm (bit 16 of P.0608=1), Deactivation (bit 16 of P.0607=1), Unload (bit 16 of P.0606=1), Warning (bit 16 of P.0605=1)**

Related parameters: **P.0145** Number of D-PRO modules

To disable: **Act on D-PRO relay or set bit 16 of all parameters P.0605, P.0606, P.0607, P.0608 to zero**

Enabled in: **MAN, AUTO, TEST, REMOTE START**

The protection is always enabled. See the technical manual of the D-PRO protection relay.

602 – Maximum transformer differential current (87T) by D-PRO relay #2

Type: **Configurable as Alarm (bit 17 of P.0608=1), Deactivation (bit 17 of P.0607=1), Unload (bit 17 of P.0606=1), Warning (bit 17 of P.0605=1)**

Related parameters: **P.0145** Number of D-PRO modules

To disable: **Act on D-PRO relay or set bit 17 of all parameters P.0605, P.0606, P.0607, P.0608 to zero**

Enabled in: **MAN, AUTO, TEST, REMOTE START**

The protection is always enabled. See the technical manual of the D-PRO protection relay.

603 – Active power reverse (32RP) by D-PRO relay #2

Type: **Configurable as Alarm (bit 18 of P.0608=1), Deactivation (bit 18 of P.0607=1), Unload (bit 18 of P.0606=1), Warning (bit 18 of P.0605=1)**

Related parameters: **P.0145** Number of D-PRO modules

To disable: **Act on D-PRO relay or set bit 18 of all parameters P.0605, P.0606, P.0607, P.0608 to zero**

Enabled in: **MAN, AUTO, TEST, REMOTE START**

The protection is always enabled. See the technical manual of the D-PRO protection relay.

604 – Reactive power reverse / Loss of excitation (32RQ/40) by D-PRO relay #2

Type: **Configurable as Alarm (bit 19 of P.0608=1), Deactivation (bit 19 of P.0607=1), Unload (bit 19 of P.0606=1), Warning (bit 19 of P.0605=1)**

Related parameters: **P.0145** Number of D-PRO modules

To disable: **Act on D-PRO relay or set bit 19 of all parameters P.0605, P.0606, P.0607, P.0608 to zero**

Enabled in: **MAN, AUTO, TEST, REMOTE START**

The protection is always enabled. See the technical manual of the D-PRO protection relay.

605 – Restricted earth fault / Maximum differential current (64) by D-PRO relay #2

Type: **Configurable as Alarm (bit 20 of P.0608=1), Deactivation (bit 20 of P.0607=1), Unload (bit 20 of P.0606=1), Warning (bit 20 of P.0605=1)**

Related parameters: **P.0145** Number of D-PRO modules

To disable: **Act on D-PRO relay or set bit 20 of all parameters P.0605, P.0606, P.0607, P.0608 to zero**

Enabled in: **MAN, AUTO, TEST, REMOTE START**

The protection is always enabled. See the technical manual of the D-PRO protection relay.

900 – Incoherent PLC parameters

Type: **Warning**

Related parameters: **-**

To disable: **-**

Enabled in: **MAN, AUTO, TEST, REMOTE START**

The protection is enabled only when a valid PLC program has been transferred to the board. It reports possible problems during the running of the PLC:

- The PLC program uses more FLASH memory than available.
- The PLC program uses more RAM memory than available.
- The PLC program has an invalid control check-sum.
- The PLC program is developed with a version not supported by this board.
- A digital or analogue output controlled by the PLC is not configured with DOF.0101 or AOF.0101 function (“used by the PLC”).
- The PLC program uses a resource (of any kind) not available on this board (for example, a digital input of a non-connected expansion module).
- An invalid parameter has been specified for one of PLC blocks.
- An invalid type of block has been specified.
- Calculation error during the running of the program.

On S.02 page, by selecting this early warning, the board shows additional information to help solving the problem.

301...552 - Generic anomalies linked to analogue inputs

See 10.6.

685...886 - Generic anomalies linked to digital inputs

See 10.7.

901...964 - Anomalies connected to the PLC

The PLC program, through one of its blocks, can activate anomalies. 901 through 964A codes are connected to such anomalies. Anomalies triggered by the PLC can be alarms, deactivations, unloads or early warnings.

Starting from version 00.79, these alarms can be activated if other alarms are still activated (see paragraph 10).

11. Other functions

11.1 PLC logic

The DST4602 controller is equipped with a PLC environment (acronym for “Programmable Logic Controller”) that carries out a sequence of functions previously stored in a proper Flash memory.

Use “Mecc Alte PlcEditor” software to create and fulfil the PLC program. Use the “BoardPrg4” software to transfer the compiled PLC program to DST4602 or to read it again from the board [14].

The PLC program is run every 100ms. This time span could not be adequate to manage protections that have to intervene very quickly.

11.2 Clock

The controller is provided with a standard hardware clock. The date/time is shown to the right in the first line of display in all the pages. Moreover, it is detailed on S.03 page of the display. It is possible to set the clock through 4.7.1 menu or serial ports. It is used for various functions:

- History logs recordings.
- Engine TEST start-up weekly planning.
- Weekly planning of time intervals in which the genset must not automatically start.

The first function has already been widely described in chapter 8. The other two functions are detailed below.

11.2.1 Clock automatic update

In case the controller has an Ethernet connection, the clock can be automatically updated through the connection towards an NTP server. The controller registers the event “EVT.1076 - Date and hour modified” in the history log, but only if the difference between the new time received and the current one is higher than one minute.

The server NTP (questioned by the controller every 5 minutes) gives the date and hour of the reference time zone (that is UCT “Universal Coordinated Time”) from which the controller can calculate and update the internal calendar considering its own time zone and eventual daylight-saving time. To this purpose, the follow parameters are available:

- P.0408: Daylight saving offset (1=15 min.; 4=1 hour). The setting limits are from 0 to 48 and allow to manage the offset to be added/subtracted for the daylight-saving time.
- P.0409: Daylight saving time.
  - “0-No” daylight saving time not in use
  - “1-Yes” daylight saving time in use (it adds P.0408 to the one received).
  - “2-Automatic (only Europe)”: It is only valid for Europe, as since 2002 has been unified (it activates ate 01.00 of the last Sunday of March and deactivates at 01.00 of the last Sunday of October).
  - “3-Automatic (by calendar)”: use calendar 15 and 16 to select the date for the daylight-saving time.
- P.0410: Time zone (1=15 min.; 4=1 hour). The setting limits are from -47 to + 48 and allow to manage all time zones of the Earth by hour quarts.

The controller registers the events “EVT.1086 - Daylight Save Time activated” and “EVT.1087 - Daylight Save Time deactivated” twice a year, based on P.0409 value. The “Daylight Save Time” condition is available for PLC and AND/OR logics by means internal status ST.127.

11.2.2 Engine test start-up weekly planning

The engine TEST start-up is planned on a weekly basis. Thus, it is possible to select in which days the engine must be started for TEST. WARNING: the activation of the scheduled test isn't in any way connected to the automatic starts of the engine. I.e. the engine may have been used just few minutes before, but test will anyway start at due time. 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 the following:

- **P.0418**: allows to specify in which days of week the engine TEST will be performed. It is a bit-configurable parameter; each bit of the parameter corresponds to a day of the week. The value to be set for the parameter is the sum of the value fields in the following table related to the days needed (see7.3.4).

Bit	Hexadecimal value	Day
0	01	Sunday
1	02	Monday
2	04	Tuesday
3	08	Wednesday
4	10	Thursday
5	20	Friday
6	40	Saturday

  For example, if you want to perform the TEST only on Monday and Thursday, you must set 12 (10+2).

- **P.0419**: allows to set start time for the TEST (Hours and minutes).
- **P.0420**: allows to configure the TEST duration (in minutes).

P.0420 sets the duration instead of an end test time. This is due to the same parameter being also used for TEST activated by an SMS command.

11.2.3 Working time intervals weekly planning.

In some applications, it is useful to inhibit the automatic intervention of the engine for mains failure in hours or days where the mains 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 on a weekly basis: therefore, it is possible to plan in which days the generator must operate. Besides days, it is possible to set a single auto operation enable time slot common to all selected days.

The parameters related to this function are the following:

- **P.0421**: allows to specify in which days of week the engine can start automatically. It is a bit-configurable parameter; each bit of the parameter corresponds to a day of the week. The value to be set for the parameter is the sum of the value fields in the following table related to the days needed (see 7.3.4).

Bit	Hexadecimal value	Day
0	01	Sunday

1	02	Monday
2	04	Tuesday
3	08	Wednesday
4	10	Thursday
5	20	Friday
6	40	Saturday

- **P.0422**: allows to configure the start of the time interval during which the engine can start automatically (in hours and minutes).
- **P.0423**: allows to configure the end of the time interval during which the engine can start automatically (in hours and minutes).

Usually P.0422 will be set to a value lower than P.0423. On the contrary, if it contains a higher value, the controller infers that the time interval is set across midnight: in this case, the time set with P.0422 refers to the days selected with P.0421, while the time set with P.0423 refers to the following days.

For example, in case an automatic genset start is required only Monday through Friday, between 08:00 and 18:00, you must set:

- P.0421= 3E (02+04+08+10+20)
- P.0422 = 08:00
- P.0423 = 18:00

11.2.4 Weekly planning of intervention forcing.

This function is available from the review 00.40. The planning of intervention forcing is performed weekly. That is, it is possible to indicate on which days of the week the generator must intervene, even if the status of the system doesn't require the intervention. Besides the days, it is possible to specify from what time to what time the intervention must be forced. This time interval is common to all the days selected.

The parameters related to this function are the following:

- **P.0426**: it allows specifying on which days of the week the intervention of the generator must be forced. It is a bit-configurable parameter; each bit of the parameter corresponds to a day of the week. The value to be set for the parameter is the sum of the value fields in the following table related to the days needed (see7.3.4).

Bit	Hexadecimal value	Day
0	01	Sunday
1	02	Monday
2	04	Tuesday
3	08	Wednesday
4	10	Thursday
5	20	Friday
6	40	Saturday

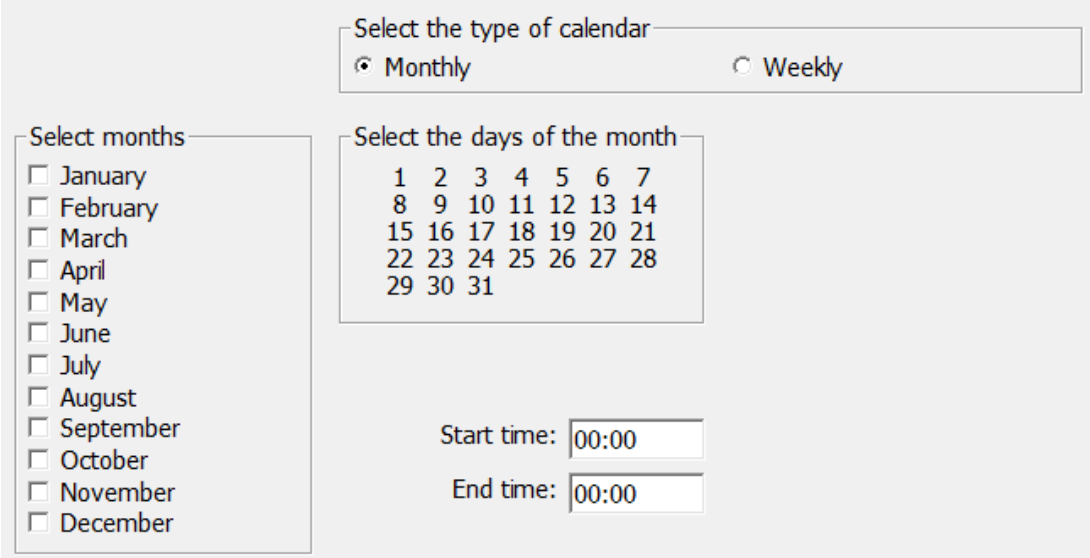
  For example, to configure the forcing of the intervention only on Monday and Thursday, it is necessary to set 12 (10+2).

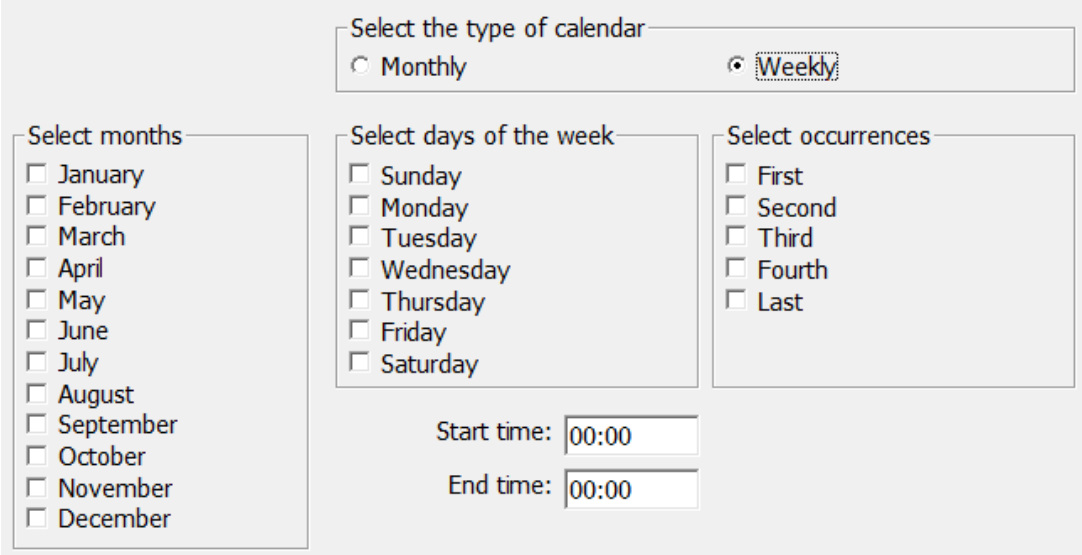
- **P.0427**: it allows setting the starting time of the forcing (in hours and minutes).
- **P.0428**: it allows setting the ending time of the forcing (in hours and minutes).

11.2.5 Configurable calendars

The controller provides 16 calendars fully configurable. They allow to select days and time-slots, inside which the controller activates an internal bit, available by means internal statuses ST.224…ST.239. This bit could then be used by AND/OR logics to activate a digital output or to create more complex logics. All calendars are identical: calendars 15 and 16, however, can be used for the activation/deactivation of the daylight save time (if parameter P.0409 is set to “3”).

Each calendar can be individually selected as “monthly” or “weekly”:





Using BoardPrg4 software, it is very easy to select whether a calendar is “weekly” or “monthly”. If you want to use the parameters of the controller, you must act on the parameter P.1900. It is a bit-field parameter; one bit is provided for each calendar:

BIT	Value	Hexadecimal	Calendar
0	1	0001	Calendar 1
1	2	0002	Calendar 2
2	4	0004	Calendar 3
3	8	0008	Calendar 4
4	16	0010	Calendar 5

5	32	0020	Calendar 6
6	64	0040	Calendar 7
7	128	0080	Calendar 8
8	256	0100	Calendar 9
9	512	0200	Calendar 10
10	1024	0400	Calendar 11
11	2048	0800	Calendar 12
12	4096	1000	Calendar 13
13	8192	2000	Calendar 14
14	16384	4000	Calendar 15
15	32768	8000	Calendar 16

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

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

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

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

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

BIT	Value	Hexadecimal	Day of month
0	1	00000001	1
1	2	00000002	2
2	4	00000004	3
3	8	00000008	4
4	16	00000010	5
5	32	00000020	6
6	64	00000040	7
7	128	00000080	8

8	256	00000100	9
9	512	00000200	10
10	1024	00000400	11
11	2048	00000800	12
12	4096	00001000	13
13	8192	00002000	14
14	16384	00004000	15
15	32768	00008000	16
16	65536	000100000	17
17	131072	00020000	18
18	262144	00040000	19
19	524288	00080000	20
20	1048576	00100000	21
21	2097152	00200000	22
22	4194304	00400000	23
23	8388608	00800000	24
24	16777216	01000000	25
25	33554432	02000000	26
26	67108864	04000000	27
27	134217728	08000000	28
28	268435456	10000000	29
29	536870912	20000000	30
30	1073741824	40000000	31

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

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

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

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

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

BIT	Value	Hexadecimal	Occurrence
0	1	00000001	First occurrence
1	2	00000002	Second occurrence
2	4	00000004	Third occurrence

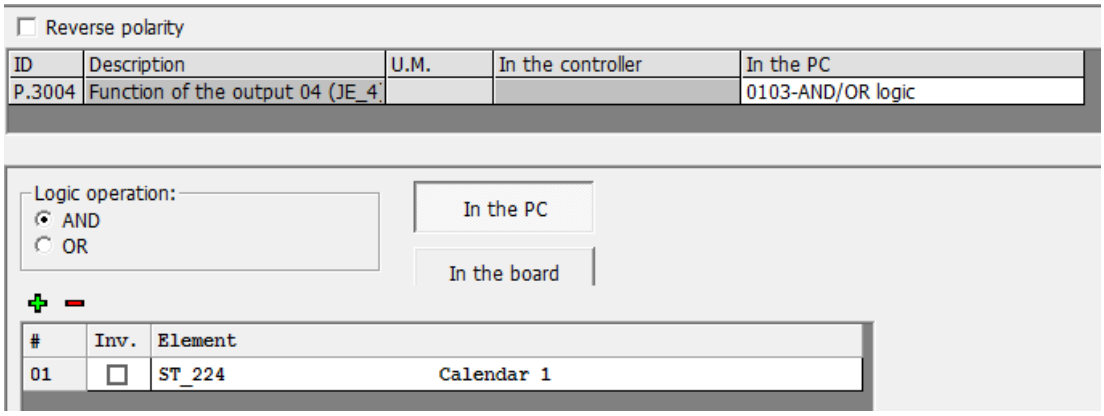
3	8	00000008	Forth occurrence
4	16	00000010	Last occurrence

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

If the "occurrence" bits are all "0", then the selected days of week will be managed in any week of the month; otherwise they will be managed for the selected occurrences only. The "last" option is useful because, depending on the month and on the year, a certain day of the week can be present 4 or 5 times in a month: using the "last" option you can do an action exactly in the last occurrence in the month. A typical example is the management of the daylight save time; in Italy, it is activated on the last Sunday of October, and deactivated on the last Sunday of March. Those Sundays can be the 4° or the 5° occurrence in the month, depending on the first day of the month. Using the "last" option, the problem is solved.

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

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



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

- Calendar 15.
  - Select "weekly" (bit 14 of P.1900 = "1").
  - Last Sunday of October:
    - Select "October" (P.1957 = "0200").
    - Select "Sunday", "Last" (P.1958 = "00010010").
  - The activation should happen at 02:00:
    - Select "2:00" as start time (P.1959).
    - Select "2:01" as end time (P.1960).

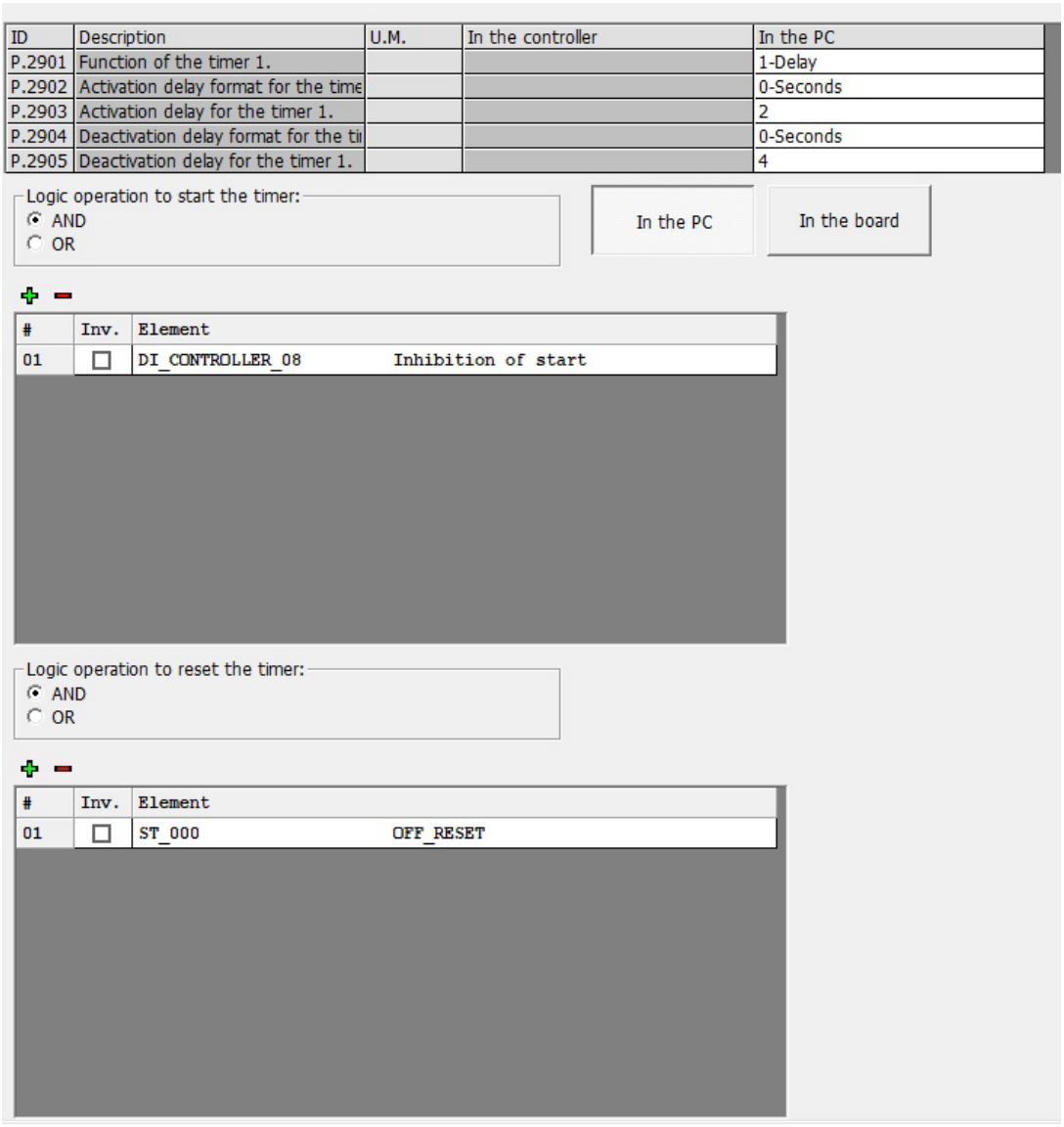
- Calendar 16.
    - Select “weekly” (bit 15 of P.1900 = “1”).
    - Last Sunday of March:
        - Select “March” (P.1961 = “0004”).
        - Select “Sunday”, “Last” (P.1962 = “00010010”).
    - The activation should happen at 03:00:
        - Select “3:00” as start time (P.1963).
        - Select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

11.2.6 Configurable timers

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

The four timers are identical.

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



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

- P.2901: function of the timer 1.
- P.2902: Activation delay format for the timer 1.
- P.2903: Activation delay for the timer 1.
- P.2904: Deactivation delay format for the timer 1.
- P.2905: Deactivation delay for the timer 1.

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

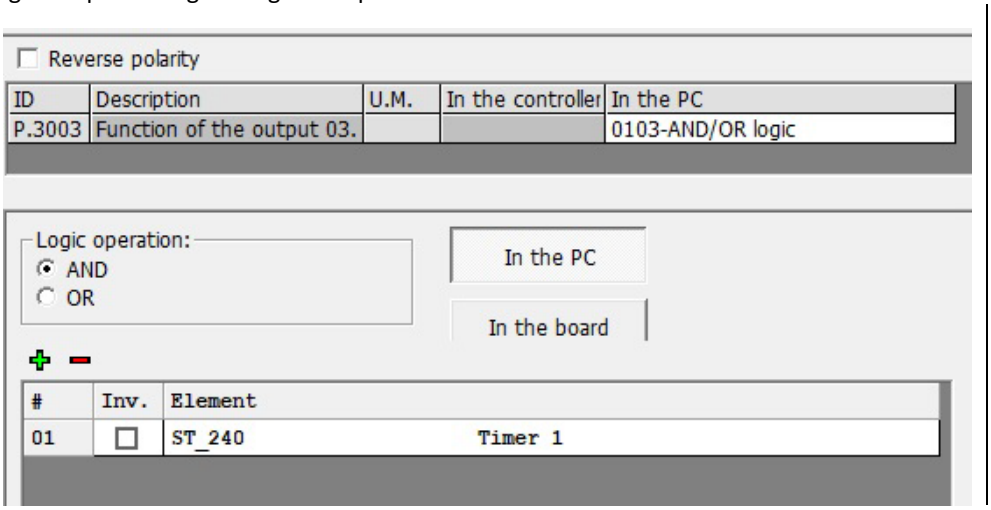
Each timer can work in four different modes, selectable by means parameter P.2901 (for the timer 1 or equivalent for the other timers):

- 0 – Not used. In this case the internal bit related to the timer is always reset.
- 1 – Delay.

- The internal bit is reset while the “reset condition” is true.
- The internal bit is set with the delay P.2902 – P.2903 from when the “activation condition” becomes true.
- The internal bit is reset with the delay P.2904 – P.2905 from when the “activation condition” becomes false.

- 2 – Pulse.
  - The internal bit is reset while the “reset condition” is true.
  - The internal bit is set for the time configured with P.2902 – P.2903 each time the “activation condition” changes from false to true.
  - The internal bit is set for the time configured with P.2904 – P.2905 each time the “activation condition” changes from true to false.
- 3 – Free run
  - The internal bit is reset while the “reset condition” is true.
  - The internal bit is reset while the “activation condition” is false.
  - While the “activation condition” is true, the internal bit is managed as a square wave: it is set for the time configured with P.2902 – P.2903, then it is reset for the time configured with P.2904 – P.2905, and so on.
- 4 – Set/Reset
  - The internal bit is reset while the “reset condition” is true.
  - The internal bit is set if the “activation condition” is true and the “reset condition” is false.
  - The internal bit keeps its previous status if the “activation condition” is false and the “reset condition” is false.

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



11.3 Thermometer

The controller is provided with a hardware thermometer, for measuring its internal temperature. The temperature is shown at page S.03, multifunction display, last line. It is used for many functions:

- At very low temperatures information display slows down. By utilizing the thermometer, when the temperature falls under a very low threshold, the board keeps always the backlighting lamp on, that contributes to heat the display and therefore to increase its efficiency.
- The electronic components inside the controller have an extended working temperature range. Despite this, it is possible in critical ambient conditions that temperature goes out of this range. The controller uses the thermometer to activate a warning if the ambient temperature goes over a threshold configurable with parameter P.0366. This serves to alert the operator, but it is also possible, by using AND/OR logics, to ensure that, when the early warning is active, also an output is activated, output that therefore can be used to start cooling the mechanisms.

11.4 Serial number

The controller features a standard software serial number detector. This device associates a univocal serial number to the controller. Two controllers cannot have the same serial number. This allows unambiguous identification of DTS4602 controllers. The serial number is shown in the multifunction display at page S.03, last line. The Mecc Alte password is related to this serial number.

11.5 Counters

The controller manages internally the following counters:

- Engine starts counter (resettable to zero)
- Engine running hours counter
- Engine running hours counter (resettable to zero)
- Load working time with GCB closed (hours) counter (resettable to zero)
- Operation hours counter with protection override (resettable to zero).
- Time to next service (hours) counter
- Resettable active power meter (kWh): it measures only the supplied power and does not measure in case of power reverse.
- Total counter for the active power produced by the generator (kWh): it only counts supplied power, it doesn't count in case of power inversion.
- Resettable counter for the reactive power produced by the generator (kvarh), it counts in absolute value.
- Total counter for the reactive power produced by the generator (kvarh), it counts in absolute value.
- Resettable counter for the active power measured on the mains (kWh).
- Total counter for the active power measured on the mains (kWh).
- Resettable counter for the reactive power measured on the mains (kvarh).
- Total counter for the reactive power measured on the mains (kvarh).
- Controller total power supply time (hours) counter

Almost all these counters and meters are displayed on the controller's front panel (only the total supply time counter is not displayed). However, all can be read via the serial port (with the Modbus protocol). Some of these counters can be reset by the operator through an appropriate procedure, or through the serial port (in the list they are highlighted by the word “resettable”; please refer to the description of the display page where they are shown). All these counters are saved in a non-volatile memory; therefore, they store their values also when the controller is powered off. Non-volatile memories have limited life cycles, therefore reducing memory writing to minimum is required. Therefore, a counter may not be immediately saved as its value changes; consequently, before powering the controller off, ensure to know when and how the counters were saved.

Counters are saved (all together and in the same time) in the following conditions:

- Immediately after each engine start (with engine running, not after each start attempt).
- Immediately after each engine stop (when controller acknowledges the engine stopped status, not when stop is requested).
- After each engine running hours counter increase (total, also if the engine has been started for instance six times for ten minutes each time).
- After each total engine running hours counter increase (total, also if the engine has been started for instance six times for ten minutes each time).
- Each time the load engine working hours counter is increased (total, also if the engine has been started for instance six times for ten minutes each time).
- Each time the key switch is turned to OFF/RESET.
- For each hour the controller is powered.
- When parameter P.0424 is changed (maintenance interval).

Furthermore, counters are saved when they are reset to zero (individually or globally) via front panel or serial port. Note that some counters have a decimal part (for example the minutes-counters associated to hours-counters), which is also saved in a non-volatile memory. Powering off the controller in an uncontrolled way can cause the loss of the decimal part. You will need to switch the key to OFF-RESET to force the controller to save data, before switching off the power.

11.5.1 Counters reset

See the description of M.05 page (6.6.4.5) and of E.02 page (6.6.5.3).

11.6 Genset lock

A command inhibiting genset operation can be sent to the controller either through a PC's serial port or a SMS. The locked genset can be re-activated either through a PC's serial port or a SMS (powering the controller off will not work). The controller signals the inhibition status by activating the alarm AA012.

11.7 Loads protection from mains breaker damages

Please refer to the document [3] that details this function.

11.8 Load thresholds

The function in hand should not be mistaken for the “load management” available in parallel systems, whose description is indicated within the document [3].

This function allows to monitor the trend of the active power to diagnose:

- A low-power condition.
- A high-power condition, to disconnect part of the loads, if needed.

It is necessary to choose a priori the condition to be monitored (using the P.0481 parameter: set it to zero to select the low power monitoring, set it to one to select the high-power monitoring).

To associate an output to this function, the code DOF.3121 (load thresholds) must be configured in the parameter P.3001 parameter (or equivalents). If no output is configured in this way, the function will not work.

It is possible to enable this function through a digital input configured by means of DIF.2703 function ("Enable load thresholds"): if the input exists, the function will be enabled when the input is activated. If the function is disabled, the output configured through DOF.3121 function will be always disabled.

Function is configured with the following parameters:

- P.0482: initial observation delay If the enabling input exists (DIF.2703), during the first P.0482 seconds starting from the input activation, the board will control the output at rest: this happens to allow time to the system for stabilizing before starting to control the power.
- P.0483: lower threshold (percentage of the rated power P.0125).
- P.0484: delay associated to the lower threshold (in seconds).
- P.0485: higher threshold (percentage of the rated power P.0125).
- P.0486: delay associated to the higher threshold (in seconds).

If the thresholds P.0483 and P.0485 are set to zero or are not congruent, the function will be disabled.

11.8.1 Low power

Aim of this function is to diagnose a low power (or low load) status and point it out by means of a digital output of the board: in a situation of more than one generators in parallel, this output could be used to deactivate some generators, even if the "load management" (see [3]) allows to do the same but in a cleverer way.

The controller watches the total active power delivered, comparing it with two thresholds (so setting a hysteresis band): the output is activated (signalling the low power condition) if the power drops below the lower threshold for the set time. In the same way, the output is disabled if the power rises above the upper threshold for the set time.

11.8.2 High power

Purpose of this function is to diagnose a high-power status (high load) to disconnect part of the less important loads. The controller watches the total active power delivered, comparing it with two thresholds (so setting a hysteresis band): the output is disabled if the power remains below the lower threshold for the set time. In the same way, the output is enabled if the power rises above the upper threshold for the set time. The output is activated in a maximum power condition and can directly be used as control for disconnecting loads. Ensure to pay attention to the thresholds: when a part of the loads is disconnected, the power will decrease. If the lower threshold is too high, the output will be disabled, and this could cause the load to be reconnected, with a pendulum effect.

11.9 EJP function

Warning: DST4602 is not able to receive EJP information directly from the mains. To use this function an external detector must be used. This detector must provide two output signals coherent with said function.

The EJP function allows to start the engine and warm it before mains failure, so when it will happen, loads can be immediately changed-over on genset, reducing to the minimum the time the loads remain unsupplied.

The system is based on two signals, available through the mains provider:

A. A signal activated well in advance with respect to the mains failure (e.g. approx. 30 minutes).

B. A signal activated just before mains failure.

We want to start the engine in (a settable) advance in relation to signal B; however, the load must be taken only when B is active. The controller can perform this operation following the steps below:

- A and B signals must remain active until mains reactivates.
- Both signals must be connected to relays with exchanging contacts.
- The time between A and B signals activation must be known.

To use this function the controller must be configured in the following way:

- Configure a digital input with feature DIF.2032 – “remote start request” in parameter P.2001 or the equivalents for the other inputs). Moreover, it is necessary to configure, for this input, the delay desired to start the engine from the moment the signal A is triggered (in seconds, in parameter P.2002 or equivalent). If, for example, we want to warm the engine for five minutes and the A signal will activate 30 minutes before B, it will require to set 1500 seconds, i.e. 25 minutes (it is possible to set delays up to 3200 seconds, i.e. 53 minutes).
- The configuration of a digital input by means of DIF.2502 function (“inhibition to power load”, P.2001 parameter or equivalent for the other inputs).
- So, it is necessary to connect the usually open contact of the signal A to the first configured input, and the usually closed contact of the signal B to the second input.

When both signals are inactive, the controller does not receive the remote start request and remains at rest in AUTO mode. The "inhibition of supply" contact is skipped.

When signal A activates, both controller inputs will be active. However, the board will not switch to REMOTE START immediately, but only after that the time span connected with the input that gets the signal A has elapsed (P.2002 or equivalent ones). So, also in this phase the inhibition of supply is skipped. At this stage, the status bar shows the time left.

After the time since activation of signal A, the controller shifts to REMOTE START mode and performs the engine start. In this phase, the inhibition of supply input is no longer skipped, and being it active (connected on contact NC), it will prevent the loads change-over on genset.

When signal B activates, the inhibition of supply input deactivates, allowing the load change-over on genset.

When the mains is on, both signals A and B deactivate. Therefore, the controller reverts to AUTO mode, due to mains on, performs the engine stop (with cooling cycle).

11.10 Unit of measure

DST4602 allows personalizing the most common standards of measurement, by selecting them in a list of available ones. The following parameters allow personalization:

- P.0191: configures the standard of measurement for temperature (°C, °F).
- P.0192: configures the standard of measurement for pressure (bar, psi).
- P.0193: configures the standard of measurement for volume (lt, gal).

All measures, regardless the way they are taken, are automatically transformed into the selected standard of measurement before being shown on the display, stored within the records or transmitted, through Modbus or SMS, on serial ports.

Protection thresholds aren't automatically converted, but they should be already set in the selected standard of measurement: in case one of the above described parameter is changed, it will be necessary to verify the value of all thresholds that operate on measures with that standard of measurement. Moreover, it will be necessary to delete the records: indeed, after the fact, it isn't possible to know the standard of measurement selected at the moment when a record was filed within records.

Note: conversion curves internally work always on base of standards of measurements (°C, bar, lt). But, both the board and the BoardPrg4 software, deal with converting single points of the curve in the selected standard of measurement, in a totally transparent manner for the operator. The only warning for the operators is that, if it is possible to personalize the standard of measurement through the BoardPrg4, attention should be paid to enter correctly one of the previous standards, in order to have automatic conversions by the system (for example, if “BAR” instead of “bar” is entered, the conversion will not take place).

11.11 CAN-BUS connection with engines

DST4602 has a CAN-BUS interface (CAN0) dedicated to the interfacing with electronic external devices. Those devices can be:

- The engine control units (ECU).
- The automatic voltage regulators (AVR) (since version 1.15).
- Some specific devices controlling the air/fuel ratio (Gas Mixers).

To activate the connection, first, it is necessary to select one or more external devices.

11.11.1 Engine control unit (ECU)

Parameter P.0700 allows to select the ECU (from the list of supported engines). It is possible to select (directly from the controller or via BoardPrg4) one of the provided ECU. Alternatively, by setting the value 300 in P.0700, it is possible (only via BoardPrg4) to select an external file (parameter F.0700) relating to the requested ECU (Mecc Alte continuously implements new files for new ECUs or for new versions of existing ECUs).

It is then possible to decide whether to receive only information from the ECU or whether to also send commands (P.0703):

- By setting P.0703 to "0", DST4602 does not transmit anything on the CAN-BUS.
- By setting P.0703 to "1", DST4602 only requests information that is not "automatically" transmitted by the ECU, but does not transmit commands.

- By setting P.0703 to a value between "2" and "90", DST4602 also transmits all the commands provided by the ECU with the exception of the speed regulation command.
- By setting P.0703 to a value between “91” and “99”, DST4602 also transmits the speed regulation command. **NOTE: for some ECU the value "98" activates special functions, see specific documentation**.

For speed control, DST4602 internally uses a percentage command. However, some ECUs accept a command directly in rpm: using the parameters P.0713 and P.0714 it is possible to convert the internal percentage in rpm before transmitting it to the ECU. **NOTE: the values 1380 and 1620 are two special values for the two previous parameters; they configure a variation of +/- 8% on the rated rotation speed, which is also maintained at 60 Hz**. It is also possible to specify the value in rpm for the low speed cycle (P.0710).

If the ECU signals specific anomalies (therefore not through the cumulative yellow and red lamps), DST4602 manages them with direct warnings/alarms (codes from 105 to 160). Using parameter P.0704 it is possible to mask these alarms on DST4602 (**attention: the ECU can still stop the engine**).

Specific options for each ECU can be activated with parameter P.0715. Furthermore, for the “generic ECU” selected with the value "1" in P.0700, parameter P.0716 specifies the address that DST4602 must use to transmit commands to the ECU.

In some cases, it is possible to activate the DROOP mode (for adjusting the rotation speed) directly in the ECU (P.0708).

Finally, it is possible to set a maximum time through parameter P.0711: DST4602 will activate an anomaly if it does not receive messages from the ECU for this time.

11.11.2 Voltage regulator (AVR)

Parameter P.1700 (available from version 1.15) allows to select the voltage regulator (from the list of supported models). It can be modified only through BoardPrg4, to select one of the available external files (Mecc Alte continuously implements new files for new regulators or for new versions of existing regulators).

It is then possible to decide whether to receive only information from the AVR or whether to also send commands (P.1701):

- By setting P.1701 to "0", DST4602 does not transmit anything on the CAN-BUS.
- By setting P. 1701 to "1", DST4602 only requests information not "automatically" transmitted by the AVR, but does not transmit commands.
- By setting P.1701 to a value between "91" and "99", DST4602 also transmits the voltage regulation command.

P.1702 ("Transmission address for voltage regulator"). It is the address that DST4062 must use when sending messages to the AVR. For some AVRs it is not used (because it is already statically defined in the file that describes the regulator). For others, however, it must be set as required by the AVR manufacturer.

P.1703 and P.1704 ("Voltage corresponding to 0% or 100% of the internal command"). If the AVR manages a voltage setpoint directly in Volts, with these parameters you can convert the internal DST4602 command (which is always a percentage) into a voltage range, based on the application.

P.1708, instead, configures the nominal voltage for the AVR, which may differ from that of DST4602 due to any transformers or due to the wiring of the voltages to the AVR. If the AVR supports it, DST4602 automatically transfers this set-point to it, thus automating management in multi-voltage applications (see 7.10).

11.11.3 HT-AF1000/AF2000

It is possible to select “HT-AF1000LS” and “HT-AF2000” engines through parameter P.0700 (up to version 00.88) of P.0750 (from version 00.89). It is a special management, carried out on a single customer's specification.

The following functions, to configure digital inputs, are linked to this management:

- DIF.2301
- DIF.2302
- DIF.2303

11.12 Expansion modules

By using CAN-BUS CAN2 (EXBUS) connection, it is possible to connect the following optional additional modules to DST4602:

- 16 modules to measure temperatures (for a total of 48 measurements). It is possible to use DITHERM or DIGRIN modules, which can be mixed in any ways.
    - DITHERM module: acquires up to three thermocouples (galvanically insulated inputs).
    - DIGRIN module: acquires up to three Pt100 probes (galvanically insulated inputs).
- 16 DIVIT modules: every module acquires up to four analogue inputs 0...5V / 0...10V / 0...10mA / 0...20mA (galvanically insulated inputs), for a total of 64 measurements.
- 8 DANOUT modules: every module controls up to four analogue outputs 0...5V / 0...10V / 0...10mA / 0...20mA (galvanically insulated outputs), for a total of 32 outputs.
- 10 DITEL 16IN module: each module acquires up to sixteen optically insulated digital outputs (for a total of 160 digital inputs). Two DITEL 8OUT relay modules can be connected to every module (for a total of 160 digital outputs). You cannot use the output modules without a related input module.

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

To configure the modules on the DST4602, it is necessary to set the number of modules available with the parameters

- P.0141 the number of DITEL 16 IN modules (with any DITEL 8 OUT module) (maximum 10).
- P.0142 the number of DITEMP modules (i.e. DITHERM or DIGRIN) (maximum 16).
- P.0143: the number of DIVIT modules (maximum 16).
- P.0144: the number of DANOUT modules (maximum 8).

Once the modules presence is configured, they appear as digital or analogue inputs or outputs and are driven the same as the ones present on the controller board. For their related parameters see [1]. In BoardPrg4, once the presence of a module is configured, it appears in the I/O menu on the left column, with each individual input/output ready to be configured.

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

But it is necessary to make a statement as to DIVIT modules. They can measure any quantity: it is necessary to convert performed measurement (Volt or mA) into the actual standard of the measured quantity. This conversion can be made directly in the module (DIVIT) or on DST4602. Beware not to have a double conversion.

Mecc Alte advises to:

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

ID	Descrizione	U.M.	Nel dispositivo	Nel PC
P.0101	Sensore 1 - Tipo ingresso	-		1-0/10 mA
I1_SO1	Ingresso 1 - Valore 1 in ingresso (mA/V)	mA/V		0,000
I1_DE1	Ingresso 1 - Valore 1 corrispondente trasmesso	-		0,0
I1_SO2	Ingresso 1 - Valore 2 in ingresso (mA/V)	mA/V		10,000
I1_DE2	Ingresso 1 - Valore 2 corrispondente trasmesso	-		100,0

- On DST4602, use a conversion curve to convert from a % value to the actual standard of measurement.

11.13 Support for redundancy

From the version 00.40 on, DST4602 adds a partial support for the management of redundancy between two boards. This support activates by setting P.0245 parameter to “1”.

This management provides two boards that share expansion modules and where only one of the two needs to be supplied. When the master board fails (it is possible to use a DITEL to diagnostic the situation), it will have to be de-energized and at the same time the slave board will have to be supplied

When the support for redundancy is activated, DST4602 SLAVE utilized a time span of a second to the turning-on (after the AUTO-TEST phase has finished and after the display starts showing normal pages) to analyse the status of the system and acknowledge the situation. Practically, DST4602:

- If it identifies a started engine status, it will adjust its controls to keep the engine in motion, without triggering any anomaly.
- It adjusts its own controls to keep MCB switch and GCB switch in the status they are at the turn-on, without triggering any anomaly.
- During the one-second span for the “system analysis” DST4602 doesn't send any message on all CAN-BUS channels. In this way:
    - It doesn't send stop command to the engine via CAN-BUS before having verified the need to keep the engine in motion.
    - It doesn't send any command (via CAN-BUS) to all expansion modules: in this way, if these modules are "shared" between the MASTER board and the SLAVE board, they freeze the last output status ordered by the master board, waiting until the SLAVE board acknowledges the situation.

11.14 PICO function

This function is available from 00.40 firmware version. In some areas of the world, at certain times of the day, the supply from the mains has a huge cost. This function allows using the generator to supply users in a given time slot (week calendar setting).

Basically, within set days and time slots, DST4602 should start the generator and put it in parallel with the mains. When in parallel, it should transfer the power absorbed by the users from the mains to the generator, then it should open the mains switch. The parallel with the mains should have a maximum

configurable duration: elapsed this time, MCB switch should be opened. At the end of the time slot, DST4602 puts back the group in parallel with the mains, transfers users' power from the generator to the mains, opens GCB switch and stops the generator. Also, in this case the duration of the parallel with the mains should be limited.

DST4602 should then (but it is not mandatory) be able to measure the power on the interchange point with the mains. It is possible to use an external instrument to carry out this measurement and connect it to an analogue input of DST4602 (AIF.2303 function for P.4001 parameters or equivalent). Alternatively, it is possible to use the fourth current transformer of DST4602 to perform this measurement. In this case set:

- P.0126 = 1 (mains/bars sensor used to measure the mains).
- P.0109 = 0 (it uses a current transformer for the fourth current).
- P.0108 = x (current transformer primary).
- P.0140 = x (current transformer secondary).
- P.0130 = 2 (current transformer connected on L1 phase of the mains).
- P.0131 = 4 (fourth current used to calculate the power on the mains).

After this, the board calculates power on phase L1 of the mains and, for three-phase systems, it multiplies it by three, therefore assuming a balanced load. This value is then multiplied by P.0132 coefficient (default 1.0), which allows correcting load imbalances.

To activate the "load transfer" function from the generators to the mains, it is necessary to configure a digital input with DIF.2096 function: this input should be active. Moreover:

- If the board is able to measure the power on the mains, the "import/export" mode should selected for the parallel with the mains (P.0880 = 2) and select "0 kW" (P.0888) as power on the interchange point.
- Alternatively, select "BASE LOAD" mode for the parallel with the mains (P.0880 = 1) and set alleged users' power in P.0884.

See document [3] that describes the "transfer to the generators" function in details.

Use P.0426, P.0427 and P.0428 parameters to select the time slot during which the intervention of the generator should be forced (see description in 11.2.4).

The maximum time that the generator can stay in parallel with the mains is generally decided by the Supplier of the power mains; it can be set with P.0890 "Maximum time in parallel with the mains" parameter. By leaving the parameter to zero, no limitation is set on the duration of the parallel to mains.

11.15 Active power derating function of the engine

This function is available from firmware version 01.09. The controller implements four digital inputs functions (DIF.2341-DIF.2342-DIF.2343-DIF.2344) and allows to request one of the four possible deratings, necessary to reduce the active power of the engine, linked to particular conditions (for example: due to the high temperatures of the intercooler, of the oil, of exhaust gases etc.). The following parameters are available combined with each derating:

- P.1281-P.1285-P.1289-P.1293: a power reduction value expressed as a percentage of the active power at the instant in which derating or the nominal power P.0125 is activated.
- P.1282-P.1286-P.1290-P.1294: a ramp value (expressed in% / s) with which the power reduction must be applied to bring it to the required value.
- P.1283-P.1287-P.1291-P.1295: a minimum time for which the power reduction must be maintained even if the request disappears.

- P.1284-P.1288-P.1292-P.1296: a bit parameter with options necessary to configure the operation of the power reduction:
  - bit 0 = 1: specifies whether the power reduction value is a percentage of the nominal power P.0125 (otherwise it is a percentage of the active power supplied at the instant of activation of the request).
  - bit 1 = 1: specifies whether, when the power reduction request became disabled, it must wait until the ramp has completed before executing the programmed delay (otherwise the waiting time starts from when the request falls).

When a derating input is activated, the controller calculates the new power setpoint relating to the request and selects the lowest one among the active requests. This setpoint is used to regulate the active power of the engine and uses the selected ramp to reach the required power. The board sends a reduced nominal power value to all the other generators, acting as if it were a group of smaller size. Therefore, the lower power supplied by this generator will be automatically compensated:

• from the other generators, in systems composed of several generators in parallel with the mains in IMPORT / EXPORT or SYSTEM BASE-LOAD mode (if necessary, the load function will start other generators).

• the load sharing function will transfer the load from the generator in derating mode to the other generators, in systems consisting of several generators without being in parallel with the mains (if necessary, the load function will start other generators).

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